Proceedings of the 2025 Australasian Road Safety Conference

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Proceedings Editors

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[3] Law and Justice, University of New South Wales (UNSW, Sydney)

Preface

Kaya, a Nyoongar Welcome, to the proceedings for the 2025 Australasian Road Safety Conference (ARSC2025) held in Boorloo (Perth), Western Australia. This was the tenth conference in the series, which began with the merging of the Australasian Road Safety Research, Policing and Education Conference and the Australasian College of Road Safety Conference. This conference provides a unique platform for road safety professionals, including researchers, practitioners, policymakers, police, educators, community and advocacy groups to connect, present their work, and engage in discussions on critical issues. These proceedings represent the diverse road safety work presented, highlighting research and practice aligned with the conference theme: *Equity, Elasticity, Evolution*. With over 650 delegates from 18 countries in attendance, the conference demonstrated the broad and collaborative effort toward reducing trauma caused by crashes on our roads.

In an important programming shift, Monday was formally included in the conference program as Day 1 for the first time (formerly the Pre-conference day). Day 1 included a range of workshops that showcased Australasian College of Road Safety networks including the Road Policing Network, Local Government Network, International Outreach Chapter, Women in Road Safety Network, Early Career Network and the forthcoming Rural Road Safety Network. Workshops were also presented on Australian Road Assessment Program (AusRAP) and Emergency vehicle safety. ARSC2025 also saw a Road Safety Field Day, hosted by the Western Australian Centre for Road Safety Research, University of Western Australia and delivered in partnership with TranSafe and WA Police and, the workshop Pitch Stop delivered by the National Heavy Vehicle Regulator (NHVR).

A Nyoongar welcome formally opened ARSC2025 at the Welcome Reception held at the Fraser State Reception Centre. Hon. Reece Whitby, Western Australian Minister for Road Safety and Policing provided an opening address at the start of Tuesday's proceedings. Keynote speakers presented thought provoking ideas on road safety including: Dr Wes Marshall (Killed by a traffic engineer), Lee Randall (Road safety apartheid and the imperative of equity) and Nigel Kapa (Ride Forever, how post licence training can work). The plenary sessions also included panel discussions, an overview from road and transport stakeholders from Australia and New Zealand (Austroads plenary: Strengthening road safety management for a path to zero) and the road safety debate: That we are on track to meet 2030 targets. ARSC2025 also included three interactive workshops: Bottom-up approaches to achieving safe speeds; Transforming road safety strategies: practising the planning for zero framework, and; Safe active streets shifting road user behaviours: collaborative design workshop.

A total of 307 submissions were received for ARSC2025. Each submission was screened and peer-reviewed by two subject matter experts (double-anonymised). Reviewers were matched according to their expertise and sector as practitioners reviewed practitioner submissions and researchers reviewed researcher submissions. Assessment criteria for all submissions included: contribution to road safety knowledge, alignment with the conference theme, and clarity and relevance to policy or practice.

More than 200 presenters shared valuable insights into road safety challenges, including education, policing, implementation of programs and projects, policy and management strategies. ARSC2025 covered a comprehensive extensive range of critical topics including such as crash data analysis, pedestrians, motorcyclist safety, rural roads, road design and road environment, personal mobility devices, safe trips to school, and enforcement practices. Authors of accepted Extended Abstracts represented both international and local institutions and organisations from all aspects of their respective communities including universities, research centres, private companies, government agencies and community groups. These Extended Abstracts highlighted significant road safety initiatives and program work being done in Australia, New Zealand and internationally and aligned with the United Nations, One UN Vision for Road Safety to reduce the number of road crashes by on the road by 50 percent by 2030. Authors were also able to submit a Full Paper, which is HERDC[1] compliant, to be considered for publication in the Journal of Road Safety[2].

Clear communication through design was also a feature of this year's conference. For the fifth time in the conference series, ARSC collaborated with Monash University's Monash Art, Design and Architecture (MADA) to connect poster authors with graphic design students. In this collaboration, authors were matched with MADA graphic communication students to translate and design their work into a poster, social media tile and PowerPoint slide. This year four authors participated in the collaboration. For the second time in the ARSC series, road safety icon stickers were provided for delegates to attach to their nametag. This assisted networking as delegates could easily identify and connect with others interested in the same topics. The road safety icons are an initiative led by A/Prof Marilyn Johnson and developed by graphic designer Sienna Fernando and were also featured in the ARSC2025 program.

Nine presenters attended the ARSC2025 with support from the Low- and Middle-Income Countries scholarship program and were from the following countries: two delegates from Indonesia and Vietnam and one delegate from Cambodia, Cameroon, India, Kenya and Malaysia. The LMIC program, along with a Rural and Regional scholarship program, was funded by the Australian Government Department of Infrastructure, Transport, Regional Development, Communications, Sport and the Arts.

ARSC2025 was made possible through the contributions of many dedicated and passionate individuals. We thank the peer reviewers for their time and thorough review of over 300 submissions. Our sincere appreciation also goes to the keynote speakers, interactive workshop organisers and presenters, as well as the ARSC2025 Host Chapter Committee, Scientific Committee, Scientific Advisory Group, Interactive Workshop liaison, judges of the ARSC Awards and judges of the conference prize judges, conference sponsors, and the session Chairs and Co-chairs. Your collective efforts were essential to the success of ARSC2025.

We are confident that the work described in these proceedings, along with the full papers to be published in the Journal of Road Safety, will advance efforts to reduce in fatalities, serious injuries and associated trauma on roads across Australia, New Zealand, and internationally. These proceedings include a comprehensive list of the conference committees and members; conference peer reviewers; prize judges; a copy of the conference program; and all the Extended Abstracts.

[1] https://www.education.gov.au/research-block-grants/higher-education-research-data-collection-herdc
[2] https://journalofroadsafety.org/

Company names, acronyms and initialisms

ACRS	Australasian College of Road Safety
ARSC	Australasian Road Safety Conference
CARRS-Q, QUT	Centre for Accident Research and Road Safety – Queensland, Queensland University of Technology
CASR	Centre for Automotive Safety Research
LMIC	Low- and Middle-Income Countries
MUARC	Monash University Accident Research Centre
NRSPP	National Road Safety Partnership Program
UNSW	University of New South Wales

Conference committees

Host Chapter Committee

- Dr Fritha Argus, Main Roads Western Australia, Australia (Chair)
- Teresa Williams, Main Roads Western Australia, Australia (Deputy Chair)
- Stacey Coppack, Road Safety Commission of Western Australia, Australia
- Dr Ingrid Johnston, ACRS, Australia
- Ms Terri-Anne Pettet, Western Australia Local Government Association, Australia
- Edward Rose, Main Roads Western Australia, Australia
- Prof Teresa Senserrick, Centre For Road Safety Research, University of Western Australia (Scientific Committee Chair), Australia

Scientific Committee

- Prof Teresa Senserrick, Centre for Road Safety Research, University of Western Australia, Australia (Chair)
- Mr Adam Wilmot, GHD, Australia (Deputy Chair)
- A/Prof Marilyn Johnson, UNSW and ACRS, Australia (Editor-in-Chief)
- Dr Richard Amoh-Gyimah, Main Roads Western Australia, Australia
- Dr Peta Dzidic, Road Safety Commission of Western Australia, Australia
- Dr Ingrid Johnston, ACRS, Australia
- A/Prof Sjaan Koppel, Monash University Accident Research Centre (MUARC), Australia
- Mr David McTiernan, Zero Transport Safety Advisory, Australia

Scientific Advisory Group

- Dr Paul Besant, Western Australia Police Force, Australia
- Dr Vanessa Cattermole-Terzic, Department of Transport and Main Roads, Queensland, Australia
- Ms Lyndall Cook, UNSW, Australia
- Ms Katherine Drakeford, Department of Transport, Western Australia, Australia
- Dr Luis Ferreira, Road Safety Commission of Western Australia, Australia
- Ms Rachel Goodsell, RAC WA, Australia
- Mr Ian Holbrook, Injury Matters, Australia
- Ms Rachael Mason, New Zealand Police, New Zealand
- Ms Prue Oswin, Planning Institute of Australia, Australia
- Ms Amalia (Amy) Rolloque, Center for Policy Studies and Advocacy on Sustainable Development, Philippines
- Ms Lola Sikora, Royal Perth Hospital, Australia
- Dr Amir Sobhani, Safe Path Consulting Pty Ltd, Australia
- Dr Ali Soltani, Flinders University, Australia
- Ms Melanie Suitor, Parkes, Forbes and Lachlan Shire Councils, Australia
- Mr David Wakelin, Transport for NSW, Australia
- Mr Adrian Wilson, Transport and Main Roads, Queensland, Australia
- Ms Angela Yan, The University of Western Australia, Australia

LMIC Scholarship Committee

- Dr Tana Tan, Safe Systems Solutions Pty Ltd, Australia (Chair)
- Dr Judy Fleiter, Global Road Safety Partnership, Australia
- Dr Lori Mooren, Safety and Communications Pty Ltd, Australia
- Dr Shane Turner, Abley, New Zealand



Conference Committee members, ARSC2025 Closing plenary
Left to right: Paul Besant, Adrian Wilson, Ian Holbrook, Sjaan Koppel, Melanie Suitor, Michael Nieuwesteeg, Adam Wilmot, Terri-Anne Pettet, Fritha Argus, Teresa Senserrick, Stacey Coppack, Teresa Williams, Angela Yan, Richard Amoh-Gyimah, Katherine Drakeford, Luis Ferreira, Peta Dzidic, Rachael Mason, Amir Sobhani, Marilyn Johnson, David McTiernan, Ingrid Johnston

Conference Prize Judges

- Dr Fritha Argus, Main Roads Western Australia, Australia
- A/Prof Lyndel Bates, Griffith University, Australia
- Dr Paul Besant, Western Australia Police Force, Australia
- Mr Jerome Carslake, NRSPP, Australia
- Prof Jude Charlton, Monash University Accident Research Centre (MUARC), Australia
- Dr Peta Dzidic, Road Safety Commission of Western Australia, Australia
- Dr Luis Ferreira, Road Safety Commission of Western Australia, Australia
- Mr Ian Holbrook, Injury Matters, Australia
- Mr Kevin Hore, Energy Queensland
- Superintendent Shane Johnson, South Australia Police, Australia
- A/Prof Sjaan Koppel, Monash University Accident Research Centre (MUARC), Australia
- Dr Rachael Mason, New Zealand Police, New Zealand
- Ms Michelle McLaughlin, Little Blue Dinosaur Foundation, Australia
- Mr David McTiernan, Zero Transport Safety Advisory, Australia
- Mr Jonathan Passmore, World Health Organization, Denmark
- Ms Terri-Anne Pettet, Western Australia Local Government Association, Australia
- Mr Edward Rose, Main Roads Western Australia, Australia
- Prof Teresa Senserrick, Centre For Road Safety Research, University of Western Australia
- Ms Melanie Suitor, Parkes, Forbes and Lachlan Shire Councils, Australia
- Michael Timms, Australasian College of Road Safety, NSW Chapter Chair, Australia
- Ms Teresa Williams, Main Roads Western Australia, Australia
- Mr Adam Wilmot, GHD, Australia

Conference prize winners

Prize	Winners			Sponsored by
	First Author	**Organisation**	**Submission title**	
Best Conference Submission	Chris Brennan	Victorian Department of Justice and Community Safety, Australia	Enhanced site selection tool for road safety cameras	
Best Conference Theme Submission	Nils van Lamoen	New Zealand Police, New Zealand	Outcomes of an intensive traffic enforcement operation in New Zealand	
Best Submission by a New Practitioner	Hang Nguyen	Asia Injury Prevention Foundation, Vietnam	Youth actions turn grass-roots ideas into practice	
Best Submission by a New Researcher	Sajani Siriwardene	Deakin University, Australia	Driver merging preferences, behaviour, and strategies at roadworks	
Best Submission by a Practitioner	Nils van Lamoen	New Zealand Police, Australia	Outcomes of an intensive traffic enforcement operation in New Zealand	
Best Submission by a Researcher	Helen Nguyen	The George Institute for Global Health, Australia	Views on age-based licensing from older drivers, families and caregivers	
Best Poster (judged)	Irene Tse	Auckland Transport, New Zealand	Debunking the myth: Raised crossings don't create significant congestion	
Best Poster (popular vote)	Giulio Ponte	Centre for Automotive Safety Research, The University of Adelaide, Australia	Event Data Recorders (EDRs): unlocking crash data for research	
Tom McLaughlin Prize for Best Submission with Implications for Improving Child Road Safety	Alice Woodruff	Active City, Australia	Travel to School: New guidance	Little Blue Dinosaur Foundation
Best Submission with Implications for Improving Road Safety Policing	Adrian Wilson	Department of Transport and Main Roads, Queensland, Australia	Estimating the road safety benefits of seatbelt cameras in Queensland	Griffith University, Griffith Criminology Institute
Best Submission with Implications for Workplace and Work-related Road Safety	Phuong Nguyen	Asia Injury Prevention Foundation, Vietnam	Driving Change: Safer Transport Solutions for Cambodian Factory Workers	National Road Safety Partnership Program (NRSPP)

Peer Reviewers

Over 150 subject matter experts completed over 600 reviews.
We thank them for their generous contribution of their time and expertise.

Subject matter peer-reviewers

Title and Name	Organisation	Country
Mr Muhamad Syukri Abdul Khalid	Malaysian Institute of Road Safety Research (MIROS)	Malaysia
Mr Muhammad Uba Abdulazeez	United Arab Emirates University	United Arab Emirates
Mr Abdullah Abdullah	Edith Cowan University	Australia
Dr Zeke Ahern	Queensland University of Technology (QUT)	Australia
Mrs Inam Ahmad	Monash University	Australia
Dr Blair Aitken	Swinburne University of Technology	Australia
Dr Hafez Alavi	HA Consulting	Australia
Dr Matthew Albrecht	University of Western Australia	Australia
Dr Richard Amoh-Gyimah	Main Roads WA	Australia
Dr Levi Anderson	MAIC-QUT Road Safety Research Collaboration, Queensland University of Technology	Australia
Dr Fritha Argus	Main Roads WA	Australia
Mrs Azhaginiyal Arularasu	Monash University	Australia
Ms Kardina Ayuningtyas	UNSW	Australia
Mr Ben Barnes	Transport for NSW	Australia
A/Prof Lyndel Bates	Griffith University	Australia
Mr Jay Baththana	Abley Limited	New Zealand
Mr David Beck	Transurban	Australia
Mr Kenn Beer	Safe System Solutions	Australia
Dr Joanne Bennett	Australian Catholic University	Australia
Dr Paul Besant	WA Police	Australia
Mr Yogen Bhatnagar	Urap International	Australia
Dr Roger Bligh	Texas A&M Transportation Institute	United States of America
Ms Anna Bray Sharpin	Abley	New Zealand
Mr Chris Brennan	Victorian Department of Justice and Community Safety	Australia
Dr David Broadbent	Deakin University	Australia
Miss Quyen Bui	AIP Foundation	Vietnam
Mr Jerome Carslake	Monash University	Australia
Mr Gregory Casey	Western Sydney University	Australia
Dr Vanessa Cattermole-Terzic	TMR Queensland	Australia
Dr Elizabeth Eu Mee Chong	Swinburne University of Technology Sarawak Campus	Malaysia
Ms Emma Clarkson	Mobility and Accessibility for Children and Adults Ltd (MACA)	Australia
Ms Lyndall Cook	UNSW, Neura	Australia
Dr Jennifer Cori	Institute for Breathing and Sleep	Australia
Dr Jolene Cox	University of the Sunshine Coast	Australia
A/Prof Ashim Debnath	Deakin University	Australia

Subject matter peer-reviewers

Title and Name	Organisation	Country
Dr Sam Doecke	Centre for Automotive Safety Research, The University of Adelaide	Australia
Mr Brett Droder	Jamieson Trauma Institute	Australia
Dr Gift Dumedah	Kwame Nkrumah University of Science and Technology	Ghana
Ms Claire Dunbar	Flinders University	Australia
Mr Paul Durdin	Abley	New Zealand
Dr Peta Dzidic	Road Safety Commission, WA	Australia
Dr Erik Eenkhoorn	Acorns b.v.	The Netherlands
Ms Alyson Elari	Injury Matters	Australia
Ms Estiara Ellizar	Ministry of Transportation	Indonesia
Mr Martin Elsegood	Centre for Automotive Safety Research, The University of Adelaide	Australia
Dr Luis Ferreira	WA Police	Australia
A/Prof Michael Fitzharris	Monash University	Australia
Dr Judy Fleiter	UNSW, The George Institute for Global Health	Australia
Ms Madeleine Fletcher-Kennedy	GHD	Australia
Dr Stephen Kome Fondzenyuy	National Advanced School of Public Works	Cameroon
Ms Tia Gaffney	Allied Forensics Group	Australia
Dr Cassandra Gauld	University of Newcastle	Australia
Ms Robyn Gerhard	Monash University	Australia
Mr Michael Gillies	TMR Queensland	Australia
Miss Rachel Goodsell	Royal Automobile Club of Western Australia	Australia
Mr Daniel Gyaase	UNSW, The George Institute for Global Health	Australia
Mr Phil Harbutt	PivotSpace	Australia
Mr Andrew Hardwick	Re:act	Australia
Ms Dale Harris	Abley Limited	New Zealand
Mr Christopher Hayes	Victoria Police	Australia
A/Prof Amie Hayley	Swinburne University of Technology	Australia
Dr Jane Hayman	Monash University	Australia
Mrs Ann-Marie Head	Abley Limited	New Zealand
Dr Brett Hughes	P7Safety	Australia
Mr Mohd Khairul Alhapiz Ibrahim	Malaysian Institute of Road Safety Research (MIROS)	Malaysia
A/Prof Marilyn Johnson	Australasian College of Road Safety, UNSW	Australia
Dr Ingrid Johnston	Australasian College of Road Safety	Australia
Dr Sunil Kumar Joshi	Kathmandu Medical College	Australia
Mr Sahid Kamid	UP National Center for Transportation Studies	Philippines
Dr Sherrie-Anne Kaye	MAIC-QUT Road Safety Research Collaboration, Queensland University of Technology	Australia
Mrs Rashmeet Kaur Khanuja	Indian Institute of Technology Delhi	India
Dr Glen Koorey	ViaStrada Ltd	New Zealand
Dr Sjaan Koppel	Monash University	Australia
Dr Jonny Kuo	Seeing Machines Ltd	Australia
Dr Aine Kusumawati	Institut Teknologi Bandung	Indonesia

Subject matter peer-reviewers

Title and Name	Organisation	Country
Prof Ioni Lewis	MAIC-QUT Road Safety Research Collaboration, Queensland University of Technology	Australia
Ms Amy Lovesey	Transport for NSW	Australia
Dr Hamish Mackie	Mackie	New Zealand
Dr Brooke Manning	Swinburne University of Technology	Australia
Miss Laura Martínez-Buelvas	Queensland University of Technology (QUT)	Australia
Dr Rachael Mason	New Zealand Police	New Zealand
Dr William McCalman	Deakin University	Australia
Mr Max McCardel	Safe System Solutions	Australia
Dr Hayley McDonald	Monash University	Australia
Mr David McTiernan	Zero Transport Safety Advisory	Australia
Dr Mario Mongiardini	Centre for Automotive Safety Research, The University of Adelaide	Australia
Dr Ashley Montero	Flinders University	Australia
Mr Rob Morgan	Robert Morgan Traffic Engineering & Road Safety	Australia
Dr Masria Mustafa	Universiti Teknologi MARA	Malaysia
Mr Daniel Mustata	Road Solutions	Australia
Dr Matin Nabavi Niaki	Austroads	Australia
Ms Sonali Nandavar	MAIC-QUT Road Safety Research Collaboration, Queensland University of Technology	Australia
Prof Anjum Naweed	Central Queensland University	Australia
Mr Darren Neagle	Transport for NSW	Australia
Dr Helen Nguyen	AIP Foundation	Vietnam
Ms Hang Nguyen	AIP Foundation	Vietnam
Ms Phuong Nguyen	UNSW, The George Institute for Global Health	Australia
Ms Prue Oswin	Sidelines Traffic	Australia
Miss Jodi Page-Smith	Transport Accident Commission	Australia
Prof Kristen Pammer	The University of Melbourne	Australia
Mr Aditya Paudel	Tech Studio of Engineering	Nepal
Ms Terri-Anne Pettet	WALGA	Australia
Mr Duc Phan	Road Solutions	Australia
Mr Giulio Ponte	Centre for Automotive Safety Research, The University of Adelaide	Australia
Ms Caitlin Reeves	University of Newcastle	Australia
Dr Madan B. Regmi	UN	Nepal
Mr Sina Rejali	Queensland University of Technology (QUT)	Australia
Dr Paul Roberts	UWA	Australia
Dr David Rodwell	MAIC-QUT Road Safety Research Collaboration, Queensland University of Technology	Australia
Ms Amalia (Amy) Rolloque	Center for Policy Studies and Advocacy on Sustainable Development, Inc. (The Policy Center)	Philippines
Mr Blessing Sai	Traffic Safety Council of Zimbabwe	Zimbabwe
Mr Harish Kumar Saini	Indian Institute of Technology Jammu	India
Prof Teresa Senserrick	University of Western Australia	Australia
Ms Kerry Shaz	Transport for NSW	Australia
Ms Ping Sim	Auckland Transport	New Zealand
Mr Keith Simmons	Austroads	Australia

Subject matter peer-reviewers

Title and Name	Organisation	Country
Dr Sajani Siriwardene	Deakin University	Australia
Ms Andrea Smithson	City of Albany	Australia
Dr Amir Sobhani	Safe Path Consulting Pty Ltd	Australia
Dr Ali Soltani	Flinders University	Australia
Mr David Soole	TMR Queensland	Australia
Dr Amanda Stephens	Monash University	Australia
Mr Andrew Stevens	Beca Ltd	New Zealand
Dr Chris Stokes	Centre for Automotive Safety Research, The University of Adelaide	Australia
Ms Melanie Suitor	Local Govt Network	Australia
Ms Roisin Sweeney	Injury Matters	Australia
Dr Muhammed Navid Tahir	Punjab university Lahore	Pakistan
Dr Tana Tan	Safe System Solutions	Australia
Ms Natalia Tanan	ITB and MPWRI	Indonesia
Mrs Rebecca Teal-Ireland	Abley	New Zealand
Dr James Thompson	Centre for Automotive Safety Research, The University of Adelaide	Australia
Dr Long Truong	La Trobe University	Australia
Mrs Irene Tse	Auckland Transport	New Zealand
Dr Georgia Tuckwell	Centre for Automotive Safety Research, The University of Adelaide	Australia
Dr Blair Turner	Abley Limited	Australia
Dr Shane Turner	Road Safety Advisory Services	New Zealand
Mr David Wakelin	Transport for NSW	Australia
Mr Trevor Wang	NTRO	Australia
Dr Natalie Watson-Brown	Queensland University of Technology (QUT)	Australia
Mrs Aimee Wescombe	GHD	Australia
Dr Tom Whyte	Transport for NSW	Australia
Mr Brett Williams	Local Govt Network	Australia
Dr Amy Williamson	Safe System Solutions	New Zealand
Prof Ann Williamson	University New South Wales	Australia
Mr Adrian Wilson	TMR Queensland	Australia
A/Prof Lisa Wundersitz	Centre for Automotive Safety Research, The University of Adelaide	Australia
Dr Rachael Wynne	University of Newcastle	Australia
Dr Shanqing Xu	Swinburne University of Technology	Australia
Ms Angela Yan	University of Western Australia	Australia
Dr David Young	Transport Accident Commission	Australia
Mr Ali Zayerzadeh	Road Safety Pioneers (RSP)	Iran

Communicating our road safety science

Design collaboration: Australasian College of Road Safety + Monash University

This is the fifth year of the collaboration between the Australasian College of Road Safety and Monash University's Department of Design. The collaboration brings together road safety professionals and communication designers and senior student communication designers from Monash Art, Design and Architecture (MADA). This year's collaboration was led by A/Prof Marilyn Johnson (ACRS, UNSW) and Warren Taylor (Art Director).

The collaboration was created in 2021 by A/Prof Marilyn Johnson (ACRS, UNSW) and A/Prof Robbie Napper (Monash University). The student designers created posters to translate key findings from research and practice to engage readers and encouraged them to find out more about the project.

All the artwork created for ARSC2025 is included in the proceedings following the Extended Abstract.

Design collaboration credit

Project Directors
A/Prof Marilyn Johnson, Project Lead
Warren Taylor, Art Director

Design collaboration posters

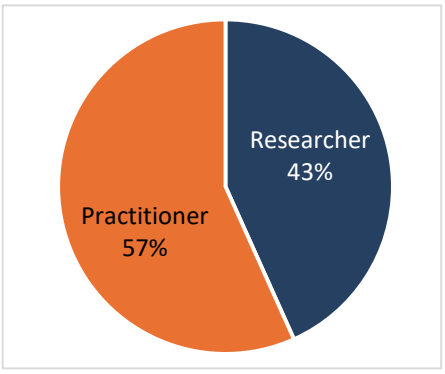
First author	Title	Lead student designer
Mary Abungu	Strengthening Multi-Sectoral Collaboration to Enhance Road Safety Data	Megan Prass
Giulio Ponte	Event Data Recorders (EDRs): unlocking crash data for research*	Annabella Kartoyo
Long Truong	Increasing Nighttime Safety at Passive Railway Crossings with Photoluminescent Elements	Liliana Bettiol
William Majani Wambulwa	Targeting High-Risk Corridors for Evidence-Based Crash Reduction in Kenya	Jennifer Hoang

*Winner, Best Poster (popular vote)

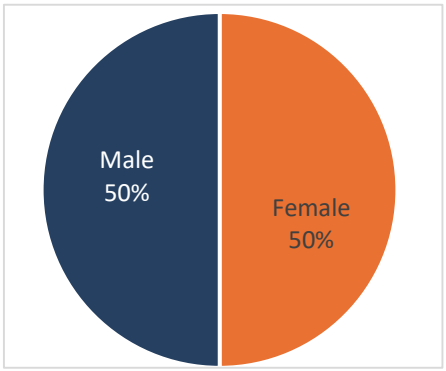
ARSC2025 Summary of submissions

307 Total number of submissions received
113 Withdrawn or rejected
194 Total number of submissions presented in the ARSC2025 program
650 Total number of authors of submissions presented

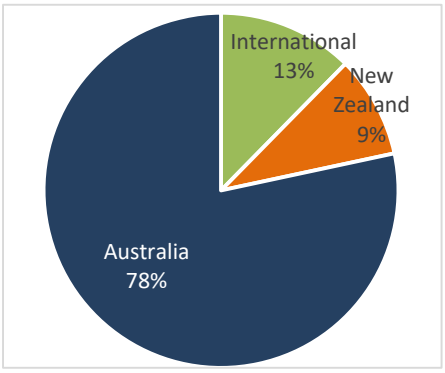
Breakdown by presentation type
87 Long oral
94 Short oral
3 Interactive workshop
8 Poster with 3 minute presentation
2 Poster only



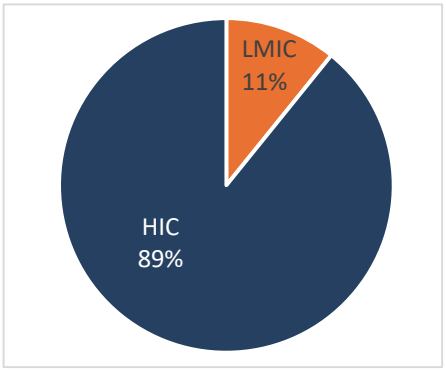
Lead author by Sector (n=194)



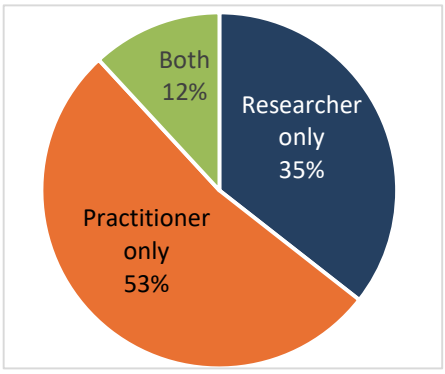
Lead author by Sex (n=194)
No authors identified as non-binary



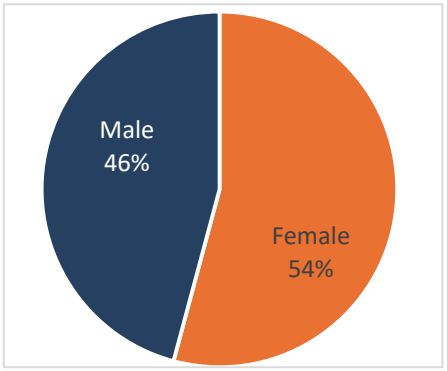
Lead author by Location (n=194)



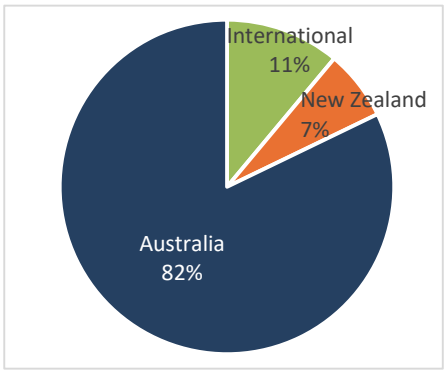
Lead author by Country Income (n=194)



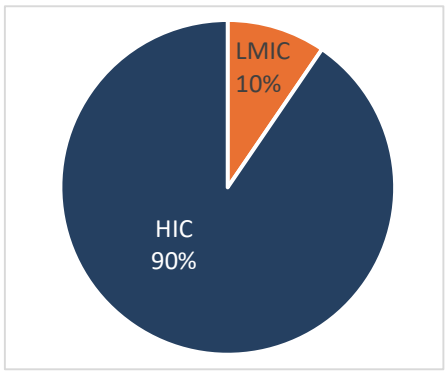
All authors by Sector by Submission (n=194)



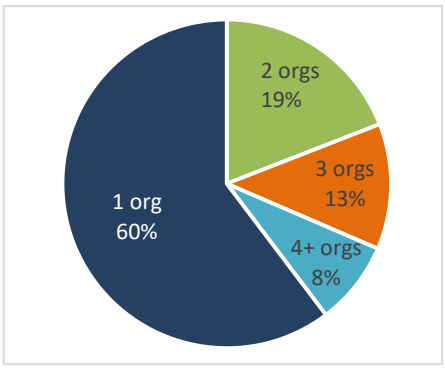
All authors by Sex (n=650)
No authors identified as non-binary



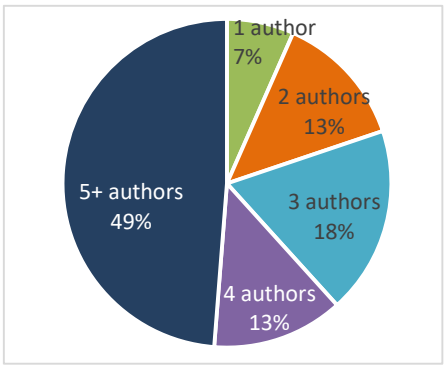
All authors by Location (n=650)



All authors by Country Income (n=650)



Number of organisations by submission (n=194)
Range of organisations: 1-9
Average per submission: 1.8



Number of authors by submission (n=194)
Range of authors: 1-17
Average per submission: 3.3


2025 Australasian
Road Safety Conference
20 - 23 OCT - PERTH, WESTERN AUSTRALIA

Day 1: Monday, 20 October 2025					
	Golden Ballroom A	Golden Ballroom B	Golden Ballroom C	Goldsworthy & Hamersley	Meeting room 5 + 6
12:30-14:30	Road Policing Network	AusRAP 2025 Results and Next Steps	Local Government Network A snapshot of Local Government engagement in delivering road safety Proudly supported by RAC For the better	Low- and Middle-Income Countries (LMIC) Speed Management in Low- and Middle-Income Countries	
14:30-15:00	Afternoon tea				
15:00-17:00	Workshop 6 Women in Road Safety Network (WiRSN) Advancing Equity, Embracing Elasticity, and Driving Evolution Together!	Workshop 7 Rural Road Safety Network	Workshop 8 Early Career Professional Network	Workshop 9 Low- and Middle-Income Countries (LMIC) Speed Management in Low- and Middle-Income Countries	Workshop 10 Emergency vehicle safety workshop
17:00-18:00					
18:00-20:00	**Welcome Reception** Frasers State Reception Centre Delivered with the support of: VOLVO				

Day 2: Tuesday, 21 October 2025				
	Golden Ballroom			
9:00-10:30	**Opening and Morning plenary** Chairperson: Teresa Williams Killed by a Traffic Engineer, Wes Marshall Delivered with the support of: Australian Government, Department of Infrastructure, Transport, Regional Development, Communications, Sport and the Arts			
10:30-11:00	Morning tea			
	Golden Ballroom A	Golden Ballroom B	Golden Ballroom C	Goldsworthy & Hamersley
11:00-12:20 Welcome	**Session 1** **Roads, road design and road environment 1** **Chair: Amir Sobhani** **Co-chair: Ashley Montero**	**Session 2** **Workplace and work-related road safety** **Chair: Jamie Mackenzie** **Co-chair: Sophie Robinson**	**Session 3** **Enforcement and Policing 1** **Chair: Lyndel Bates** **Co-chair: Mike Dalla-Costa**	**Session 4** **Community and school programs** **Chair: Peta Dzidic** **Co-chair: Alexander Weber**
11:01-11:16	The evolution of network risk assessment: where to from here? **(Dale Harris) Matt Allan** Abley Limited	Driving Change: Safer Transport Solutions for Cambodian Factory Workers **(Phuong Nguyen) Piseth Im** Asia Injury Prevention Foundation	How partnership-based general deterrence changed perceptions of drink-driving **Ping Sim** Auckland Transport	The RACQ Streets Ahead program: An impact evaluation **Ioni Lewis and Louise Hart** MAIC-QUT Road Safety Research Collaboration
11:17-11:32	Evaluating Zigzag Pavement Marking for Speed Reduction at Pedestrian Crossings **Paul Roberts** University of Western Australia	Fit For Fleet Safety: Safety Management for Small Fleet Operators **(Nicholas Duck) Damien Colabattista** Opposite	Estimating the road safety benefits of seatbelt cameras in Queensland **Adrian Wilson and Stuart Newstead** Department of Transport and Main Roads	Don't come to us, we'll come to you: Advertising evolution **Stacey Coppack and Kirsten Brent** Road Safety Commission of Western Australia
11:33-11:48	Developing South Australia's metro network safety plan **Chris Stokes and Farhana Ahmed** University of Adelaide, Centre for Automotive Safety Research / Department for Infrastructure and Transport, Government of South Australia	Evaluation of traffic control treatments in End-of-Queue situations at roadworks **Ashim Debnath** Deakin University	Outcomes of an intensive traffic enforcement operation in New Zealand **(Nils van Lamoen) Peter McKennie** New Zealand Police	Re:act for Change: Engaging young Australians to reduce road trauma **Andrew Hardwick and Zoey Portilla** Re:act
11:49-11:56	Updating Making Roads Motorcycle Friendly: Enhancing Safety for Riders **Kenn Beer** Safe System Solutions Pty Ltd	New Zealand's work-related road safety Harm Reduction Action Plan **Hamish Mackie** Mackie	Improving driver licensure through police and community services collaboration **Rachael Mason** New Zealand Police	Youth actions turn grass-roots ideas into practice **Hang Nguyen** Asia Injury Prevention Foundation
11:57-12:04				Preventing low-speed vehicle runovers of children through collaboration **Darren Neagle and Louise Cosgrove** Transport for New South Wales
12:05-12:12	Raising guidance for Queensland Raised Crossings **Michael Gillies and Prue Oswin** Department of Transport and Main Roads Queensland	User experience of GSR ADDW Regulations in Australian Heavy Vehicles **Jonny Kuo** Seeing Machines Ltd	Enhanced site selection tool for road safety cameras **(Chris Brennan) Lilian Chan** Victorian Department of Justice and Community Safety	Improving safety of young Western Australians: P.A.R.T.Y. program evaluation outcomes **Judy Fleiter and Lisa Le** Western Australian Centre for Road Safety Research / Road Safety Commission
12:13-12:20	Keeping people safe when walking – improving guidance **(Max McCardel) Phil Harbutt** Safe System Solutions Pty Ltd	Solving a Wicked Problem Achieving Vision Zero in Logging Transport **Tia Gaffney** Allied Forensics Group	AI Enforcement Evolution to Improve Road Safety in Western Australia **(Duncan Murcott) Jason Csincsi** Acusensus	Effectively engaging with communities on the issue of speed **Cath Jacobs** Abley Limited
12:20-13:15	Lunch			12:30-13:00 Lunchtime Session Delivered with the support of VERRA MOBILITY

	Golden Ballroom A	Golden Ballroom B	Golden Ballroom C	Goldsworthy & Hamersley
13:15-14:30	**Session 5** **Local Government** **Chair: David McTiernan** **Co-chair: Melanie Suitor**	**Session 6** **E-scooters** **Chair: Rod Katz** **Co-chair: Alex Price**	**Session 7** **Enforcement and Policing 2** **Chair: Glen Spencer** **Co-chair: Adrian Wilson**	**Session 8** **Fatigue** **Chair: Paul Roberts** **Co-chair: Natalia Tanan**
Welcome				
13:17-13:32	Shire of Manjimup Progressing Road Traffic Safety Management Systems ISO39001 **(Katherine Celenza) Catherine Mills** Western Australian Local Government Association RoadWise	Knowledge of changed e-scooter rules in Queensland **(Narelle Haworth) Sherrie-Anne Kaye** MAIC-QUT Road Safety Research Collaboration	A Structured Framework for Implementing and Evaluating Mobile Point-to-Point (MP2P) Enforcement **Amir Sobhani and Matin Nabavi** Safe Path Consulting Pty Ltd	Perceptions of truck driver fatigue enforcement amongst Australian enforcement functionaries. **Gregory Casey** Western Sydney University
13:33-13:48	RoadWise Refocused Supporting Local Governments Differently **Terri-Anne Pettet** Western Australian Local Government Association	Finding the Right Path: An Evaluation of Queensland's E-Scooter Regulations **Cindy Tran** Department of Transport and Main Roads	Seatbelt enforcement in NSW: Evolving a life-saving camera program **Amy Lovesey** Transport for New South Wales	Integrating Fatigue Detection: A Framework for Safer Roads **Anjum Naweed** Central Queensland University
13:49-14:04	RoadWise Recognised: Inspiring Better Road Safety Practice **Rebecca Bampton** Western Australian Local Government Association	E-scooter riders in Victoria **(Jodi Page-Smith) Abhiraj Kanwar** Transport Accident Commission	Reckless to Responsible – Shifting Gears Road Safety Session **Susan O'Connor** South Australia Police	Predicting Driver Sleep history with Machine Learning: A Simulator-Based Study **Georgia Tuckwell** University of Adelaide
14:05-14:12	Victoria's "Safe Local Roads and Streets Program" for Local Governments **(Henry Lim) Chris Hall and Katriona Dall'Oste** Department of Transport and Planning	More Than E-Scooters: Road safety education supporting children's independent travel **Prue Oswin** Sidelines Traffic	Assessing Safer Methods of Enforcement on High-speed Roads **Christopher Hayes** Victoria Police	Do life satisfaction and risk perceptions impact drowsy driving? **(Olivia Bullen) David Rodwell** MAIC-QUT Road Safety Research Collaboration
14:13-14:20		e-Scooter-Related Workers Compensation Claims in Queensland: 2019-2024 **(Brett Droder) Joel Tucker** The Royal Automobile Club of Queensland	Community perceptions of road safety cameras **(Chris Brennan) Maria Saki** Victorian Department of Justice and Community Safety	Observing Work and Rest Behaviours of Truck Drivers in Australia **Gregory Casey** Western Sydney University
14:21-14:28	City of Salisbury Safe Journeys Action Plan: An Integrated Approach **Malcolm Mak & Stephanie Yue** National Transport Research Organisation	Hidden in Plain Sight: Analysis of E-Scooter Crashes in Victoria **Abhiraj Kanwar** Transport Accident Commission	Police Perceptions After Two Different Types of Random Breath Tests **Lyndel Bates** Griffith Criminology Institute and School of Criminology and Criminal Justice, Griffith University	Sleep irregularity is associated with driving impairment during sleep deprivation **Ashley Montero** Flinders University
14:30-14:35	room change			

	Golden Ballroom A	Golden Ballroom B	Golden Ballroom C	Goldsworthy & Hamersley
14:35-16:00	**Session 9** **Motorcyclists**  **Chair: Glen Koorey** **Co-chair: Hang Nguyen**	**Session 10** **Technology**  **Chair: Andrew Hardwick** **Co-chair: Madeleine Fletcher-Kennedy**	**Session 11** **Roads, road design and road environment 2**  **Chair: Aimee Wescombe** **Co-chair: Nicole Coaker**	**Session 12** **Crash data 1**  **Chair: Brett Williams** **Co-chair: Stacey Coppack**
Welcome				
14:37-14:52	Development of a retrofit motorcycle forward collision alert system **Mohd Khairul Alhapiz Ibrahim** Malaysian Institute of Road Safety Research	The Victorian School Crossing Risk Assessment Framework **(Justin Lu) Matt Bennett** Real Time Traffic	A Review of the Western Australia Regional Road Safety Program **Richard Amoh-Gyimah and David Moyses** Main Roads Western Australia	Exposure-adjusted hospitalised injury rates in transport crashes by socioeconomic status **Robyn Gerhard** Monash University
14:53-15:08	Big bike crashes in Malaysia **Muhamad Syukri Abdul Khalid** Malaysian Institute of Road Safety Research (MIROS)	Harnessing Integrated Technology to Reduce Road Traffic Fatalities and Injuries **Verushka Balaram** ARRB Systems PTY Ltd	Driver merging preferences, behaviour and strategies at roadworks **Sajani Siriwardene** Safe Future Mobility Research Lab, Deakin University	Event Data Recorders (EDRs) in Australia: prevalence and benefits **Sam Doecke** Centre for Automotive Safety Research, The University of Adelaide
15:09-15:24	Helmet Quality and Use Behaviour Among Motorcyclists in Tamale, Ghana **Daniel Gyaase** The George Institute for Global Health	A Predictive Risk and Confidence Modelling Framework Based on Near-Miss Observations **Stefan Filippone** Real Time Traffic	Road Safety Challenges on Difficult Terrain: Case Study **Yogen Bhatnagar** JBS Engineers	Linking trauma registries with crash data to advance road safety **Robyn Gerhard** Monash University
15:25-15:32	Evaluation of motorcycle gear rating programs MotoCAP and CRASH Moto CAP **Tom Whyte** Moto CAP	Insights From Road Safety Camera Technology **(Kai Zhen) Luis Ferreira** Road Safety Commission of Western Australia	Vehicle Barrier for Shielding Pedestrians, Bicyclists, and Other Vulnerable Users **Roger Bligh** Texas A&M Transportation Institute	Modelling the Impact of Injury Mechanism on Insurance Claim Severity **(Sajeewa Siriwardena) Shamsunnahar Yasmin** Queensland University of Technology
15:33-15:40			Improving Safe System Performance of Intersections on Rural Divided Roads **Philip Rosser** Department of Transport and Planning (DTP)	Mobile notifications and crash risk at regional telecommunication coverage boundaries **(Matthew Johnston) Alexander Price** Main Roads Western Australia
15:41-15:44	Inequity in Protection Levels of Female and Male Motorcycle Gear **Yao Yu** IFM	AI-Based Estimation of Alcohol Intoxication and Drowsiness from Facial Analysis **Abdullah Abdullah** Edith Cowan University	Identifying Safety Features for Tramway Implementation in Bogor, Indonesia **Ulfi Puarada** Transportologi	Risk inequity in the safe systems approach to road safety **Giulio Ponte** Centre for Automotive Safety Research, The University of Adelaide
1544-1549		NaviStation Initiatives Preparing the Golden Generation Through Transportation Safety Education **Widyarini Weningtyas** Institut Teknologi Bandung		
15:49-15:51	Do Exclusive Motorcycle Lanes Enhance Safety? Insights from Bayesian Analysis **Harish Kumar Saini**		Increasing Nighttime Safety at Passive Railway Crossings with Photoluminescent Elements **Long Truong** La Trobe University	Event Data Recorders (EDRs): unlocking crash data for research **Giulio Ponte** Centre for Automotive Safety Research, The University of Adelaide
15:52-15:56			Debunking the myth: Raised crossings don't create significant congestion **Irene Tse** Auckland Transport	Does training work: 10 years of the New Zealand experience **Gareth Smith** ACC
16:00-16:20	Poster author discussion, Exhibition Hall (Pilbara room)			

16:00-16:20	Afternoon tea
	Golden Ballroom
16:20-17:30	**Afternoon plenary** Debate: That we are on track to meet 2030 targets Moderator: Iain Cameron Affirmative team: Hafez Alavi, Lee Randall, Ping Sim Negative team: Joe Collard, Judy Fleiter, Wes Marshall
17:30-19:00	
19:00-22:00	**Gala dinner** River View Rooms, Optus Stadium Delivered with the support of:  Australian Government Department of Infrastructure, Transport, Regional Development, Communications, Sport and the Arts

Day 3: Wednesday, 22 October 2025				
	Golden Ballroom			
9:00-10:30	Morning plenary Road safety apartheid and the imperative of equity, Lee Randall Chairperson: Katie Hodson-Thomas Panel: Katherine Drakeford, Stephen Kome Fondzenyuy, Jonathon Passmore, Lee Randall, Shane Turner, William Wambulwa			
10:30-11:00	Morning tea			
	Golden Ballroom A	Golden Ballroom B	Golden Ballroom C	Goldsworthy & Hamersley
11:00-12:15	**Session 13** **Early childhood and Safe trips to school** **Chair: Alexandra Compton** **Co-chair: Angela Yan**	**Session 14** **Impaired driving 1** **Chair: Kathryn Collier** **Co-chair: Rachel Mason**	**Session 15** **Roads, road design and road environment 3** **Chair: Sjaan Koppel** **Co-chair: Sajani Siriwardene**	**Session 16** **Interactive workshop 1**
Welcome				
11:02-11:17	Transforming Indonesia's School Zones with a Data-Driven and Participatory Approach **Estiara Ellizar** Ministry of Transportation	How alcohol consumption influences attitudes and behaviour towards risky driving **(Brooke Manning) Amie Hayley** Swinburne University of Technology	Evolving Roadside Safety Hardware: Designing for the Future **James Kovar** Texas A&M Transportation Institute	Bottom-up approaches to achieving safe speeds **Judy Fleiter and Blair Turner** The George Institute for Global Health Panellists: Ping Sim (Auckland Transport) Val Stamper (City of Sydney) Diana Weekes (City of Coffs Harbour) Chika Sakashita (Global Alliance of NGOs for Road Safety) Peter Varris (City of Vincent)
11:18-11:25	Influencing the school travel system for a healthier future **(Ann-Marie Head) Matthew Noon** Abley Limited	A risk-based combined sanctions therapeutic approach to manage drug-driving offenders **Michael Fitzharris and Sara Liu** Accident Research Centre (MUARC)	Stopping Sight Distance Assessment Using LiDAR Survey **Lloyd Baker** Main Roads Western Australia	
11:26-11:33			LiDAR Point Cloud Data and AusRAP Star Rating Communication Strategy **Fritha Argus and Richard Amoh-Gyimah** Main Roads Western Australia	
11:34-11:41	Travel to School: New Guidance for Safe and Active Travel **Alice Woodruff** Active City	Comprehensive resources supporting informed decisions around medicinal cannabis and driving **Sophie Robinson** Department of Transport and Planning Victoria	Performance evaluation of safety roller barriers made of recycled rubber **Shanqing Xu** Swinburne University of Technology	
11:42-11:49	Road Safety in Specialist School Settings **Lauren Brooker** Transport Accident Commission		Rural corridor safety prioritisation using curve context **(Joseph Corbett-Davies), Shane Turner** Abley Limited	
11:50-11:57	Barriers to Appropriate CRS Use for Child Occupants in UAE **Inam Ahmad** Monash University	Can the induced hypocrisy paradigm reduce young drivers' phone use? **Cassandra Gauld** University of Newcastle	How we raised a skewed signalised intersection **Jay Baththana and Reilly Connor** Abley Limited	
11:58-12:05	Safe Active Travel to School: influencing the system in WA **Helen Ginbey** Department of Transport WA	Alcohol and driving: a study of drivers aged 18-25 years **Hayley McDonald** Monash University Accident Research Centre	Streets Alive: A community-led approach to road safety **Kendell Terrell** Town Team Movement	
12:06-12:13	Enabling Active Travel to School **Sonja Hayes** PJA Australia	Eyes on the Road: THC Impacts Oculomotor Activity During Driving **Brooke Manning** Swinburne University of Technology	Rural compact roundabouts within the Mornington Peninsula **Mathew McQuinn and Brett Whitwam** Mornington Peninsula Shire	
12:15-13:15	Lunch			

	Golden Ballroom A	Golden Ballroom B	Golden Ballroom C	Goldsworthy & Hamersley
13:15-14:30	**Session 17** **Licensing and training** **Chair: Laura Russ** **Co-chair: Ulfi Puarada**	**Session 18** **Roads, road design and road environments 4** **Chair: Richard Amoh-Gyimah** **Co-chair: Elvira Lazar**	**Session 19** **Policy development and implementation** **Chair: Brett Hughes** **Co-chair: Amy Lovesey**	**Session 20** **Interactive workshop 2**
Welcome				
13:17-13:24	Integrated Training to Improve Young Drivers' Hazard and Speed Management **(Boripat Ratchaneepun) Brett Molesworth** University of New South Wales	Enhancing iRAP Star Ratings in Brunei **Shane Turner** Abley Limited	Filling in Vietnam's legal gap with public-facing media campaigns **Quynh Anh Phan** Asia Injury Prevention Foundation	Transforming Road Safety Strategies: Practising the Planning for Zero Framework **Hafez Alavi and Micheal Nieuwesteeg** HA Consulting
13:25-13:32			Supporting Safe System through the Road and Roadside Safety Policy **Brayden McHeim** Department of Transport and Planning	
13:33-13:40	Views on age-based licensing from older drivers, families and caregivers **Helen Nguyen** The George Institute for Global Health	Driver behaviour preceding crashes at stop/give way sign-controlled intersections **James Thompson** Centre for Automotive Safety Research, The University of Adelaide	Gender Mainstreaming in Road Safety: A Policy Framework for Equity **Tasha Prabhakar and Evelyn Bratchford** NineSquared	
13:41-13:48		Investigating the safety of raised platform markings **Angela Yan** Western Australian Centre for Road Safety Research	De-colonising road safety: Aboriginal Moiety and the Safe System approach **Bobbi Brodie** Transport for New South Wales	
13:49-13:56	People Crossing Safely: Developing Multi-domain Training for Older Adult Pedestrians **Joanne Bennett** Australian Catholic University	Evaluating Road Markings as a Safety Measure in Indonesia **Natalia Tanan** Institut Teknologi Bandung	Malaysia's 5-stars manoeuvre for better road safety **Muhamad Syukri Abdul Khalid** Malaysian Institute of Road Safety Research (MIROS)	
13:57-14:04		Reducing crashes with innovative lane guidance on a managed motorway **Ishan Gangabada** Transurban	Equity and Safety within remote aboriginal communities **Tim Judd** PJA Australia	
14:05-14:12	Evaluating Ryda with content mapping and process reviews **Ioni Lewis and Brooke O'Donnell** MAIC-QUT Road Safety Research Collaboration	Design Characteristics of Raised Safety Platforms for Enhancing Road Safety **(Zeke Ahern) Wahi Rabbani** Queensland University of Technology	Road safety impact of medical cannabis **Matthew Albrecht** Western Australian Centre for Road Safety Research (WACRSR)	
14:13-14:20	A review Hazard Perception Test characteristics and safety outcomes **Simon Raftery** Centre for Automotive Safety Research, The University of Adelaide	Assessment of Road Safety Performance using Indonesian Star Rating Method **Aine Kusumawati** Institut Teknologi Bandung	Evolving our approach to implementing speed limit changes **(Paul Durdin) Matt Allan** Abley Limited	
14:21-14:28	Breaking Barriers: Addressing Licensing Challenges in Regional and Remote WA **Katherine Drakeford** Department of Transport	Common Issues in Road Safety: Pooled Insights from Lead Auditors **Kenn Beer** Safe System Solutions Pty Ltd	Pedestrian Crash Risk from Evasive Actions Using AI-Based Video Analytics **(Saransh Sahu) Shimul (Md Mazharul) Haque** Queensland University of Technology	
14:30-14:35	room change			

	Golden Ballroom A	Golden Ballroom B	Golden Ballroom C	Goldsworthy & Hamersley
14:35-15:50 Welcome	**Session 21** **Safe Speed 1** **Chair: David Elston** **Co-chair: Yogen Bhatnagar**	**Session 22** **Impaired Driving 2** **Chair: Long Truong** **Co-chair: Matt Albrecht**	**Session 23** **Road safety management 1** **Chair: Teresa Senserrick** **Co-chair: Tasha Prabhakar**	**Session 24** **Interactive workshop 3**
14:37-14:52	Examining speed-crash relationship in low- and-middle-income countries: Speed-Safety impact tool **Stephen Kome Fondzenyuy** National Advanced School of Public Works	Distracted driving beliefs and behaviours and the association with rules **Sina Rejali** Queensland University of Technology	Monitoring safety performance indicators to enhance road safety in NSW **(Sanju Joshi) Sayantan Sen** Transport for New South Wales	Safe Active Streets Shifting Road User Behaviours: Collaborative Design Workshop **Zarin Salter, Fiona Goodbody and Caroline Elliott** Western Australian Department of Transport
14:53-15:00	How wicked are speed management challenges? An experts' opinion study **Maria Eugenia Keller** Queensland University of Technology	Mood, task load and driver distraction: what is the relationship? **Amanda Stephens** Monash University Accident Research Centre	Understanding Equity across the Safe System in New Zealand **Amy Williamson** Safe System Solutions	
15:01-15:08		Distractibility of In-Vehicle Infotainment Systems: Methodological Protocol to Measuring Distraction **Rachael Wynne** University of Newcastle	The relationship between the Safe System and risky road use **Candice Potter** MAIC/UniSC Road Safety Research Collaboration	
15:09-15:16	Implementing speed management: Lessons from Australasian case studies **Blair Turner** Road Safety Advisory Services	Adult attachment and speaking up to distracted drivers **(Jessie Bethune) David Rodwell** MAIC-QUT Road Safety Research Collaboration	Evolving the safe system: Safe mobility in strategic transport planning **Philippa Webb** Transport for New South Wales	
15:17-15:24		New apps and context considerations: Young drivers' intended phone use **Sherrie-Anne Kaye** MAIC-QUT Road Safety Research Collaboration	Equity in National Road Safety Strategies **Brett Hughes and Lee Randall** P7Safety	
15:25-15:32	What is an Optimal Speed Limit? **Glen Koorey** ViaStrada Ltd	A systems thinking-based approach to address drug driving-related road trauma **Jolene Cox** University of the Sunshine Coast	A look into road safety in the outback (East Arnhem) **(Daniel Mustata) Duc Phan** Road Solutions	
15:33-15:40		Impairments in simulated driving for young adults with sleep disorders **(Claire Dunbar) Amy Reynolds** Flinders University	Implementation of The Safer Road Concept in Bandung City **(Muty Maulani) Widyarini Weningtyas** Institut Teknologi Bandung	
15:41-15:48		Has the COVID-19 Pandemic influenced current driving behaviours? **(Natalie Watson-Brown) Razi Hasan** The University of Western Australia	Road safety for future generations **Aimee Wescombe** GHD	
15:50-16:15	Afternoon tea			

	Golden Ballroom	
16:15-17:30	**Afternoon plenary** Austroads, Strengthening Road Safety Management for a Path to Zero Speakers: Geoff Allan, Hafez Alavi, Claire Campbell, Michael Nieuwesteeg Panel: Iain Cameron, Jo Cruickshank, Nicole Downing, Craig Hoey, Fabian Marsh	
	Social event	Social event
18:00-19:00	Twilight Safari at Perth Zoo Sponsorted by: COMPASS	Quiz Night Hosted by ACRS WA Chapter ACRS ROAD SAFETY WA Chapter Event

	Golden Ballroom A	Golden Ballroom B	Golden Ballroom C	Goldsworthy & Hamersley
11:00-12:20	**Session 25** **Cyclists** **Chair: Michael Timms** **Co-chair: Michele Prior**	**Session 26** **Emergency services, medical and post-crash care** **Chair: Ann Williamson** **Co-chair: Helen Nguyen**	**Session 27** **Road user behaviours and human factors** **Chair: An Rendell** **Co-chair: Chris Harrison**	**Session 28** **Crash data 2** **Chair: Adam Wilmot** **Co-chair: Robyn Gerhard**
Welcome				
11:02-11:17	Leveraging data-driven approach to promote safer cycling infrastructure in Vietnam **(Quyen Bai) Quynh Anh Phan** Asia Injury Prevention Foundation	Post-crash care and its role in trauma reduction **Bernard Carlon** Transport for New South Wales	Australian Parents' Perspectives on Teenagers Use of Uber Teen **Sjaan Koppel** Monash University Accident Research Centre	Understanding Aboriginal road crash fatalities in South Australia **Lisa Wundersitz** Centre for Automotive Safety Research, The University of Adelaide
11:18-11:33	An Investigation of Vehicle-Bicycle Lateral Interactions Using Computer Vision Data **Megan Oakey** British Columbia Centre for Disease Control	Crash related mental health issues - The invisible injury **Sally Edwards** Centre for Automotive Safety Research, The University of Adelaide	Understanding community views on road safety issues in WA **(Rachel Goodsell) David Elston** Royal Automobile Club of Western Australia	Speeding in Victorian high-severity crashes: Event Data Recorder (EDR) insights **Martin Elsegood** Centre for Automotive Safety Research, The University of Adelaide
11:33-11:48	Predictors of aggression towards cyclists **James Thompson** Centre for Automotive Safety Research, The University of Adelaide	Empowering Emergency Responders to address post-crash mental health **Alyson Elari** Injury Matters	Driving with Bioptic Telescopes: human factors, driver performance and safety **Kim Mestroni** Department of Transport and Planning	Seat belt non-compliance in crashes: Event Data Recorder (EDR) insights **Martin Elsegood** Centre for Automotive Safety Research, The University of Adelaide
11:49-12:04	Changing behaviour of young e-bike riders **Robynann Dixon** Northern Beaches Council	Virtual Reality Training for Multi-Agency Traffic Incident Management **(Michael Mortimer) Ashim Debnath** Deakin University	Case studies from fatal crash investigations by Court-appointed Expert Witness **Johann Tay** Traffic Vehicles & Logistics Pty Ltd	Piloting the Safe System Crash Investigation Program **David Young** Transport Accident Commission
12:05-12:12	Evolving safety training for gig-economy delivery bicycle riders **Sarah Nader** Uber Australia	The lived experiences of individuals responsible for unintentional road trauma **Sonali Nandavar** MAIC-QUT Road Safety Research Collaboration	Current Practices in Fitness to Drive Assessments for Older Adults **Mollie Cahill** University of New South Wales	Horizontal curve crashes on the Western Australian rural road network **Matthew Albrecht** Road Safety Commission of Western Australia
12:13-12:16	Advancing Cycling Safety with Sensor Data and Safe System Insights **Irene McAleese** See.Sense	Beyond the Crash: Addressing the Psychological Impact of Road Incidents **Roisin Sweeney** Injury Matters	MOVETech: Increasing coMpetency and confidence of Older drivers in AVTs **Lisa Keay** University of New South Wales	Strengthening Multi-Sectoral Collaboration to Enhance Road Safety Data **(Mary Abungu) William Majani Wambulwa** Sustainable Mobility Africa
12:17-12:20				Targeting High-Risk Corridors for Evidence-Based Crash Reduction in Kenya **William Majani Wambulwa** World Bank Group / Global Road Safety Facility (GRSF)
12:20-12:25	room change			

	Golden Ballroom A	Golden Ballroom B	Golden Ballroom C	Goldsworthy & Hamersley
12:25-13:45	**Session 29** **Workplace and Technology** **Chair: Ian Holbrook** **Co-chair: Luis Ferreira**	**Session 30** **Road safety management 2** **Chair: Fritha Argus** **Co-chair: Mollie Cahill**	**Session 31** **Pedestrians** **Chair: Ioni Lewis** **Co-chair: Philippa Webb**	**Sesssion 32** **Safe speed 2** **Chair: Shane Turner** **Co-chair: Quynh Anh Phan**
Welcome				
12:26-12:41	In-field evaluation of sleepiness and distraction driver monitoring systems **Jennifer Cori** Institute for Breathing and Sleep	A model to predict safety benefits of conditionally automated vehicles **Azhaginiyal Arularasu** Monash University Accident Research Centre	Promoting Pedestrian Safety through Improved Driver Yielding: A Behavioural Intervention **(Mohammad Sarker) Martin Small** Roads and Highways Department (RHD)	Applying Connected Vehicle Speed Data for AusRAP Star Rating Assessments **Michael Kwok** Compass IoT
12:42-12:49	Insights from Practitioners -Reporting the National Traffic Controller Safety Survey **Rebecca Bullock** Traffic Management Association of Australia	Road transport injury compensation access for Aboriginal communities **(Courtney Ryder) Rebecca Ivers** University of New South Wales	Intervention preferences and motivation in road user behaviour change **(Mohammad Sarker) Martin Small** Roads and Highways Department (RHD)	An evaluation of Speed Awareness Monitor Signs in regional Queensland **David Soole** Department of Transport and Main Roads
12:50-12:57			Minimum datasets for pedestrian safety **Glen Koorey** ViaStrada Ltd	
12:58-13:05	Attentional Capture in Mixed Traffic Environments **Caitlin Reeves** University of Newcastle	Deconstructing ambiguity in road safety performance indicators **Alexander Price** Main Roads Western Australia		Willingness to speed: A motonormativity effect? **Paul Roberts** University of Western Australia
13:06-13:13		Main Roads Application of Road Safety Management Process **Edward Rose** Main Roads Western Australia	Safety review of a rainbow crossing at a signalised intersection **(Anna Bray Sharpin) Matthew Noon** Abley Limited	
13:14-13:21	Impact of Advanced Driver Assistance Systems on Insurance Claim Severity **(Heshani Rupasinghe) Shamsunnahar Yasmin** Queensland University of Technology	An overview of PCYC Queensland's Road Safety Programs **Alexander Weber** PCYC Queensland		Applying theory to explore low-level speeding perceptions in Western Australia **Teresa Senserrick** Centre For Road Safety Research, University of Western Australia
13:22-13:29	Road Safety Ed Tech Disruption Disruptors - Barriers to Adoption **Clint Hoffmann** DriveAbout World Pty Ltd	Enhancing Safety Through Collaborative Contract Management **Yogen Bhatnagar** Urap International	Understanding Inequity in Pedestrian Safety Outcomes **Phil Harbutt** PivotSpace	
13:30-13:37		Queensland's Road Safety Governance Framework **Tracey Houghton** Department of Transport and Main Roads, Queensland Government		Fatality risk for side-impact car into car crashes **Kardina Ayuningtyas** University of New South Wales
13:38-13:45		Communicating AusRAP 2025 Results **Keith Simmons** Austroads		Measuring Speed: Can we trust Connected Vehicle Data? **(Sarah D Dods) Madeleine Fletcher-Kennedy** GHD
13:45-14:30	Lunch			
	Golden Ballroom			
14:30-16:00	Closing Ceremony Includes Future Leaders Chairperson: Ingrid Johnston			

Posters

Author	Organisation	Title
Abdullah Abdullah	Edith Cowan University	AI-Based Estimation of Alcohol Intoxication and Drowsiness from Facial Analysis
Mary Abungu	Sustainable Mobility Africa (SUMO Africa)	Strengthening Multi-Sectoral Collaboration to Enhance Road Safety Data
Glen Koorey	ViaStrada Ltd	Developing a Model for the Safety Impacts of Mode Shift
Giulio Ponte	Centre for Automotive Safety Research, The University of Adelaide	Event Data Recorders (EDRs): unlocking crash data for research
Taha Rashidi	UNSW Sydney	Intelligent Transport Systems Evolution for Cyclist Safety: A VR Approach
Gareth Smith	Accident Compensation Corporation	Does training work: 10 years of the New Zealand experience
Long Truong	La Trobe University	Increasing Nighttime Safety at Passive Railway Crossings with Photoluminescent Elements
Irene Tse	Auckland Transport	Debunking the myth: Raised crossings don't create significant congestion
William Majani Wambulwa	World Bank Group / Global Road Safety Facility (GRSF)	Targeting High-Risk Corridors for Evidence-Based Crash Reduction in Kenya
Widyarini Weningtyas	Institut Teknologi Bandung	NaviStation Initiatives Preparing the Golden Generation Through Transportation Safety Education

Big bike crashes in Malaysia

Muhamad Syukri Abdul Khalid[1], Ahmad Azad Ab. Rashid[1]

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Abstract
'Big bikes' is a common phrase in Malaysia referring to motorcycles with engine capacity of more than 250cc. Users in this group often ride long distance for commuting to work, or weekend leisure travelling. Due to its bigger engine, and capabilities of travelling at high speed, they are facing higher risk of road crashes and fatalities. This study explored big bike crash patterns, and consequently the gaps in Malaysia from media reports. Majority of big bike crashes resulted in fatalities, with 80% of them died on the spot. Inference from these cases indicates riding skill and behaviour contributes the most, on top of other factors. Reflecting this with the present training and licensing policy for these riders in Malaysia reveals an improvement opportunity for better enabling equity and elasticity of these riders' safety.

Social media post
Big bikes. Big power. Bigger risks. 80% never got a second chance.

Introduction
Motorcycle is one of the main modes of transport in Malaysia, especially for daily commuting. Being smaller in size provides them the ability to manoeuvre anywhere in the traffic, allowing them to reach their destination quicker; hence making them as the favourite more of transport (Ibrahim et al., 2019; Abdul Khalid et al., 2020). Consequently, they account for almost 70% of all road trauma cases in Malaysia (Manan & Várhelyi, 2012).

Generally, motorcycles in Malaysia fall into two groups: (1) Kapchai (motorcycles with engine capacity of lower than 250cc); (2) Big bike (motorcycles with engine capacity of more than 250cc). Kapchai dominates the roads with more than 90% of motorcycles in Malaysia are in this group (Zulkipli et al., 2021). Kapchai is normally used for daily commuting to work as it is cheaper to operate and maintain as well as more flexible in the traffic; whereas the big bikes more commonly populate the roads during the weekends for leisure rides (sometimes in a long distance convoy).

As they differ in terms of engine size, power, torque, top speed, handling and manoeuvring; they require different riding licenses. This is to address different risks profile between these groups. As big bikes are lesser in population, studies about their risk is less common, relative to its Kapchai counterpart. Thus, this study aims to explore the big bikes crash risks pattern by collecting and analysing data from media reports. The results from this study would contribute to the identification of potential intervention to these big bikers.

Methods and data collection
This study employed secondary data from main media reports in Malaysia (The Sun, New Strait Times, Utusan, Harian Metro, KOSMO, Borneo News, Berita Harian). Data are extracted from reports – regardless of formats, e.g written, digital, video, etc. – related to road crashes involving big bikes for two years (2018 – 2019). One hundred reports were eligible for analysis after cleaning and removal of duplicates and irrelevant content. The analysis considered several variables: travelling purposes, crash type, crash partners, time, day, road type and configuration, number of victims. A group of experts reviewed these cases to determine its most probable causal factor.

Results and discussion
Table 1 contains all the results. 86% of these cases involved fatalities. In both crashes, travel purpose was unknown in a significant proportion of the cases. Among fatal cases, identified travel purposes included leisure (24.4%) and work-related travel (12.8%). In contrast, non-fatal crashes had a higher proportion of work-related travel (35.7%), while leisure and crime-related travel accounted for 7.1% each.

Most fatal crashes involved multiple vehicles (70.9%), with single-vehicle crashes contributing to 29.1% of cases. In non-fatal crashes, the proportion of multi-vehicle collisions was 85.7%, while single-vehicle crashes were comparatively lower at 14.3%. In terms of vehicle involvement, 62.8% of fatal crashes involved two vehicles, followed by 29.1% involving a single vehicle. A small proportion of cases (7.0%) involved three vehicles, and one case (1.2%)

involved five vehicles. In contrast, non-fatal crashes predominantly involved two vehicles (85.7%), with single-vehicle cases making up 14.3%.

Fatal crashes were more frequent during daytime hours (75.6%), with 37.2% occurring during peak hours. Non-fatal crashes followed a similar pattern but with a higher proportion during night-time (42.9%). Peak hour crashes were slightly more common in non-fatal cases (42.9%) than in fatal cases. Crashes were nearly evenly distributed between weekdays (53.5%) and weekends (46.5%) for fatal cases. Similarly, non-fatal crashes had an equal distribution across weekdays and weekends (50.0% each).

Fatal crashes were distributed almost equally between highways (49%) and federal roads (50%), with one case (1%) occurring on a track. Non-fatal crashes followed the same highway-federal road distribution (50.0% each). Regarding road configurations, 45.3% of fatal crashes occurred at junctions, followed by 33.7% on straight roads and 20.9% on curved or cornered roads. Non-fatal crashes showed a similar trend, with junctions accounting for 35.7%, straight roads for 42.9%, and curved roads for 21.4%.

The fatal cases involved 103 motorcycle users; meanwhile 17 users were in the non-fatal cases. From these users, the most affected age group in fatal crashes was 31–40 years (27.0%), marginally followed by 21–30 years (25.8%) and 41–50 years (19.1%). Individuals over 50 accounted for 21.3% of fatal case victims. In non-fatal cases, the 21-30 age group highly dominated (52.9%), while the 31–40 age group accounted for 17.6%. The proportion of victims above 50 was lower in non-fatal crashes (11.8%), and 41–50-year-old individuals were absent in this category.

Noteworthy, most (92.1%) of the victims in fatal cases died at the crash locations, while 7.9% of them passed away at the hospital. Remaining victims survived with miros and severe injuries.

In both cases, lack of skills among the riders constituted as the most probable causal factor for the crash. Reckless behaviour was at the second and third place in the fatal and non-fatal cases, respectively. The experts concluded 4.7% of the fatal cases were accident (after considering and giving necessary the benefit of the doubt to the users), while 28.6% accidents in the non-fatal condition. A total of 9 cases lack sufficient information to make a good inference of the causal factor.

Conclusion

In general, several main trends of big bike crashes are evident: individuals aged 21–40 years are the most affected by crashes; multi-vehicle collisions dominate, suggesting that traffic density and interaction between vehicles significantly contribute to crash occurrences; junctions emerge as high-risk locations, where conflicts mostly happen; work-related trips tend to result in non-fatal crashes, while leisure trips are more often associated with fatalities; crashes peak during the daytime when road usage is at its highest. Furthermore, additional riding competency and skillset seems to be the most contributing factor for these crashes – this includes risk appreciation and speed management.

These gaps indicate significant opportunity for improving big bikes' safety situation. In addition to improving infrastructure – preferably through complete segregation from other traffic – the training and licensing system for big bike riders should also be reformed to improve its sustainability and ensuring better safety for this segment of road users in Malaysia.

Table 1. Details of crash reports collected from online sources from 2018 – 2019.

Description	Fatal Cases	Non-fatal Cases
Number of cases / reports collected	86	14
Travelling purposes	Leisure: 21 (24.4%) Work: 11 (12.8%) Unknown: 54 (62.8%)	Leisure: 1 (7.1%) Work: 5 (35.7%) Crime: 1 (7.1%) Unknown: 7 (50.0%)
Crash type	Single-vehicle: 25 (29.1%) Multi-vehicles: 61 (70.9%)	Single-vehicle: 2 (14.3%) Multi-vehicles: 12 (85.7%)
Crash partners involved	1 vehicle: 25 (29.1%) 2 vehicles: 54 (62.8%) 3 vehicles: 6 (7.0%) 4 vehicles: 0 (0%) 5 vehicles: 1 (1.2%)	1 vehicle: 2 (14.3%) 2 vehicles: 12 (85.7%) 3 vehicles: 0 (0%) 4 vehicles: 0 (0%) 5 vehicles: 0 (0%)
Crash time	Daytime (0700-1900): 65 (75.6%) Night-time (1900-0600): 21 (24.4%) Peak hours: 32 (37.2%) Non-peak hours: 54 (62.8%)	Daytime (0700-1900): 8 (57.1%) Night-time (1900-0600): 6 (42.9%) Peak hours: 6 (42.9%) Non-peak hours: 8 (57.1%)
Crash day	Weekdays: 46 (53.5%) Weekend: 40 (46.5%)	Weekdays: 7 (50.0%) Weekend: 7 (50.0%)
Road type	Highway: 49 (49%) Federal: 50 (50%) Track: 1 (1%)	Highway: 7 (50.0%) Federal: 7 (50.0%)
Road configuration	Junction: 39 (45.3%) Corner / curvy: 18 (20.9%) Straight: 29 (33.7%)	Junction: 5 (35.7%) Corner / curvy: 3 (21.4%) Straight: 6 (42.9%)
Number of victims (big bike users)	89	17
Victims age	16 – 20: 4 (4.5%) 21 – 30: 23 (25.8%) 31 – 40: 24 (27.0%) 41 – 50: 17 (19.1%) Above 50: 19 (21.3%) Not available: 2 (2.2%)	16 – 20: 1 (5.9 %) 21 – 30: 9 (52.9%) 31 – 40: 3 (17.6%) 41 – 50: 0 (0%) Above 50: 2 (11.8%) Not available: 2 (11.8%)
Death pronounced	On the spot: 82 (92.1%) At hospital: 7 (7.9%)	Severe injury: 15 (88.2%) Minor injury: 2 (11.8%)
Causal factor	Lack of Skills: 63 (73.3%) Reckless: 9 (10.5%) Accident: 4 (4.7%) Fatigue: 1 (1.2%) Road infrastructure: 1 (1.2%) Insufficient Information: 8 (9.3%)	Lack of Skills: 7 (50.0%) Reckless: 1 (7.1%) Accident: 4 (28.6%) Fatigue: 0 (0.0%) Road infrastructure: 1 (7.1%) Insufficient Information: 1 (7.1%)

References

Abdul Khalid, M. S., Khamis, N. K., Abu Mansor, M. R., & Hamzah, A. (2020b). Motorcycle conspicuity issues and intervention: A systematic review. *Iranian J. of Public Health*, 50(1),24.

Abdul Manan MM, Várhelyi A. (2012). Motorcycle fatalities in Malaysia. *IATSS Research*,36(1):30–39.

Ibrahim, M. K. A., Jamil, H. M., Manan, M. M. A., & Hanowski, R. J. (2019). Roaming the virtual lanes: Motorcyclists' lane filtering-splitting manoeuvres and exposure to road crashes. *Journal of the Society of Automotive Engineers Malaysia*, 3(2),229-235.

Zulkipli, Z. H., Alias, N. K., Omar, A., Kak, D. W., Khalid, M. A., Amir, A. S., ... & Kassim, K. A. (2021). MyMAP: World's first holistic rating system for motorcycles. *Journal of the Society of Automotive Engineers Malaysia*, 5(3), 408-416.

Malaysia's 5-stars manoeuvre for better road safety

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Abstract
Road safety remains a critical concern in Malaysia, with 6,500 fatalities annually. Nevertheless, improvements towards road safety ecosystem is challenging still as it demands commitments from various parties, especially the industry players who mainly focus on business performances. To navigate this challenge, Malaysia has employed several star rating programs as one of the prominent movements to nudge these industry players . This strategic manoeuvre has addressed the equity issue among the lower income groups who used to be at a disadvantage in accessing better safety and quality. Even without explicit legal support, these rating programs have progressed and self-sustain to adapt with new challenges for the region. This article elaborates several star rating programs presently in place as well as the future plan for Malaysia.

Social media post
It is on! Malaysia sets to introduce more star rating programs under their 5-stars road safety initiative for a better road safety ecosystem.

Introduction
In 2023, Malaysia has registered almost 600,000 road crashes and more than 6,000 fatalities. These trends have been consistent for more than a decade. To address this, Malaysia has launched the Malaysia Road Safety Plan 2022-2030 entailing various road safety initiatives and interventions to achieve the target of 50% reduction by 2030 (WHO, 2021). Central to the plan is its mission, "Engendering the Culture of Road Safety Towards the Nation's Prosperity"; shifting the focus from sole role of the government to the involvements of multiple stakeholders and industry sectors. To achieve this, Malaysia has adopted various star rating programs. The program has seen impactful outcome especially when dealing with the industry players whose priority for road safety are secondary than maximising profit.

Clutching on education and awareness, the programs empower road users to choose for better safety. Results of these programs are deployed in various stakeholders engagements with the public, and campaigns for users to refer to. This helps users to make an informed decision before committing to any services or product. This has created not only safety-oriented demands, but also pushed the industry to shift the focus in their offerings to the users. We are seeing more investments and prioritisation of safety in newer products. In the longer run, the industry has become self-regulated when managing challenges and specific condition from the users, ensuring a sustained improvement to road safety. Additionally, star rating programs serve as a supplement monitoring mechanism for the targeted scopes, providing the decision makers clearer role of road safety situation – including the gaps.

In Malaysia, these rating programs encompass wide spectrum in road safety – vehicle safety, road and environment safety, and drivers' safety. The determination of target scopes are based on local situation that is highly vehicle and technological oriented – especially motorcycles and mopeds. The next section contains more detailed elaboration on each star rating program presently active in Malaysia.

National road safety initiative: star rating program
Table 1 shows the star rating programs already established in Malaysia as one of the national road safety initiatives.

Future star rating program
As we progress towards making road safety as a communal responsibility, we see the approach of star rating as a strategic move. The lessons learned from the present programs provide a solid stepping stone for the introduction of similar programs in wider target scopes.

The positive impacts current programs have brought further strengthen the confidence of this approach. Table 2 includes the future road safety oriented star rating program in Malaysia.

Table 1. Established star rating programs that are related to road safety initiative in Malaysia.

Program	Focus	Details
Malaysia Vehicle Assessment Program (MyVAP) (Jawi et al., 2013)	Passenger vehicle	• MyVAP was the first road safety related rating program in Malaysia to assess vehicle safety (including technology, passive and active features) based on compliances to standards. • The program received well support from the national vehicle brands • Program was discontinued when MIROS and Global NCAP launched the ASEAN NCAP.
New Car Assessment Program for Southeast Asian Countries (ASEAN NCAP) (Abu Kassim et al., 2019)	Passenger vehicle	• With the support from Global NCAP, ANCAP (Australia), Euro NCAP, J-NCAP (Japan) and Latin NCAP (Amerika Selatan), ASEAN NCAP was founded in 2012. • The program has significantly improved local and ASEAN vehicle market, including the standardisation of airbags, anti-lock braking system (ABS), electronic stability control (ESC), autonomous emergency braking (AEB), blind-spot technology (BST) and motorcycle safety technology, in recent passenger vehicles. • National crash statistics show reduction of road fatalities among passenger cars despite the increase of passenger vehicle crashes (RMP, 2024) after NCAP's full deployment.
Malaysia Road Assessment Program (MyRAP) (Armstrong et al., 2011)	Road infrastructure	• MyRAP was founded through RAP worldwide program, with assistance from International RAP (iRAP). • Malaysia's MIROS is one of the iRAP centres of excellence. • The aim was to achieve 75% of the roads to achieve a minimum 3-stars rating in 2020.
Malaysia Motorcycle Assessment Program (MyMAP) (Zulkipli et al., 2021)	Motorcycle / Powered-two-wheeler	• The first motorcycle assessment program in the world, MyMAP provides rating for motorcycles in terms of technologies and support program. • A collaborated program between MIROS and Malaysia Automotive, Robotics and IoT Institute (MARii), MyMAP early focus was to standardise motorcycle ABS to every low-capacity engine motorcycle model. • This program has become a stepping stone to the recent enactment of motorcycle ABS law in Malaysia.
Safety Star Grading (SSG) (Batcha et al., 2021)	Commercial vehicle (Bus)	• A rating program focusing on commercial bus operator. • Several bus operators that have achieved 4-5 stars rating show significant changes in their operation especially in terms of safety. • The program is currently on hold as the government calls for improvement to be incorporated in the operator's permit and licensing requirement.
Dashcam Safety Score Card (CamScore) (CamScore, 2024)	Vehicle accessories	• A star rating for dashboard camera (dashcam) focusing on quality and capability to assist users while driving (build-in ADAS warning system). • The program considers additional aspect of digital data safety and security, cybersecurity and vehicle crash forensic. • It has significantly reduced the sub-standards dashcam in the market and has contributed a lot in post-crash analysis data.
Driving Institute Rating (IM Rating) (Jawi et al., 2018)	Driving institute	• A collaborative assessment program between MIROS and the Road Transport Department (JPJ) Malaysia. • The program pushes the quality of driving training program by these institute operators to produce competent drivers. • Current progress has seen a significant improvement on the operation, professionalism, and compliance to standards for majority of the operators.
Malaysia Courier Safety Star Rating Program (MyKurier)	Courier Operator	• A recently launched star rating program for courier operator to advocate safety in their services and operating practices. • Preliminary evidence indicate positive impact to the industry as improvement of the service quality and safety is becoming more evident.

Table 2. Future star rating programs that will be established under the national road safety initiative.

Program	Focus	Details
ASEAN Motorcycle Assessment Program (SEAMAP)	Motorcycle / Powered-two-wheeler	• The expansion of MyMAP to other countries within the southeast Asia region. • Supported by the World Bank, the United Nation Road Safety Fund (UNRSF), and motorcycle manufacturers. • Tentatively to be commenced in 2027.
Tracking System Score Card (TrackScore)	Vehicle accessories (tracking device)	• Inspired from the success of CamScore, TrackScore aims to ensure the quality of a tracking device and its capabilities to collect and store as many travelling data as possible. • Important for post-crash emergency, analysis, and a more objective intervention. • Tentatively to be commenced in 2025.
Motorcycle Camera Safety Score Card (MotoCamScore)	Vehicle accessories	• The expansion of CamScore to a motorcycle camera (motocam). • Assessment would be adaptation of CamScore to suit into motorcycle use. • Tentatively to be commenced in 2025.
Malaysia Bus Safety Rating (MBSR)	Commercial vehicle (Bus)	• Evolving from SSG, MBSR aims to improve the safety of the operation and vehicles of bus industries in Malaysia. • MBSR will be used as the requirement for the bus operators to renew their permits and licenses. • Tentatively to be commenced in 2026.
Commercial Vehicle Assessment Program (CVAP)	Commercial vehicle (Lorry)	• Inspired from MyVAP, ASEAN NCAP and MyMAP, the CVAP aims to improve heavy vehicles (lorry) safety through standardisation of passive and active safety technologies. • Tentatively to be commenced in 2027.
Malaysia Star Rating For School (MySR4S)	Road infrastructure	• Inspired from Star Rating For School (SR4S), MySR4S aims to improve road infrastructure around school area, for a better safety in school. • Tentatively to be commenced in 2026.
Professional Driver Score Card (PDSEA)	Road user	• A post-licensing program aims to improve driver competency and skills on the road to become a better road user. • Tentatively to be commenced in 2026.

Conclusion

[equity and resilience, and non-exclusive impact]

In the situation where road users are facing limited options for road safety, the star rating programs are seen capable to address this. The ASEAN NCAP, as the most established safety oriented rating program in Malaysia, has brought tremendous benefit to the consumers of private vehicles – e.g., when 2 airbags were once offered as luxury feature, it is now has become standard in any new car regardless of pricing. Road users with lower income are now able to enjoy better vehicle safety as they should had. In addition, despite being a relatively young program, CamScore has managed to ensure most of the offerings in the market are at least at a satisfactory level. The beauty (and strength) of star rating program lies not only on its non-legislative – hence lesser resistance – but also offer faster and more flexible room for future improvement manoeuvres towards sustainable road safety standards in Malaysia.

References

Abu Kassim, K. A., Ahmad, Y., Jawi, Z. M., & Ishak, S. Z. (2019). ASEAN NCAP's success and challenges in promoting safer vehicles in the ESCAP Region. *Transport and Communications Bulletin for Asia and the Pacific*, 89, 1-15.

Armstrong, K., McInerney, R., & King, M. (2011). iRAP Malaysia training course: Decade of action for road safety. *Journal of the Australasian College of Road Safety*, 22(2), 23-25.

Batcha, W. A., Ahmad, M. S., Alias, N. K., Othman, I., & Ariffin, A. H. (2021). The Effectiveness of Safety Star Grading (SSG) in Improving Compliance of ICOP RTA 2010 among Express Bus Operators. *Journal of the Society of Automotive Engineers Malaysia*, 5(4), 67-74.

Dashboard Camera Safety Scorecard Program (CamScore) (2024). Dashboard Camera Safety Scorecard Program. http://camscore.com.my.

Jawi, Z. M., Deros, B. M., Saad, M. H., & Ab Rashid, A. A. (2018). The influence of income level and remuneration scheme on job satisfaction among professional driving instructors in Malaysia. *Malaysian Journal of Public Health Medicine*, Special Volume (2), 128-134.

Jawi, Z. M., Kassim, K. A. A., & Sadullah, A. F. (2013). ASEAN NCAP - The best bet for vehicle safety in the region's safe system? *International Journal of Trade, Economics and Finance*, 4(6), 358.

Nasionalkini (2023). Fahmi lancar MyKurier. https://www.nasionalkini.my/semasa/fahmi-lancar-mykurier/.

Royal Malaysia Police (RMP). (2024). Malaysia Road Crash Statistical Report 2023.

Zulkipli, Z. H., Alias, N. K., Omar, A., Kak, D. W., Khalid, M. A., Amir, A. S., ... & Kassim, K. A. (2021). MyMAP: World's first holistic rating system for motorcycles. *Journal of the Society of Automotive Engineers Malaysia*, 5(3), 408- 416.

World Health Organization (WHO). (2021). Global Plan for the Decade of Action for Road Safety 2021-2030. Available from: https://www.who.int/teams/social-determinants-of-health/safety-and-mobility/decade-of-action-for-road-safety-2021-2030

AI-based estimation of alcohol intoxication and drowsiness from facial analysis

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Abstract

Drunk and drowsy driving are major contributors to road crashes, necessitating innovative and non-intrusive detection methods. Despite widespread breathalyser testing and significant law enforcement efforts over the past few years, alcohol-related crashes have not declined significantly, highlighting the need for automated, scalable solutions. This study presents an AI-driven system that identifies blood alcohol intoxication and drowsiness using facial cues and deep learning. Our deep learning framework analyses features such as blink rate, eye closure duration, skin tone variations, and head positioning to detect driver impairment. By offering real-time, contactless monitoring, this technology has the potential to enhance road safety and smart city initiatives. The framework, trained on a publicly available dataset containing diverse male and female participants across various age groups, achieved 85% accuracy for intoxication detection and 89% for drowsiness classification.

Social media post

🚗 AI-powered road safety! Our deep-learning model detects drunk and drowsy drivers using only facial cues—no breathalyser or wearables needed! Built on a diverse public dataset, it ensures fairness and safety for all. #ARSC2025 #RoadSafety #AIforGood.

Introduction

Driver impairment due to alcohol intoxication and drowsiness is a leading cause of road fatalities, impacting people across all demographics including Australia (Vecino et al., 2022; RoadSense, n.d). Over the past decade, alcohol-related road crashes do not seem to have significantly declined (Devlin & Fitzharris, 2013; Department of Infrastructure and Transport, 2017) even with the extensive deployment of breathalyser tests and law enforcement resources on roads. The limitations of traditional methods including the need for direct driver interaction and high manpower requirements demonstrate the need for a scalable, real-time, and non-invasive detection system. This research introduces an AI-based, non-intrusive detection system that passively analyses facial video footage to identify both intoxication and drowsiness before they lead to accidents.

Conference Theme

This research aligns with the ARSC2025 themes of Evolution and Equity by advancing smart road safety systems through AI-powered, real-time impairment detection. Unlike conventional breathalyser based methods that rely on resource-intensive manual enforcement, our automated system offers continuous, non-intrusive monitoring, enhancing driver safety and urban mobility. Additionally, by training and validating the model on a public dataset with diverse male and female participants across various age groups, this research ensures fairness across demographics, promoting equitable access to road safety for all road users.

Methodology

Our framework as shown in Figure 1, utilises a lightweight Xception network (Chollet et al., 2017) to process facial video data. Our system works by analysing videos of a driver's face and analyse facial features like (Eye blink rate, eye opening and closing ratio and subtle variance in face muscles). These videos, captured in regular colour (RGB) format, are fed into our network. The network focuses only on the driver's face by automatically cropping that part of the video. It then examines 300 - 360 frames essentially going through a series of images from the video to closely observe facial features like eye movements, blinking patterns, and head position. Based on this analysis, the system can detect whether the driver is intoxicated or drowsy, helping to identify signs of impairment.

The framework was trained and evaluated on two publicly available datasets: the MiX Telematics dataset (Keshtkaran et al., 2024), where ground-truth blood alcohol concentration (BAC) levels are used to label intoxication, and the NTHU-DDD dataset (Simonyan & Zisserman, 2014), which includes expert annotations of drowsiness levels based on behavioural and physiological cues. Each dataset comprises diverse participants across genders and age groups. Model

performance was assessed using stratified train-test splits, reporting metrics such as accuracy, F1-score, and AUROC to ensure robust and interpretable evaluation.

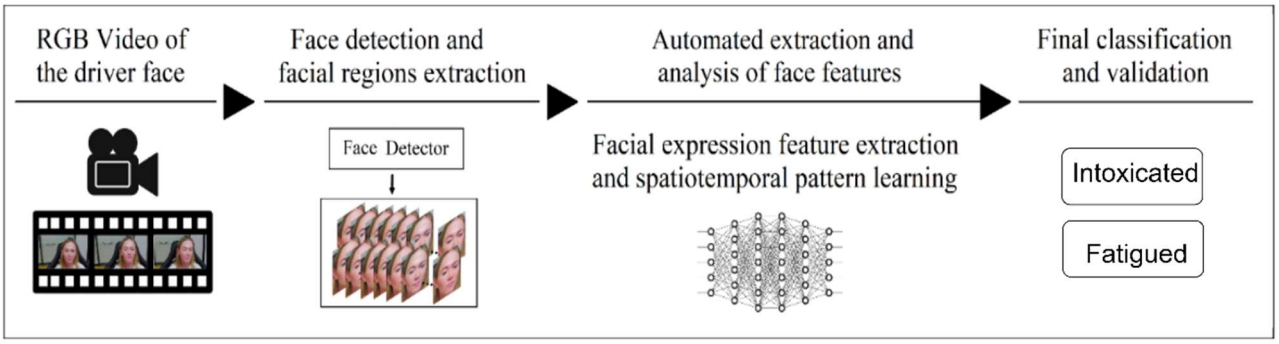


Figure 1. Overview of our AI based Framework

Results

To assess the reliability of our system, we split the dataset into separate parts for training and testing. The model was trained on one portion of the data and then tested on completely unseen samples to ensure fair evaluation. We used standard performance measures such as accuracy (how often the system is correct), F1-score (balance between correct detection and false alarms), and AUROC (a measure of the system's overall ability to distinguish between impaired and non-impaired drivers).

- Achieved 85% accuracy for detecting intoxication.
- Achieved 89% accuracy for classifying drowsiness levels.

Benefits to Road Safety

- Non-intrusive, real-time detection, requiring no driver cooperation.
- Reduces law enforcement burden by minimising roadside breathalyser tests.
- Supports proactive accident prevention, preventing impaired drivers from starting trips.
- Ensures fair and equitable detection, working across diverse populations.
- Can be integrated into smart city infrastructure and vehicle safety systems.

Implications for Policy and Practice

The adoption of AI-driven intoxication and drowsiness detection presents significant opportunities for enhancing road safety. Policymakers could mandate the integration of such systems in commercial and public transport fleets or develop roadside screening systems for real-time impairment detection. However, to ensure responsible implementation, privacy and ethical considerations must be addressed**.**

References

Chollet, F. (2017). Xception: Deep learning with depth wise separable convolutions. In *Proceedings of the IEEE conference on computer vision and pattern recognition* (pp. 1251-1258).

Department for Infrastructure and Transport. (2017). *Drugs and alcohol: 2017-2021*. Government of South Australia. https://www.dit.sa.gov.au/__data/assets/pdf_file/0006/247308/Drugs_and_alcohol_2017-2021.pdf

Devlin, A., & Fitzharris, M. (2013, August). An analysis of single-vehicle fatality crashes in Australia at various blood alcohol concentrations. In *Proceedings of the 2013 Australasian Road Safety Research, Policing and Education Conference*.

Keshtkaran, E., Von Berg, B., Regan, G., Suter, D., & Gilani, S. Z. (2024). Estimating blood alcohol level through facial features for driver impairment assessment. In Proceedings of the IEEE/CVF Winter Conference on Applications of Computer Vision (pp. 4539-4548).

RoadSense. (n.d.). Understanding road statistics (Aus). RoadSense. https://roadsense.org.au/understanding-road-statistics-aus/

Simonyan, K., & Zisserman, A. (2014). Two-stream convolutional networks for action recognition in videos. In Advances in neural information processing systems (Vol. 27).

Vecino-Ortiz, A. I., Nagarajan, M., Elaraby, S., Guzman-Tordecilla, D. N., Paichadze, N., & Hyder, A. A. (2022). Saving lives through road safety risk factor interventions: Global and national estimates. *The Lancet, 400*(10347), 237-250.

Strengthening multi-sectoral collaboration to enhance road safety data

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Abstract

Effective road safety management requires accurate, timely, and integrated data across sectors. Drawing on findings from the SUMO Africa Road Safety Data Enhancement Workshop (2024) and an extensive literature review, this paper identifies challenges and strategies for strengthening multi-sectoral collaboration in Kenya. Key issues include fragmented data systems, inconsistent reporting standards, limited stakeholder coordination, and technological barriers. Successful international practices reveal that integrated data platforms, co-located inter-agency teams, and evidence-based governance frameworks significantly enhance road safety interventions. Workshop discussions endorsed the establishment of a National Multi-Sectoral Technical Working Group, standardised digital data-sharing protocols, and capacity-building initiatives. Pilot interventions demonstrated notable improvements in data accuracy and reporting timeliness. Policy recommendations emphasise robust stakeholder engagement, formal data governance frameworks, community involvement, and systematic monitoring and evaluation to effectively reduce road fatalities and injuries in Kenya.

Social media post

Effective road safety needs accurate, timely, and integrated data. Findings from the SUMO Africa Workshop (2024) urge a national technical working group, digital protocols, and capacity-building to fix fragmented systems and save lives. #RoadSafety #VisionZero #SUMOAfrica

Introduction

Road traffic crashes remain a critical public health challenge in Kenya, causing over 4,386 fatalities in 2023 alone (NTSA, 2024). Despite the severity, data collection and analysis remain fragmented, hindering effective interventions. Integrating diverse data sources from police crash reports, health records, to insurance claims is essential for a comprehensive understanding and targeted interventions. This paper combines practical insights from the SUMO Africa Road Safety Data Enhancement Workshop (2024) with an extensive literature review of global best practices to identify effective strategies for strengthening multi-sectoral collaboration in road safety data management.

Background

The effectiveness of road safety interventions is highly dependent on the availability, accuracy, and accessibility of crash and injury data. However, in Kenya, road safety data collection is fragmented across multiple agencies, leading to inconsistencies and underreporting. The *Global Plan for the Decade of Action for Road Safety 2021–2030* (WHO, 2021) underscores the importance of data-driven policy and evidence-based interventions to reduce road traffic deaths and injuries.

Conference Theme

Equity: By improving data accessibility and transparency, the workshop aimed to empower policymakers with informed choices that lead to equitable road safety interventions, ensuring all road users are fairly represented in decision-making processes. **Elasticity:** Road safety data systems must be adaptable and resilient to accommodate technological advancements, policy changes, and evolving mobility trends. The workshop addressed this by promoting inter-agency collaboration and digital integration, to enable real-time crash data collection and analysis. This enhances the system's elasticity, allowing for dynamic responses to emerging road safety challenges and fostering equitable access to safer transport systems, particularly in underserved areas. **Evolution:** The evolution of a Safe System approach was central to the workshop's discussions, reflecting on past challenges, current gaps, and future opportunities in road safety data governance. By benchmarking against international best practices (such as the UK's STATS19 and the World Bank's Road Safety Data Governance Framework), the workshop explored how data systems have developed over time and what steps are needed to implement an effective data-driven Safe System approach in Kenya.

Project description

The *SUMO Africa Road Safety Data Enhancement Workshop* was a one-day event held in Nairobi, Kenya, bringing together all road safety stakeholders within the Safe System Approach to assess existing data collection and sharing practices, discuss institutional challenges, and propose solutions to improve road safety data governance.

Approach

A focused literature review was undertaken to identify international best practices in road safety data governance. Three global observatories were selected for in-depth review: Eastern Partnership Road Safety Observatory (EaP RSO), Ibero-American Road Safety Observatory (OISEVI), and the African Road Safety Observatory (ARSO). The review revealed that coordinated, digital, and standardised data systems significantly contribute to improved road safety outcomes:

- EaP RSO: *Moldova*: 46% reduction in crash fatalities (2010-2020), *Azerbaijan*: 25% reduction attributed to centralised data platforms and evidence-based policy frameworks.
- OISEVI (Latin America and Caribbean): *Argentina*: Fatality rate decreased from 12.6 to 9.6 per 100,000 people (23.8% drop) between 2010–2020 informed by shared data.

The conducted workshop was structured into two key sessions:

1. Stakeholder Presentations – Representatives from NTSA, KeNHA, the Ministry of Health, and Kenya National Police shared insights into their data collection, reporting frameworks, current challenges, and opportunities for collaboration.
2. Panel Discussions – Experts in transport safety and data management engaged in discussions on interoperability, data accessibility, and policy integration.

Table 1. Mapped stakeholders and their relevance to the workshop

Stakeholder	Role	Data Contribution	Responsibilities
NTSA (Lead Agency)	Coordination, policy leadership	Crash database, regulatory data	Coordination, policy development, oversight
Police (Traffic Dept.)	Enforcement, reporting	Crash scene reports	Efficient data collection and enforcement
Ministry of Health (MOH)	Health data integration	Injury records	Real-time injury reporting and analysis
Road Authorities (KeNHA, KURA, KeRRA)	Road infrastructure safety	Safety audits, infrastructure data	Road audits, infrastructure safety improvements
Insurance Sector	Economic analysis	Insurance claims data	Crash cost analysis, compensation data
Private Sector (Transport Operators)	Compliance, best practices	Vehicle and operational data	Data-sharing, promoting safe practices
NGOs/CSOs	Advocacy, public engagement	Community-based intervention data	Advocacy, education, behaviour change initiatives
Research/Academic Institutions	Data analytics, capacity-building	Research findings, data insights	Data analysis, methodological support, training

Following the workshop, qualitative data from presentations and discussions were systematically reviewed and synthesised. Recurring themes, challenges, and proposed solutions were coded and analysed to identify consensus areas and actionable recommendations. These were further cross-referenced with global best practices and relevant literature to inform the final workshop findings and policy suggestions.

Results

Cross-Cutting Data Challenges

- Fragmentation: Data collection systems are siloed across institutions (e.g., NTSA, MOH, Police), causing inconsistencies and duplication.
- Underreporting and Data Gaps: Particularly for pedestrian and bodaboda (motorcycle) crashes, underreporting remains prevalent, driven by lack of standardised forms and digital tools.
- Technological Gaps: Continued use of manual systems undermines timely reporting and accuracy. Over 60% of stakeholders represented reported still relying on manual, paper-based systems for data collection. Agencies such as NTSA and KeNHA highlighted delays due to analog data capture methods.

Common Themes and Solutions Identified

- Multi-Sectoral Collaboration: A shared recognition of the need to form a National Technical Working Group to coordinate road safety data efforts.
- Standardised Protocols: A strong consensus on the need for formal data-sharing agreements, uniform reporting templates, and interoperable digital systems.
- Capacity Building: Highlighted as critical, especially in county governments and police units. NGOs were identified as key partners for training and community outreach.
- Commitment to Inter-Agency Collaboration: Key stakeholders agreed to explore formal data-sharing agreements to enhance data transparency.
- Recommendations for Digital Integration: The workshop highlighted the potential of leveraging digital platforms and GIS-based systems to streamline data collection and real-time reporting.

Key findings from the workshop included:

- Lack of Interoperability: Agencies use different data formats and structures, making integration challenging.
- Need for a Centralised Data Repository: Stakeholders recognised the importance of a unified system for real-time crash data analysis.
- Policy and Legal Framework Challenges: Institutional barriers, including data confidentiality policies and lack of enforcement, hinder effective data sharing.
- Best Practices from Other Countries: Case studies from Australia and the UK provided insights into structured and standardised data collection approaches.

Evaluation and effectiveness

To assess the impact of the workshop, *SUMO Africa* implemented a post-workshop evaluation survey targeting participants from key agencies. Results indicated:

- 85% of participants acknowledged the workshop improved their understanding of the importance of collaborative data-sharing mechanisms.
- 50% of agencies committed to engaging in follow-up meetings to advance data integration discussions.
- Strong stakeholder interest in piloting a digital data-sharing platform to improve inter-agency coordination.

Future efforts will focus on:

- Establishing a formal Memorandum of Understanding (MoU) between key road safety agencies.
- Advocating for policy reforms to institutionalise standardised road safety data-sharing frameworks.
- Developing a pilot project for a centralised digital crash data repository in Kenya.

Benefits to road safety

The workshop's outcomes are expected to significantly improve road safety in Kenya by enhancing evidence-based decision-making through accurate and reliable data, improving resource allocation by identifying high-risk locations and crash patterns, strengthening inter-agency collaboration, leading to more coordinated road safety interventions, and supporting international road safety commitments, such as the Global Plan for the Decade of Action for Road Safety 2021–2030 (WHO, 2021).

Implications for policy and/or practice

The findings and recommendations from the workshop have direct implications for policy and practice, including Establishing a national road safety data governance framework to integrate and standardise crash data collection, mandating real-time data sharing between law enforcement, transport agencies, and the health sector, developing an open-access road safety data portal to improve transparency and research., and aligning Kenya's data governance strategies with global best practices, such as Vision Zero and Safe System approaches.

Conclusions

The *SUMO Africa Road Safety Data Enhancement Workshop* demonstrated the critical need for improved data management and collaboration among road safety stakeholders. By leveraging innovation, partnerships, and a systems-thinking approach, the initiative aligns with global best practices and contributes to Kenya's efforts in reducing road traffic deaths and injuries. While the workshop underscored strong consensus on the need for integrated data systems, multi-sectoral collaboration, and standardised protocols, key implementation barriers remain. These include limited funding, institutional resistance to data sharing, inadequate digital infrastructure, and gaps in technical capacity. Addressing these will be critical to translating recommendations into sustainable action.

References

African Road Safety Observatory (ARSO). (2018). African Road Safety Observatory Overview. Africa Transport Policy Program (SSATP). https://www.ssatp.org/topics/african-road-safety-observatory

Bliss, T., & Breen, J. (2015). Implementing the recommendations of the World Report on Road Traffic Injury Prevention. Global Road Safety Facility, World Bank.

Global Road Safety Facility. (2022). Delivering road safety in Africa: Leadership, data, and funding. World Bank. https://www.worldbank.org

Government of Kenya. (2024). National Road Safety Action Plan 2024–2028. National Transport and Safety Authority (NTSA). http://libraryir.parliament.go.ke/handle/123456789/27722

ITF/OECD. (2018). Big Data and Transport: Understanding and assessing options. International Transport Forum Policy Papers, No. 59. Paris: OECD Publishing. https://doi.org/10.1787/db0585e7-en

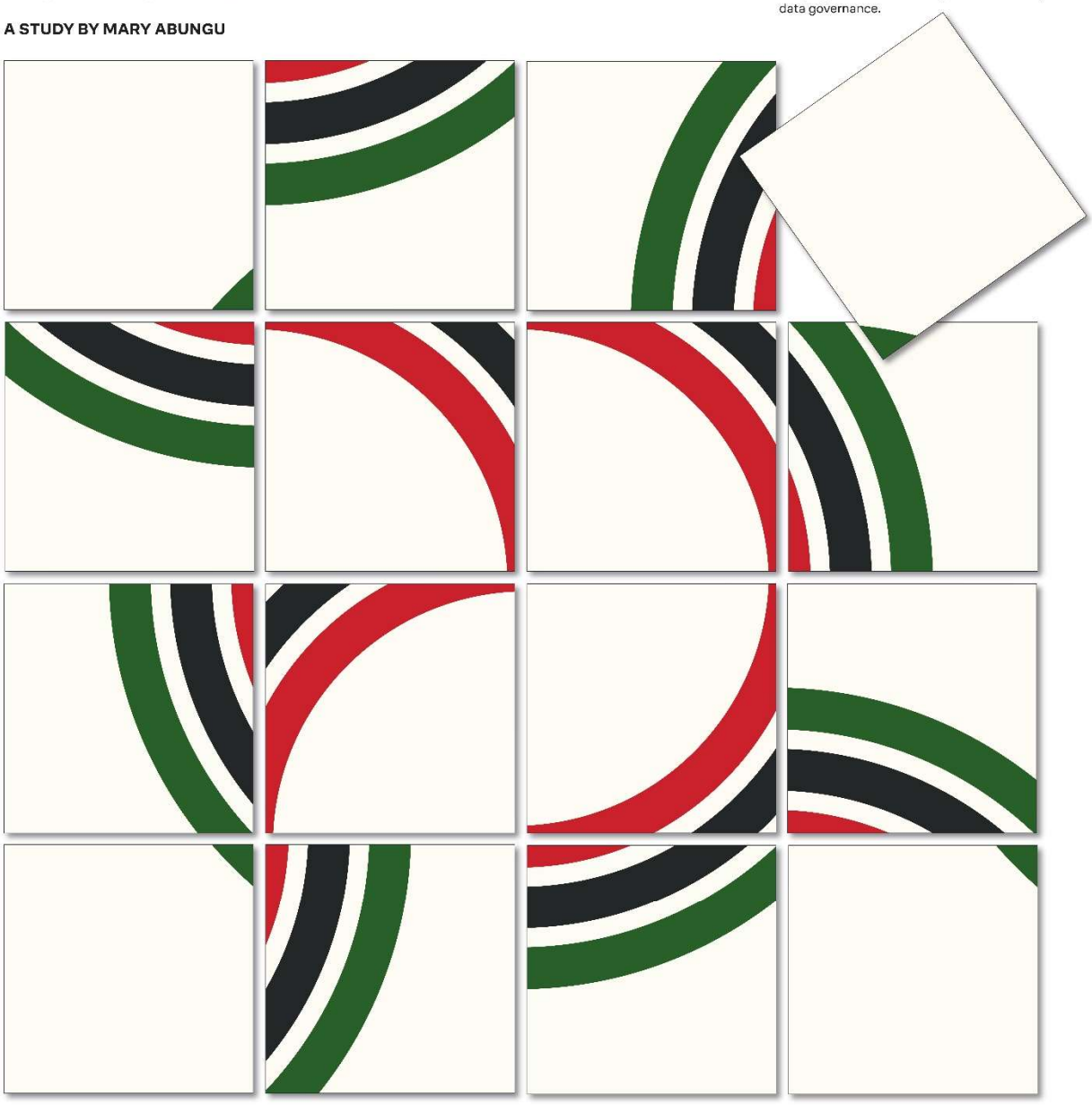
World Health Organization. (2021). Global plan for the decade of action for road safety 2021–2030. https://www.who.int

Poster presentation

STRENGTHENING MULTI-SECTORAL COLLABORATION TO ENHANCE ROAD SAFETY DATA

A STUDY BY MARY ABUNGU

The SUMO Africa Road Safety Data Enhancement Workshop was a one-day event held in Nairobi, Kenya, bringing together all road safety stakeholders within the Safe System Approach to assess existing data collection and sharing practices, discuss institutional challenges, and propose solutions to improve road safety data governance.



CHALLENGES

Fragmentation: Data collection systems are fragmented across institutions (e.g., NTSA, MOH, Police), causing inconsistencies and duplication.

Underreporting and Data Gaps: Underreporting remains prevalent, driven by lack of standardized forms and digital tools.

Lack of Interoperability: Agencies use different data formats and structures, making integration challenging.

Policy and Legal Framework Challenges: Institutional barriers, including data confidentiality policies and lack of enforcement, hinder effective data sharing.

Technological Gaps: Continued use of manual systems undermines timely reporting and accuracy. Over 60% of stakeholders represented reported still relying on manual, paper-based systems for data collection.

60%

PROPOSED SOLUTIONS

Need for a Centralised Data Repository: Introduction of a unified system for real-time crash data analysis.

Multi-Sectoral Collaboration: Formation of a National Multi-Sectoral Technical Working Group to coordinate road safety data efforts.

Standardised Protocols: Formal data-sharing agreements, uniform reporting templates, and interoperable digital systems.

Capacity Building: Invest in initiatives and training for county governments and police units

SUMO AFRICA

EXPECTED IMPACTS

Improved Data Quality: Greater accuracy and timeliness in reporting.

Evidence-Based Decisions: Reliable data to guide policy and interventions.

Stronger Collaboration: Enhanced inter-agency coordination for road safety.

Reduced Fatalities & Injuries: More effective interventions to save lives.

EVALUATION AND EFFECTIVENESS

85%

85% of participants acknowledged the workshop improved their understanding of the importance of collaborative data-sharing mechanisms.

50%

50% of agencies committed to engaging in follow-up meetings to advance data integration discussions.

Design characteristics of raised safety platforms for enhancing road safety

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Abstract
Road fatalities remain a critical concern, and Raised Safety Platforms (RSPs) have shown potential to improve road safety by reducing vehicle speeds. While RSPs are widely implemented as speed-calming measures, their broader impact on speed reduction, beyond specific design features, remains underexplored. Do design features such as visibility and markings significantly enhance the effectiveness of RSPs? This study utilises open-source data from OpenStreetMaps and Compass IoT to conduct a before-and-after analysis, evaluating the effectiveness of an RSP in Spring Hill, Brisbane, after improvements were made to its marking and visibility characteristics. Notably, these improvements to the existing RSP resulted in a 31.8% reduction in vehicle speeds.

Social media post
🚗 💡 Visualising the impact of Raised Safety Platforms! Our study shows that upgrades to RSPs, like better markings & visibility, reduce vehicle speeds by 31.8%. See how road upgrades are leading to safer roads for all users! 🌟 #TrafficSafety #RoadDesign

Introduction
The integration of big data analytics into road safety evaluation represents a significant shift toward data-driven policymaking. By leveraging connected vehicle data and open-source resources, advanced analytical tools can now inform the design and deployment of safety interventions. Among these interventions, Raised Safety Platforms (RSPs) have emerged as a critical speed-calming measure to enhance road safety.

RSPs are designed with intentional vertical deflection to encourage drivers to slow down, creating safer environments for all road users, including pedestrians, cyclists, and motor vehicles (Lawrence et al., 2021). Global research consistently highlights the safety benefits of maintaining lower speeds, particularly in areas with vulnerable users. Studies by Agerholm et al., (2017) and Gitelman et al., (2017) show that speeds under 30 km/h significantly reduce the severity of vehicle-pedestrian collisions. In urban areas, RSPs are especially effective in enhancing pedestrian visibility and encouraging compliance with reduced speed limits.

Conference Theme
The evolution of data availability has unlocked new opportunities to develop cost-effective methods for evaluating the impact of road safety designs, enhancing the adaptability of prevention strategies. By leveraging existing resources like Compass IoT data, which tracks vehicle trajectories and speeds for a significant portion of Queensland's connected vehicles, we can gain detailed insights into road usage patterns. When combined with Google Maps historical imagery, it becomes possible to identify the implementation of key measures, such as RSPs, and compare vehicle speeds before and after these treatments were introduced.

This adaptive approach highlights the potential of utilising existing open-source data to overcome traditional barriers associated with costly, resource-intensive studies. By reducing the need for expensive methods to evaluate cause-and-effect relationships in road safety, this approach paves the way for future interventions that are both innovative and accessible.

Project Description
This project utilised OpenStreetMap to identify existing RSP locations in Brisbane, Australia. By reviewing Google Maps' update history, we approximated the implementation dates of RSPs. Since Compass IoT data provides vehicle

trajectory and speed data from 2020 onwards, RSPs without significant treatment features added were excluded from the study.

For eligible RSPs, Google Street View's historical imagery was used to validate installation dates by pinpointing the most recent timeframe when the RSP had improvements made and the earliest timeframe when improvements were not made. This process led to the identification of one RSP with visible upgrades, which became the focal point of our analysis

Results

Figure 1 compares the 2022 and 2024 images of Isaac Street. Significant upgrades are evident, including a more prominent and brighter raised platform with a clearly defined, red painted surface tabletop and well-marked piano-keys. The speed limit of the road remains unchanged during this period (40 km/h).



Figure 1. Raised Platform on Issac St, Spring Hill, 2022 compared to 2024
Source: Google Maps

Using Compass's speed aggregation tool, we analysed vehicle speeds within a 25.35-metre span, starting 10 metres before the raised platform and ending 10 metres after it. The platform itself is 5.35 metres in length. Aggregated speed data from Compass's connected vehicles were used to evaluate vehicle speeds over the raised platform (RSP). Also, it's important to note that the placement of this platform is on a hill, which means vehicles are more likely to move faster downhill than uphill. As a result, the chainage of the vehicle reflects these variations based on the incline. This analysis focused on two distinct time periods: March 2020 to March 2021 and April 2024 to February 2025. The average speeds of all connected vehicles during these timeframes were calculated, and the results are presented in Figure 2. For the 2020–2021 period, the dataset includes 186 vehicle transitions over the RSP, while the 2024–2025 period includes 375 vehicle transitions.

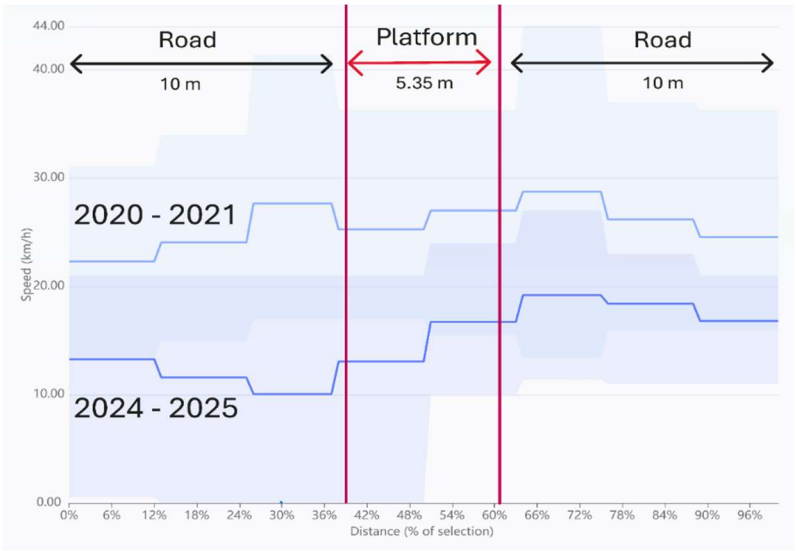


Figure 2. Vehicle Speeds Over the Raised Safety Platform: Comparison Before and After the Upgrade
Source: CompasIOT.

Findings

The results clearly demonstrate that vehicle speeds over the RSP decreased following the platform's upgrade when comparing the two time periods. When normalising speed over the trajectory path, the average speed is reduced by 31.8%. However, the larger sample size in the latter period introduces some caveats to directly comparing the two approaches. The difference in sample size is primarily due to the limited available time span and the reduced connectivity of connected vehicles during the earlier period. Despite the smaller sample size in the earlier dataset, no major outliers were identified in either dataset. This supports the conclusion that the design features of the RSP play a critical role in influencing vehicle speeds. Specifically, factors such as the platform's visibility, surface markings, and material or surface type significantly contribute to the effectiveness of speed reduction. These findings highlight the importance of thoughtful design in traffic calming measures, as well as the need to prioritise features that enhance the platform's visibility and clarity for drivers. By addressing these aspects, the upgraded RSP not only improves compliance with speed limits but also reinforces road safety for all users.

Benefits to Road Safety

Using the available resources, we identified a location where multiple RSP design characteristics were implemented at the same site. Although this represents just one example among the many RSP designs currently in use, it underscores the importance of leveraging the insights we can extract from the data available. With additional information, such as precise installation dates, we could identify and analyse more study sites, enabling a more thorough comparison of conditions before and after RSP installation.

It is important to recognise that RSPs feature diverse design characteristics tailored to their specific contexts. Factors such as road speed limits, traffic volume, and surrounding land use influence the appropriate gradient and design of each RSP. By systematically compiling detailed installation dates, road attributes, and design specifications, a comprehensive database could be developed. Such a resource would correlate various road design elements with corresponding RSP configurations, facilitating a robust evaluation of their performance and effectiveness.

This approach would not only enhance the understanding of how specific RSP designs impact vehicle speeds and safety outcomes but also provide valuable guidance for future RSP deployments. With a well-structured database, decision-makers could ensure that RSP designs are optimised for the unique characteristics of each location, ultimately improving road safety and traffic management.

This framework offers actionable insights for policymakers and practitioners by connecting RSP design characteristics with measurable safety outcomes. To translate these findings into policy and practice:

- Evidence-Based Design Standards: The results emphasise the importance of thoughtful design features, such as enhanced visibility, clear surface markings, and appropriate gradient selection. Transportation agencies can incorporate these findings into design standards for new RSPs.
- Prioritisation of Interventions: By leveraging data analytics, policymakers can identify high-risk locations where RSP upgrades would yield the greatest safety benefits. This ensures that limited resources are effectively allocated.
- Continuous Monitoring and Evaluation: Integrating IoT-based speed monitoring systems into policy frameworks allows for ongoing evaluation of RSP effectiveness. This data-driven approach supports iterative improvements and ensures that interventions remain effective over time.
- Scalability to Urban and Regional Contexts: The framework is adaptable to varying urban and regional contexts. By building a comprehensive database of RSP designs and corresponding safety outcomes, decision-makers can tailor interventions to local conditions, such as traffic volumes, road types, and land use patterns.

This methodology not only supports the development of safer road environments but also aligns with broader policy goals, such as Vision Zero initiatives and sustainable urban mobility strategies.

Conclusion

This study presents a potential framework for building a database of RSP design features using analysis of vehicle speed data. By examining the relationship between RSP design characteristics and their impact on vehicle speeds, this approach highlights the significance of factors such as visibility, surface markings, gradients, and surface type (Blewden, 2020). Notably, for the site analysed, speeds over the RSP were reduced by 31.8%. This significant reduction supports the conclusion that thoughtful design upgrades can effectively lower vehicle speeds, highlighting the importance of tailoring RSP features to the specific conditions of the area.

The study further underscores the value of leveraging available data to extract meaningful insights, even when working with limited resources. Identifying sites with varying RSP designs and correlating these with road attributes, such as speed limits and traffic conditions, can provide a more comprehensive understanding of their effectiveness. With additional information, such as precise installation dates and detailed road characteristics, a robust database could be developed to support comparative analyses across multiple sites.

Such a database would enable transportation planners and policymakers to evaluate the performance of different RSP designs systematically. This, in turn, would provide evidence-based guidance for future RSP deployments, ensuring that design features are optimised to enhance road safety and align with the specific needs of each location, in which case we propose this for future research.

References

Agerholm, N., Knudsen, D., Variyeswaran, K., 2017. Speed-calming measures and their effect on driving speed–Test of a new technique measuring speeds based on GNSS data. Transportation research part F: traffic psychology and behaviour 46, 263-270.

Blewden M, Mackie, H., and Thorne R (2020). Effectiveness and implementation of raised safety platforms. Technical report, Austroads

Gitelman, V., Carmel, R., Pesahov, F., Chen, S., 2017. Changes in road-user behaviors following the installation of raised pedestrian crosswalks combined with preceding speed humps, on urban arterials. Transportation Research Part F: Traffic Psychology and Behaviour 46, 356-372.

Lawrence, B., Fildes, B., Cairney, P., Davy, S., & Sobhani, A. (2021). Evaluation of raised safety platforms (RSP) on-road safety performance. *Sustainability*, *14*(1), 138.

Barriers to appropriate CRS use for child occupants in UAE

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Abstract

This study used the Social-Ecological Model (SEM) to investigate the barriers that influence correct and/or appropriate restraint use for child occupants aged 10 years and younger in the United Arab Emirates (UAE). Semi-structured focus group discussions were conducted with 20 participants. The analysis identified six key themes: Non-Use of Restraints, Difference Between Reported and Observed CRS Use, Perceptions of CRS Non-Use and Appropriate Use, Encouragement and Discouragement of CRS Use, Effectiveness of Child Restraint Law, and General Issues Related to CRS Use. Data were analysed within the SEM, and multiple barriers to CRS use were found at various SEM levels. The inadequate enforcement of law at the societal level, cultural norms at the community, knowledge gap at the interpersonal, and children's behaviour at the individual were considered as barriers. The findings highlight the need for stricter enforcement of child restraint laws, and to foster a safety culture in the UAE.

Social media post

A 2024 Study: UAE child restraint use faces barriers—weak law enforcement, low awareness, parental knowledge gaps. Focus groups (20 parents) reveal misuse, non-use, and cultural hurdles. Stronger enforcement, better campaigns, and clear guidance are needed for safer kids in cars.

Introduction

According to The Abu Dhabi Early Childhood Authority ECA (2024) and Department of Health Abu Dhabi (2019), road traffic crashes are the top cause of child deaths in the UAE, claiming two-thirds of fatalities—triple the global average. The UAE has made progress in addressing this issue by introducing Federal Traffic Law No. 178 in 2017 which mandated mandates the use of CRS or booster seats for child occupants aged four years and younger and prohibits children under 10 years or shorter than 145 cm from sitting in the front seat, requiring them to be in the rear seats. Yet, inadequate enforcement and low CRS use have slowed improvements (The Abu Dhabi Early Childhood Authority ECA, 2024).

Previous research demonstrates that incorrectly restrained children incorrectly restrained are nearly twice as likely to sustain an injury be injured in a crash (Anund et al., 2003; Durbin et al., 2005). Two years after the introduction of the legislation, a study was conducted by Abdulazeez et al., (2023) that highlighted a significant gap in the correct and appropriate use of restraints for child occupants, particularly among children aged 5-12 years in the UAE. The authors highlighted that, in the UAE, child injuries and fatalities due to vehicle crashes were increasing and it was important to take necessary precautionary measures to address this issue.

In 2017, Ahmad et al., (2022) surveyed parents/caregivers of at least one child aged 10 years or younger, on their attitudes and behaviours towards restraining their eldest child while travelling in their motor vehicle. The authors reported that 23.8% ‘never’/’almost never’ restrained their eldest child, with non-use increasing with child age. In 2019, Ahmad et al., (2024) conducted at observed real-world CRS use, finding 51.7% of children unrestrained, 8.3% seated on laps, and only 22.8% appropriately restrained. Many were incorrectly restrained (59.9%), especially in vehicles with unrestrained drivers.

The current study utilised the findings from the previous two studies referred to previously Ahmad et al., (2022) and Ahmad et al., (2024) to apply the Social-Ecological Model to examine barriers to CRS use, aiming to inform policy, enforcement, and awareness initiatives to enhance child-occupant safety in the UAE.

Theoretical model

The Social Ecological Model (SEM) explains how individual, interpersonal, community, and societal factors influence health behaviours. Originally proposed by Bronfenbrenner (1979), it has been widely applied in public health. The ‘inside-out’ SEM, introduced by Golden et al., (2015), emphasises policies and environmental factors as key drivers of behaviour change. This study applies the inside-out SEM to explore child restraint system (CRS) use among parents in the UAE.

Aims

This study examines societal, community, interpersonal, and individual factors affecting CRS use among UAE parents through the inside-out SEM framework. A qualitative approach using semi-structured focus groups explores CRS use, non-use, legal effectiveness, and influencing factors.

Method

Twenty participants, recruited via community organisations, parenting groups, and social media, met the criteria of being UAE residents aged 18 or older with at least one child aged 10 or younger. Each focus group (6–10 participants) followed a semi-structured guide covering awareness of the 2017 CRS law, perceived benefits and barriers, cultural influences, and enforcement challenges. Sessions, conducted in Arabic and English, were recorded, transcribed, and thematically analysed using NVivo. Data were deductively coded to the four SEM levels, followed by inductive coding to identify emerging themes.

Results

The analysis identified six key themes: Non-Use of Restraints Factors, Difference Between Reported and Observed CRS Use, Perceptions of CRS Non-Use and Appropriate Use, Encouragement and Discouragement of CRS Use, Child Restraint Law and its Effectiveness in the UAE, and General Issues Related to CRS Use. Participants identified several factors contributing to the continued non-use of child restraints in the UAE, under each of the suggested six themes of the discussion. Several key factors were repeatedly mentioned, including inadequate enforcement of restraint law, parental habits, societal norms, and knowledge gaps with many parents unaware of the severe risks associated with non-compliance. Additionally, children's resistance to CRS use often leads parents to forgo enforcement. All participants admitted unfamiliarity with booster use in the UAE, emphasising that parents follow guidelines diligently when children are infants but often shift to using seatbelts prematurely as children grow older, underestimating the risks involved, which is considered as a barrier to CRS appropriate use. Additional factors such as large family sizes, vehicle constraints, short travel distances, and the cost of CRS also played a role in discouraging proper use. While some parents exhibited overconfidence in their driving abilities, believing CRS unnecessary, others cited a lack of clear guidance on CRS installation and usage as a barrier to compliance.

Benefits to road safety

Despite UAE law mandating CRS use, child road fatalities persist due to inadequate enforcement and parental knowledge gaps. Participants highlighted a lack of awareness regarding risks, proper installation, and booster seat importance. Educational campaigns targeting parents and children are crucial. Cultural norms, including reliance on private drivers, also hinder CRS adoption. Overconfidence, cost, and children's resistance further impede compliance. Recommendations include stricter enforcement, school-based road safety education, and public awareness initiatives. Efforts to address these issues by providing and promoting proper CRS use are crucial.

Implications for policy and/or practice

This study used the inside-out SEM to analyse factors affecting child restraint use in the UAE. To address these:

- Mandatory education: Implement programs in hospitals for new parents.
- Awareness campaigns: Utilise media to inform about restraint benefits and risks.
- Visual aids: Provide practical demonstrations of correct CRS installation.
- Highlight crash unpredictability: Emphasise that crashes can happen regardless of driving skill.
- Promote passive safety: Importance of restraint use as vital, irrespective of driving ability.

Conclusions

This study identified several factors contributing to the continued non-use of child restraints despite the introduction of CRS law in the UAE. At the individual level, a major barrier is the lack of awareness regarding the importance of CRS use for child occupants. Many parents appear to not fully understand the risks associated with non-use of CRS and/or are unsure of the appropriate restraints for different age groups. Another barrier at this level is parental overconfidence in their driving skills, which may lead to the belief that CRS is unnecessary. At the Interpersonal level, resistance from the children themselves to using a restraint presents a challenge for the families involved. The challenges at the community level comprise large family sizes, which can complicate CRS use. Another issue at this level is the lack of adequate CRS use instruction from salespersons or healthcare providers. At the societal level the cultural norms that de-emphasise CRS use and allow practices like having children sit on laps were identified as major barriers. The fast-paced lifestyle in the UAE also contributes to neglect of CRS use. These insights suggest the need for stronger enforcement,

better awareness campaigns, and clearer usage instructions to encourage compliance with CRS law. In summary, applying the SEM to the study of CRS use in the UAE reveals the need for a comprehensive, multi-level approach to improve compliance. Interventions should focus on enhancing knowledge, addressing behavioural and logistical barriers, and shifting societal norms to foster a culture of safety and compliance with CRS regulations.

Conference theme

The work of this study aligns with Equity, where it is recognising the value of child safety as road users, who should be treated fairly.

References

Abdulazeez, M. U., Khan, W., & Abdullah, K. A. (2023). Predicting child occupant crash injury severity in the United Arab Emirates using machine learning models for imbalanced dataset. IATSS research, 47(2), 134-159.

Ahmad, I., Fildes, B. N., Logan, D. B., & Koppel, S. (2022). Restraint Use for Child Occupants in Dubai, United Arab Emirates. International journal of environmental research and public health, 19(10), 5966.

Ahmad, I., Fildes, B. N., Logan, D. B., & Koppel, S. (2024). Restraint use within vehicles transporting child occupants in Dubai, United Arab Emirates: An observational study. Journal of Transport & Health, 34, 101746.

Anund, A., Falkmer, T., Forsman, Å., Gustafsson, S., Matstoms, Y., Sörensen, G., . . . Wenäll, J. (2003). Child safety in cars: literature review: Statens väg-och transportforskningsinstitut.

Bronfenbrenner, U. (1979). The ecology of human development: Experiments by nature and design: Harvard university press.

Department of Health Abu Dhabi. (2019). Secure your child in a car seat. Retrieved from https://www.haad.ae/roadsafety/childseatbelt.html

Durbin, D. R., Chen, I., Smith, R., Elliott, M. R., & Winston, F. K. (2005). Effects of seating position and appropriate restraint use on the risk of injury to children in motor vehicle crashes. Pediatrics, 115(3), e305-309. doi:10.1542/peds.2004-1522

Golden, S. D., McLeroy, K. R., Green, L. W., Earp, J. A. L., & Lieberman, L. D. (2015). Upending the social ecological model to guide health promotion efforts toward policy and environmental change. In: Sage Publications Sage CA: Los Angeles, CA.

The Abu Dhabi Early Childhood Authority ECA. (2024). Guidelines for child safety in vehicles in Abu Dhabi, UAE. Retrieved from https://www.adphc.gov.ae/Public-Health-Programs/Injury-Prevention/Child-Injury-prevention

Transforming Road Safety Strategies: Practising the Planning for Zero Framework

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Abstract
This interactive workshop demonstrates how to operationalise the Planning for Zero Framework (PfZF), developed by Austroads' Charting a Path to Zero project, through four essential components for achieving zero serious road trauma: (1) Developing Zero Pathways, (2) Communication and Stakeholder Engagement, (3) Technical Training Concept Development, and (4) Change Management. Working on a hypothetical jurisdiction scenario, participants will create a roadmap for stronger strategies, robust engagement, upskilling, and effective leadership interventions. The format is highly participatory: teams brainstorm, rotate to share ideas, refine them collaboratively, and present final proposals. By session's end, attendees gain practical methods and frameworks they can adapt to their own jurisdictions and day-to-day road safety efforts. By the end of this workshop, participants will (1) understand how to apply the Planning for Zero Framework in practice, (2) learn robust communication, training, and change management techniques to enable road safety strategies, and (3) develop tangible next steps for implementing zero pathways in their own jurisdictions.

Social media post
Join us at ARSC2025 for a hands-on "Charting a Path to Zero" workshop! Learn about our latest findings, master four pillars—Zero pathways, communication, training, and change management—and harness the Planning for Zero Framework to build stronger road safety strategies.

Introduction
Around 1,500 people lose their lives each year in road crashes in Australia and NZ. Another 40,000 people suffer serious injuries each year. The current trends of road fatalities and serious injuries in both countries are upwards. Austroads project, Charting a Path to Zero, aims to guide road safety management and strategy development across Australia and New Zealand to achieve 2030 and 2050 road safety targets.

Last year, we presented the early progress of Austroads' Charting a Path to Zero Project, highlighting strategies for achieving a road network free from deaths and serious injuries by 2050 (the Planning for Zero Framework). Since then, the project has advanced significantly, uncovering key enablers, challenges, and pathways to integrate the PfZF approach into everyday practice across Australia and New Zealand.

The project is near completion, and all major findings are ready to share with the road safety community. This workshop examines the refined pathways to zero, emphasising diverse stakeholder communication, targeted technical training, and robust change management. Attendees will gain practical guidance on closing the gap between planning and practice. Through a combination of short presentations and hands-on group work, participants will discover tools for tackling ambitious 2030 and 2050 road safety goals.

Conference Theme
Equity: Our session highlights inclusive Zero Pathways and tailored communication plans that prioritise both universal and vulnerable road users and cohorts. Participants learn strategies ensuring all communities benefit, promoting road-safety-for-all and informed decisions throughout the road transport system.

Elasticity: Adapting to shifting population demands, political climates, and technological evolutions is vital. Workshop activities illustrate how flexible road safety strategy development, training approaches and stakeholder engagement methods can help practitioners refine solutions for ever-changing local contexts.

Evolution: Moving from traditional practices to a holistic Safe System approach calls for bold leadership and transformative organisational shifts. Our final pillar—Change Management—delves into evolving political landscapes, institutional mindsets, and methods for sustaining progress. It builds on the Planning for Zero Framework's evolution across Australia and New Zealand, showcasing how to keep road safety agendas dynamic and future-ready.

By completing this workshop, participants will leave with a clear, hands-on grasp of how to integrate the Planning for Zero Framework into their own road safety contexts. They will have practiced mapping out Zero Pathways for a hypothetical jurisdiction, exchanging insights through dynamic group exercises and refining solutions collaboratively. Alongside strategic roadmap development, they will have learned practical approaches to stakeholder engagement, technical training, and change management—equipping them to address political, cultural, and institutional barriers. Ultimately, attendees will possess a concrete, step-by-step method for strengthening road safety strategies and steering their jurisdictions toward achieving ambitious serious road trauma reductions.

Facilitator

Dr Hafez Alavi is Austroads Project Manager for the Charting a Path to Zero Project. He is the Principal and Transport Lead of HA Consulting and has over 22 years of experience in the fields of road safety, injury prevention research, transport planning and sustainable mobility in the public/private sectors and the academia. He was a key contributor in strategising, planning, developing, delivering, and evaluating the Victorian Government's ambitious Towards Zero Strategy and Action Plan, amongst other national and international road safety strategies. He is a regular guest speaker at national and international road and transport safety conferences and has multi-disciplinary communication skills to forge lasting relationships with key stakeholders and the community to drive transformational agendas. Hafez has run numerous interactive workshops (in person and virtually) and is adept with a variety of techniques to elicit effective participation and contribution in his workshops.

Workshop leaders

Our workshop leaders are highly experienced professionals in road safety policy, strategy, research, and change management. Dr. Blair Turner is a global expert in road safety, speed management, and Safe System implementation. Paul Durdin specialises in infrastructure safety and local government planning. Cath Jacobs has expertise in stakeholder engagement and communications. Emily McLean leads infrastructure safety projects at NTRO, focusing on technical training and risk assessments. Claire Murdoch has over 20 years of experience in road safety policy and regulation. David Shelton is a Vision Zero specialist with extensive government advisory experience. Phil Reed brings deep expertise in policy reform and public communication. Dr. Soames Job is a leading global road safety expert in behaviour change and research. Michael Nieuwesteeg, Austroads' Program Manager for Road Safety and Design, leads research, guidance development, and policy coordination across Australian and New Zealand jurisdictions.

Horizontal curve crashes on the Western Australian rural road network

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Abstract
Horizontal curves are associated with a higher crash risk. There is a need to understand factors contributing to crashes on curves on WA rural roads and identify possible treatments. 7,291 WA rural road sites were analysed with a wide range of radii. Crash analysis used data between 2017-2021 using negative binomial regression. Standard predictors of crash rates were statistically significant: traffic volume, radius, and section length. However, other significant predictors of crash rates on curves highlights the difficulty of using cross-sectional crash data to reliably identify causal contributors to crash rates. For example, higher posted speed limit (110 km/h) predicted fewer crashes compared to 80 km/h sites. But these higher posted-speed limits are attached to roads with different qualities that make the road safer than lower posted-speed limits – qualities that are not usually captured in available asset data.

Social media post
The evidence for low-cost interventions specifically on curves is low and any low-cost intervention proposed should be assessed using a randomised controlled design to fully understand the impact.

Introduction
Horizontal curves are associated with a higher crash risk than straight/tangential sections (Park et al., 2010). Crash risk on curves is inversely proportional to the radius, with before-after studies showing considerable crash rate reductions following adjustment of road segments to a higher radius (Srinivasan et al., 2018). In Australia, 48% of fatal crashes on rural roads are on or around curves, with 70% of those crashes occurring where the radius is less than 300 m (Charlton & De Pont, 2007). However, curve realignments are expensive treatments requiring land to be available and so are limited in how widely they can be implemented. Therefore, there is a need to understand the impacts of other factors that contribute to crash risk on WA rural roads and what possible treatments could be applied, especially lower cost treatments. The aim of this study was to identify risk factors and sites for treatment. We also aimed to predict dangerous/risky curves for eventual treatment as could be used for a curve treatment program.

Conference theme – Evolution
Studies consistently show that sharp horizontal curves increase crash rates, making it crucial to address these curves to enhance road safety. This research is aligned with the evolution theme. By understanding how various road features—such as carriageway type, barriers, and pavement width—affect the risk associated with curves, we can implement effective treatments to mitigate these risks and create more forgiving roads aligning with a safe system. After these treatments, the previously high-risk road curves will align with safe system principles, transforming them into lower-risk roads.

Methods

Design and data
The study was principally a cross-sectional design, with curved road segments on the State rural network identified by Main Roads asset management. Curves were treated as a single curve when separated by a straight segment <30 m. Crash data included 100 m either side. Curves were defined as: *Simple curves*: single arc of a circle with the same radius; *Reverse curves*: two adjacent arcs in a different direction; *Spiral curves*: two or more simple curves with different radii but turning in the same direction. Crash data between 2012-2021 inclusive at curve sites were extracted from the Integrated Road Information System, maintained by Main Roads. Crash severity is coded based on the "most serious injury in a crash", including crashes involving a fatality, requiring hospitalisation but no fatality within 30 days, medical treatment not requiring admission to hospital, and two-levels of property damage only crashes based on cost. There were 1374 crashes of all severities and road user movements, 404 lane departure casualty crashes, and 308 lane departure KSI crashes used for this analysis. The category lane departure crashes included both run-off-road and head-on opposite direction crashes.

Statistical Analysis
Generalised linear models with a negative binomial link function were used to analyse the crash data. Two general models: a simple "base model", and an expanded model were developed based on the number of variables used:

- *Base model*: volume, speed limit, radius, type of curve, link subcategory, length of segment.
- *Expanded model*: base model + rainfall, overtaking lane, total pavement width, shoulder width, barrier, pre-sign presence, chevron sign presence, safe speed differential (difference between posted speed limit and assessed safe speed limit).

Site Ranking and Prediction Analysis
Predictive performance of various ranking strategies was evaluated by comparing the proportion of sites captured in the top 10 sites by crash count from the actual data and the top 10 predicted sites, and then repeated up to the top 100 sites (Huang et al., 2009). E.g., if the model predicts 9 out of the 10 highest crash sites by observed crashes, then a score of 0.9 is given with scores ranging from 0 (no ability to predict) to 1 (100% ability to predict). To assess this, separate models were developed on the 2012-2016 crash data. Then used to predict crashes between 2017-2021.

Results

Base Model

Table 1 presents the coefficients from the negative binomial models for all crashes, lane departure casualty, and lane departure FSI crashes. Significant predictors of crash rate were volume (AADT), radius, and length (all log transformed). Speed limit was an additional significant predictor in the model for all crashes.

Table 1. Effects of AADT, speed limit, radius, length, and curve type on crash risk

	All Crashes			**Lane Departure Casualty**			**Lane Departure FSI**		
Variable	β	se	p	β	se	p	β	se	p
Intercept	-5.16	0.35	0.000	-5.25	0.66	0.000	-5.96	0.74	0.000
log(AADT)	0.78	0.03	0.000	0.70	0.05	0.000	0.77	0.06	0.000
Speed 90 (vs 80)	0.06	0.17	0.729	0.04	0.32	0.911	0.05	0.37	0.891
Speed 100 (vs 80)	-0.16	0.16	0.323	-0.10	0.32	0.747	0.04	0.36	0.921
Speed 110 (vs 80)	-0.39	0.15	0.012	-0.05	0.29	0.876	0.00	0.33	0.992
log(Radius)	-0.18	0.04	0.000	-0.31	0.08	0.000	-0.32	0.09	0.000
log(Length)	0.74	0.09	0.000	0.55	0.17	0.001	0.61	0.19	0.001
Simple Curve (vs Reverse)	0.18	0.20	0.348	-0.21	0.44	0.626	0.04	0.43	0.931
Spiral Curve (vs Reverse)	0.12	0.23	0.610	-0.72	0.61	0.236	-0.54	0.61	0.379

Expanded Model
In addition to variables found to be significant predictors in the base model above (i.e., AADT, radius, speed limit [all crashes], and length), carriageway, barriers, pavement width, and rainfall were additional significant predictors of all crashes. Single lane carriageways, barrier presence, and greater rainfall were associated with a higher risk of all crashes. For lane departure casualty and FSI crash categories, total pavement width was associated with a lower crash risk. Barriers were not significantly associated with increased risk in the expanded model for casualty or KSI crashes, but the effect sizes were consistent with the crash analysis (i.e., an increase in risk, albeit slightly smaller).

Ranking Performance – Ability to predict future crash sites
Anticipated future performance was estimated by fitting models to the 2012-2016 data and generating predictions for 2017-2021, then the 2017-2021 crash data was used to evaluate performance as shown in Figure 1. The ability of these models to predict sites being in the top N sites was 15-40%. Generally, the model-based predictions outperformed the simple crash history predictions. The model based entirely on previous period KSI lane departure crashes from 2012-2016 performed very poorly, failing to predict any sites with higher crash rates in 2017-2021.

Discussion

Crash rates on curves were most strongly tied to traffic volumes, radius, and the lengths of the curved sites, standard risk factors for crash data. The association was present for all crash severities and all road user movements. For radius specifically, sharper curves were associated with greater crash risk, and the risk was greater for lane departure casualty

and lane departure KSI crashes compared to all crashes. Importantly, these three variables are necessary to include in any analysis that attempts to tease apart the impact of other risk factors with crash rates on curves.

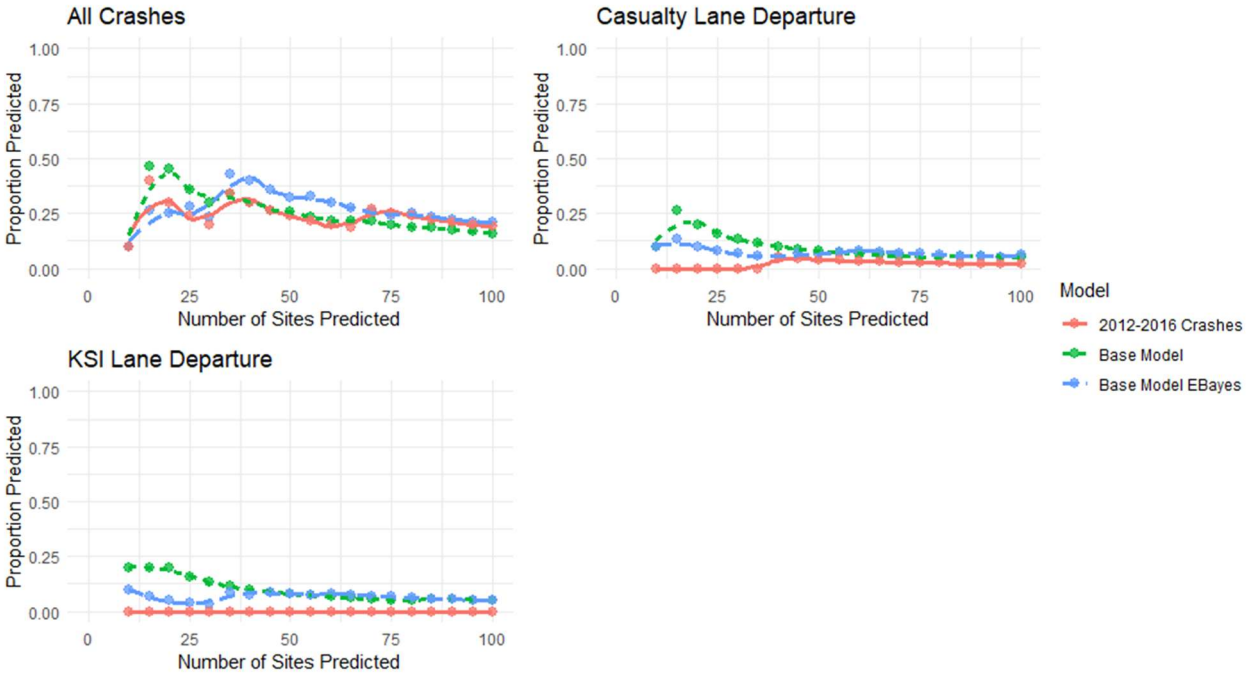


Figure 1. Future rank sensitivity - proportion of sites predicted to be in the top 15-100 crash sites for all crashes, lane departure casualty crashes, and KSI lane departure casualty crashes

In the expanded analysis, carriageway type, barriers, rainfall, and total pavement width influenced crash rates for different types of crashes. Single carriageways (vs dual), barriers, and rainfall were all positively associated with crash rates. The effect of carriageway may be due to road quality and engineered safety. Dual carriageway roads are generally higher quality compared to single carriageway and residual confounding likely exists. A related effect identified that 110 km/h speed limits were associated with a reduction in all crashes (but practically no impact on lane departure casualty crashes) which is likely related to unidentified “road quality” variables, where the higher posted-speeds are on inherently safer roads due to multiple features potentially not explicitly captured in the road asset database. Similarly, the negative effect of barriers on safety may be because barriers are placed on more dangerous curves and are thus used as a treatment for crashes. This is a form of endogeneity bias, where, in this case, the presence of the treatment (barriers) has been caused by the dependent variable (crash counts) (Kim & Washington, 2006).

The ability of these models to predict future KSI crashes is relatively poor. Part of the reason for low-prediction ability is because the number of crashes captured at any one site was relatively low, this makes rank prediction based on crash numbers (and models developed on crash numbers) more uncertain due to issues with restricted ranges for prediction. This has implications for planning treatment programs, such as Black Spot Programs, that are based usually on relatively low crash counts. Such low counts are much more suspect to random variation leading to regression-to-the-mean biases, discussed repeatedly in the crash analysis literature (e.g., Albrecht & Hasan, 2025). One remedy to the issue of confounding and other biases is to incorporate a randomised controlled designs into assessing low-cost treatment programs that address crashes on curves. This could be done by randomising the order of treatment for the top 100 - 200 sites selected, depending on risk tolerance and funding constraints.

Limitations

The analysis/design was primarily cross-sectional. As outlined above, this has substantial problems due to: endogeneity bias (Elvik, 2011), omitted variable bias (Elvik, 2011) and unreliable crash modification factor estimation (Hauer, 2010). Additionally, traffic volumes and road features were a snapshot of the most recent estimate, instead of year-by-year values. Rank-based predictions would improve if there were accurate projections of volumes on these road segments.

References

Charlton, S. G., & De Pont, J. J. (2007). *Curve speed management*.

Elvik, R. (2011). Assessing causality in multivariate accident models. *Accident Analysis & Prevention*, *43*(1), 253–264. https://doi.org/10.1016/j.aap.2010.08.018

Hauer, E. (2010). Cause, effect and regression in road safety: A case study. *Accident Analysis & Prevention*, *42*(4), 1128–1135. https://doi.org/10.1016/j.aap.2009.12.027

Huang, H., Chin, H. C., & Haque, Md. M. (2009). Empirical Evaluation of Alternative Approaches in Identifying Crash Hot Spots: Naive Ranking, Empirical Bayes, Full Bayes Methods. *Transportation Research Record*, *2103*(1), 32–41. https://doi.org/10.3141/2103-05

Kim, D.-G., & Washington, S. (2006). The significance of endogeneity problems in crash models: An examination of left-turn lanes in intersection crash models. *Accident Analysis & Prevention*, *38*(6), 1094–1100. https://doi.org/10.1016/j.aap.2006.04.017

Park, B.-J., Fitzpatrick, K., & Lord, D. (2010). Evaluating the effects of freeway design elements on safety. *Transportation Research Record*, *2195*(1), 58–69.

Srinivasan, R., Carter, D., Lyon, C., & Albee, M. (2018). Before–After Evaluation of the Realignment of Horizontal Curves on Rural Two-Lane Roads. *Transportation Research Record*, *2672*(30), 43–52.

Road safety impact of medical cannabis

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Abstract

The use of medical cannabis is increasing rapidly in Australia. The current legal environment provides a significant equity issue to patients prescribed cannabis products containing the impairing compound tetrahydrocannabinol (THC). Several systematic reviews and meta-analyses show relatively minimal effects of cannabis presence or detection on crash risk or crash culpability. We recently conducted a meta-regression of culpability studies to understand the dose-response relationship between culpability and blood THC concentration. Consistent with previous meta-analyses, there is practically no increase in culpability risk associated with low THC blood concentrations (under ~2-3 ng/ml), but culpability risk may increase at higher blood concentrations. The overall literature should be integrated into discussions of medical cannabis policy, especially as it relates to equity.

Social media post

Medical cannabis use likely poses minimal risk to road safety. Education and safe systems approaches could offset any small increase in risk.

Background

In 2016, cannabis products containing the main psychoactive component THC have been available on a special access scheme to be prescribed to patients for a range of medical conditions. The prescription rates and access to medical cannabis products has skyrocketed, with 1.68 million units sold in 2023 and 2.87 million units sold in the first half of 2024 (Penington Institute, 2024). This is on the back of increasing legalisation across the globe, including various states in the US rolling out full legalisation of cannabis, not just for medical use. The full impact on road safety is not yet fully clear, but through a number of meta-analyses of crash risk and case studies of areas enacting legalisation, trends are emerging that might indicate the risk may not be as great as initially anticipated. In a survey of Australians using medical cannabis, 72% of respondents reported that their medical cannabis use does not impair their driving, nor their ability to assess their own fitness to drive (Arkell et al., 2021). However, it is currently illegal to drive with the presence of THC in a body fluid in Australia, bringing patients prescribed medical cannabis and the law into conflict.

The impairing effects of THC on cognitive performance, as assessed in tightly controlled laboratory experiments, is clear – a large number of studies have investigated the impact of varying doses of THC on driving-relevant cognitive performance (McCartney et al., 2021). The aggregate outcome indicates modest impairments across multiple cognitive domains including processing speed, executive function, tracking, selective and sustained attention, and working memory. Impairments are also dependent on the dose and time since administration, with one meta-analysis suggesting practical absence of impairment 5 hours post-acute inhaled administration of THC (McCartney et al., 2021). Despite the robust evidence, the actual effect size aggregated over domains is relatively modest, with many of the most affected indicating an ~0.5 standard deviation reduction in performance (again depending on cognitive domain, route of administration, time since administration, and amount administered). While this impairment would certainly make driving a vehicle less safe for a naïve user of cannabis within the timeframe of impairment, the overall impact has not translated robustly into population crash-statistics and epidemiological studies of crash or culpability risk, as we will discuss below.

THC and crash risk

A significant body of literature is present that evaluates the relationship between THC and crash risk. On aggregate, these studies suggest a 1.1 – 1.8 odds increase in the risk of a crash or crash culpability in drivers with detectable levels of THC (White & Burns, 2021). There are methodological concerns with a number of these papers highlighting possible biases towards showing an increase in risk from cannabis. For example, a major confound of these studies is that the personality and risk appetites associated with individuals that smoke cannabis and drive is likely very different to people that do not use cannabis, or do not use cannabis within a detectable time-frame of driving. This confound extends to frequent users of cannabis, who often have detectable levels of THC days to weeks after using cannabis because of the high lipid solubility of THC. These previous meta-analyses also did not examine blood-concentration

risk relationships, which potentially alleviates a number of these confounds as the lower blood concentrations become a "control" group for the higher concentrations.

We recently conducted a meta-regression analysis of the available blood-concentration culpability risk studies (Albrecht et al., 2025. Papers from existing meta-analyses were extracted, with an expansion of the initial search terms yielding no further articles. We included studies that had isolated THC in some way by either excluding people who had used alcohol, or who had used regression models accounting for alcohol and other drug use. We show a robust dose-response relationship with crash culpability risk (Figure 1). Below blood concentrations of 1-3 ng/ml, there is practically no increase in culpability risk. While above 3 ng/ml risk begins to increase. We should caution that there is limited data on high blood concentrations of THC in these papers to adequately assess the risk of high concentrations of THC. Nevertheless, the risk becomes greater with increasing concentration. We suspect that the higher concentrations are an index for recent high dose usage, but this is unclear from the available evidence.

Our meta-regression alleviates some of the issues identified in previous papers by allowing a comparison across cannabis users (risk associated with high concentrations of THC can be compared to low concentrations), thereby alleviating some of the personality factors associated with cannabis use itself. There is likely still confounding at the higher end of the blood concentration risk curve.

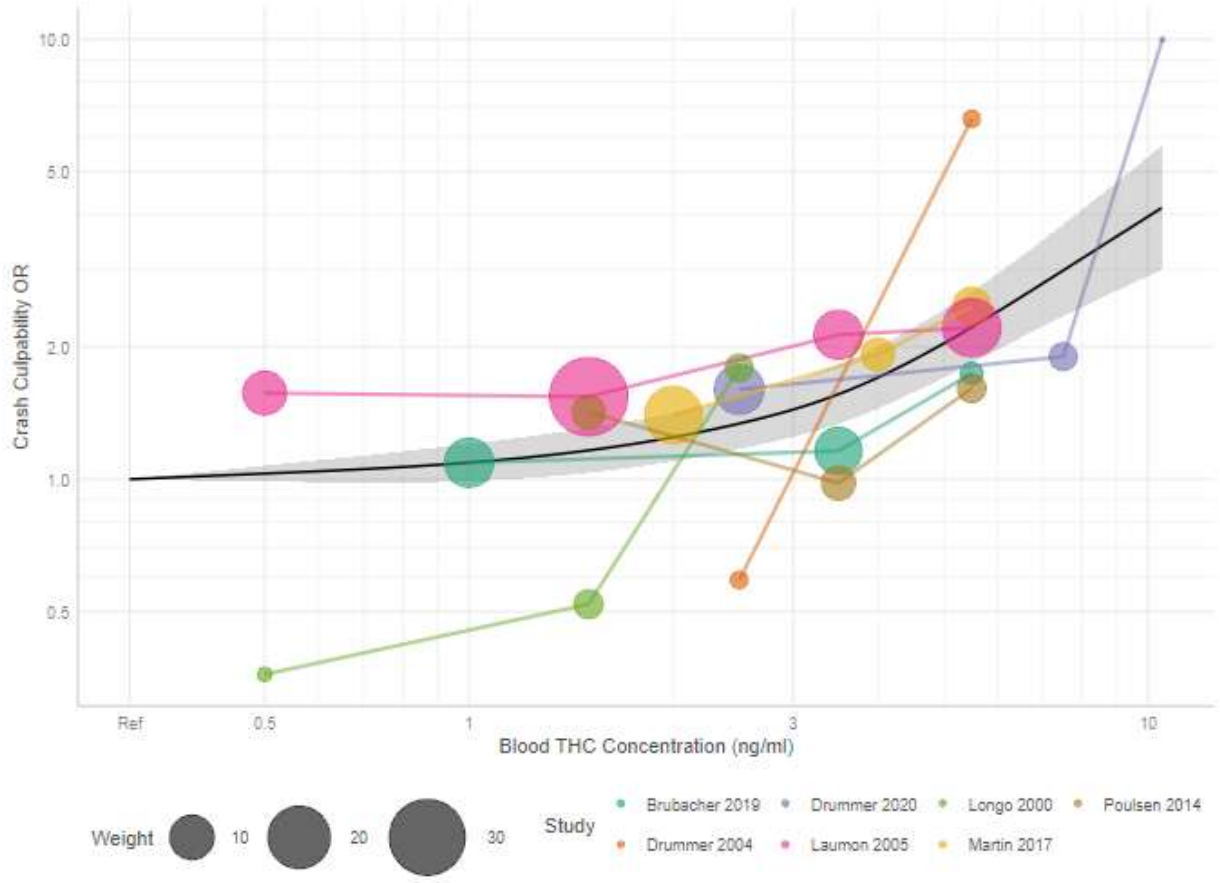


Figure 1. Crash-culpability dose-response relationship for the effects of blood concentrations of THC (Albrecht et al., 2025)

Is medical cannabis use likely to be less risky

Most research so far, including the crash-culpability literature has focussed on recreational users of cannabis. Medical users of cannabis, with a prescription, are likely to have different risk profiles. Partially, this may be due to personality and innate risk differences of the users, but also tolerance to the effects of cannabis (Colizzi & Bhattacharyya, 2018) and the amount used for a prescribed indication (as opposed to obtaining a recreational high) will play substantial roles in mitigating any risk from medical cannabis use. Of the few high-quality controlled studies that do assess medical use patterns, they show a minimal level of impairment with low-moderate doses used regularly, and practically no impairments the following day when THC may still be detected (McCartney et al., 2023). Thus, medical use of THC-containing products at low-moderate doses likely poses little, if any, increased crash risk with appropriate medical use, adaptation, waiting times before driving, and experience.

Implications for Policy and/or Practice

A more accurate understanding and appreciation of the relationship between crash culpability risk and THC blood concentration will assist in forming better policy regarding cannabis and driving. Regardless of whether regulation begins to allow driving with a prescription for medical cannabis, several avenues are available to optimise road safety outcomes. Perceptions of risk appear to play a major role in influencing behaviour around driving under the influence of drugs (Hasan et al., 2022). Consistent with this, studies that evaluate the impact of education programs focussing on informed road decisions, safe celebrating, and drug and alcohol use are associated with a reduction in crash rates (Senserrick et al., 2009). There is thus a substantial missed opportunity for educating medical cannabis users about impairment and road safety with the current zero-tolerance approach to driving with the presence of THC. Other aspects of the safe system are also effective at supporting the safety of all road users regardless of impairment, e.g., infrastructure investments and speed policies. Similarly, support for alternative transportation reduces impaired driving and crashes from impaired driving (Fell et al., 2020). All of which can be achieved and worked towards within the continued controversial environment of driving and medical cannabis users.

Conclusion

As cannabis gains acceptance for medical use in Australia, balancing personal autonomy with public safety becomes crucial. Crash risk studies show minimal increase in crash risk for detectable levels of THC, albeit with dose-response relationships indicating increase culpability at higher blood concentrations. Detection-based penalisation has little relationship with crash involvement and conflicts with patients' perceptions of procedural justice. Addressing the road safety implications of medical cannabis leads to opportunities to reduce road trauma that are potentially wide reaching, through education, structural support, and existing solutions to make roads safer.

References

Albrecht M, Hasan R, Kekez D, Zhou H (2025) Dose response relationship between blood concentrations of THC and crash culpability risk: an updated meta-regression of culpability studies. Drug Science, Policy and Law. https://doi.org/10.31234/osf.io/mp9sz

Colizzi M, Bhattacharyya S (2018) Cannabis use and the development of tolerance: a systematic review of human evidence. Neuroscience & Biobehavioral Reviews 93:1–25. https://doi.org/10.1016/j.neubiorev.2018.07.014

Fell JC, Scolese J, Achoki T, et al (2020) The effectiveness of alternative transportation programs in reducing impaired driving: A literature review and synthesis. Journal of Safety Research 75:128–139. https://doi.org/10.1016/j.jsr.2020.09.001

Hasan R, Watson B, Haworth N, et al (2024) How do perceptions of procedural justice, police legitimacy, and legitimacy of laws influence intentions to drug drive? Journal of Safety Research 90:86–99. https://doi.org/10.1016/j.jsr.2024.06.006

Hasan R, Watson B, Haworth N, Oviedo-Trespalacios O (2022) A systematic review of factors associated with illegal drug driving. Accident Analysis & Prevention 168:106574. https://doi.org/10.1016/j.aap.2022.106574

McCartney D, Arkell TR, Irwin C, McGregor IS (2021) Determining the magnitude and duration of acute Δ9-tetrahydrocannabinol (Δ9-THC)-induced driving and cognitive impairment: A systematic and meta-analytic review. Neuroscience & Biobehavioral Reviews 126:175–193. https://doi.org/10.1016/j.neubiorev.2021.01.003

McCartney D, Suraev A, McGregor IS (2023) The "Next Day" Effects of Cannabis Use: A Systematic Review. Cannabis and Cannabinoid Research 8:92–114. https://doi.org/10.1089/can.2022.0185

Penington Institute (2024) Cannabis in Australia 2024. Melbourne, Victoria

Senserrick T, Ivers R, Boufous S, et al (2009) Young Driver Education Programs That Build Resilience Have Potential to Reduce Road Crashes. Pediatrics 124:1287–1292. https://doi.org/10.1542/peds.2009-0659

White MA, Burns NR (2021) The risk of being culpable for or involved in a road crash after using cannabis: A systematic review and meta-analyses. Drug Science, Policy and Law 7:20503245211055381. https://doi.org/10.1177/20503245211055381

Wieghorst A, Roessler KK, Hendricks O, Andersen TE (2022) The effect of medical cannabis on cognitive functions: a systematic review. Syst Rev 11:210. https://doi.org/10.1186/s13643-022-02073-5

A review of the Western Australia Regional Road Safety Program

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Abstract
This study reviews Western Australia's Regional Road Safety Program (RRSP), focusing on the first three phases (0, 1, and 2) out of a total of eight. The RRSP succeeded the Regional Run-Off Road Crash Program (RRORP), which was completed in 2019. So far, the RRSP has improved a total of 7,200 kilometres out of a planned 8,243 kilometres using various treatments, including sealing shoulders, installing audible edge and centre lines, removing roadside vegetation, and providing roadside safety barriers. A before-and-after evaluation with control groups was conducted using generalised linear mixed-effects regression modelling (GLMM) to assess the program's impact on reported crashes, casualty crashes, and fatal or seriously injured (FSI) crashes. The findings indicate that the RRSP led to a 52% decrease in the overall number of fatal crashes, along with a 51% reduction in fatal lane departure crashes. This improvement equates to saving approximately nine lives per year.

Social media post
Western Australia's Regional Road Safety Program has significantly reduced fatal crashes, demonstrating a BCR of 3.5 and saving approximately nine lives per year on Western Australia rural roads.

Introduction
Western Australia's regional roads represent a significant concern for road safety, accounting for a disproportionate number of road fatalities. In 2020, Infrastructure Australia (Infrastructure Australia, 2021) identified this issue as one of National Significance. Despite having a lower population and traffic volume compared to metropolitan areas, 59% of road fatalities in WA occurred in regional areas in 2020 (Road Safety Commission, 2020). A large number of these incidents involve lane departures, including run-off-road and head-on collisions. The higher fatality rates in regional areas can likely be attributed to several factors, including higher speed limits, longer travel distances that increase fatigue and inattention, and road infrastructure that is less forgiving of driver errors.

To address this serious national concern, the Regional Road Safety Program (RRSP) was established in 2020 after the Regional Run Off Road Crash Program (RRORP) was completed in 2019. Like the RRORP, the objective of the RRSP is to improve safety on regional roads by specifically targeting run-off-road and head-on crashes. The program typically considers treatments that have been shown to effectively reduce lane-departure incidents, such as sealing road shoulders and installing audio-tactile edge lines and centre lines, in accordance with the Austroads Safe Systems Alignment Framework. Since the RRSP began in 2020, the State and Commonwealth Governments have dedicated nearly $1 billion to upgrade regional roads across Western Australia. This study reviews the RRSP, the need for the program, current status, and the current evaluation results. Often, multiple treatments are implemented in combination; therefore, the evaluation aspect examines the program as a whole and its various treatment combinations to understand the safety and cost-effectiveness of the RRSP in reducing fatal and serious injury crashes (FSI), casualty crashes, and all reported crashes.

Conference theme – Equity and Evolution
The RRSP first align with the conference theme of equity. Currently, regional roads serve only a small portion of Western Australia's population. However, the Regional Roads Safety Program (RRSP) values every individual's life, promoting equitable access and inclusiveness by enhancing road safety, even if only few people use the road. Especially as regional areas lack resources such as health and emergency services.

The RRSP also aligns with evolution as the provision of treatments such as audio-tactile centreline and edgelines, and sealed shoulders by the program effectively transition the regional road network to be safe system compliant. These treatments provide drivers with space and enough time to react in the event of an error, allowing the roads to be more forgiving.

The Regional Road Safety Program (RRSP) in Western Australia

This section reviews the RRSP which started in 2020. However, the section starts with a brief overview of the Regional Run Off Road Crash Program (RRORP) which preceded the RRSP.

Before the RRSP

Main Roads WA previously addressed safety risks on regional roads, but the State's road safety strategy for 2008-2020, titled Towards Zero, identified rural run-off-road crashes as a priority area that needed a dedicated treatment program. Consequently, Main Roads initiated an extensive improvement program for key regional routes that exhibited a higher-than-average risk of vehicle run-off-road crashes. This initiative began in 2012 and was known as the RRORP. Typical treatments implemented under the RRORP included enhancing road delineation, widening and sealing shoulders, installing audible edge lines, removing roadside vegetation, and providing roadside safety barriers. By the conclusion of the program in 2019, approximately 1,364 kilometres of rural roads in WA had been treated using funds from the Road Trauma Trust Account (RTTA).

An early evaluation in 2016, which used data from 2012 to 2015, reported a 40% reduction in run-off-road crashes of all severities and a 28% reduction in run-off-road casualty crashes (Chow et al., 2016). A comprehensive evaluation of the entire program in 2020 indicated that combining shoulder widening with audible edge line treatments yielded the most significant benefits. Specifically, this combination produced a 13-83% reduction in casualty crashes and a 37-81% reduction in fatal crashes, although the expected number of fatal crashes was very low, at just 14 (Albrecht et. al., 2020).

The Regional Road Safety Program

In response to the success of the RRORP and the need to address the disproportionate number of road fatalities on rural roads, the Regional Road Safety Program (RRSP) was established in 2020. Unlike the RRORP, which was funded through the Road Trauma Trust Account, the RRSP is financed by the State and Commonwealth Governments, with approximately $1 billion allocated for evidence-based safety treatments across the regional road network. The goal of the RRSP is to improve roughly 8,243 kilometres of Western Australia's regional road network.

Implementation of the RRSP

The RRSP has been organised into eight tranches (0-7) to ensure a smooth implementation process. The entire program is expected to last for five years (2020-2025). As of February 2025, a total of 7,200 kilometres out of 8,243 kilometres has been completed. Figure 1 illustrates the kilometres treated or in progress across the various tranches and the WA state road network showing which sections have been treated or are currently undergoing treatment.

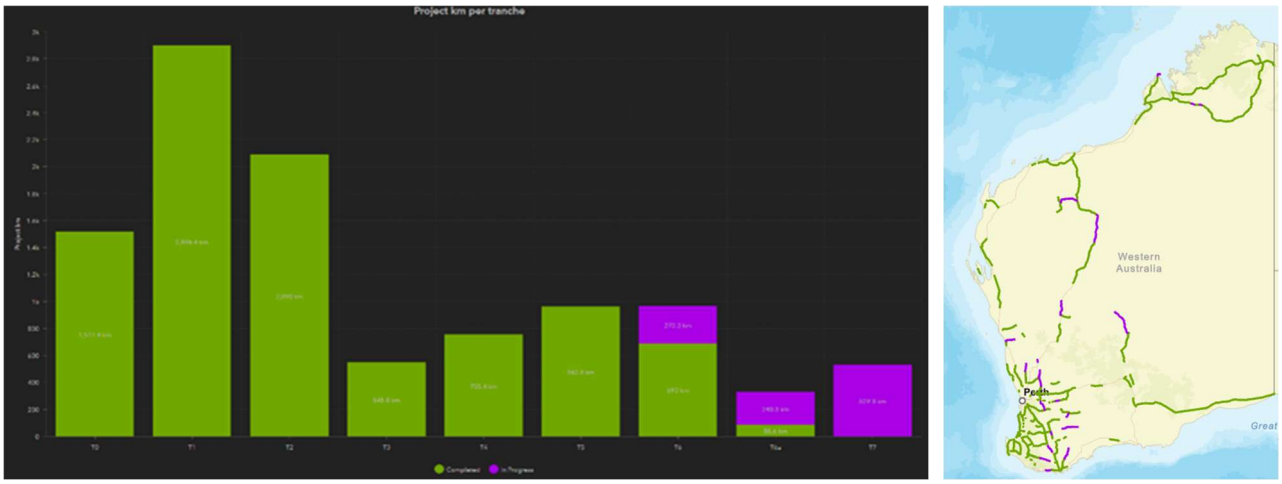


Figure 1. Length of RRSP treated network (km) across tranches (left). RRSP mapped onto the WA state road network (right)

Table 1 provides a breakdown of the program by Main Roads WA Regions, highlighting that the Kimberley Region has benefited the most, with a total of 2,368 kilometres treated so far.

Table 1. Distribution of RRSP treatments across Main Roads Regions

Region	Seal Shoulder	AEL	ACL	Widening	Total project
Goldfields-Esperance	459	1,101	851	98	1,822
Great Southern	468	566	34	156	651
Kimberley	381	1,137	1,073	170	2,368
Metropolitan	15	15		15	15
Mid West-Gascoyne	644	1,283	213	273	1,337
Pilbara	734	1,210		151	1,268
South West	1,089	1,058	659	251	1,565
Wheatbelt	995	1,566	164	451	1,566
Total	10,592				

AEL = Audio tactile edgelines; ACL = Audio tactile centreline

Evaluation of the Regional Road Safety Program (RRSP)

The Western Australian Centre for Road Safety Research (WACRSR) completed a preliminary evaluation of the program in November 2024. This evaluation focused on tranches 0, 1, and 2, completed between 2020 and 2022. This provided an average follow-up period of approximately 2.3 years, allowing for a reasonably reliable analysis. Initially, 179 sites were identified within tranches 0, 1, and 2, serving as the primary treatment locations. Due to overlaps among these three tranches (i.e., some sites received multiple treatments), these sites were subdivided into subsites. Each segment that underwent a second treatment was treated as distinct from the original site. This process resulted in a total of 231 sites, covering 5,994.1 kilometres. In this study, the evaluation employed a before-and-after design with controls, utilising generalised linear mixed-effects regression modelling (GLMM; Albrecht & Hasan 2025). To assess safety and cost-effectiveness, we analysed all reported crashes, casualty crashes, and fatal and serious injury (FSI) crashes that occurred between 2012 and 2023.

The overall findings indicate that the RRSP was most effective at lowering the number of fatal crashes, achieving an impressive mean reduction of 52%. Additionally, when considering a treatment lifespan of 20 years and a discount rate of 5%, the RRSP yields a benefit-cost ratio (BCR) of 3.5. This demonstrates the program's economic advantages and underscores the significant impact of reducing fatal crashes. A further analysis focused on lane departure crashes (such as run-off-road and head-on crashes), reveals that the RRSP has led to a 51% reduction in fatal lane departure crashes. The most notable improvement from various treatment combinations includes a 62% reduction in all fatal crashes when combining Audio-tactile Edge Line (AEL) and Shoulder Sealing. The combination of AEL and Audio-tactile Centre Line (ACL) also led to a significant reduction in fatal crashes. However, it is important to interpret the results from these combined AEL and ACL treatments cautiously, as there were relatively few crashes during the baseline period, which limits a robust and reliable analysis.

Table 2. Effectiveness of the RRSP on Crashes from the GLMM

Severity	RUM Grouping	Crash Rate Reduction		
		Mean	95% CI	
All	All	7.8%	-4.6%	18.7%
Casualty	All	7.4%	-15.1%	25.4%
FSI	All	16.6%	-10.8%	37.2%
Fatality	All	51.9%	14.4%	72.9%
All	Lane Departure	13.3%	-5.4%	28.8%
FSI	Lane Departure	10.0%	-26.3%	35.9%
Casualty	Lane Departure	4.1%	-28.9%	28.6%
Fatality	Lane Departure	51.3%	8.3%	74.1%

Implication for Road Safety and Conclusion

The RRSP directly delivers the national key road safety priorities by identifying and implementing specific road safety infrastructure improvements to reduce run-off-road and head-on crashes on regional and remote roads. The program has effectively treated about 7,200 kilometres of rural road which is making these roads more forgiving for Western Australians. Overall, the program has successfully reduced fatal crashes on treated roads by approximately 50%, with an estimate of 9 lives per year being saved. Additionally, it demonstrates significant economic benefits, achieving a benefit-cost ratio (BCR) of 3.5. The success of the program thus far in reducing fatal and serious injuries on the regional road network suggests this program should be continued.

References

Albrecht, M. A., & Hasan, R. (2025). Reliable crash analysis: Comparing biases and error rates of empirical Bayes before-after analyses to mixed-models. *Accident Analysis & Prevention*, *212*, 107921.

Albrecht MA, Amoh-Gyimah R, Lajszczak H, et al (2021) A full Bayes before-after analysis of the effectiveness and cost-effectiveness of shoulder widening and combined shoulder widening and audible edgeline treatments in Western Australia between 2012 and 2019. Curtin University, Perth, Western Australia

Chow K, Meuleners L, Wong A (2016) An evaluation of the effectiveness and cost-effectiveness of a rural run-off-road crash program in Western Australia. Main Roads WA.

Infrastructure Australia (2021). Infrastructure priority list: Project and initiative summaries 2020. https://apo.org.au/node/276676

Road Safety Commission (2021) Western Australian Road Fatalities 2020. Western Australian State Government, Perth, Western Australia

LiDAR Point Cloud Data and AusRAP Star Rating Communication Strategy

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Abstract

In 2023, Main Roads Western Australia partnered with Anditi to carry out the world's largest αiRAP project. Main Roads collected LiDAR data using mobile laser scanning and then employed artificial intelligence and machine learning to extract and code AusRAP features according to the newly emerging αiRAP framework. Using the extracted AusRAP features, Main Roads has developed star ratings for all state roads. These star ratings are crucial for informing improvement initiatives and treatment decisions. After completing the star rating project, it became essential to effectively communicate the results across the organisation to enable their practical application. Staff must understand how the LiDAR data and star ratings can support their business objectives. Here we share insights from the project, including how the data and results were communicated to staff, the various platforms where the results are accessible, and the lessons learned in conveying the star ratings to internal teams.

Social media post

Main Roads WA & Anditi are leading the world's largest αiRAP project—using LiDAR, AI & ML to star rate all state roads. Now, we're sharing how we made the data accessible across teams to drive safer, smarter decisions. #Strategic communication #aiRAP #AusRAP.

Background

iRAP Star Ratings provide an objective and proactive way to assess a road's safety performance based on the physical characteristics of the road environment, road user flows, and speeds (iRAP, 2021b). AusRAP star ratings reflect the risk as it relates to an individual road user; vehicle occupant, motorcyclist, pedestrian, or cyclist.

In late 2019, iRAP introduced αiRAP. Main Roads piloted the implementation of αiRAP by using LiDAR and 360° imagery for the autonomous extraction of AusRAP features using 2,000km of the state road. According to iRAP (2021a), "αiRAP aims to utilise existing stores of readily available commercial and open-source data, such as LiDAR, video, and satellite data, along with automated data analytics techniques including machine learning and artificial intelligence to provide 'accelerated and intelligent' road assessment data for Australia and beyond." The implementation of αiRAP has the potential to minimise errors, speed up processes, and simplify the undertaking of reliable, repeatable, and scalable road safety assessments (Anditi, 2024). In 2022, Main Roads expanded its use of αiRAP by launching the Network LiDAR Project with three primary objectives: 1) to collect LiDAR data using mobile laser scanning for approximately 20,000 km of Western Australia's state road network, 2) to procure a web-based portal for accessing and interacting with the resulting 3D point cloud and imagery data, and 3) to employ artificial intelligence and machine learning to extract and categorise AusRAP road features in line with the new αiRAP framework.

Since early 2023, LiDAR 3D point cloud data has been available and accessible to all Main Road staff via a web-based portal. Communication about the access, use and benefits of the LiDAR portal started immediately to a) give users the opportunity to use the freshly collected LiDAR data, b) get early buy-in from different business areas to help shape the direction of further projects and collections, and c) enable demonstration of early wins to ensure continued management support. The AusRAP star rating results for nearly every state road became available from late 2024. The next step for this project is to encourage and educate internal Main Roads staff to utilise the star ratings to support the business goals of Main Roads by continuing to build off the buy-in developed in the promotion of the LiDAR portal. This is crucial as Main Roads have access to rich and current data and tools to facilitate efficient, reliable, and informed decision-making.

Noting that the use of LiDAR technology and the automated feature extraction process is currently the largest αiRAP initiative in the world, there have been many lessons learned. This study outlines the communication strategy adopted to educate Main Roads staff about the available LiDAR data and star rating results. It also discusses lessons learned and the implications for road safety.

Conference Theme – Evolution

This study aligns with the evolution component of the 2025 conference theme. Traditionally, iRAP star ratings were generated by manually coding video and street images according to iRAP specifications. However, in this study, we utilised αiRAP, an accelerated and intelligent approach to road assessment, to automate the coding process. This evolution from a manual to an automated system has the potential to reduce errors, save time, and lessen the effort required for reliable, repeatable, and scalable road safety assessments.

The Communication Process

This section outlines the process implemented by the Main Roads project team to communicate the project and its products internally. Our approach was based on a Formative Evaluation approach where the aim is to gather information whilst the campaign is being developed to continue to modify and improve the campaign based on feedback received (Elliott, 1989). The first two stages of Formative Evaluation are described in this report. Developmental Formative Evaluation involving discussion with champions and interested parties, and Implementation-focused Formative Evaluation involving tracking the number of attendees at training (Elwy, 2020). These stages were applied for both sharing of the LiDAR data and sharing of AusRAP star ratings.

Sharing the LiDAR Data

The LiDAR data and web portal were completed and made available to all internal staff in 2023. The team organised training workshops in all Main Roads regions. The team collaborated with regional managers to schedule training sessions for their staff, focusing on presenting the features of the web-based portal housing the 3D point cloud LiDAR data. These workshops provided an overview of the data available on the web portal and guidance on how to access it. Due to high interest from the regions, as of the end of February 2025, the team had organised approximately 20 training sessions across the organisation.

Sharing AusRAP Star Ratings

AusRAP data and results became available in late 2024. The project team employed various strategies to effectively communicate and share the AusRAP star ratings, opting for a two-phase launch: a "soft launch" and a "formal launch."

Soft Launch

As per the Developmental Formative Evaluation phase, the soft launch aimed to engage specific individuals or groups known as "AusRAP Champions," who would help promote the AusRAP Star Rating initiative throughout Main Roads. The objectives of the soft launch included:

- Gathering feedback on the star ratings and scores, as well as the visual outputs (maps, tables, and charts).
- Determining the appropriate level of detail to present to various individuals and groups within Main Roads.
- Identifying suitable platforms for housing the data and results.

The feedback from the AusRAP Champions was instrumental in refining the communication process and strategy for the AusRAP star ratings before the formal launch.

Formal Launch

The formal launch followed the soft launch after incorporating the feedback received, resulting in an improved communication process for AusRAP star ratings. This launch was strategically timed with the Australia-wide promotion of AusRAP by Austroads. During the formal launch, training sessions were conducted for various staff and groups across all Main Roads in all regions. The focus of the training and workshop was largely on how to utilise the star ratings to enhance their work and decision-making.

Sharing the Results

A key question regarding the AusRAP star ratings was how the results would be communicated among staff at Main Roads. Several methods were initially considered for sharing the star rating results. Ultimately, the results were presented in four different formats.

Spreadsheet Availability

The star rating data and results were made accessible as a spreadsheet through Main Roads' Integrated Road Information System (IRIS). Users can select specific road sections, entire roads, regions, or even the entire state, and download the corresponding star rating data, including both VIDA input data and star rating results for all road users.

Power BI Dashboard

A Power BI dashboard was developed to visualise star ratings. This platform provides a high-level summary but does not allow users to download the data. Additionally, to the internal Power BI dashboard, Main Roads staff are able to access the national AusRAP dashboard platform where the star ratings of state controlled roads across the entire country are provided to the general public.

Spatial Layer in iMaps
The star ratings were incorporated as a spatial layer in Main Roads' spatial platform, 'iMaps'. This platform integrates key digital spatial information and functionality used by Main Roads, enabling users to overlay other layers, such as crash data and road condition data, for effective assessments.

Access via ViDA
Access to the star rating data was granted in ViDA for those interested in using the data on the iRAP online platform. This option allows users with access to conduct detailed assessments and analyses.

Lessons Learnt

Engagement and Interest

Even before the onset of the network LiDAR project, there was significant consultation with various individual and stakeholder groups within the organisation. This led to tremendous interest in the project (Williams, 2023). Understanding that LiDAR provides high-quality data and that star ratings can enhance investment decisions across Main Roads, many individuals and groups became actively engaged from the beginning. Interest came from multiple departments, including Network Management, Heavy Vehicle Services, Project Development, Asset and Geospatial Information, Environmental Services, Occupational Health and Safety, and Fleet Management. This widespread interest resulted in strong corporate support and therefore funding for the project, given the broad range of business areas that would benefit. There have been numerous instances where individuals and groups reached out to the project team to inquire about the project's progress and status.

Lessons from Training

- One major lesson learned from the training was the importance of conducting both a 'soft launch' and a formal launch'. The soft launch training provided valuable feedback that allowed for adjustments to be made before rolling out the full training across the entire organisation.
- Additionally, during the soft launch training period, much of the documentation on the use of AusRAP was not ready. While the feedback from the soft launch led to document revisions, having all documentation prepared prior to the formal launch was highly beneficial.
- Different departments have unique needs regarding the LiDAR and AusRAP star ratings. Understanding these varying needs and structuring the training accordingly was critical. For example, it was necessary to differentiate between training for staff who only needed to know the star ratings of their roads and those who required knowledge on how to use the data to develop a star rating project.

Benefits and Implication for road safety

Effective communication and comprehensive training on utilising data and tools, such as point cloud data and star rating results, are essential for their efficient application. Proper training for staff using point cloud LiDAR data has enabled accurate identification and measurement of road and roadside characteristics and hazards. The use of point cloud data has significantly reduced delays in obtaining roadside data, facilitating timely decisions and interventions aimed at improving safety on the road network.

Star Ratings serve as a crucial foundation for supporting road improvements and treatment decisions. Main Roads can now evaluate the safety impact of various design modifications during road improvement projects, to maximise safety by incorporating design elements that achieve higher star ratings. Additionally, various departments involved in investment decisions are utilising star ratings to prioritise road safety investments and allocating funds to upgrade roads with lower star ratings to enhance overall safety. Finally, the star rating system provides a clear and understandable means of communicating road safety performance to the public, fostering increased transparency and accountability from Main Roads to the public.

References

Anditi (2024): Enhancing Road Safety Through AiRAP and LiDAR. https://www.anditi.com/case-study/mrwa
Elliott, B. (1989). *Effective road safety campaigns: A practical handbook.* Australia: Federal Office of Road Safety.
Elwy, A. R., Wasan, A. D., Gillman, A. G., Johnston, K. L., Dodds, N., McFarland, C., & Greco, C. M. (2020). Using formative evaluation methods to improve clinical implementation efforts: Description and an example. Psychiatry Research, 283(1), 112532. https://doi.org/10.1016/j.psychres.2019.112532
iRAP 2021a. AiRAP. Available at: https://irap.org/project/ai-rap/
iRAP 2021b. iRAP star ratings. Available at: https://irap.org/rap-tools/infrastructure-ratings/star-ratings/

Williams, J. (2023). AusRAP news: Main Roads WA adopts AiRAP road assessment technology - iRAP. IRAP. https://irap.org/2023/04/main-roads-wa-adopts-and-presents-airap-road-assessment-technology/

A model to predict safety benefits of conditionally automated vehicles

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Abstract
A Dynamic Systems model was developed to estimate reductions in fatal and serious injuries (FSI) in Victoria, Australia, to 2050 from the progressive adoption of SAE Levels 3, 4 and 5 Automated Vehicles (AV) into the light vehicle fleet. The introduction of AVs using projected adoption years and take-up curves was used to forecast the light vehicle fleet composition at various levels of automation. The Operational Design Domain (ODD) for each AV level was synthesised from publicly-available data from vehicle manufacturers and predicted individual technology capabilities, to calculate its effectiveness in crash prevention. The model predicted almost 3,800 cumulative serious casualties prevented, with 638 saved annually by 2050. Six additional scenarios tested indicated a wide range of potential savings, demonstrating the importance of early take-up and the optimisation of the road infrastructure. The model established a flexible foundation framework for researchers to build on in future.

Social media post
A new dynamic systems model estimating the benefits of automated light vehicles in preventing road crashes in Victoria predicts that around 640 fatalities and hospitalisations could be avoided annually by 2050, helping achieve Vision Zero.

Introduction
Between 2019 and 2023, an average of 250 people were killed, and 6,570 were seriously injured (Road Safety Partners of Victoria, 2020)) annually on the roads of Victoria, Australia. This demonstrates the significant work remaining to achieve the goal of Vision Zero in the state. A transportation system comprising a large proportion of AVs is hypothesised to significantly reduce road crashes (Litman, 2023). However, limited evidence-based research has quantified the technology-specific road safety benefits of AVs in terms of their crash reduction potential, while considering fleet penetration rates of various automation levels. To address this gap, the overarching goal of this research was to develop a Dynamic Systems model to estimate reductions in FSI through the gradual adoption of SAE Level 3 (Conditional), SAE Level 4 (High), and SAE Level 5 (Full) driving automation in light passenger and commercial vehicles in Victoria.

Conference Theme
Evolution: Automated vehicles are likely to be introduced into the light vehicle fleet in the coming decades. It is imperative to understand their potential safety benefits in order to inform the development of policy, both to maximise the FSI savings and integrate with the other pillars of the Safe System.

Method
A dynamic systems model was built for the period 2018 to 2050 and includes two sub-modules: a fleet propagation module and an FSI reduction module, using the software package *Analytica*. The light vehicle fleet size was projected using annual vehicle growth and attrition rates to estimate the proportion of AVs in the fleet, and by assuming an S-curve (Litman, 2023 and Lavasani et al., 2016) to represent sales projections. An SAE Level 3 (with Highway Drive Pilot (HDP) and Traffic Jam Pilot (TJP)), a projected SAE Level 4 and an SAE Level 5 AV were modelled for introduction in 2026, 2029 and 2040 respectively (BITRE, 2021). SAE Levels 3 and 4 AVs were assumed to reach saturation by 2037 and 2041 respectively, while SAE Level 5 saturation fell beyond the simulation period considered in this research. The effectiveness of each AV type in crash prevention was estimated based on an FSI pool from Victorian police-reported crash data collected for the period 2017-2019 from the Transport Accident Commission (TAC). The ODD for HDP and TJP was synthesised using a composite of publicly available data from vehicle manufacturers. The ODD for SAE Level 5 was assumed to encompass the majority of the road system and currently-occurring crash types. Finally, the SAE Level 4 ODD was constructed as a more constrained subset of SAE Level 5, excluding minor arterials and local roads. The effectiveness of AVs in addressing each crash type was estimated based on the mix of AVs and conventional vehicles in the projected light vehicle fleet and the individual crash configurations. To simplify the analysis while accounting for the majority of the potential benefits, the crash types corresponding to the top 90% of

crashes in the identified FSI pool were considered. Overall effectiveness was calculated to be 74% (95% C.I. 69%-79%), 70% (95% C.I. 66%-74%) and 69% (95% C.I. 65%-73%) for SAE Levels 3, 4 and 5 AVs, respectively.

A Technology Utilisation Factor (TUF) was introduced to represent the proportion of crashes for which the driver had not activated AV technology, representing the propensity for drivers to be initially less accepting of new technologies and therefore not always switch them on. This factor started at 20% technology activation in the year of introduction, rising to 90%, following a Logistic function, for SAE Levels 3 and 4 (Naumann et. al., 2023). For SAE Level 5, the TUF was assumed to be 1 since it was assumed that fully automated vehicles would be isolated from user control. Additionally, a Technology Improvement Factor (TIF) to accommodate progressive developments in the ODD (other than physical infrastructure) was incorporated. For SAE Level 4, the TIF was incorporated to reflect the improvements in the scope of the technology over time, starting from 0.33 in the year of introduction, and rising to 1 in the year of saturation, within the ODD tested. In the case of SAE Levels 3 and 5, the TIF was assumed to be 1, since the technology was assumed to be fully capable at introduction. The FSI projection module then modelled reductions relative to a Baseline FSI Trauma Trend model (Newstead et al., 2021), generating estimates of FSI reductions and residuals with confidence intervals from 2018 to 2050.

To test the model, a base case was devised with a hypothetical combination of AV adoption curves and high-level technology capabilities, addressing the key areas identified for this research. Six additional scenarios were created to explore, separately and in combination, changes in (a) timelines of introduction of AVs and (b) variations in technology capability as represented by the ODD and level of technology activation by users. Together, these scenarios indicate the potential range of possible FSI savings resulting from AV adoption. Table 1 presents details on the values adopted for the adoption timeline and the technology capabilities for each scenario.

Table 1. Key scenarios developed with input parameters adopted

<table>
<tr><td rowspan="5">Take-up rate</td><td></td><td colspan="6">Technology Improvement</td></tr>
<tr><td></td><td>Conservative</td><td colspan="5">Base case</td><td>Aggressive</td></tr>
<tr><td>Conservative</td><td>Scenario #5

Base
+ Scenario #1
+ Scenario #3</td><td colspan="5">Scenario #1
As for Base, except:
Timeline*
L3: Not available
L4: 2035 / 50% / Slow
L5: Not available
TUF: L3 & L4: 0.2 – 0.6</td><td></td></tr>
<tr><td rowspan="3">Base case</td><td rowspan="3">Scenario #3

As for Base, except:

ODD
L4: No B and C roads

TIF
L4: 0.64 – 0.1</td><td></td><td>ODD</td><td>TIF</td><td>Timeline*</td><td>TUF</td><td rowspan="3">Scenario #4

As for Base, except:

ODD
L4: Added Arterial others

TIF
L4: 1</td></tr>
<tr><td>L3</td><td>Freeways and M roads</td><td>1</td><td>2026 / 90% / Moderate</td><td>0.2 - 0.9</td></tr>
<tr><td>L4</td><td>Freeways, M, Arterial Highways, A, B, C roads**</td><td>0.33 - 1</td><td>2029 / 90% / Moderate</td><td>0.2 - 0.9</td></tr>
<tr><td>Aggressive</td><td></td><td colspan="5">Scenario #2
As for Base, except:
Timeline*
L3: 2026 / 99% / Rapid
L4: 2028 / 99% / Rapid
L5: 2034 / 99% / Rapid
TUF: L3 & L4: 0.6 – 0.9</td><td>Scenario #6

Base
+ Scenario #2
+ Scenario #4</td></tr>
<tr><td></td><td></td><td colspan="5"></td><td></td></tr>
</table>

Results

From the current 6,549 FSI in Victoria, the base case scenario estimated that the adoption of AVs in light vehicles would prevent 638 FSI (95% C.I. 581-704) annually by 2050, with a cumulative 3,877 FSI (95% C.I. 3,523-4,283) avoided over the simulation period (2018-2050). By 2050, the most conservative scenario estimated annual FSI savings of 58 (95% C.I. 51-67), while the most aggressive scenario projected 795 FSI (95% C.I. 725-874) annually. Figure 1 shows the combined results of all six scenarios together with the base case results, showing the range of potential annual FSI savings.

Implications for policy

The model provides a nuanced and comprehensive framework with the ability to accommodate new estimates for any of the input parameters and assumptions as new research becomes available. It could be adapted to estimate the FSI savings from the progressive adoption of AVs in any other region worldwide, as well as helping inform Safe System

integration, including road infrastructure to support effective AV operation. Supplementing other projections of future road trauma under broader road safety strategies, the model helps provide a more robust understanding of the likely road safety benefits from AVs. This PhD research program was supported by a Graduate Research Industry Partnership scholarship generously provided by the Transport Accident Commission (TAC), Victoria.

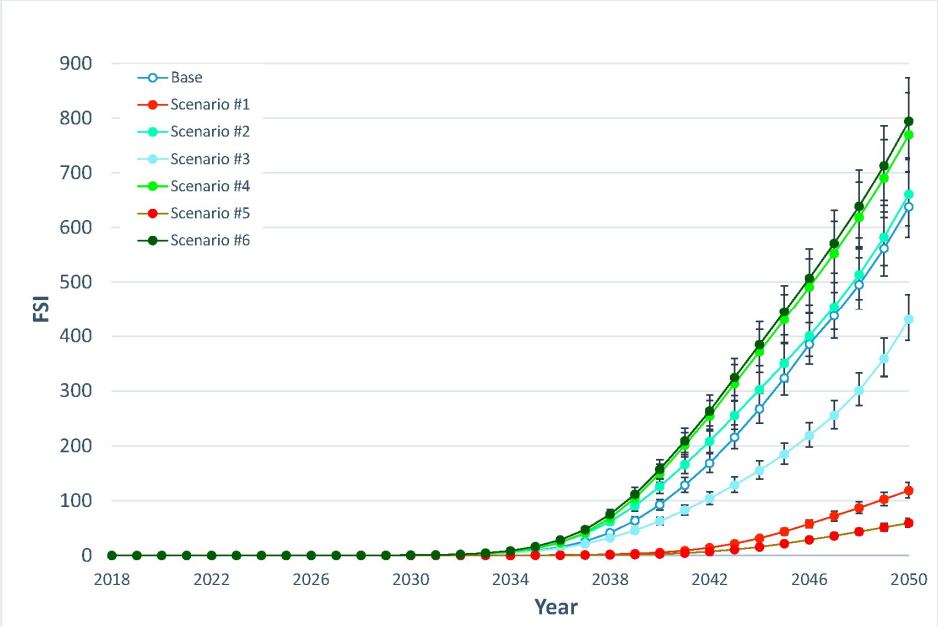


Figure 1. Annual FSI savings up to 2050 for the key scenarios

Conclusions

In line with the principles of 'Vision Zero,' Victoria aims to achieve zero fatalities by 2050. This corresponds to the total elimination of the currently occurring 165 light vehicle fatalities. The FSI savings estimated from the scenarios suggested that light vehicle fatalities in Victoria would reduce from a projected 105 (out of a total of 6,549 FSI) in 2050 to between 92-104 for the scenarios investigated. This shows that the AVs, as a lone driver of change/driver to mitigate crashes, at the assumed level of adoption and technology capabilities, would contribute to achieving a 13% reduction in fatalities in the most ambitious scenario—a modest yet meaningful step toward the ultimate goal of eliminating fatalities on Victorian roads by 2050.

This model incorporates more sophisticated projections of adoption rates and saturation years, based on the best available data, offering a structured framework for projecting AV uptake. It focuses on technology-based effectiveness and examines specific crash configurations to present a unique contribution to the literature by estimating AV effectiveness based on crash configurations tied directly to the ODD assumed for each level of automation. The wide variation of past estimates strongly suggests that adoption timelines will change in future due to market conditions, policy interventions, or technological breakthroughs. This methodological advancement allows for a more refined and accurate evaluation of how AVs can reduce crashes and lead to FSI savings, moving beyond generalised crash reduction metrics to more specific, evidence-based safety outcomes. This research provides compelling evidence of the potential for AVs to reduce fatalities and serious injuries and supports the need for continued investment in AV development and deployment.

References

BITRE 2021, Forecasting uptake of driver assistance technologies in Australia, Canberra, ACT, Available: https://www.bitre.gov.au/publications/2021/forecasting-uptake-driver-assistance-technologies-australia

Lavasani, M., Jin, X., & Du, Y. (2016). Market Penetration Model for Autonomous Vehicles on the Basis of Earlier Technology Adoption Experience. *Transportation Research Record, 2597*(1), 67–74. https://doi.org/10.3141/2597-09

Litman, T. (2023). *Autonomous Vehicle Implementation Predictions Implications for Transport Planning*. Victoria Transport Policy Institute. https://www.vtpi.org/avip.pdf

Naumann, R. B., Kreuger, L. K., Sandt, L., Lich, K. H., Bauchwitz, B., Kumfer, W., & Combs, T. (2023). *Examining the safety benefits of partial vehicle automation technologies in an uncertain future.* AAA Foundation for Traffic

Safety. https://aaafoundation.org/wp-content/uploads/2023/08/AAAFTS-Report-Summary-Safety-Benefits-of-ADAS-.pdf

Newstead, S., Logan, D. B., D'Elia, A. & Rampollard, C. (2020). A national prediction model to support development of the National Road Safety Strategy, AUSTROADS.

Road Safety Partners of Victoria. (2020). *Victorian road safety strategy 2021–2030*. https://www.tac.vic.gov.au/road-safety/victorian-road-safety-strategy/victorian-road-safety-strategy-2021-2030

Fatality risk for side-impact car into car crashes

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Abstract
Vehicle side-impacts are among the most common types of crashes, commonly occurring at intersections. Reducing fatalities/serious injuries includes the management of safer speeds and appropriate speed limits. Wramborg (2005) suggested a speed limit of 50 km/h for intersections or roads where side-impact crashes are likely to occur. This speed limit has been widely adopted despite the lack of supporting data or methods in his study. A systematic review and meta-analysis found that the impact speed for a 10% fatality risk for a side-impact car into car collisions corresponds to 43.7 km/h (95% CI: 34.7 km/h, 52.8 km/h). Given the considerable variation in impact speeds associated with fatality risk and large range of years, a larger dataset is needed to determine a more survivable speed for side-impact crashes. The results could then be considered by policymakers in establishing safer speed limits.

Social media post
Analysis of side impact car to car crashes found that the impact speed associated with a 10% fatality risk for a side-impact car into car collisions corresponds to 43.7 km/h (95% CI: 34.7 km/h, 52.8 km/h). This is slightly below the Safe System Approach's recommended speed limit of 50 km/h for roads where side-impact crashes may occur.

Introduction
Side-impact car crashes are among the most common types of collisions, most commonly occurring at intersections and account for a significant proportion of overall crashes. Injuries in side-impact collisions tend to be more severe due to the limited side-crush space (Farmer et al., 1997). Many vehicles provide little protection beyond the car door, despite some models featuring side airbags. Reducing fatalities and serious injuries by at least 50% has been a global target for 2021–2030. Managing speed and setting appropriate speed limits are critical components of the Safe System Approach, aligning with the goal of reducing road trauma. A study by Wramborg (2005) suggested that on streets where there is a risk for a side impact collision, vehicles should not be allowed to drive faster than 50 km/h, which was taken from a 10% fatality risk curve. This recommendation has been widely adopted as a speed limit, despite the study not providing supporting data or methodological details.

Previous studies examining the relationship between speed and fatality risk have primarily focused on speed limits. However, speed limits alone cannot fully represent the speed at which crash injury outcomes occur. The relationship is sometimes made between travel speed and impact speed. Travel speed often correlates with the speed limit, and impact speed is often defined by travel speed. The severity of injuries sustained by road users in a crash depends on the impact speed, or delta-V, to which they are subjected at the moment of collision. Many previous studies investigating the relationship between impact speed (rather than speed limits) and injury severity have been based on experimental methods, such as human cadaver and sled tests, barrier crash tests, or computer simulations. However, predicting human body tolerance to crashes through these tests remains challenging, and real-world crash data would provide a more accurate result. This study aims to determine the fatality risk associated with impact speed in side-impact car into car crashes using all available real-world crash data.

Hussain et al., (2019) conducted a systematic review and meta-analysis to examine the relationship between pedestrian fatality risk and impact speed in vehicles into pedestrian crashes. Systematic reviews and meta-analyses are considered extensive and comprehensive methods within the evidence hierarchy when assessing the effectiveness of health interventions or other safety-related policies. Given the gaps in previous studies and the effectiveness of these methods in addressing such issues, this study aims to examine the relationship between impact speed and fatality risk in side-impact crashes by collating all relevant real-world crash data.

Conference theme

This research aligns with the conference's theme of Evolution. It reviews the fatality risk of related to impact speed in side-impact crashes over a range of years. However, it was not possible to distinguish whether the advancement in vehicle technology (e.g., side air curtain) and infrastructure (intersection roundabouts) has resulted in higher survivability impact speed for a 10% fatality risk. It also discusses the potential for improved survivability in side-impact crashes, considering such advancements if more reliable and accurate data can be obtained for a more refined historic analysis.

Method

A systematic review and meta-analysis using PRISMA guidelines (Page et al., 2021) was conducted in this study for side-impact car into car crashes. The inclusion criteria for this study included: side-impact crashes between cars which have fatal and non-fatal data and known impact speed, whether vehicle occupants/drivers were wearing seatbelts, and excluding multiple impacts or rollovers crashes. A systematic search was conducted across seven databases (Scopus, Web of Science, PubMed, Embase, IEEE Xplore, CINAHL, and Compendex). Other methods including citation searching and contacting organisations that might have relevant data were also conducted. Records from the databases and other methods were combined, and duplicate records were removed. The remaining records were then assessed by two authors, with a third author adjudicating any disagreements. The screening process included title and abstract screening, full-text review, and data assessment to ensure the data was sufficient to be included in the meta-analysis.

Data from included studies were then analysed using logistic regression models to estimate the fatality curve for individual studies and a random effects logistic regression model was used to synthesise the data across all studies. A 10% fatality risk threshold was chosen because evidence suggests that cumulative injuries and fatalities increase exponentially above this threshold (Wramborg, 2005; Jurewicz et al., 2015).

Results

There were 1886 records screened of which 286 studies were found possibly relevant after title and abstract screening. Of those 286 studies, further screening using full text revealed that 43 studies were directly relevant. However, only four studies had sufficient data that could be used in a meta-analysis (Monk et al., 1997; Foret-Bruno et al., 1980; Dean et al., 2023; RAIDS, 2024) and one study provided a fatality risk curve for side impact car crashes (Sunnevang et al., 2009). From the four studies, two provided sufficient data for analysis, data had to be requested from one of the other study authors which was provided. For the fourth dataset used, the RAIDS organisation was contacted and they provided the data. In the one study where the fatality risk curve was published using data from 1994-2006, the risk of a fatality was 10% at an impact speed of around 41 km/h (Sunnevang et al., 2009). They were a total of 662 data points available from the four datasets (Monk et al., 1997; Foret-Bruno et al., 1980; Dean et al., 2023; RAIDS, 2024) which were analysed using a logistic regression model and the R program. It was found that the impact speed for a 10% fatality risk using the Monk et al., (1977) data from the US which was prior to 1978, occurred at 33.4 km/h. The study by Foret-Bruno et al., (1980) using data from before 1980 estimated 10% fatality risk occurred at 46.1 km/h. The more recent study by Dean et al., (2023) using US data from 2017-2020 estimated a 10% fatality risk occurred at 43.8 km/h, whereas the UK data from RAIDS (RAIDS, 2024) from 2012-2023 estimated a 10% fatality risk occurred at 46.8 km/h. The estimated impact speed for a 10% fatality risk across studies ranges from 33.4 km/h to 46.8 km/h. Moreover, the overall result from a meta-analysis estimates the impact speed for a 10% fatality risk for a side-impact car into car collisions corresponds to 43.7 km/h (95% CI: 34.7 km/h, 52.8 km/h) as in Figure 1.

This result is not significantly different from the value suggested by Wramborg in his study. However, it is important to note that improvements in vehicle safety may have contributed to the slight increase in impact speed for the 10% fatality risk observed in the most recent study using a recent dataset. Nevertheless, the difference between the recent studies by Dean et al., and RAIDS is not substantial when compared to older studies by Monk et al., Foret-Bruno et al., and Sunnevang et al., The dataset used in this study was relatively small and may not fully represent the optimal speed limit for side-impact crashes. Therefore, further research with a larger dataset is needed to enhance the reliability of the results and to determine whether there has been any improvement in survivability resulting from recent safety features, such as vehicle technology and infrastructure (e.g., public datasets from NHTSA or datasets from other countries and organisations).

Benefits to road safety

Understanding the relationship between impact speed and fatality risk for side-impact car-to-car crashes is essential for setting appropriate speed limits, particularly where there is a high risk of side-impact crashes occurring. This information is important for helping regulators achieve the 2030 global road safety target of reducing fatalities by 50%.

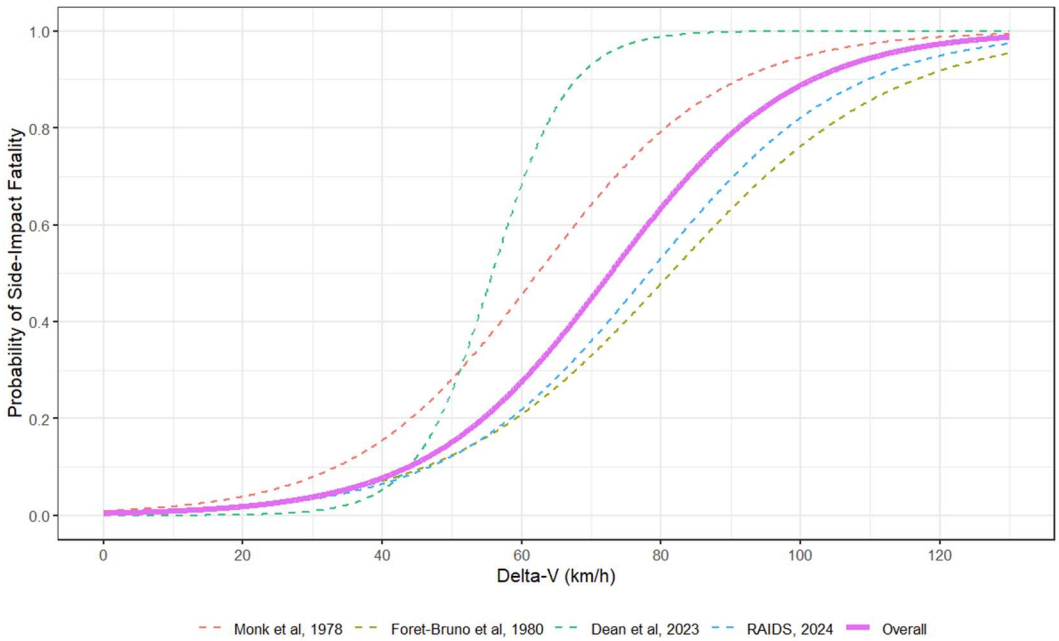


Figure 1. Fatality risk versus delta-V for side-impact passenger vehicle crashes, 10% probability of fatality corresponds to 43.7 km/h (95% CI: 34.7 km/h, 52.8 km/h)

Implications for policy and/or practice

Examining the relationship between fatality risk and impact speed for side-impact car-to-car crashes using all available crash data provides valuable information for road safety stakeholders in setting safer speed limits. The results from this study show that a 10% fatality risk for a side-impact car into car collisions corresponds to 43.7 km/h (95% CI: 34.7 km/h, 52.8 km/h). However, further research is needed to determine a more representative value for fatality risk by impact speed in side-impact car into car crashes, particularly using larger and more recent datasets.

Conclusions

Side-impact crashes account for a significant portion of fatalities and serious injuries. Managing speed and setting safer speed limits are critical for reducing such fatalities and injuries. A previous study by Wramborg in 2005 suggested a speed limit of 50 km/h for roads where there is a possibility of side-impact crashes and has been used widely. This current study found that the impact speed for a 10% fatality risk for a side-impact car into car collisions corresponds to 43.7 km/h (95% CI: 34.7 km/h, 52.8 km/h). Nevertheless, it is essential to conduct more comprehensive research that includes all available datasets, including publicly available data, to establish a more representative relationship between fatality risk and impact speed. This information could then be used by road safety stakeholders when determining survivable speed limits where there is a high risk of side impact crashes occurring.

References

Dean, M. E., Lubbe, N., Fredriksson, R., Sternlund, S., & Gabler, H. C. (2023). Assessing the applicability of impact speed injury risk curves based on US data to defining safe speeds in the US and Sweden. *Accident Analysis & Prevention*, *190*, 107151. https://doi.org/https://doi.org/10.1016/j.aap.2023.107151

Farmer, C. M., Braver, E. R., & Mitter, E. L. (1997). Two-vehicle side impact crashes: The relationship of vehicle and crash characteristics to injury severity. *Accident Analysis & Prevention*, *29*(3), 399-406. https://doi.org/https://doi.org/10.1016/S0001-4575(97)00006-7

Foret-Bruno, F. Hartemann, C. Thomas, C. Tarriere, B. Loyat, G. Stcherbatcheff, C.Got, & Patel, A. (1980). Occupant Velocity Change in Side Impact Method of Calculation - Application to a Sample of Real- World Crashes. Twenty-Fourth Stapp Car Crash Conference,

Hussain, Q., Feng, H., Grzebieta, R., Brijs, T., & Olivier, J. (2019). The relationship between impact speed and the probability of pedestrian fatality during a vehicle-pedestrian crash: A systematic review and meta-analysis. *Accid Anal Prev*, *129*, 241-249. https://doi.org/10.1016/j.aap.2019.05.033

Jurewicz, C., Sobhani, A., Woolley, J., Dutschke, J., & Corben, B. (2015). Proposed vehicle impact speed - severe injury probability relationships for selected crash types. In I. Cameron, N. Haworth, & L. McIntosh (Eds.), *Proceedings of the 2015 Australasian Road Safety Conference (ARSC2015)* (pp. 1-11). Australasian College of Road Safety (ACRS). https://eprints.qut.edu.au/90800/

Monk, M., Burgett, A., & Delarm, L. (1977). Computerized side impact injury analysis [Conference Paper]. *SAE Technical Papers*. https://doi.org/10.4271/770940

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., . . . Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *International Journal of Surgery*, *88*, 105906. https://doi.org/https://doi.org/10.1016/j.ijsu.2021.105906

RAIDS. (2024). *Road accident in-depth studies (RAIDS)*. https://www.gov.uk/government/publications/road-accident-investigation-road-accident-in-depth-studies/road-accident-in-depth-studies-raids

Sunnevang, C., Rosén, E., & Bostrom, O. (2009). Real-life fatal outcome in car-to-car near-side impacts--implications for improved protection considering age and crash severity. *Traffic Inj Prev*, *10*(2), 194-203. https://doi.org/10.1080/15389580802594127

Wramborg, P. (2005, 5-7 October 2005). A New Approach to a Safe and Sustainable Road Structure and Street Design for Urban Areas. Road Safety on Four Continents Warsaw, Poland.

Stopping Sight Distance Assessment Using LiDAR Survey

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Abstract

Stopping sight distance (SSD) is a key design parameter for road geometry and is a measurement of a driver's ability to sight hazards on the road surface and stop prior to reaching the hazard. Current methods to assess available sight distance rely on simplified survey models, or significant assumptions about the surrounding road environment. The increasing use of LiDAR technology for survey purposes presents an opportunity to leverage this data to assess existing SSD deficiencies prior to detailed design work and identify opportunities for improvement before project development begins. This research has demonstrated that analysis of LiDAR data is an effective method of measuring sight distance and removes the majority of false-positive indications other methods are susceptible to.

Social media post

As road authorities build significant inventories of LiDAR data, there is an opportunity to leverage this for benefits to road safety. This project demonstrates how LiDAR data can be used to assess stopping sight distance and identify deficiencies to improve project planning.

Introduction

Stopping sight distance (SSD) is a key design parameter for road geometry and is a measurement of a driver's ability to sight hazards on the road surface and stop prior to reaching the hazard. In general, it should be achieved at all points along the road and represents the minimum visibility that should be provided to road users. Stopping sight distance is generally obstructed by either crest curves (see Figure 1) or roadside features on the inside of horizontal curves (see Figure 2). Research by Turner et al (2010) indicates that a 30% reduction in crash risk can be achieved by improving sight distances on rural roads.

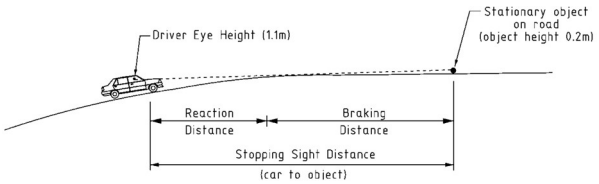


Figure 1. Stopping sight distance measurement on a vertical (crest) curve (Austroads 2021)

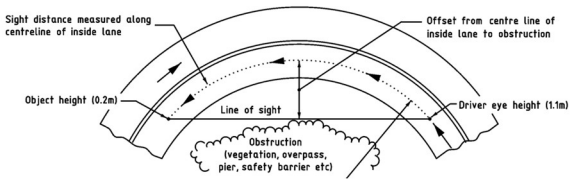


Figure 2. Stopping sight distance measurement on a horizontal curve (Austroads 2021)

Current methods to assess available sight distance rely on simplified survey models, or significant assumptions about the surrounding road environment. These can generally be broken into two categories:

- Vertical Alignment – Quick analysis of straight sections where crests obstruct visibility, does not consider horizontal alignment.
- Design Software – Time consuming, and generally conservative.

These two traditional methodologies face several challenges, such as being overly simplistic, applying only to newly constructed roads, and relying on significant assumptions. This current study utilises advanced technology, like LiDAR, to more accurately assess sight distance, especially in existing road environments.

Conference Theme - Evolution

Traditional methods of sight distance assessment are generally limited to newly constructed roads, or very simplistic models of the roadside environment. Advancements in technology, specifically the use of LiDAR has changed the way road authorities obtain information about their assets, and the integration of LiDAR technology presents opportunities for more accurate and detailed analysis of sight distance deficiencies. This project is an evolution of the existing calculation methods and will allow existing roadside environments to be assessed without significant modelling work.

Approach

This project is building on data gathered for Star Rating Assessments using αiRAP and being developed as a tool to better leverage existing LiDAR data that the Road Authority holds. The pilot study focused on a 45 km stretch of rural single-carriageway selected for its combination of horizontal and vertical alignment features that can restrict sight distance. This section provides a summary of the assessment process.

Benchmark Assessments

Vertical Alignment Method

This analysis uses the position of the observation vehicle to develop a 2D profile model of the road. This can be used to analyse sight distance failures shown in Figure 1. Horizontal alignment (see Figure 2) is not assessed.

Design Software (OpenRoads)

This method requires a Digital Ground Survey to complete the assessment. The terrain surface is modelled, and sight distance is assessed at a consistent offset from the road centreline. This method generally highlights the same sight distance deficiencies as the Vertical Alignment method, but will also include cut batters and other ground surfaces that may impact visibility. This method can then be further extended to include an assumed "vegetation wall" modelled at the bottom of any adjacent table drain, or at a consistent clearing boundary should one exist. The results (particularly around curves) are very conservative, and do not always represent real-world conditions.

LiDAR Assessment

The method for calculating sight distance is well defined in the Austroads Guide to Road Design Part 3 (Austroads 2021), and is the method used by OpenRoads. This process is well suited to design models with smooth surfaces and minimal obstructions, but does not have any methods for filtering "noise" associated with LiDAR data.

1. Calculate the position of observation stations (observer) every 5 m through the analysis area.
2. Based on speed limit and road gradient, calculate the position of a stationary object (target) that should be visible from each observation point.
3. Draw a sight line between these points, and determine whether there is any intersecting surface that would prevent visibility of the target. Repeat this step for each observer point.
    a. If the target is visible, report the location as a "PASS".
    b. If the target is not visible, move the observer slightly (0.5 m forward/back/sideways) and check visibility. If any of these locations achieve visibility to the target, report the location as a "PASS"
4. If both steps 3 (a) and (b) result in a failure, the road is not meeting the desirable standards specified by the road authority. The stopping distance is relaxed to the theoretical maximum braking action as described in Austroads (2021).
    a. Incrementally move the target closer to the observer, until the target can be seen. Report "Pass - Absolute"
    b. If the object cannot be seen at the relaxed distance, assess other object heights in accordance with Table 1. These are recorded as "EDD (Extended Design Domain) Category #".
5. Repeat steps 2-4 for each observer point.

Table 1. Stopping sight distance assessment matrix ("dry" region as defined in Austroads (2021), on flat ground)

	Object Height	Result
Sight Distance > 209 m	0.2 m – Stationary Object on Road	Pass – Desirable Min
139 m < Sight Distance < 209 m	0.2 m – Stationary Object on Road	Pass – Absolute Min
	0.4 m – Dead Animal	EDD Category 1
	0.8 m – Car Tail Light	EDD Category 2
	1.25 m – Top of Car	EDD Category 3
Sight Distance < 139 m	1.25 m – Top of Car	Fail

EDD (Extended Design Domain) – Meets some of the required standards, and could be justified in limited circumstances.

Results

45 km Pilot Section

The LiDAR analysis showed that 75.2% of the network met the desirable criteria set by the Road Authority, and that 95.4% met the absolute minimum criteria (see Table 2). Figures 3 and 4 show the same section of road, including an enlargement that shows the intersecting object restricting sight distance on the inside of the curve. Each individual line

represents the visibility between an observer (from the bottom of the image) to a target object (top of the image). Figure 5 shows the achieved sight distance associated with each individual sight line in Figures 3 and 4, along with the required sight distances associated with the categories “Pass – Desirable Min” and “Pass – Absolute Min”.

The LiDAR assessment is able to clearly sight over the right bend shown in Figures 4, and is obstructed slightly in the left bend by a tall tree. The OpenRoads assessment in Figure 3 introduces a large vegetation wall on the left bend, which significantly restricts the sight distance achieved. In this case, manual assessment of this individual location would be required by an experienced road designer to assess the vegetation, and determine whether there is a sight visibility issue at this location. With the LiDAR model, this section no longer requires detailed assessment, and other (worse) sections can be prioritised when completing the assessment.

Table 2. Proportion of Pilot Section Achieving Visibility

		OpenRoads		
	2D Assessment	No Vegetation	Assumed Vegetation	LiDAR
Pass – Desirable	92.4%	86.7%	77.1%	75.2%
Pass – Absolute	5.9%	10.6%	14.4%	20.2%
Subtotal - Pass	98.3%	97.3%	91.5%	95.4%
EDD Category 1	1.3%	1.8%	2.7%	2.7%
EDD Category 2	0.3%	0.5%	1.0%	1.1%
EDD Category 3	0.1%	0.3%	0.5%	0.2%
Fail	0.0%	0.1%	4.3%	0.6%

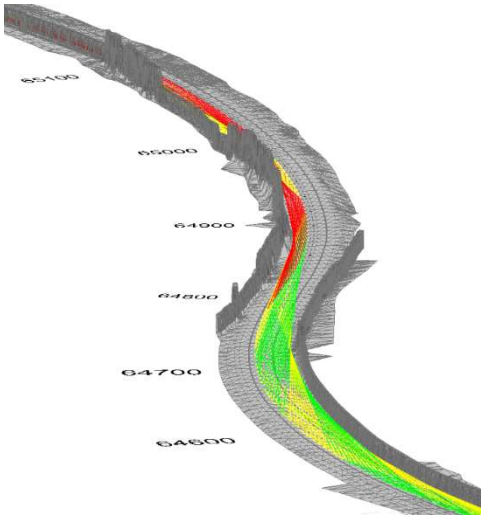


Figure 3. OpenRoads Assessment (Vegetation Model)

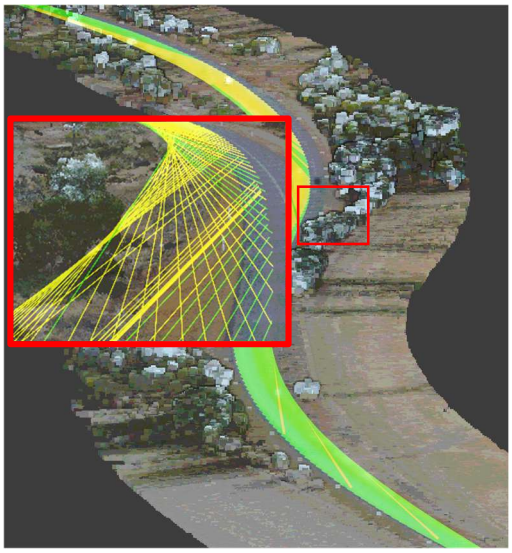


Figure 4. LiDAR Assessment

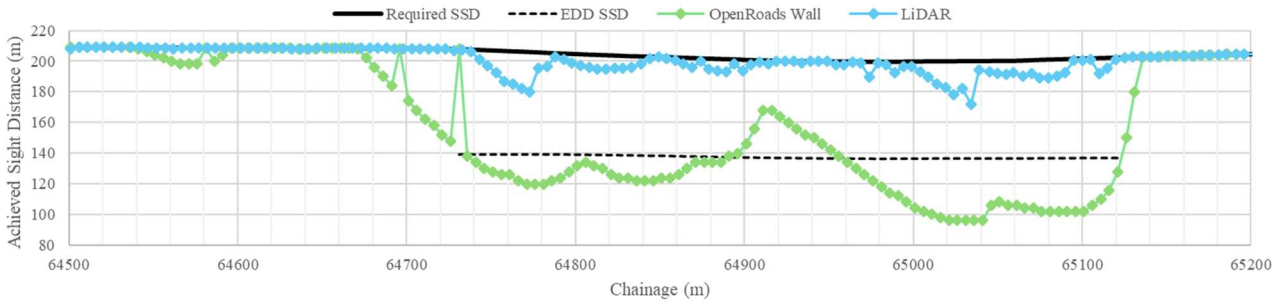


Figure 5. Achieved stopping sight distance around reverse curves displayed in Figures 3 and 4

Implications for Policy and/or Practice

The use of LiDAR data for sight distance assessment presents opportunities for road authorities to analyse their network, and identify deficiencies when scoping new projects. The LiDAR sight distance assessment can be completed using raw LiDAR data, eliminating the major cost when analysing using other modelling software. In addition, manual assessment of individual location by an experienced road designer can be reduced to true failures, eliminating the majority of false positives inherent with the existing design software methods.

The next stage of this project is to analyse approximately 2000 km of the Road Authority's network where shoulder sealing and widening is proposed as part of the Road Authority's Regional Road Safety Program. Most of these projects are completed with minimal design work, and the use of LiDAR presents opportunities to improve or resolve latent issues with the road geometry and environment. This includes identifying locations where minor works (such as pruning, signage relocation) may provide a significant improvement to road safety, and where additional shoulder width could be included in the project scope to support the adoption of Extended Design Domain object heights (by adopting shoulder widths that comply with Manoeuvrer Sight Distance (Austroads, 2021)). This will allow these future projects to develop better scopes of works, to deliver targeted sight distance improvements to the worst sections of road.

Conclusion

The pilot project for assessing stopping sight distance using LiDAR data has proven the methodology is suitable, and significantly improved accuracy compared to existing models. An extension of this project is currently underway to assist in the development of future projects as part of the Road Authority's shoulder widening program.

References

Austroads (2021). Guide to Road Design Part 3 – Geometric Design. AGRD03-16. https://austroads.gov.au/publications/road-design/agrd03/media/AGRD03-16_Guide_to_Road_Design_Part_3_Geometric_Design_Ed3.4.pdf

Turner, B., Imberger, K., Roper, P., Pyta, V. and McLean, J. (2010). Road Safety Engineering Risk Assessment Part 6: Crash Reduction Factors. Austroads AP-T151/10. https://austroads.gov.au/publications/road-design/ap-t151-10/media/AP-T151-10.pdf

Harnessing integrated technology to reduce road traffic fatalities and injuries

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Abstract

Road safety remains a global challenge, especially in low- and middle-income countries where limited resources combine with high traffic volumes and complex road user behaviours to produce a heavy burden of fatalities (WHO, 2018). ARRB Systems has pioneered integrated technology solutions—namely the H2000 NSV, iPAVe, and iSAVe to conduct comprehensive road condition surveys and enable data-driven road safety assessments through the internationally recognised iRAP methodology. Field implementations across provinces in South Africa and in a developing state such as Mississippi in USA have produced actionable insights that have transformed road maintenance from a reactive to a proactive discipline. These projects have not only improved star ratings and reduced fatalities but also fostered capacity building, informed public awareness campaigns, and influenced policy formulation. This paper details the technology, methodologies, project implementations, results, and policy implications that highlight the role of integrated technology in saving lives on roads globally.

Social media post

Integrated road assessment technology from ARRB Systems (H2000 NSV, iPAVe, iSAVe) is revolutionising road safety worldwide. From South Africa to the USA, proactive surveys using iRAP data drive targeted interventions, improve star ratings, and reduce traffic fatalities, transforming road maintenance practices and influencing policy at multiple levels.

Introduction and Background

Road traffic accidents claim over 1.2 million lives annually worldwide, with developing regions disproportionately affected due to limited infrastructure investment, inadequate maintenance, and behavioural factors (WHO, 2018). Traditional road management practices often react to failures only after accidents occur. In response, integrated data-driven approaches have emerged that combine high-resolution pavement assessment with advanced safety evaluation methodologies. ARRB Systems' suite of solutions—including the H2000 NSV, iPAVe, and iSAVe—collects comprehensive pavement, structural, and friction data at highway speeds, enabling the application of the International Road Assessment Programme (iRAP) methodology to objectively assess and manage road safety (ARRB, 2023).

The iRAP methodology (iRAP,2021) uses star ratings, fatality and serious injury estimations, and Safer Roads Investment Plans to provide an evidence-based framework for road improvement. In low- and middle-income countries, where road fatalities are high and resources are limited, the integration of proactive assessments and maintenance prioritisation is essential for achieving "Vision Zero" goals and fostering sustainable development.

Conference Theme Alignment: Equity, Elasticity, Evolution

Equity: Improved safety on high-risk roads, often in underserved areas.
Elasticity: Scalable methodologies suitable for varying terrains and funding contexts.
Evolution: Transition from reactive maintenance to proactive safety prioritisation.

Road Safety Projects undertaken in various developing and developed nations

Since 2019 projects have been conducted for the KZN Department of Transport in South Africa. Here an entire paved network equating to approximately 8600 kilometres have been collected by integrated equipment called the Intelligent Pavement Assessment Vehicle (iPAVe). This system collects structural and surface condition data including deflection, georeferenced images, profiles, texture (MPD, SMTD), rutting, ground penetrating radar (GPR) and cracking which informed detailed safety assessments through the iRAP framework. This type of work has expanded to the Province of Limpopo in South Africa. This is a privately funded project by Anglo American through their Corporate Social Responsibility initiative and managed by The Impact Catalyst, the Limpopo project utilised the H2000 Network Survey Vehicle to survey 1,000 km of roads. The data, quality assured by iRAP protocols, was disseminated among stakeholders national and provincial road agencies, engineering firms, and research institutes to inform the Limpopo Road Safety Programme (LRSP) (Venter et al., 2023). As experience was gained a pilot project was undertaken by the

Mississippi Department of Transportation showcasing the Continuous Friction Sideway Force Coefficient device, the iSAVe system, a Safety Assessment Vehicle designed to measure pavement friction and geometry to supplement traditional safety assessments. The pilot project is intended to serve as a blueprint for other states to implement enhanced, friction-based safety assessments. The outcomes of these projects were as follows:

KwaZulu Natal, South Africa

- Undertaking network wide safety assessments has helped the road authority understand their network which helped improve accident data statistics and a measurable reduction in fatalities.
- A shift in road management culture from condition-based maintenance to proactive safety-oriented practices.
- Policy influence: Adoption of national Road Safety Policies (Practice Note and DoRA Bill) mandating continuous assessments to secure grant funding.

Limpopo, South Africa

- Expected prevention of a significant number of accidents and lives saved, with quantitative estimates currently under evaluation.
- Extension of the project due to demonstrable success and plans to replicate assessments in other high-risk areas.
- Strengthened local capacity for continuous road safety monitoring and policy implementation.

Mississippi, USA

- Improved identification of hazardous road segments leading to targeted countermeasures.
- Integration of friction data has increased the accuracy and reliability of safety assessments.
- Potential to catalyse a nationwide safety assessment campaign that can significantly reduce road fatalities.

Results and Evaluation

Proactive, technology-driven assessments have led to measurable safety improvements, including reduced fatalities and upgraded road star ratings in KZN and Limpopo. Capacity-building initiatives have strengthened local expertise in iRAP methods, supporting long-term sustainability. In Mississippi, friction data added critical insights, helping detect high-risk areas that traditional methods may miss.

Early results from KZN and Limpopo indicate a clear reduction in crash severity and fatalities, reinforcing the value of proactive safety assessments. These outcomes have influenced national policy, making continuous assessments a funding requirement in South Africa. The technology's adaptability across diverse environments from urban roads to rural networks proves its scalability and global relevance.

Benefits to Road Safety

Continuous, data-driven assessments improve infrastructure quality, enable timely maintenance, and reduce accidents. By addressing human factors and high-risk areas, road user safety is significantly enhanced. These approaches also ensure cost-effective resource use and long-term savings. The technology's adaptability delivers safety benefits across cultures and regions, while local training initiatives build lasting capacity and promote nationwide adoption of proactive road safety strategies.

Implications for Policy and Practice

Policies now mandate continuous road safety assessments, shifting the focus from purely condition-based to safety-led maintenance. This proactive approach helps prevent crashes and save lives. Pilot projects, like Mississippi's, offer scalable models for broader adoption, while international collaboration through shared methodologies like iRAP promotes global best practices—especially valuable for improving safety in low- and middle-income regions.

Conclusion

Integrated technology has transformed road safety by enabling proactive, data-driven interventions. ARRB Systems' solutions—H2000 NSV, iPAVe, and iSAVe—combined with iRAP assessments, offer vital insights for improving road conditions and saving lives. Successes in KZN, Limpopo, and Mississippi demonstrate a shift toward safety-first road management. These tools not only enhance infrastructure and policy but also support sustainable development and capacity building across diverse regions.

References

ARRB Systems. (2023). *iPAVe – Intelligent Pavement Assessment Vehicle*. https://arrbsystems.com/service/ipave/

iRAP, (2021), iRAP Methodology and factsheet, https://irap.org/methodology/

Venter, K, JAMES J, AHMED F, GREYLING N, MAVUSO S, MALAN C, ROMIJN M, HARDING C and BAKER R. (2023), Implementation of the Safe System Approach in South Africa: Overview of the Limpopo Road Safety Programme. UPSpace Repository, https://repository.up.ac.za/bitstream/handle/2263/92517/2C_01.pdf?sequence=1&isAllowed=y

World Health Organization. (2018). *Global status report on road safety 2018*. Geneva: WHO. https://www.who.int/publications/i/item/9789241565684

RoadWise Recognised: Inspiring Better Road Safety Practice

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Abstract

RoadWise Recognised is a fresh approach from the Western Australian Local Government Association (WALGA) to work with Western Australian (WA) Local Governments, through its RoadWise Program, to bridge the gap between recognised best practice road safety theory and practical implementation. The RoadWise Recognised initiative is based on a combination of successful reward and accreditation programs. It aims to guide and motivate Local Governments towards the application of safe system principles and theory across all areas where Local Government can influence road safety. Initial Local Government engagement with RoadWise Recognised suggests that a shift in thinking from the conventional behaviour change approach to a holistic systems approach is possible. It is hoped that an independent evaluation will demonstrate that the practical application of the safe system approach to road safety as initially intended is viable for Local Governments.

Social media post

RoadWise Recognised: A fresh approach supporting Local Governments towards better practice road safety.

Background

In WA Local Governments are responsible for the management and maintenance of 87% of the road network where 56% of deaths and serious injuries occur. Without the involvement of Local Governments, it will be very difficult to meet road safety objectives and achieve National and State targets (Road Safety Strategies, n.d.).
Local Government managed roads encounter a wide range of environments and mix of road users making managing road safety challenging. Road safety is one of many competing priorities for Local Governments, with solutions often following the conventional approach which focuses on driver education activities. Opportunities for improving road safety outcomes through road management, planning and fleet management have not always been approached in a systematic or consistent manner.

While the safe system approach to road safety is globally agreed as best practice and has been adopted in WA, there remains a gap between the safe system theory and principles and tangible actions (Green et al., 2024). WALGA's road safety team has developed the RoadWise Framework to help bridge that gap and encourage road safety effort across the different functional areas of Local Government. The RoadWise Framework (the Framework) is aligned to systems thinking and tailored to the Local Government context.

RoadWise Recognised was launched in 2023 and uses the Framework as a means of motivating and guiding action.

Conference theme

Evolution: Both WA Local Governments and WALGA are evolving to work together to explore and implement safe systems thinking and practice in the Local Government sector.

RoadWise Recognised is unlike any other accreditation or recognition scheme as it aims to reward the evolution towards full implementation of safe system principles. This evolution relies on Local Governments engaging with and embracing an evolved RoadWise program.

WALGA's road safety team traditionally operated under a program delivery model which involved working with Local Governments and their communities to deliver road safety programs and events. RoadWise Recognised is part of the transition to a service delivery model where WALGA's road safety team offer direct support to RoadWise Councils (NB this is the subject of a separate extended abstract), Local Governments who have made a commitment to transition to embed safe system principles and theory into all aspects of their business.

Approach

RoadWise Recognised is based on a combination of successful accreditation and reward programs and uses the allocation of Points and Ribbons to guide, encourage and monitor progress towards evidence based better road safety practice.

Local Governments who participate in RoadWise Recognised are assigned a Road Safety Advisor who provides direct support. Through regular contact, current work in road safety is identified and recorded, and future plans are discussed. The recorded activities, which include projects, interventions, policy and process works, are then submitted for analysis and the allocated of Points and Ribbons.

Points

Points are used for benchmarking purposes and subsequent monitoring of progress. Points allocation follows a complex, specially designed matrix to reflect the expected level of road safety impact, the scale or reach of the intervention, the longevity of the expected road safety benefits and the level of ease of implementation. A panel, including representatives from the Local Government sector, road safety practitioners and researchers oversee the allocation to ensure a consistent and fair process.

Ribbons

Ribbons are the public face of the program and indicate how comprehensive the approach to road safety is across Council business and governance. A Ribbon status, up to a maximum five Ribbons, is updated annually. Ribbons are achieved when each of the four Local Government functional areas and Council (governance) body, as described in the Framework, record activity that will positively impact road safety.

Recognition process

RoadWise Recognised uses public recognition of effort to motivate Local Government in adopting and embedding the safe system approach to road safety across business. The internal monitoring of the accumulations of activities and Points provides a medium to easily monitor their progress towards better practice road safety.

Public recognition is provided continually through the year via the RoadWise website, the *RoadWise Update* (digital newsletter) and other WALGA media platforms. In addition, annual recognition is provided during a WALGA Awards night in the presentation of RoadWise Awards. The rhythm of recognition and the supporting process is as follows:

Quarterly

Recognition of ongoing activities, innovations and implemented work is provided publicly and internally through the following cycle:

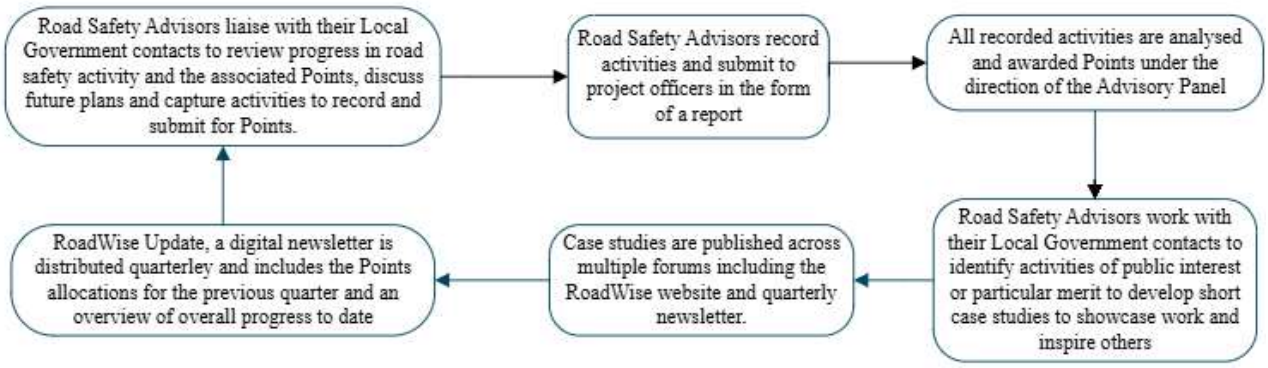


Figure 1. Quarterly process for RoadWise Recognised.

Annually

RoadWise Awards are presented at the WALGA Local Government Awards Night . All participating Local Governments are acknowledged with the announcement of updated Ribbon Statuses. In addition, special mention is made of the ten Local Governments who have shown the greatest progress in their region and the one who has made the greatest progress in the State.

Sponsorship is currently being sought to allow award recipients to receive a tangible reward in addition to the public recognition and glass plaque.

Results

Engagement with the RoadWise Recognised initiative has been sporadic. While most participating Local Governments have interacted regularly with their assigned Road Safety Advisor, a regular turnover of staff and prolonged staff vacancies presented issues with regular and consistent recording of activity. However, even with gaps in the data we have seen promising results in a short period of time.

Points allocated to an activity represent a general indication of the value or contribution to road safety of that activity relative to other activities, therefore an increase in Points over time is desired. Movement towards better practice road safety will be indicated by an increase in Points combined with a plateauing or decrease in numbers of activities. Using a Points per activities ratio as a performance indicator allows demonstration of focusing effort in areas expected to give the best results. The graph below shows early indicators that collectively participating Local Governments are heading in a safe-system-aligned direction, recording both an increase in Points and Points per Activity Ratio.



Figure 2. Progress indicators, combined Points and Points per activity ratio

Evaluation and effectiveness

Process evaluation

An internal process evaluation of RoadWise Recognised identified the following insights:

- Consistency in the recording of activities is critical to ensure effective benchmarking and equity when providing ad hoc recognition and annual awards.
- Despite staff turnover and extended vacancies, RoadWise Recognised has been well received and embraced by the participating Local Governments who are engaged and keen to work towards better practice.

Outcome evaluation

Planning is underway to design and implement evaluation to understand Local Government's experiences of the fresh approach, and to ascertain whether RoadWise Recognised is achieving the goal of encouraging Local Governments towards the practical implementation of safe system theory.

Benefits to road safety

If successful, RoadWise Recognised will demonstrate that an evolution to a holistic systems approach to road safety is possible, which in turn will provide the benefits to road safety expected from the implementation of the safe system approach.

Implications for policy and/or practice

The features of the RoadWise Recognised initiative are easily transferable and could be implemented in other jurisdictions.

Conclusions

Implementation of this initiative has demonstrated that a shift in thinking and practice is possible and highlighted that with adequate support, Local Governments can support the evolution to the practical implementation of the safety system approach to road safety.

References

Green, M., Muir, C., & Oxley, J. (2024) What is the purpose? Practitioners' perspectives of Safe System approach to road safety in Australia. *IATSS Research, 48*(1), 84-99. https://doi.org/10.1016/j.iatssr.2024.01.004

Road Safety Strategies. (n.d.). Retrieved from https://www.roadwise.asn.au/about-roadwise/road-safety-strategies.aspx#:~:text=Local%20Governments%20are%20responsible%20for,or%20serious%20injury%20crashes%20occur.

Police perceptions after two different types of Random Breath Tests

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Abstract

Police-public interactions that incorporate the elements of procedural justice result in changes in driver perceptions and behaviour. However, we need to understand how police officers perceive these interactions so we can identify the facilitators and challenges to implementation. This study surveyed police officers participating in a six-month randomised field trial with a standard and a procedurally just random breath test condition. If a police officer had post high school qualifications, less than five or more than 10 years of service, was a general duties officer and were open to innovation, they were more likely to report that it was important to treat the publicly fairly and with respect. Given this, police agencies should include general duties officers in policing operations where possible, support officers to further their qualifications and encourage people to be open to innovation in order to support higher quality interactions between police officer and road users.

Social media post

Ever wondered how police view random breath testing? Our findings suggest that officers with certain traits – like post-high school qualifications and openness to innovation – are more likely to prioritise fair and respectful interactions.

Introduction

When procedural justice, where the elements of respect (or dignity), trustworthiness, neutrality and voice, are incorporated into interactions with drivers there are positive impacts on subsequent behaviour (Mazerolle et al., 2012; Bates et al., 2023). However, there is limited research regarding police perceptions of interactions between police officers and road users (see Bates et al., 2015 for an exception). Gaining an understanding of how police officers perceive these interactions is essential to inform our understanding of the practical facilitators and challenges of effectively implementing the use of the procedural justice framework within the field. This study identified if police officers administering a random breath test (RBT) in either the standard or procedurally just manner, their level of education, years of policing experience and openness to innovation affected the officers' perceptions of how they should treat drivers and riders.

Conference theme

A key focus of this study was equity by identifying and enhancing the inherent value of road users to ensure they are all treated fairly and with dignity.

Method

This study was a six-month randomised control trial with two conditions: a standard (n = 18) and a procedurally just (n = 18) RBT police operations. The trial involved officers administering the RBTs to drivers and motorcycle riders at a high-crash location in Brisbane, Australia. In the first condition, the RBT was administered as per normal. In the second condition, police officers incorporated the principles of procedural justice into their interaction with drivers and riders.

Participants in this study were police officers from a police district in Queensland, Australia, whose primary responsibilities included traffic or general duties. Participating officers were encouraged to complete an online learning package on procedural justice, containing information summarising key aspects of this approach prior to participating in their first RBT operation within the project. At the commencement of each operation, a senior police officer attended on-site and provided each police crew with a detailed verbal briefing of the requirements for each condition. Each deployment lasted on average between 1.5 and 2 hours. An experienced researcher from Griffith University attended each briefing and addressed any research questions raised by officers.

Police officers completed post-operation surveys (n = 80; standard RBT n = 33, procedurally just RBT n= 47). If they completed more than one operation and survey (total n = 120), only the first survey was included for analysis in this study to eliminate confounding effects between conditions. Within the survey, police officers provided information regarding their age, education level, years as a police officer and whether their primary role was in traffic or general duties. They also answered four questions (e.g., We (the police) should treat everyone with the same level of respect regardless of how they behave) which were combined to create a scale measuring perceptions of whether officers should treat the publicly fairly and with respect. This variable was called Perceptions of Police Treatment of the Public. Two items (e.g., Innovations in policing are an appropriate use of organisational resources) were combined to create a scale measuring called Openness to Innovation. Scale items were answered on a five point scale (1) strongly disagree to (5) strongly agree.

Results

As shown in Table 1, there were no differences between the standard and experimental groups on age, education level, years as a police officer of their primary duty.

Table 1. Demographics of the sample in both conditions (N = 80)

	Standard RBT	Experimental RBT	Total and chi-square
Age			X2 (3) = 5.9, p = 0.1 > 0.05
35 years and under	8 (24%)	16 (34%)	24 (30%)
36 – 45 years	4 (12%)	13 (28%)	17 (21%)
46 – 50 years	13 (40%)	9 (19%)	22 (28%)
51 years and above	8 (24%)	9 (19%)	17 (21%)
Education level			X2 (2) = 1.0, p = 0.6 > 0.05
University degree	15 (45%)	20 (43%)	35 (44%)
Other qualification[1]	12 (36%)	14 (30%)	26 (33%)
High school or less	6 (18%)	13 (28%)	19 (24%)
Years as police			X2 (3) = 4.3, p = 0.3 > 0.05
5 years or less	8 (24%)	13 (28%)	21 (26%)
6 – 10 years	3 (9%)	8 (17%)	11 (14%)
11 – 15 years	3 (9%)	9 (19%)	12 (15%)
16 years or more	19 (58%)	17 (36%)	36 (45%).
Primary role			X(1) = 2.1, p = 0.1 > 0.05
General duties	12 (36%)	26 (55%)	38 (48%)
Tactical Crime Squad	0 (0%)	0 (0%)	0 (0%)
Traffic duties	21 (64%)	21 (45%)	42 (53%)

[1] Other qualifications include Trade or Technical qualifications.

As shown in Figure 1, there was an effect of education level on police treatment, dependent on the experimental condition (F=5.3, p=0.02). Highest responses were given from police officers who only completed part or all of high school, under the standard RBT condition. Police officers with tertiary qualifications scored higher in the experimental condition than the standard, and those without university qualifications higher in the standard interaction.

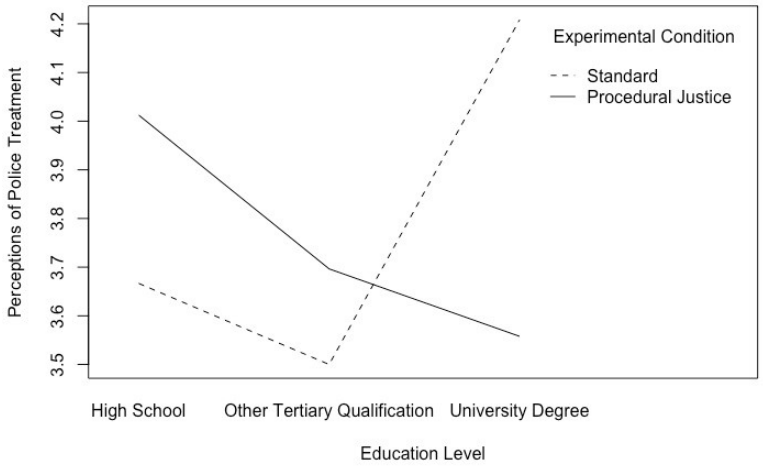


Figure 1. Education and Intervention Type on Perceptions of Police Treatment of the Public

There was no significant interaction between years as a police officer and experimental condition on perceptions of whether officers should treat the publicly fairly and with respect found in two-way ANOVA testing. However, years as a police officer had an effect (F = 4.2, p = 0.04), with significantly lower responses given by police officers with 6 – 10 years of experience than other groups. Further research is needed to identify why this group provided lower responses. There was no interaction effect present when considering the main role of the police officer and perceptions of whether officers should treat the publicly fairly and with respect. However, there was a significant direct effect (F = 7.3, p = 0.009) with police officers whose main role was general duties having higher perceptions (mean = 4.0, sd = 0.7) than those whose primary role was traffic duties (mean = 3.6, sd = 0.5).

There was no significant interaction between openness to innovation and experimental condition on perceptions of whether officers should treat the publicly fairly and with respect. However, a linear regression analysis identified that there was a very significant direct effect (F=11.79, p=0.001) with perceptions of whether officers should treat the publicly fairly and with respect responses increasing as openness to innovation increased. As shown in Figure 3, openness to innovation was shown to be similarly significant (parameter 0.35, p=0.002), meaning that for every 1.0 increase in openness to innovation score, responses on police treatment increased by 0.35 points.

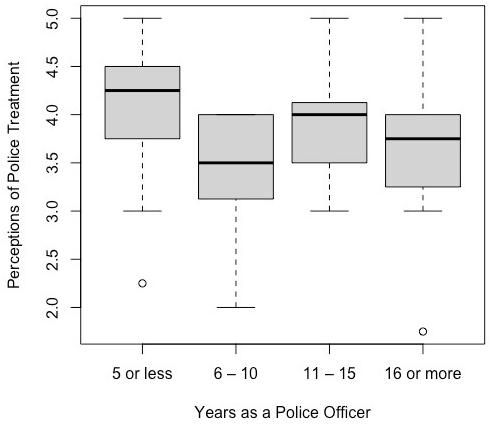


Figure 2. Years of Policing Experience and Perceptions of Police Treatment of the Public

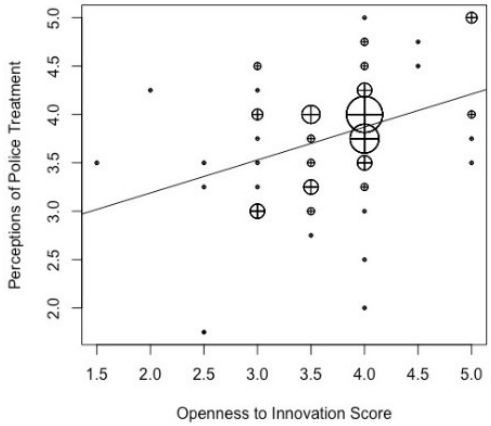


Figure 3. Openness to Innovation and Perceptions of Police Treatment of the Public

Benefits to road safety

RBT interactions are a frequent interaction between drivers and riders and police officers. They have an important role in reducing crashes and injuries on the road. However, despite the increasing use of procedural justice in roadside policing interactions, there is limited research regarding the views of police participants in this process. This study has used a randomised field experiment to consider perceptions of whether officers should treat the publicly fairly and with respect after two different types of RBT interactions: standard and procedurally just. The findings of this research suggests that tertiary or further education and training, years of service (5 or less or more than 10), being a general duties officer and being open to innovation are associated with police perceptions regarding treatment of the public. Thus, police officers with these characteristics are more likely to indicate that they should be fair to people, take time to explain their decisions, allow the public to voice their opinions and treat people with respect. Undertaking RBT interactions within these frameworks is likely to result in more positive perceptions of the police by the public.

Implications for policy and/or practice

This study provides further support for the value of including general duties police officers in RBT interactions. This is because those whose main role was general duties had higher perceptions of whether officers should treat the publicly fairly and with respect. Additionally, given that individuals with tertiary qualifications or further training post high school and those who are open to innovation have stronger perceptions regarding police treatment of the public, there is value in supporting police officers to undertake further tertiary training. As well as tertiary qualifications, openness to innovation, should also be considered within the recruitment process. By doing so, the officers undertaking the RBT interactions will have stronger perceptions regarding treating members of the public with fairness and respect.

Conclusions

This study involved surveying police officers who participated in a randomised controlled field trial regarding their perceptions of whether officers should treat the publicly fairly and with respect in both a control and procedurally just

RBT. While there was no direct effect of the experimental condition those whose main role was general duties, were open to innovation or had post high school qualifications had higher perceptions of whether officers should treat the publicly fairly and with respect. By doing so, this study has identified the practical facilitators and challenges to effectively implement the use of procedural justice in roadside interactions.

References

Bates, L., Antrobus, E., Bennett, S., & Martin, P. (2015). Comparing police and public perceptions of a routine traffic encounter. *Police Quarterly*, *18*(4), 442–468. https://doi.org/10.1177/1098611115589290

Bates, L., Bennett, S., Irvine, C., Antrobus, E., & Gilmour, J. (2023). A procedurally just flyer reduces subsequent speeding offences: Evidence from the Queensland Speeding Engagement Trial (QSET). *Journal of Experimental Criminology*. https://doi.org/10.1007/s11292-023-09582-w

Mazerolle, L., Bennett, S., Antrobus, E., & Eggins, E. (2012). Procedural justice, routine encounters and citizen perceptions of police: main findings from the Queensland Community Engagement Trial (QCET). Journal of Experimental Criminology, 8(4), 343-367. https://doi.org/10.1007/s11292-012-9160-1

How we raised a skewed signalised intersection

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Abstract
Replacing a roundabout with traffic signals at a skewed cross-intersection has certain challenges. These challenges are heightened when the design evolves to be a raised signalised intersection. This is a case study of a such intersection in New Zealand. The presentation will detail some of the key challenges from a traffic signals design and civil engineering perspective that road safety practitioners should consider when designing similar intersections.

Introduction
Signalisation of intersections for greater capacity and efficiency is not news. In urban growth areas existing intersections will eventually require upgrades if the existing form of the intersection develops a safety problem due to growth in traffic volume associated with adjacent land use changes. However, replacing a roundabout with a signalised intersection is a conundrum for a safety engineer as it is misaligned with the safe system philosophy. Safe system requires intersections to be designed to ensure vehicle speeds are reduced to survivable levels, which an urban roundabout achieves. Therefore, it is only sensible that a replacement intersection is raised to ensure slower vehicle speeds decreasing the chances of fatal and serious injuries in side impact crashes and also in crashes involving vulnerable road users.

Project Description
The signalisation of the subject roundabout was programmed to be signalised in the RCA Long Term Plan. A large supermarket is to be developed at the corner of the intersection, which would increase traffic volumes and vulnerable road users at the intersection. The supermarket development includes significant improvements to the street frontage. After collaborative meetings between the developer and local council, both parties agreed to deliver all road improvements as a single package of works managed by the local council. On behalf of the local council, the practitioner developed the concept design for the signalisation of the roundabout.

The existing roundabout is a safe system aligned intersection design replacing it with a standard signalised intersection would be less aligned to safe system principles. As such, a signalised intersection with raised platforms was considered for the intersection. On this basis, the concept design started to evolve to be a fully raised signalised intersection prior to detailed design phase. The existing roundabout is shown below in Figure 1.



Figure 1. Existing Roundabout

Initial Design

The intersection was designed with the 100mm raised platform. In the initial design, median islands were required one three of the approaches to ensure turning heavy vehicles cross the grade transition at right angle to avoid losing stability. However, this meant that the departure ramps were setback from the intersection. Pedestrian crossings were provided in line with the desire line rather than at the shortest distance. The concept design is shown in Figure 2.

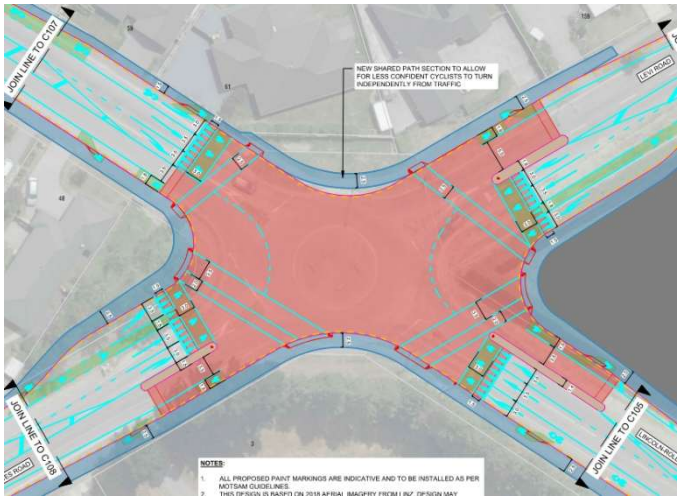


Figure 2. Concept Intersection Design

Safe System Audit Findings

A safe system audit was conducted on the concept design plans. The external audit team identified the serious concerns with the concept design,

1. The distance between the limit line and departure lane on both legs of the intersection is approximately 70m. This will significantly increase the phasing time for all movements and affect the efficiency of the intersection.
2. On road cyclists will require longer clearance phases to move through the intersection, increasing the exposure and likelihood of crashing with other vehicles. A cyclist traveling at 20km/h would need approximately 12 seconds to move through the intersection
3. The length of the raised safety platform means vehicles may speed up between the on/off ramps, which means that safe system speeds for vulnerable users may not be achieved, worsening the severity of crashes at the intersection.
4. The size of the intersection makes it difficult for users to discern their path while travelling through the intersection. The implied alignment for some straight through movements will likely clash with opposing traffic or traffic in adjacent turn lanes.

Developments during Detailed Design

During the detailed design phase the local council engineers requested that semi trailer trucks must be acocodated at three of the four left turns at the intersection. Due to the geometry, allowing such movements at the left turn lanes meant the left turn bays were more than 7m wide which created an undesirablely wide approach with extreme crossing distances. Also such wide slip lanes are undesirable for pedestrians due to excessive speeds.

Approach

The project team reviewed available design guidelines on raised safety platforms and intersections. However limited guidance could be sources on designing for intersections with similar skewed geometry. The RCA saw this intersection as a gateway to the local area as such wanted to pursue with the raised intersection design and challenged the designers to find an appropriate design.

Road Safety Considerations

Controlled left turns are preferred at signalised intersections to ensure pedestrian safety at the intersection is not compromised. Slip lanes with or without flush zebra crossings compromises pedestrian safety due to motorists being distracted by finding a gap in traffic and also turning too fast when a gap is available. On the other hand, providing slip lanes could increase capacity greatly at an intersection if the left turn demand is high.

Traffic Signal Considerations

Long pedestrian desire lines, especially if parallel to the approach roads require greater protection periods and clearance times. This can increase phase time requirements of minor phases which can affect safe operation of the intersection if overall efficiency is adversely affected.

When distance to traverse the intersection can become too long, intergreen times and overall intersection loss time increases. Longer traversal times increases the time for vehicle acceleration resulting in higher than desired speeds at the far side of the intersection where a crosswalk will be located and potential conflict points with pedestrians with red light runners. Enlarged footprints pushes the limits of lantern visibility and potential for requiring larger lanterns in the lower secondary and tertiary locations.

Civil Engineering Considerations

There were many Civil Engineering challenges that were encountered in designing and constructing the raised intersection platform. These challenges often required a delicate balance between road safety considerations and design constraints. Such challenges include:

- Traffic median islands were installed to separate traffic lanes however this restricted private property access. It was agreed to have flush mounted median island would be designed to allow access but provide traffic lane visual separation.
- The raised platform was designed to be 75 mm above adjacent road level this induced ramps at a 1V:20H gradient. Pedestrian islands traversed these ramps and therefore needed to follow the grade change to ensure a min 50 mm upstand on the Mountable kerb was maintained at all times. This is not standard practice but need to be completed this way to ensure pedestrians were protected.
- The raised platform intersection and Levi Rd was part of the Councils stormwater secondary flow path which was directed through the intersection. The road geometric design had to be designed to ensure the raised platform didn't 'dam' the secondary flow path. Modelling was undertaken to ensure the secondary flow path was maintained and adjacent residents and development would not be flooded in a secondary flow event.

Considering all of the above the solution was to introduce slip lanes with raised pedestrian crossings on two of the problematic left turn lanes. Introducing slip lanes ensured the efficiency of the intersection wasn't compromised for safety and introducing the raised crossings ensured that the safety of pedestrians wasn't compromised. The inclusion of slip lanes also brought the crosswalks and stop lines closer to the intersection centre reducing the excessive intersection footprint mitigating some of the concerns raised in the safety audit. IN the revised design some pedestrian crosswalks can run with main movements reducing protection requirements.

Benefits to road safety/ Implications for practice

This design of the signalised intersection could be used as a case study for future design in any jurisdiction. In many road design projects safe system aligned treatments are discarded due to similar challenges faced in this project. However, finding a way to balance competing design considerations and getting the project team on board with the safe system thinking can result in a favourable outcome for all parties involved.

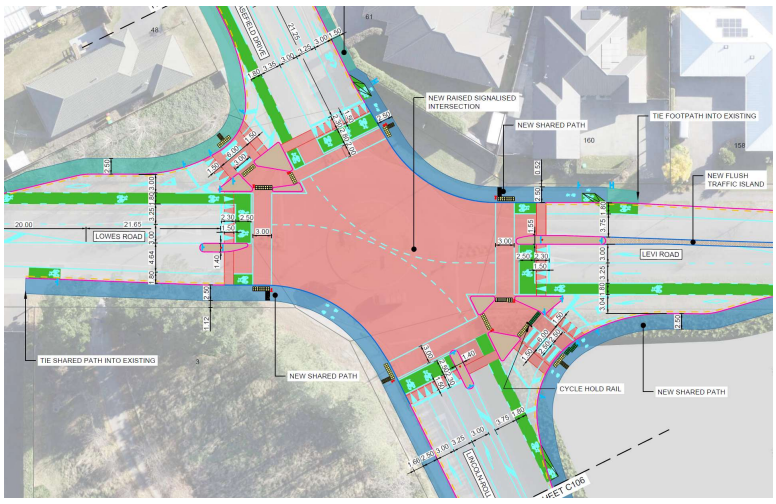


Figure 3. Revised Intersection Design

References

Austroads Guide to Road Design – Part 3 Geometric Design
Austroads Guide to Traffic Management – Part 6: Intersections, Interchanges and Crossings
Austroads, 2020, Effectiveness and Implementation of Raised Safety Platforms, AP-R642-20
Safe System Solutions, Raised Safety Platforms Fact Sheet
VicRoads, 2019, Road Design Note – Raised Safety Platforms (RSPs), RDN 03-07 – Issue C

Common issues in road safety: pooled insights from Lead Auditors

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Abstract
Road safety auditing has been a key component of road safety practice in Australia for over 30 years. Auditors assess designs or the existing road network from a risk-based perspective, identifying hazards and recommending treatments rather than strictly checking compliance with standards. Audits are conducted at a project level, and the vast volume of audit findings across Australia have not been systematically pooled or analysed. Some jurisdictions have explored recurring issues in audits to inform updates to standards, guidelines, and industry capability, but this has not been formalised on any large scale. The Lead Road Safety Auditor course has presented a unique opportunity to gather insights from experienced auditors on industry challenges, including industry misinterpretations of standards and common safety concerns. This paper highlights key issues identified by course participants from Australia (all states and territories except Western Australia) and New Zealand, providing examples and recommendations for improving industry practices through changes to guidance, standards, training, and awareness initiatives.

Social media post
Road safety audits identify risks, not just check standards. With thousands conducted yearly, findings aren't systematically pooled. The Lead Road Safety Auditor course gathered insights on recurring issues. This paper highlights key themes and ways to improve guidance, training, and industry practices.

Introduction
Road safety auditing has been an established practice in Australia for over three decades, with auditors playing a critical role in identifying risks and making recommendations to improve road safety. Unlike compliance checks, audits focus on assessing risks in designs or the built environment and propose treatments to mitigate potential crash outcomes (Austroads, 2021).

Despite the thousands of audits conducted annually across Australia and New Zealand, there has been limited systematic analysis of recurring issues. Some jurisdictions have taken steps to examine common audit findings and explore potential improvements to standards, guidelines, and industry capability. However, a broader effort to consolidate and address these trends remains absent.

There are two levels of road safety audit course in Australia: the Road Safety Auditor course and the Lead Road Safety Auditor course. The latter is for experienced auditors wishing to step up to the next level and lead teams of auditors. Due to the participants' experience, the Lead Auditor course provides an opportunity for experienced practitioners to highlight systemic industry issues, gaps in guidance, and misinterpretations of existing standards. These are issues they frequently identify in audits.

Conference Theme
The paper/presentation aligns with the conference theme of "Evolution: Evolution of a Safe System" by highlighting how road safety auditing has progressed beyond a purely engineering-based compliance check to a more holistic, risk-based approach. Through insights gathered from experienced Lead Road Safety Auditors, the research illustrates how audits consider human factors, industry misinterpretations of standards, and recurring systemic issues that influence road safety outcomes. The findings emphasise that auditors play a crucial role in evolving the Safe System by identifying risks that extend beyond engineering measures - such as user behaviour, visibility, and interaction with infrastructure. The paper advocates for a more structured pooling of audit findings to refine industry standards, improve training, and enhance awareness, ensuring that road safety evolves in a way that is responsive to both past learnings and future challenges.

Approach
The insights presented in this paper/presentation were gathered through the Lead Road Safety Auditor courses conducted in 2024 and 2025, where participants were tasked with identifying an industry-wide issue from their experience as an experienced road safety auditor. Each participant was required to identify a specific issue, describe its

nature, and propose potential solutions to improve industry practice. The findings were then compiled and categorised into key themes.

The identified issues reflect real-world challenges occurring frequently in projects in Australia and New Zealand.

Results

This paper/presentation presents a summary of key issues identified by over 100 Lead Road Safety Auditor course participants from all states and territories in Australia (except for Western Australia), and from New Zealand. The paper highlights areas where industry practices could be refined and improve road safety outcomes. The findings provide insights into gaps, inconsistencies, and misinterpretations in existing road design, traffic engineering and planning, as well as opportunities to improve guidance, standards, and practitioner capability.

Rather than focusing solely on compliance with standards, the issues raised emphasise practical challenges. By addressing these concerns, industry can continue to improve, and systemic issues be identified and progressively removed.

The Austroads Guide to Road Safety Part 6 (Austroads, 2021) provides an overarching framework for road safety auditing, outlining best-practice methodologies for risk assessment and mitigation. There is some reference to pooling common audit findings in the close-out section of the Austroads Guide, however there is limited information, and the practice of pooling findings is infrequent. The issues found in Audits are known to be of benefit to road safety. Previous studies have highlighted the effectiveness of road safety audits in reducing crashes and improving road user safety (Turner et al., 2009; Montella, 2010). Thus, pooling these findings to draw out themes and subsequent opportunities should make significant strides in improving road safety.

Drawing from a pool of over 100 experienced auditors, the list of systemic issues in road design and project application was extensive. It included issues like:

- Measurement inconsistencies – Variability in how practitioners assess bike lane widths.
- Roadside hazards in urban areas – Challenges in applying risk assessments to roadside elements in built environments.
- Traffic signal placement – Risks associated with the "see-through" effect caused by closely spaced signals.
- Pedestrian crossing sight distance – incorrect methods being applied to assess the sight distance to pedestrian crossings
- Road safety barrier lengths – variability across industry on the method to calculate the length-of-need of a barrier system.

These and the many other recurring concerns illustrate broader gaps in industry practices that may require updates to standards, targeted upskilling, or improved awareness among practitioners.

The findings from this research provide valuable input for policymakers, road authorities, and industry professionals. Potential actions include:

- Updating standards and guidelines to address common misinterpretations and inconsistencies.
- Improving road design/engineering training to ensure these issues are highlighted and the correct risk mitigation measures are understood.
- Enhancing industry awareness through case studies, guidance documents, and targeted professional development.

By incorporating these insights into industry practice, industry can continue to evolve and deliver more effective safety outcomes.

This paper/presentation explores the variation of jurisdictional supplements that address some of these systemic issues, however only in some regions. An example is the Queensland Transport and Main Roads supplement to the Austroads Guide to Road Design Part 4A, where they address a sight distance at pedestrian crossings issue that was raised by one of the Audit course participants.

Benefits to Road Safety

By systematically pooling insights from experienced auditors, this research helps identify recurring safety issues that may otherwise go unnoticed. Addressing these systemic gaps through updated standards, targeted training, and

improved industry awareness leads to more effective and consistent road safety practices. By considering human factors alongside engineering measures, the approach ensures that road designs evolve to better protect all road users, ultimately reducing crash risks and improving overall road safety outcomes.

Implications for Policy and/or Practice

The findings have significant implications for policy and practice, highlighting the need for a more structured approach to integrating road safety audit insights into industry standards and guidelines. By addressing common misinterpretations and inconsistencies in design practices, policymakers can refine regulations to better reflect real-world safety challenges. For practitioners, the research highlights the importance of moving beyond compliance checks to a more risk-based and human-centred approach, ensuring that infrastructure is designed and maintained with all road users in mind. Enhancing auditor training and fostering industry-wide knowledge sharing will further strengthen the effectiveness of road safety audits, supporting continuous improvement in road safety policy and practice.

The future of pooling audit findings

Austroads is currently leading a road safety audit harmonisation project, which includes the development of a comprehensive teaching syllabus. As part of this initiative, there have been ongoing discussions about the potential for periodic reviews of pooled audit findings, aimed at enhancing consistency and improving the overall effectiveness of road safety audits.

Conclusion

This research highlights key issues identified by experienced road safety auditors, showcasing opportunities for improvement in guidance, training, and industry practice. By addressing these challenges, road/street designs can become more consistent and effective in mitigating road risks. Future efforts should focus on consolidating audit findings at a broader level to inform national guidance and industry-wide improvements.

References

Austroads (2021). Guide to Road Safety Part 6: Road Safety Audit. Austroads Ltd, Sydney, Australia.

Montella, A. (2010). A comparative analysis of European road safety audit procedures. Accident Analysis & Prevention, 42(4), 1178-1187.

Turner, S., Imran, A., & Tate, F. (2009). Effectiveness of road safety audits. NZ Transport Agency Research Report 395.

Updating *Making Roads Motorcycle Friendly*: enhancing safety for riders

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Abstract

Motorcyclists are significantly overrepresented in road trauma across Australia and New Zealand, accounting for only 2 per cent of vehicle kilometres travelled but 17 to 20 per cent of road fatalities and serious injuries. Despite this, guidance on road design, maintenance, and operations has historically focused more on cars, trucks, and, in recent years, bicyclists. The original *Making Roads Motorcycle Friendly* guide, published by VicRoads in 2007, provided foundational recommendations for improving motorcyclist safety. However, advances in research and practice have necessitated an update. This paper outlines the process of updating the guide, incorporating contemporary best practices, stakeholder insights, and emerging research. Key updates include enhanced guidance on surface defects, road safety barriers, superelevation, compound curves, work zones, and Audio Tactile Line Marking (ATLM). By integrating these improvements, the revised guide provides a practical, research-backed framework to assist road designers, engineers, and maintenance crews in improving motorcyclist safety across Australasia.

Social media post

Motorcyclists make up 17-20% of road deaths but only 2% of travel. The updated *Making Roads Motorcycle Friendly* guide tackles key safety issues, including surface defects, barriers, curves, and work zones.

Introduction

Motorcyclists are significantly overrepresented in road trauma statistics across Australia and New Zealand. Despite accounting for only around 2 per cent of total vehicle kilometres travelled, they comprise between 17 to 20 per cent of all fatalities and serious injuries (Victorian Government, 2025). This stark disparity underscores the heightened vulnerability of motorcyclists and urgent need for targeted safety measures in road design, maintenance and operations.

The extent of guidance available for different road users varies considerably. Road infrastructure and operational guidelines have traditionally been designed with a focus on cars and trucks, ensuring their safety and efficiency on the road network. Over the past two decades, there has been a growing emphasis on providing safe infrastructure for bicyclists, with extensive guidance developed to support their needs (Austroads, 2017). Pedestrians have also benefited from increasing attention to safety measures, particularly in urban environments. However, motorcyclists remain largely underrepresented in road safety guidance, with relatively little tailored information available to support their unique safety challenges.

In 2007, VicRoads released the first Making Roads Motorcycle Friendly guide (Clarkson & Beer, 2011), which compiled the best available knowledge at the time to identify key road design features, maintenance practices, and operational considerations that influence motorcycle safety. This guide provided foundational recommendations for improving road safety outcomes for motorcyclists by addressing issues such as road surface quality, roadside hazards, and curve design (VicRoads, 2007). The seminars that accompanied the guide were evaluated in 2010 by UltraFeedback and the results indicated the program was effective in raising awareness amongst practitioners about the needs of riders in road design, maintenance and management.

Since the release of this guide, further research and advancements in motorcycle safety have emerged, warranting a comprehensive update to reflect contemporary best practices. This paper examines the process of updating Making Roads Motorcycle Friendly and highlights key contemporary practices incorporated into the new Making Roads Motorcycle Friendly package. By integrating the latest evidence and industry knowledge, this update aims to ensure that motorcyclists receive the same level of consideration in road safety design and operations as other road users.

Conference Theme

Equity in transport safety means ensuring all road users - regardless of their mode of travel - are treated fairly and provided with safe infrastructure. Motorcyclists, despite being highly vulnerable and overrepresented in road trauma, have historically been overlooked in road design, maintenance, and policy considerations. The updated *Making Roads*

Motorcycle Friendly guide takes a step towards addresses this inequity by integrating contemporary best practices to ensure that riders receive the same level of safety-focused infrastructure as other road users. By improving guidance on road surfaces, barriers, curves, and work zones, the guide enables informed choices for motorcyclists and promotes a transport system that respects their dignity and safety. Recognising motorcyclists as legitimate road users and embedding their needs into design and policy is an important step towards an equitable road network.

Approach

The process of updating *Making Roads Motorcycle Friendly* involved a multi-faceted methodology designed to ensure that the revised guidance reflects contemporary best practices, industry knowledge, and the real-world experiences of motorcyclists. This methodology combined a comprehensive literature review, stakeholder engagement, analysis of past infrastructure investments, and development of interactive resources to enhance accessibility and practical application.

Literature Review

A structured literature review was undertaken to identify current best practices, emerging research, and international trends in motorcycle safety and road infrastructure design. This review encompassed:

- Existing road design, maintenance, and operational guidelines relevant to motorcyclist safety, including national and international standards (e.g., Austroads, European Transport Safety Council reports).
- Research studies on crash risk factors, road surface treatments, and the effectiveness of various motorcycle-friendly road safety measures.
- Case studies of jurisdictions that have successfully implemented motorcycle-friendly infrastructure.

The literature review provided an evidence base for identifying gaps in current guidance and opportunities for improvement in road design, maintenance, and operational practices to better accommodate motorcyclists.

Stakeholder Engagement: Workshops and Consultations

A series of structured workshops and consultations were conducted with a diverse range of stakeholders to gather insights and validate key findings. Participants included motorcyclists, industry bodies, road safety researchers, policymakers, and government representatives, ensuring diverse insights into motorcycle safety, infrastructure, and regulation. These engagements aimed to capture real-world challenges faced by motorcyclists, identify common safety concerns, and ensure that the updated guidance would be both relevant and practical. Stakeholder feedback played a crucial role in shaping the recommendations and refining the proposed safety measures.

Review of Past Motorcycle Safety Levy Investments

A retrospective review of past investments made through the Motorcycle Safety Levy was conducted to assess their impact on infrastructure safety improvements. This involved:

- Analysing reports and evaluations of previously funded road safety projects targeting motorcyclists.
- Identifying lessons learned from past interventions, including what worked well and where improvements could be made.
- Exploring opportunities to align future infrastructure investments with the updated *Making Roads Motorcycle Friendly* guidance.

This review provided valuable insights into how financial resources have been allocated in the past and informed recommendations on future funding priorities to maximise safety benefits for motorcyclists.

Filming and Photography for Visual Documentation

To enhance the accessibility and engagement of the updated guidance, a dedicated effort was made to visually document key road safety issues through filming and photography. This involved capturing footage of motorcycle crash risks, showcasing best-practice infrastructure, and conducting expert interviews on key safety issues. The visual content serves as an educational tool, helping to illustrate key safety principles and reinforce the recommendations outlined in the updated guide.

Guideline Development and Training Package

The final stage of the methodology focused on translating the research findings and stakeholder insights into a comprehensive, user-friendly guideline. Key activities included:

- Writing and structuring the updated *Making Roads Motorcycle Friendly* guide to ensure clarity, practicality, and ease of use.
- Integrating interactive links to video content within the document to provide additional context and real-world examples.

- Developing a complementary training package to support industry adoption of the guidelines. This package includes instructional materials for road authorities, engineers, and maintenance crews to enhance their understanding of motorcycle safety considerations in road design and maintenance.

By combining research, stakeholder input, and interactive resources, this methodology ensures that the updated *Making Roads Motorcycle Friendly* guide is grounded in evidence, informed by industry expertise, and effectively communicated to practitioners and policymakers.

Results

The updated *Making Roads Motorcycle Friendly* guide has been produced and is now publicly available through the Victorian Government website: https://www.vic.gov.au/sites/default/files/2024-07/Making-roads-motorcycle-friendly.pdf . This updated guide builds upon the 2007 version, incorporating contemporary research, industry feedback, and recent best practices to better address the unique challenges faced by motorcyclists on the road network.

Key improvements in the updated guide include: enhanced surface defect considerations, a new metal plate skid resistance standard, improved guidance on geometric design, new information on compound curves and curve tightens warning signs, updated road safety barrier considerations for motorcyclists, expanded guidance on work zones and temporary traffic management, audio tactile line marking (ATLM) considerations for motorcyclists, and a new prompt list for practitioners.

Benefits to Road Safety

Improving road infrastructure for motorcyclists enhances overall road safety by reducing crash risks for one of the most vulnerable road user groups. The updated *Making Roads Motorcycle Friendly* guide ensures that design and maintenance practices consider the unique needs of riders, addressing hazards like surface defects, unsafe barriers, and poorly designed curves. By proactively integrating motorcycle-friendly measures, road authorities can create safer environments that not only protect motorcyclists but also contribute to a more predictable and forgiving road network for all users.

Implications for Policy and/or Practice

The updated *Making Roads Motorcycle Friendly* guide has important implications for policy and practice, ensuring motorcyclists are no longer an afterthought in road design and maintenance. Policymakers can use the guide to integrate motorcycle safety into broader transport strategies, while practitioners can apply its recommendations to create safer, more inclusive road environments. By embedding motorcycle-friendly principles into standards, training, and funding decisions, road authorities can drive systemic change, leading to a more equitable and proactive approach to road safety.

Conclusion

Motorcyclists remain significantly overrepresented in road trauma across Australia and New Zealand, yet historically, guidance on road design, maintenance, and operations has not adequately addressed their distinct safety needs. The updated Making Roads Motorcycle Friendly guide represents a major step forward in ensuring that motorcyclist safety is more effectively integrated into road infrastructure planning and management.

This update builds upon the 2007 version by incorporating contemporary research, industry expertise, and real-world insights gathered through stakeholder engagement. Key additions—such as enhanced considerations for surface defects, road safety barriers, superelevation, compound curves, work zones, and Audio Tactile Line Marking (ATLM) - provide road designers, maintenance crews, and safety practitioners with clearer, more actionable guidance on mitigating risks for motorcyclists. The inclusion of a structured prompt list further ensures that motorcyclist safety is proactively considered at every stage of road planning, design, and maintenance.

While this guide is a significant advancement, it should not be viewed as a static document. As motorcycle safety research continues to evolve and new road safety technologies emerge, ongoing updates and refinements will be necessary to keep pace with best practices. Additionally, further efforts should be made to expand the integration of motorcyclist considerations into mainstream road design and safety policies, ensuring that riders are afforded the same level of safety-focused infrastructure as other road users.

By adopting and applying the principles outlined in the updated guide, road authorities, engineers, and policymakers can contribute to a safer, more inclusive road network for motorcyclists - ultimately reducing crash risks and saving lives.

References

Austroads (2017). Cycling Aspects of Austroads Guides. Austroads Ltd, Sydney, Australia.

Clarkson E and Beer K (2011), Making Roads Motorcycle Friendly, Australasian Road Safety Conference, Melbourne, Australia.

UltraFeedback (2010), Evaluation of the Making Roads Motorcycle Friendly seminars, Melbourne, Australia

VicRoads (2007). Making Roads Motorcycle Friendly. VicRoads, Melbourne, Australia.

Victorian Government (2025). Motorcycle Safety Data and Statistics. Available at: www.data.vic.gov.au.

People crossing safely: developing a training program for older adult pedestrians

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Abstract
Older adults are a particularly vulnerable road-user group. There has been limited research conducted on interventions to support older adult pedestrian safety. Research to date would suggest that to be a safe pedestrian we need to improve cognitive functioning, physical capacity and street-crossing skills; however, no intervention has yet combined these skills. There are no best practice principles for designing road safety training programs and therefore researchers have taken ad-hoc approaches. The goal of this program of research is to ensure the development of an evidence-based intervention that uses best practice from a multi-disciplinary design team. This has been achieved through a four-stage process; feasibility testing, evidence gathering by testing older adults using comprehensive assessments and virtual reality tasks, development of the program with iterative usability trials with end users, and a longitudinal efficacy study with older adults to test the outcomes of the program for improving pedestrian safety.

Social media post
People Crossing Safely uses best practice design principles to develop an evidence-based, online, user-friendly program to improve the cognitive function, physical capacity and street-crossing safety of older adult pedestrians.

Introduction
Older pedestrians account for 40% of pedestrian crash fatalities despite only making up around 18% of the population (BITRE, 2019). Older adult pedestrians are the second highest at-risk group to incur an injury which requires hospitalisation (BITRE, 2019) and are 4.5 times more likely to require long-term care than younger adults (Rod et al., 2021). This increased rate of crash involvement has been argued to be caused by age-related decline in cognitive function, physical capacity, and critical safety skills such as hazard perception (Wilmut & Purcell, 2021).

To date there have been limited training interventions designed to improve the safety of older adult pedestrians (Blanks et al., 2024). Whilst research has demonstrated that it is the combination of cognitive function, physical capacity, and street-crossing skills that determine safety (Rod et al., 2021), training interventions have focused on improving just one of these aspects at a time (Blanks et al., 2024). Interventions that combine both cognitive and physical training have been demonstrated to have greater efficacy than those that only target one of these areas (Gavelin et al., 2021). Furthermore, the development of these training interventions has been ad-hoc with limited detail on the evidence used to support their development and the design principles followed to ensure usability of the programs.

We are currently developing an intervention for older adult pedestrians entitled *"People Crossing Safely"* that targets improving their cognitive functioning, physical capacity and street-crossing skills. To ensure the development of this project adheres to the highest scientific rigor and best practice design principles we are taking a four-stage approach. This paper will detail these four-stages and the findings, limitations and implications along the way. By developing this program in steps and using established design principles it is an evolution in how we create road safety interventions.

Method and Results

Stage One: Feasibility Trial
To determine the effectiveness of a training intervention it is important that the outcome measure is well-validated and suitable for use in the population of interest. To date, pedestrian behavioural outcome measures derived from technology such as virtual reality (VR) have not followed evidence-based design principles (Bennett et al., 2025). We first conducted a feasibility trial to ensure that our validated VR pedestrian street-crossing test (VR-PSCT; Bennett et al., 2025) was not only suitable for use by older pedestrians but also provided the expected pattern of results.

Using a mixed-method design, this trial determined the feasibility and acceptability of a protocol using the VR-PSCT with older adults. Data was collected from 14 younger adults (25-45 years) and 14 older adults (> 60 years). Participants completed tasks that measured cognitive function (e.g., visuospatial attention), physical capacity (e.g., balance) and the street-crossing skills of hazard perception and gap acceptance (via the VR-PSCT). The VR-PCST presented a series of 360-degree video clips captured from real-world pedestrian situations in a VR headset. The older adults reported that the protocol length was too long and induced high levels of fatigue. The VR-PSCT was well tolerated with some instances of mild cybersickness and motor instability for the older adults. As expected, older adults performed more poorly on the VR-PSCT relative to younger adults, supporting its validity for use. Modifications to the protocol were made to improve stability and reduce fatigue.

Stage Two: Evidence-Gathering Study

Whilst cognitive function and physical function have been cited as being important for underlying pedestrian safety in older adults, the evidence on which specific skills and their relative importance is limited (Valos & Bennett, 2024). Before developing an integrated training program, it is critical to ensure that we have a strong evidence base for the skills we are targeting. Using strong theoretical frameworks, and following thorough reviews of the literature (Valos & Bennett, 2023; Blanks et al., 2024), a suite of tasks that captured the known skills relevant for older adult pedestrians was tested.

100 older adult participants (M = 68.83 years, SD = 5.25; 51% female) completed the VR-PSCT and suite of cognitive and physical tasks. Findings showed that cognitive function, in particular working memory, visual search and response inhibition predicted hazard perception, and lower limb strength and walking speed predicted gap acceptance. Their pattern of performance on the pedestrian tasks were also examined with difficulties with gap acceptance, vehicle size, and visual clutter identified. These have formed the basis of the training program developed in Stage Three.

Stage Three: Development and Usability Trial

To develop the training program a team of domain experts in road safety, developmental psychology, neuropsychology, exercise physiology and digital design were assembled. Comprehensive planning for the three components of the training program was conducted using evidence derived from the literature and from Stage Two. Stakeholder feedback was sought throughout the development phase.

A four-week, 16 session online training program was developed. In each session participants complete:

1. A 15-minute street-crossing training task. There is a different lesson each session with sessions involving gap acceptance, hazard perception, time to arrival determination, speed estimation and safe route selection, and vary on vehicle size, speed, number of lanes and visual clutter. See Figure 1 for screenshots from an example training session.
2. A 15-minute cognitive task. Participants will rotate between three tasks targeting working memory, visual search and inhibition. All tasks are based on standardised neuropsychological tasks.
3. A 15-miunte physical training task. Participants will alternate between two tasks, one designed to improve lower limb strength and one for lower limb mobility.

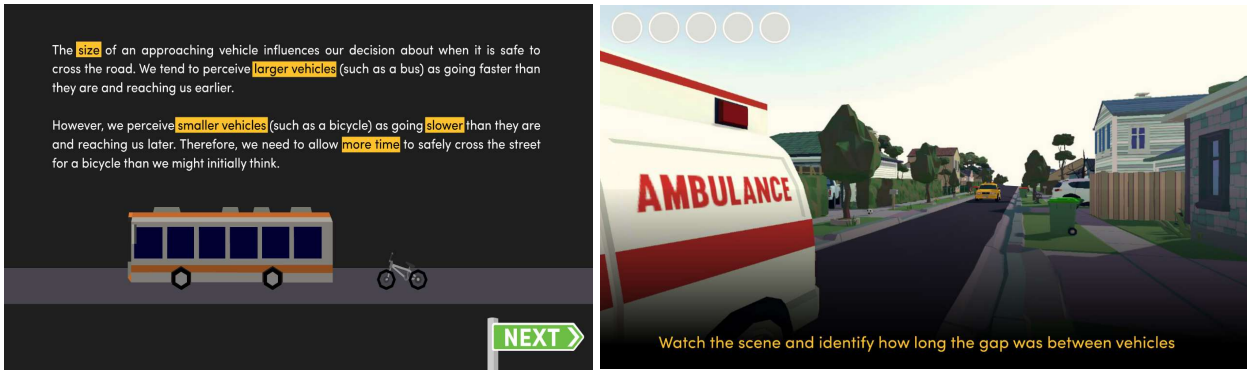


Figure 1. Example Street Crossing Training Session Where Participants Estimate Time of Arrival of Vehicles of Different Sizes

An iterative set of usability trials were conducted at three time points with older adults. 10 participants completed each of the three sessions. In the first usability trial, participants completed session one of the training, including all three components. Researchers observed as participants completed the session to identify pain points with the user

experience. Feedback was sought from the participants in an interview. Based on the feedback changes were made to session one and re-tested by five participants during the second usability trial. The changes saw an improvement in the user experience and received positive feedback about the program. During the second usability trial five participants completed the second training session with alternative street-crossing training, cognitive and physical tasks. For the third usability trial we employed the same process.

Stage Four: Efficacy Study

The efficacy of the training program will be tested from July 2025. A case-control longitudinal design will be employed. 100 participants will be randomly assigned to either a training group or a waitlist control group, and will have their street-crossing skills, cognitive function and physical capacity tested before, after, and at a one-month follow-up. An even gender split, and a split of participants in the younger-old (between 60-75 years) and older-old (>75 years) will be tested. Preliminary findings from this study will be presented at the conference.

Benefits to Road Safety

Older adult pedestrians are a particularly vulnerable population group, and with an ageing population in much of the world, the need for targeted programs to improve their safety has never been greater. By developing an evidence-based program that adheres to best practice education and design principles we can ensure that any program designed for older adults does indeed make them safer pedestrians. The steps we have taken with developing this program acts as a roadmap for others who are interested in developing evidence-based intervention programs. By developing this program in steps and using established design principles it is an evolution in how we create road safety interventions.

Implications for Practice

Our funding partner, the Australian Automobile Association, will be making this program available online to older Australians. Their partner organisations will promote this program to their members. Ensuring that the program is user friendly and can be accessed easily will help empower older adults to take their safety into their own hands. Through this program we will ensure equity for all older road users by providing them with free access to a program that will not only improve their road safety, but their broader health as well.

Conclusion

The current program of research outlines the staged process that we took in the development of an evidence-based, user-friendly multi-disciplinary training program designed to improve the street-crossing safety of older adult pedestrians. Limited research on how to develop these type of interventions programs exists. This staged approach could act as a guide for future researchers and practitioners who are looking to develop training interventions for road users.

References

Bennett, J. M., McGuckian, T. B., Healy, N., Lam, N., Lucas, R., Palmer, K., ... & Duckworth, J. (2025). Development of a virtual reality pedestrian street-crossing task: The examination of hazard perception and gap acceptance. *Safety Science*, *181*, 106706.

Blanks, L. N., Carrick, Z. T., McGuckian, T. B., & Bennett, J. M. (2024). The efficacy of training to improve road safety in elderly pedestrians: A systematic review. *Accident Analysis & Prevention*, *207*, 107735. https://doi.org/10.1016/j.aap.2024.107735

Bureau of Infrastructure and Transport Research Economics. (BITRE). (2019). *Road safety of older Australians: Recent Statistics.*

Gavelin, H. M., Dong, C., Minkov, R., Bahar-Fuchs, A., Ellis, K. A., Lautenschlager, N. T., ... & Lampit, A. (2021). Combined physical and cognitive training for older adults with and without cognitive impairment: A systematic review and network meta-analysis of randomized controlled trials. *Ageing Research Reviews, 66,* 101232. https://doi-org/10.1016/j.arr.2020.101232

Rod, J. E., Oviedo-Trespalacios, O., Senserrick, T., & King, M. (2021). Older adult pedestrian trauma: A systematic review, meta-analysis, and GRADE assessment of injury health outcomes from an aggregate study sample of 1 million pedestrians. *Accident Analysis & Prevention, 152,* 105970. https://doi.org/10.1016/j.aap.2021.105970

Valos, N., & Bennett, J. M. (2023). The relationship between cognitive functioning and street-crossing behaviours in adults: A systematic review and meta-analysis. *Transportation Research Part F: Traffic Psychology and Behaviour*, *99*, 356-373. https://doi.org/10.1016/j.trf.2023.10.018

Wilmut, K., & Purcell, C. (2021). Why are older adults more at risk as pedestrians? A systematic review. *Human Factors,* 0018720821989511. https://doi.org/10.1177/0018720821989511

Adult attachment and speaking up to distracted drivers

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Abstract
Limited research has examined how relationship dynamics influence passengers' intentions to speak up to a driver who is texting. Founded on the Theory of Planned Behaviour (TPB), attachment theory, and emotional intelligence (EI) theory, participants (N = 131, M = 33.63 years, SD = 12.73 years, 66% women) completed a 20-minute online questionnaire. Four scenarios manipulated if a texting driver activated a passenger's internal attachment system (romantic partner vs. acquaintance) and vehicle movement (driving vs. stopped at traffic lights). Results indicated that intentions to speak up were significantly higher in the partner driving/vehicle moving scenario than all other scenarios. Mixed support was found for the influence of the TPB constructs on intentions to speak up. However, neither attachment security nor EI were significant predictors. Subjective norms were the strongest predictor of intentions to speak up. The current study highlights how relationship factors and subjective norms could be targets for interventions.

Social media post
Interpersonal relationship factors may influence passengers' intentions to speak up to a texting driver, but further research is needed

Introduction
Passengers are often able to positively intervene in risky driving situations by speaking up to dangerous driving (Lewis et al., 2021). Psychosocial factors such as those included in the Theory of Planned Behaviour (TPB; Ajzen, 1991) may be useful targets to encourage speaking up by passengers (Kennedy et al., 2018). In the TPB, attitude functions as a person's personal judgement about a behaviour while subjective norms encompass the social pressure they perceive about performing the behaviour, and Perceived Behavioural Control (PBC) reflects a self-evaluation of whether they can successfully perform the behaviour. However, the research examining psychosocial factors underpinning intentions to speak up is limited in several ways. First, most studies have examined cognitive factors but potentially important emotional and affective influences have not yet been comprehensively investigated. Second, while passengers in non-professional driving contexts are likely to be known to drivers, no research has investigated how interpersonal dynamics may influence passengers' intentions to speak up to a driver who is texting.

Attachment theory proposes that humans have an innate need to form secure bonds with caregivers, particularly in infancy, and that these early relationships impact upon an individual's ability for social connection and interpersonal intimacy (Bowlby, 1958). Contemporary studies indicate that attachment processes persist across the lifespan and are particularly relevant in adult romantic relationships (Shaver & Mikulincer, 2008). Emerging research has also linked attachment and driving suggesting that insecure attachment is associated with risky driving (e.g., Gillath et al., 2017). Emotional Intelligence (EI) refers to the ability to perceive, understand, manage, and utilise one's own and others' emotions and consists of five dimensions: self-awareness, self-regulation, motivation, empathy, and relationship management (Goleman, 1996). Some studies have linked higher EI with safer driving (e.g., Hayley et al., 2017).

Given its importance in adult relationships and links with risky driving, it is possible that attachment anxiety and avoidance may influence communication between passengers and drivers in romantic relationships, and therefore the likelihood that a passenger will speak up to driver who is texting. Similarly, links between EI and driving suggest that EI may influence passenger behaviours, especially in interpersonal contexts such when a romantic partner is driving. This study aimed to address a limitation of the existing field of knowledge about passenger interventions for risky driving by extending the TPB to explore the potential influences of attachment and EI on passengers' intentions to speak up to a texting driver. It was hypothesised that: (1) there would be significant differences in intentions to speak up to a driver who is texting based on the combination of relationship type and driving condition, and (2) controlling for demographics and relationship satisfaction, higher levels of the TPB constructs, higher levels of EI, and more secure attachment would significantly predict stronger passenger intentions to speak up to texting drivers.

Conference theme

Addressing the conference theme of evolution, this research advances understanding of passenger interventions for distracted driving by examining interpersonal dynamics and affect as psychosocial predictors of passengers' intentions to speak up to texting drivers, contributing to an emerging field of study. The focus on passenger behaviours in response to distracted driving rather than driver characteristics or behaviours aligns with the equity theme by presenting knowledge that can inform interventions that empower passengers to enhance their own road safety.

Method

Participants (N = 131; M = 33.63 years, SD = 12.73 years) were required to be 18 years or older, hold a current, valid Provisional or Open Driver's license (Australian or International), have been a passenger in a vehicle within the last month, and currently have/have previously had a romantic partner. A within-groups cross-sectional online survey design was used. The questionnaire began with demographic and relationship satisfaction questions. Attachment security was measured using the Experiences in Close Relationship Scale-Short Form (Wei et al., 2007). EI was measured using the Brief Emotional Intelligence Scale (Davies et al., 2010). Participants were then asked to read four short written scenarios (see Figure 1) which each represented a different combination of relationship status (romantic partner vs. acquaintance) and vehicle movement (moving vs. stopped). Participants responded to Likert scale items (1 strongly disagree – 7 strongly agree) about their attitudes, subjective norms, PBC, and intentions (items were informed by Ajzen, 1991) to speak up to the driver who was using their mobile phone in the scenario described (i.e., the TPB items were each responded to a total of four times, once after reading each scenario).

Vehicle Moving/Romantic Partner You are the only passenger in the front seat of a car. The car is travelling at 60km per hour down an inner-city road. Your current/previous romantic partner, who is driving the car, picks up their phone to send a text message.	**Vehicle Moving/ Acquaintance** You are the only passenger in the front seat of a car. The car is travelling at 60km per hour down an inner-city road. An acquaintance of yours, who is driving the car, picks up their phone to send a text message.
Vehicle Stopped/Romantic Partner You are the only passenger in the front seat of a car. The car is stopped at traffic lights. Your current/previous romantic partner, who is driving the car, picks up their phone to send a text message.	**Vehicle Stopped/Acquaintance** You are the only passenger in the front seat of a car. The car is stopped at traffic lights. An acquaintance of yours, who is driving the car, picks up their phone to send a text message.

Figure 1. Scenarios read by participants manipulating relationship type and vehicle movement

As participants answered all items in the survey, the intentions variable was conceptualised as a 'within-subjects' variable enabling the statistical comparison of intentions between each scenario. To test hypothesis 1, intentions to speak up were examined using a 2 (travelling at a speed of 60 km/h vs. stopped at traffic lights) x 2 (romantic partner driving vs. acquaintance driving) repeated measures Analysis of Variance (ANOVA). To test hypothesis 2, four hierarchical multiple regressions were undertaken, one for each scenario. For these analyses, demographics were entered into Step 1, TPB variables were entered into Step 2, EI was entered into Step 3, and attachment was entered into Step 4. This study was granted ethics approval (8426) by the QUT Human Research Ethics Committee.

Results

The repeated measures ANOVA indicated a significant main effect for driving condition, $F(1,123) = 54.70$, $p < .001$, $\eta^2 = .31$ and for relationship type, $F(1, 123) = 39.28$, $p < .001$, $\eta^2 = .24$ but no significant interaction was observed. The results of six follow up Bonferroni-adjusted paired t-tests (Table 1) revealed that participants had significantly higher intentions to speak up in the vehicle moving/romantic partner driving condition when compared to all other conditions. Participants also had significantly higher intentions to speak up in the vehicle moving/acquaintance driving condition compared to the vehicle stopped/acquaintance driving condition. Medium to large effect sizes were observed in tests where significant differences were found.

Table 1. Paired samples t tests of scenarios manipulating driving condition and relationship type

Paired Samples	N	*M*diff	SD	95% *CI*	t(df)	d
Moving/Partner vs Stopped/Partner	125	0.98	1.64	[0.69, 1.27]	6.70(124)**	.60
Moving/Partner vs Stopped/Acquaintance	125	1.57	1.78	[1.25, 1.88]	9.85(124)**	.88
Moving/Partner vs Moving/Acquaintance	124	0.63	1.26	[0.40, 0.85]	5.56(123)**	.50
Moving/Acquaintance vs Stopped/Partner	126	-0.36	1.83	[-0.68, -0.04]	-2.21(125)	-.20
Stopped/Partner vs Stopped/Acquaintance	128	0.60	1.21	[0.39, 0.81]	5.61(127)**	.50
Moving/Acquaintance vs Stopped/Acquaintance	126	0.94	1.48	[0.68, 1.20]	7.18(125)**	.64
** $p \leq .001$. All *p*-values are two-tailed. *N* = number, *M*diff = mean difference, *SD* = standard deviation, *CI* = confidence intervals, *t* = t-statistic, *df* = degrees of freedom						

The final step in each of the regressions significantly explained large amounts the variance in intentions to speak up in each scenario (Table 2). Age and relationship satisfaction emerged as significant predictors in one regression each. Attitudes and subjective norms emerged as significant predictors in three out of four regressions, and PBC was a significant predictor of intentions in one regression. EI and attachment security were not significant predictors in any of the four regressions. All significant individual predictors displayed a positive relationship with intentions.

Table 2. Summary of the results of final step in each hierarchical multiple regression

Scenario	F(df)	p	R^2	R^2 (adj)	Significant predictors in the final step
Moving/Partner	5.94 (9, 115)	<.001	.37	.32	Relationship satisfaction, Subjective norms
Moving/Acquaintance	5.61 (9, 116)	<.001	.30	.25	Age, Attitudes, PBC
Stopped/Partner	16.82 (9, 119)	<.001	.56	.53	Attitudes, Subjective norms
Stopped/Acquaintance	12.93 (9, 119)	<.001	.51	.48	Attitudes, Subjective norms
R^2 = coefficient of determination, R^2 (adj.) = adjusted coefficient of determination					

Benefits to road safety

This study results indicate that passengers were more inclined to speak up when the driver was a romantic partner and when the vehicle was moving. The TPB constructs generally predicted intentions, although PBC was a less consistent predictor. However, neither EI nor attachment significantly predicted intentions. Despite these non-significant findings, the study provides benefits to road safety in shedding some light on how passengers may interact differently with romantic partners who are texting while driving compared to those who they are simply acquainted with.

Implications for policy and/or practice

In practice, the findings hint at the potential for public education campaigns and targeted interventions to be developed that leverage subjective norms and positive attitudes to enhance passenger intentions, willingness, and ability to intervene in situations where drivers are distracted by text messages. The findings also suggest that while attachment and EI may not be important predictors of intentions to speak up, other aspects of interpersonal relationship dynamics such as communication styles and patterns or power imbalances in relationships may be of importance and should be of interest for future research.

Conclusion

This study investigated passenger intentions to speak up to a texting driver with a focus on the influence of interpersonal relationship dynamics, captured via attachment style, and emotional intelligence. The findings were mixed with the results suggesting that relationships may play a part in whether a passenger speaks up but that attachment anxiety and avoidance, and EI, may not directly motivate these behaviours.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211. https://doi.org/https://doi.org/10.1016/0749-5978(91)90020-T

Bowlby, J. (1958). The nature of the child's tie to his mother. *The International Journal of Psychoanalysis, 39,* 350-373. https://www.sas.upenn.edu/~cavitch/pdf-library/Bowlby_Nature.pdf

Davies, K. A., Lane, A. M., Devonport, T. J., & Scott, J. A. (2010). Validity and reliability of a Brief Emotional Intelligence Scale (BEIS-10). *Journal of Individual Differences, 31*(4), 198-208. https://doi.org/10.1027/1614-0001/a000028

Gillath, O., Canterberry, M., & Atchley, P. (2017). Attachment as a predictor of driving performance. *Transportation Research Part F: Traffic Psychology and Behaviour, 45*, 208-217. https://doi.org/https://doi.org/10.1016/j.trf.2016.12.010

Goleman, D. (1996). Emotional Intelligence. Why it can matter more than IQ. *Learning, 24*(6), 49-50. https://eric.ed.gov/?id=EJ530121

Hayley, A. C., Ridder, B. D., Stough, C., Ford, T. C., & Downey, L. A. (2017). Emotional intelligence and risky driving behaviour in adults. *Transportation Research Part F: Traffic Psychology and Behaviour, 49*, 124-131. https://doi.org/https://doi.org/10.1016/j.trf.2017.06.009

Kennedy, A., Cullen, B., Firman, D., Fleiter, J. J., & Lewis, I. (2018). Peer passenger intentions to speak up to a risky driver: A theoretically-guided investigation of the effects of a high school road safety education program. *Transportation Research Part F: Traffic Psychology and Behaviour, 54*, 15-27. https://doi.org/https://doi.org/10.1016/j.trf.2018.01.011

Lewis, I., Watson, B., & Ho, B. (2021). Slow down! Get off that phone! The impact of a high school road safety education program in influencing whether a young person speaks up to a risky driver. *Transportation Research Part F: Traffic Psychology and Behaviour, 78*, 353-368. https://doi.org/10.1016/j.trf.2021.02.016

Shaver, P. R., & Mikulincer, M. (2009). An overview of adult attachment theory. In J. H. Obegi & E. Berant (Eds.), *Attachment theory and research in clinical work with adults* (pp. 17-45). The Guilford Press. https://psycnet.apa.org/record/2009-02347-002

Wei, M., Russell, D. W., Mallinckrodt, B., & Vogel, D. L. (2007). The Experiences in Close Relationship Scale (ECR)-short form: Reliability, validity, and factor structure. *Journal of Personality Assessment, 88*(2), 187-204. https://doi.org/10.1080/00223890701268041

Enhancing safety through collaborative contract management in LMIC

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Abstract
Road safety in low- and middle-income countries (LMICs) remains a critical challenge despite global efforts to reduce road traffic fatalities. A fundamental issue is the lack of understanding and commitment to the Safe System approach among road safety professionals and decision-makers. Many LMICs struggle with cultural perceptions that road crashes are an unavoidable consequence of progress or even fate, leading to limited urgency in implementing preventive measures. Additionally, weak institutional frameworks and enforcement mechanisms further hinder progress. This paper examines the key barriers to implementing effective road safety measures in LMICs based on a decade of experience working in India and Georgia. It explores the challenges of overcoming deep-rooted cultural beliefs, inadequate safety enforcement, and non-compliance with occupational health and safety (OHS) standards. The paper also highlights the role of effective contract management—particularly through Output and Performance-Based Road Contracts (OPRCs)—in enforcing road safety and OHS requirements. By embedding road safety into contractual frameworks, establishing strict compliance mechanisms, and leveraging collaborative safety management strategies, LMICs can achieve significant safety improvements. The findings contribute to the development of more resilient and safety-focused contract management practices applicable to both developing and developed countries.

Social media post
Improving road safety in LMICs through strong leadership, cultural shifts, and contract enforcement.

Introduction
The Safe System approach, widely adopted in countries like Australia and Sweden, is a proven framework for reducing road fatalities. It acknowledges that human errors are inevitable and designs road systems to minimise the consequences of crashes. However, in many low- and middle-income countries (LMICs), road safety is often deprioritised, and crashes are seen as an unavoidable consequence of progress and increased mobility. In some cultures, fatal crashes are even perceived as fate or divine will, which diminishes the urgency to implement preventive measures.

This paper aligns with the conference theme of Evolution by examining the progression of road safety strategies in low- and middle-income countries (LMICs) and the challenges associated with implementing the Safe System approach. It explores the historical context of road safety in LMICs, where reactive and enforcement-driven measures have dominated, and contrasts this with the emerging shift towards proactive, system-based interventions. By drawing on experiences from India and Georgia, the paper highlights the difficulties in transitioning from traditional, fragmented approaches to a holistic Safe System framework that integrates infrastructure design, enforcement, behavioural change, and contract management. Additionally, it provides insights into future challenges, such as institutional resistance, cultural barriers, and the need for stronger contractual mechanisms like Output and Performance-Based Road Contracts (OPRCs) to drive safety compliance. The findings contribute to the ongoing evolution of road safety by emphasising the role of governance, accountability, and human factors in achieving sustainable safety outcomes.

Research on road safety in LMICs has consistently highlighted the disparities between developed and developing nations in terms of policy implementation, enforcement, and public awareness. According to the World Health Organization (WHO, 2018), LMICs account for approximately 93% of global road traffic deaths despite having only 60% of the world's vehicles. This indicates a disproportionate burden of road crashes in these regions.

Studies have emphasised the effectiveness of the Safe System approach in reducing fatalities and serious injuries. Countries like Sweden and Australia, which have successfully implemented this model, have seen significant reductions in road deaths (OECD/ITF, 2016). However, research also suggests that for LMICs, the main challenge is not the lack of knowledge but rather the absence of institutional commitment, weak enforcement mechanisms, and cultural barriers (Bliss & Breen, 2009).

Contract management as a tool for improving road safety has been widely discussed in literature, particularly in the context of performance-based contracts. The Asian Development Bank (ADB, 2020) and World Bank (Heggie & Vickers, 1998) have both advocated for the use of OPRCs, which link contractor payments to safety and maintenance performance. Studies on OPRCs in developing countries indicate that these contracts drive better compliance with safety regulations, reduce workplace injuries, and lead to improved road conditions over time (Bhatnagar, 2024). Nonetheless, implementation challenges remain, particularly in regions where oversight and accountability structures are weak (Zietlow, 2004).

Furthermore, literature highlights the role of behavioural change campaigns and leadership commitment in enhancing road safety. Case studies from Latin America and Africa have shown that sustained political will, combined with public education and rigorous enforcement, can lead to a significant decline in road fatalities (Peden et al., 2004). This aligns with findings from projects in India and Georgia, where contractor compliance and road safety outcomes improved when safety was embedded as a contractual obligation with stringent penalties for non-compliance.

Challenges in Implementing Safe System Principles

Cultural and Institutional Barriers

One of the most significant challenges in LMICs is the deeply ingrained belief that road crashes and fatalities are an unavoidable by-product of progress. In India, for example, fatalism often influences perceptions of road safety. Many people believe crashes are preordained, which reduces the incentive to take proactive safety measures (Gururaj, 2008).

Similarly, in Georgia, road safety policies have historically been reactive rather than preventive. While progress has been made in recent years, enforcement remains inconsistent, and road users often do not prioritise safety measures such as seatbelt use, speed control, or pedestrian safety infrastructure (WHO, 2015). Without strong leadership commitment, it is difficult to shift the mindset of policymakers, contractors, and the general public toward a safety-first approach.

Lack of Commitment from Leadership and Road Authorities

While many LMICs have road safety strategies on paper, implementation remains weak due to a lack of political will and leadership commitment. Senior management in road authorities and transportation agencies must champion road safety and ensure that its principles are embedded at all levels of decision-making. However, in both India and Georgia, enforcement of road safety standards is often seen as an additional burden rather than a necessity (ADB, 2020).

Without a top-down approach to drive safety culture, efforts remain fragmented, and enforcement mechanisms fail to hold contractors and road users accountable.

Non-Compliance with Occupational Health and Safety (OHS) Standards

Another critical issue is the lack of adherence to worker safety regulations during road construction. In many projects in India, Personal Protective Equipment (PPE) usage is either ignored or poorly enforced. Construction zones often lack adequate signage, barriers, and safe pedestrian pathways, leading to preventable worker fatalities (World Bank, 2019).

In Georgia, international standards for OHS are gradually being integrated into infrastructure projects, but compliance remains inconsistent, particularly in rural and smaller-scale projects where supervision is minimal. Traffic management plans are often poorly designed or not implemented at all, increasing risks for both workers and road users (OECD/ITF, 2016).

The role of contract management in improving road safety

A key mechanism for ensuring road safety compliance in LMICs is integrating strong contractual obligations in road infrastructure projects. Proper contract management can significantly improve safety outcomes by ensuring clear expectations, measurable performance indicators, and strong enforcement mechanisms.

Embedding Safety in Contractual Frameworks

Contracts must clearly define safety obligations, including provisions for:

- Mandatory road safety audits at different project stages
- Implementation of Safe System principles in design and construction
- Strict adherence to international OHS standards, including PPE use
- Regular safety training for contractors and workers

In India, projects funded by international agencies such as the World Bank and Asian Development Bank have incorporated safety clauses that mandate compliance with global best practices. However, enforcement remains a challenge due to weak monitoring and resistance from local contractors who prioritise cost savings over safety.

Enforcing Compliance through Performance-Based Incentives and Penalties

Contractors often deprioritise safety unless it directly affects their financial bottom line. Therefore, integrating performance-based incentives and penalties into contracts can drive compliance. Mechanisms include:

- Liquidated damages for non-compliance: Applying financial penalties when contractors fail to meet safety requirements.
- Incentives for achieving safety milestones: Rewarding contractors who demonstrate proactive safety management and zero-fatality projects.
- Withholding payments: Linking contractor payments to safety performance metrics to ensure ongoing compliance.

For instance, in Georgia, contractual frameworks for international projects have increasingly included safety-specific key performance indicators (KPIs), which are monitored through regular audits. However, there is still a need for more rigorous enforcement.

The Role of Output and Performance-Based Road Contracts (OPRCs)

Output and Performance-Based Road Contracts (OPRCs) have proven to be an effective mechanism in ensuring adherence to road safety and occupational health and safety (OHS) standards. These contracts explicitly embed road and worker safety clauses as key performance indicators, with strict penalties for non-compliance. The main features of OPRCs include:

- Contractors are accountable not just for constructing roads but also for maintaining them at predefined safety and quality levels.
- OHS standards, including the use of PPE, implementation of traffic management plans, and adherence to speed limits, are strictly monitored.
- Any non-compliance results in severe penalties and payment deductions, ensuring that safety remains a priority throughout the contract duration.

In India, several World Bank-funded OPRC projects have successfully integrated safety measures, leading to a significant reduction in worksite accidents and improved road user safety. Similarly, in Georgia, performance-based contracts have driven higher compliance levels among contractors, reducing road fatalities in construction zones.

Promoting Collaborative Safety Management

Safety should be a shared responsibility between clients, contractors, and consultants. Key strategies include:

- Regular joint safety audits: Conducted by road authorities, contractors, and independent safety experts to identify and rectify issues before they escalate.
- Multilingual safety training programs: Given the diversity of the workforce in LMICs, ensuring that training materials and safety protocols are available in local languages can improve understanding and compliance.
- Engagement with the local community: Educating the road users, including pedestrians and drivers, about road safety can help change long-term behaviors and attitudes.

Conclusion

Achieving significant road safety improvements in LMICs requires a paradigm shift in the way safety is perceived and managed. Leadership commitment, stringent enforcement, and collaborative contract management play a vital role in ensuring compliance with safety standards. By prioritising transparent communication, well-defined responsibilities, and active stakeholder engagement, project managers can significantly improve safety outcomes. The adoption of OPRCs, with embedded road safety and OHS performance indicators, has further strengthened enforcement mechanisms and improved safety outcomes. By integrating road safety into every phase of infrastructure development, we can create a safer road environment that protects both workers and road users. The insights gained from India and Georgia highlight the urgent need for a systematic and sustainable approach to road safety, paving the way for reduced fatalities and long-term behavioural change.

References

Asian Development Bank (ADB). (2020). Road Safety Guidelines for Developing Countries. ADB Publications.

Bhatnagar Y. (2024). OPRC India – Reduction in Crashes by Applying Safe Systems Principles, *Australasian Road Safety Conference, Hobart, Australia*

Bhatnagar Y. (2024). OPRC Georgia – Meeting Road Safety Challenges at the Summit, *Australasian Road Safety Conference, Hobart, Australia*

Bliss, T., & Breen, J. (2009). Implementing the Safe System Approach. World Bank Global Road Safety Facility.

Gururaj, G. (2008). Road Traffic Injuries and Prevention in India. National Institute of Mental Health and Neurosciences.

Heggie, I., & Vickers, P. (1998). Commercial Management and Financing of Roads. World Bank Technical Paper.

OECD/ITF. (2016). Zero Road Deaths and Serious Injuries: Leading a Paradigm Shift to a Safe System. ITF Research Reports.

Peden, M., Scurfield, R., Sleet, D., Mohan, D., Hyder, A. A., Jarawan, E., & Mathers, C. (2004). World Report on Road Traffic Injury Prevention. World Health Organization.

WHO. (2015). Global Status Report on Road Safety. World Health Organization.

WHO. (2018). Road Safety in Low- and Middle-Income Countries. World Health Organization.

World Bank. (2019). Improving Road Safety through Performance-Based Contracts. World Bank Transport Division.

Zietlow, G. (2004). Performance-Based Road Management and Maintenance Contracts. GTZ Publications.

Road safety challenges on difficult terrain: case study

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Abstract
This paper examines the road safety measures implemented following the upgrade of a winding mountainous road from gravel to a paved surface. The improved pavement, combined with steep grades and sharp curves, led to increased vehicle speeds, heightening crash risks, particularly in densely populated residential areas with minimal roadside buffers. The absence of adequate separation between the roadway and residences further exacerbated hazards for both motorists and pedestrians. To mitigate these risks, a combination of Safe System principles, innovative engineering solutions, and targeted public awareness initiatives was deployed. Stakeholder collaboration played a critical role in addressing safety concerns. A comparative analysis of traffic data before and after the implementation of safety interventions demonstrated significant reductions in vehicle speeds and crash incidence, validating the effectiveness of these measures. This case study provides valuable insights into enhancing road safety in high-risk environments and contributes to best practices in road infrastructure development.

Social media post
Transforming Mountain Roads: Innovative Safety Measures for a Safer Journey

Introduction
The Chokhatauri-Zoomleti road in Georgia is a winding mountainous route with steep grades, navigating through a densely populated residential area where houses are built in close proximity to the carriageway. Sharp curves and significant elevation changes created challenging driving conditions, while the lack of buffer space between the roadway and residences increases risks for both motorists and pedestrians. Prior to rehabilitation, the road was a gravel surface, which limited travel speeds and minimised the potential for high-speed crashes. However, following its upgrade to a paved road, significantly higher travel speeds were generated and the combination of limited sight distances, excessive speeds, and frequent local access points, further exacerbated safety concerns, making it a critical corridor requiring enhanced road safety measures and infrastructure improvements.

Understanding the importance of equity, the project integrated Safe System principles to ensure that all road users—drivers, pedestrians, and local communities—benefited from safer infrastructure. Key interventions included geometric enhancements, skid-resistant pavement, safety barriers, traffic calming measures such as pedestrian crossings, sidewalks, speed humps and speed enforcement. Public awareness campaigns and stakeholder collaboration played a critical role in addressing human factors. These measures also reflect the evolution of road safety strategies, adapting past approaches to modern challenges. A pre- and post-implementation crash analysis demonstrated significant safety gains, reinforcing the need for context-sensitive, equitable, and evolving road safety solutions. The findings contribute to global best practices for safer and more inclusive road networks.

Literature Review
Effective road safety management in challenging terrains, especially in high-altitude, hilly, and semi-urban areas, has been extensively studied. According to the available literature, roads with steep gradients and sharp curves are prone to frequent crashes due to reduced sight distances, driver fatigue, and limited vehicle control (Wu et al., 2005). The Safe System approach, which focuses on forgiving roads, speed management, and robust infrastructure design, has been proven effective in reducing fatalities and injuries on hazardous road segments (Bhatnagar et al., 2009; Bhatnagar et al., 2010).

Paved surface, when upgraded from gravel roads, resulted in 20-50% increase in average vehicle speeds and increased traffic volume, which can be dangerous in hilly areas with sharp curves and steep gradients, leading to more frequent and severe crashes (Xu et al., 2017).

Research conducted in countries like India and Georgia demonstrates the effectiveness of applying protective measures such as guardrails, traffic calming measures, proper signage, road markings, and rumble strips on hilly roads (Bhargab

et al., 2012; Rondeli et al., 2019). Furthermore, integrating community awareness programs and enforcement mechanisms enhances overall road safety outcomes (Turner et al., 2015).

However, a gap exists in adapting these interventions to the unique geographical, cultural, and infrastructural contexts of the project in Georgia. This paper provides practical insights from the implementation of road safety measures in the Georgian context.

Project Area and Road Characteristics

The project encompasses an 11 km gravel road section of the Chokhatauri–Zoomleti road in Georgia's Guria Province, traversing a complex hilly terrain at high altitudes. This corridor is characterised by a series of sharp horizontal curves, steep longitudinal gradients, and constrained cross-sectional widths, with high embankments posing stability challenges. The alignment is further influenced by significant geographical constraints, limiting opportunities for extensive widening or realignment interventions.

The region also experiences severe environmental conditions, including heavy rains and snowfall. These adverse climatic factors exacerbate visibility, skid resistance and contribute to hazardous driving conditions. High pedestrian volumes, generated by adjacent residential areas, schools, and commercial establishments, present a critical vulnerability, particularly in constrained roadway sections with limited pedestrian facilities.

Problem Statement

Increased Speeds and Speed-Related Crashes

- Transforming a gravel road into a paved surface significantly improved mobility, connectivity and promoted economic development. However, the paved surface resulted in average speed increase from 20 km/h (gravel) to 50 km/h (paved) that were significantly higher than the design (posted) speed limit of 30km/h. In some sections, where geometric improvements were also made (such as widening and alignment corrections), speeds increased to 60 km/h.
- The increased speed was incompatible with the road's geometric characteristics and the local environment. This sudden increase in speeds led to heightened concerns from residents who felt unsafe due to the risk of crashes, especially in areas with sharp curves, narrow sections, and populated zones. Higher travel speeds increased the potential of speed-related crashes.
- Increased vehicle speeds made vulnerable road users (pedestrians and cyclists) more vulnerable to severe crashes. Lack of pedestrian walkways forced people to walk along the main carriageway, increasing risks.

Driver Adaptation and Risk-Taking Behaviour

- Gravel roads had sharp curves and steep gradients that were previously manageable at low speeds but became dangerous at higher speeds on a paved surface.
- Drivers were unfamiliar with paved roads overestimated their ability to handle higher speeds.
- Motorcyclists and truck drivers took greater risks, increasing crash severity.

Methodology

The upgraded section demonstrated frequent crashes and a huge outrage from residents, necessitating a robust approach to road safety improvements. Any safety measure must integrate Safe System principles, focusing on enhanced geometric design, high-friction surfacing, and appropriate traffic calming measures to mitigate crash risks and ensure all-weather operational reliability. A comprehensive approach was undertaken to address these concerns. The methodology involved:

- Application of Safe Systems principles to ensure road safety improvements align with the capabilities and limitations of road users.
- Engineering interventions aimed at reducing travel speeds and enhancing safety.
- Collaboration with local stakeholders and road users to identify safety concerns and develop appropriate solutions.
- Public awareness campaigns aimed at educating drivers and residents about road safety measures.
- Analysis of crash data before and after the implementation of safety measures to assess effectiveness.

Interventions and Solutions

The key interventions implemented included:

- Engineering Interventions:

    - Road Geometry Improvements: Realignment of sharp curves, widening of narrow segments, and flattening of steep gradients where feasible.
    - Installation of Guardrails: Placement of guardrails along dangerous curves, embankments and steep drop-offs to prevent vehicles from leaving the roadway.
    - Improved Drainage Systems: Construction of proper drainage channels to prevent water accumulation and reduce slipperiness during heavy rainfall and snow fall.
    - Skid-Resistant Pavement: Installation of specialised pavement to improve traction, particularly in wet conditions.
- Traffic Management Measures:
    - Installation of Speed Control Measures: Speed Zoning with gateway speed limit signs, pedestrian crossings, sidewalks and number of speed humps were installed at critical points.
    - Enhanced Delineation: Application of chevron alignment markers, curve warning signs and rumble strips to alert drivers of potential hazards.
    - Installation of advanced warning signs indicating dangerous curves, steep gradients, pedestrian crossings, and other hazards.
- Community Engagement and Awareness Programs:
    - Educational Campaigns: Awareness programs targeting local communities to promote safe road-crossing practices and discourage risky behaviour. Training and educational campaigns were conducted to promote safe driving practices and foster a culture of responsibility among road users.
    - Stakeholder Collaboration: Established a robust mechanism for engagement with local authorities and road users to ensure understanding and acceptance of implemented measures.

Results and Discussion

Analysis of crash data and travel speeds before and after the implementation of safety measures demonstrated significant improvements (Table 1).

Table 1. Analysis of Data

Feature	Before Implementation (2023)	After Implementation (2024)
Average Travel Speed (km/h)[1]	50	30
Number of Crashes[2]	15	5
Complaints received under GRM[3]	35	2

1. Vehicles equipped with GPS device. Post-processed to compute speed and travel time.
2. Monthly Progress Report from Monitoring Consultant
3. Grievance Redress Mechanism (GRM) Register

The interventions resulted in:

- Reduced travel speeds to acceptable levels for the road's geometric design.
- Decreased frequency and severity of crashes.
- Enhanced safety perception among local residents and road users.

The findings indicate that the application of Safe Systems principles, supported by engineering measures and public awareness efforts, can effectively mitigate risks associated with increased travel speeds on rehabilitated roads.

Conclusion

The case study of the Chokhatauri-Zoomleti road highlights the importance of implementing targeted road safety measures following rehabilitation projects that result in increased travel speeds. The combination of engineering interventions, stakeholder collaboration, and public awareness campaigns proved successful in enhancing safety. The findings provide valuable insights for similar projects in high-risk areas worldwide.

Recommendations

Future projects involving road rehabilitation in mountainous or high-risk areas should:

- Anticipate potential safety issues related to increased travel speeds.
- Incorporate Safe Systems principles from the planning and design stages.
- Engage with local communities to identify safety concerns early.
- Implement a robust monitoring and evaluation framework to continuously assess the effectiveness of safety measures.

References

Bhargab Maitra, & S. Kumar (2012). Safety Analysis of Roads in Hilly Terrain: Case Study of Shimla Region in India. Journal of Transportation Engineering, 138(5), 541-551.

Bhatnagar Y., Saffron D., de Roos M. and Graham A. (2010). Changes to Speed Limit and Crash Outcome - Great Western Highway case study, *Australasian Road Safety Research, Policing and Education Conference, Canberra, Australia*

Bhatnagar Y, de Roos M, Graham R, Johnson H and Carruthers P. (2009). Speed Zoning Guidelines – making NSW roads safer. *Australasian Road Safety Research, Policing and Education Conference, 2009, Sydney, Australia.*

Rondeli, A., & Mamradze, L. (2019). Road Safety Management and Safe System Approach in Georgia. *Journal of Road Safety, 30(4), 89-101.*

Turner, B., & Mackie, H. (2015). Effective Road Safety Interventions for Hilly and Mountainous Areas. *Transportation Research Procedia, 14, 2836-2845.*

Wu, C., Gan, A., & Lu, J. (2005). Safety Performance of Roadway Geometric Design Features: Literature Review. *Transportation Research Record, 1908(1), 134-140.*

Xu, P., Huang, H., Dong, N., & Wong, S. C. (2017). The effects of roadway and environmental factors on traffic crashes: A review. *Accident Analysis & Prevention, 100, 85-97. https://doi.org/10.1016/j.aap.2017.01.005*

Vehicle barrier for shielding pedestrians, bicyclists, and other vulnerable users

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Abstract

Due to right of way and other constraints, facilities for vulnerable users such as pedestrians and bicyclists are being more frequently placed in close proximity to vehicle travel lanes. This results in an increased risk to the vulnerable users from errant motorists. Traditional barrier systems may be impractical due to cost or deflection. A new multi-functional roadside barrier system was developed to address this problem and improve accommodation and safety for vulnerable users, including those with disabilities. The new barrier was successfully crash tested under high-speed impact conditions and provides a low-deflection option for shielding vulnerable user facilities located near travel lanes.

Social media post

Space constraints often put shared use paths for pedestrians and bicyclists in close proximity to traffic. A novel roadside safety barrier has been designed to accommodate the combined safety needs of motor vehicles and vulnerable users.

Introduction

According to the World Health Organization (WHO), more than half of all road traffic deaths worldwide involve vulnerable road users (WHO, 2025). More and more, vulnerable users such as pedestrians and bicyclists are expected to jointly use facilities that have constrained lateral offsets between the travel lanes and vulnerable user transportation facilities such as sidewalks and multi-use paths. On many of these facilities, right of way (ROW), fiscal, and/or geographical constraints prohibit transportation agencies from increasing the offset distance.

Most existing safety barrier systems utilised to shield vulnerable users from the roadway are rigid concrete or concrete-metal combination rails (i.e., a concrete parapet or with a metal railing on top). Concrete barriers experience little to no deflection during a design impact event and, therefore, represent a good option as a multi-functional barrier for multi-use paths near the travelway. However, such barriers typically require anchorage to a deck or foundation structure and, due to their cost, are generally only considered for bridge applications. More conventional roadside guardrail systems, though not as expensive as concrete barriers, have significant lateral deflection during an impact event (Polivka et al., 2006), and their components can present tripping and snagging hazards for pedestrians and bicyclists behind the barrier.

More economical barrier solutions are needed that provide protection for errant motorists but also provide a safer travel space for pedestrian and bicycle traffic behind the barrier. The objective of this research was to develop a barrier that accommodates the combined safety needs of pedestrians, bicyclists, and motor vehicles.

Conference Theme

The research aligns with the conference theme components of Equity and Evolution. In terms of Equity, the barrier was designed to accommodate all road users, including pedestrians, bicyclists, and motorists, including those with disabilities. Regarding Evolution, the barrier system addresses Safe Road Users and Safe Roads within the elements of the Safe System. It accommodates vulnerable user needs while maintaining impact performance for motorists.

Method

This research was performed under National Cooperative Highway Research Program (NCHRP) Project 22-37 by researchers at the Texas A&M Transportation Institute (TTI) (Dobrovolny et al., 2024) and completed in August 2023.

The impact performance of roadside barriers was evaluated through crash testing following relevant standards. One such standard followed by the United States (US), Australia, and many other countries is the American Association of State Highway and Transportation Officials' (AASHTO) *Manual for Assessing Safety Hardware (MASH)* (AASHTO 2016). AASHTO also publishes two guides that are standards for pedestrian and bicyclist facility design: the *Guide for the Development of Bicycle Facilities* (AASHTO, 2012), also known as the Bike Guide, and the *Guide for the Planning, Design, and Operation of Pedestrian Facilities* (AASHTO, 2021), also known as the Pedestrian Guide.

Many US state DOTs either adopt the AASHTO guides as their prevailing design guidance or adapt the AASHTO guidelines with minor modifications. Therefore, they form the prevailing national design guidance in this area that has consensus among state DOTs. The Bike Guide contains several design parameters that are relevant for barrier design: (a) bicyclist design dimensions, (b) bridge railing or barrier height, (c) shared use path side clearance, and (d) bicycle handlebar rub railing (AASHTO 2012). In Section 5.2.2 (Shared-Use Paths Adjacent to Roadways), the Bike Guide says the following about separating shared use paths and roadways (AASHTO, 2012): "*Where the separation is less than 5 ft (1.5 m), a physical barrier or railing should be provided between the path and the roadway."*

The Pedestrian Facility Design chapter (Chapter 3) of the Pedestrian Guide (AASHTO, 2021) has extensive references to the AASHTO Bike Guide. The AASHTO pedestrian guide also refers extensively to US Access Board guidelines when discussing accessibility of shared use paths to persons with disabilities. The US Access Board worked with numerous stakeholders to develop specific guidance for how to accommodate persons with disabilities in transportation and public ROW settings. The prevailing guidance has been the Public Rights-of-Way Accessibility Guidelines (PROWAG) (U.S. Access Board, 2011). PROWAG contains several design parameters relevant to barrier design such as no protruding objects, a treatment for cane detection, and a handrail (U.S. Access Board, 2011).

Based on these national guidance documents, a literature review, and survey, the research team developed recommendations for barrier development. These included a minimum rail height of 42 inches (1.07 m) for bicyclists, no protruding objects on the back of the rail, a handrail, and a safety toe rail (i.e., cane detection rail). The project panel added an additional design constraint for the dynamic deflection of the barrier to be less than 24 inches (610 mm) when impacted under MASH Test Level 3 (TL-3) impact conditions, which is the basic test level for high-speed roadways. The research team developed several design options to address these design elements while maintaining the basic requirements for motor vehicle impact performance. The project panel selected their preferred design option, and that design option was fully developed and detailed through engineering analyses and finite element computer simulation.

Finite element models of the selected barrier concept were developed and impact simulations were performed using ANSYS LS-DYNA (ANSYS 2025) following MASH Test 3-10 and Test 3-11 impact conditions using models of a 1100C Toyota Yaris passenger car (CCSA 2016) and 2270P Dodge RAM pickup truck (CCSA 2022), respectively. The impact simulations were used to select an appropriate post spacing to achieve the desired deflection limit for the barrier and to select critical impact points for full-scale crash testing.

Results

The final barrier design consisted of an HSS 12×6×¼ inch steel tube mounted at a height of 32 inches (813 mm) above grade on top of steel posts spaced 66 inches (1.68 m) on centre. An HSS 4×4×¼ inch steel tube rubrail was mounted on the traffic face at a height of 13 inches (330 mm) above grade. Two field-side handrails were fabricated from HSS 1.90-inch (48mm) diameter × 0.145-inch (3.7 mm) thick tubing. The pedestrian handrail was mounted at a height of 36 inches (914 mm), and the bicycle handrail was mounted at 42 inches (1.07 m). A cane rail fabricated from 11-gauge, 4-inch (102 mm) wide steel plate was attached to the field side of the posts with its bottom edge 1-inch (25 mm) above grade. The posts were set in a 19-inch (483 mm) wide, 4-inch (102 mm) thick continuous area of low-strength grout, with 24-inch (610 mm) wide, 4-inch-thick (102 mm) concrete slabs on both sides. A drawing showing the cross-section of the multi-functional barrier is presented in Figure , and a photograph of the test installation is shown in **Error! Reference source not found.**.

Full-scale crash tests were conducted in accordance with *MASH* TL-3 conditions. This included Test 3-10 (2,420-lb (1100 kg) passenger car impacting at a speed of 62 mi/h (100 km/h) and angle of 25 degrees) and Test 3-11 (5,000-lb (2270 kg) pickup truck impacting at a speed of 62 mi/h (100 km/h) and angle of 25 degrees). Both tests successfully met *MASH* TL-3 evaluation criteria. In both tests, the impacting vehicles remained upright during the impacts and were contained and redirected by the barrier system, which satisfied the structural adequacy criterion. The acceleration-based occupant risk criteria (occupant impact velocity and ridedown acceleration) of MASH were also satisfied. These criteria evaluate the risk of serious injury of an unbelted vehicle occupant during the barrier impact. Finally, the occupant compartment deformation inside the vehicle resulting from the impacts was below the acceptable threshold.

Benefits to Road Safety

Use of the new multi-functional roadside barrier at appropriate locations should enhance the safety of vulnerable users while maintaining MASH TL-3 performance for motorists. The maximum dynamic deflection of the barrier under stringent MASH TL-3 conditions was only 16 inches (406 mm). This is significantly less than the target deflection limit of 24 inches (610 mm) and the approximately 48-inch (1.2 m) deflection of common guardrail systems. The deflection

of the new barrier will be even less for lower speed roadways. This enables the new barrier to be used in locations with restricted offsets to shared-use paths.

Implications for Policy and Practice

The new multi-functional barrier and associated transition system provide an option for designers to use when site conditions require positive barrier protection to separate traffic and non-motorised transportation facilities such as sidewalks, bicycle facilities, and shared use paths. The low deflection barrier and associated transition system satisfy *MASH* TL-3 criteria and are considered acceptable for use on high-speed facilities. The barrier details can be incorporated into standard detail sheets that can be used on road projects to enhance the safety of vulnerable users when shared-use paths are adjacent to higher speed road facilities.

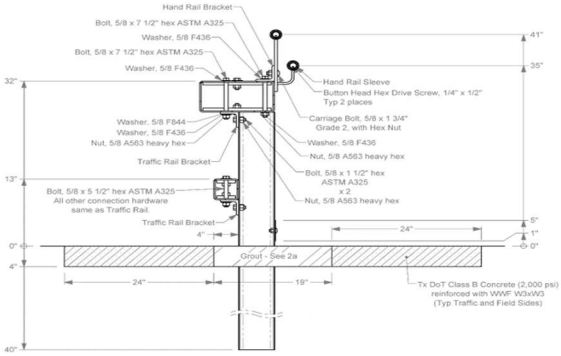


Figure 2. Cross Section of Multi-Functional Barrier System



Figure 2. Test Installation of Multi-Functional Barrier System

Source: Texas A&M Transportation Institute (reproduced with permission)

Conclusions

Researchers developed a non-proprietary roadside barrier system for use in separating pedestrians, bicyclists, and other vulnerable users (including people who use a wheelchair and people who are blind or have low vision) from motor vehicle traffic. The new barrier system met goals for both the traffic and vulnerable user sides of the barrier. Its low deflection can accommodate restricted offsets of shared-use paths that would otherwise be within the deflection limits of other guardrail systems. There was no debris generated by the barrier during the design impacts following MASH conditions. Some inevitable debris from the vehicle was present, but was primarily comprised of lightweight plastic pieces that should not pose a significant threat to vulnerable users outside the deflection limits of the barrier.

References

AASHTO (2021). *Guide for the Planning, Design, and Operation of Pedestrian Facilities*, Second Edition. American Association of State Highway Transportation Officials, Washington, D.C.

AASHTO (2016). *Manual for Assessing Safety Hardware*, Second Edition. American Association of State Highway and Transportation Officials, Washington, D.C.

AASHTO (2012). *Guide for the Development of Bicycle Facilities*, Fourth Edition. American Association of State Highway Transportation Officials, Washington, D.C.

ANSYS (2025). LS-DYNA Multiphysics Solver. https://www.ansys.com/products/structures/ansys-ls-dyna

Center for Collision Safety and Analysis (CCSA) (2022) 2018 Dodge RAM Finite Element Model, George Mason University. https://www.ccsa.gmu.edu/models/2018-dodge-ram/

Center for Collision Safety and Analysis (CCSA) (2016) 2010 Toyota Yaris Finite Element Model, George Mason University. https://www.ccsa.gmu.edu/models/2010-toyota-yaris/

Dobrovolny, C., Park, S., Turner, S., Bligh, R., & Kovar, J. *Development of a MASH Barrier to Shield Pedestrians, Bicyclists, and Other Vulnerable Users from Motor Vehicles*. NCHRP Research Report 1116, National Academies of Sciences, Engineering, and Medicine, Washington, D.C.

Polivka, K., Faller, R. Sicking, D., Rohde, J., Bielenberg, B., & Reid, J. (2006). *Performance Evaluation of the Midwest Guardrail System – Update to NCHRP 350 Test No. 3-11 with 28" C.G. Height*, Report No. TRP-03-171-06, Midwest Roadside Safety Facility, Lincoln, NE.

U.S. Access Board (2011). Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way, 36 CFR Part 1190, Federal Register.

WHO (2025). Road Traffic Injuries. https://www.who.int/news-room/fact-sheets/detail/road-traffic-injuries

Safety review of a rainbow crossing at a signalised intersection

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Abstract
Safety concerns related to the potential user confusion at the Cuba Street Rainbow Crossing sparked a review of the crossing operation. The review found that pedestrian behaviour at the intersection was consistent with behaviour at other nearby intersections, and safety was greater than at other signalised crossings within a 1 km radius, due to traffic calming resulting in very low operating speeds at the Rainbow Crossing site.

Social media post
Safety concerns related to the potential user confusion at the Cuba Street Rainbow Crossing sparked a review of the crossing operation. The review found greater safety at the Rainbow Crossing when compared to regular pedestrian crossings within a 1 km radius, due to traffic calming and resultant very low operating speeds.

Background
In 2018 rainbow flag art was painted on the pavement at a signalised intersection where a single lane, one way street intersects with a pedestrian only street in Central Wellington. This became known as the Cuba Street Rainbow Crossing. The rainbow flag road art covers the area in the middle of the intersection between the two crossing areas which are demarcated with white road marking paint. The rainbow flag was installed parallel to the direction of vehicular traffic (Figure 1).

In 2024, safety concerns were raised on the basis that the rainbow flag art too closely resembled a pedestrian priority ‘Zebra’ crossing and pedestrians could misinterpret the street layout. The concern was that the parallel rainbow flag art could have been misunderstood to indicate pedestrian right of way. Should the intended pedestrian crossings be ignored, pedestrians may cross without consideration of the control signals while vehicles were approaching.

The safety review considered New Zealand guidance and legislation as well as the functionality of the intersection by road safety experts.



Figure 1. View of Rainbow Crossing and speed cushion from carriageway

Conference Theme
The project is relevant to the Equity and Evolution Themes.

Equity
Rather than immediately removing the rainbow flag art, the review allowed all road users to be considered. The safety concerns were considered and evaluated using existing legislation and site-specific findings. Importantly, the review ensured that art promoting the inclusion of the LGBTQ+ community was protected and only removed if it truly posed a risk to safety.

Evolution
Pavement art is an emerging area in street design and road safety practice in New Zealand. Regulations to allow for this were only completed in 2020, and preliminary guidance was developed at that time, prior to any local implementation experience to draw on. Existing legislation indicates that rainbow flag art should be installed perpendicular to the direction of vehicular traffic flow (Waka Kotahi NZTA, 2020). However, the results of the safety review conclude that the road art is safe for all road users. There was more pedestrian compliance at the intersection compared with surrounding art-less crossings within a 1 km radius. This indicates that it would be valuable for the guidance to evolve over time, informed by findings from pavement art that has now been implemented in New Zealand.

Approach
The safety review first considered the Draft Handbook for Tactical Urbanism in Aotearoa – Guidance: Roadway Art (Waka Kotahi NZTA, 2020). The handbook indicates that while rainbow flag stripes are permissible in New Zealand, they should be parallel to the direction of pedestrian travel so that it could not be misinterpreted as a zebra crossing. The Rules regarding pavement art also require that operating speeds of all vehicles are at or under 30km/h at the site of the pavement art. Reference is made to the Land Transport Rule: Traffic Control Devices 2005 manual (Ministry of Transport, 2004).

A search of the Waka Kotahi NZTA Crash Analysis System for the past 10 years was conducted. The results were analysed to check for collisions that could have resulted from misunderstanding of the rainbow flag art. Operating speeds of the intersection were also reviewed.

The safety review team collected pedestrian behaviour and compliance data from the intersection on multiple occasions at varying times of day. Pedestrian behaviour was checked by noting if pedestrians were crossing in the two pedestrian crossing locations, or over the rainbow flag art. Pedestrian compliance considered whether pedestrians were adhering to the crossing signals, and if they were not, whether they were first checking for oncoming traffic before crossing. The safety review team conducted similar data collection on pedestrian behaviour and compliance at other signalised crossings within a 1 km radius of the Cuba Street Rainbow Crossing.

Findings
Crash History
The search of the Waka Kotahi NZTA Crash Analysis System of the intersection since the installation of the artwork found no evidence of collisions between vehicles and pedestrians that could have been caused by confusion related to the artwork. This indicated that there was unlikely to be a crash risk associated with a misunderstanding of the crossing operation.

Operating Speeds
A review of the traffic calming investment related to the crossing found that speed cushions installed at the same time as the pavement art in 2018 had not reduced the operating speed to the necessary level, so the local authority installed further traffic calming in 2020 to support this.

Immediately prior to the introduction of the second set of speed cushions (installed either side of the rainbow flag art work on 27 August 2020), the 85th percentile operating speed was 31.0 km/h and 17.8% of vehicles were travelling above 30 km/h. Immediately following the introduction of the second set of speed cushions, the 85th percentile operating speed reduced to 24.0 km/h and only 1.8% of traffic movements were recorded to be travelling above 30 km/h. This speed survey shows the second set of speed cushions had a significant impact on operating speeds, to within the parameters established in the Regulations, and the Safe System survivability thresholds for vulnerable road users.

Pedestrian Movement and Behaviour at the Rainbow Crossing

Pedestrians are the predominant mode using the intersection accounting for 78.3% of all movements. Pedestrian use of the intersection was significantly higher in the 5:00 – 6:00 pm period than other observed periods. Most pedestrians (77.7%) crossed at the delineated crossing locations. This proportion was significantly influenced by the 5:00-6:00pm survey where 35.3% of pedestrians crossed the painted rainbow area due to the very high pedestrian volumes in this period as pedestrians were simply spreading out across the crossing in preference to queuing behind one another. Only 5.4% of pedestrian movements were recorded across the painted rainbow area in the 8:00 – 9:00am and 10:00 – 11:00am survey periods.

Comparison with Pedestrian Compliance at nearby Locations

Observations found that pedestrian non-compliance at crossings was highly consistent across all the other sites reviewed for the study, despite significant variation in the characteristics of the intersections. Non-compliance was between 37.7% and 43.6% across all sites. Non-compliant pedestrian behaviour demonstrated a consistent pattern where a significant proportion of pedestrians observed traffic flows and crossed during a gap in traffic regardless of the traffic light cycle.

The safety review team determined that this style of highly observant non-compliant pedestrian behaviour is very common in the Wellington CBD, even in locations where traffic volumes and vehicle speeds are much higher, such as the Customhouse Quay / Waring Taylor Street intersection, which has a 50 km/h speed limit and three lanes of traffic in each direction.

The Cuba Street intersection has higher levels of non-compliant behaviour (58.4% compared to a range of 37.7 – 43.6%). The safety review team believe there are several probable reasons for this including:

- the very short crossing distance;
- relatively low vehicle volumes, which are overshadowed by the number of pedestrian movements; and
- the very slow speed environment.

It was concluded that the Cuba Street Rainbow Crossing posed a negligible risk to safety and actually had better pedestrian safety compared to other nearby intersections due to the very low operating speeds generated by the significant effort to use traffic calming devices to lower the speed.

Implications for policy and/or practice

The safety review of the Cuba Street Rainbow Crossing can be used as a case study for determining the appropriateness of rainbow street art at alternative locations. The Draft Handbook for Tactical Urbanism in Aotearoa (Waka Kotahi NZTA, 2020) concludes that rainbow flag street art can not be installed parallel to the flow of vehicular traffic for fear of misinterpretation of the road markings. As pedestrian compliance was better at this intersection compared to others nearby, policy regarding the installation of rainbow flag art could be updated.

Conclusions

The Cuba Street Rainbow Crossing has proven to have a negligible risk to road safety and there is no evidence that the design is confusing to road users. The combination of the street art with the raised speed cushions has reduced the operating speed of Dixon Street to an extremely safe level, and people crossing appear to be more influenced by the narrow road width and low traffic volume than the street art.,. Pedestrian safety is greater at this location compared with neighbouring intersections.

References

Ministry of Transport. (2004). Land Transport Rule - Traffic Control Devices 2004.
Waka Kotahi NZTA. (2020). Draft Handbook for Tactical Urbanism in Aotearoa - Guidance: Roadway Art.

Community perceptions of road safety cameras

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Abstract
Road safety cameras are an effective tool to improve compliance with specific road rules, however community perception towards enforcement by road safety cameras varies depending on a range of factors, including personal experiences, media influence, cultural norms, and level of understanding. The Victorian Department of Justice and Community Safety (DJCS), in conjunction with the Victorian road safety partnership, sought advice from Monash University Accident Research Centre (MUARC) to better understand the association between community perceptions and road safety outcomes. Three waves of community perceptions surveys from the Office of the Road Safety Camera Commissioner were analysed to inform MUARC's findings. Pending outcomes of this research, the Victorian road safety partnership will be better informed about community perception towards road safety cameras and whether there are particular areas of focus to strengthen community sentiment in order to achieve better road safety outcomes for the Victorian community.

Social media post
How much is compliance with road rules influenced by community perception towards road safety cameras? This presentation seeks to outline the association between community perception and road safety behaviours, using survey data commissioned by the Victorian Road Safety Camera Commissioner.

Background
This extended abstract seeks to address the Conference theme of Equity. Effective road safety cameras programs deter high risk driving behaviours, thereby improving road safety for all road users. Through this work, DJCS aims to increase its understanding of the association between community perceptions of road safety cameras and behaviours which affect the safety of all Victorian road users.

Road safety cameras are a proven, effective tool for supporting compliance with some important road safety behaviours and reducing road trauma. The way that road safety cameras improve road safety outcomes can be explained through the principles of deterrence theory. Deterrence theory in road safety suggests that the effectiveness of road safety cameras relies on the certainty, severity and swiftness of sanctions associated with the illegal behaviour. In other words:

- you must believe that there is a reasonable likelihood of being caught,
- the severity of the penalty must be sufficient to influence your behaviour to be compliant,
- the sanction must be applied in a timely manner so that it is more strongly connected to your behaviour.

The introduction of automated enforcement through road safety cameras was first introduced in Victoria with red-light intersection cameras in 1983, followed by mobile road safety cameras in 1990. These developments presented a significant increase in enforcement activity which in turn increased the likelihood of getting caught ('certainty' in deterrence theory). Over time, these programs have grown, resulting in a greater spread of enforcement activity across the state.

However, due to the inextricably linked relationship between enforcement and monetary penalties ('severity' of sanction in deterrence theory), claims of governments using road safety cameras for revenue raising have never been far away. This is despite monetary penalties being only one component of the severity of penalties/sanctions with others including loss of demerit points, licence sanctions and relicensing conditions.

Community perceptions towards road safety cameras wavers and little is known about whether changes in community perceptions over time translate through to changes in compliance levels and hence road safety outcomes.

Project Overview

Surveys of community attitudes towards road safety cameras have been conducted over many years. In Victoria, the Office of the Road Safety Camera Commissioner (ORSCC) has engaged EY Sweeney to undertake three waves of its community perceptions survey – in 2017, 2020 and in 2023. The survey was initially launched to research community awareness and perceptions of road safety cameras and the ORSCC, with subsequent waves highlighting changes in the perceptions and behaviours of the Victorian community since 2017. Results and/or findings from these surveys have been published on the ORSCC public website.

The three waves of the ORSCC survey involved online interviews with participants over the age of 18 years and currently residing in Victoria. The number of participants for each survey wave were:

- Wave 1 – 1204 respondents
- Wave 2 – 1233 respondents
- Wave 3 – 1223 respondents

Some of the key findings from the most recent wave of the survey include:

- Deliberate speeding and attempts to avoid camera detection are highly prevalent in Victoria
- Infringements continue to positively impact speeding behaviour
- A strong correlation exists between traffic infringements and collisions
- Distracted driving and seatbelt cameras now widely recognised within Victoria

While these surveys have provided some valuable insights, including changes in community perception over time towards various parts of Victoria's road safety camera program, the correlation between community perceptions and real-world compliance (around speeding, red-light running, illegal portable device use while driving and seatbelt wearing) in Victoria is largely unknown. For example, if there is a decrease in community support for a particular road safety camera program, does it follow that there will be an increase in the non-compliant behaviour that the program is seeking to deter?

To help answer this question, and others, the Victorian Road Safety partnership sought advice from Monash University Accident Research Centre under the baseline program of road safety research.

Approach

DJCS manages Victoria's road safety camera programs which address speeding, red-light running, illegal portable device use and not wearing a properly adjusted and fastened seatbelt.

As part of the baseline program of road safety research, funded by the Victorian road safety partners and delivered by MUARC, DJCS garnered support from the road safety partnership to request advice from MUARC using survey data from the three waves of the ORSCC Community Perceptions survey.

To respond to the key research questions, MUARC's methodology included the following tasks:

1. Controlled cross-sectional analysis of factors associated with high-risk behaviours and crash risk
2. Time-based analysis of factors associated with program acceptance, high risk behaviours and crash involvement

Through this research, we aim to develop a better understanding of the association between acceptance of road safety cameras, high-risk behaviours and crash risk, and whether there have been any changes in these factors over time.

While MUARC's analysis is currently underway, it is scheduled to be completed by mid-2025, enabling results to be presented at the Conference in October 2025.

Benefits to Road Safety and Implications for Policy and/or Practice

Advancing our knowledge around community perceptions and beliefs towards road safety camera programs and how much these shape people's behaviours can influence our engagement and communication regarding road safety cameras. Furthermore, an increased understanding of community perceptions towards road safety cameras could influence future operations of road safety cameras to increase compliance rates and deliver better road safety outcomes for the Victorian community.

Conclusion

Since their inception, road safety cameras have been supported by some members in the community, however there remains a proportion of the community who hold the view that cameras are nothing more than a revenue raising tool for government. While various external reviews and academic evaluations have validated the road safety benefits of road safety cameras, the extent to which community perception and support for road safety cameras actually influences behaviours and resultant road trauma is less well understood. This research, the findings of which are expected by mid-2025, aims to provide an insight into any association between community perception towards road safety cameras and road safety behaviours, laying the foundation for future efforts to influence community perception about road safety cameras.

Enhanced site selection tool for road safety cameras

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Abstract

Road Safety Cameras are critical in providing a deterrence to speeding, playing a significant role in supporting compliance with safe speeds. Mobile road safety cameras support the general principle that speeding drivers can be caught anywhere, anytime, whereas fixed road safety cameras typically support compliance at high-risk locations. Decisions on the placement of cameras, both fixed and mobile has traditionally been a laborious process, relying on manual assessment of different factors in isolation. An in-house road safety camera site selection tool has transformed how sites are assessed. This innovative tool integrates data from multiple sources, consolidating geospatial and crash information to rapidly evaluate locations of interest. Prior to this, site assessments were very labour-intensive, requiring site visits and physical evaluations – with a backlog of 800 sites, that would have taken more than three months to complete. With the use of this tool, the backlog was cleared within two weeks.

Social media post

Where to prioritise placement of road safety cameras for maximum road safety benefit? The development of the site selection tool has enabled DJCS to quickly and effectively assess risk at a statewide level to help prioritise the enforcement response.

Introduction

This extended abstract seeks to address the Conference theme of Evolution. Under the safe system approach of managing energy to survivable levels, enforcement (speed enforcement specifically) plays a crucial role in supporting compliance with safe speeds and other road safety behaviours. Through this innovative work, the Victorian Department of Justice and Community Safety (DJCS) has developed a tool to more readily assess risk at a statewide level to inform optimised placement of road safety cameras to deliver improved road safety outcomes.

Road safety cameras are a proven, effective tool for supporting compliance with some important road safety behaviours and reducing road trauma (Wilson et al., 2010). Research on Victoria's fixed digital speed and red light cameras found a 47% casualty crash reduction on the intersection leg where the camera was positioned (Budd et al., 2011). In addition, in its submission to a Victorian Parliamentary Inquiry, Monash University Accident Research Centre stated that implementation of the 75% increase in mobile camera operations in rural sites could be expected to save 22.5 fatal crashes and 172 serious injury crashes per year (s66---monash-arc_redacted.pdf).

Road safety camera enforcement cannot be at every intersection and on every road or highway across the state. One of the key challenges for DJCS and Victoria Police, is the determination of where to place new fixed road safety cameras and where to deploy mobile road safety cameras for maximum road safety impact.

Currently in Victoria, mobile road safety cameras operate for 16,300 hours per month at sites selected from more than 2000 Victoria Police approved locations. Additionally, Victoria has 326 fixed camera sites across 276 intersections and 50 highway locations.

The Road Safety Camera Site Selection Committee (the Committee) was formally created over a decade ago as a central representative body with the function of assessing, prioritising and identifying potential fixed road safety camera sites based on the risks to road users and recommending enforcement and/or non-enforcement options to minimise risks to road users and improve road safety outcomes. As part of this function, the Committee accepts submissions from the public for suggestions of new road safety camera sites.

The previous site selection process involved the Committee setting up monthly meetings and discussing public submissions based on professional knowledge of the location and observations made through Google Maps. Where additional information (such as crash history, traffic signal configuration, existing enforcement infrastructure) were required, the relevant members of the Committee would obtain the information from various sources, and the discussion would be deferred to a later meeting.

Over the decade, an increase in the number of submissions was observed to the point that the Committee could not keep up with the assessments. Additionally, the committee did not have the capacity to pro-actively pinpoint and assess the highest risk locations outside of what was being suggested by the public.

Overview

Recognising the potential for improvement to the site selection process, a proof of concept was developed to integrate spatial data processing into the site selection workflow.

The proof of concept provided analysts with contextualised spatial insights, resulting in the clearance of an 800-site backlog within two weeks. Additionally, it enabled the identification of the riskiest sites across the state with increased accuracy and efficiency. Further development has enhanced the tool's capability to analyse historical crash data and commercial telemetry data for intersections, road segments, and nominated points, providing contextualised risk assessments in a comprehensive spatial environment.

Hosted in the cloud, this opensource system delivers data-driven insights using an ETL pipeline and spatial analysis that significantly improve situational awareness and decision-making. This innovation has transformed the site selection process, reducing the time required to evaluate single sites from days to hours. By streamlining operations and shifting the paradigm towards an evidence-based approach, this solution has set a new standard for efficiency and effectiveness in public service road safety initiatives.

Implications for policy and/or practice

The development of the site selection tool has provided DJCS with a number of potential use cases, including:

Use case 1: Analyse suggested locations in the context of state-wide data. Any suggested location can be very quickly assessed for "risk" and placed in the context of state-wide priorities. DJCS can also aggregate suggested locations, identifying clusters of public concern.

Use case 2: Analyse known areas. DJCS can analyse intersections, road segments and points state-wide. This can be used by analysts to identify areas where behaviour change has worked, or is needed.

Use case 3: Analyse the effectiveness of enforcement at existing sites. When combined with speed compliance data and traffic volume DJCS can use this tool to begin to assess the effectiveness of existing road safety camera sites.

Use case 4: Developing if/then scenarios. Using historical data and employing linear regression the program developed for the site selection tool can begin to estimate the probable effect of placing a fixed camera at a given location. NOTE: this is not Predictive modelling.

Limitations/constraints

While this tool is not designed to replace a human analyst, it is imperative that human analysts understand the limitations of the tool and the data fed into the tool. For example, the telemetry data only represents a small, very specific subset of the Victorian fleet, however this will increase over time; Data ingested by the tool may be incomplete, may be of a different time period and will often not be referenced to the same base datasets.

This tool does not make a decision on site selection, rather its use is to effectively inform site selection decisions in a more efficient manner, taking into account the various factors and objectives of site selection (including specific and general deterrence).

Conclusions

While the development of the site selection tool has already been utilised to good effect by clearing the backlog of 800 sites for assessment of road safety risk and suitability for an enforcement response, significant potential remains as described by the use cases above. DJCS is considering how to enhance the tool so that the data can be more accessible to staff and systems beyond the analysts conducting site assessments.

References

Wilson C, Willis C, Hendrikz JK, Le Brocque R, Bellamy N. Speed cameras for the prevention of road traffic injuries and deaths. Cochrane Database of Systematic Reviews 2010, Issue 11. Art. No.: CD004607. DOI: 10.1002/14651858.CD004607.pub4

Budd, L., Scully, J., & Newstead, S. (2011). Evaluation of the Crash Effects of Victoria's Fixed Digital Speed and Red-Light Cameras. Monash University Accident Research Centre – Report #307 Evaluation of the Crash Effects of Victoria's Fixed Digital Speed and Red-Light Cameras - Accident Research Centre

De-colonising road safety: Aboriginal Moiety and the Safe System approach

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Abstract

While NSW has adopted a Safe System approach aimed at reducing fatalities and serious injuries, Aboriginal people continue to be disproportionately represented in road trauma and experience poorer health outcomes following a crash. Although various crash prevention initiatives are currently in place, the existing system does not adequately address the impact of harm after a crash. This presents a critical opportunity to integrate Aboriginal cultural frameworks, such as Moiety – social divisions based on ancestry, kinship, and collective responsibility – into post-crash care. Incorporating these cultural foundations would help ensure that the system is inclusive, culturally safe, and responsive to the specific needs of Aboriginal communities. Moving beyond a narrow clinical focus, it is essential to acknowledge and understand the collective trauma experienced by Aboriginal people. This broader approach would foster trust, promote Aboriginal self-determination in policy and program development, and ultimately lead to better road safety and health outcomes for all.

Social media post

How do we make the Safe System approach work for Aboriginal people? Acknowledging – and incorporating – Aboriginal Moiety will ensure that the impact of road trauma on kinship structures becomes part of the solution to addressing disproportionate road crash rates in Australia.

Conference theme

Evolution: Through an exploration of an alternative approach to the Safe System framework adopted by the NSW State Government, this paper aligns with the theme *Evolution*. The inclusion of an Aboriginal lens on this key policy framework challenges the existing approach and offers an inclusive way forward for road safety practitioners and policy experts.

Equity: Addressing Aboriginal road safety should begin with an acknowledgement that many government policies have not been co-designed with those most impacted. Consequently, there is a legacy of mistrust that must be recognised and addressed to effectively counter the systemic and institutional barriers experienced by too many Aboriginal people. Incorporating a key aspect of Aboriginal culture and identity into a policy framework ensures that this paper also aligns with the theme *Equity*.

Introduction

Transport has a key role to play in Closing the Gap – both as an enabler for social, economic, educational, health and cultural outcomes and through transport-specific outcomes, including road safety. The Safe System approach to road safety has been part of the Australian road safety policy framework since 2014. It challenges traditional thinking and understanding of how to address road trauma, looking at how the elements of the road transport system can work together to protect people from being killed or seriously injured (Austroads, 2020). Underpinned by the Safe System approach, the Towards Zero vision is based on the belief that no one should be killed or seriously injured from using the road network (Towards Zero Foundation, 2015).

While post-crash care – involving emergency treatment, trauma care and rehabilitation – has been formally adopted into the Safe System approach in many jurisdictions, the NSW State Government's 2026 Road Safety Action Plan contains no mention of this key aspect of road safety. Importantly, even jurisdictions that *do* embed post-crash care in their Safe System approach, focus solely on the clinical aspect of care, which fails to incorporate interventions that address the impact of historical and ongoing trauma on Aboriginal people's engagement with road safety and health services.

It is widely recognised that enhanced post-crash care produces better road safety outcomes (Turner, et al., 2021). However, evidence indicates that Aboriginal patients are often reluctant to access available health services, and in some cases, are actively excluded from them. Although Aboriginal people are 30 per cent more likely to be hospitalised due to road crashes – frequently resulting in serious disability or long-term health conditions – medical literature reveals

concerning disparities in hospital care. Aboriginal people are 1.5 times more likely to leave hospital before being seen by a medical practitioner, and 2.5 times more likely to discharge themselves against medical advice, compared to non-Aboriginal people (Edmonston, 2016). With Aboriginal people far less likely to receive the same post-crash care as non-Aboriginal people, the current Safe System framework does not recognise the Aboriginal experience of road trauma.

There is an urgent need for a road safety policy framework that not only includes Aboriginal perspectives but also demonstrates active respect for their experiences, as a means of achieving systemic improvements in outcomes for Aboriginal road users. Integrating trauma-informed care with cultural governance structures, such as Moiety, is essential to building safer, more effective, and culturally respectful road safety approaches.

Implications for policy and practice

In Aboriginal culture, Moiety is a system of social organisation and a foundational aspect of kinship and governance. Moiety governs relationships, responsibilities and decision-making. Deeply embedded in the traditions and spiritual life of Aboriginal people, each Moiety typically has specific roles, responsibilities, and customs – ensuring that individuals are connected to both their immediate family group and a broader cultural framework (McConvell et al., 2018). For Aboriginal people, Moiety encompasses an individual's obligations to other people, the land, and natural resources. It constitutes a system that governs the relational dynamics between individuals and their environment, with the overarching aim of fostering societal cohesion and harmony. It defines not only the responsibilities individuals bear toward one another, but also the way these obligations manifest through ways of communication, ceremonial practices, funeral rites and mourning, and established behavioural norms. Individuals are duty-bound to adhere to its principles and fulfill their responsibilities through their actions.

An example of the effective integration of Moiety into the Safe System framework would be training healthcare providers in culturally safe care practices, including how Moiety, kinship, and Sorry Business influence care decisions and discharge planning. With cultural liaison officers embedded in hospitals and recovery services to support Aboriginal patients after road trauma, correct communication channels to talk about sensitive issues such as illness or death could be identified early. This would help avoid breaches of cultural protocol, ensure respectful engagement and build trust between the health system and the Aboriginal community.

While the disproportionate statistics for Aboriginal road users are often blamed on transport disadvantage, including geographic remoteness, lack of access to driver training and licensing, or lower road safety literacy levels, this leads to a misguided focus on ‘fixing symptoms’ rather than ‘building on strengths’ inherent to Aboriginal communities (McPhail-Bell & Bond, 2015). Moiety is a “powerful prescriptor of Aboriginal social behaviours and interactions” (Shore & Spicer, 2004), suggesting that its incorporation into a policy framework such as the Safe System approach could tap into collective pride and unity. An example of integrating Moiety in this context would be partnering with a local Aboriginal community to co-design a culturally appropriate road safety campaign. Recognising the importance of Moiety in community structure and decision-making, this would involve Elders, knowledge holders, and community representatives shaping messaging, selecting campaign imagery, and advising on appropriate dissemination strategies. The campaign would use language, symbols, and stories that reflect each Moiety's perspectives, ensuring cultural legitimacy and broader community acceptance.

Moiety also provides a pathway for policy development and implementation that has not yet been explored in Australian jurisdictions – including NSW. While Transport for NSW has developed Guiding Principles and Framework for Aboriginal Engagement (Transport for NSW, 2021) and has committed to working in partnership with Aboriginal organisations and communities through the National Agreement on Closing the Gap, there remains a fundamental disconnect between these agreements and the lived reality of road safety policy and practices in NSW. An example of integrating Moiety in this context could be through policy monitoring and evaluation. Rather than relying only on traditional metrics, an inclusive design would prioritise culturally relevant indicators of success, such as community participation, trust levels, and increased engagement. In addition, qualitative feedback would be valued in the same way that quantitative data around injury and fatality rates is. This could include the use of Moiety-informed feedback loops, such as storytelling circles or yarning sessions with each moiety group, to review policy effectiveness. Policy or program impact would also be reviewed regularly through already existing governance frameworks such as Local Decision Making, allowing for iterative improvements, rather than simply an assessment at the end of funding cycle.

Conclusion

The Safe System approach is the accepted foundation for road safety policy and practice in NSW and all other Australian jurisdictions. To ensure that the unique experiences of Aboriginal people are reflected in this approach, a

change is needed. Aboriginal Moiety provides a pathway to that change by encouraging all road safety decision makers and practitioners to understand that – for Aboriginal communities – road safety is a collective responsibility, and any intervention designed to address road trauma must reflect that.

References

Austroads (2020). The Safe System Approach. Traffic Management Training Module, Safe System Approach to Traffic Management. Online course.

Edmonston, C. J. (2016). Profiling Indigenous & non-Indigenous road trauma in rural and remote North Queensland: it's not all black and white (Doctoral dissertation, Queensland University of Technology).

McConvell, P., Kelly, P. & Lacrampe, S. (Eds.). (2018). Skin, Kin and Clan: The dynamics of social categories in Indigenous Australia. ANU Press, Canberra.

McPhail-Bell, K., Bond, C., Brough, M. & Fredericks, B. (2015). 'We don't tell people what to do': ethical practice and Indigenous health promotion. Health Promotion Journal of Australia. Dec. 26(3): 195-199. doi: 10.1071/HE15048.

Senserrick, T., Ivers, R., Martinuik, A., Clapham, K., Lyford, M. & Grzebieta, R. (2011). Safe System demonstration project involving an Indigenous community: Literature review and methods (AP-R377A/11). Sydney: Austroads.

Shore, J. & Spicer, P. (2004). A model for alcohol-mediated violence in an Australian Aboriginal community. Social Science & Medicine, 58, 2509-2521.

Towards Zero Foundation (2015). Safe System Principles. Website. https://www.towardszerofoundation.org/the-safe-system

Transport for NSW (2021). Ngiyani Winangaybuwan Bunmay, Principles and Framework for Aboriginal Engagement. Available at: https://home.transport.nsw.gov.au/documents/sppreview/417bb480-bfc6-4298-b10b-c494c0d6d335

Turner, B., Job, S. & Mitra, S. (2021). Guide for Road Safety Interventions: Evidence of What Works and What Does Not Work. Washington, DC., USA: World Bank.

Road safety in specialist school settings

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Abstract
A survey of Victorian Specialist Schools was undertaken by the TAC in 2024. This survey compliments surveys taken of primary and secondary schools in 2023. The Specialist School survey garnered responses from representatives of 38 Specialist Schools from across Victoria. The aim of this survey was to ascertain how Specialist Schools are implementing road safety education into their school programs and policies. This survey establishes a benchmark for future evaluations of the new road safety measures being implemented across all education settings in Victoria. The research findings will assist Government Road Safety agencies in identifying opportunities to enhance road safety both within and around school environments. Understanding the unique road safety challenges faced by Specialist Schools can help relevant agencies provide the most appropriate support to improve safety in these settings.

Social media post
Research among Specialist Schools found that teaching and improving road safety is a high priority. Many Specialist Schools incorporate road safety into the school curriculum. This research highlighted the road safety strengths and challenges faced by specialist schools when considering the diverse needs of their students.

Background
Victorian Specialist Schools provide tailored education for students with disabilities and high needs, encompassing a range of intellectual, physical, sensory, and psychosocial conditions. These schools operate under specific enrolment criteria aligned with their area of specialisation and aim to deliver highly individualised support to maximise student engagement and learning outcomes (Anderson & Boyle, 2015; Graham, 2020). The built environment often presents barriers limiting participation of students with disabilities in everyday activities, including safe navigation of school surroundings (Jackson, 2018). As a result, specialist schools require differentiated approaches to design, infrastructure, and engagement, particularly in high-risk areas such as road safety. Despite heightened vulnerabilities and the need to understand how road safety is incorporated into specialist school policy and practice, limited research exists.

This survey aimed to address the gap by capturing how Victorian Specialist Schools engage with road safety education, policy development, and external partnerships. A total of 96 Victorian Specialist Schools were invited to participate in this survey, with a final sample of 38 completed surveys being achieved. Establishing a baseline understanding of current practices will assist in identifying tailored strategies to support safer travel environments for students in specialist school communities. The Victorian Government Road Safety Education agencies sought to understand current road safety education efforts in specialist schools and identify opportunities to build effective road safety policies, improve practice and advocate for improved road safety in the school community. This research establishes a baseline understanding of the use of road safety programs and policies and the level of external engagement undertaken by Specialist Schools. These findings will inform future practice in designing targeted educational resources and working to improve the safety of the students and the wider school precinct to ultimately improve the safety of specialist school students. Future survey results will continue to be recorded and tracked over time.

Conference Theme
This research aligns with the ARSC 2025 theme of Equity, Elasticity, Evolution by addressing **equity** in road safety education for students with diverse needs, advocating for adaptable policies and programs (**elasticity**), and contributing to the **evolution** of safer school environments through improved infrastructure and stakeholder collaboration.

Project Description
A quantitative survey was conducted between May 2024 and July 2024 with representatives from 38 Victorian Specialist Schools. This survey measured road safety program participation, curriculum inclusion, communication with parents, and prioritisation of road safety concerns. The research builds on prior studies among Victorian primary and secondary schools, ensuring a comprehensive understanding of road safety education across different school types.

Results

The survey achieved broad uptake of specialist schools across Victoria [participating specialist schools: n=38; total sample specialist schools: n=96]. Key findings indicate there is an opportunity to improve road safety education, engagement of specialist schools with external agencies, and the road environment around specialist schools.

Specialist schools are likely (66% of respondents) to consider road safety a high or essential priority. This was slightly higher than Primary and Secondary schools.

Table 1. Approaches to road safety in different Victorian school settings

Approach and perception of road safety	Specialist Schools (n=38)	Primary Schools (n=497)	Secondary Schools (n=139)
Focusing on road safety is a high or essential priority	66%	63%	56%
Focusing on road safety is a medium or low priority for school	34%	36%	42%
Have a standalone road safety policy	16%	8%	11%

The level of engagement in tangible road safety activities in Specialist Schools is comparable or higher than non-specialist primary and secondary schools, as is shown in Table 2 below.

Given the high prioritisation of road safety and the inclusion of road safety into the curriculum, there is opportunity for even greater engagement with road safety practices among Specialist Schools. For example, only 16% of schools reported having a dedicated road safety policy. While this is higher than non-specialist primary and secondary schools it does present an opportunity to engage further and more proactively with Specialist Schools on road safety.

Table 2. Road Safety Delivery over the last five years

	Specialist Schools (n=38)	Primary Schools (n=497)	Secondary Schools (n=139)
Delivered a road safety program	70%	67%	77%
Delivered road safety as part of the curriculum	63%	48%	45%
Have a standalone road safety policy	16%	8%	11%

School representatives were asked to rate the level of risk they believed different road safety issues posed to their students. Each respondent rated their perceptions of risk on a scale of 1 to 5, with 1 being ‘not a risk’ and 5 being ‘very high risk’. The road safety issues that were considered to present the highest level of risk were parking and congestion around school drop-off and pick-up times and drivers exceeding the speed limit. Driver behaviour, the presence of heavy vehicles and inappropriate speed settings were all regarded as posing considerable risk.

Table 3. Perceived risks to students in the school environment

Safety Issues	Risk rating
Parking and congestion at school drop off and pick up	3.9
Drivers exceeding the speed limit	3.8
Driver behaviour around designed crossing points	3.4
Heavy vehicles on the roads around the school	3.3
Speed setting not appropriate for the environment around the school	3.1
Location of, or routes to public transport stops or stations	2.7
Lack of footpaths	2.5
Safety of railway crossings in the area	2.0

Just under two thirds of Victorian Specialist Schools surveyed report taking action to improve the road safety environment outside of the school gate over the past 5 years. Given the majority of Specialist Schools regard road safety to be a high or essential priority and having concerns about safety issues around their schools, there is some potential for Specialist Schools to be supported and encouraged to advocate more for improvements in their school neighbourhoods.

Table 4. Action outside the school gate in different Victorian school settings

	Specialist Schools (n=38)	Primary Schools (n=497)	Secondary Schools (n=139)
Have acted outside the school gate to improve road safety in the last five years	63%	74%	68%

Benefits to road safety

This project is part of a large-scale suite of baseline surveys of schools and early learning services in Victoria to gain an in-depth understanding of the current state of road safety knowledge and practices. Baseline data has provided valuable insights into how road safety is currently being addressed and the key issues and priorities within and around Victorian Specialist Schools. Research findings will be used to inform the Victorian Government Road Safety Partners in developing effective interventions that will improve road safety and contribute to a reduction in road trauma. Additional benefits may include increasing knowledge regarding best practice road safety and motivating Specialist Schools to improve road safety within and beyond their school boundaries.

Implications for policy and/or practice

Findings from this research highlight the need for targeted policy and practice enhancements to improve road safety outcomes for Victorian Specialist Schools. While specialist schools are more likely than mainstream schools to prioritise road safety, only 16% have a dedicated road safety policy. Policy development guidance and tailored resources could support schools in formalising road safety actions and commitments. Additionally, Specialist Schools could be encouraged to engage and partner with local councils and road safety stakeholders to strengthen advocacy activities and facilitate infrastructure improvements. While awareness and uptake of road safety programs and resources is relatively high, ensuring that programs and resources are tailored for the varying needs of Specialist Schools. Engaging regularly with students, educators, school leaders and parents from Specialist Schools will help ensure accessible road safety education programs and resources are widely available and utilised.

Conclusions

Victorian Specialist Schools recognise the importance of road safety and a large proportion utilise road safety education programs and resources. Opportunities exist in increasing road safety policy development as well as being more proactive in advocating for the development of safer road environments around Specialist School. The high level of interest and prioritisation of road safety as an issue for these schools could be leveraged by road safety agencies to offer targeted interventions, policy enhancements, and greater stakeholder collaboration. Future research will track the impact of these recommendations over time.

References

Anderson, J., & Boyle, C. (2015). Inclusive education in Australia: Rhetoric, reality and the road ahead. *Support for Learning*, *30*(1), 4–22. https://doi.org/10.1111/1467-9604.12074

Graham, L. J. (2020). Inclusive education for the 21st century: Theory, policy and practice. Allen & Unwin.

Jackson, M. A. (2018). Models of disability and human rights: Informing the improvement of built environment accessibility for people with disability at neighborhood scale. *Laws*, *7*(1), 10. https://doi.org/10.3390/laws7010010

Leveraging data-driven approach to promote safer cycling infrastructure in Vietnam

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Abstract
Vietnam's roads are primarily designed for motorised vehicles, leaving young cyclists vulnerable due to a lack of dedicated infrastructure. To address this, AIP Foundation and IoTeamVN, with support from FIA Foundation, launched the "Ride Safe - Bike Safety" pilot project in 2024. By using GPS tracking on student bicycles, the project mapped cycling routes in Gia Lai province, helping identify priority areas for infrastructure improvements. The Bike Safely web app visualised this data, leading to government-backed upgrades and integration into the provincial website. With strong government support, this initiative sets the stage for expanding safe cycling infrastructure and promoting sustainable mobility across Vietnam.

Social media post
"Ride Safe - Bike Safety" and its innovative approach to map student cycling routes with GPS to drive safer infrastructure in Vietnam, paving the way for a cycling-friendly future.

Background
In 2023, nearly 900 road crashes involving students aged 6-18 were recorded in Vietnam, with 490 killed and 827 injured, resulting in enormous short- and long-term losses for families and the national economy. (Vietnam Government Portal, 2023) A study in 2017 also found that 67% of Vietnamese students aged 15 use bicycles or walk to school, making them the most vulnerable road users. (Ministry of Health, 2017) However, Vietnam's road infrastructure is designed and built with the priority of motorised vehicles, such as motorcycles and cars, over other modes of sustainable transportation, such as bicycles and pedestrians. Moreover, to design cyclist-friendly roads, Vietnamese government still has meagre information to identify and prioritise investment in safe bicycling infrastructure.

Conference theme: Elasticity
This abstract introduces an innovative approach to supporting the government in identifying priority roads for cycling infrastructure. By leveraging data-driven insights, this initiative aims to create safer and more accessible environments for young cyclists while promoting sustainable transportation in Vietnam.

Project Description:
In 2024, AIP Foundation and IoTeamVN, with support from FIA Foundation, launched "Ride Safe - Bike Safety" - a one-year pilot project aimed at enhancing road infrastructure and promoting sustainable transportation among Vietnamese youth by utilising map-based technology. The project deployed 300 GPS tracking devices across 1,250 student bicycles in 11 secondary schools in Gia Lai province, providing real-time data on student commuting patterns. Each GPS device recorded the bicycle's coordinates every 20 seconds, with the data securely stored on a cloud server and displayed on Bike Safely, a web-based interactive map. This platform visualised students' commuting routes and pinpointed areas with high cyclist density. In parallel, educational activities were conducted to improve students' knowledge of cycling techniques, traffic rules, and hazard awareness, fostering safer riding behaviors.

Results
After 5 weeks of collecting data, the system recorded 27,687.32 km of travel. and showcased the recorded signal in the form of a heatmap. Based on the map, more than 100 road sections were identified and categorised into five levels based on the number of target students passing these streets, presenting the prioritised routes to the government for infrastructure improvements. Additionally, it is found from a study regarding the fleet characteristics and fuel consumption of motorised vehicles in Vietnam that a fuel-consumed two-wheel vehicle can generate an average of 46.23g/km in terms of CO2 emission to the environment. (Tran et al., 2022) Therefore, it was expected that the total travelled distance recorded during the pilot could result in a potential reduction of 1.26 tons of CO2 equivalent

The results from the pilot garnered strong government support, with 90.6% of officials recognising the value of GPS data and 93% trusting the app's findings. As a result, local authorities integrated the BikeSafely platform into the provincial website, reinforcing its role in transportation planning.

Additionally, the knowledge survey conducted among students showed significant improvement in cycling safety awareness. The rate of students with excellent or good knowledge increased from 79.8% to 92.1%, with those demonstrating excellent knowledge rising from 23.7% to 57.2%.

Benefits to road safety

Ride Safe - Bike Safety enhances road safety by identifying key cycling routes for infrastructure upgrades and reducing crash risks. It also improves student awareness through education, fostering safer cycling habits and supporting long-term policy changes for safer, more inclusive roads.

Implications for policy and practice

The Bike Safely app has proven to be a valuable tool for local authorities, enabling data-driven decision-making for cycling infrastructure development. The endorsement of this technology by the Gia Lai government represents a significant step toward safer roads for cyclists and a broader shift toward sustainable mobility starting from this province in Vietnam. Furthermore, the project's educational component has played a crucial role in shaping safer cycling behaviors and fostering a stronger cycling culture among youth.

Conclusion

Building on the success of the pilot, AIP Foundation plans to scale this initiative across Vietnam, particularly in urban areas, to further assess its effectiveness and upgrade the Bike Safely app. This pilot sets a foundation for improving cycling infrastructure and safety, offering a model for other developing nations facing similar challenges.

References

Ministry of Health (2017) 90% of children's road crashes happen to high school students. *Vietnam Ministry of Health Portal*. https://moh.gov.vn/web/phong-chong-tai-nan-thuong-tich/tin-noi-bat/-/asset_publisher/iinMRn208ZoI/content/90-so-vu-tai-nan-giao-thong-cua-tre-em-roi-vao-hoc-sinh-thpt?inheritRedirect=false

Tran, D. S., Le, H., & Yang, Z. (2022). Two-wheelers in Vietnam: A baseline analysis of fleet characteristics and fuel consumption in 2019 and 2020. *International Council on Clean Transportation.* https://theicct.org/publication/2w-lvs-vietnam-asia-baseline-feb22/

Vietnam Government Portal (2023) Government Directive 31/CT-TTG. *Vietnam Government Portal*. https://vanban.chinhphu.vn/?pageid=27160&docid=209268

Do life satisfaction and risk perceptions impact drowsy driving?

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Abstract
Drowsy driving is a leading cause of crashes, yet psychosocial factors leading to it are underexplored. This study examined if life satisfaction and risk perceptions, included as part of an extended Theory of Planned Behaviour (TPB), predict drowsy driving intentions and behaviour. Participants (N = 166, *M* = 27.38, *SD* = 12.16) completed two linked online surveys, making responses in relation to written scenarios that manipulated time and social pressures, and a third control scenario. Regression analyses found that attitudes, subjective norms, Perceived Behavioural Control (PBC) significantly predicted intentions, but life satisfaction and perceived risk did not. Intentions alone predicted behaviour. Repeated measures ANOVA indicated that time and social pressures significantly increased drowsy driving intentions. The findings suggest that interventions could particularly target PBC for drowsy driving along with situational time and social factors to mitigate drowsy driving.

Social media post
Study finds perceived behavioural control (PBC) and time and social pressures are more important than life satisfaction or risk perceptions when it comes to drowsy driving.

Introduction
Drowsy driving, defined as operating a vehicle while sleep-deprived, represents a road safety concern in both professional and non-professional road user contexts. The effects of sleep deprivation include increased reaction time, reduced hazard perception ability, and increased risk of microsleep, all of which may greatly contribute to car crashes. Studies have equated 17 hours of sleep deprivation with a Blood Alcohol Concentration of 0.05% and 24 hours with a BAC of 0.10% (Dawson & Reid, 1997). Research also suggests drowsy driving is very common, that there are few feasible ways to enforce laws against it, and that it is generally considered to be more ‘acceptable’, ‘necessary’, and less dangerous than other risky driving behaviours (Vanlaar et al., 2008; McNicholas, 2019). Given these mixed perceptions of drowsy driving as an illegal but acceptable behaviour, decisions to engage in it may be influenced by factors more typically associated with positive behavioural engagement as well as those related to risk-taking.

The Theory of Planned Behaviour (TPB; Ajzen, 1991) is a flexible framework that has been previously used to understand intentions to and engagement in drowsy driving (Jiang et al., 2017) through three key psychosocial constructs: attitudes, subjective norms, and perceived behavioural control (PBC). Perceived risk is a construct that is commonly applied in extended TPB studies which captures assessment of both the likely occurrence of an event and the severity of its consequences; research suggests that higher perceived risk facilitates preventative health behaviors and has been implicated in reduced drowsy driving intentions (Harbeck et al., 2018; Lee & Beck, 2019). Life satisfaction, representing the cognitive component of subjective wellbeing (Carrillo et al., 2021) and defined as contentment with personal circumstances compared to internal standards (Diener, 1984), has been associated with reduced risky driving (Bowen et al., 2020). However, it appears that life satisfaction is yet to be comprehensively investigated in relation to drowsy driving. As a cognitive construct, life satisfaction is readily able to be included in an extended TPB framework.

The present study examines four hypotheses: it is predicted that, when controlling for demographics, driving history, and sleep quality indicators, (1) more positive attitudes towards, greater subjective norms (i.e., more perceived social approval) and a higher level of PBC over drowsy driving will be associated with stronger intentions to drive while drowsy; (2) when controlling for the standard TPB variables, higher perceived risk associated with drowsy driving will predict weaker intentions to drive while drowsy; (3) when controlling for the standard TPB variables and perceived risk, greater life satisfaction will be associated with weaker intentions to drive while drowsy; and (4) stronger intentions, higher PBC, lower perceived risk and weaker life satisfaction will be associated with higher self-reported engagement in driving while drowsy. The study also examined if external time and social pressures impact upon intentions to drive while drowsy.

Method

The study consisted of two quantitative online surveys. The first section of survey 1 investigated sociodemographic (age, gender, license type, State of residence, employment), driving history (hours driven per week, crash involvement, fines/demerits), and sleep quality indicators (current diagnosis of sleep/sleep-related disorder, self-rated sleep quality). The employment item asked if participants were a Fly-in, fly-out/Drive-in, drive-out worker, professional driver, or shift worker as these roles may impact opportunities for sleep or sleep schedules. Participants then answered questions examining perceived risk and life satisfaction. Following this, they read three scenarios presented in random order which described situations where drowsy driving was possible. One scenario manipulated either time or social pressure while the third was a control scenario (see Table 1). Participants responded to items investigating the standard TPB constructs (attitudes, subjective norms, PBC) in response to each scenario (i.e., three times each). At the conclusion of survey 1, participants were invited to provide an email to participate in a follow-up survey, which was sent to those who accepted, and asked three questions relating to their drowsy driving behaviour in the two weeks after submitting survey 1. Participant responses to both surveys were associated with each other using a self-generated, anonymous ID code.

Table 1. Drowsy driving scenarios read by participants

Condition	Scenario
Control	You have woken up after only getting a few hours of sleep, and you are still feeling quite drowsy. It is a clear day and you are deciding if you will drive your car.
Time pressure	You have woken up after only getting a few hours of sleep, and you are still feeling quite drowsy. **You have to go to work**. It is a clear day and you are deciding if you will drive your car.
Social pressure	You have woken up after only getting a few hours of sleep, and you are still feeling quite drowsy. **You have to go to a close friend's birthday party**. It is a clear day and you are deciding if you will drive your car.

Participants (N = 166; M = 27.38 years, SD = 12.16, years; Female = 78%; Open license = 66%) had to be aged at least 17 years, hold a current (P1, P2 or Open) Australian driver's license and live in Australia. However, due to scenario randomisation and participant dropout, a slightly smaller and different subsample of responses were used in the analyses for each scenario (see table 2). Similarly, the optional nature of the second survey resulted in a smaller, different subsample of 57 participants (M = 29.09 years, SD = 12.97 years; Female =80%; Open license = 70%). Independent groups t tests found no significant differences between females and males suggesting that the gender imbalance in the samples was not a major consideration for the analyses. Preliminary analyses examined intercorrelations between all the variables; non-theoretical variables (e.g., age) that were significantly correlated with at least one of the theoretical variables (e.g., intentions) were retained for the main analyses. The main analyses were three separate hierarchical multiple regressions that examined the effects of age, gender, license type, hours driving per week (step 1), perceived risk (step 2), the standard TPB variables (step 3), and life satisfaction (step 4) on drowsy driving intentions related to each scenario collected in survey 1. Similarly, a linear multiple regression was used to assess the link between intentions, PBC, perceived risk and life satisfaction from survey 1, and self-reported drowsy driving behaviours from survey 2. A repeated-measures Analysis of Variance (ANOVA) with a Greenhouse-Geissler correction and follow-up pairwise comparisons were conducted to establish if there were significant differences between the intentions reported in each scenario. Ethics approval (8423) from the QUT Human Research Ethics Committee was obtained before commencing data collection.

Results

Overall, step 4 in each of the hierarchical multiple regressions and the linear multiple regression predicting behaviour was significant (table 2). PBC was a significant predictor of intentions in each hierarchical regression, attitudes was a significant predictor in two regressions. Subjective norms, hours spent driving per week, and sleep quality were significant predictors in one regression apiece. Risk perceptions and life satisfaction were not significant predictors in step 4 of any hierarchical regression. Intentions was the only significant predictor of self-reported drowsy driving behaviour in the linear multiple regression. The results of the repeated measures ANOVA indicated a significant difference in intentions based on the scenario, $F(1.996, 307.332) = 24.188$, $p < .001$, partial $\eta 2 = .136$. Bonferroni-adjusted post hoc pairwise comparisons indicated that intentions were significantly higher in the time pressure scenario (M = 4.14, SD = 1.72) than in the control (M = 3.49, SD = 1.64; $p < .001$) and social pressure scenarios (M = 3.74, SD = 1.69; $p < .001$), and between the social pressure and control scenarios ($p = .019$). Therefore, the results partially supported hypothesis one and four but not hypothesis two and three.

Table 2. Summary of the results of the regression analyses.

	N	F(df)	p	R^2	R^2 (adj)	Significant predictors in the final step
Control	160	18.574(12,138)	<.001	.62	.58	Hours driving (+), Sleep quality (-), Attitudes (+), PBC (+)
Time pressure	161	11.696(12,136)	<.001	.51	.46	Subjective norms (+), PBC (+)
Social pressure	160	13.565(12,137)	<.001	.54	.50	Attitudes (+), PBC (+)
Behaviour	57	6.754(4,52)	<.001	.34	.29	Intentions (+)
R^2 = coefficient of determination, R^2 (adj.) = adjusted coefficient of determination; '+' = positive relationship, '-' = negative relationship.						

Benefits to road safety

This study examined some potentially important psychosocial predictors of drowsy driving, an illegal and dangerous driving behaviour, yet one that is commonly engaged in and perceived as acceptable despite its risks. The current study highlights the importance of PBC for drowsy driving as an indirect predictor of drowsy driving behaviour via intentions. The study also emphasises the importance of external situational and contextual factors, such as time and social pressure, in relation to drowsy driving intentions. Future research could expand upon these findings by examining the effect of more diverse social situations with differences in perceived social obligation, such as attendance at a loved one's funeral or a culturally significant event such as the ANZAC Day Dawn Service.

Implications for policy and/or practice

The study findings suggest that interventions targeting drowsy driving in the general population should focus particularly on PBC and situational factors. For example, public awareness campaigns could target erroneous perceptions of driving ability while drowsy, perhaps by associating the effects of sleep deprivation with those of drink-driving which are now well-understood by the public. More broadly, interventions that reduce time pressure generally, such as more flexible starting hours for school, university or work, more flexibility in working/studying from home arrangements, or greater investment in and deployment of programs to improve individual time management may also have flow on effects to reduce drowsy driving intentions and behaviours. Finally, greater investment and improvement in public transportation networks to make them safe, convenient and affordable for all people would likely reduce reliance on cars and hence intentions for and engagement in drowsy driving.

Conference themes

This study addresses the conference themes of equity and evolution. First, equity is addressed by examining drowsy driving intentions and behaviors, which have the potential to negatively affect all road users. The study further addresses the equity theme by suggesting targets for interventions at both the individual (e.g., messaging campaigns targeting individual driver's PBC for drowsy driving) and larger society, (e.g., measures to provide greater flexibility in work arrangements; development of more accessible and convenient public transport) levels. However, this study was preliminary and future research could more thoroughly investigate sociodemographic factors important for equity including aspects of ethnicity, cultural background, and socio-economic status and the interaction of these factors with external pressures to drive. The study addresses the evolution theme by thinking critically about the mixed nature of perceptions about drowsy driving, which is unique in that it is both illegal but thought to be a relatively acceptable driving behaviour, and, in doing so, this study extended the TPB to include examination of life satisfaction, a variable not previously examined in relation to drowsy driving.

Conclusion

This study investigated psychosocial factors that influence intentions and engagement in drowsy driving. While the findings were mixed, support was found for the standard TPB variables as factors that contribute to drowsy driving which may be targeted with interventions. Likewise, the study findings suggest that situational factors related to time and social pressures are important in relation to drowsy driving which could be targets for policy and practice.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179-211. https://doi.org/10.1016/0749-5978(91)90020-T

Bowen, L., Budden, S. L., & Smith, A. P. (2020). Factors underpinning unsafe driving: A systematic literature review of car drivers. *Transportation Research Part F: Traffic Psychology and Behaviour*, *72*, 184-210. https://doi.org/10.1016/j.trf.2020.04.008

Carrillo, A., Etchemendy, E., & Baños, R. M. (2021). Past, present, and future life satisfaction: The role of age, positive and negative mood. *Current Psychology: A Journal for Diverse Perspectives on Diverse Psychological Issues*, *40*(2), 629-638. https://doi.org/10.1007/s12144-018-9981-9

Dawson, D., & Reid, K. (1997). Fatigue, alcohol and performance impairment. *Nature*, *388*(6639), 235. https://doi.org/10.1038/40775

Diener, E. (1984). Subjective well-being. *Psychological Bulletin*, *95*(3), 542-575. https://doi.org/10.1037/0033-2909.95.3.542

Harbeck, E. L., Glendon, A. I., & Hine, T. J. (2018). Young driver perceived risk and risky driving: A theoretical approach to the "fatal five". *Transportation Research Part F: Traffic Psychology and Behaviour*, *58*, 392-404. https://doi.org/10.1016/j.trf.2018.06.018

Jiang, K., Ling, F., Feng, Z., Wang, K., & Shao, C. (2017). Why do drivers continue driving while fatigued? An application of the theory of planned behaviour. *Transportation Research Part A: Policy and Practice*, *98*, 141-149. https://doi.org/10.1016/j.tra.2017.02.003

Lee, C. J., & Beck, K. H. (2019). Mediational impact of perceived risk on drowsy driving intention and willingness in university students. *Transportation Research Part F: Traffic Psychology and Behaviour*, *63*, 165-173. https://doi.org/10.1016/j.trf.2019.04.008

McNicholas, W. T. (2019). Sleepiness and Driving: The Role of Official Regulation. *Sleep Medicine Clinics*, *14*(4), 491-498. https://doi.org/10.1016/j.jsmc.2019.08.006

Vanlaar, W., Simpson, H., Mayhew, D., & Robertson, R. (2008a). Fatigued and drowsy driving: A survey of attitudes, opinions and behaviors. *Journal of Safety Research*, *39*(3), 303-309. https://doi.org/10.1016/j.jsr.2007.12.007

Insights from practitioners – reporting the National Traffic Controller Safety Survey

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Abstract

Traffic controllers' workplace safety remains a significant concern, driven by ongoing reports of driver non-compliance, near-miss incidents, and abuse. This presentation shares findings from the 2024 National Traffic Controller Safety Survey, which garnered 1,575 responses from frontline workers across Australia, a 500% increase from 2023. The mixed-method survey captured detailed demographic, geographic, and occupational insights, revealing that traffic controllers with 6 to 10 years of experience and those in high-speed or low-visibility environments feel the least safe. Key findings indicate widespread exposure to verbal abuse (87%) and frequent near-misses involving distracted or speeding drivers. Trends over time suggest modest improvements in perceived safety but highlight ongoing systemic challenges. The results advocate for vigorous enforcement, public education, and structural protections. These findings underpin critical industry and stakeholder reforms and underscore the importance of longitudinal, worker-led safety data to enhance site conditions and influence advocacy efforts in national road safety policy.

Social media post

Every day, traffic controllers face speeding cars, abuse, and near misses. TMAA's 2024 survey gave over 1,500 workers a voice, and their message was clear: safety is improving, but serious risks remain. It's time for stronger protections and lasting reform.

Background

Since its establishment in 2011, the TMAA has been at the forefront of advocating for a safer traffic management industry in Australia. Representing over 170 member organisations, TMAA is committed to promoting innovation, training, and policy reform that supports a "zero harm" industry. The National Traffic Controller Safety Survey has become a key mechanism for assessing traffic controllers' lived safety experiences and identifying areas for industry-wide improvement. These insights enable TMAA to benchmark safety perceptions over time, shape best practice standards, and inform collaboration with government and road authorities.

Project Description

This project presents findings from the 2024 National Traffic Controller Safety Survey, an initiative to understand traffic controllers' safety challenges better. The study focuses on identifying key risk factors, evaluating the effectiveness of current safety measures, and recommending improvements to enhance the working conditions of traffic controllers across Australia. Insights are drawn from a diverse participant base across all Australian states and territories, encompassing gender, age, occupational role, employer size, and years in the position. The project seeks to provide a robust evidence base for enhancing the safety of workers in temporary traffic management environments.

Survey Overview

Conducted in March 2024, the online survey was distributed via TMAA member organisations and social media, resulting in 1,575 total responses, of which 1,054 were fully completed. Participants represented all states and territories, with strong representation from Victoria (35%), Queensland (27%) and New South Wales (20%). Respondents included male (59.6%) and female (40.4%) traffic controllers across various experience levels. The largest occupational groups were Traffic Control Team Leaders (35%) and Traffic Controllers (26%).

Notably, the 2024 survey includes a more representative and significantly larger dataset than previous years, enhancing the reliability of trend analysis. The 2023 survey had only 198 responses; the 2024 sample offers a national perspective with meaningful subgroup analysis.

Approach

The project employed a mixed-method design combining quantitative data with qualitative insights from open-text comments. The survey measured safety perceptions (on a scale of 0–10), risk exposure types, incident frequency, and perceived causes of workplace danger. Key variables included occupation, tenure, work environment, state location, and

type of road or site. Qualitative feedback was analysed thematically to contextualise quantitative trends and highlight worker-identified solutions. This dual approach enables diagnostic and prescriptive data use in policy and practice. The longitudinal nature of the survey enables policymakers and industry stakeholders to track progress, assess the impact of past interventions, and adjust strategies accordingly.

Results

The findings confirm several entrenched safety issues:

- Vehicle Non-Compliance & Disrespect: 53% of traffic controllers encounter vehicles failing to stop at least weekly, 5% encounter non-compliance daily, 54% report verbal abuse weekly, and 9% have experienced physical abuse.
- Near-Miss Incidents: 49% of respondents have nearly been struck by a distracted driver, and 44% have had near misses due to speeding vehicles. Poor visibility and adverse weather conditions contributed to 28% of reported near-misses.
- Safety Concerns in Specific Environments: The most significant risks are those associated with high-speed roads, site setup and removal, and working in live lanes. Notably, the time of day does not significantly impact perceived safety, suggesting that site-specific conditions are more critical in determining risk levels (Figure 1)

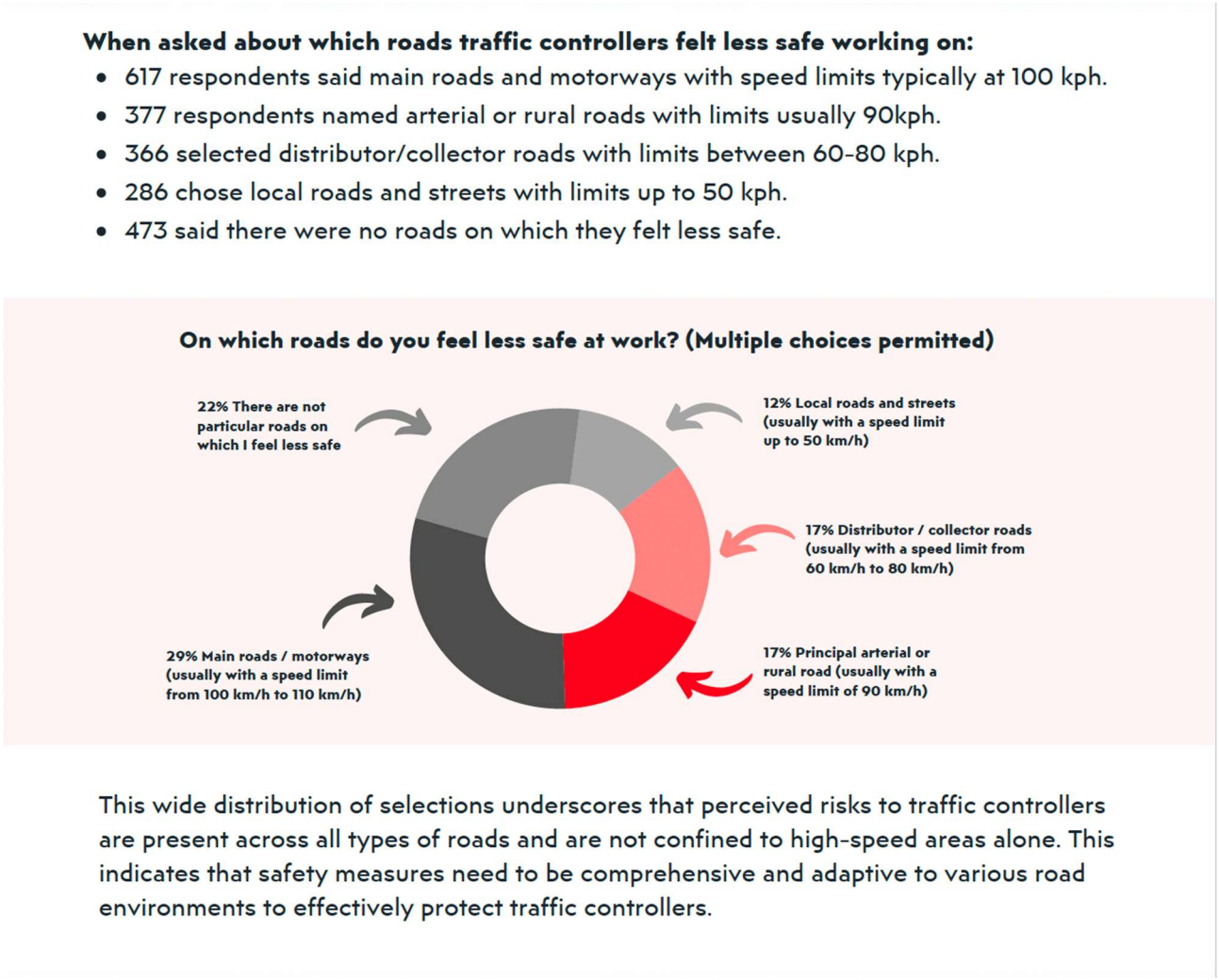


Figure 1. Survey responses about site-specific safety concerns

Despite these risks, the national safety perception average rose to 7.1, up from 6.3 in 2023. However, controllers with 6–10 years' experience reported the lowest perceived safety (mean 6.7), suggesting mid-career heightened awareness of systemic risks.

These results reveal ongoing, systemic challenges for traffic controller safety. Respondents emphasised the necessity for controls that actively minimise exposure, such as physical separation from vehicles (live lanes), speed enforcement, and public accountability measures. While training remains crucial, the data suggest that it is inadequate on its own.

Longitudinal comparisons reveal modest improvements in general safety perception; however, many core risks, like driver non-compliance and verbal abuse, either remain unchanged or have worsened in particular environments. The survey also confirms that site-specific risk factors outweigh time-of-day concerns, underscoring the importance of protocols that respond to the environment.

As one respondent put it, “The public know that there is next to nothing we can do… in my view only way is to have police presence or speed cameras… only other thing is to be able to keep controllers further off the road, for safety.” Additionally, the survey illuminates the evolving challenges of road safety by demonstrating the changing behaviours of road users and the effectiveness of implemented safety measures. The findings provide a roadmap for future technological innovations, enforcement strategies, and education campaigns/programs to reduce incidents and enhance compliance with traffic regulations.

Benefits to Road Safety

The study’s findings contribute significantly to the ongoing ***evolution*** of road safety by:

- Providing empirical data that supports evidence-based policy decisions.
- Strengthening enforcement of road rules at work zones to reduce non-compliance.
- Encouraging the adoption of advanced traffic control technologies such as portable traffic lights, boom gates, and attenuators to enhance worksite safety.
- Enhancing public awareness campaigns to foster respect for traffic controllers and increase compliance with road safety laws.
- Encouraging industry-wide adoption of high-quality training programs that include real-world, scenario-based learning experiences.
- Offering a data-driven approach to risk assessment that enables more efficient allocation of safety resources and interventions.
- Development of the Safety, Innovation and Technology subcommittee within TMAA Members to develop the industry Safety Guidelines document for dissemination to members and non-members nationally.

However, these benefits rely on continued investment and cross-sector collaboration. Survey insights alone are insufficient; implementing the recommended measures is crucial to achieve a lasting impact.

Implications for Policy or Practice

To address these challenges, TMAA is advocating for a multi-faceted approach, including:

- Enforcement Measures: Implement mobile speed cameras at traffic-controlled sites and increase visible warnings for road users.
- Public Education Campaigns: Promoting awareness of traffic controllers’ vital role, their right to a safe working environment, and the enforceability of reduced speed limits.
- Technological Innovations: Expanding the use of portable traffic lights, boom gates, attenuators, speed detection, remote-controlled signals, visibility aids and other safety-enhancing technologies.
- Training and Standards: Supporting unified national training standards and practical on-site experience. Including developing specific training and professional development through the Association.

Additionally, the survey results offer policymakers a structured understanding of high-risk areas that require targeted legislative action, such as stricter penalties for road users who disregard traffic management directives. The increasing dataset also allows for improved predictive modelling to anticipate future risks and develop proactive safety measures.

Conclusions

The 2024 National Traffic Controller Safety Survey confirms traffic controllers’ ongoing, unacceptable exposure to preventable risks. Despite minor improvements in perceived safety, core hazards remain widespread and deeply embedded. The findings highlight the necessity for comprehensive, systemic interventions beyond workforce training, including legislative, technological, and public-facing reforms. The value of this survey lies not only in its findings but also in its ability to track trends and amplify workers' voices over time. However, the persistently high rates of vehicle non-compliance and verbal abuse reinforce the need for systemic change. Future surveys will continue to build a longitudinal evidence base to drive sustained improvement and ensure that all traffic controllers return home safely.

Current practices in Fitness to Drive assessments for older adults

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Abstract
As Australia's population ages, ensuring the safety of older drivers has become a critical public health issue. Despite a decline in overall road fatalities, fatalities amongst older adults aged 75+ have increased. Fitness to Drive (FtD) assessments are essential for identifying older drivers at risk, yet current practices remain inconsistent across practitioners, and research suggests gaps in access to training and resources across several key practitioner groups. We conducted a national survey on the FtD assessment practices of 144 General Practitioners, Occupational Therapists, driving instructors, optometrists, and neuropsychologists. The findings indicate that while currently available resources are used by most practitioners, gaps and barriers are apparent in terms of access to training, access to validated tools, and the comprehensiveness and recency of available resources. These findings can guide improvements to current resources and the development of accessible training options for a range of practitioners supporting older driver safety.

Social media post
A national survey of Australian practitioners highlights key challenges in Fitness to Drive assessments for older adults, revealing barriers, training gaps, and lack of assessment tools. Addressing these barriers can enhance assessments, clinical decision making, and road safety.

Introduction
As Australia's population ages, ensuring the safety of older drivers has become a critical public health issue. Older adults, particularly those over 75, are at a higher risk of road trauma, despite a general decline in overall road fatalities (Wallis et al., 2020). Factors such as physical frailty, cognitive decline, and sensory impairment can compromise driving abilities and increase the likelihood of accidents (Anstey et al., 2005). Fitness to Drive (FtD) assessments are crucial in determining whether older drivers are medically fit as well as possessing the necessary sensory, cognitive, and motor skills for safe driving (Urlings et al., 2018). Prior research has focused on key practitioner groups that provide input into FtD assessments, such as General Practitioners, Occupational Therapists and Psychologists, and found gaps in access to training, resources, and validated assessment tools to support evidence-based assessment of older drivers (Sims et al., 2012). For example, it has been reported that the Austroads 'Assessing Fitness to Drive' guidelines, whilst widely available, may lack specificity and may not adequately meet the decision-making needs of GPs (McKernan et al., 2022, Sims et al., 2012). Given that FtD assessments are often multidisciplinary, it is necessary to understand the practice needs of all involved disciplines, and their familiarity with and barriers to using available resources to guide evidence-based practice.

Conference theme
This study aligns with the theme of 'Evolution' by examining the evolving practices and challenges related to FtD assessments for older drivers in Australia. Over the past two decades, there has been a growing recognition of the need to refine and standardise these assessments to ensure older drivers' safety whilst maintaining their independence on the road. These have led to some changes such as recent updates to the Austroads guidelines, efforts from professional bodies such as RACGP and OTA to improve practice standards and knowledge, as well the increasing availability of commercial online and app-based assessment tools. However, there is a need to understand the practice experiences of all disciplines involved in the FtD process to provide more comprehensive and coordinated efforts to improve safe systems around older drivers. Through a national survey of Australian practitioners, this research highlights the evolution of FtD assessment practices, shedding light on the barriers that hinder the adoption of evidence-based approaches. The findings reveal gaps in the familiarity and uptake of current resources and differences across practice contexts, including information on the barriers to uptake in disciplines such as optometry, geriatricians, neuropsychologists, and driving instructors, as well as OTs and GPs.

Method

A national cross-sectional survey was conducted to investigate FtD assessment practices amongst Australian practitioners, including GPs, OTs, neuropsychologists, driving instructors and optometrists. Data collection took place between 24th October – 18th December 2024. Participants were recruited through professional associations, with survey invitations distributed via newsletters and research advertisements. The survey was developed based on a comprehensive review of the literature and feedback from an expert panel. It comprised 46 questions covering the frequency and methods of FtD assessments, practitioners' familiarity with guidelines, the use of screening tools, perceived barriers, and practitioners' confidence in making FtD recommendations. Ethical approval was granted by the Human Research Ethics Committee at the University of New South Wales (approval number 7160). The survey was administered online using Qualtrics, allowing for secure and efficient data collection.

Results

A total of 144 participants responded to the FtD practice audit survey. The sample was diverse in professional roles, with most participants being male (70.8%) with an average age of 46.4 years. Participants had an average of 2.8 years' experience in their roles, with occupational therapists having the most (3.2 years). Most were employed full time (81.3%) and 63.2% worked in private practice. Geographically, the majority were based in New South Wales (51.4%). Frequency of FtD assessments varied across disciplines with OTs, Optometrists and Driving instructors reporting at least 1-2 per week or more. Across the sample, most practitioners reported having 'some' training (30%) or a lack of adequate training and a desire for more (37%) ($\chi 2=57.36$, $p<0.001$). OTs reported having adequate training, while GPs, Optometrists and Neuropsychologists were more likely to report training needs. The resources most familiar to practitioners were cognitive screening tests (65%), vision screening tests (56%) and the Austroads guidelines (53%) The latter was most familiar to GPs (95%), OTs (94%), Geriatricians (100%) and Optometrists (67%), but less familiar to neuropsychologists (29%) and driving instructors (22%). OTs and GPs were familiar with the highest number of resources while other practitioners had access to fewer training and testing resources. Most practitioners preferred accessing resources through online websites or printed materials. Further training in the use of validated screening instruments was the top area (65%) identified by practitioners as likely to improve FtD practices. Other suggested improvements included visual aids for decision making (GPs), more training in dementia, and updated practice guides (OTs), targeted professional development (DIs), clearer advice on visual field requirements and guidance on borderline cases for FtD (Opt), access to up-to-date research, discipline specific guides, and ecologically valid assessment tools (NPsychs), and greater access to OT assessments and access to screening tools (Geris).

Benefits to road safety

Ensuring that older drivers are assessed using consistent, evidence-based approaches can enhance road safety by reducing the risk of crashes associated with age-related cognitive, sensory, and physical decline. This study identifies gaps in practitioner training and access to validated assessment tools, which may contribute to inconsistencies in Fitness to Drive assessments. By addressing these challenges, we can improve the accuracy of assessments, better support practitioners, and promote safer mobility for older adults whilst maintaining their independence.

Implications for policy and/or practice

The findings suggest that refining national guidelines could improve clarity and applicability across the disciplines involved in Fitness to Drive assessments. Additionally, expanding access to multidisciplinary training and validated assessment tools may help support more consistent, evidence-based practices. Further exploration of these areas could contribute to better-informed decision-making and enhanced support for practitioners working with older drivers.

Conclusions

The findings from the survey on current practices in terms of training, familiarity with available resources and barriers to uptake indicate that there are significant differences between practice contexts in the resource needs to support accurate and evidence-based FtD assessment of older drivers. In addition to general resources such as the Austroads guidelines, practitioners may see benefit from more detailed, standardised, and practice-specific guidance to aid decision making. Greater access to validated screening tools and associated training in their use may also benefit FtD assessments.

References

Anstey, K., Wood, J., Lord, S., & Walker, J. (2005). Cognitive, sensory and physical factors enabling driving safety in older adults. Clinical Psychology Review, 25(1), 45-65. https://doi.org/10.1016/j.cpr.2004.07.008

Sims, J., Rouse-Watson, S., Schattner, P., Beveridge, A., & Jones, K. M. (2012). To Drive or Not to Drive: Assessment Dilemmas for GPs. International Journal of Family Medicine, 2012, 1-6. https://doi.org/10.1155/2012/417512

McKernan, E., Chia, S. Y. D., Traynor, V., Veerhuis, N., McNeil, K., & Pond, C. D. (2022). Driving assessments for older adult patients: Interviews with general practitioners to gauge current strategies and future directions. Australian Journal of General Practice, 51(6), 457-462. https://doi.org/10.31128/ajgp-09-21-6170

Urlings, J. H. J., Cuenen, A., Brijs, T., Lutin, M., & Jongen, E. M. M. (2018). Aiding medical professionals in fitness-to-drive screenings for elderly drivers: development of an office-based screening tool. International psychogeriatrics, 30(8), 1211-1225. https://doi.org/10.1017/S1041610217002678

Wallis, K. A., Matthews, J., & Spurling, G. K. (2020). Assessing fitness to drive in older people: The need for an evidence-based toolkit in general practice. Medical Journal of Australia, 212(9), 396-398.e1. https://doi.org/10.5694/mja2.50588

Table 1 Demographics for participants who completed the Fitness to Drive Practice Audit Survey

Characteristic		Full Sample (n=144)	General Practitioners (n=20)	Occupational Therapists (n=17)	Neuropsychologists (n=42)	Optometrists (n=12)	Geriatricians (n=12)	Driving Instructors (n=41)
Age (mean ± SD)		46.4 (12.4)	38 (7.2)	42 (5.9)	49 (10.0)	36 (6.3)	43 (11.8)	54 (15.0)
Gender (%)	Male	102 (70.8%)	15 (75%)	12 (70.6%)	25 (59.5%)	6 (50%)	6 (50%)	38 (92.7%)
	Female	42 (29.2%)	5 (25%)	5 (29.4%)	17 (40.5%)	6 (50%)	6 (50%)	3 (7.3%)
Years of experience (mean ± SD)		2.8 (0.7)	2.6 (0.7)	3.2 (0.7)	2.7 (0.7)	2.2 (0.7)	2.3 (1.2)	3.0 (0.4)
Type of organisation (%)	Private practice	98 (63.2%)	10 (45.5%)	6 (30%)	26 (56.5%)	12 (100%)	3 (21.4%)	41 (100%)
	Government	49 (31.6%)	12 (54.5%)	14 (70%)	12 (26.1%)	-	11 (78.6%)	-
	NGO sector	8 (5.2%)	-	-	8 (17.4%)	-	-	-
Employment status (%)	Full-time	117 (81.3%)	18 (90%)	16 (94.1%)	33 (78.6%)	9 (75%)	9 (75%)	32 (78%)
	Part-time	27 (18.8%)	2 (10%)	1 (5.9%)	9 (21.4%)	3 (25%)	3 (25%)	9 (22%)
State or Territory of practice (%)	Australian Capital Territory	2 (1.4%)	2 (10%)	-	-	-	-	-
	New South Wales	74 (51.4%)	10 (50%)	10 (58.8%)	18 (42.9%)	5 (41.7%)	6 (50%)	25 (61%)
	Northern Territory	-	-	-	-	-	-	-
	Queensland	21 (14.6%)	3 (15%)	5 (29.4%)	5 (11.9%)	2 (16.7%)	4 (33.3%)	2 (4.9%)
	Western Australia	6 (4.2%)	2 (10%)	-	2 (4.8%)	1 (8.3%)	1 (8.3%)	-
	South Australia	1 (0.7%)	1 (5%)	-	-	-	-	-
	Tasmania	-	-	-	-	-	-	-
	Victoria	40 (27.8%)	2 (10%)	2 (11.8%)	17 (40.5%)	4 (33.3%)	1 (8.3%)	14 (34.1%)

Post-crash care and its role in trauma reduction

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Abstract
Post-crash care for road trauma has been increasingly recognised in safety strategies both internationally and across Australia. The National Road Safety Strategy 2021-2030 and the UN Decade of Action for Road Safety 2021-2030 both highlight post-crash response as a component of wholistic road safety. NSW has revisited post-crash care, particularly regarding support for individuals and families of road trauma. Recent work with the Road Trauma Support Group NSW resulted in the passing of the Victim Rights and Support Amendment Bill, which provides access to 22 hours of counselling to family members of a person killed in a car crash (where someone has been charged in relation to the crash). Support for post-crash trauma victims and their families is crucial for both physical and psychological recovery. While our systems continue to improve medical treatment, additional support is needed to improve the lives of those individuals involved in a road crash.

Social media post
Post-crash care and its role in trauma reduction

Introduction
Post-crash care is a critical component of road safety that focuses on the immediate and long-term consequences of road trauma. While road safety often focuses on crash prevention or mitigation, post-crash support is crucial in reducing ongoing trauma for victims of road crashes and their families. Timely interventions in medical, psychological and emotional support can minimise long-term health consequences and lead to better outcomes for the NSW community.

This abstract provides a discussion on the potential **evolution** of a safe system that addresses post-crash trauma reduction - particularly around emotional and psychological impact - for crash victims and their families.

Psychological and emotional impact on crash survivors
Recent improvements have been made in medical care and emergency services to support the immediate care for crash victims. In 2022, the NSW Government announced a $1.76B investment into frontline emergency care which aimed to improve response times and the quality of pre-hospital care (Smith, 2022). Additionally, advancements have been made in pre-hospital interventions, such as pre-hospital blood transfusions that allow NSW Ambulance retrieval teams to provide life-saving medical support enroute to emergency centres (Shand et al., 2021). However, more work needs to be done to support victims and their families psychologically and emotionally in the aftermath of a crash.

Research shows that post-traumatic stress disorder (PTSD), depression and anxiety are prevalent in victims of road crashes (O'Donnell et al., 2007). Recent studies from the World Health Organisation shows that worldwide prevalence of PTSD following road traffic crashes ranged from 6 to 45 per cent and remains “one of the most common consequences of road traffic incidents” (World Health Organisation, 2016). Individuals who are seriously injured in a crash might have weeks, months and sometimes years of ongoing medical interventions that can impact their emotional and psychological wellbeing. This can also have further-reaching impacts: studies have shown that Australian patients who were injured due to a road traffic crash, and developed symptoms of depression, were 3.5 times less likely to return to work (WHO, 2016).

A bereaved person who has lost a loved one in a violent and sudden death such as a road crash can also develop PTSD symptoms (Kaltman & Bonanno, 2003). In fact, recent research from Road Trauma Support Group NSW showed that 59 per cent of people who had lost a close friend or loved one to fatal road crime (a road event resulting in the death of an individual attributable to the movement of a road vehicle on a public road due to a criminal act of another road user) in NSW have experienced mental health challenges such as depression, anxiety or PTSD (Fiftyfive5, Road Trauma Support Group NSW, 2024). This can have a huge impact on the wider NSW community as the ripple effect of road crashes can be felt through family members, colleagues and other community members.

Road Trauma Support Group NSW

The Road Trauma Support Group NSW was established in 2021 by family members who have lost loved ones due to criminal road crashes in NSW. They have partnered with the NSW Government to improve vital post-crash care for families and communities of those who have been impacted by road crashes, particularly road crimes.

In 2024, Road Trauma Support Group NSW was successful in lobbying the government to pass the Victim Rights and Support Amendment Bill, which provides access to 22 hours of counselling to family members of a person killed in a car crash (where someone has been charged in relation to the crash). This support, in addition to the support that this organisation provides through professional trauma-informed counselling, will be crucial in improving psychological and emotional wellbeing of victims of road crashes.

Conclusions

By addressing both physical and psychological aspects of post-crash care, we can improve overall recovery and prevent long-term trauma. Well-equipped emergency response systems, robust mental health services and support programs like the one developed by Road Trauma Support Group NSW are essential in reducing the impact of road trauma in NSW.

References

Fiftyfive5, Road Trauma Support Group NSW. (2024). The enduring impact of criminal road trauma in NSW. Sydney.

Kaltman, S., & Bonanno, G. A. (2003). Trauma and bereavement: Examining the impact of sudden and violent deaths. Journal of Anxiety Disorders, 131-147.

O'Donnell, M. L., Bryant, R. A., Creamer, M., & Carty, J. (2007). Mental health following traumatic injury: Toward a health system model of early psychological intervention. Clinical Psychology Review, 387-406.

Shand, S., Curtis, K., Dinh, M., & Burns, B. (2021). Prehospital Blood Transfusion in New South Wales, Australia: A Retrospective Cohort Study. Prehospital Emergency Care, 404-411.

Smith, A. (2022, June 5). NSW Ambulance gets $1.76 billion lifeline for new paramedics and stations. Sydney Morning Herald, pp. https://www.smh.com.au/politics/nsw/nsw-ambulance-gets-1-76-billion-lifeline-for-new-paramedics-and-stations-20220604-p5ar2z.html.

World Health Organisation. (2016). Post-crash response: Supporting those affected by road traffic crashes. Geneva: WHO Press.

Observing work and rest behaviours of truck drivers in Australia

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Abstract
Truck driver fatigue is a leading contributor in truck crashes. Despite control measures that prescribe hours of work and rest, truck drivers work with a high level of autonomy and are mostly left to self-manage their fatigue. However, there is little Australian research examining truck drivers' rest-stop behaviour in relation to fatigue compliance. This study reports on an exploratory participant observation study of truck drivers undertaken at two truck rest stops in one Australian state. While most truck drivers were found to comply with rest requirements, load type, driver changeovers, access to parking, and time spent working at rest areas affected truck drivers' rest time.

Social media post
An observation study of truck drivers' behaviour at rest stops showed that load type, driver changeovers, access to parking, and time spent working at rest areas affected how much time they spent resting.

Background
Truck driver fatigue is a leading contributor in truck crashes (Howard et al., 2004; Ren et al., 2023). In Australia, truck drivers travel across vast geographical areas and jurisdictions, often over extended shifts while doing so in isolation (van Vreden et al., 2022). They work at times that affect regular sleep patterns and rest, limiting their capacity to obtain the "*recuperative rest"* (Williamson et al., 2011, p499) they require, thereby increasing their fatigue risk (Ren et al., 2023). To combat this problem, most Australian states (like other jurisdictions worldwide) restrict the number of hours truck drivers can work (Anund & Dahlman, 2023; Dawson et al., 2023). The 'central tenet' underpinning restrictions is to *"limit the number of working and driving hours without rest"* (Goel et al., 2012, p. 1122). This study's aim was to identify whether truck drivers comply with work and rest requirements and to identify any factors that may affect compliance and rest.

Conference theme
This study contributes to the conference theme of equity, elasticity and evolution because it has identified that rigid fatigue laws are unfair to truck drivers, since they lack elasticity and do not account for the range of circumstances seen to confront those participating in the study. It supports recognition of the inherent value of truck drivers, and their vital contribution to our society, by recommending that laws, policy and practice evolve to ensure they can partake of recuperative rest, so they can stay safe at work and can reduce the risks of fatigue related road crashes for themselves and all those with whom they share the road.

Method
Unobtrusive Participant Observation was chosen because of its ability to elicit data about truck driver behaviour within their normal working environment. Over ten days, truck driver behaviour was observed at two locations (Tarcutta and Narrandera in south-west New South Wales). As figure #1 shows, these two sites enabled the capture of journeys occurring between the five most populous Australian capital cities (Sydney, Melbourne, Brisbane, Adelaide and Perth). Additionally, they are temporally and distally consistent with prescribed rest times, regardless of whether drivers were on their outward or return journey, therefore they are situated where most truck drivers on these journeys are likely to be due for at least a minimum 15-minute rest break. Day time, afternoon and nighttime observations were conducted. Participants were included based on vehicle and journey types to which current fatigue laws apply. Data was collected on individual observation record sheets designed by the research team and *"Work"* and *"Rest"* definitions as per Heavy Vehicle National Law (NSW, 2013) were applied.

Findings
The final sample included 378 truck drivers (Tarcutta, n=142; Narrandera, n=236). More than half of those observed (54.5%) complied with the minimum 15-minute rest requirement. Further analysis identified four distinct themes affecting truck drivers' rest.

Load type or freight influences rest stop behaviour

Of all load types observed, only half of the drivers carting livestock (50%) and slightly more than half of those carting refrigerated loads (52%) had rest periods of at least 15-minutes. While drivers of general freight trucks were marginally better, showing 53% compliance with 15 minute minimum rest periods, 60% of drivers of tippers (or dump trucks) were compliant, as were drivers of liquid tankers (65% compliant) and car carriers (75% compliant). This finding showed variations in rest across load types, but this is not recognised within the truck driver fatigue regulations, and this suggests that regulations need to change to account for the impact of different loads on rest behaviour.

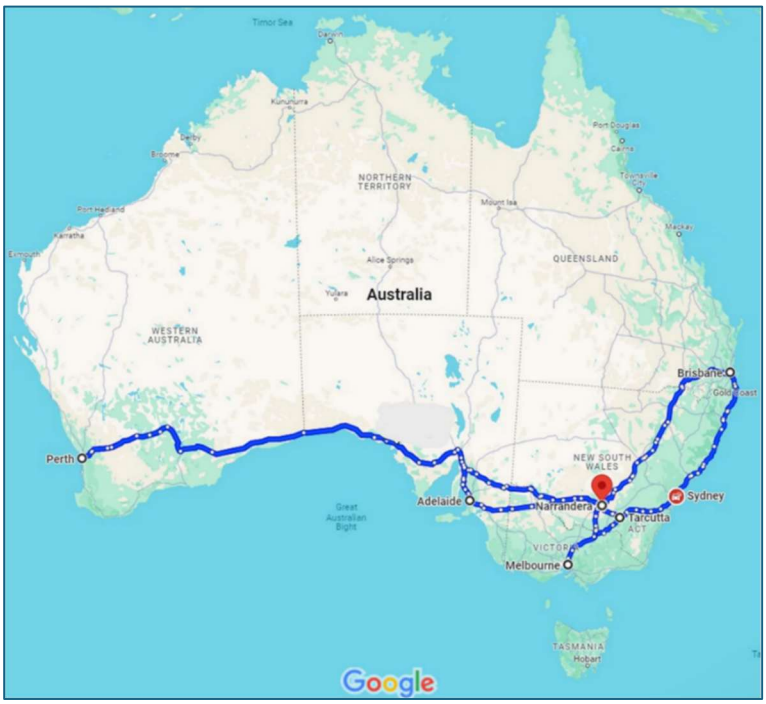


Figure 1. Observation sites at Tarcutta and Narrandera and their relationship to journeys between Australian capital cities

Freight exchange and driver changeover reduces time spent at rest

16 truck driver changeovers were observed, which involves two truck drivers exchanging their respective trailers/loads, before returning to their home base. Of all truck drivers participating in changeovers (n=32), 56% had less than 15 minutes rest, which increased to 75% amongst drivers who arrived second. The finding that most truck drivers involved in changeover work did not have sufficient rest shows that there is a need for policy makers and transport industry managers to acknowledge the effect of this practice on truck drivers rest so that it can be better managed.

Designated rest stop parking and illegal parking influences rest stop behaviour

During the observation nine trucks were affected by lack of parking space due to designated truck parking spaces being occupied by other trucks, unattended trailers, campervans, caravans or a convoy of horse floats. Three trucks were unable to find parking space and continued driving. Furthermore, various parking restrictions were applied at and near each site, yet of the drivers who parked illegally in these spaces, 58% had more than 15-minutes rest. This finding shows that when truck drivers can park (legally or illegally), it is likely to positively influence rest related behaviour, which is consistent with earlier research (Thornthwaite and O'Neill, 2016; Pritchard et al., 2020; Pritchard et al., 2023). Policymakers and planners need to consider the effects of parking availability on truck drivers rest behaviour.

Work related behaviour at rest stops influences rest

More than three quarters (76%) of all truck drivers observed worked while parked on site. Although most of these drivers (84%) also had a separate 15-minute rest period, it was observed that some (16%) of the working cohort spent more time checking their load, including tending to the welfare of their livestock, checking tyres, repairing their truck, or loading and unloading trailers. This reduced the time they spent at rest to less than 15 minutes, leaving them in breach of rest regulations. Under the definition of *'work'* these behaviours are clearly defined as work-related and are in breach of mandatory rest requirements. Whether these were intentional breaches of mandatory rest requirements, or a lack of understanding of driver fatigue laws, is an area of research that needs further enquiry.

Conclusion

When analysing truck drivers' rest stop behaviour, and how this shapes their compliance with fatigue regulations, this exploratory study found that while 54.5% of truck drivers are compliant, over 45% were not. There is therefore a need to better understand how load type or freight, freight exchange and driver change-over, designated or illegal parking, and work-related behaviours (that reduce rest time) affect truck drivers' capacity to obtain rest and comply with fatigue regulations. Future research examining truck driver behaviour at rest-stops could include truck driver interviews in situ, multiple observers at additional rest-stop sites, and longitudinal studies. Analysis of behavioural contrasts between drivers facing optimal or sub-optimal rest taking situations could help to determine whether the findings from this study are generalisable, and representative, of truck driver rest-stop behaviour across Australia. Despite this, this study has, for the first time, benefitted road safety knowledge by identifying and describing factors that influence truck drivers' rest stop behaviour. While recommendations from each finding have implications for policy and practice that may reduce truck drivers' non-compliance with inflexible fatigue laws, the study has also provided a baseline and justification for further research.

References

Anund, Anna & Dahlman, Anna Sjors, 2023, Challenges in Fatigue Research and Enforcement, in *The Handbook of Fatigue Management in Transportation : Waking up to the Challenge.* Rudin-Brown, Christina M., and Ashleigh J. Filtness (eds) Milton: Taylor & Francis Group, 2023.

Dawson, D., Sprajcer, M. & Thomas, M.J.W., 2023, Regulatory and Legal Frameworks for Managing Fatigue in Transportation, in Rudin-Brown, Christina M., and Ashleigh J. Filtness (eds) 2023, *The Handbook of Fatigue Management in Transportation : Waking up to the Challenge* (1st ed.). CRC Press. https://doi.org/10.1201/9781003213154

Goel, Asvin., Archetti, Claudia. and Savelsbergh, Martin., 2012. Truck driver scheduling inAustralia, in *Computers and Operations Research*, Vol 39, No 5, pp 1122-1132, https://doi.org/10.1016/j.cor.2011.05.021

Heavy Vehicle National Law, 2013 (NSW), https://legislation.nsw.gov.au/view/html/inforce/current/act- 2013-42a

Howard, M. E., Desai, A. V., Grunstein, R. R., Hukins, C., Armstrong, John G., Joffe, David., Swann, Phillip, Campbell, Donald A. and Pierce, Robert J., 2004, Sleepiness, sleep-disordered breathing, and accident risk factors in commercial vehicle drivers. *American Journal of Respiratory and Critical Care Medicine, 170*(9), 1014-21. http://ezproxy.uws.edu.au/login?url=https://www.proquest.com/scholarly-journals/sleepiness-sleep-disordered-breathing-accident/docview/199559829/se-2

Pritchhard, E., Van Vreden, C. and Iles, R., 2020 Report No 7: Uneven Wear: Health and well-being of *truck drivers,* https://bridges.monash.edu/articles/report/Driving_Health_Study_Report_No_7_Uneven_wear_Health_and_wellbeing_of_truck_drivers_/13316000

Pritchard, E., van Vreden, C., Xia, T., Newnam, S., Collie, A., Lubman, D., de Almeida Neto, A. & Iles, R., 2023, Impact of work and coping factors on mental Health: Australian truck drivers' perspective. *BMC Public Health* **23**, 1090 (2023). https://doi.org/10.1186/s12889-023-15877-4

Ren, X., Pritchard, E., van Vreden, C., Newnam, S., Iles, R., & Xia, T. (2023). Factors Associated with Fatigued Driving among Australian Truck Drivers: A Cross-Sectional Study. *International Journal of Environmental Research and Public Health*, *20*(3), 2732 https://doi.org/10.3390/ijerph20032732

Thornthwaite, L., & O'Neill, S. (2016). *Evaluating approaches to regulating WHS in the Australian Road Freight Transport Industry: final report to the Transport Education, Audit and Compliance Health Organisation Ltd (TEACHO)*. Macquarie University, Centre for Workforce Futures.

van Vreden, C., Xia, T., Collie, A., Pritchard, E., Newnam, S., Lubman, D.I., de Almieda Neto, A. & Iles, R., 2022, The physical and mental health of Australian truck drivers: a national cross-sectional study. *BMC Public Health* Vol 22, 464 (2022), https://doi.org/10.1186/s12889-022-12850-5

Williamson, A., Lombardi, D. A., Folkard, S., Stutts, J., Courtney, T. K., & Connor, J. L. (2011). The link between fatigue and safety. *Accident Analysis and Prevention*, *43*(2), 498–515. https://doi.org/10.1016/j.aap.2009.11.011

Perceptions of truck driver fatigue enforcement amongst Australian enforcement functionaries

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Abstract

Truck driver fatigue (TDF) is regarded as a serious safety hazard and a leading factor in road crashes in the Australian road transport industry. Since 2014 most Australian states have enforced truck driver fatigue regulation via prescribed hours of work and rest. Despite these control measures, TDF remains a safety issue, exacerbated by inconsistent regulation between the organisations and functionaries tasked with its management. This exploratory study presents the findings from interviews with a small cohort (n = 9) of law enforcement officers (LEO) and transport regulation agents (TRA) to determine factors that influence their intentions and behaviours regarding the enforcement of TDF regulations. All the themes that emerged could be linked back to foundational training.

Social media post

Interviews with law enforcement functionaries showed vast differences between them regarding how they enforce truck driver fatigue, all of which could be linked back to foundational training.

Background

The fact that truck driver fatigue continues as a leading contributor in truck crashes (Meuleners et al., 2015; Ren et al., 2023) raises questions regarding whether regulation of TDF in Australia is appropriately managed. Despite attempts to achieve uniformity via national legislation (National Heavy Vehicle Regulator, n.d.) the regulation of TDF is still viewed as *"fragmented"* with approaches that vary across jurisdictions (Frontier Economics, 2020, p 19). While LEO and TRA are granted similar regulatory power to manage TDF, (*Heavy Vehicle National Law, 2013,* (NSW), Part 9.1; Part 9.2), there is little Australian research which examines how they differ in practice when applying regulatory power to manage TDF. This study aimed to identify the perceptions of LEO and TRA regarding the factors that support or undermine behavioural practice towards the enforcement of TDF laws in Australia.

Conference theme

This study addresses the conference theme of **equity,** because it identifies factors that result in inconsistent and unfair enforcement of truck driver fatigue laws. It identifies contrasts in law enforcement functionaries' practice knowledge that result in differential policing of these laws, and it is possible that this influences truck drivers' perceptions of legitimacy and fairness regarding how they are enforced. To increase perceptions of these laws' legitimacy, and to provide more equitable approaches to their enforcement, the study recommends better approaches to the core issue of foundational training for functionaries, which is likely to increase compliance and reduce fatigue related risks for truck drivers and those with whom they share the road.

Method

Semi-structured interviews were conducted with LEO and TRA working in one Australian HVNL jurisdiction to enable exploration of the processes that affect TDF enforcement and to explore issues likely to emerge during the process of enquiry (Robson & McCartan, 2016). Nine participants volunteered to be interviewed (six LEO, three TRA). All LEO interviewed were attached to highway patrol units. Telephone interviews were conducted, with all data audio recorded then transcribed. The interview data was analysed using Braun and Clarke's (2012) thematic analysis process, and Ajzen's (2005) Theory of Planned Behaviour was applied to examine the factors that enable or disenable TDF enforcement.

Findings

Limited foundational training affects practice knowledge

Differences emerged between the responses of LEO and TRA, with TRA referring to the *"intensive"(TRA#2)* TDF training they received. In contrast, all LEO (6/6) discussed the lack of TDF training within their organisation. The only TDF training LEO reported receiving was lost amongst the *"1000 other lectures"(LEO#5)* they received during their

initial highway patrol training. The interview data clearly identified that the quality and quantity of TDF training differentially affects TDF practice knowledge, with LEO left lacking knowledge and confidence to sufficiently regulate TDF.

Limited practice knowledge undermines confidence and enforcement actions

Both participant cohorts spoke of how their colleagues perceived TDF enforcement as a complex activity and how this perception influenced confidence and affected behaviour. Most participants (7/9) linked a lack of TDF practice knowledge to low confidence in the ability to enforce TDF regulation and talked about this problem being prevalent in the workplace. One participant commented, *"The knowledge is very poor. And the confidence is very poor". (LEO#5).* This suggests that the perceived complexity of the task, when combined with a lack of practice knowledge and confidence, reduces the likelihood that TDF will be enforced.

Use of discretionary powers may mask skill gaps

Discretion was discussed by LEO and TRA in the context of how they made decisions regarding TDF breaches. Notably however only LEO discussed discretion in the context of avoiding TDF enforcement. The risk of being exposed (to colleagues or truck drivers) as someone lacking knowledge emerged as a reason why LEO use discretion to mask their lack of knowledge or avoid TDF enforcement.

Competing occupational demands constrain TDF enforcement

Most participants (6/9) discussed competing occupational demands as a factor inhibiting their capacity to enforce TDF. LEO spoke of the effect of extraneous duties (e.g., traffic control, road crashes, other crime or public order events, etc), while TRA spoke of the impact of their broader heavy vehicle enforcement duties (e.g., mass, dimension, mechanical compliance). The data clearly supported the finding that competing occupational demands constrain both LEO and TRA capacity to enforce TDF laws.

Exposure to TDF incidents reinforces enforcement practice

All participants (9/9) felt that those who have attended a fatigue related truck crash, or who have engaged with a fatigue affected truck driver, were more likely to be motivated to develop their TDF enforcement capabilities. Participants emphasised the influence of these experiences when comparing them with the obverse effect, suggesting that those lacking such experience *"may not view fatigue as a big issue"* (LEO#2). As such, it became clear that experience with fatigue related incidents is likely to positively influence attitudes, perceptions, motivation and regulatory practice of LEO and TRA regarding TDF enforcement.

Self-motivated field learning positively affects knowledge and practice skills

Self-learning was perceived by participants as a means of gaining knowledge and experience in TDF regulation, however, a key point raised by all LEO (6/6) was that this only occurs if LEO are self-motivated to improve their knowledge and practice skills. It emerged that self-learning occurs by (i) reading relevant legislation, (ii) working with motivated colleagues and (iii) interacting with truck drivers in the field. However, it was also recognised that senior colleagues or trainers who avoid TDF enforcement (to mask their own lack of knowledge) are also likely to limit the self-learning experiences of others by discouraging engagement in TDF enforcement activities.

Conclusion

This exploratory study has provided an important baseline for more research across a broader cohort regarding behavioural influences on LEO and TRA across Australia. This will determine the generalisability of the findings and may identify other behavioural (occupational) determinants that may not have been elicited in this study. A further important benefit for road safety is that, for the first time, it has been shown that limited foundational training and knowledge is a core issue affecting TDF enforcement practice. The implications of this mean that truck drivers are exposed to inequitable, or differential, policing of TDF laws. To bridge existing knowledge gaps, improved foundational training programs, complemented by field training and exposure, are likely to have a broadly positive effect on LEO and TRA intentions to enforce TDF from the outset. Furthermore, consistent training standards across all TDF enforcement cohorts may reduce inconsistent and unfair regulatory practices. Better deployment management that reduces competing demands on LEO and TRA is likely to increase their ability to conduct TDF regulation as part of their occupational role, thereby facilitating a more consistent deterrence-based presence regarding TDF regulation, greater compliance, and safer roads for truck drivers and all other across Australia with whom they share the road.

References

Ajzen, Icek, 2005, Attitudes, Personality and Behaviour, Second Edition, Open UniversityPress, New York

Braun, V. & Clarke, V., 2012, Thematic analysis, In, H. Cooper, P. M. Camic, D. L. Long, A. T.Panter, D. Rindskopf, & K. J. Sher (Eds), *APA handbook of research methods in psychology, Vol. 2: Research designs: Quantitative, qualitative, neuropsychological, and biological,* (pp. 57-71). Washington,DC: American Psychological Association. https://psycnet.apa.org/doi/10.1037/13620-000

Frontier Economics, 2020, *HVNL Review Consultation Regulation Impact Statement*, accessed26/06/2020 from:- https://www.ntc.gov.au/sites/default/files/assets/files/HVNLR-consultation-RIS.pdf

Heavy Vehicle National Law (NSW) No 42 of 2013, accessed 21st April 2022 from:- https://legislation.nsw.gov.au/view/html/inforce/current/act- 2013-42a

Meuleners, L., Fraser, M. L., Govorko, M. H., & Stevenson, M. R. (2015). Obstructive Sleep Apnea, Health-Related Factors, and Long Distance Heavy Vehicle Crashes in Western Australia: A Case Control Study. *Journal of Clinical Sleep Medicine*, *11*(4), 413–418. https://doi.org/10.5664/jcsm.4594

National Heavy Vehicle Regulator, n.d., *Heavy Vehicle National Law and Regulations,* accessed 15th April 2023 from; https://www.nhvr.gov.au/law-policies/heavy-vehicle-national-law-and-regulations

Ren, X., Pritchard, E., van Vreden, C., Newnam, S., Iles, R., & Xia, T. (2023). Factors Associated with Fatigued Driving among Australian Truck Drivers: A Cross-Sectional Study. *International Journal of Environmental Research and Public Health*, *20*(3), 2732 accessed 2nd September 2023;. https://doi.org/10.3390/ijerph20032732

Robson, Colin and McCartan, Kieran, 2016, *Real World Research, A Resource for Users of Social Research Methods in Applied Settings,* Fourth Edition, John Wiley and Sons, West Sussex.

Shire of Manjimup Progressing Road Traffic Safety Management Systems ISO39001

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Abstract

Road traffic safety is a global concern, with approximately 1.19 million fatalities and 20-50 million non-fatal injuries annually (W.H.O. (n.d)). In Western Australia, from 2018 to 2022, 8,570 people were killed or seriously injured (KSI), with over half occurring on roads managed by Local Governments (WALGA, 2024a). The Shire of Manjimup, located in Western Australia's South West region, experienced 24 KSI incidents during this period (WALGA, 2024b). Since 2021, the Shire evolved their road safety application through developing a Road Traffic Safety Management System guided by an international standard. This evolution aims to demonstrate the significant role Local Governments can play in reducing road deaths and injuries by adopting best practices and integrating safe system principles into their policies and practices within their context and scope as a road manager. Early outcomes have seen several successes, indicate improved road safety performance and a greater understanding of the safe system approach.

Social media post

Shire of Manjimup is enhancing road safety with ISO 39001. Developing a Road Traffic Management System and already seeing leadership success through implementation of the overarching Road Traffic Safety Policy prioritising safe system and best practice delivery.

Background

Road traffic safety is a global concern. Road traffic crashes result in the deaths of approximately 1.19 million people around the world each year and leave between 20 and 50 million people with non-fatal injuries. (W.H.O. (n.d)) In Western Australia between 2018 and 2022 there were 8,570 people killed and seriously injured (KSI) with more than half (56%, 4,839) having occurred on roads managed by Local Governments. (WALGA, 2024)

Local Governments in the South West region manage 86% of the regions road network, however this network carries about 28% of the vehicle usage based on million vehicle kilometres travelled (MVKT). Majority of the vehicle travel in the region occurs on the state managed roads (72% MVKT), however, the locally managed road network accounts for almost half (47%) of people killed and seriously injured (WALGA, 2024). This is disproportionate to the amount of use of the network.

The Shire of Manjimup is located in the South West region of WA, with a population of 10,000 people and covering 7,000km^2 with four townsites, 85% is State Forrest/ National Park. The Shire manages a road network of approximately 1,300km with 800km of this being an unsealed network. Between 2018 and 2022 on roads managed by the Shire, there were 24 people killed (3) and seriously injured (21) (WALGA, 2024).

In 2021 the Shire of Manjimup was approached by WALGA RoadWise to participate in a Safe System Demonstration Project to apply the International Organisation for Standardization (ISO) 39001: Road Traffic Safety Management System (I.S.O, 2012) to the Local Government context. The project aimed to evolve current practices towards safe system and demonstrate the significant influence Local Governments can have in the prevention of road death and serious injury through the adoption and application of best practice in road safety.

The Shire is being guided by the standard to work towards embedding best practice within the Shire's identified areas of influence and through the integration of the safe system principles into organisational policies and practices. This project represents an evolution in the Shire's approach to road safety, highlighting the safe system application in the Shire's influence and context, already seeing successful outcomes.

Conference Theme

Evolution: Evolving from current practices and the "way it has always been done" to working through the ISO process to take a hard look at the roles and responsibilities within the Shire's influence. Progressing through a systematic approach to develop a road safety management system which ensures the Shire is working to improve road safety based on best practice to achieve the safe system end state where no one is killed or seriously injured on the Shire's road network.

Project Overview

The project involves` working through the steps of ISO 39001 and will result in the development of a road traffic safety management system specific for the Shire. Focusing on applying best practice application within the context and scope of the Shire as a road manager, resulting in applying road safety objectives and performance measures to guide how activities are planned and implemented. The international standard outlines a six-step process shown in Figure 1. The Shire has completed the first two steps and currently working on the third.



Figure 1. Process from the International Organization for Standardization (2012) being used to guide the development of the project

Step 1: Scope and Context

A determination of the Shire's involvement in all aspects of road safety was made through mapping impact at an organisational level focussing on the Local Governments functions and responsibilities. This identified where there is currently an impact on road safety outcomes and where there are opportunities to improve.

The Shire conducted an in-depth review to identify its scope and context and to map its current undertakings and opportunities for influence in all aspects of road safety. This included prioritising the Shire's road safety responsibilities within each of the following operational functions of the Shire.

- road asset owner and manager,
- town planner and urban designer,
- fleet manager
- community development and leadership

Step 2: Leadership

The Shire demonstrated its leadership by establishing a commitment and developing an overarching policy which embeds safe system principles and applies best practice to areas of road safety in which the Shire identified as having influence on. The Shire developed and adopted the policy 9.1.21 Road Traffic Safety Policy in 2022 which set safe system principles for the management of the road network and set objectives along with making a commitment for the Shire to systematically improve road safety performance. The policy aims to ensure the Shire has a robust approach to road traffic safety, embedding safe system methodology across the organisational activities. This policy applies to all Shire managed roads, roadsides, footpaths and cycle paths across the Shire and directly informs and influences the systematic review process of policies to ensure they align with this overarching policy.

Step 3: Planning

The Shire is currently working through determining the risks and opportunities through assessment of current performance and identifying performance measures based on identified road traffic safety performance factors aligned to the ISO 39001. Identifying areas of influence, priority level and opportunities relevant to the Shire to develop objectives and targets for each performance factor to establish an action plan with measurable outcomes.

Results

While working through this project the Shire has already benefited from several successes, outlined as follows.

Adoption of Road Traffic Safety Policy

9.1.21 Road Traffic Safety Policy was adopted by the Shire of Manjimup Council on the 7 July 2022. The policy's key objectives are for the Shire to achieve a safe road traffic management system through setting objectives aligned to the Shire's functions and responsibilities and prioritising the safe system approach and best practice delivery for road safety. The policy measures set objectives under:

- Roads and roadsides
- Intersections
- Reducing travel speeds
- Fleet safety, and
- Post-crash response

The policy also identifies related documents which this policy will have an influence on including strategic, corporate and informing plans and all other policies, this overarching policy will inform and guide alignment towards best practice within key documents.

Review and Update of Road Hierarchy Policy

The Shire identified the Council Policy 9.1.14 Road Hierarchy Policy as a key policy which identifies minim standards for road construction and maintenance to Council, the Shire and the community. This policy has been an important policy to be updated to align with the Road Traffic Safety Policy and is currently in the review process. The in-depth review aimed to update the policy to align with the Road Traffic Safety Policy, as well as embedding safe system, applying minimum best practice standards to the level of service delivery for each identified road hierarchy level, and applying movement and place values to road hierarchy levels which will support speed management (in consultation with Main Roads WA) and the requirements of suitable infrastructure.

Centre Line Marking Trial

One of the policy measures identified in the Road Traffic Safety Policy under roads and roadsides is that where possible consider separation of all road traffic on roads, roadsides, footpaths and intersections. The Shire identified an opportunity to systematically and progressively improve the safety of the Shire's road network through the implementation of a centre line marking trial, which aimed to provide a low cost, visual separation for drivers on high-speed roads of significance.

In Western Australia, to apply line markings there are certain warrants required including, a certain seal width and number of vehicle movements per day. The Shire identified regionally significant roads which have no markings though meet the seal width for a centre line, but not the vehicle numbers. The application of a centre line would progressively improve the safety of these roads as a low-cost treatment with them being the default 110km speed limit and have no visual cues for drivers and where there are environmental constraints. Based on the Policy the Shire worked with Main Roads WA (MRWA) to establish a centre line marking trial where, with design approval from MRWA, the Shire could fund the installation and maintenance of centre lines. This trial is aiming to systematically and progressively improve the safety of the Shire's network, provide visual information to drivers for the safe positioning of their vehicles, create separation (visual) of vehicles and to provide information to drivers on choosing safer locations when overtaking. The Shire has delivered $10,000 worth of centre line markings and has budgeted $20,000 to $40,000 every 2 years for further works within the Shire's 15 year Forward capital Works Plan.

Benefits to Road Safety

Working through this process has identified key areas where the Shire as a road manager has an influence and can embed best practice to plan to systematically and progressively upgrade the network towards safe system. Outcomes from the Road Traffic Policy are already being implemented, with the centre line marking projects established to create safer roads through increasing the readability and providing drivers with visual inputs for safe positioning of vehicles. Working through updating policies to align to this overarching policy has embedded minimum levels of service for upgrading and construction of roads to apply minimum safety standards to move towards a road network aligned to best practice road safety.

Conclusion

While still in progress, the process of working through ISO 39001 to establish a road traffic safety management system for the Shire of Manjimup has been worthwhile and has already achieved several road safety outcomes aligned to better practice for the Shire's road network. The process has also supported a greater understanding of the safe system approach and identified the wide range of influence and impact that the Shire can have on road safety.

References

International Organization for Standardization. (2012). Road traffic safety (RTS) management systems – Requirements with guidance for use (ISO Standard No. 39001:2012). https://www.iso.org/standard/44958.html

WA Local Government Association, RoadWise. (2024a). Road Safety Performance Local Government Roads 2018-2022 All of WA Report.

WA Local Government Association, RoadWise. (2024b). Road Safety Performance Local Government Roads 2018-2022 South West Region Report.

World Health Organisation (n.d) *Road Traffic Injuries: Overview*. Retrieved February 18, 2025, from https://www.who.int/health-topics/road-safety#tab=tab_1

Don’t come to us, we’ll come to you: advertising evolution

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Abstract

The Road Safety Commission (Commission) is taking an innovative approach to behaviour change campaign development and media placement. Rather than trying to get the target market to come to the advertisement, we are taking the advertisements directly to our target market. We are talking to them in their environment with tailored messaging that suits the medium. The Road Safety Commission’s digital transformation has seen the introduction of Targeted Digital Advertising (TDA) to its integrated media approach. The Commission is leading the WA Government in its TDA approach which sees ‘audience first’ ads run across digital display and social media to target the right person, at the right time, with the right message. This highly targeted digital always-on activity covers fatigue, drink driving, motorcycles, eRideables, safe vehicles and mobile phones.

Social media post

The Road Safety Commission is taking a new approach to its behaviour change campaign development and media placement. The Commission’s Digital transformation has seen a move to an ‘audience first’ approach through its Targeted Digital Advertising. Find out how we are targeting the right person, at the right time, with the right message.

Background

Road trauma impacts the lives of too many Western Australians every year, with 8709 people killed or seriously injured (KSI) in reported crashes, including 818 fatalities and 7891 people seriously injured between 2019 and 2023 (Road Safety Commission, 2024). The Commission’s advertising campaigns communicate that we all have a part to play to make every journey a safe one, with messaging striving to improve the community’s road safety attitudes, curb illegal road use behaviours and ultimately prevent road trauma across Western Australia.

Campaign activity is evidence informed, with the BJ Fogg Behaviour Model forming the cornerstone of the overarching campaigns strategy. The model considers human behaviour as a combination of motivation, ability and triggers with change requiring activation of these three components. Unique to this model, ethical persuasion influence people’s behaviours as opposed to attitudes (Fogg, 2009; Fogg, 2019). Other research sources and data that informs the Commission’s campaigns include killed and seriously injured (KSI) statistics, segmentation reports, community attitude monitoring reports, citizen engagement modelling and learnings from prior campaigns. Combined, these sources provide the Commission with an understanding of the nuances of WA road user behaviours, with behaviour change theory providing insight as to how messaging can be tailored to the needs of diverse road users to ultimately increase campaign efficacy.

In recent years the Commission has experienced a period of marked evolution in the campaign and media space, moving away from running large numbers of distinct, smaller campaigns to now launching fewer, but bolder campaigns. This shift has led to the development of an integrated media approach, combining research, insights and evaluation and concept development and production with campaigns, digital media and digital content to create a highly targeted ‘audience first’ approach, ensuring that Western Australian road users are at the heart of all campaigns (see Figure 1).

Conference theme

The Commission’s Creative Advertising presentation is best aligned to the conference theme of *‘Elasticity’*. Rather than relying solely on the system’s adaptability, we are adapting the creative advertising approach to meet the *evolving* way in which WA road users consume and interact with campaign messaging.

Approach to the activity

Targeted Digital Advertising (TDA) in the form of Dynamic Creative Optimisation (DCO) digital website display banners and social media always-on activity across Meta (Facebook and Instagram), TikTok, Snapchat and X is the latest phase of the Commission’s digital transformation.

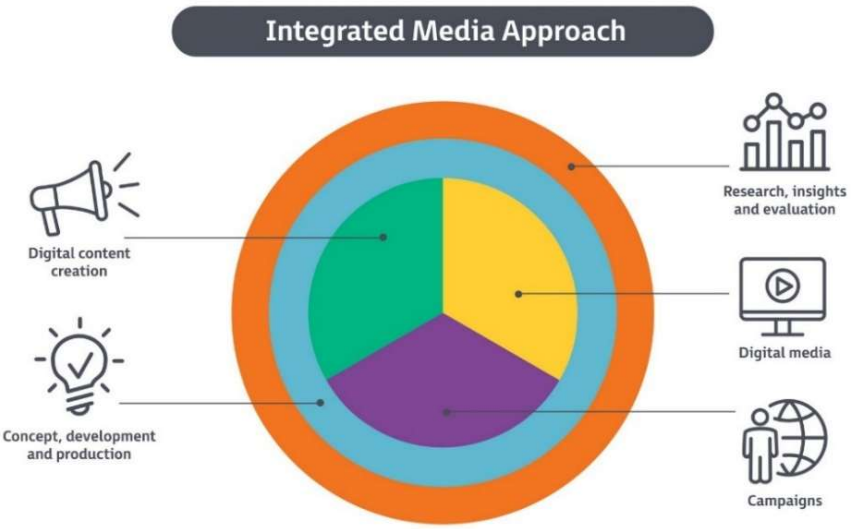


Figure 1: The Road Safety Commissions integrated media approach.

This targeted advertising acts as 'always-on' digital activity across websites and apps where display ads appear and social media platforms. The approach works in a similar way to the Commission's out of home schedule and allows for audience first messages to always be in market. This activity is channel-led, with topics and messaging being selected specifically for digital display and social media placements. Examples of the scenarios and targeting that is currently in market for the digital display activity includes:

- **Fatigue – long trips:** targeting people who frequently visit regional WA destinations, and those who actively consume content/articles around interstate travel (4WD, camping, etc.).
- **Drink driving – spur of the moment:** this ad is served to people who may not have expected to have a few drinks (i.e., after work drinks or had more drinks than planned with dinner), through location targeting of people visiting nightlife locations and events, including bars, clubs and restaurants.
- **eRideables – couriers:** targeting couriers who work for rideshare and food delivery services.

The activity differs from our mass media campaigns due to its highly targeted nature, making sure the ads reach the right person, at the right time, and with the right message. The Commission is leading the government in this highly targeted digital space, being one of the first government agencies to utilise always-on dynamic digital advertising through our media partner Initiative.

Examples of taking the advertisements directly to our target market in the mass media space include the recent 'Not worth the (beep) risk' drink driving campaign and utilises a multi-media approach across television, broadcast/catch-up TV, radio, digital, social media, press and out-of-home advertising. Launched in December 2024, this campaign targets people who are likely to drink drive as well as the general population, the latter as they are the advocates reinforcing that drink driving is unacceptable behaviour.

The evolution in the Commission's media campaign to curb drink driving activity has been through identifying and reaching the target market of young males. To reach this market entailed the use of an integrated content series, Cricket Howlers, becoming the first state-targeted campaign to run across Foxtel's digital platforms with the Commission serving as the inaugural WA ad partner for the new BINGE Sport platform. Further sports placements were also included, including event activations at basketball games (Perth Wildcats and Perth Lynx) and a wider cricket TV commercial buy with free to air networks. In addition to the Cricket Howlers, this integrated campaign also featured contextual media placements such as out-of-home screens in bars and pubs across WA, large format billboards in high traffic areas, catch-up TV and digital audio on streaming platforms.
The benefit of engaging audiences through sport is that 83.4% of WA drivers consume sports content, meaning you can reach a large proportion of your target market in one space.

Outcome of this activity

The Commission tracks and evaluates its large mass media advertising campaigns to ensure their continued success and to report on the key performance indicator of Campaign Awareness. The Commission works closely with a number of external stakeholders including media partner Initiative and market research organisations to ensure campaigns are

accurately tracked, and optimisations made where needed during campaign bursts due to media results. This enables the Commission to assess the effectiveness of major advertising campaigns in terms of unprompted and prompted awareness, believability, understanding of key messages as well as the impact on knowledge, attitudes and behaviours of the WA community. In addition, the effectiveness of media placement and targeting of demographics – including audience engagement – is measured by post campaign reporting. The 'Not worth the (beep) risk' drink driving campaign utilised new creative material and ran between December 2024 and February 2025, with media sentiment being very positive. By seamlessly integrating the drink driving messaging into the world of sports, the attention of a highly engaged audience is captured, reinforcing the significance of responsible decision-making both on and off the field.

The Commission's TDA activity was launched in a staggered approach from November 2022, with performance consistently outperforming industry benchmarks for click through rates (CTR).

In 2024, the digital display banners across five topics (fatigue, drink driving, motorcycles, eRideables and safe vehicles) achieved a total of 58.98 million impressions, 87,312 clicks to the Road Safety Commission website and a CTR of 0.27%, significantly above the 0.05% benchmark for traditional digital display assets across Government campaigns.

The most successful digital display banner versions have been the drink driving 'ability' scenario, targeting people who may think they're okay to drive after a few drinks by featuring the ad on booze bus/RBT updateable apps. These versions have achieved a CTR of 0.69%-3.02% dependent on audience, with the male motorcycle riders audience having the highest CTR of all the digital display activity at 3.02%. This indicates a strong correlation between the audience and relevance of content, serving them real-time information about the dangers of drink driving.

The activity's current learnings and results clearly demonstrate the success in this new approach, indicating that the targeted ads are an effective way to engage with the road user community. The implication of this activity is that other government agencies can learn and apply similar tactics and strategies to enhance the efficacy of mass media and targeting digital advertising campaigns.

Conclusion

By focussing on what people need from the Commission, rather than what Commission needs from people, the approach has evolved to get the attention of the community in their own space. The Commission's advertising evolution over the past several years has seen a move away from having many small campaigns in market at any one time, to having fewer, bolder and more integrated campaigns with more contextual targeting. This has helped build the Commission's brand and has reduced the instances of campaigns competing with themselves in market – something which also makes the messages more easily understood and remembered.

This work has been accompanied by a digital transformation project, which saw the launch of the Commission's Government-leading Targeted Digital Advertising activity. This new approach represents a significant shift in how behaviour change campaigns are formulated, leading to positive results for all Western Australian road users.
This is just the start of the Commission's changes in the advertising space, with plans to continue evolving to ensure the approach encompasses best practice, dynamic and contextual media placement and highly targeted engaging creative well into the future.

In conclusion, the Road Safety Commission understands that people are busy – more so now than ever before – and the easier it is for the audience engage with and understand the message, the more likely it will have the desired results – people who commit to using WA roads more safely.

So don't come to us, well come to you – with the right message at the right time.

References

Fogg, B. (2009). A behavior model for persuasive design. *Proceedings of the 4th International Conference on Persuasive Technology*, 1–7. https://doi.org/10.1145/1541948.1541999

Fogg, B. J. (2019). Designing for Behavior Change--New Models and Moral Issues: An Interview with B.J. Fogg: B.J. Fogg talks with Jim Euchner about persuasive technology and Behavior Design. *Research Technology Management*, *62*(5), 14-. https://doi.org/10.1080/08956308.2019.1638490

Road Safety Commission. (2023). *Western Australian riad fatalities and serious injuries 2023.* https://www.wa.gov.au/system/files/2024-09/ksi-report-western-australia-.pdf

Rural corridor safety prioritisation using curve context

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Abstract

Proactive approaches to identifying locations for safety treatments are increasingly preferred in order to reduce the influence of random variation in observed crashes. This work presents a proactive corridor prioritisation framework for rural roads in the United States, based on horizontal curve risk. Road centreline geometry and speed limit data is used to estimate typical operating speeds and "curve context" – the degree to which the estimated operating speed of a curve differs from its safe traversal speed. Curve context and other geometric and traffic variables are used to fit a crash prediction model. Estimation and validation of the model using Arkansas and California datasets indicates that poor curve context is a significant predictor of crash risk. Corridors are prioritised according to predicted curve crash risk per unit of corridor length, a proxy for high expected safety benefit relative to treatment cost.

Social media post

Rural curves that are out of context with the surrounding road have an especially high crash risk. By using curve context as a predictor, we highlight rural road corridors in Arkansas and California where safety improvements will most efficiently reduce deaths and serious injuries.

Introduction

Historically, high-risk curves have been identified reactively, based on examination of crash history. However, to reduce the influence of random variation in observed crashes, proactive approaches, which estimate underlying crash risk, are increasingly preferred. Crash prediction modelling provides a proactive approach to identifying high risk road segments, as it highlights crash risk variation related to observable differences in road characteristics. High-risk sites identified based on predicted risk do not suffer from the same regression-to-the-mean effects as sites identified from crash history.

Extensive prior research has highlighted the increase in crash risk associated with curve characteristics such as radius, length, and grade (Bauer & Harwood, 2014). Researchers have found an association between curve crash risk and spatial factors, for example the presence or radii of adjacent curves in close proximity (Elvik, 2019) or isolated curves with long straight approaches (Donnell et al., 2019). Prior work has also explicitly estimated *curve context* – the degree to which a curve is unexpected given the surrounding road environment – using road geometry and expected operating speed modelling (Abeysekera et al., 2018).

More recently, the safety impacts of curve context, and spatial road geometry more generally, have become an increasing focus of crash analyses in the United States and other countries. A Federal Highway Administration study by Donnell et al., models curve crashes in Washington State and Utah, including consideration of curve and tangent road sections upstream and downstream of the curve of interest (Donnell et al., 2019). Elvik (2019) summarises existing research into the impact on curve crash risk of adjacent curve locations and characteristics. Curves with sharper neighbouring curves are found to have lower crash risk. This finding supports an interpretation that corridors containing many sharp curves in proximity may be safer than corridors with only a small number of curves spaced further apart. However, this analysis is a purely statistical approach that does not explicitly consider likely operating speeds of vehicles based on road and curve geometry.

In summary, while the crash risk of isolated curves has been studied at some length, approaches to date have typically used simplified geometric models. Some prior work has developed more detailed methods using operating speed models to assess desired and likely curve speeds, but the prioritisation of rural corridors based on predicted risk has still largely relied on reactive analysis, and is therefore subject to statistical variation in crash data. There is a need for proactive approaches to curve risk analysis in rural contexts, such that models can be developed and applied to areas with potentially missing or incomplete crash data.

Conference theme

There are significant equity impacts associated with the ongoing rural road safety crisis in the United States (among other countries). Lower socio-economic and remote rural areas tend to face disproportionate risk of death and serious injury due to higher levels of driving and lower-quality infrastructure. Given limited funding for transport improvements, it is critical to target safety interventions to where they will have the largest impact. Historical reactive approaches to prioritisation have well-known flaws but are slow to adapt. This work continues the evolution of safety treatment targeting by improving on prior proactive approaches and extending the reach of such tools to areas with limited available crash and roadway data.

Method

Data sources and exclusions

Road network and crash datasets from California and Arkansas were used to develop and evaluate the predictive model. Divided highways, unsealed roads, and roads with speed limits below 40 mph were excluded to restrict the dataset to infrastructure and speed environments typical of rural highways. Estimated traffic volume for each road was taken from the Highway Performance Management System (HPMS). Crash data was sourced from state Departments of Transportation and included all reported injury crashes (fatal, serious, and minor severities) from 2018-2022 (five years). Crashes coded as intersection related were excluded from the analysis. Crashes were assigned to the nearest road segment within a 50-metre radius.

Curve segmentation and context estimation

To estimate curve context, the centreline dataset is segmented into curved and straight sections using a sliding window approach. Then an Austroads speed model (Austroads, 2009) is applied to estimate directional desired and actual operating speeds for each road segment based on prevailing speed limit, adjacent road geometry, and alignment type. Thirdly, estimated curve approach speeds are compared to safe curve negotiation speeds according to Austroads design limits (Austroads, 2009), and curves are categorised as Class 1 (highly out of context), Class 2 (out of context), or Class 3 (within context).

Crash prediction modelling

For model fitting and validation, the combined dataset was split into training, test and validation sets containing approximately 60%, 20%, and 20% of corridors, respectively. Variables found to have robust predictive power in the training dataset were included in the model, with the test dataset used for interim testing and the validation dataset used to assess the final model fit.

The model of curve injury crashes uses a generalised linear model with errors assumed to follow a negative binomial distribution based on the observed overdispersion in the crash data. Alternative approaches such as Poisson or Zero-Inflated count models did not improve model fit so were not pursued further. The model includes traffic volume and curve length, in addition to the derived variables for curve context and curve intensity (curve deflection angle divided by radius). Intuitively, a curve that is out of context from both directions of travel is expected to have higher crash risk than a curve out of context in only one direction. Indicator variables are included in the model which reflect the curve context from one or both directions of travel.

Corridor prioritisation

We prioritise corridors for safety treatment according to the *total predicted out-of-context curve crashes per unit length of corridor*. This metric incorporates both total estimated risk on out-of-context curves, such that corridors with more, or higher-risk, out-of-context curves are prioritised. Normalising by corridor length recognises that road safety treatment cost (e.g., implementation cost or travel time impact) will scale proportionally to corridor length. The metric targets corridors where the largest absolute crash reductions can be expected from safety treatments targeting out-of-context curves.

Results

Model fit and validation

Table 1 shows model variables, fitted coefficients and confidence intervals. These coefficients imply, for example, that a curve with Class 1 context from both directions of travel has a 102% higher crash risk than an in-context curve.

Table 1. Corridor Priority Bands (California and Arkansas)

Variable	Coefficient	exp(Coefficient)	95% Confidence Interval	
Intercept	-9.18	–	-9.43	-8.94
Average annual daily traffic	0.54	–	0.53	0.56
Curve Length (m)	0.72	–	0.68	0.76
Class 2 curve context, one travel direction	0.23	1.26	0.16	0.30
Class 2 curve context, both travel directions	0.49	1.63	0.39	0.59
Class 1 / class 2	0.67	1.96	0.55	0.80
Class 1 curve context, one travel direction	0.42	1.53	0.33	0.51
Class 1 curve context, both travel directions	0.70	2.02	0.59	0.82
Curve intensity (deg/m)	0.24	1.27	0.22	0.26
Overdispersion	1.30	–	1.21	1.39

Error! Reference source not found. shows average crash rates for Class 1 (highly out of context) or Class 2 (out of context) curves, by how many directions of travel exhibit that curve context class. Curves where both directions of travel are out of context tend to have higher crash rates, particularly for Class 1 curves.

Table 2 shows goodness-of-fit metrics for models of increasing complexity. The inclusion of curve context and curve intensity variables improves model fit, as evidenced by higher AIC and lower MAD. The full model was validated against the independent validation subset of the data and predicted 71% of the variation in injury crashes on out-of-context curves, and

Table 2. Model fit results

Model	MAD	AIC	McFadden's Pseudo-R2
Traffic volume and curve length	0.360	88,372	0.094
Add curve context variables	0.355	87,235	0.106
Add curve intensity	0.350	86,297	0.116

Corridor Prioritisation

Table 3 shows the priority band thresholds used to achieve the given target network length within each band, based on crash risk predicted on the full sample of California and Arkansas corridors. Consistent with the empirical road safety literature, the distribution of corridor risk has positive skew (a long right tail). Corridors in the "high" risk band on average have a predicted out-of-context curve crash density more than twice that of "medium-high" risk and approximately 60 times higher than "low" risk corridors. The highest-risk 10% of corridors by network length carry over 40% of the predicted out-of-context curve crash risk.

Table 3. Corridor Priority Bands (California and Arkansas)

Priority Band	Network Length	Predicted Annual Out-of-context Curve Injury Crashes Per 100 mi of Corridor		Network Out-of-context Curve Risk	
		Band Lower Threshold	Band Average	Band	Cumulative
High	10%	11.55	20.20	42%	42%
Medium-High	15%	6.36	8.54	27%	69%
Medium	20%	3.32	4.70	20%	88%
Medium-Low	20%	1.40	2.29	10%	98%
Low	35%	0.00	0.34	2%	100%

Conclusions

This work has shown that curve context and curve geometry provide useful additional information when determining crash risk on rural roads. Predicted crash risk has been used to construct a metric of out-of-context curve crash risk per unit of corridor length, which is used to prioritise corridors for cost-effective treatment. The highest-priority 25% of network length holds over two-thirds of the total out-of-context curve crash risk, with the remaining 75% of the network accounting for less than a third of the total risk. Treatments to improve out-of-context curves on these high priority routes are expected to generate the largest safety benefits per unit of corridor length, and hence form an efficient and effective approach to reducing death and serious injury on rural roads.

References

Abeysekera, R., Brodie, C., Durdin, P., Gardener, R., Harris, D., & O'Neil, C. (2018). Vehicle Speed and Risk Modeling of Horizontal Curves at a Network Level. Transportation Research Board 97th Annual Meeting. Washington DC, United States.

Austroads. (2009). Guide to Road Design Part 3: Geometric Design. Austroads, Sydney, Australia.

Bauer, K. M., & Harwood, D. W. (2014). Safety Effects of Horizontal Curve and Grade Combinations on Rural Two-Lane Highways. Federal Highway Administration, McLean, VA.

Brodie, C. (2016). Risk Ranking of Curves on New Zealand State Highways for Skid Resistance Monitoring and Treatment. Transit New Zealand. Retrieved from https://saferroadsconference.com/wp-content/uploads/2016/05/Colin-Brodie-Risk-Ranking-of-Curves-NZ-SH.pdf

Donnell, E., Porter, R. J., Li, L. H., Himes, S. C., & Wood, J. (2019). Reducing Roadway Departure Crashes at Horizontal Curve Sections on Two-lane Rural Highways. Federal Highway Administration, Washington, DC.

Elvik, R. (2019). The more (sharp) curves, the lower the risk. Accident Analysis & Prevention, 133. doi:https://doi.org/10.1016/j.aap.2019.105322.

In-field evaluation of sleepiness and distraction driver monitoring systems

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Abstract

Individuals who drive for work are susceptible to sleepiness and distraction. Sleepiness and distraction driver monitoring systems (DMS) continuously monitor for, and alert to, sleepiness and distraction in real-time. The safety benefit and validity of these systems have not been well evaluated in-field. To address this, we conducted a controlled cross-over study. Eighteen individuals who drive for work utilised sleepiness and distraction DMS for eight weeks, alternating between alarms off and on. With alarms on, there was no change in distraction events, but sleepiness, harsh braking, and harsh cornering events reduced by 55%, 48% and 34% respectively ($p<0.05$). A 1-hour increase in drive duration was associated with a 2.5-fold [95% CI 1.2, 5.3] and 3.1-fold [1.2, 7.8] increase in the odds-ratio for a sleepiness and distraction affected drive respectively ($p<0.05$). While a significant safety benefit of DMS was observed for sleepiness and driving performance, further research is required to determine whether this translates to reduced crashes.

Social media post

Can tech help to keep tired & distracted drivers safe? Our in-field study found driver monitoring systems reduced sleepiness by 55%, harsh braking by 48%, & harsh cornering by 34%. Promising—but do they cut crashes? More research required. 🚛💤 #RoadSafety #HumanFactors

Introduction

Motor vehicle crashes result in 1.2 million fatalities globally (James et al., 2019), with a third estimated to be caused by sleepiness or distraction (Tefft, 2014; Sundfør et al., 2019). Driver sleepiness results from insufficient or poor-quality sleep, excessive wakefulness, driving when biological sleepiness is high, and extended duration driving. Driver distraction results from mobile phone use, mind wandering, adjusting devices, and outside of the vehicle events.

Individuals who drive for work are susceptible to sleepiness and distraction. Driver monitoring systems (DMS) may reduce sleepiness related risk by continuously monitoring for, and alerting drivers to, sleepiness and distraction in real-time. Many DMS measure sleepiness via ocular parameters, such as eye closure and blink duration, which are reliable indicators of sleepiness (Cori et al., 2019). DMS that also detect distraction, typically do this via eye gaze or head position.

The safety benefits of DMS have not been well evaluated in-field (Cori et al., 2021). Two uncontrolled studies found a 50% to 66% reduction in sleepiness events with alarms to drivers relative to an alarm off period (Cori et al., 2025; Fitzharris et al., 2017). One of these studies also measured distraction events, but found they did not vary with alarms on (Cori et al., 2025). Additionally, one study has evaluated the validity of DMS in-field. This retrospective study demonstrated that drive duration was positively associated with both sleepiness and distraction events (Ferreira et al., 2019).

The objective of this study was to conduct a controlled cross-over trial to evaluate the efficacy and validity of sleepiness and distraction DMS in individuals who drive for work during their regular work shifts. It was hypothesised that alarms would reduce sleepiness, distraction, and adverse drive events; and, be associated with known sleepiness and distraction risk factors. This study was one component of a broader program of research into sleepiness and distraction technology.

Conference theme

This study aligns to the conference theme of evolution, by evaluating the efficacy and validity of technology that contributes to safe systems, by assisting drivers in recognising and responding to human factors of sleepiness and distraction.

Method

Participants with a full driving licence and who drove at work for at least 15 hours per week were recruited from the Telstra Group, Australia. Participants who reported excessive sleepiness (Epworth Sleepiness Scale >18) were excluded, as a score at this level doubles crash risk (Howard et al., 2004) and contraindicates driving. The study was a counterbalanced cross-over design, where drivers were allocated to complete 4-weeks of alarms on first, or, four of alarms off first, before crossing to the alternate condition (see Figure 1). During both conditions, the DMS recorded sleepiness events (eyes closed) and distraction events (focus off road). Drivers wore a wrist-worn actigraph to track sleep and completed a sleep and work log, on days that they were working throughout the 8-weeks.

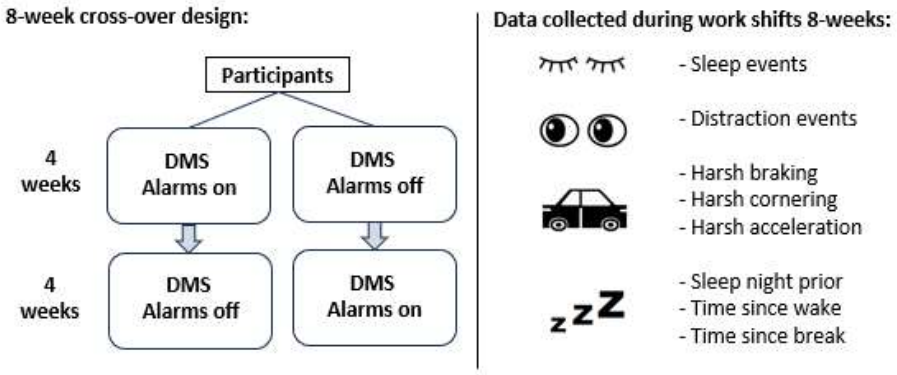


Figure 1. Overview of study design

Drivers' work vehicles were fitted with the DMS, which comprised part of the Guardian Gen 2.1 solution (Seeing Machines, Australia). A driver facing camera was positioned on the dash, and utilised proprietary algorithms to detect sleep (eyes closed) and distraction (eyes off the road). Drivers were alerted to these events in real-time via auditory and vibration alarms. Short video snippets of the detected events were sent to a Seeing Machines event verification centre, where trained analysts reviewed the DMS events and reclassified them. The complete Guardian solution sends the verified events to the drivers' safety manager in as close to real-time as possible. For this study, only the instantaneous alerts to the driver were utilised. The analyst verified events were reported as outcomes. Adverse drive events of harsh braking, acceleration and cornering were recorded by MTData (Australia) which was already installed in the Telstra work vehicles. Objective sleep was recorded via a wrist worn actigraphy. Work and sleep logs collected information on work shifts, breaks, subjective sleepiness, and sleep durations.

Results

Twenty-two participants were recruited into the study, with 18 (1 female) completing the study. The mean age (SD) was 41±10 years. Participants worked a median of 8 hours per day, 5 days a week, and drove 16 hours per week. Half of the participants worked metro routes and half worked regional. All participants worked day shift (0700-1500hr), with 16% also working afternoon (1500-2300hr) and 22% also working night (2300-0700hrs). Vehicle types were similar across participants with utes the most common (66.7%), followed by cars (16.7%) and vans (16.7%). DMS trip and event data are shown in Table 1. Validated sleepiness events were half as likely in the alarm on condition than the alarm off reference condition (rate-ratio [95% CI] = 0.45 [0.19, 0.98], p-value = 0.015). There was no difference in validated distraction events with alarm condition (rate-ratio [95% CI] = 0.81 [0.23, 2.66], p-value = 0.355).

MTData is shown in Table 2. MtData was working in only 16 participants' vehicles, hence the disparity in trips with the DMS. As data was analysed as a rate-ratio, this disparity has no implications on the results. Rate-ratio analysis found that harsh braking (IRR 0.52 [0.28, 0.93], p-value = 0.009) and harsh cornering (IRR 0.66 [0.47, 0.91], p-value = 0.004), were reduced by 48% and 34% respectively with alarms on. There was no change in harsh acceleration events with alarms (IRR 1.12 [0.15, 8.37], p-value = 0.447).

Table 1. Trip and event data from DMS

Driver monitoring system		**Alarms off**	**Alarms on**
Total trips	Trips	1420	1314
	Driving time (hours)	897	830
Per participant	Total no. of trips - mean (SD)	78.9 (29.6)	73.0 (25.6)
	Total driving hours - mean (SD)	49.8 (16.7)	46.1 (17.4)
	Drive minutes p/trip - mean (SD)	39.2 (8.8)	38.2 (8.3)
Detected events	Sleepiness (N)	105	76
	Distraction (N)	196	177
Verified sleepiness events	Total (N)	24	10
	Every x hours	37.4	83
	Every x kms	1,754.5	4,174.5
Verified distraction events	Total (N)	8	6
	Every x hours	112.1	138.3
	Every x kms	5,263.55	6,957.48

A 1-hour increase in drive time was associated with a 2.5-fold [1.2, 5.3] increase in the odds-ratio [95 CI] for a drive with a sleep event ($p = 0.014$) and a 3.1-fold [1.2, 7.8] increase for a drive with a distraction event ($p = 0.016$). A 1-hour increase in sleep duration trended towards a reduced odds-ratio (0.6 [0.3, 1.1]) for a drive with a sleep event ($p = 0.089$). There was no impact of sleep duration on drives with a distraction event (odds-ratio [95 CI] = 0.9 [0.3, 2.3], $p = 0.837$).

Table 2. Trip and event data from MTData

MTData		**Alarms off**	**Alarms on**
Total trips	Total trips (n)	1,157	1,096
	Total driving time (hours)	807	720
Per Participant trips	Total no. of trips – mean (SD)	72.3 (28.3)	68.5 (33.7)
	Total driving hours – mean (SD)	50.4 (17.9)	45.0 (20.2)
	Drive minutes p/trip - mean (SD)	45.2 (20.7)	41.5 (12.6)
Adverse events	Hard braking events total	39	18
	Every x hours	20.7	40
	Hard acceleration events total	3	3
	Every x hours	269.1	240
	Hard cornering events total	106	62
	Every x hours	7.6	11.6

Benefits to road safety

This controlled cross-over trial demonstrated that DMS alarms to drivers, reduced sleepiness events by half, and adverse drive events by a third to a half. Based on these results, DMS may in theory positively impact road safety by making drivers aware of their sleepiness state, which has flow on beneficial effects to their driving performance.

Implications for policy and practice

This study suggests that DMS substantially reduces sleepiness and adverse driving events for workers whose spend part of their role driving. Hence, DMS are a valuable tool that companies can use to mitigate sleepiness risk amongst their workers who drive. In this sample, no benefit to distraction events were observed, although only few events were observed and this may be different in a larger sample or a different population (e.g., drivers who shift work more or drive longer distances). Regardless, it is important for companies to understand that DMS while beneficial, will have limitations, and should be used as part of a wider safety plan to manage sleepiness and distraction.

Conclusions

This is the first controlled trial to evaluate DMS. The study showed a valuable impact on driver sleepiness and driving performance, but not distraction. Further research should utilise a larger sample size and evaluate professional drivers who drive longer distances and at times of the day that are most conducive to sleepiness. Additionally, future research should examine whether DMS use translates to reduced crash incidence and ultimately saves lives.

References

Cori, J. M., Anderson, C., Shekari Soleimanloo, S., Jackson, M. L., & Howard, M. E. (2019). Narrative review: Do spontaneous eye blink parameters provide a useful assessment of state drowsiness? *Sleep Medicine Reviews*, *45*.

Cori, J. M., Booker, L. A., Sletten, T. L., Rajaratnam, S. M. W., Stanley, D., Francis, L., McMahon, K., Wilson, K., Mulhall, M., & Howard, M. E. (2025). Evaluating the effectiveness of camera-based fatigue and distraction detection technology in a rural truck driver cohort (Accepted for publication). *Journal of Occupational and Environmental Medicine*.

Cori, J. M., Manousakis, J. E., Koppel, S., Ferguson, S. A., Sargent, C., Howard, M. E., & Anderson, C. (2021). An evaluation and comparison of commercial driver sleepiness detection technology : a rapid review. *Physiological Measurement*, *42*(7), 74007.

Ferreira, S., Kokkinogenis, Z., & Couto, A. (2019). Using real-life alert-based data to analyse drowsiness and distraction of commercial drivers. *Transportation Research Part F: Traffic Psychology and Behaviour*, *60*, 25-36.

Fitzharris, M., Liu, S., Stephens, A. N., & Lenné, M. G. (2017). The relative importance of real-time in-cab and external feedback in managing fatigue in real-world commercial transport operations. *Traffic Injury Prevention*, *18*(sup1), S71–S78.

Howard, M. E., Desai, A. V, Grunstein, R. R., Hukins, C., Armstrong, J. G., Joffe, D., Swann, P., Campbell, D. A., & Pierce, R. J. (2004). Sleepiness, sleep-disordered breathing, and accident risk factors in commercial vehicle drivers. *American Journal of Respiratory and Critical Care Medicine*, *170*(9), 1014–1021.

James, S. L., Lucchesi, L. R., Bisignano, C., Castle, C. D., Dingels, Z. V., Fox, J. T., Hamilton, E. B., Liu, Z., McCracken, D., Nixon, M. R., Sylte, D. O., Roberts, N. L. S., Adebayo, O. M., Aghamolaei, T., Alghnam, S. A., Aljunid, S. M., Almasi-Hashiani, A., Badawi, A., Behzadifar, M., … Mokdad, A. H. (2019). Morbidity and mortality from road injuries: Results from the Global Burden of Disease Study 2017. *Injury Prevention*.

Sundfør, H. B., Sagberg, F., & Høye, A. (2019). Inattention and distraction in fatal road crashes – Results from in-depth crash investigations in Norway. *Accident Analysis and Prevention*, *125*(January), 152–157.

Tefft, B. C. (2014). *Prevalence of Motor Vehicle Crashes Involving Drowsy Drivers, United States, 2009-2013*. AAA Foundation for Traffic Safety;1-10. https://aaafoundation.org/wp-content/uploads/2017/12/PrevalenceofMVCDrowsyDriversReport.pdf

A systems thinking-based approach to address drug driving-related road trauma

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Abstract
Drug driving is a pressing road safety issue, yet there is limited understanding of the causes of drug driving-related road trauma and its prevention. Building on recent calls for a paradigm shift, this project applied systems thinking methods to identify the set of interrelated factors responsible for drug driving-related road trauma (using a Causal Loop Diagram [CLD]) and examine the likely impacts of potential interventions on the number of drug driving-related crashes in Queensland (using System Dynamics [SD] modelling). The CLD demonstrates that drug driving-related road trauma results from complex interrelationships among factors relating to societal drug use, road user behaviour, and road safety transport system and its conditions. The SD modelling demonstrates that drug driving cannot be solely managed through road safety interventions but rather through a more holistic approach that includes other influential aspects of the system (e.g., societal health). The implications for road safety practice are discussed.

Social media post
Our study found that drug driving is a road safety issue caused by a complex interplay among factors relating to societal drug use, road user behaviour, the road transport system and its conditions. Addressing this road safety issue would require a holistic, integrated public health approach.

Introduction
Drug driving is one of the 'fatal five' behaviours contributing to road trauma. Data from a recent survey conducted with Queensland drivers indicate that approximately 5–17% of respondents have driven under the influence of illicit drugs in the last 12 months (Libatique, 2024). Statistics from the Queensland coronial data further emphasise the extent of the drug driving issue, showing that drugs were present in 24.8% of fatal crashes occurring between 2011-15 (Davey et al., 2020). Interventions, focusing mainly on driver education and enforcement, have been developed and implemented to prevent drug driving; however, there is little evidence for their effectiveness (Razaghizad et al., 2021). Critically, the driver-centric focus in addressing drug driving (and other fatal five behaviours) overlooks the influences of the broader road transport system (e.g., Salmon et al., 2012). Contemporary systems thinking-based models of accident causation argues for the need to consider the entire societal system rather than its components (e.g., drivers) (Dekker, 2011). Underpinning systems thinking-based models is the notion that a system comprises multiple components, and it is from the non-linear, dynamic interactions among these multiple components that safety and accidents emerge.

The present study involved the application of systems thinking methods to examine the issue of drug driving and drug driving-related road trauma in Queensland. More specifically, this study applied systems thinking methods to (i) identify and understand the interrelated factors responsible for drug driving-related road trauma in Queensland (using a Causal Loop Diagram [CLD]), and (ii) simulate the likely impacts of a range of interventions on drug driving-related serious injury and fatal crashes in Queensland (using System Dynamics [SD] modelling). The present study aligns with the 2025 conference theme of "Evolution", as the study represents, for the first time, the use of a novel systems thinking-based approach to address the complex issue of drug driving.

Method and Results

Identifying and understanding the interrelated factors responsible for drug driving-related road trauma
A CLD (Sterman, 2000) was developed to enable the conceptual (qualitative) representation of stakeholders' views on the interrelated factors responsible for drug driving-related road trauma in Queensland. All systems, including the road safety system, comprise interacting networks of positive and negative feedback loops that influence behaviour (e.g., drug driving). CLD was used to elicit and represent stakeholders' views on what these feedback loops comprise, the

relationships that exist between them, and how they interact dynamically to influence behaviour. Stakeholder views are inherent to the CLD development and is considered the preferred data source (over other data sources such as existing literature) (Littlejohns et al., 2021). The integration of knowledge and experience of diverse stakeholders can better represent a system understanding of the topic under study (Friel et al., 2017).

In a CLD, factors are connected using causal arrows with polarity to illustrate hypothetical or empirically-driven causal relationships. Causal arrows with a positive polarity ("+") indicate that a change in a source factor causes a change in the destination factor in the same direction (e.g., as one factor increases, the other factor increases). Causal arrows with a negative polarity ("-") indicate that a change in the source factor causes a change in the destination factor in a different direction (e.g., as one factor increases, the other factor decreases).

A 1-day in-person group modelling workshop was held to facilitate the development of the drug driving-related road trauma CLD. A total of 24 participants (10 male, 14 female) attended this workshop, bringing expertise in road and transport safety (n = 9), policing (n = 6), justice (n = 4), and public health, including drug and alcohol services and ambulance services (n = 4). In this first workshop, the research team provided a background on CLDs before participants engaged in the workshop activities. Participants were first asked to identify factors they believed to be responsible for drug driving-related road trauma in Queensland, and then the relationships among the factors. The research team developed a first draft of the CLD during the workshop and refined this draft CLD post-workshop through an iterative process.

The CLD represented a set of interrelated factors across five distinct groups: (i) societal health (e.g., trauma and adverse incidents, social and work pressures, cost of living, drug consumption), (ii) drug control (e.g., supply of and access to illicit drugs, illicit drug enforcement), (iii) road safety (e.g., drug driving-related crashes, recognition of the problem), (iv) alternative transport (e.g., shift to personal mobility devices, alternative transport options), and (v) policy resistance (policy action, education and awareness, research and funding). The CLD also described three drug user populations that contribute to the number of individuals engaging in drug driving on Queensland roads: (i) recreational/incidental users, (ii) therapeutic (medicinal cannabis) drug users, and (iii) persons with illicit substance dependence. The CLD showed that factors relating to societal health are key influencers in the use of drugs, which, in turn, influences the number of individuals engaging in drug driving and the number of drug driving-related crashes. An important observation is the multi-factorial nature of drug driving and the need for a more holistic approach focusing on influential aspects such as societal health, societal drug use, and alternative forms of transport to address the complex issue of drug driving.

The CLD was subsequently transformed into a quantitative model incorporating the complex feedback processes and dynamic mechanisms influencing the number of drug driving-related serious injuries and fatal crashes in Queensland. This quantitative model was expressed using differential equations to describe the relationships between the factors and, importantly, the behaviour of the system over time.

A draft SD model of drug driving-related serious injury and fatal crashes in Queensland was created by the research team and then reviewed by stakeholders in an online workshop. A total of nine participants (4 male, 5 female) participated in this workshop, bringing expertise in road and transport safety (n = 5), policing (n = 1), justice (n = 2), and public health (n = 1). In this second workshop, the research team provided a summary of the first workshop, including the final CLD, and a background on SD modelling. Participants then engaged in the main activity, which was reviewing and providing feedback on the SD model structure. The SD model was further refined by the research team post-workshop through an iterative process. Once the SD model structure was completed, the research team obtained empirical data from various sources (e.g., government agencies, published literature), and where data was not available, estimations were made based on other available proxy data. The model was assessed through an iterative process to ensure that the model structure describes the behaviour of the system in the real world (based on the CLD) and that the outputs of the model match the observed problem behaviour.

Simulating the likely impacts of interventions on the number of drug driving-related crashes

The SD model was then used to simulate the likely impact of different interventions proposed to reduce the number of drug driving-related serious injury and fatal crashes in Queensland, over a 30-year period. The identification of system interventions for testing occurred during the second workshop, where workshop participants discussed potential interventions that could be tested in the SD model (listed in Table 1). The effect sizes for the interventions tested were estimated based on a literature review. Due to the limited empirical research on drug driving interventions, the research team gathered evidence from other proxy literature (e.g., drink driving interventions), discussed the evidence, and made a consensus decision on the estimated effect sizes for input into the SD model. The baseline data used was the number

of drug driving-related serious injury and fatal crashes reported in the calendar year 2022 in Queensland, which was 236 crashes (supplied by the Queensland Department of Transport and Main Roads). Table 1 summarises the likely impacts of the interventions tested.

Table 1. Likely impacts of the system interventions on the number of drug driving-related serious injury and fatal crashes

Intervention	Number of serious injury and fatal crashes	Change from baseline
Road safety interventions		
1. General roadside drug testing	196	-16.95%
2. Mandatory curriculum-based education programs in schools (before licensure)	214	-9.32%
3. Broad-based education programs for drug driving	205	-13.13%
4. Roadside impairment testing technology	196	-16.95%
5. Increased penalties	236	0.00%
Societal health interventions		
6. Health-based interventions for individuals with illicit substance dependence	237	0.00%
7. General intervention to address structural societal health concerns	167	-29.24%
Combined interventions		
8. Combination of Intervention 1 and Intervention 3	171	-27.54%
9. Combination of Intervention 3 and Intervention 6	206	-12.71%
10. Combination of Intervention 1 and Intervention 5	196	-16.95%
11. Combination of Intervention 1, Intervention 3, and Intervention 7	121	-48.74%

Among the road safety interventions tested (Interventions 1–5), general roadside drug testing (Intervention 1) and roadside impairment testing technology (Intervention 4) resulted in a larger projected decline in the number of crashes (-16.95%). Among the societal health interventions tested (Interventions 6 and 7), a general intervention to address structural health concerns (Intervention 7) resulted in a larger projected decline (-29.24%). Finally, among the combined interventions tested (Interventions 8–11), the combined intervention of general roadside drug testing (Intervention 1), broad-based education programs (Intervention 3), and the general intervention to address structural societal health concerns (Intervention 7) resulted in a larger projected decline in the number of crashes (-48.74%).

Benefits for Road Safety and Implications

The study outcomes indicate that the issue of drug driving cannot be addressed solely using road safety interventions. The close relationship between road safety and societal health evidenced in this study can be leveraged to better understand and prevent drug driving-related road trauma. Accordingly, an integrated public health approach is required to address drug driving. Road safety stakeholders should coordinate their activities with those addressing drug misuse and substance dependence. Primary prevention efforts are likely to be effective through targeting the broader societal issues that result in drug use.

Conclusions

Substantial reductions in drug driving-related serious injury and fatal crashes could be achieved through a combination of interventions that target both road safety and societal health. It is concluded that a whole-of-government approach to the issue of drug driving is required.

References

Davey, J. D., Armstrong, K. A., Freeman, J. E., & Parkes, A. (2020). Alcohol and illicit substances associated with fatal crashes in Queensland: An examination of the 2011 to 2015 Coroner's findings. *Forensic Science International, 312*, 110190.

Dekker, S. (2011). Drift into failure: From hunting broken components to understanding complex systems. Routledge.

Libatique, R. (2024). RACQ unearths troubling patterns in drug use among young Queensland drivers.

Razaghizad, A., Windle, S. B., Gore, G., Benedetti, A., Ells, C., Grad, R., Filion, K. B., & Eisenberg, M. J. (2021). Interventions to prevent drugged driving: A systematic review. *American J Preventive Medicine, 61*(2), 267–280.

Salmon, P. M., McClure, R., & Stanton, N. A. (2012). Road transport in drift? Applying contemporary systems thinking to road safety. *Safety Science, 50*(9), 1829–1838.

Sterman, J. D. (2000). Business dynamics: Systems thinking and modelling for a complex world. McGraw-Hill Education.

Evaluation of traffic control treatments in end-of-queue situations at roadworks

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Abstract

Traffic queues at the end-of-queue (EOQ) location of roadwork sites are often associated with rear-end crashes, posing risks to roadworkers and motorists alike. However, little is known about which EOQ treatments are effective in managing the associate crash risks. To address this important safety issue, a major research project was undertaken in New South Wales in which the best practices in EOQ risk management were first identified through a literature review and consultation with international experts and local stakeholders. A total of 33 treatments were trialled in 13 worksites over 116 days and evaluated using a statistical before-after evaluation methodology. The effectiveness of the treatments was evaluated in terms of i) change in speeds and speeding cases, ii) change in crash risk, and iii) driver views on the treatments' effectiveness and their future use. Synchronised traffic lights and speed-feedback signs, police presence, narrow lane width, flashing lights on queue warning signs, and rumble strips were among the most effective treatments. This research provides an evidence base for traffic control and EOQ crash risk management in work zones.

Social media post

Australian researchers and roadwork experts tested a large number of treatments to reduce end-of-queue crashes at worksites, helping identify the most effective solutions for safer roadworks.

Introduction

Roadworks pose significant risks to roadworkers and motorists alike. While the risks are recognised by agencies involved in road construction and maintenance activities, significant work is needed to develop strategies to mitigate these risks at Australian roadwork sites. Research from Australia and international jurisdictions (Qi et al., 2013) shows that rear end crashes at advance warning areas, particularly at EOQ situations, account for about 40% of all roadwork crashes and are one of the major types of crashes at roadwork sites.

As the EOQ locations can vary depending on traffic volumes and number of vehicles stopped in a queue (Messenger et al., 2023), researchers and practitioners have developed, tested, and evaluated a range of treatments (Benekohal et al., 2010; Debnath et al., 2017; Brown & Edara, 2022). While the findings obtained from the literature provide useful information on the controls and treatment options to mitigate the risks at EOQ situations, it is important to examine the effectiveness of the controls and treatments by considering local conditions, road user behaviour, and practices around roadwork traffic control setups. There is a general lack of understanding about the effectiveness of EOQ treatments in the context of Australian roadworks. As such, EOQ crash risk management in Australian roadwork sites has primarily relied on using anecdotal information about the EOQ treatments' effectiveness. This research aims to address this important gap in the literature by identifying the best practices in EOQ risk management worldwide and evaluating a range of EOQ treatments at real-world worksites, in order to develop an evidence-base for traffic control and crash risk management at future roadwork sites. This research—the largest ever roadwork safety trial in Australia to the best of the authors' knowledge—contributes to the evolution of a safe system in work zone crash risk management through undertaking field trials of existing and new safety treatments.

Methodology

A list of 25 EOQ treatments was identified through a rigorous search and consultation process, including a review of the literature and consultations with international experts and local industry stakeholders (individual and group meetings to gather best practices worldwide). Some of these treatments were field trialled in combination with others, resulting in a total of 33 treatment combinations for trials. The treatments included various static and variable message signs, radar-activated speed feedback signs, UHF radio warnings, rumble strips, an advanced EOQ warning system, a gateway treatment, police presence, and synchronised traffic control devices (E-Series). These treatments were trialled at 13 worksites with different speed and volume conditions, over a total period of 116 days of data collection across all sites. The identified treatments were evaluated using a before-after evaluation methodology in terms of three evaluation

criteria: i) change in driver speeds and speeding cases, ii) change in crash risk, and iii) driver views on the treatments' effectiveness and their future use.

Data for criterion 1 were collected using automatic traffic counters placed at 4-6 locations at one end of the study sites in order to capture the speeds and speeding profiles of all motorists across different parts of the worksites. The collected speed data were analysed using descriptive analysis (Debnath et al., 2014a) and a multivariate Tobit regression analysis approach (Debnath et al., 2014b) which allows modelling the amount of excess speed (i.e., speed above posted speed limits) and the probability of speeding by controlling for the effects of traffic and environmental factors. Marginal effects estimated from the regression models allowed quantifying the effects of the treatments on speed and speeding.

Change in crash risk (criterion 2) was estimated by collecting video recordings of traffic movements in the queue and queue approach areas, and analysing the video data using advanced image processing and Extreme Value Theory analysis methods. Specifically, traffic conflicts were measured using Time to Collision (TTC) and Deceleration Rate to Avoid Crash (DRAC). Serious conflicts were defined for cases with TTC less than 1s and DRAC above 3.4ms^{-2} (Fazekas et al, 2017; Van der Horst, 1990).

Roadside driver surveys were used for criterion 3. The surveys included short questions with pre-defined answer options that the surveyors ticked based on verbal responses provided by drivers while stopped at a queue. Drivers' responses were analysed descriptively to obtain indicators of their levels of agreement with statements, comprehension of the treatments, and preferences of different design options. At least 30 drivers per treatment were surveyed.

Results

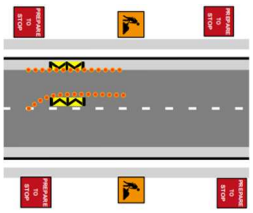
This evaluation study produced numerous results for the 33 treatment combinations across three types of work zones (high speed high volume, high speed low volume, and low speed high volume). The key results for five most effective treatments (see Figure 1) are presented in this article. A comprehensive report containing all results is to be published in the coming months through iMOVE CRC.



E-series devices



Police presence



Gateway (narrow lane width)



Temporary rumble strips



Queue warning sign with flashing lights

Figure 1. Examples of effective EOQ treatments

The E-Series devices were trialled in six configurations. The most effective configurations were the ones that included two Variable Message Signs (VMSs) with a portable traffic signal on the left side of the road. These devices reduced excess speed (i.e., speed above posted speed limits) by around 2km/h and the probability of speeding by around 18%. Further, the probability of exceeding the DRAC threshold reduced from 78% to 43% and the probability of exceeding the TTC threshold reduced from 48% to 20%. Drivers were supportive of these treatments to be used at roadworks.

Police presence was another effective treatment, especially with regards to speed reduction. The marginal effects of the Tobit model showed that when police were present at the site, a 3.7km/h reduction in excess speed was observed while the probability of speeding reduced by 35%. However, the rear-end collision risk increased with the probability of exceeding the DRAC threshold (increased from 78% to 87%), and the probability of exceeding the TTC threshold increased from 48% to 58%. Driver views on this treatment's effectiveness and future use were mixed.

The gateway (narrow lane width) treatment was found effective in reducing speeding through work zone. The excess speed reduced by around 3km/h when the treatment was in-place, while the probability of speeding reduced by 30%. Similar to police presence, the probability of having a critical TTC value slightly increased (by around 3%) when the treatment was in place. Due to technical difficulties, the data was not suitable for DRAC analysis and the roadside driver surveys were not possible to be conducted for this treatment due to traffic not stopping at the studied worksites.

The rumble strips reduced the likelihood of speeding by approximately 14%. However, their impact was localised to the strips' location, with the speed reduction effect diminishing once drivers passed them. Four different rumble strip

configurations were trailed in this study and the most effective one had 3 strips at 3m spacing between strips. For rumble strips, the probability of exceeding the DRAC threshold increased by around 34% and the probability of exceeding the TTC threshold also increased from 36% to 58%, potentially due to drivers decelerating/accelerating suddenly around the location of the strips. Driver surveys showed positive support for the use of the strips.

The queue warning sign with flashing lights also had a reduction in probability of speeding (about 9%), and a reduction in the probability of exceeding the DRAC threshold from 46% to 42%. However, the probability of exceeding the TTC threshold increased from 35% to 42%. The comments from drivers were also mostly in favour of this treatment.

Overall, the results indicate that implementing appropriate treatments at work zones can help reduce EOQ crashes and also demonstrated that different crash causing factors can be addressed with specific treatments. While some measures effectively reduce speeding, they may also increase the risk of rear-end collisions. Conversely, treatments like rumble strips, though limited in impact to their immediate location, play a crucial role in improving driver attentiveness. These trials also assisted in identifying treatments that are not effective in either reducing speed or reducing collision risk at Australian work zones.

Conclusions

This research evaluated a large number of temporary traffic management controls and strategies to reduce the risk of EOQ crashes at roadwork sites. The approach of the evaluation was built on a classical before-after evaluation methodology, in which several metrics (vehicle speed, speeding cases, rear-end crash risk) were computed and compared between two study conditions: with EOQ treatment and without EOQ treatment (i.e., baseline condition, by considering site characteristics). By collecting an extensive amount of data from field trials, the treatments were evaluated in terms of reduction in speed/speeding and rear-end crash risk and overall driver views about the treatments.

From the trialled treatments, the E-Series devices were identified as effective treatments for Australian work zones. Further, police presence, gateway (narrow lane width), and rumble strips treatments were also effective in reducing speeding; however, the rear-end crash risk increased with these treatments. Even though the speed reduction figures are substantial, the queue warning sign with flashing lights is also a reasonable treatment to be utilised to reduce EOQ crashes as this also assists in reducing driver inattentiveness.

The evaluation methodology's short-term nature did not allow for the examination of any potential novelty effects of the studied EOQ treatments. Future research should look into longer-term trials of the treatments to examine their long-term effects beyond the novelty effects.

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References

Benekohal, R.F., Hajbabaie, A., Medina, J.C., Wang, M., & Chitturi, M.V. (2010). Speed photo-radar enforcement evaluation in Illinois work zones. *Springfield, Illinois Department of Transportation*.

Brown, H., & Edara, P. (2022). Use of Smart Work Zone Technologies for Improving Work Zone Safety. *NCHRP Synthesis 587. Washington D.C., The National Academies Press*. https://dx.doi.org/10.17226/26637

Debnath, A.K., Blackman, R., & Haworth, N. (2014a), Effectiveness of pilot car operations in reducing speeds in a long-term rural highway work zone, In: Transportation Research Board (TRB) 93rd Annual Meeting Compendium of Papers, Washington, DC, USA.

Debnath, A.K., Blackman, R., & Haworth, N. (2014b), A Tobit model for analyzing speed limit compliance in work zones. Safety Science, 70: 367-377.

Debnath, A.K., Blackman, R., Haworth, N., & Adinegoro, Y. (2017), Influence of remotely operated stop–slow controls on driver behavior in work zones, Transportation Research Record, 2615: 19-25.

Fazekas, A., Hennecke, F., Kalló, E. and Oeser, M. (2017) A Novel Surrogate Safety Indicator Based on Constant Initial Acceleration and Reaction Time Assumption. Journal of Advanced Transportation. 2017, 1-9.

Messenger, R., Islam, M. Z., Whitlock, M., ... & Ekin, S. (2023). Real-time traffic end-of-queue detection and tracking in uav video. *International Journal of Intelligent Transportation Systems Research*, *21*(3), 493-505.

Qi, Y., Srinivasan, R., Teng, H., & Baker, R. (2013) Analysis of the frequency and severity of rear-end crashes in work zones. Traffic Injury Prevention, 14, 61-72.

Van der Horst (1990) A time-based analysis of road user behaviour in normal and critical encounters. Ph.D. dissertation. Delft University of Technology.

Changing behaviour of young e-bike riders

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Abstract

In response to needs, Council developed a change behaviour campaign for young e-bike riders. This followed a rapid increase in the use of e-bikes among this demographic. Community members, especially vulnerable seniors, have reported that they no longer feel safe on our paths due to the speed, and lack of experience and respect displayed by some riders. Legislative gaps render enforcement inadequate. The sudden and local scope of the issue meant there were little or no educational resources on e-bike safety, and no recognised need to develop them. With behavioural scientists, we developed the 'E-Bike Code' education campaign. The campaign gained extensive media coverage, in local and national media. Advocacy and campaign activity resulted in raising awareness with Transport for NSW and the Department of Education, and also legislative recommendations to a NSW Government inquiry. Data indicates that the campaign was successful in improving safety on the path for pedestrians.

Social media post

Navigating legislative gaps and lack of educational materials for e-bike riders, Council develops the E-Bike Code education campaign to help pedestrians and young e-bike riders share the path safely.

Background

Since 2022 there has been a rapid increase in the purchase and use of e-bikes. A 'fat-tyre' e-bike distributor gifted several of these bikes to local surfing identities as a marketing ploy. Since the local area has an influential surfing community, their use of these e-bikes meant that the trend quickly spread to a younger demographic, some as young as 14 years old with the majority being under 16. Road safety issues soon emerged including:

- Young riders on footpaths, resulting in concerns from other users of the path
- Lack of experience and etiquette by the riders
- High incidence of overriding of speed and motor capacity defaults and removing of bells
- Increased conflict and injury risks due to the size and weight of the e-bikes
- Awareness of the lack of road safety regulation and of legislative gaps with e-bikes

For young people, e-bikes have a lot of benefits. They provide greater independence, and a sustainable, convenient, and fun form of transport without licencing or registration costs. They enjoy transporting themselves, and their friends as pillion passengers, without needing to rely on time-poor parents or infrequent public transport.

Since the magnitude of this issue was only relevant to our council area initially, governing transport and educational bodies did not see the need to address it. Similarly, there were also significant legislative gaps which did not meet the new culture of e-bikes, therefore enforcement could not address the issue. The demographic of the e-bike riders also provided a challenge as the users did not think there was a problem.

Conference Theme

The theme of this project addresses two aspects of the theme: Equity and Elasticity.

Equity: When considering the Safe System Approach principles of safe speeds, safe people and safe vehicles, the current culture of 'fat' e-bikes are removing the equity for pedestrians to use the paths that these e-bike riders are taking. The riders are travelling at risky speeds, on bikes that are illegally allowing fast speeds, and posing a safety risk for pedestrians afraid of being hit by the heavy bikes. The 'fat bike' weight is 34kgs and the handlebar width is 60cm. With many of our paths being only 1.2 metres wide, there is only capacity for 60cm for a rider to pass safely, allowing little room for error, as evidence by injury complaints from residents. Compared with the average weight of a standard bicycle of 8kg, a crash with a fat-tyre e-bike has a greater risk of a more serious injury, for both the rider and the pedestrian. This is not an equitable sharing of a footpath.

Elasticity: The combined effort of promoting a behaviour change and providing improved infrastructure and improving legislation will promote a shift towards more sustainable transport modes (not only e-bikes, but also walking and other pedal bike riding). In the short term, education via a behaviour change program, together with the recommended legislation changes, for the young riders can encourage them to safely approach and overtake people on the path. In the

longer term, and with funding, separated bike paths can be installed to remove the potential conflict of bike riders with pedestrians, while maintaining the option for their preferred mode of travel.

Research

Research undertaken by Council, and key insights identified because of this research is presented in Table 1.

Table 1. Research and Key Insights

Research included	• Physical audit of paths • Reviewing community feedback and a undertaking a survey to gauge attitudes and behaviours • Engaging with external Behavioural Science Architects • Analysis of e-bike related incidents and complaints data • Review of global literature on e-bike use by young people • Focus groups with young people and parents • Consultation with Council staff, Police, schools, parents, retailers and safety groups
Key insights identified	• The current e-bike rules are confusing • Pedestrians felt unsafe sharing pathways with speeding/inattentive riders • There was a knowledge shortfall among young riders • Strong community frustration and demand for better education to address concerns • Young e-bike riders viewed pedestrians as angry people encountered on paths • Parents found risk and safety conversations unproductive • Young e-bike riders believed they were contributing to the transport sustainability solution • Young e-bike riders don't see their behaviour as a problem

Project description

Overview

To meet the existing gap in legislation the strategy was to develop a short-term campaign that was visually driven and based on behavioural science. The goal was to promote e-bike safety with broad community, media and government appeal. The campaign used relatable models, including a young teenage boy and girl riding the 'fat-tyre' e-bikes, to encourage safe behaviour and to promote awareness that they are sharing paths. As we were asking youth for multiple behaviours to change, we needed to make them easy to recall, so a simple code, mirroring the surfer's code helped make messaging stick:

1. Slow Down
2. Ring your bell
3. Be ready for sudden changes – people, pets and prams can be unpredictable.

We also:

- educated parents on what to consider before buying an e-bike, including legal requirements, liability and insurance concerns, safe speeds, and advice on how to safely use shared paths
- provided resources to schools to help them educate their students about the E-Bike code
- targeted the local community to inform that Council is responding to their requests on e-bike safety.

Approach

The tools of behaviour science were employed to get cut through to the younger audience, with the mentally 'sticky' message, strong Calls To Action, vivid and unambiguous language and imagery. Appropriately framing the message explained reasoning for behaviour change and avoided any perception of finger wagging. Educational messages were also provided to help parents understand their role in their children's e-bike safety awareness. The distribution of the physical and online resources was sufficient to reach a high percentage of the local community.

The content of the campaign relied on key personas, teenage riders, a grandmother, a parent with a pram, and a dog. These were featured in short, sharable videos and stills, with a series depicting safe riding practices and etiquette. There was a mix of stylised high-quality videos and images to build brand trust, and lower quality, unpolished videos that would resonate with a younger audience. Outdoor installations were highly visual life size cutouts of personas and signage helping to make the e-bike code come alive on busy routes, intersections and schools. All installations had Call To Actions and QR codes connecting to the Council e-bike landing page.

Stakeholders played significant roles, with local schools and students, bike shop retailers, police and Bicycle NSW assisting with research, the media launch and with amplifying the message. Stakeholder engagement, marketing and advertising were key to the campaign's success.

Results and Discussion

The campaign was launched in May 2024 for 8 weeks. As the first council in NSW to address e-bike safety with a campaign, it received a high level of local and national media attention.

The campaign was successful in providing road safety education on e-bike safety through:

- Extensive media coverage, reaching 2.78 million, including Channel 9 News, The Panel, metro radio and local publications
- Social media, with over 635,000 reach, 12,400 engagements, and 268,000 video plays. A stylised campaign video remains the highest played video to date on Council's Instagram
- The Council website landing page which saw 4,200 sessions, with the outdoor signage driving 30% of traffic
- Increase in traffic to the Council website road safety resources by 45%
- 289 posters and signs that were installed across 56 outdoor locations, and 20 local high schools delivering potential reach of more than 20,000 youth
- Print ads which reached an audience of over 150,000

Advocacy and campaign activity resulted in:

- Bicycle NSW producing an online module for responsible bike riding
- NSW Department of Education trialling new e-bike education module and education pilots with selected Councils and schools, including our local Council
- Transport for NSW commencing research into e-bike riders at local high schools; and the NSW Government inquiry into e-scooters, e-bikes, and related mobility options
- Several Australian councils requested use of the e-bike code campaign as a model for their own campaigns
- The 'E-bike code' campaign effectively established the Council as a catalyst for change in e-bike safety
- The NSW Inquiry recommendations include that the NSW Government should invest in a campaign for young people about safe and responsible use of e-mobility devices

The number of complaints received in the 9 months before the campaign remained the same in the 9 months after the campaign. Data approximates collected from schools (Figure 1) and from local e-bike shops (Figure 2) indicated a significant increase in youth riding e-bikes in the community. Despite this significant increase in e-bike use, the complaints did not rise. From this we conclude that the educational behaviour change campaign was a success.

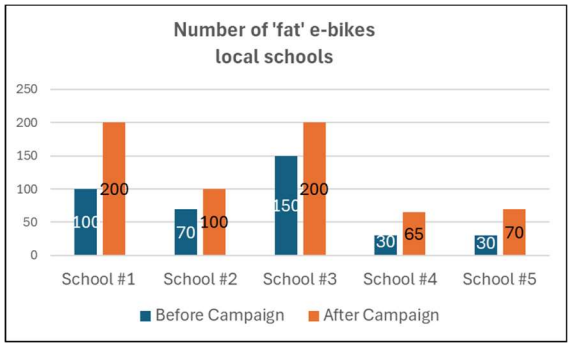


Figure 1. Approximate number of e-bike riders at 5 of the local high schools

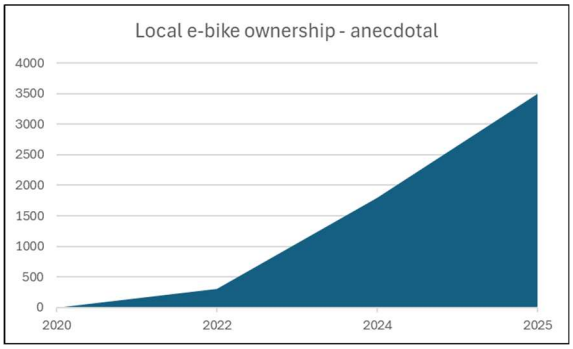


Figure 2. Approximate number of 'fat' e-bike sales on Northern Beaches, primarily to youth

Conclusions

In this project we developed and delivered the E-Bike Code education campaign. With a focus on e-bike rider skills and improving safety between bike riders and pedestrians in shared spaces, the campaign proved successful. This is based on the data showing there was not an increase in the number of complaints during the 9 months after the campaign relative to the 9 months before the campaign. This was despite an increase in the number of young people riding e-bikes continuing to increase.

References

Government response – Report No. 25 – Portfolio Committee No. 6 – Transport and the Arts – Use of e-scooters e-bikes and related mobility options. https://shorturl.at/G1DJJ

Report No.25 – PC 6 – Use of e-scooters e-bikes and related mobility options. https://shorturl.at/y8r7P

Measuring speed: can we trust connected vehicle data?

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Abstract

Speed is a key element of the Safe System framework, as inappropriate speed contributes to both the risk of crashes and their severity. This paper compares the strengths, weaknesses, characteristics and reliability of speed characterisation based on Connected Vehicle Data (CVD) and data from Automatic Traffic Counters (ATC). CVD provides real-time data direct from vehicles with the technology fitted, offering year-round information on the whole road network but only from some traffic. In contrast, ATC data is collected through road-based sensors that measures all traffic but only at the deployment location road and only for its deployment period. Our comparative analysis explores data volumes needed to assess operating speeds from both sources and examines the statistical distribution of speed records. We demonstrate the strengths of CVD in capturing operating speeds and its potential for adoption in funding applications, road safety assessment, and community engagement.

Social media post

We know speed is a critical factor in safety on our roads. Understanding speed across the road network is harder. Anonymous data from Connected Vehicles offers a new approach, but can we trust it, and how big a sample do you need?

Introduction

Vision Zero and the Safe System provides a framework for designing a road system that does not allow human error to have a serious or fatal outcome. Speed is a key element of the framework, as inappropriate speed contributes to both the risk of crashes, and their severity. It is one of the few lead indicators for future accident risk that can be measured and addressed through enforcement, education or engineering treatments.

In an ideal world, prioritisation of speed treatments would be informed by a full speed profile characterisation of the whole road network, recording the operational speed of all traffic along every section of every road, all the time. That vision is not a current practical reality, and so traffic engineers and enforcement have developed tools and approaches based on sampling traffic interactions with the road network. Automatic Traffic Counters (ATC) are one sampling technology that has been used effectively for many years. ATC data is collected through road-based sensors that provides a complete measurement of traffic at the location it is deployed to, and for the period of time it is deployed for – usually a few weeks. It measures speed, axle counts, and traffic volume.

Evolution Theme

Vehicle technology now offers new ways to characterise operational speeds, which are fundamentally different to traditional methods. Connected Vehicle Data (CVD) provides real-time data direct from the on-board computer of various vehicle types, suitably anonymised. Based on the sample of traffic that is fitted with the technology (2-8% and rising annually), it provides a broad perspective on how that sample interacts with the entire roads network, across the entire year. It provides speed, accelerometer, and gyroscope measurements, as well as vehicle type, route and driver behaviour information throughout trips. It does however have the limitation that it only comes from newer vehicles or heavy commercial vehicles fitted with telematics. If these two groups are not representative of the overall traffic behaviour then the findings will be biased.

Previous studies (Puan et al., 2019) have compared ATC data collection with video recording and found no significant differences between traffic volumes and compositions. However, both of these methods are only temporarily deployed and do not capture seasonal variation. CVD in contrast, represents a different statistical sample of traffic and its behaviour.

This paper compares the strengths, weaknesses, characteristics and reliability of speed characterisation based on Connected Vehicle Data (CVD) and data from Automatic Traffic Counters (ATC).

Approach

ATC datasets were sourced from a number of historical deployments, while CVD data was sourced from the Compass IoT Road Intelligence suite. Compass IoT is an Australian company that collects, consolidates, anonymises and serves connected vehicle data for all of Australia, as well as other jurisdictions around the world.

In particular, we examined a nine day ATC deployment to a section of Camms Road, Cranbourne in outer Melbourne from December 2024. Both data sets had all speeds below 10 km/h removed as is industry standard for data collection. This removed the impact of slow-moving vehicles and stationary traffic.

CVD was obtained for the site for the 2024 calendar year. Both datasets were limited to light vehicles. Statistical summaries were calculated for each method, and the overall speed profiles compared. The CVD sample was much smaller than the ATC dataset, which raised the question of whether speed profiles could be accurately drawn from the CVD data. Given we are not using CVD to count vehicles, but rather understand typical driver behaviour, the key question is the reliability of the speed metrics; median and 85th percentile.

To better understand traffic survey critical data sample sizes, we undertook statistical assessment of the ATC data to find out the minimum number of vehicle data points needed in a measurement to produce a robust and reproducible speed profile. By evaluating key speed metrics such as the 50th percentile (mean) speed, 85th percentile speed, and measures of variability (e.g., range, variance) from different sample sizes, the purpose of this analysis is to provide an understanding of sample size requirements to ensure that the traffic behaviour profile accurately reflects real-world conditions.

The ATC dataset was sequentially split by randomly assigning each data point to one of two subsamples. Speed profiles were then determined for each subsample, including median and 85th percentile speeds. Statistical metrics included the mean, the range (maximum – minimum), and 95 and 99 percent confidence intervals. A 95 percent confidence interval can be interpreted as 95 percent confidence that the true average lies within this range, providing a measure of the stability and repeatability of the speed profile. The splitting process was repeated iteratively for each subsample to identify the sample size at which estimates of the median and 85th percentile speed begin to deviate significantly from the values reported when using the complete dataset.

A second analysis is currently underway to similarly analyse a full year of traffic data from three permanent collection sites in Tasmania. This study has allowed us to compare the sample variability from data collected at different times of year against data from a small but whole-of-year traffic sample. Furthermore, this study has allowed us to investigate the differences observed on arterial roads with speed limits of 70 km/h, 80 km/h and 100 km/h compared to Camms Road which only receives local traffic and has a default speed limit of 50 km/h. Results will be presented at the conference.

Results and Findings

Table 1 shows the characteristics of the ATC and CVD traffic samples collected from Camms Road. The two datasets are very different sizes, yet show similar statistical characteristics, which is further confirmed by comparing plots of the speed distributions in Figure 1. There is a small offset between the two curves, which is likely due to the different physical processes underlying each collection method. ATC data is speed as measured ‘on road’, while CVD represents speed as indicated on the speedometer. There is an Australian design rule that this presented speed may not be lower than the true speed, and so the speedometer is calibrated with a small offset.

Table 1. Comparison of ATC and CVD traffic samples and speed statistics

Data collection method and duration	Sample count (all vehicles)	Filtered count (light vehicles only)	Speed profile (km/h)						
			mean	50%	85%	s2	skew	min	max
ATC (9 days)	80,277	78,442	38.9	38.7	44.5	33	0.10	10	89
CVD (365 days)	3,782	1,843	37.8	40.0	46.1	100	-0.65	0	54

Table 2 shows the variability in metrics as the number of data points sampled from the ATC reduces. The table shows that for samples with a high number of data points, the precision of the estimate exceeds practical speed measurement limitations. For decision support, it is of little additional value to know the median speed to within 0.1 km/h over an estimate to within 1.0 km/h. The tipping point where estimate precision meets measurement accuracy is at a sample size of around 300 counts.

Implications for Policy and Practice

The analysis of speed data from ATC and CVD methods indicates that CVD can be effectively used to understand speed behaviour at specific locations along the street. A minimum of 300 data packets is recommended, which can be collected over a longer sample period if necessary. Sites with as few as 100 data packets will still provide operating speed records within a 99 percent confidence interval of 2 km/h. This level of accuracy is sufficient for a scan of speeds across the network to identify speed-related risk, community engagement about speed within their neighbourhood, and for identifying if an intervention has led to a practical change in operating speed.

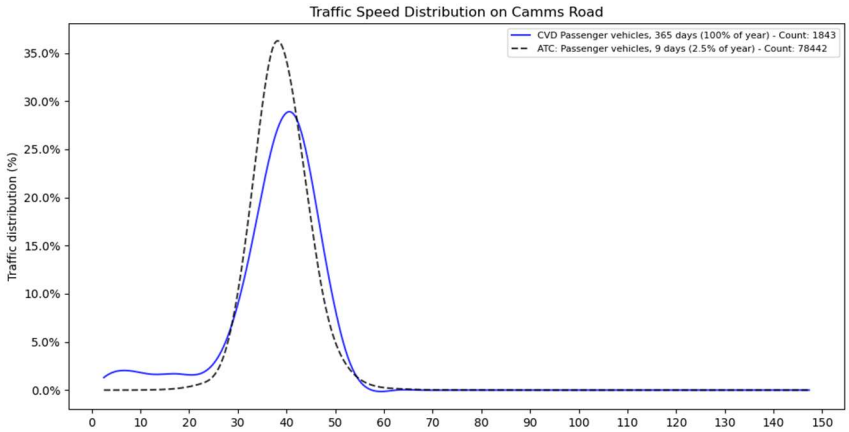


Figure 1. CVD vs ATC speed distributions

Table 2. Variability of speed metrics calculated with decreasing ATC sample size

Data Split (1/x)	Data count	Median Speed			85th Percentile Speed		
		Range (km/h)	95% c.i. (km/h)	99% c.i. (km/h)	Range (km/h)	95% c.i. (km/h)	99% c.i. (km/h)
1	78,442	0.0	-	-	0.0	-	-
2	39,221	0.1	±0.1	±0.2	0.1	±0.1	±0.2
4	19,611	0.1	±0.1	±0.2	0.3	±0.2	±0.3
8	9,806	0.2	±0.1	±0.2	0.4	±0.2	±0.3
16	4,903	0.3	±0.2	±0.3	0.5	±0.3	±0.4
32	2,452	0.5	±0.2	±0.3	1.0	±0.4	±0.6
64	1,226	0.8	±0.3	±0.5	1.1	±0.5	±0.7
128	613	1.4	±0.5	±0.7	1.8	±0.7	±0.9
256	307	2.3	±0.8	±1.0	2.6	±1.0	±1.3
512	154	2.9	±1.1	±1.4	4.0	±1.4	±1.9
1024	77	4.1	±1.5	±1.9	7.1	±2.1	±2.7

Utilising CVD also avoids the safety challenges, equipment risks, and time delays associated with ATC deployment. Instead, current and archived data is available on demand providing a desktop capability to scan and understand speed behaviour across the entire road network, offering new safety insights to practitioners on where interventions are needed most. Whilst this may sound idealistic, we have already applied the technique to mapping speed profiles across entire towns and LGAs. As well as proactively identifying areas of unsafe operational speeds, CVD also offers a new path to evaluate speed interventions in different contexts and gain new learnings on the factors that influence their effectiveness. For consultation about speed-related risk and the need for speed related measurements, CVD data can provide an objective consultation tool to visualise what is happening across communities, and particularly near community facilities with high numbers of vulnerable road users such as schools.

References

Department of State Growth. (2022). Traffic Counts in Tasmania. Tasmania Traffic Data website. https://tasmaniatrafficdata.drakewell.com/publicmultinodemap.asp

Part 1: A Brief Background on Connected Vehicles. (2022). https://www.compassiot.com.au/ultimate-guide-to-connected-vehicles/background-on-connected-vehicles

Puan, O. C., Nor, N. S. M., Mashros, N., & Hainin, M. R. (2019). Applicability of an automatic pneumatic–tube–based traffic counting device for collecting data under mixed traffic. *IOP Conference Series: Earth and Environmental Science*, *365*, 012032. https://doi.org/10.1088/1755-1315/365/1/012032

Event Data Recorders (EDRs) in Australia: prevalence and benefits

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Abstract
Event Data Recorders (EDRs) in motor vehicles are devices that record data from a vehicle's sensors when a crash occurs. This study aimed to quantify the percentage of the Australian light vehicle fleet that have EDRs that are accessible through publicly available tools, and to understand the perspective of stakeholders on the benefits of EDRs, and EDR regulation. The percentage of the fleet that had EDRs accessible through the Bosch tool had grown to 30% in 2021 but may peak at 40% in 2033. The new Collision Sciences tool could access 45% of the light vehicle fleet, but this result was less certain. The benefits of EDRs noted by the EDR stakeholders included considerable time and monetary savings, aiding justice, highly accurate data, and benefits for road safety research leading to improved road safety policy and practice. Many stakeholders strongly supported the introduction of an Australian EDR regulation.

Social media post
About 30 to 45% of Australian light vehicles have accessible Event Data Recorders (EDRs) that are similar to black boxes in aeroplanes. EDRs were found to have many benefits for road safety and justice, though improved access is needed.

Introduction
Event Data Recorders (EDRs) in motor vehicles are devices that record data from a vehicle's sensors when a defined event occurs, usually related to a crash. The data recorded can include speed, driver inputs, Advanced Driver Assistance Systems (ADAS) functioning, passive safety system deployment, and crash severity metrics. This data can be retrieved using an EDR tool compatible with the specific vehicle. While EDRs may offer many potential benefits, their benefits are less immediately clear when compared to other vehicle safety technologies as they do not directly reduce crashes or injuries.

Data from EDRs has been used in Australia and internationally to conduct innovative research on a range of important safety topics. Research conducted using EDR data has included determining the relationship between speed and the risk of serious injury (e.g., Doecke et al., 2021), examining driver behaviour (e.g., Riexinger et al., 2019), research related to ADAS (e.g., Wiacek et al., 2023), and research on speeding (e.g., Elsegood & Doecke, 2024).

Australia is lagging many countries with regard to introducing an EDR regulation. In particular, the United States has had an EDR regulation since 2006 (NHTSA, 2006). China, Japan, Korea and the European Union have also introduced EDR regulations in recent years (e.g., European Union, 2019) There are three important parts to EDR regulation; mandating EDRs, mandating what EDRs record, and mandating that the data can be accessed through a publicly available tool.

In Australia, there are currently two publicly available tools which have the capability to extract data from crash-involved vehicles: the Bosch CDR tool and the Collision Sciences tool. The Bosch CDR tool has been on the market for over a decade, while the Collision Sciences tool has been developed locally in recent years.

The study summarised in this extended abstract aimed to determine the percentage of the Australian vehicle fleet that have accessible EDRs with the two publicly available EDR tools, and how this had changed over time. A further aim of the study was to explore the benefits of EDRs through interviews with EDR end-users, and understand the views of vehicle manufacturers, EDR tool providers, and EDR end-users on EDR regulation.

Conference theme (equity, elasticity and evolution)
EDRs represent an evolution of the way in which crash data related to the performance of the Safe System can be collected through the provision of data that is more accurate than that obtained by other methods, and data that cannot otherwise be obtained.

Method

The percentage of vehicles that each EDR tool can access was examined across three different datasets; the registered vehicle fleet in Australia, new vehicle sales in Australia, and crash involved vehicles in Victoria. Data on the registered vehicle fleet was sourced from the Australian Bureau of Statistics (ABS). New vehicle sales data, known as VFACTS, was provided by the Federal Chamber of Automotive Industries (FCAI), and data on crash involved vehicles from the Victoria Police Accident Records System (VPARS) was provided by the Transport Accident Commission (TAC). The Australian vehicles sales data was used to model the percentage of vehicles that will have accessible EDRs in the future, when the new vehicles sold in recent years will represent the average vehicle in the Australian registered fleet.

Different methods of determining vehicle coverage had to be employed for the two EDR tools. Bosch regularly releases updated vehicle coverage lists, often with multiple updates within a single year. Given that some vehicle-based datasets in the analysis were only available annually, for consistency, the latest software version released for each year was used. At the time of writing, Collision Sciences did not have an official updated support list. However, they confirmed support for all models on the latest Bosch international support list, those supported by a tool for Hyundai, Kia and Genesis not sold in Australia, and select additional makes and models. Since historical support lists were not available from Collision Sciences, it was not possible to assess their support levels retrospectively.

The benefits of EDRs were explored through conducting interviews with EDR end-users. The end-users interviewed were police, a road safety practitioner, two private crash investigators, a member of the insurance industry, and a road safety researcher. Perspectives on EDR regulation were explored with these end-users, and through interviews with four vehicle manufacturers and the two EDR tool providers.

Results

Figure 1 shows the proportion of the registered and crashed vehicle fleets that are supported by each EDR tool, and future projections based on new vehicle sales. After an initial rapid rise, the increase in the proportion of fleet (registered or crashed) that can be accessed with the Bosch tool has slowed considerably. In 2021, 30% of the registered light vehicle fleet had EDRs accessible with the Bosch tool. However, new vehicle sales suggest that this may peak at 40% in 2033 before beginning to decrease. The projected decrease in supported vehicles is largely due to a considerable increase in Chinese vehicle brands that are not currently supported by the Bosch tool. The Collision Sciences tool can currently access a larger proportion of the fleet than the Bosch tool, with vehicle coverage projected to reach around 70% in 2034. However, because the Collision Sciences tool is very new, its future is less certain.

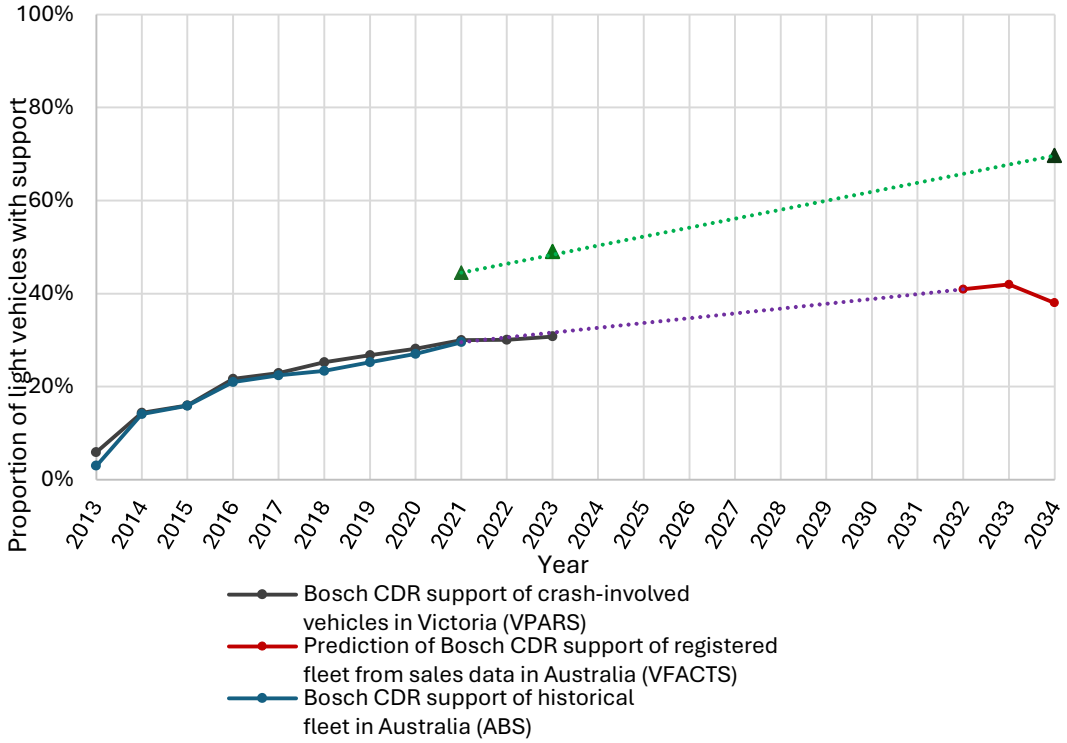


Figure 1. Proportion of the Australian registered and Victorian crashed light vehicle fleets supported by publicly available EDR tools over time, including projections based on new vehicle sales

The interviews highlighted many benefits of EDRs. The benefits of EDRs for end-users included considerable time savings (that would translate to monetary savings), aiding justice, highly accurate data, and the unique capacity of EDR data to provide answers and enhance the understanding of crash circumstances. The road safety benefits of EDRs were also noted, with the aforementioned benefits leading to enhanced research findings, which would then lead to more effective road safety policy and practice. Benefits for vehicle manufacturers were also highlighted, including assistance with product validation, and quality or safety investigations. EDRs have benefits for road safety practitioners, police, private crash investigators, road safety research, the insurance industry, and vehicle manufacturers.

There was also considerable support for an EDR regulation in Australia, and no opposition, amongst the EDR end-users, vehicle manufacturers and EDR tool providers. However, different groups had different desires when it came to what should and should not be included in a regulation. For vehicle manufacturers, their main priority was that there was consistency with international regulation. The end-users desired increased duration (from the current 5 seconds to at least 10 seconds) and resolution (from the current 2 Hz to 10 Hz) of pre-crash data and consistency in what pre-crash data elements were included in line with the EDRs that recorded the most pre-crash data elements. Data on all available Advanced Driver Assistance Systems (ADAS) and data from impacts with vulnerable road users that are often not currently recorded were also desired by the end-users. A vehicle manufacturer and end-users desired a provision to ensure EDR accessibility through a publicly available tool, as is specified in the EDR rule in the United States.

Discussion and Conclusions

It is important to note that the main lack in EDR data in Australia is due to a lack of access rather than a lack of vehicles having EDRs installed. Hynd and McCarthy (2014) state that EDRs are fitted to almost all new light passenger vehicles in Europe. It is likely that the situation in Australia is similar, with most new vehicles, and much of the existing fleet, having EDRs.

The slow rate at which the proportion of the light vehicle fleet with accessible EDRs is increasing, and the possible future decrease, highlights that regulatory intervention is likely required for the penetration of accessible EDRs in light vehicles to approach 100%. It is recommended that stakeholders take steps to encourage uptake, and ultimately regulation, of accessible EDRs in Australia as a means to receive the benefits of this technology. The specifications required by international regulations vary, and an optimal approach would be to take the best of each. It is critical that any steps to increase uptake and access of EDRs also ensure that a suitable tool, or tools, to access the EDRs is made publicly available. The ability to use such a tool to access EDRs in existing vehicles would maximise the benefits to end-users.

References

Doecke, S. D., Dutschke, J. K., Baldock, M. R., & Kloeden, C. N. (2021). Travel speed and the risk of serious injury in vehicle crashes. *Accident Analysis & Prevention, 161*, 106359.

Elsegood, M. E., & Doecke, S. D. (2024). Speeding prevalence and profile in high severity crashes: data from Event Data Recorders (EDRs) obtained by Victoria Police (CASR238). Adelaide: Centre for Automotive Safety Research.

European Union. (2019). Regulation (EU) 2019/2144 of the European Parliament and of the Council of 27 November 2019 on type-approval requirements for motor vehicles and their trailers, and systems, components and separate technical units intended for such vehicles, as regards their general safety and the protection of vehicle occupants and vulnerable road users. EUR-Lex : https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02019R2144-20240707b

McCarthy, M., & Hynd, D. (2014). *Study on the benefits resulting from the installation of event data recorders: final report,* Publications Office. https://data.europa.eu/doi/10.2832/66709

National Highway Traffic Safety Administration. (2006). *Event data recorders (49 CFR Part 563)* [Docket No. NHTSA-2006-25666; RIN 2127-AI72]. Department of Transportation.

Riexinger, L. E., Sherony, R., & Gabler, H. C. (2019). A preliminary characterisation of driver evasive manoeuvres in cross-centreline vehicle-to-vehicle collisions. *International Research Consortium on the Biomechanics of Injury Florence, Italy.*

Wiacek, C., Firey, L., & Mynatt, M. (2023). EDR Reported Driver Usage of Crash Avoidance Systems for Honda Vehicles. In *27th International Technical Conference on the Enhanced Safety of Vehicles (ESV) National Highway Traffic Safety Administration* (Paper No. 23-0040).

Breaking barriers: addressing licensing challenges in regional and remote WA

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Abstract

This extended abstract shares lessons on delivering a program that is improving licensing rates in regional and remote Western Australia. The Department of Transport's Driving Access and Equity Program (DAEP) supports people who statistically represent one of the highest risk cohorts for vehicle crashes resulting in fatalities or serious injury: 100% of participants reside in a regional or remote location; 63% of participants under 25 years of age; 64% of participants identify as Aboriginal or Torres Strait Islander, and; all participants meet disadvantage factors. Since 2021, DAEP has provided access to 45 licensed five star rated ANCAP vehicles, and 52 licensed driving instructors who have delivered 40,000 hours of in-car supervision or instruction, supporting almost 4,000 participants to achieve almost 1,500 licensed drivers. This presentation will discuss how the program effectively engaged this hard-to-reach cohort resulting in more safe and licensed drivers for the regions.

Social media post

Find out how @TransportWA is helping people living in remote and regional WA overcome transport disadvantage to become safe and licensed drivers, gain independence, and unlock new opportunities for work and education with the Driving Access and Equity Program #TransportWA #gotmylicence

Background

Drivers in regional and remote areas of Australia face significantly higher risks of road fatalities and serious injuries than those in major cities (Austroads, 2019). The Road Safety Commission reveals that unlicensed drivers are much more likely to be killed or seriously injured cases if involved in crash (Road Safety Commission, 2024). Unlicensed driving is particularly prevalent among disadvantaged groups in regional and remote WA, with Aboriginal and Torres Strait Islander communities being disproportionately affected (Cullen et al., 2016). Stakeholder research completed by the Department of Transport revealed that there are systemic barriers stopping this disadvantaged group getting their driver's licence. DAEP is designed to engage this cohort, overcome those barriers, teach safe driving behaviors, and ultimately increase the number of people in remote and regional WA with a driver's licence.

Consultation with over 400 stakeholders identified that in Western Australia, those living in the regions face the following barriers when trying to get their licence; limited access to support networks, driving supervisors, instructors, and safe vehicles. In addition, distance from a licensing service, literacy, language, and cultural barriers, along with difficulty obtaining proof of identity documents can further entrench transport disadvantage. The Driving Access and Equity Program was developed to address these challenges by increasing access to Department of Transport services and working with trusted organisations in the community to provide place-based support to get a driver's licence. In its four years of operation almost 4,000 participants have signed up for support and engaged or re-engaged with the licensing process and more than 1,500 have got their licence.

Conference Theme

DAEP directly addresses the conference theme of Equity by ensuring that people in regional and remote Western Australia, particularly those facing socio-economic disadvantage, have improved access to the resources needed to obtain a driver's licence.

By removing financial, logistical, and systemic barriers to licensing, the program empowers individuals to drive safely and find greater opportunities for employment, education, and community involvement. The program is helping to close the gap and improve outcomes for Aboriginal and Torres Strait Islanders with strong Indigenous participation.

Overview

DAEP was established to support disadvantaged individuals in regional and remote Western Australia to overcome barriers to obtaining a driver's licence and become safer drivers. The program was designed to assist individuals by

providing access to suitable support services, instructors, supervisors, and vehicles to complete the necessary training and requirements.

Since February 2022, the program has awarded $26m in grants to trusted local community-based organisations and is currently supporting 32 driver education and training projects across WA. The grants have been designed to respond to the unique road safety and licensing challenges posed in 84 geographically diverse locations. DAEP has proven to be scalable as demonstrated by its rapid growth over the last 3-4 years. In 2022, 12 grants were awarded across two regions, in 2023 an addition 10 projects across three regions were funded and in 2024 two more regions and another 10 projects were added.

To compliment the grant projects DAEP has also funded:

- Ten driving instructor training sessions in local regional settings resulting in more licensed culturally appropriate driving instructors in the regions and better prepared supervisors able to educate on safe driving techniques and behaviours.
- Six additional Department of Transport Remote Services Officers to deliver more licensing services and education in regional WA, including more practical driving assessments.
- A suite of culturally appropriate resources including an improved oral version of the theory test required to get your learners permit, three animations explaining the licensing process, a talking poster and more visual and easier understand information sheets have also been produced.

To assess the effectiveness of DAEP the Department collects quantitative data that tracks the licensing outcomes of all participants. The participant demographics confirm that the program is reaching its intended target group. The data is further interrogated via the qualitative data that is collected to reveal the social impact of the program. Evidence to date indicates that program meaningfully engages Aboriginal and Torres Strait Islander people and is resulting in life-changing licence attainment.

Results

DAEP collects participant numbers, driving hours, and licensing outcomes from participating grant organisations and verifies and enhances these statistics with the use of the Department of Transport's driver licence database (TRELIS). This allows us to interrogate multiple data sets and provides a complete picture of a participant's journey through the driver licensing process. Based on this analysis, since 2021, DAEP has achieved the following outcomes:

- Supported almost 4,000 participants in learning to drive.
- Assisted close to 1,500 participants in obtaining a driver's licence.
- Over 40 per cent of participants to achieve a licence have improved employment outcomes.
- Trained 52 licensed driving instructors in regional and remote areas.
- Funded 45 licensed five-star ANCAP-rated vehicles for communities.
- Achieved a first-time practical driving assessment (PDA) pass rate of 79%, compared to a statewide average of approximately 50%.

Qualitative data is collected from Grant Organisation every six months via a questionnaire that asks them to assess the efficacy of their projects. This has revealed that grant organisations have been effective in reaching the target populations as projects have quickly become fully subscribed through referrals and word of mouth recommendations.

Findings

DAEP collects qualitative data to provide context and depth, and gain insights into participant experiences and program effectiveness. Grant organisations collect and provide 'Stories of Change' from participants as part of the reporting process where participants describe the impacts of engagement with the program in their own words. These 'Stories of Change' capture the social impact of the program. Grant organisations also provide quarterly Milestone Reports that provide commentary on the challenges faced in program delivery and the strategies employed to overcome these problems and improve delivery. For instance, organisations are regularly asked to report on how cultural protocols (local Indigenous history, culture and values) have influenced the design and delivery of their project, including what practical changes/adaptations they have made.

As part of the external evaluation completed at the end of first year of DAEP delivery, interviews were conducted with grant organisations generating a list of program improvements that would better meet that needs of disadvantaged people trying to get their licences. These have been implemented and now participants signing up are assessed for the level of support required and are then provided with tailored support. Crucially, this can include support to collect the proof of identity documents required to start the licensing process. Grant organisations hire staff with people skills

(experienced youth and community workers) and then train for driving instruction and supervision skills. This creates a culturally safe learning environment where participants can concentrate on learning to drive. Participants with learning and/or literacy issues can also access appropriate materials and testing support.

Evaluation and effectiveness

Integrating both quantitative and qualitative data has enabled DAEP to generate actionable insights for leadership and stakeholders, supporting strategic, data-driven decision-making. The evaluation framework has been developed around multiple data sources, including the driver licence database (TRELIS), external evaluations, 6-monthly milestone reports, participant feedback and grant agreement data. Participant data provided through surveys and Stories of Change illustrate individual experiences, highlight the program's broader impact and provide qualitative evidence of its effectiveness.

This data confirms DAEP is achieving its intermediary goal of supporting disadvantaged people to get their licence and is on track to achieve its longer-term road safety goals.

Benefits to road safety

DAEP plays a critical role in improving road safety through:

- Assisting close to 1,500 participants in obtaining a driver's licence addresses the issue of unlicensed driving, which is associated with higher crash risks (Road Safety Commission, 2024).
- Funding 45 licensed five-star ANCAP-rated vehicles provides learners access to modern vehicles with advanced safety features, reducing fatalities and serious injuries through enhanced crash protection (Soltani et al., 2025).
- Achieving a significantly higher first time PDA pass rate, compared to the state average, indicates the effectiveness of DAEP's comprehensive support in preparing competent and safe drivers.

Implications for Policy and or Practice

- Early, ongoing and committed collaborations with local organisations have been key to DAEP's success. Strengthening community partnerships enhances program delivery and ensures long-term sustainability.
- DAEP's success highlights the need for continued investment in culturally appropriate licensing support programs, particularly in regional and remote areas.
- Policymakers should consider incorporating structured licensing support into broader road safety policies to ensure long-term improvements in driver education and road safety compliance.

Conclusions

DAEP has demonstrated a scalable and effective model for improving licensing rates in regional and remote WA in disadvantaged populations. By addressing systemic barriers, the program enhances road safety, education, and employment opportunities for participants. The ongoing delivery of DAEP will contribute equitable access to obtaining a driver's licence, resulting in more trained and licensed drivers and consequently safer roads.

References

Austroads. (2019). Guide to road safety part 5: Road safety for regional and remote areas. *Austroads.* Retrieved from: Guide to Road Safety Part 5: Road Safety for Regional and Remote Areas

Cullen, P., Clapham, K., Hunter, K., Treacy, R., & Ivers, R. (2016). Challenges to driver licensing participation for Aboriginal people in Australia: a systematic review of the literature. *International Journal for Equity in Health, 15*(1). *https://doi.org/10.1186/s12939-016-0422-9*

Main Roads Western Australia. (2024). Road Facts Summary Sheet. *Government of Western Australia.* Retrieved from Main Roads Annual Report 2024 -- Road facts summary sheet.

National Aboriginal Community Controlled Health Organisation. (2021) Inquiry into Road Safety. Retrieved from Submission to the Joint Select Committee on Road Safety.

Road Safety Commission. (2024). Western Australian Road Fatalities and Serious Injuries 2023. *Government of Western Australia*. Retrieved from https://www.wa.gov.au/system/files/2024-09/ksi-report-western-australia-2023.pdf

Soltani, A., Afshari, S., & Amiri, M. A. (2025). Projecting Road Traffic Fatalities in Australia: Insights for Targeted Safety Interventions. *Injury,* 112166–112166. https://doi.org/10.1016/j.injury.2025.112166

e-scooter-related workers compensation claims in Queensland: 2019-2024

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Abstract
The use of e-scooters has seen significant uptake in most Australian jurisdictions across shared schemes and private usage. E-scooter usage is mainly undertaken on similar infrastructure to bicycles such as footpaths, bike paths and some roads. The exposure to other users of this infrastructure and other e-scooters have led to injuries to e-scooter users, pedestrians and users of other transport types. Increasingly, e-scooter have been replacing or supplementing users commutes to and from work from other transport types such as cars, and in some cases are used during work activities. Claims data from between 2019 and 2024 was analysed and found that the number of claims related to e-scooter injuries have been increasing, as well as the associated cost. It is critical to monitor the number and costs related to these claims and develop safety messaging to the workforce to reduce injuries and time away from work.

Social media post
e-Scooters are becoming a more common travel mode for commuters in Queensland. Workers' compensation claims involving e-scooters have significantly increased.

Introduction
In Queensland, the use of personal mobility devices (PMDs) has been steadily increasing since the introduction of shared schemes in late 2018. E-scooters are the vastly predominant PMD type among shared schemes and private use. With more private devices becoming readily available on the market, the usage types are shifting towards increased private usage. Users are increasingly using these devices for part or all of their commute to and from workplaces and in some cases during work times. As a result, injuries sustained while using these devices in these circumstances can often result in a worker's compensation claim. By examining the data from these claims, trends and costs associated with these incidents can be analysed and compared with the impact and costs of other worker's compensation claims in Queensland. WorkCover Queensland reported that the average cost for any physical injury claim was $9,900 for the 2023–2024 period (WorkCover Queensland, 2024).

Conference theme
This body of work aligns with the elasticity and evolution of transport systems, as e-scooters have shown significant changes in how people commute, travel and explore in many Australian cities. Legislation and regulations have been changing and maturing with the increase in the number of users, and the results of accidents and injuries has had a noticeable impact on the healthcare and insurance industries.

Method
A descriptive analysis of the overall patterns and trends in workers compensation claims for e-scooter-related injuries between January 2019 and November 2024 in Queensland was conducted. It is important to note this is only in relation to people using e-scooters for commuting to and from work or using them as part of their normal work activities. As such, recreational use, which is arguably the most common usage is not captured.

Results
There were 1078 e-scooter-related workers compensation claims recorded between January 2019 and November 2024 (67% males, 32% females, 1% other), with the most common age group being the 25–34-year-olds (34.8%) followed by 35–44-year-olds (21.0%) (see Table 1).

The cost of claims initially fell from 2019 to 2020 despite a similar number of claims, however sharply rose in 2021 and has gradually increased over the period, with a large spike in the cost in 2023. The total cost during the period was $17,875,267.90 with an overall average of $16,581.88 per claim.

The number of claims increased over time, with an average of 5 claims per month in late 2019, to an average of 30 claims per month in mid to late 2024. While claims decreased slightly during COVID restrictions, the number has consistently increased since 2021. Tuesday was the most common day of the week for claims, with the weekend days significantly lower than the Monday to Friday period.

Table 1. Age and gender of e-scooter-related injury claimants

	Female		Male		Other		Total	
Age Groups	N	%	N	%	N	%	N	%
<18yrs	4	0.4%	31	2.9%	4	0.37%	39	3.6%
18-24yrs	51	4.7%	117	10.9%	3	0.28%	171	15.9%
25-34yrs	137	12.7%	236	21.9%	2	0.19%	375	34.8%
35-44yrs	68	6.3%	156	14.5%	2	0.19%	226	21.0%
45-54yrs	49	4.5%	97	9.0%	0	0.00%	146	13.5%
>54yrs	39	3.6%	82	7.6%	0	0.00%	121	11.2%
Total	348	32.3%	719	66.7%	11	1.02%	1078	

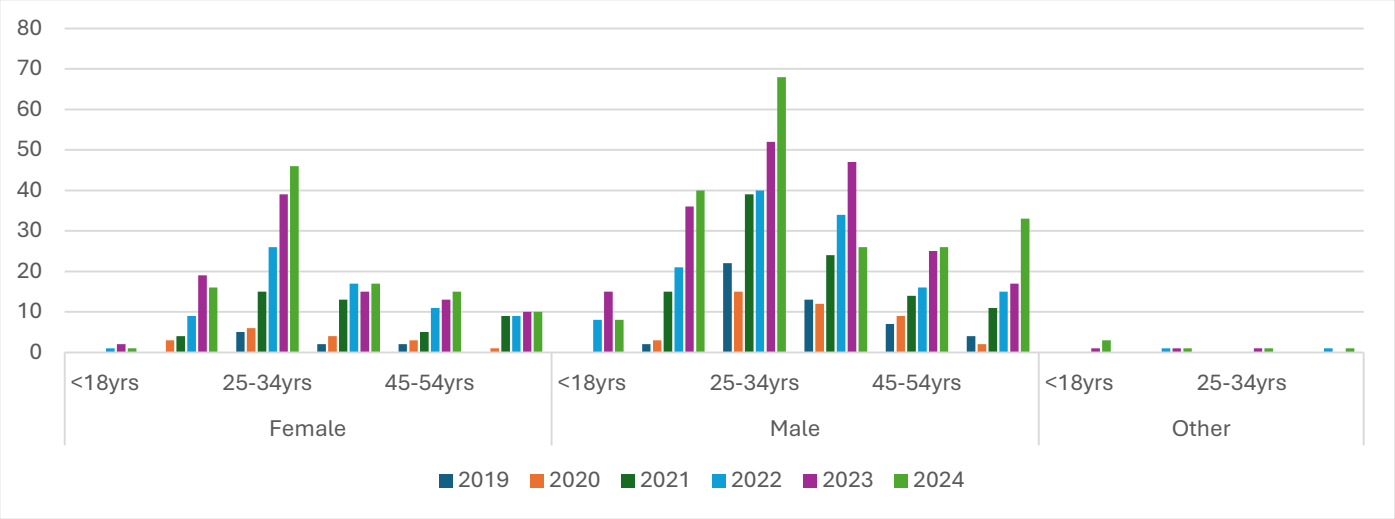


Figure 1: Number of e-scooter related work-related injury claims per year by age group and gender

Table 2: Number of claims, sum of claims cost and average claims cost per year

Year	Number of Claims	Sum of Gross Claims Cost	Average of Gross Claims Cost
2019	57	$1,462,204.73	$25,652.71
2020	58	$685,763.18	$11,823.50
2021	149	$3,290,547.72	$22,084.21
2022	209	$3,729,995.83	$17,846.87
2023	293	$5,240,052.72	$17,884.14
2024*	312	$3,466,703.72	$11,111.23
Total	1078	$17,875,267.90	$16,581.88

*2024 from January to November

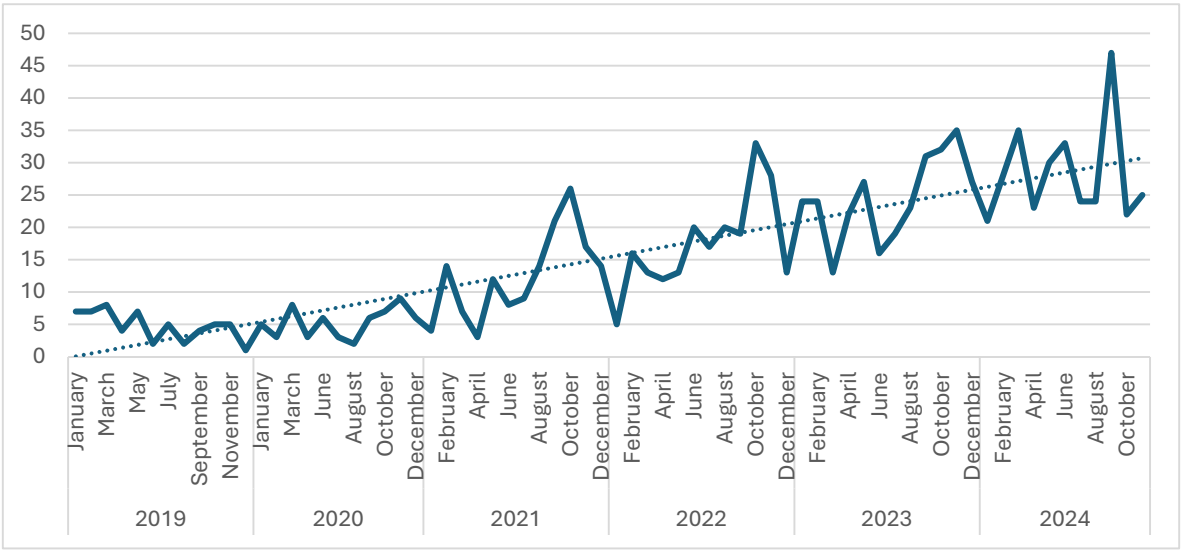


Figure 2: e-scooter work-related injury claims over time Queensland January 2019 - November 2024

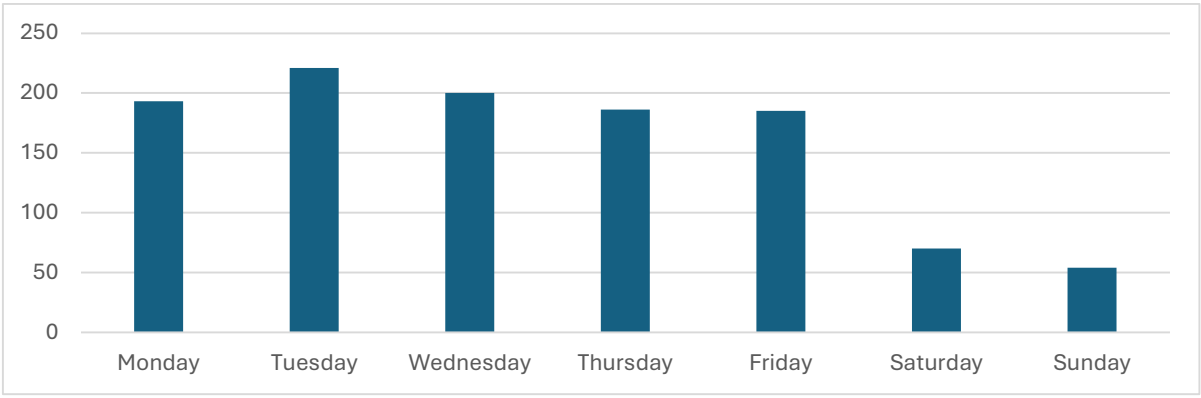


Figure 3: Claims per day of week for e-scooter work-related injury claims

Benefits to road safety

So far in Queensland, significant e-scooter-related road safety education and other interventions have been aimed at influencing the behaviours of younger and recreational PMD users, and especially those using hire scheme e-scooters. This research shows that there is a need for employers to play a more active role in promoting safer e-Scooter travel to and from work, to supplement the ongoing policy and enforcement work being undertaken regarding PMDs in Queensland.

Implications for policy and/or practice

The use of an alternative data source to the usual road safety data sets used by Government and shows that there is benefit in jurisdictions monitoring hospital and workers' compensation claims data to better understand the outcomes of emerging or growing transport modes. E-scooter injuries don't always occur on road and are not often reported to police (especially if they don't involve other road users apart from the PMD rider) and so they are often not captured in traditional road crash data sets. These types of 'road safety adjacent' injuries are expected to become more common (as illustrated by the sixfold increase in average monthly claims found in this study) and so ongoing work is needed to better understand and utilise the datasets capturing these instances.

Conclusions

Analysis shows a clear increase in claims over time and suggests the weekday commutes were a more common time when incidents occurred. Safety messaging should be encouraged to Queenslanders to allow extra time for their commutes, to wear appropriate safety equipment and obey road rules. Employers should look at ways to assist their workforce to use PMDs more safely, to reduce injuries and associated time away from work.

References

WorkCover Queensland. (2024). Annual Report 2023-2024. Brisbane.

Fit for Fleet Safety: safety management for small fleet operators

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Abstract
The Australian Road transport industry faces significant safety challenges, with smaller operators often lacking resources to comply with regulations. Tight profit margins, limited administrative capacity, and a competitive market have resulted in low safety compliance and high risks for drivers and road users. Funded by the National Heavy Vehicle Regulator (NHVR), and in collaboration with SCT logistics, and Sadleirs, this project aims to establish a transport safety management system (SMS) tailored to smaller fleet operators, making safety compliance simple, practical, and achievable. The project also seeks to deliver a simple prequalification tool to identify compliance gaps, a series of short e-learning modules with practical safety advice, and a database of easy-to-use templates for critical safety need. By simplifying safety compliance, this project will enhance safety standards for smaller fleet operators, resulting in fewer risks for driver and road users.

Social Media Post
Funded by the NHVR and supported by the Australian Government, the Fit for Fleet Safety project is empowering smaller fleet operators by offering:

- A quick tool to identify compliance gaps
- Practical, bite-sized e-learning modules
- Ready-to-use templates for key safety needs
- An all-in-one safety management platform

Background
The road transport industry is one of the highest-risk industries in Australia, with the highest fatality rate and frequency of serious claims, particularly among truck drivers, who account for 84% of worker fatalities and 54% of serious claims (Australian Bureau of Statistics, Jul 2019-Jun 2023). Managing these risks requires structured Safety Management Systems (SMS), incorporating planning, safe work practices and competency assurance. However, evolving Australian road laws introduce stricter requirements, posing compliance challenges for small operators, who make up most of the industry (Cantor et al., 2013).

Research indicates that only 2% of the 51,000 road freight businesses are not small businesses or owner-operators, meaning most operators lack the resources and capability to engage with compliance requirements (Cantor et al., 2013). With small profit margins and limited administration time (they spend most of their time on the roads), smaller operators tend to rely on more informal systems and lack access to training and resources, making the introduction and maintenance of compliance control systems difficult (Hensher et al., 1991; Fellows Medlock & Associates, 2018; Safe Work Australia, 2018). The issue of compliance was evident in Isuzu's The Future of Trucking Report which found that only 33% of small operators (1-5 trucks) already had or have developed Chain of Responsibility policies, compared to 69% of larger operators (20+ trucks) (Isuzu Australia Limited, 2022). In a similar way, owner-operators have reported the least awareness of NHVR's SMS guidance materials (Isuzu Australia Limited, 2022). Addressing these gaps is crucial to improving safety outcomes across the industry.

Although safety-enhancing technologies, such as electronic logbooks, are available, small operators struggle to adopt them due to complexity, cost, and time constraints (Transport Workers Union of Australia, 2012; Cantor, 2016; Fellows Medlock and Associates, 2018). Most safety tools are designed for larger businesses, making them difficult for smaller operators to implement effectively (Safe Work Australia, 2018). These challenges contribute to higher rates of out-of-service violations and overall lower compliance among small operators (Cantor, 2016). Engaging small operators in compliance initiatives is also difficult due to their decentralised and mobile nature. Many operate from their trucks or homes without a central office, making them harder to reach (Transport Workers Union of Australia, 2012; ITF, 2018).

This project seeks to support smaller fleet operators by improving their access to practical safety management solutions. By addressing key barriers such as limited resources, lack of awareness, and low engagement, the project aims to simplify compliance processes and enhance the adoption of safety practices. Through targeted strategies, smaller operators will be better equipped to manage safety risks, meet regulatory requirements, and ultimately contribute to a safer transport industry.

Conference Theme

This project directly supports the conference themes by enhancing equity, elasticity, and evolution in road transport safety. It promotes **equity** by addressing the barriers small fleet operators face, such as limited resources and compliance knowledge, through tailored tools, training, and outreach strategies that ensure fair access to safety management systems. It strengthens **elasticity** by designing adaptable and scalable compliance solutions—such as simplified templates and e-learning tools—that accommodate the operational constraints of smaller operators while fostering a more resilient safety culture. Lastly, it drives **evolution** by refining safety management approaches through industry feedback, proactively engaging with small operators to improve compliance adoption, and preparing them for future regulatory and technological advancements.

Project overview

The main aim of this project is to establish the first transport safety management system (SMS) platform designed for smaller fleet operators. The key objectives include (1) developing a user-centred SMS for smaller fleet operators, including tools and resources to improve safety compliance, (2) providing smaller operators with accessible tools and resources (such as e-learning modules and templates) to facilitate compliance with essential safety critical controls, and (3) overcoming barriers to engagement and ensure widespread adoption of safety management tools by tailoring communication strategies and providing support to onboard small fleet operators.

This project involves four main phases: (1) Planning Phase which focuses on assembling a project team, finalising plans, and launching the project, (2) Research and Tool Design Phase which involves conducting workshops, interviews, and data collection with small fleet operators to design user-friendly, fit for-purpose safety management tools, (3) Prototype and Testing Phase, which focuses on developing prototypes for key safety tools, including a prequalification system, to be tested for accessibility and usability in real-world settings, and (4) Implementation and Evaluation Phase, which involves rolling out finalised tools, gathering feedback, and evaluating their effectiveness in improving safety compliance and outcomes. Currently, we are finalising the Planning Phase which included key tasks such as identifying stakeholders, developing a communication strategy, and launching a project website (fitforfleet.com). We'll shortly begin engaging small fleet operators and safety experts through interviews and social media campaigns. By the time of the conference on 20 October, we expect to have completed the project, and ready to share key insights from the project, highlighting common challenges and practical strategies for improving safety compliance.

Findings

As a result of the key activities and associated outputs, there will be an increased adherence to safety compliance amongst owner-operators due to the ease of navigating the safety management system and understanding compliance requirements, provided through the small fleets system that is introduced. Other outcomes will include self-reported usage by operators, updated safety policies for operators, reduced incident rates, reduced insurance claims, decreased vehicle maintenance costs, and improved driver retention, satisfaction, and productivity.

Benefits to Road Safety

By improving safety standards among smaller fleet operators, the project has the potential to enhance road safety nationwide, reducing fatalities and serious injuries in the road transport industry. The project will deliver a suite of tools that can be shared with the broader industry as a practical solution for safety compliance. To enhance the widespread focus of the project, we aim to identify and approach online platforms, such as Muval, to introduce the small fleets system so it can be utilised by a larger group of small fleet operators. This platform will complement NHVR’s 9 Step SMS roadmap by specifically addressing the needs of smaller operators across a diverse array of roles. Furthermore, the engagement process with small fleet operators and the co-design methodology used in developing the tools will provide a valuable framework for future preventative interventions.

Implications for Policy and Practice

While some small fleet operators have safety and compliance policies in place, these can lack visibility and practicality, leading to reduced impact on daily operations (NHVR, 2022). By developing tailored and accessible safety tools and

resources, there is an opportunity to bridge the gap between policy and practice. The Fit for Fleet Safety resources can support small operators in implementing safety measures that are both relevant to their workflows and effective in guiding procedures. Ultimately, this approach may drive policy changes that better reflect real-world operational needs, fostering a stronger culture of safety, transfer of policy to procedure and compliance within the industry.

Conclusions

The Fit for Fleet Safety project addresses a critical gap in road transport safety by providing small fleet operators with practical, scalable tools to improve compliance and reduce risk. Through a co-designed approach and industry collaboration, the project will deliver accessible solutions tailored to the unique challenges faced by smaller operators. By simplifying safety management with user-friendly resources, the project will foster a stronger safety culture, enhances regulatory adherence, and ultimately contributes to safer roads for all users. The outcomes of this initiative will support long-term improvements in transport safety, ensuring that small operators have the tools they need to succeed in an evolving regulatory landscape.

References

Australian Bureau of Statistics. (Jul2019-Jun2023). Counts of Australian Businesses, including Entries and Exits. ABS. https://www.abs.gov.au/statistics/economy/business-indicators/counts-australian-businesses-including-entries-and-exits/latest-release

Cantor, D. (2016). Owner-Operator versus Company-Driver Safety Performance Analysis. https://cdn-wordpress.webspec.cloud/intrans.iastate.edu/uploads/2018/03/owner-operator_vs_company-driver_safety_w_cvr.pdf

Cantor, D. E., Celebi, H., Corsi, T. M., & Grimm, C. M. (2013). Do owner–operators pose a safety risk on the nation's highways? *Transportation Research Part E: Logistics and Transportation Review, 59,* 34–47. doi:10.1016/j.tre.2013.08.002

Fellows Medlock and Associates. (2018). Analysis of Heavy Vehicle Safety Accreditation Schemes in Australia: Final Report February 2018. https://www.nhvr.gov.au/files/201812-0966-analysis-of-hv-safety-accreditation-schemes-in-aus.pdf

Hensher, D., Battellino, H., Gee, J., Daniels, R. (1991). Long distance truck drivers on-road performance and economic reward. University of Sydney, Washington DC.

International Transport Forum. (ITF). (2018). Safety Management Systems: Summary and Conclusions. *ITF Roundtable 172.* https://www.itf-oecd.org/sites/default/files/docs/safety-management-systems.pdf

Isuzu Australia Limited. (2022). Future of Trucking Report. https://www.isuzu.com.au/media/apulua04/0203ar_fot_report_v16.pdf

NHVR. (2022). Heavy Vehicle Industry Safety Survey 2022: Final Report. https://www.nhvr.gov.au/files/media/document/237/202303-1348-heavy-vehicle-industry-safety-survey-2022.pdf

Safe Work Australia (2018). Road Transport: Priority Industry Snapshots 2018

Transport Workers Union of Australia. (2012). Make our roads safer for all Australians.

Impairments in simulated driving for young adults with sleep disorders

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Abstract
One in five young adults have a sleep disorder significant enough to warrant clinical investigation, yet over 80% are undiagnosed. This demographic also experience a high burden of road accidents. Undiagnosed sleep disorders, along with sleep deprivation may increase accident risk. We assessed this using simulated driving performance over ~29h of sleep deprivation in participants reporting no sleep difficulties (Study 1; *n*= 36, M_{age}(SD)= 26.6(5.0)) and those with recently diagnosed, unmanaged sleep disorder (Study 2; *n*=28, M_{age}(SD) = 26.6(4.6)). Steering deviation from the middle of the road was significantly worse for individuals with delayed sleep wake phase disorder (n=12) compared with healthy sleepers (n= *36,* p=0.049) and those with insomnia (*n*=12, *p*=0.020) at 19h, and at 25h of sustained wakefulness (*p*<0.001 for both comparisons), reflecting more impaired driving. This finding has important implications for education of younger drivers and clinicians around risks associated with unmanaged sleep disorders.

Social media post
Young drivers with delayed sleep wake phase disorder are at high risk of experiencing adverse driving events. Education, diagnosis and treatment are needed to support safer road use.

Introduction
Approximately 20% of 22 year old Australians have a sleep disorder with symptoms significant enough to warrant clinical investigation (McArdle et al., 2020). Common sleep disorders in early and emerging adulthood include insomnia, obstructive sleep apnoea (OSA), restless legs and Delayed Sleep Wake Phase Disorder (DSWPD). Delayed Sleep Wake Phase Disorder (DSWPD) in particular is poorly understood and managed (Robbins & Quan, 2024). This demographic are also at increased risk of sleep-related road accidents (Watling et al., 2020; Smith et al., 2024), with young adults over-represented in sleepiness related road accidents (Smith et al., 2009; Martiniuk et al., 2013), and accounting for a significant portion of road related deaths in Australia (~19%) (Smith et al., 2024).

The underlying causes of sleepiness are more commonly attributed to behavioural factors, which lead to insufficient sleep. While this is undoubtedly contributing to road safety issues, clinical sleep disorders are also independently associated with near-miss road accidents in young adults (Sansom et al., 2023), yet are rarely recognised or appropriately treated in this at risk age group. Further exacerbating poor sleep, many young road users are undertaking shift work which places additional pressure on the timing and duration of their sleep opportunities (Reynolds et al., 2022).

Little is known about how undiagnosed and unmanaged sleep disorders may impact driving performance in this demographic. The aim of this analysis was to explore the effect of a simulated transition to night shift (sustained wakefulness of ~29h) on simulated driving performance in early and emerging adults (18-39 years) with an unmanaged clinical sleep disorder and compare the response to healthy sleepers.

Conference Theme: Evolution: This work aligns with the evolution theme which targets human factors, future challenges and the development of safe systems. Through this work, more effective education on the risks of sleep disorders, deprivation and driving for young people may become standardised.

Method
Study Design: Preliminary findings are reported from an ongoing trial of simulated transition from day to night work without a nap opportunity (reflected as an extended wake period of ~29hrs) in early and emerging adults with undiagnosed sleep disorders (ACTRN12624000339550).

These analyses incorporate young adults with no self-reported sleep complaints (Study 1, *n*=36), as a healthy control comparison, and young adults with sleep complaints (Study 2), who were at risk for a clinical sleep disorder according to screening questionnaires. To date, *n*=28 participants who met criteria for a sleep disorder have sufficient data for inclusion in preliminary analyses. Participants underwent extensive clinical assessment including a Structural Clinical Interview for Sleep Disorders (SCISD-R) by a psychologist, and an overnight level 1 diagnostic polysomnogram for sleep-breathing disorders such as obstructive sleep apnoea (OSA). Diagnoses were determined according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-V-TR) and the International Classification of Sleep Disorders (ICSD-3-TR) by AHPRA registered psychologists and/or sleep physicians.

Driving Performance

All participants performed five 60-minute long driving simulations using the AUSED driving simulator. Steering deviation was taken from the AUSED driving simulation task. Twelve individuals with sleep disorders who were unable to sustain wakefulness for a minimum of 19hrs of sleep deprivation were included in the analysis, and assigned a performance value equal to that of the worst performer within their sleep disorder category. This method assumes that if the participants were unable to sustain wakefulness, they would perform equally to the worst performer who was able to sustain wakefulness.

Linear mixed effects models using the lme4 package from open source software R version 4.3.3. (Bates et al., 2015; RCoreTeam, 2024) with a random intercept specified for participant were used to examine the relationship between sleep disorder type, driving performance and time spent awake.

Results

To date, sixty-four young adults (Age: Mean±Standard Deviation, 26.6±4.8) have completed the extended wakefulness protocol across Studies 1 and 2. The presenting sleep disorders included in these analyses were Insomnia Disorder (*n*=12), Delayed-Sleep-Wake-Phase Disorder (DSWPD) (*n*=12) and Obstructive Sleep Apnoea (OSA) (*n*=4). Linear mixed effects modelling revealed a significant interaction between sleep disorder diagnosis and time awake on driving performance ($F(12,223.3)=5.54$, $p<.001$). Specifically, steering deviation from the middle of the road was significantly worse for individuals with DSWPD (Estimated marginal Mean(SE) 115.8(12.2)*cm*) relative to both healthy controls (64.9(7.17)*cm* ,p=0.049) and those with insomnia (48.9(12.2)*cm, p*=0.020) at 19hrs of sleep deprivation. This interaction remained at 25hrs of wakefulness (DSWPD = 181.7(12.9)*cm*, healthy control = 80.4(7.6)*cm*, insomnia = 85.9(12.5)*cm*, all $p<0.001$; Figure 1).

Benefits to road safety

Undiagnosed and unmanaged sleep disorders are a modifiable risk factor for road safety incidents in early and emerging adulthood, and are a particular concern in the early hours of the morning. These findings highlight the potential benefit of education and providing avenues for treatment of sleep disorders in young road users.

Implications for policy and/or practice

DSWPD is a poorly understood sleep disorder, with very low diagnosis and management rates, and high relapse rates. DSWPD is more prevalent in early adulthood. Uniquely, these data provide practical insight into the potential road safety risks of unmanaged DSWPD in the community and highlight the need for solutions to improve outcomes. We suggest that awareness of the risks of sleep disorders, sleep loss and impairment on the road should be covered as standard in all education for young drivers, particularly if they are entering careers where shift work may further perturb their sleep opportunities.

Conclusions

Undiagnosed and unmanaged DSWPD poses a road safety risk when paired with extended periods of wakefulness, which can be seen in shift workers transitioning from day shift to night shift without adequate opportunity to rest. These findings may have implications for education, awareness and clinical support for young drivers at risk.

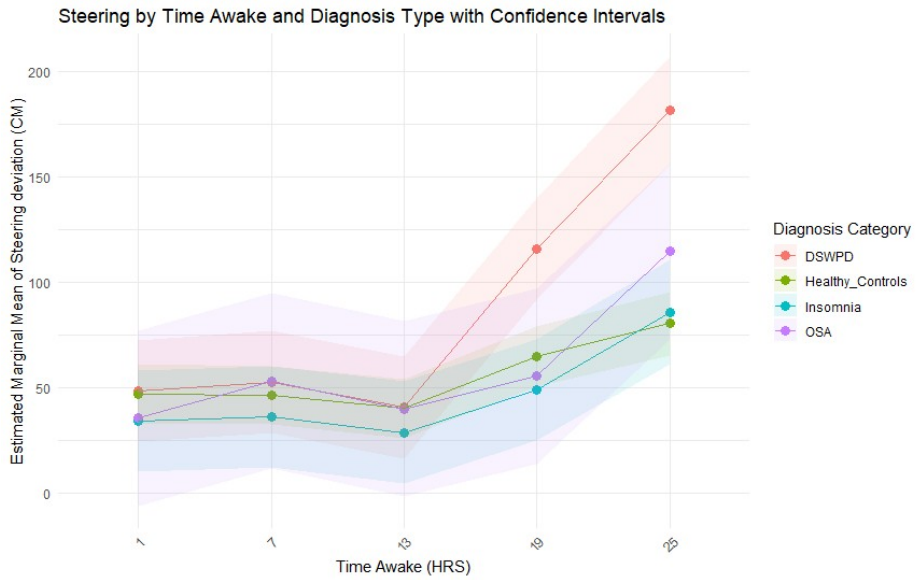


Figure 1. Time by steering deviation (cm) from the middle of the road during simulated driving performance by sleep disorder diagnosis relative to healthy controls.

Acknowledgements

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References

Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of statistical software*, *67*, 1-48. https://doi.org/10.18637/jss.v067.i01

Martiniuk, A. L., Senserrick, T., Lo, S., Williamson, A., Du, W., Grunstein, R. R., Woodward, M., Glozier, N., Stevenson, M., & Norton, R. (2013). Sleep-deprived young drivers and the risk for crash: the DRIVE prospective cohort study. *JAMA pediatrics*, *167*(7). https://doi.org/https://doi.org/10.1016/j.aap.2009.03.016

McArdle, N., Ward, S. V., Bucks, R. S., Maddison, K., Smith, A., Huang, R.-C., Pennell, C. E., Hillman, D. R., & Eastwood, P. R. (2020). The prevalence of common sleep disorders in young adults: a descriptive population-based study. *Sleep*, *43*(10), zsaa072. https://doi.org/https://doi.org/10.1093/sleep/zsaa072

RCoreTeam. (2024). _R: A Language and Environment for Statistical Computing_. R Foundation for Statistical Computing. In. Vienna, Austria.: <https://www.R-project.org/>.

Reynolds, A. C., Lechat, B., Melaku, Y. A., Sansom, K., Brown, B. W., Crowther, M. E., Wanstall, S., Maddison, K. J., Walsh, J. H., & Straker, L. (2022). Shift work, clinically significant sleep disorders and mental health in a representative, cross-sectional sample of young working adults. *Scientific Reports*, *12*(1), 16255. https://doi.org/https://doi.org/10.1038/s41598-022-20308-2

Robbins, R., & Quan, S. F. (2024). Sleep disorders. *NEJM evidence*, *3*(10), EVIDra2400096. https://doi.org/10.1056/EVIDra2400096

Sansom, K., Eastwood, P., Brown, B., Crowther, M., Wanstall, S., McArdle, N., Adams, R., & Reynolds, A. (2023). P074 Sleep-Related Predictors of Road and Workplace Safety in Young Adults: Results from a Community Representative Sample. *Sleep Advances: A Journal of the Sleep Research Society*, *4*(Suppl 1), A63. https://doi.org/10.1093/sleepadvances/zpad035.159

Smith, S. S., Horswill, M. S., Chambers, B., & Wetton, M. (2009). Hazard perception in novice and experienced drivers: The effects of sleepiness. *Accident Analysis & Prevention*, *41*(4), 729-733. https://doi.org/https://doi.org/10.1016/j.aap.2009.03.016

Smith, S. S., Rossa, K. R., Soleimanloo, S. S., Pattinson, C. L., Mann, D. L., Edmed, S. L., Salmon, P. M., & Sullivan, K. A. (2024). Reducing crash risk for young drivers: Protocol for a pragmatic randomised controlled trial to improve young driver sleep. *Heliyon*, *10*(5). https://doi.org/10.1016/j.heliyon.2024.e27066

Watling, C. N., Shaw, L. M., & Watling, H. (2020). Sleep-impaired emotional regulation, impaired cognition, and poor sleep health are associated with risky sleepy driving in young adults. *Traffic injury prevention*, *21*(2), 133-138. https://doi.org/https://doi.org/10.1080/15389588.2019.1710499

Evolving our approach to implementing speed limit changes

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Presenter: Matt Allan

Abstract
There is growing alignment in Australia and internationally on the key speed management principles for speed zoning policy and guidelines. Despite the convergence of principles, there is limited appreciation that the principles do not exist harmoniously in all circumstances. There is often a tension, especially where road design features do not support speed limits that are proposed to minimise harm, reflect the street function or promote transport choice. Experience from New Zealand highlights the political risk of overlooking the significance of the principle of speed limit credibility. The long-term success of speed zoning policy rests with careful implementation planning. We must evolve our speed management practices to prioritise speed zone changes in locations where credibility is likely to be high, ahead of locations that could reduce credibility and public acceptance, even if lower limits are technically justified and aligned with Safe System principles.

Social media post
A tension exists between speed zoning principles, especially where road design features do not support speed limits that minimise harm. Learn why we must evolve our speed management practices to prioritise speed zone changes in locations where credibility is likely to be high.

Background
There is growing awareness in jurisdictions throughout Australia and internationally, that speed management is a critical tool for improving road safety and achieving 2030 and 2050 road trauma reduction targets. A review of policies and practices across all jurisdictions in Australia, and internationally, reveals a convergence of key speed management principles upon which speed zoning policy and guidelines are based.

The World Bank *Guide for Safe Streets: Managing Traffic Speeds to Save Lives and Improve Liveability* (2024) is a leading international resource that provides practical information and recommendations for managing speeds on all types of urban and rural roads. It introduces a newly developed process for setting safe speed limits: the Roads-for-Life (R4L) framework. The R4L framework is based on the Safe System approach, a human-centric approach to road transport that focuses on safety of all road users, on the scientific consensus on crash risk, severity, and survivability, and on international good practice for planning, designing, and managing safe roads and road networks.

The R4L framework draws upon key elements of the Movement and Place philosophy and reflects the growing expert consensus that roads should prioritise not just motorised transport, but the safety and mobility of pedestrians and cyclists and especially vulnerable people including children, older people, and persons with disabilities. This framework aims to contribute to the much-needed paradigm shift on speed management: a shift from prioritising vehicular traffic towards valuing socio-economic benefits of safe and accessible mobility for all road users, climate considerations, and quality of life. The R4L framework stipulates that all speed limit setting activities should be guided by four basic principles to ensure that speed limits at national and local levels are safe and credible (Figure 1). This means that they are accepted by most drivers without enforcement due to the alignment between road infrastructure and the speed limit.

These principles are reflected in the speed zoning policies of many jurisdictions across Australia; however different terminology is often used. This extended abstract focuses on the importance of the principle of ‘predictability’, which in the Australian context is often referred to as ‘credibility’.

Discussion
The Australasian College of Road Safety produced a policy position statement on speed management in 2023. The objective of the policy position is to describe a more holistic framework for speed management. It notes that speed management is best achieved through a comprehensive scope such as the eight-step approach to speed management policy put forward by the Organisation for Economic Co-operation and Development (OECD) and European ministers

of transport. The principal tenet of that approach is that the nature and function of roads and speed limits must be consistent. This means that, as far as possible, roads should be designed to explain the safe and appropriate speed to road users and make the safe speed in that location obvious and intuitive to drivers. This results in speed limits and enforcement that is credible and realistic to drivers and other road users.

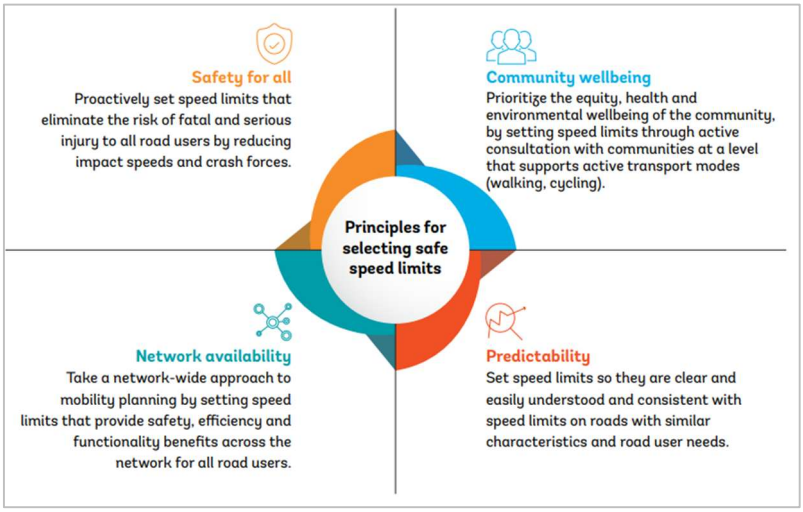


Figure 1. Guiding principles for selecting safe speed limits
Source: Guide for Safe Speeds (Turner et al., 2024)

Whilst the principle of credibility is embedded in most speed zoning policies in Australia (and New Zealand prior to the 2023 change in government), this principle is sometimes ignored or given lesser priority than other principles, such as setting Safe System aligned speed limits when it comes to implementation. This issue was highlighted in an independent review of the 2023 NSW Speed Zoning Standard (unpublished), which found there was a disconnect between the principles of the Standard, the speed zone review process and resulting outcomes. It is important that policy makers and practitioners charged with implementing speed zoning policy appreciate and understand that the principles upon which speed zoning policy are based do not exist harmoniously in all circumstances. In fact, there is often a tension between the principles, and there is limited guidance provided on how to handle such conflicts.

Austroads *Guide to Road Safety Part 3: Safe Speed* (2024) notes that because large parts of road networks require lower speed limits, as a transitional measure, there is growing support for prioritising the implementation of speed limits on roads where existing travel speeds align with the proposed speed zone. This process is likely to be seen as being more credible to the public and can still achieve significant crash risk reductions.

The Austroads guidance is strongly supported, but rarely followed. The predominant approach to instigating speed zone reviews across most jurisdictions involves a nomination process either by the department, local government or members of the public. However, nomination processes tend to be biased towards locations with higher levels of road use, locations with a known history of crashes or perceived crash risk. Whilst implementing appropriate speed limits on these parts of the network is important, a wider network view is required to check if a new speed zone will be intuitive and credible for road users.

Recent experience from New Zealand highlights the risk associated with implementing speed limit changes where they are not credible to road users. The New Zealand government that came into power in late 2023 implemented legislation and policy directives that requires the reverse many of the speed limits that were changed since 2020. Key reasons cited for the reversals are the lack of credibility of the speed limit changes and excessive speed limit restrictions on key movement corridors (New Zealand Government, 2024).

Analysis of New Zealand's National Speed Limit Register shows that more than 10,000 km of road network had a speed limit change since 2020, representing more than 11% of New Zealand's road network. In 2024, New Zealand recorded its lowest number of road deaths since 2013, bucking the trend seen across Australia. There is little doubt that the widespread implementation of lower speed limits that are better aligned with Safe System principles has contributed to this outcome, but those excellent road trauma reductions are now at risk due to the proposed speed limit reversals.

Despite the compelling numbers, the reversal of some speed limit reductions continues to be pursued because of the perceived unpopularity of these measures. Many of the examples cited draw upon instances where the speed limit

change has been introduced in an environment that does not align with the design of the road. In urban areas, this commonly manifests where areawide 30 km/h speed limits have been introduced to local streets, despite the local streets having highly dissimilar designs, such as those shown in Figure 2, all of which are located within a 1 km radius of each other. We must evolve our approach to implementing speed limit changes to avoid jeopardising long-term application of Safe System aligned speed limits across our road networks.

Some jurisdictions in Australia are starting to introduce guidance to avoid speed zones being introduced to roads where the road design does not match with the proposed speed limit. NSW are currently exploring incorporating guidance into their Speed Zoning Standard to give effect to a policy principle that speed zones should be self-explanatory, consistent and support compliance. Measures being explored include guidance on the extent of speed zone reviews to avoid network inconsistencies, and the need for supporting infrastructure measures to create environments where the operating speed will align with the proposed speed zone. NSW is also embracing Austroads guidance for prioritising the implementation of speed limits on roads where existing travel speeds align with the proposed speed zone.

Credible 30 km/h road designs





Low credibility 30 km/h road designs





Figure 2. Examples of credible and low credibility road designs to support 30 km/h speed limits

Conclusion

There is growing alignment in Australia and internationally on the key speed management principles for speed zoning policy and guidelines. These principles can be summarised as:

- Minimising harm based on the Safe System approach
- Setting speed limits based on road function using a Movement and Place approach
- Matching speed limits with road design features to enhance credibility and compliance
- Maximising wellbeing by setting speed limits that promote transport mode choice

Despite the convergence of principles, there is limited appreciation that the principles do not exist harmoniously in all circumstances and often there is a tension, especially where road design features do not support speed limits that are proposed to minimise harm, reflect the street function and promote transport choice.

Experience from New Zealand highlights the political risk of overlooking the significance of the principle of speed limit credibility. The long-term success of widespread application of speed zoning policy rests with careful implementation planning. We must evolve our speed management practices to prioritise speed zone changes in locations where credibility is likely to be high, ahead of locations that could reduce credibility and public acceptance, even if lower limits are technically justified and aligned with Safe System principles.

References

Australasian College of Road Safety. (2023). ACRS Policy Position Statement - Speed Management. Retrieved from https://acrs.org.au/wp-content/uploads/ACRS-Speed-Management-PPS-2023.pdf

Austroads. (2024). *Guide to Road Safety Part 3: Safe Speeds*. Sydney, NSW: Austroads.

New Zealand Government. (2024, September 28). Government delivers sensible approach to speed limits. Retrieved from https://www.beehive.govt.nz/release/government-delivers-sensible-approach-speed-limits

Turner, B. M., Eichinger-Vill, E. M., El-Samra, S., Adriazola-Steil, C., & Burlacu, F. A. (2024). *Guide for Safe Speeds: Managing traffic speeds to save lives and improve livability.* Washington DC: World Bank & World Resources Institute.

Crash related mental health issues: the invisible injury

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Abstract
This study investigates the long-term mental health outcomes of individuals involved in road crashes in South Australia, including those who did not sustain physical or serious injuries, and considers any post-crash intervention strategy that might improve road safety outcomes and individual wellbeing based on the findings. Fifty-nine participants were interviewed following their involvement in a road crash and again at least 12 months post-crash. Standardised psychological questionnaires measured symptoms of depression, anxiety, stress, post-traumatic stress disorder, resilience and perceived social support. Injury data was gleaned from hospital records while crash information was obtained at the crash scene and from police records. Findings indicated that 75% of participants sustained minor or no physical injury, but mental health conditions doubled from 15% pre-crash to 32% at follow-up. Additionally, 16% of participants developed PTSD symptoms and 42% reported a decline in general mental health due to the crash. The study suggests that early identification of symptoms through mental health screening, including those uninjured, could facilitate timely interventions, potentially reducing long-term mental health impacts, and the burden on road safety.

Social media post
Think road crashes only hurt physically? Think again. Even without major injuries, mental health conditions doubled 12 months after a crash and16% developed PTSD symptoms. Early mental health screening could prevent long-term damage.

Conference theme
The study emphasises equity by promoting early identification and intervention for mental health struggles among all road users involved in crashes, whether uninjured, at fault, or witnesses – ensuring equal access for all. Elasticity is evident through the adaptability of the Safe System's approach, enhancing awareness and responsiveness to the mental health needs of crash involved road users with a focus on preventative and post-crash measures to promote long-term well-being.

Introduction
The impact of mental health on road safety has become of increasing concern, exacerbated in the wake of the COVID-19 pandemic's significant effects on individual wellbeing. While important longitudinal research on the mental health impact of road crashes in Australia have been undertaken, the literature has focused on individuals who sustained physical injuries, including those requiring hospitalisation or seeking compensation, to the exclusion of non-injured participants. Studies have shown that individuals seriously injured in road crashes are at higher risk of developing conditions such as major depressive disorder, post-traumatic stress disorder (PTSD) and substance use disorders (Hruska et al., 2014; O'Donnell et al., 2015). The exacerbation of pre-existing mental health conditions such as anxiety, depression, and trauma responses are also a significant concern, as these factors can contribute to poor wellbeing and problem driving behaviours. For instance, a recent Australian study of 400 drivers hospitalised after a crash found that mental health conditions and/or psychological distress contributed to 12.2% of casualty crashes (Fitzharris et al., 2020).

There is a need for longitudinal research to better understand the long-term impact of crashes on mental health in the South Australian population of road users, including non-injured participants. Such research is essential for developing preventative and intervention strategies that support road safety, including considerations of fitness to drive. Barriers to the personal disclosure of deteriorating mental health, such as stigma, lack of awareness, or fear of license revocation can prevent individuals from seeking help, making it critical to address these issues in road safety initiatives. Existing literature also highlights challenges in allied health assessments of fitness to drive for individuals with mental health conditions, indicating a need for a more comprehensive understanding of how mental health affects driving and crash causation (Dun et al., 2020).

The present study aimed to examine the long-term mental health effects of road crashes on individuals, including those who sustained minimal or no physical harm. It also considers any post-crash interventions that might improve road safety outcomes and individual wellbeing based on the findings.

Method

Fifty-nine participants who had been involved in a road crash in South Australia were recruited from the research team's larger at scene crash investigation study. Participants were interviewed between 2020 and 2024 at two time points. Interview duration varied depending on participant responses, ranging from approximately 45 to 60 minutes per interview. The first interview was undertaken as soon as practicable following their crash (baseline) and again at least 12 months post-crash (follow-up). Participants were invited to the study by mail, or at the crash scene, prior to a follow-up telephone call. Interviews were conducted by two of the research team who were highly experienced and adept at ethical interviewing. Follow-up interviews were undertaken blind to baseline functioning. All but one participant (who attended face-to-face) opted to have their interview by telephone. Standardised psychological questionnaires were administered retrospectively and longitudinally to measure symptoms consistent with depression, anxiety and stress (Depression, Anxiety and Stress Scale - 21 items, DASS21), resilience (Brief Resilience Scale, BRS) and at follow-up to measure post-traumatic stress disorder (PTSD; PTSD Checklist for DSM-5, PCL-5) and perceived social support (Social Support Scale, SSS). The self-report Subjective Units of Distress Scale (SUDS) was used to assess distress on a scale from zero (absence of emotion) to 10 (highest level of emotion). Injury data was obtained from hospital records (and supplemented by self-report at interview) and coded by a medically trained researcher/clinician based on the Abbreviated Injury Scale (AIS) using the maximum AIS (MAIS) for injury severity. Participant demographic data was accessed from police records, including licence number and contact details. Participant licence number was matched, where available, with the Transport Regulation User Management Processing System (TRUMPS), maintained by the Department for Infrastructure and Transport. TRUMPS holds information relating to licencing records, including infringement history, previous disqualifications, conditions to licence and type of licence held.

Results

An 84% (N=59/70) response rate was achieved for follow-up interviews, resulting in a sample of 59 participants, ranging in age at baseline from 19-84 years with a mean age of 46.6 years (SD= 18 years). The sample consisted of 26 females (mean age = 51.2 years; SD= 17.9 years;) and 33 males (mean age = 43 years; SD= 17.5 years). The majority of respondents were drivers (93.2%; n=55/59;) and there were also three cyclists and one motorcycle rider (7%; n=4/59). The majority lived in a major city of South Australia (71.2%), a further 27.2% in regional or remote South Australia and one participant resided interstate.

A total of 37.3% received no physical injury (MAIS = 0; n=22/59) as a result of the crash. For those recording an injury, 22 participants sustained a minor injury (MAIS $\leq$1; 37.3%) while eight participants sustained a significant injury (MAIS 2; 13.6%) and seven participants a serious injury (MAIS 3 or greater, 11.9%). MAIS was not significantly related to any mental health symptoms at baseline nor follow-up (i.e., DASS21, PTSD or SSS). Even when no physical injuries were sustained, 26% (n=5/19) perceived that their mental health had worsened since the crash.

Mental health conditions doubled from 15.3% (n=9/59) pre-crash to 32.2% (n=19/59) at follow-up. Notably, of those with a mental health condition, 42.1% (n=8/19) reported the emergence of their mental health condition since the crash, while 21.1% (n=4/19) reported that the crash had re-triggered a previously resolved condition, and 36.8% (n=7/19) were pre-existing conditions. The most common conditions were depression (63.2%; n=12/19) followed by anxiety (42.1%; n=8/19) and PTSD (26.3%; n=5/19, which included trauma unrelated to the crash). Only17.6% of those with a mental health condition (n=3/17; two were not asked this question) had been spoken to by their practitioner about the impact of mental health on driving. Six of those with a reported mental health condition (31.6%) took prescribed medication to support this.

PTSD symptoms related specifically to the crash were measured at follow-up, which revealed that 15.5% (n=9/58) of participants had developed PTSD symptoms indicating probable diagnosis of PTSD (herein referred to as PTSD). Of those not meeting criteria for PTSD, 42.9% (n=21/49) experienced symptoms that were clinically significant on at least one of the four PTSD symptom domains, indicating an ongoing experience of elevated trauma symptoms. Two additional participants reported no mental health condition but were assessed on a standardised measure to have probable PTSD, raising the prevalence of having a mental health condition at follow-up to 35.6% (N=21/59).

Overall, 50 participants completed the DASS21 at baseline and follow-up. Three non-parametric Wilcoxon Signed-Rank Tests revealed statistically significant increases on all three domains of distress between the two time points which represent the change in functioning before and after their involvement in a crash. Results indicated that participants experienced a significant increase in intensity of symptoms consistent with depression ($Z = 3.008$, $p = 0.003$), anxiety ($Z = 2.312$, $p = 0.021$) and stress ($Z = 4.076$, $p < .001$).

There were significant strong positive correlations between PTSD total scores and DASS21 stress (ρ=.679, p = <.001), DASS21 depression (ρ=.642, p = <.001) and DASS21 anxiety (ρ=.544, p = <.001) scores at follow-up, and a moderate correlation with DASS21 stress scores (ρ=.350, p = <.05) at baseline. These results indicated that as stress, depression and anxiety scores increased, trauma symptoms tended also to increase.

The majority of participants (74.6%, n=44/59) experienced events in their lives post-crash that they considered to have been very stressful or traumatic, which remained ongoing for 91% at follow-up. Scores at follow-up on the SUDS relating to compensation seeking were significantly positively correlated with PTSD scores (ρ=.455, p = <.01). These results indicated that as participants subjective distress increased, their trauma symptoms tended also to increase. At follow-up 42.4% (n=25/59) of participants reported that the crash had a negative impact on their mental health functioning generally.

Scores on the SSS were significantly negatively correlated with PTSD scores, (ρ=−0.576, p = <.001), with follow-up scores on DASS21 depression (ρ=-.497, p < .001), DASS21 anxiety (ρ= -.291, p = <.05) and DASS21 stress (ρ=-.274, p = .05). Scores on the BRS were also significantly negatively correlated with PTSD scores, (ρ=−0.576, p = <.001). These results suggested that higher levels of social support and resilience are associated with fewer mental health symptoms.

Discussion and Conclusions

The present study aimed to examine the longer-term mental health functioning of individuals affected by road trauma, with the goal of informing road safety initiatives. The findings underscore the significant mental health impact that follows road trauma, highlighting that the injury burden extends beyond physical harm to include substantial psychological consequences, even among those who sustained minor or no physical injuries (75% of the sample). Participants were increasingly vulnerable to symptoms of depression, anxiety and PTSD related to the crash as perceived stress increased in their daily lives. Notably, participants' scores on measures of depression, anxiety and stress (i.e., the DASS21) all increased significantly between baseline and follow-up, and the distress of compensation seeking was significantly related to increased PTSD symptoms. Previous research has indicated the predictive ability of the DASS21 subscales of depression and anxiety in detecting those seeking compensation for their road crash injury who will go on to develop PTSD and/or Major Depressive Disorder (Guest et al., 2018). Notably, mental health deterioration can be accompanied by limited insight, while stigma surrounding mental health may influence individuals' awareness of the psychological effects of a crash, both of which can contribute to a reluctance in seeking support. Optimally, early identification of common symptoms of deteriorating mental health, including elevated stress, access to social support, and recognising symptoms of PTSD, depression and anxiety could result in timely intervention and prevent the longer-term exacerbation of mental health conditions.

Given the increased prevalence of mental health conditions arising post-crash, it is evident that a comprehensive approach to post-crash care is crucial, both for individual recovery and to lessen the burden on the road traffic and healthcare systems. The findings point to a focus on improving both the physical and psychological recovery of individuals involved in road crashes, emphasising the need for a more comprehensive approach to post-crash care so that individuals do not face protracted emotional distress due to road trauma. These include early screening and detection for mental health interventions, with a view to integrating mental health assessment and treatment alongside physical recovery. A holistic approach between road safety and the health sector could be used to ensure that those vulnerable to mental health deterioration post-crash receive the appropriate care and support, which could be vital in reducing the impact of longer-term suffering. This could be achieved through development of initiatives, including routine mental health screenings for all crash survivors regardless of injury severity.

Implications for policy and/or practice

Addressing these adverse mental health related consequences of road crashes would reduce individual suffering and lessen the burden on road safety and the healthcare system. Ideally, mandatory screening could facilitate the early identification of common symptoms that indicate a risk of deteriorating mental health, leading to timely intervention and preventing the longer-term exacerbation of mental health conditions.

References

Dun, C., Swan, J., Hitch, D., & Vlachou, V. (2020). Occupational therapy driver assessments with mental health consumers: A mixed-methods study. *Australian Occupational Therapy Journal, 67*, 330-340. https://doi.org/10.1111/1440-1630.12652

Fitzharris, M.P., Lenné, M.G., Corben, B., Arundell, T.P., Peiris, S., Liu, S., Stephens, A., Fitzgerald, M., Judson, R., Bowman, D., Gabler, C., Morris, A., & Tingvall, C. (2020). *Enhanced crash investigation study (ECIS): ECIS*

Report 1: Overview and analysis of crash types, injury outcomes and contributing factors. Australia: Monash University.

Guest, R., Tran, Y., Gopinath, B., Cameron, I. D., & Craig, A. (2018). Prevalence and psychometric screening for the detection of major depressive disorder and post-traumatic stress disorder in adults injured in a motor vehicle crash who are engaged in compensation. *BMC Psychology, 6*, 1-12. https://doi.org/10.1186/s40359-018-0216-5

Hruska B, Irish LA, Pacella ML, Sledjeski EM, Delahanty DL. (2014). PTSD symptom severity and psychiatric comorbidity in recent motor vehicle accident victims: a latent class analysis. *Journal of Anxiety Disord*ers, *28*, 644-9. doi: 10.1016/j.janxdis.2014.06.009.

O'Donnell, M. L., Grant, G., Alkemade, N., Spittal, M., Creamer, M., Silove, D., McFarlane, A., Bryant, R. A., Forbes, D., & Studdert, D. M. (2015). Compensation seeking and disability after injury: The role of compensation-related stress and mental health. *The Journal of Clinical Psychiatry, 76*, e1000–e1005. https://doi.org/10.4088/JCP.14m09211

Empowering emergency responders to address post-crash mental health

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Abstract

In Western Australia, road traffic incidents in regional and remote areas pose a significant burden on public health due to the high incidence of road trauma. Emergency responders, who are often the first to arrive at the scene, are uniquely positioned to identify and refer individuals in need of psychological support post-crash. To address this need, Injury Matters delivers Road Trauma Support WA (RTSWA) which provides person-centred psychological support for individuals impacted by road trauma. Over a two-year period, Injury Matters conducted 23 targeted information sessions, reaching 321 emergency responders across regional Western Australia (WA), aimed to empower first responders with the knowledge and skills to identify and refer individuals impacted by road trauma for psychological support. Evaluation results indicated increased knowledge and confidence among responders in referring individuals for support. By enhancing access to timely psychological care, Injury Matters seeks to reduce distress and improve recovery outcomes for those impacted by road crashes in regional communities. Ultimately, this initiative aims to improve long-term well-being and contribute to a safer road system.

Social media post

Emergency responders in regional and remote WA are often the first on the scene of road crashes. Road Trauma Support WA is helping them identify and refer those in need of psychological support. In the past 2 years, Injury Matters has delivered 23 sessions to 321 responders, increasing their ability to offer timely care and improve recovery outcomes for those affected by road trauma.

Introduction

In Australia, the risk of being involved in a road traffic incident increases with remoteness. In 2023, Western Australia recorded 25,827 road traffic crashes, resulting in 158 fatalities - 89 in regional areas and 69 in metropolitan regions (Government of Western Australia, 2023; Main Roads WA, 2024). Considering the vast regional road network within Western Australia, emergency responders, both paid and volunteers, are strategically located within local communities to provide immediate assistance after these traumatic events. The critical work of first responders plays a pivotal role in providing effective and responsive frontline support to those in need. However, this vital work also increases their exposure to potentially traumatic incidents, which can have a significant impact on their mental and emotional well-being.

A meta-analysis has reported that post-traumatic stress disorder (PTSD) was prevalent in 22% of road traffic crash survivors (Lin et al., 2018). Additionally, survivors commonly experience psychological conditions such as depression, driving phobias, and other anxiety-related disorders. The prevalence of these conditions can significantly impact an individual's quality of life, social interactions, financial independence, and long-term health outcomes (Mayou & Bryant, 2002; Momenyan et al., 2024).

To mitigate the psychological and social distress faced by individuals affected by road trauma, Injury Matters delivers the RTSWA program. RTSWA provides information and support, education and training and a free trauma-informed counselling service for anyone impacted by road trauma in Western Australia.

Injury Matters recognises that regional and remote emergency responders, including frontline personnel in hospitals and emergency departments, are uniquely positioned to identify individuals and families in need of psychological support following a traumatic road event and refer them to the service. As part of RTSWA's workforce development initiatives, a 30-minute to 1-hour targeted information session was developed for first responders and front-line staff in regional and remote WA.

Conference theme

To improve community resilience and reduce the risk of elevated distress contributing to mental ill-health after a crash, preventative measures including psychological support can have a significant impact. All road users are entitled to a

safe road system, and equally, to access post-crash care when necessary. By enhancing the elasticity of regional first responders - we are building their capacity to not just respond to road incidents but to empower them to identify, support, and refer individuals in need of post-crash care. This is a critical strategy for improving access to care in regional Western Australia. This approach ensures that individuals are informed about the available support options, ultimately facilitating better outcomes for affected individuals in these communities.

Project description

Over two years (2023 and 2024), RTSWA delivered 23 targeted in-person information sessions to 321 emergency responders across regional and remote WA including Police, St John WA, Department of Fire and Emergency Services and Hospital Emergency Departments. These first responder participants were contacted via telephone and email, and offered a free information session for staff. Sessions were delivered across all regions of Western Australia except the Kimberley.

The information sessions are evidence-informed, delivered by experienced recovery professionals and focus on topics including the impact of road trauma in WA, recognising common psychological reactions to trauma, how to facilitate third-party referrals for affected individuals and where to access support for both affected individuals and responders. The content delivered in each information session varied slightly, depending on the time available and the needs of the participant group.

To evaluate the effectiveness of these sessions, a tailored survey was developed for each workshop which participants were asked to complete following each session. The survey included questions relating to the following domains: knowledge, understanding, confidence, satisfaction and intent to apply learnings. A statistical and thematic analysis was conducted to analyse the quantitative and qualitative responses provided by participants.

Results

Twelve of the information sessions were evaluated, with 134 responses received. Session-specific surveys were developed, meaning that not all respondents were presented with the same set of questions. Overall the respondents agreed that the information session was valuable in increasing their understanding of the RTSWA service (100%, n=59), understanding of trauma (91%, n=69), knowledge of where to seek support and professional help for trauma reactions (98%, n=132) and confidence to seek professional help if required (88%, n=100). The majority of respondents also indicated intent to apply the learnings from the information session to areas of their life (92%, n=104) and were satisfied with the session (97%, n=130).

Qualitative feedback from the surveys includes ‘Well presented, easy to understand and timely given the roles and work we conduct’, ‘Educational information delivered easily with graphs and statistics not to wordy. Engaging, letting the audience answer questions to clarify their understanding. Clear information on impacts and supports. Amazing delivery, engaging and so informative’ and ‘I thoroughly enjoyed learning how the service works, and it will help me a lot now when referring people involved in road trauma’.

Benefits to road safety

Providing appropriate post-crash care can assist with the prevention of future road traffic incidents. Mental health conditions have the potential to increase an individual’s risk of being involved in a road traffic incident, as they can impair focus and attention (Unsworth et al., 2017). In 2023, 9% of fatalities on WA roads were related to inattention-related crashes (n=14) (Road Safety Commission, 2023). Consequently, reducing inattention on WA roads is a vital component of improving Safe Road Users and therefore the overall safety of WA roads.

Community engagement is crucial in raising awareness, educating the public, and promoting a culture of safety and shared responsibility on the roads. Information sessions with first responders are essential not only for reducing barriers to accessing psychological support post-crash but also for enhancing public awareness of the importance of a safe road system.

Implications for policy and/or practice

The participation of emergency responders in information sessions, coupled with the positive outcomes reported, underscores the value of delivering tailored training programs. These initiatives contribute to enhancing individuals' knowledge of road safety.

The fifth pillar, post-crash care, is critical to the development of a comprehensive and effective safe road system. The success of this pillar is closely linked to the collaboration and support of emergency services and frontline staff, who are instrumental in delivering rapid and effective care to those affected. Engaging with and building the capacity of this cohort can further build their resilience, allowing them to continue in their emergency service roles.

A key element that underpins these efforts is the need for accessible, timely, and person-centred psychological support, which is vital in addressing the mental health needs of individuals impacted by road trauma. Across Australia, ensuring the availability of such psychological support enhances recovery and well-being for all those affected by road-related incidents.

Conclusions

In regional and remote Western Australia, road traffic incidents create significant trauma, with emergency responders often being the first to assist. Injury Matters has enhanced the ability of responders to identify and refer individuals in need of psychological support through targeted RTSWA information sessions. These sessions have increased responders' knowledge and confidence in facilitating timely referrals. By improving access to post-crash psychological care, RTSWA helps reduce distress, support recovery, and strengthen community resilience. This approach is key to improving mental health outcomes and fostering safer roads for all in Western Australia.

References

Government of Western Australia. (2023). Western Australian Road Fatalities and Serious Injuries 2023. https://www.wa.gov.au/system/files/2024-09/ksi-report-western-australia-2023.pdf

Lin, W., Gong, L., Xia, M., & Dai, W. (2018). Prevalence of posttraumatic stress disorder among road traffic accident survivors: A PRISMA-compliant meta-analysis. *Medicine, 97(e9693).* https://doi.org/10.1097/MD.0000000000009693

Main Roads WA (2024). Unpublished 2023 Crash Data Extracted by Injury Matters from the Main Roads WA Reporting Centre.

Mayou, R., & Bryant, B. (2002). Outcome 3 years after a road traffic accident. *Psychological Medicine, 32*(4), 671-675. https://doi.org/10.1017/S003329170200546X

Momenyan, S., Chan, H., Erdelyi, S., Pei, L., Shum, L., Jae, L., Taylor, J., Staples, J., Bryan, S., & Brubacher, J. (2024). Trajectories of health-related quality of life following road trauma: Latent growth mixture modelling across a 12-month cohort study. *Accident Analysis & Prevention, 202*, *107574.* https://doi.org/10.1016/j.aap.2024.107574

Unsworth, C., Baker, A., So, M., Harries, P., & O'Neill, D. (2017). A systematic review of evidence for fitness-to-drive among people with the mental health conditions of schizophrenia, stress/anxiety disorder, depression, personality disorder, and obsessive-compulsive disorder. *BMC Psychiatry, 17(318).*

Transforming Indonesia's School Zones with a data-driven and participatory approach

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Abstract

This study examines the transformation of school zones in three cities in Indonesia from 2021 - 2024, employing an evidence-based methodology and a participatory framework to bolster road safety. Indonesia recorded 31,063 road traffic deaths in 2021, disproportionately affecting those aged 5-29. This project tackled the notable safety hazards school zones present to children and youth by creating a safer school environment. The iRAP Star Rating for Schools (SR4S) methodology was employed to evaluate pedestrian infrastructure and guide targeted interventions. Additionally, a collaborative approach engaged youth and key stakeholders in both design and implementation process. This youth-led initiative garnered widespread support, yielding significant outcomes: infrastructure improved by 3-star (medium) to 5-star (safest), increased youth participation, and stronger stakeholder partnerships. These outcomes underscore the value of data-driven and participatory strategies, offering a scalable model for policy development to improve school zone safety and contribute to broader road safety advancements across Indonesia.

Social media post

Thrilled to share our work on transforming school zones in Solo, Bandung, and Bekasi, Indonesia! Through youth-led initiatives and multi-stakeholder collaboration, we've improved road safety in high-risk areas to achieve minimum 3-star ratings per iRAP Star Rating for Schools methodology.

Background

Ensuring safe access to schools is a critical component of road safety efforts, particularly in low- and middle-income countries where pedestrian infrastructure is often neglected. Indonesia recorded 31,063 road traffic deaths in 2021, disproportionately affecting those aged 5-29 (WHO, 2023), highlighting an urgent need for safer mobility solutions. In Indonesia, many school zones lack the adequate infrastructure to protect children and youth from traffic-related dangers, putting their safety at risk daily. Only 7% of the roads in Indonesia assessed by iRAP are rated 3-star or higher for pedestrian safety (iRAP Safety Insights Explorer, 2025). Addressing this challenge requires a multi-stakeholder effort, bringing together government agencies, private sector partners, and the students as daily users to create safer school environments.

This paper examines three case studies from Solo, Bandung, and Bekasi, from 2021 - 2024, where young people played a key role in advocating for and implementing road safety improvements. Through a data driven and participatory approach, the initiatives aimed to address students' mobility needs with evidence-based solutions while engaging local stakeholders to ensure community ownership (Ellizar et al., 2023). Although the three case studies shared a common methodology, they differed in stakeholder participation, engagement approach, and funding mechanisms, providing valuable lessons on the impact of various implementation models.

Conference theme

These projects align with the conference theme with the explanation as follows:

1. Equity: The paper underscores the importance of ensuring that all children and youth have access to safe school environments. By integrating the iRAP Star Rating for Schools (SR4S) and adopting a participatory approach from youth and multi-stakeholder, these projects uphold the principles of fairness, dignity, and inclusivity, ensuring that every student can contribute to making their travel to school safer.
2. Elasticity: The study highlights the adaptability and resilience of road safety interventions in different cities. While the methodology remains consistent, variations in stakeholder engagement strategies and funding demonstrate the flexibility of these initiatives in responding to political will, local needs and constraints.

3. Evolution: By examining the transformation of school zones in Solo, Bandung, and Bekasi, this paper contributes to the broader discourse on the evolution of the Safe System approach in Indonesia. The role of youth engagement in shaping policy and infrastructure improvements also highlights the growing recognition of community-driven road safety solutions.

Approach

The school zone transformation projects in Solo, Bandung, and Bekasi followed a structured approach, combining youth participation, stakeholder collaboration, and data-driven safety improvements. Each project utilised the SR4S methodology to assess pedestrian infrastructure risks, engaged youth in road safety advocacy, and secured funding from various stakeholders to implement infrastructure changes (Ellizar et. al., 2023). Key elements of the approach included:

1. Youth Participatory Approach: This approach engages young people in the decision-making process, ensuring their perspectives are integrated into the advocacy for safer road environments. It begins with capacity-building initiatives on road safety, followed by participatory survey and design activities, and culminates in empowering youth to contribute to the implementation of road safety measures actively. This fosters a sense of ownership and responsibility among youth, strengthening the effectiveness of the interventions.
2. Participatory Engagement: This approach prioritises collaboration among a range of stakeholders, including government agencies, private sectors, NGOs, and youth. The participation of multiple stakeholders fosters shared responsibility, and funding sources, and optimises the expertise to enhance the effectiveness of school zone safety improvements. Measuring the influence and importance of multiple stakeholders is crucial for identifying key stakeholders and their willingness to participate in the activity. The Responsible, Accountable, Consulted, and Informed (RACI) approach helps define the level of participation for individuals or groups in these initiatives.
3. Infrastructure Improvement: This approach involves upgrading physical infrastructure, such as pedestrian crossings, signage, traffic-calming measures, and speed management to enhance the safety of school zones. The initial baseline conditions and the enhanced conditions following upgrades were assessed using the iRAP Star Rating for Schools (SR4S) to monitor infrastructure safety improvements with evidence-based analysis.
4. Funding Mechanisms: The projects implemented by diverse funding mechanisms, leveraging contributions from government agencies, private sector partners, and NGOs. These varied funding approaches underscore the importance of flexible financial strategies in sustaining and scaling school zone transformation projects.

Results

The transformation of the school zones in Solo, Bandung and Bekasi has significantly enhanced road safety around the schools, from 1-star to achieve minimum 3-star rating as mandated on the Global Road Safety Performance Targets (WHO, 2017). While the SR4S assessments provided objective safety ratings, the youth participation captured students' firsthand experiences and concerns, including issues such as speeding vehicles, inadequate crossings, which directly informed the proposed interventions. The funding mechanisms in these projects primarily covered infrastructure improvement, while technical assistance, including capacity building, assessments, and advocacy support, was provided by non-governmental organisations. Below is an overview of the projects including findings, key interventions, funding mechanisms, and iRAP Star Rating changes (before - after) for each city.

Solo and Bandung both faced road safety challenges due to newly constructed flyovers near schools, while Bekasi reflected common issues seen in many Indonesian schools. Solo achieved a 4-star improvement with a marked pedestrian crossing, fully funded by the government and initiated by the YOURS (NGO). Bandung saw the most significant improvement, reaching 5 stars, supported with the most comprehensive interventions, including crossings, speed control measures, and signage, funded by the government and 3M Indonesia (Private). Meanwhile, Bekasi improved its rating by 3 stars through pedestrian crossings and speed limit signage, fully funded by Bridgestone Indonesia (Private).

These three case studies highlight that all funding models including government-led, non-government, hybrid, and private-funded can successfully transform school zones when coupled with evidence-based assessments, participatory approach, strong stakeholder engagement, and effective intervention design. As each city had a unique combination of infrastructure improvements, higher star-rating improvements were not determined solely by the type of funding but rather by the scope and effectiveness of the implemented interventions. Future projects should focus on scalability and policy integration to ensure long-term safety improvements for school zones nationwide.

Benefits to road safety

Integrating youth participation and multi-stakeholder engagement with evidence-based methodologies like iRAP Star Rating for Schools (SR4S) ensures that road safety improvements are both data-driven and community-centred, directly reducing crash risks and saving lives. These road safety initiatives address real safety concerns, empowering the key stakeholders, and create lasting change, preventing injuries and fatalities while shaping safer, more resilient urban environments. The measurable increase in iRAP star ratings across school zones reflects tangible safety improvements, protecting children and vulnerable road users.

Table 1. Results of school zones project

No	City	Findings	Key interventions	Multi-stakeholder engagement*	Funding Mechanisms		iRAP Star Rating changes	
					Govt	non-Govt	Before	After
1	Solo (SMPN 1 Surakarta: Mar - Dec 2021)	• New flyover constructed • High speed and volume • Lack of crossing facilities • Incomplete traffic signs	• Pedestrian crossing (marked)	Local Actions Project from Global Youth Coalition for Road Safety (DoT, DoPW, DoE, Police, YOURS, iRAP SR4S, 50 students)	100%	-		4
2	Bandung (SMPN 22 Bandung: Aug 2022 - Mar 2023)	• New flyover constructed • High speed • Inadequate pedestrian sidewalks • No pedestrian crossing	• Pedestrian crossing (marked and refugee) • School signs (flashing beacons) • Speed hump • Speed limit signage	GRSLC Alumni Fellowship Program (DoT, DoPW, DoE, Police, Police, iRAP SR4S, 3M Indonesia, 50 students)	25%	75%	2	5
3	Bekasi (SMPN 2 Bekasi: April - Dec 2024)	• High speed • High traffic volume • No pedestrian crossing • Incomplete traffic signs	• Pedestrian crossing (marked and refugee) • Speed hump • Speed limit signage	CSR Road Safety Program from Bridgestone Indonesia (DoT, DoPW, DoE, Police, iRAP SR4S, Bridgestone Indonesia, 200 students)	-	100%		3

*DoT: Dept. of Transport; DoPW: Dept. of Public Works; DoE: Dept. of Education; YOURS: Youth for Road Safety; GRSLC: Global Road Safety Leadership Course, hosted by Global Road Safety Partnership and Johns Hopkins University

Implications for policy and/or practice

Incorporating the iRAP Star Rating for Schools (SR4S) alongside community engagement ensures a holistic approach that drives evidence-based decision-making while addressing the community's urgent needs. By adopting SR4S as a standard assessment tool, policymakers can allocate resources more effectively, target high-risk areas, and enforce minimum safety standards for school environments, while direct input from youth ensures interventions are relevant and responsive. This combined approach not only enhances infrastructure but also fosters multi-stakeholder collaboration, local empowerment, leading to long-term, sustainable improvement in school zone safety.

Conclusions

The increase in iRAP Star Ratings reflects significant improvements in the safety of school zones in all three cities. The youth participatory approach proved effective in identifying key road safety issues and tailoring infrastructure upgrades that aligned with the students' needs. Collaboration among government agencies, private sector partners, and community involvement, played a critical role in the success of the interventions. Each project demonstrated the importance of context-specific solutions, with variations in funding sources and stakeholder engagement models contributing to different levels of success and sustainability. These findings emphasise that a collaborative, inclusive approach, combined with continuous monitoring and community participation, is essential for sustaining long-term road safety improvements.

References

Ellizar, E., Larastiti, S., Bawono, T. E., Mulyana, W., & Kurniawan, C. (2023). Youth Participation in School Safety Zones Assessment: A Case Study in Indonesia. *Journal of Road Safety*, *34*(2), 1–9. https://doi.org/10.33492/ JRS-D-22-00033

International Road Assessment Programme. (2025). *iRAP Safety Insights Explorer*. https://irap.org/safety-insights-explorer/

International Road Assessment Programme. (2020). *Star Rating for Schools Coding Guide*. https://starratingforschools.org/how-to/

World Health Organization. (2023). *WHO Global Status Report 2023*.https://cdn.who.int/media/docs/default-source/documents/health-topics/road-traffic-injuries/global-plan-for-road-safety.pdf?sfvrsn=65cf34c8_35&download=true

World Health Organization. (2017). *Global Road Safety Performance Targets*. https://www.who.int/publications/m/item/global-road-safety-performance-targets

Seat belt non-compliance in crashes: Event Data Recorder (EDR) insights

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Abstract

Despite their proven effectiveness in preventing and reducing road crash-related injuries, seat belts are not always worn. This study analysed Event Data Recorder (EDR) data from 3,383 vehicle occupants involved in road crashes, across three datasets to examine seat belt use and their association with other crash risk factors. Of the 655 vehicle occupants with a valid EDR-recorded seat belt status, 4.6% (n=30) were unbuckled. Unbuckled occupants in crashes were significantly more likely to be in a speeding vehicle, in a crash at night-time and being in an at-fault vehicle. Police-documented seat belt use did not always align with EDR data, highlighting potential misreporting. Critically, 83.3% (n=20/24) of unbuckled drivers were engaged in additional high-risk behaviours such as speeding, alcohol/drug use or dangerous driving. Although intelligent seat belt reminders were present for 97.4% (n=638/655) of crash-involved occupants, non-compliance was still pervasive, and frequently part of a broader pattern of unsafe driving behaviours.

Social media post

Seat belts save lives, but some drivers don't buckle up. Our study of 655 occupants with EDR-recorded seat belt status found unbuckled crash-involved occupants were often speeding, driving at night, or at fault. 83% (n=20/24) engaged in concurrent additional risky behaviors.

Introduction

Seat belts are a fundamental safety feature that significantly reduce the risk of injury or death in road crashes. Research indicates that seat belt use reduces the likelihood of fatal injury by approximately 45% for drivers and 60% for front-seat passengers (Høye, 2016). Traditional methods of determining seat belt use, such as police reports and physical evidence from crashes, can be prone to error or misinterpretation.

Event Data Recorders (EDRs) are devices equipped in vehicles that capture objective crash-related data, including vehicle speed, delta-*v* and seat belt use. Unlike many other countries, such as the US, UK, Europe, China, Japan and South Korea, Australia has no regulation mandating public access to EDR data through a standardised toolkit. As a result, EDR data are inconsistently accessible in vehicle crashes. Additionally, the type and quality of data recorded vary between vehicles, and objective seat belt status is only occasionally captured. When available, this information provides a more accurate and reliable indication of whether occupants were buckled at the time of the crash.

Prior research on seat belt use in South Australia has shown concerning trends; while most vehicle occupants use seatbelts, non-use is over-represented in serious crashes. In 2009, observational studies showed seat belt non-use rates were 1.6% in metropolitan Adelaide and 2.4% in rural South Australia (Wundersitz & Anderson, 2009). Between 2000 and 2007, 33.1% of injured occupants involved in fatal crashes and 12.4% of those in hospital-admission-level crashes were recorded as being unrestrained (Wundersitz et al., 2009). In 2008, 36.5% of fatally injured occupants were unrestrained (Raftery & Wundersitz, 2011). More recent data from South Australia's Department for Infrastructure and Transport (DIT) revealed that between 2018 and 2022, an average of 41 people per year were seriously injured or killed while unrestrained, representing 27% of all fatalities and 8% of serious injuries (Department for Infrastructure and Transport, 2024). In Victoria, the Transport Accident Commission (TAC) reported that in 2022, 21 vehicle occupants (17% of road fatalities) were not wearing a seat belt (TAC, 2023). Self-reported TAC data from 2024 indicated that 2.7% of drivers and 4.2% of passengers admitted to not wearing a seat belt (TAC, 2024).

Equity in road safety is important because some communities may have more difficulty accessing safety resources or taking part in prevention efforts. Using EDRs can provide more accurate data on seat belt use and driver behaviours, helping to identify and address inequalities in road safety across different groups. EDRs also highlight the **evolution** of a safer system by providing objective data on seat belt usage, which enhances our understanding of occupant behaviours in crashes.

Method

This study analysed three sources of Australian EDR data:

- A sample of Written-off vehicles from South Australia (SA),
- Vehicles investigated by the South Australian Police's Major Crash Investigation Section (SAPOL MCIS), and
- Vehicles investigated by Victoria Police's Collision Reconstruction and Mechanical Investigation Unit (CRMIU).

Each crashed vehicle was matched with the associated crash reported data to contextualise the circumstances of the crash, as well as the vehicle and occupant involvement in that crash. The primary focus of this study was to examine unbuckled occupants involved in crashes, as recorded by EDRs.

Results

This study analysed data from 3,383 vehicle occupants of crashed vehicles with available EDR files. Of these, 655 (19.4%) had a valid seat belt status recorded by the EDR, with 30 (4.6%) identified as unbuckled. This reflects a relatively low proportion of cases with usable seat belt status data, highlighting a key limitation in relying on EDRs as a consistent source for restraint use information in Australia. The distribution of unbuckled rates across each data source is shown in Table 1.

Table 1. Counts of buckled and unbuckled occupants, and their unbuckled rate, for each EDR data source

EDR source	Buckled	Unbuckled	Unbuckled rate	Total
Written-off vehicles (SA)	460	16	3.4%	476
SAPOL MCIS (SA)	20	0	0.0%	20
Victoria Police's CRMIU (Victoria)	145	14	8.8%	159

The distributions of occupant injury severity proportions for each data source are shown in Figure 1. The Written-off vehicles dataset consisted of mainly non-injury and lower-severity injuries, whereas the SAPOL MCIS sample consisted mainly of hospital-injury level severities. The Victorian dataset consisted of a more even spread of severities, including a larger number of fatalities.

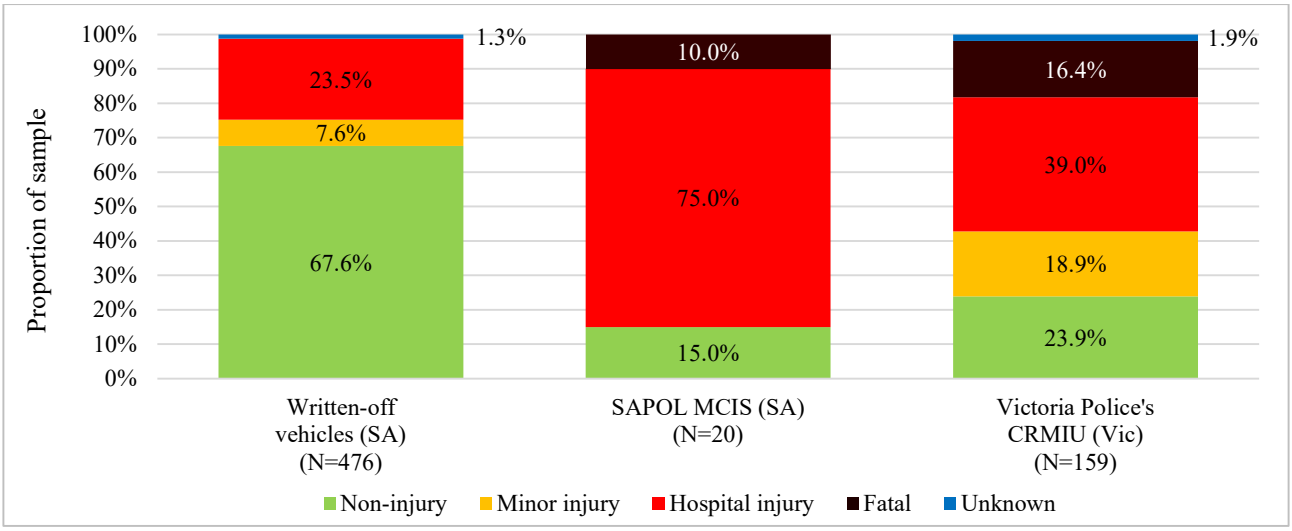


Figure 1. Proportions of occupant injury severity of each dataset

Associations between unbuckled seat belts and crash characteristics were examined using Fisher's Exact tests to account for low sample sizes. Key findings included:

Unbuckled cases in the **Written-off vehicles dataset** were associated with:

- being a passenger (p = .02, OR = 4.61 [95% CI: 1.40-15.15])
- speeding at any level (p = .01, OR = 5.18 [95% CI: 1.61-16.71])
- extreme speeding (30 km/h or more over the speed limit) (p < .01, OR = 37.00 [95% CI: 9.08-150.84])
- being at-fault for the crash (p < .01, OR = ∞ [95% CI: 1.28-372.35])

Unbuckled cases in the **Victorian dataset** were associated with:

- night-time crashes (p = .04, OR = 3.42 [95% CI: 1.09-10.75])
- speeding at any level (p = .02, OR = 8.23 [95% CI: 1.02-66.42])
- extreme speeding (30 km/h or more over the speed limit) (p = .04, OR = 8.27 [95% CI: 0.95-71.63])

A notable feature of the datasets was the prevalence of intelligent seat belt reminder systems in vehicles, which were found for 97.4% (n=638/655) of vehicle occupants in EDR-equipped vehicles. The unbuckled rate was 4.4% (n=28/637) in vehicles with intelligent seat belt reminder systems, compared to 11.8% (n=2/17) in vehicles without them. The finding that 28 occupants were unbuckled in seats with intelligent seat belt reminders indicates that the presence of these systems does not guarantee seat belt compliance.

A comparison of police-documented seat belt status with EDR data revealed discrepancies in 21 cases (14 in the Written-off vehicles dataset and seven in the Victorian dataset), where the seat belt status was incorrectly documented in the police reports (for example, documenting that a seat belt was worn when the EDR showed it was unbuckled, or vice versa). Furthermore, in the Victorian dataset, a police-documented seat belt status of "unknown" was recorded for 35.8% (n=57/159) of the occupants in the Victorian dataset, despite the availability of downloaded EDR data. These findings indicate that police crash reports were not consistently updated to reflect the accurate seat belt status from EDRs, highlighting the opportunity to improve reporting procedures.

All 30 unbuckled cases were further analysed in more detail, and any concurrent associations with other dangerous driving behaviours were identified. It was found that 83.3% (n=20/24) of the unbuckled drivers in the sample concurrently engaged in a high-risk driving behaviour, such as speeding, alcohol consumption, illicit drug use, or dangerous driving. The following observations were made for the associated high-risk behaviours:

- Speeding: Defined by maximum travel speed recorded by the EDR in the seconds before the crash. Of the 23 unbuckled drivers with known vehicle speeds, 17 (73.9%) were speeding, with 11 (47.8%) exceeding the speed limit by 30 km/h or more.
- Alcohol and drug use: Positive test results for alcohol were found in 3 of 11 tested drivers (27.3%), while 2 of 7 tested drivers (28.6%) were positive for illicit drugs. None of the 24 drivers tested positive to both alcohol and illicit drugs.
- Other dangerous driving, such as excessive acceleration, involvement in police pursuits, not checking for traffic in certain situations, erratic driving, mobile phone use, substantial distraction, loss of control of vehicle, and fleeing the crash scene: Evidence suggests other dangerous driving in this list was present in 14 of 24 cases (58.3%) of unrestrained drivers.
- Overall: A high proportion of drivers (20 of 24, 83.3%) were engaged in an additional high-risk behaviour while being unbuckled. More than half (58.3%) of the unbuckled drivers were engaged in two or more additional associated high-risk behaviours. Only four unbuckled drivers (16.7%) were not detected partaking in other high-risk behaviours at the time of the crash.

Conclusions

The findings of this research highlight that unbuckled seat belts are often associated with other high-risk driving behaviours. Across the SA Written-off vehicles and Victorian datasets, night-time crashes, speeding, and being at fault were common factors linked to unbuckled occupants. Intelligent seat belt reminders were prevalent but not universally effective, as some occupants remained unrestrained despite these systems. This is concerning, and more research is required to determine the features of reminder systems that could improve their effectiveness, or whether stronger seat belt reminder systems, such as seat belt ignition interlocks are needed to address this persistent road safety issue. Additionally, police-documented seat belt use did not always align with EDR data, underscoring the value of EDR regulation, easy accessibility and the integration of EDR findings into crash investigations for greater accuracy.

In this sample, 83.3% (n=20/24) of unbuckled drivers were engaging in concurrent additional risky behaviours, and 58.3% of the unbuckled drivers were engaging in two or more additional risky behaviours, such as speeding, alcohol or drug use, or dangerous driving. Only a small fraction (16.7%) of unbuckled drivers exhibited no other high-risk behaviours at the time of the crash. These results suggest that non-use of seat belts is not an isolated issue but part of a broader pattern of reckless driving behaviours. These insights emphasise the importance of continued enforcement including automated camera enforcement as well as public safety campaigns promoting seat belt use as a fundamental, life-saving behaviour.

References

Department for Infrastructure and Transport (2024). South Australia's Road Safety Strategy to 2031 -Interim Annual Progress Report 2022. Government of South Australia. https://www.dit.sa.gov.au/__data/assets/pdf_file/0005/1339637/South-Australias-Road-Safety-Strategy-to-2031__Interim-Annual-Progress-Report-2022.PDF

Høye, A., (2016). How would increasing seat belt use affect the number of killed or seriously injured light vehicle occupants? Accid. Anal. Prev. 88, 175-186.

Raftery, S. J., & Wundersitz, L. N. (2011). No restraint? Understanding differences in seat belt use between fatal crashes and observational surveys (CASR090). Adelaide: Centre for Automotive Safety Research.

Transport Accident Commission (2024). Road Safety Monitor: 2023 report. TAC - Transport Accident Commission. Available at: https://www.tac.vic.gov.au/__data/assets/pdf_file/0006/872745/RSM-2023-Report.pdf

Transport Accident Commission. (June 30, 2023). Seatbelts. TAC - Transport Accident Commission. https://www.tac.vic.gov.au/road-safety/staying-safe/seatbelts?tab=1 Accessed on 20/12/2024.

Wundersitz, L. N., & Anderson, R. W. G. (2009). On-road observational survey of restraint and child restraint use, 2009. Adelaide: Centre for Automotive Safety Research.

Wundersitz, L. N., Hiranandani, K., & Baldock, M. R. J. (2009). Annual performance indicators of enforced driver behaviours in South Australia, 2007 (CASR058). Adelaide: Centre for Automotive Safety Research.

Speeding in Victorian high-severity crashes: Event Data Recorder (EDR) insights

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Abstract

Event Data Recorders (EDRs) are devices within vehicles that capture crash-related data, providing valuable insights for road safety research. This study analysed EDR data from 271 vehicles involved in 256 crashes between 2017 and 2022, collected by Victoria Police's Collision Reconstruction and Mechanical Investigation Unit (CRMIU), matched to crash and injury information from the Transport Accident Commission (TAC). The sample included severe crashes, with 45% fatal and 43% causing major injuries. Vehicles were classified as bullet vehicles (those with the most kinetic energy) and free-speed vehicles (those traveling unhindered). Speeding was common: 53% of bullet vehicles and 61% of free-speed vehicles in fatal crashes exceeded the speed limit, with higher rates among single-vehicle crashes. Statistical analysis identified younger drivers, alcohol and drug use, night-time crashes, and urban areas as key risk factors for speeding. Targeted interventions addressing these risks could help reduce speeding-related fatalities and serious injuries.

Social media post

Speeding is a major factor in fatal crashes. Analysis of 271 crash-involved vehicles in Victoria found 53% of bullet vehicles and 61% of free-speed vehicles in fatal crashes were speeding. Key risk factors included young drivers, alcohol, drug use, night driving, and urban areas.

Introduction

Many modern vehicles are equipped with Event Data Recorders (EDRs), which capture crash-related data, including travel speed, impact speed, brake and accelerator pedal positions, delta-*v* (crash impact severity), seat belt usage, and safety system deployment (e.g., airbags and seatbelt pretensioners). In 2017, the Centre for Automotive Safety Research (CASR) initiated the development of a database of EDR data from crashed vehicles: the CASR-EDR database. The CASR-EDR database has enabled innovative research into important road safety topics, such as speeding (e.g., Doecke et al., 2023). However, the CASR-EDR database only included data from South Australia that was largely representative in terms of injury severity and therefore contains only a small percentage of high severity crashes. The Victorian Police's Collision Reconstruction and Mechanical Investigation Unit (CRMIU) has been collecting EDR data from crash-involved vehicles to assist with investigations. In 2024, cases from the Victorian CRMIU were added to the CASR-EDR databases as it was thought that they would represent a useful stand-alone dataset, would add more high severity crashes to the database, and would broaden the geographical coverage of the database. The present study aimed to examine the representativeness of the cases from the CRMIU, and to analyse speeding within this sample.

Method

This study analysed EDR data downloaded by Victoria Police's CRMIU from 271 crash-involved vehicles involved in 256 unique crashes between 2017 and 2022. The EDR data were matched to official crash records and injury data (obtained through the Claims database at the Transport Accident Commission (TAC), mapped from ICD-10-AM codes). The sample included a high proportion of severe crashes, with 45% resulting in fatalities and 43% in major injuries (58% of which had a Maximum Abbreviated Injury Score (MAIS) of 3 or more). Doecke et al. (2023), found that the CRMIU's sample of fatal crashes was reasonably representative of all fatal crashes in Victoria in terms of crash location, speed zone, and crash type. However, the sample of major injury cases was skewed towards higher severity crashes and may also have been biased towards cases involving evidence of criminal negligence, such as speeding, failing to give way, distraction, drug or alcohol affected driving, and fatigue. Speeding was defined as exceeding the posted speed limit. The prevalence and distribution of speeding levels was analysed for bullet vehicles (those whose speed has the greatest influence on crash outcome) and free-speed vehicles (those travelling at a freely selected, unhindered speed). Bullet vehicles were typically those with right of way (e.g., through-vehicles at intersections) and usually had higher speeds than other vehicles involved. Specific definitions were applied based on crash type: in turning manoeuvre crashes, the through vehicle was the bullet vehicle; in rear-end crashes, the rear-most vehicle; in single-vehicle crashes, the crashed vehicle; and in both head-on and side-swipe crashes, both vehicles were classified as bullet

vehicles. Some vehicles were classified as both bullet and free-speed, indicating these classifications were not mutually exclusive. The prevalence of speeding was also analysed by crash type. Crashes were grouped into four broad types: collisions with fixed objects, collisions with other vehicles, rollovers, or striking pedestrians.

Statistical testing (using chi-square tests) was conducted on characteristics of speeding vehicles in the categories of the driver, vehicle and crash circumstances to examine characteristics associated with speeding. Driver characteristics examined were age, sex, blood alcohol concentration, drug test results, and license type and status. Vehicle characteristics examined were body type, transmission type, colour, number of occupants, and age category. Crash characteristics were weekday and time category, area, intersection type, road class, road curvature, surface wetness, and speed zone.

Results

Fatal crash cases in the dataset were found to be reasonably representative of all fatal crashes in Victoria in terms of area, speed zones and crash types. However, the 'major injury' cases may be skewed toward crashes where illegal activity was suspected, such as speeding, due to the police prioritising EDR downloads for criminal investigations.

Among bullet vehicles involved in fatal cases, 53% (n=36/68) were speeding, compared to 70% (n=52/74) of those involved in 'major injury' crashes. For free-speed vehicles, 61% (n=39/64) of those in fatal crashes were speeding, while 79% (n=52/66) of those in 'major injury' cases were speeding. These proportions were even higher for vehicles involved in single vehicle crashes, as shown in Table 1.

Table 1. Proportions of bullet vehicles and free-speed vehicles speeding in crashes in Victoria (including separated by crash types), by crash severity

Category	Bullet vehicles			Free-speed vehicles		
	Speeding count	Total count	Speeding proportion	Speeding count	Total count	Speeding proportion
Vehicles involved in '**major injury**' crashes	52	74	70%	52	66	79%
Collided with a fixed object	22	24	92%	20	21	95%
Collided with another vehicle	25	44	57%	28	41	68%
Struck a pedestrian	1	2	50%	-	-	-
Rolled over	4	4	100%	4	4	100%
Vehicles involved in **fatal** crashes	36	68	53%	39	64	61%
Collided with a fixed object	20	23	87%	19	20	95%
Collided with another vehicle	13	39	33%	17	40	43%
Struck a pedestrian	2	5	40%	2	3	67%
Rolled over	1	1	100%	1	1	100%

Figures 1 and 2 illustrate the distributions of speeding levels across 'major injury' and fatal cases for bullet vehicles and free-speed vehicles, respectively. Among bullet vehicles in fatal crashes, 53% were speeding overall, with 28% exceeding the speed limit by more than 40 km/h and 7% exceeding it by more than 100 km/h. For free-speed vehicles in fatal crashes, 61% were speeding overall, with 33% exceeding the speed limit by more than 40 km/h and 8% exceeding it by more than 100 km/h.

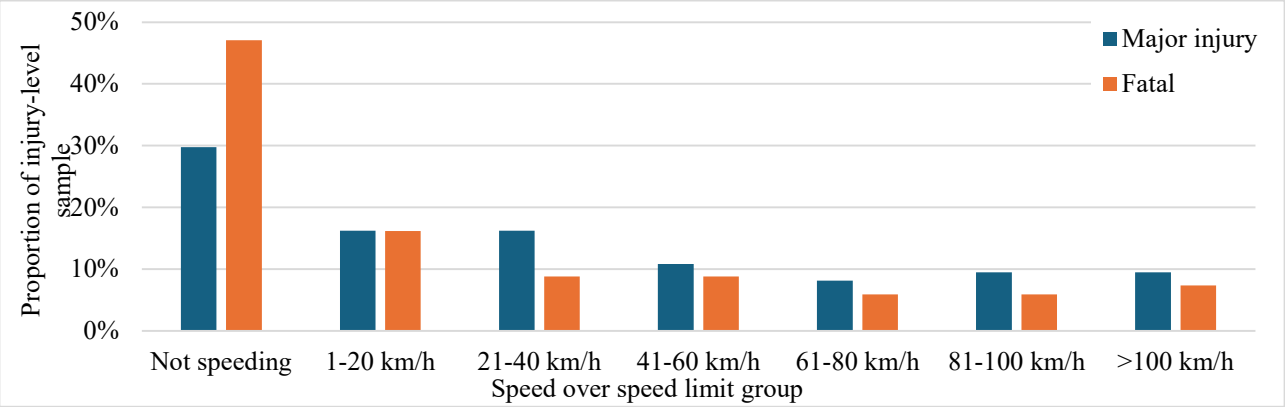


Figure 1. Bullet vehicles and their travelling speed over the speed limit, by crash severity

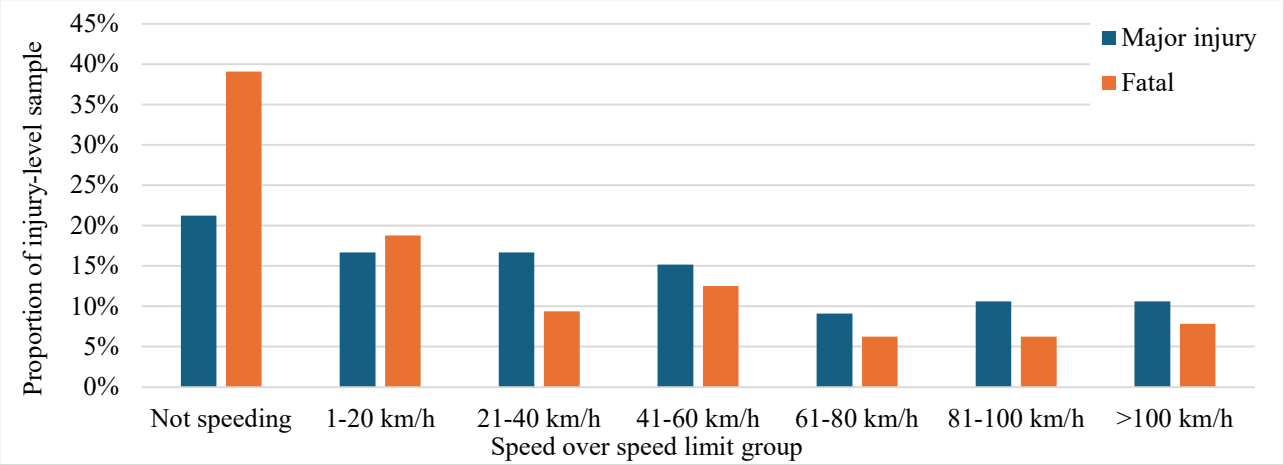


Figure 2. Free-speed vehicles and their travelling speed over the speed limit, by crash severity

Statistical testing (using chi-square tests) was conducted on characteristics of speeding vehicles in the categories of the driver, vehicle and crash circumstances. This was conducted on the whole sample (all severity levels), which consisted of 165 bullet vehicles and 147 free-speed vehicles. A significant association with speeding in **bullet vehicles** was found for:

- younger drivers ($X^2_{(3)} = 15.12$, $p < .01$),
- drivers who tested positive for alcohol ($X^2_{(1)} = 6.60$, $p = .01$),
- drivers who tested positive to methamphetamine or THC ($X^2_{(2)} = 7.07$, $p = .03$),
- crashes occurring during weekday nights ($X^2_{(3)} = 13.16$, $p < .01$),
- crashes occurring at T-junctions ($X^2_{(2)} = 8.52$, $p = .01$),
- vehicles travelling in 40-80 km/h speed zones ($X^2_{(2)} = 10.95$, $p < .01$),
- vehicles involved in lane-departure crashes ($X^2_{(3)} = 9.34$, $p = .03$).

A significant association with speeding in **free-speed vehicles** was found for:

- drivers who tested positive for alcohol ($X^2_{(1)} = 5.78$, $p = .02$),
- crashes occurring during weekday nights and weekend nights ($X^2_{(3)} = 7.87$, $p = .049$),
- crashes occurring in Melbourne metropolitan areas ($X^2_{(1)} = 8.17$, $p < .01$),
- crashes occurring at T-junctions ($X^2_{(2)} = 10.28$, $p < .01$),
- vehicles travelling in 40-80 km/h speed zones ($X^2_{(2)} = 25.25$, $p < .01$).

Conclusions

Speeding is a significant contributor to road trauma. This study found that 53% of bullet vehicles, and 61% of free-speed vehicles involved in a representative sample of fatal crashes were speeding, with even higher rates for vehicles involved in single-vehicle crashes. Targeted interventions should focus on high-risk driver groups, including younger drivers, those driving under the influence of alcohol or drugs, and those travelling in urban environments or at night. Addressing these risk factors could help reduce speeding-related fatalities and serious injuries. Practical measures could include stricter penalties for high-risk offenders, increased enforcement during high-risk periods (e.g., night-time), expanded use of Intelligent Speed Assistance (ISA) technology in high-risk driver cohorts, and tailored public education campaigns targeting younger drivers and impaired driving.

References

Doecke, S. D., Ponte, G., & Elsegood, M. E. (2023). *Determining the prevalence and profile of speeding in vehicle crashes using Event Data Recorders (EDRs).* 27th International Technical Conference on The Enhanced Safety of Vehicles, Yokohama, Japan, 3-6 April.

A predictive risk and confidence modelling framework based on near-miss observations

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Abstract

Recent intersection and road configuration changes across several sites in NSW, VIC and WA resulted in unintended, high-risk driver behaviours, including illegal overtaking, lane confusion, tailgating, and conflicts involving vehicles, pedestrians, and cyclists. To better understand and proactively address these risks, solar-powered, AI-enabled NearMiss camera systems were deployed across multiple locations for 14 weeks. Cameras captured comprehensive behavioural data, including vehicle paths, speed profiles, harsh braking, swerving, Post-Encroachment Time (PET), and near-miss interactions involving vulnerable road users. Using advanced computer vision analytics, frequent unsafe manoeuvres and high-risk events were identified and categorised. Data-driven interventions, such as adjusted speed limits, improved signage, line-markings, and intersection treatments, were promptly implemented, leading to measurable reductions in hazardous events. This scalable approach demonstrates the significant potential of AI-driven analytics in proactive road safety management, informing positive interventions that enhance safety outcomes for all road users.

Social Media Post

AI-powered cameras at sites across NSW, VIC and WA identified risky road-user behaviours in real-time, enabling proactive safety interventions. Improved signage, speed management, and clearer markings significantly reduced near-misses, enhancing road safety. #RoadSafety #AI #SmartRoads

Introduction

Changes to road layouts, particularly intersections and overtaking lanes, are designed to improve traffic flow and enhance safety. However, these modifications can sometimes have the opposite effect, creating confusion and leading to unsafe behaviours such as illegal overtaking, sudden merges, tailgating, and increased conflicts between vehicles, pedestrians, and cyclists. A recent and well publicised example of this is the Rozelle Interchange in Sydney, where recent changes resulted in unexpected congestion, driver frustration and hazardous shortcuts through residential streets (NSW Parliament, 2024). Reports of motorists ignoring traffic signals, driving the wrong way on one-way streets, and struggling with new traffic patterns highlight the risks that can emerge when road changes do not align with driver expectations.

Traditional road safety assessments often rely on crash data or anecdotal reports, which can be reactive and slow to identify emerging risks. To address this gap, this project deployed AI-powered computer vision analytics across multiple road sites in NSW, VIC and WA. By capturing real-time behavioural data—including vehicle movements, pedestrian interactions, and critical near-miss events—the system provided objective insights into high-risk behaviours as they occurred. This data-driven approach enabled targeted, evidence-based interventions, improving road safety and complementing traditional assessment methods with proactive, real-time risk identification.

Conference Theme Alignment

Evolution: The project demonstrates significant evolution in road safety practice by shifting from reactive approaches based solely on historical crash data towards proactive, real-time risk identification and intervention using AI technology. It provides evidence-based, dynamic road safety strategies to anticipate and mitigate risks before incidents occur.

Elasticity: The flexibility and adaptability provided by AI-powered real-time data analytics allowed rapid identification of emerging safety concerns and immediate intervention at multiple locations. Interventions such as speed adjustments, improved signage, and revised line-markings exemplify the resilience and elasticity of modern road safety management.

Equity: By capturing interactions involving diverse road users—including pedestrians, cyclists, and vehicles—the project emphasises equitable safety outcomes. Objective analysis ensures safety treatments are informed, inclusive, and responsive to the safety needs of all road users, recognising their equal right to safe transport infrastructure.

Project Description

From December 2024 to March 2025, mobile, solar-powered NearMiss camera systems with 4G connectivity were deployed across multiple sites in NSW, VIC and WA. These temporary units recorded detailed behavioural data, including:

- Vehicle turning movements and incorrect lane usage.
- Illegal overtaking and unsafe merges.
- Near-misses involving pedestrians, cyclists, and vehicles.
- Intersection conflicts and tailgating.

Key metrics analysed included vehicle paths, speeds, acceleration/deceleration, harsh braking, swerving, PET, pedestrian and cyclist interactions, and detailed near-miss event categorisation. AI-driven analysis was conducted through cloud-based processing, with manual validation to ensure accuracy. There were some connectivity challenges on one of the sites, however local data storage ensured complete data recovery.

Results and Key Insights

AI analysis provided detailed insights into high-risk behaviours across monitored sites. Key findings included:

- Frequent illegal overtaking attempts and unsafe lane changes immediately following road configuration changes, with a substantial reduction in these behaviours after implementing targeted interventions.
- A significant number of near-miss incidents involving vulnerable road users (pedestrians and cyclists) previously undetected by traditional monitoring, notably reduced after proactive treatments were applied.
- Clear patterns of driver confusion related to lane usage were identified, leading to targeted signage and line-marking improvements that effectively reduced incidents of sudden merges, harsh braking, and intersection conflicts.

Rapid deployment of these AI-informed safety interventions resulted in measurable and consistent reductions across all high-risk behaviours, confirming the effectiveness of real-time, data-driven approaches to improving road safety.

Implications for Policy and Practice

The successful implementation of AI-powered analytics highlights the value of real-time behavioural data in road safety. Policymakers and road managers can utilise these scalable technologies to rapidly identify high-risk sites, enabling proactive and precise safety interventions. Wider adoption of these practices would substantially improve the effectiveness and responsiveness of road safety management strategies nationwide.

Conclusions

This project showcases how AI-driven computer vision can revolutionise proactive road safety management. Real-time identification of unsafe behaviours, near-miss interactions, and prompt interventions significantly enhanced safety outcomes across multiple locations. Integrating such advanced technologies into broader road safety practices could substantially reduce road trauma and better protect all road users.

References

NSW Parliament. (2024). *Impact of the Rozelle Interchange*. Retrieved from https://www.parliament.nsw.gov.au/tp/files/188982/Report%20No.%2023%20-%20PC%206%20-%20Impact%20of%20the%20Rozelle%20Interchange.pdf

Transport Accident Commission. (2023). *Towards Zero Road Safety Strategy 2023–2030.* Retrieved from https://www.tac.vic.gov.au/road-safety/towards-zero

Transport for NSW, VIC. (2022). *NSW, VIC Road Safety Plan 2026.* Retrieved from https://roadsafety.transport.NSW, VIC.gov.au/aboutthecentre/strategies/road-safety-plan-2026.html

A risk-based combined sanctions therapeutic approach to manage drug-driving offenders

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Abstract
Addressing drug-driving behaviour is a priority of the *National Road Safety Strategy 2021-2030.* All Australian States and Territories have implemented Roadside Drug Testing enforcement programs using Oral Fluid Testing as the primary mode of detection. Jurisdictions have also implemented a suite of penalties that include fines, loss of demerit points, licence suspension or cancellation, the prospect of prison and/or a criminal infringement conviction being recorded by the Courts. Despite this sophisticated regime over 50,000 drivers were detected drug-driving in 2023 in Australia and repeat offending is significant. Recognising the complexity of managing drug-driving and the impact of drug dependency, we outline a risk-based framework that splits the post-offence management response for cannabis and methamphetamine. The framework identifies nine risk tiers based on a range of parameters. By incorporating a combination of sanctions, behaviour change programs, and therapeutic intervention responses that are risk-based and proportionate, reductions in drug-driving could be achieved.

Social media post
Over 50,000 drivers are detected drug-driving in Australia each year and one-in-four are repeat offenders. Using crash risk of detected drug(s) and driver history, we outline a risk-based framework with escalating penalties and therapeutic approaches to address drug misuse and addiction to manage drug-drivers post-offence.

Introduction
Drug-driving, including repeat offending, is a significant road safety challenge nationally. That this is the case is evidenced by drug-driving being identified as a priority in the *National Road Safety Strategy 2021-2030,* as well as being mentioned in the road safety strategy of each Australian State and Territory. Notwithstanding differences in reporting, a substantial proportion of killed and injured drivers test positive to an illicit drug across Australia and in New Zealand. By way of example, in Victoria across the 2015 to 2019 period 15.2% of killed drivers and 10.0% of injured drivers tested positive to methamphetamine (MA) and 14.0% of killed drivers and 7.2% of injured drivers tested positive to THC (i.e., cannabis) (Schumann et al., 2025). Similarly, the effects of illicit drugs – including MA and THC – were seen to be a contributing factor in 12.7% of hospitalisation-severity crashes in Victoria (Fitzharris et al., 2020). In Queensland, an analysis of 2011 – 2015 Coroners reports relating to drivers or controllers of vehicles killed in crashes found that 15.5% were positive for THC and 9% for MA (9%) (Davey et al., 2020), whilst in NSW illicit drug presence was reported to be a factor in 21% of fatality crashes (Transport for NSW, 2022).

To combat drug-driving jurisdictions have introduced a raft of sanctions that include fines, loss of demerit points, licence suspension or cancellation, and imprisonment. Penalties are more severe for repeat drug-driving offenders who must attend Court than they are for first-time drug-driving offenders who may be issued with an immediate Traffic Infringement Notice; further, a separate offence exists where drug-driving and drink-driving is detected concurrently. Mandatory participation in drug-driving content-specific Behavioural Change Programs (BCP) is seen across all jurisdictions. The suite of penalties includes the possibility of a criminal infringement conviction being recorded by the Court where drug-driving matter is heard. Whilst differences exist across Australian States and Territories and New Zealand as to the quantum of fines issued and demerit points loss, the approach to managing drug-drivers is broadly similar.

To support the drug-driving program, Roadside Drug Testing Oral Fluid Testing enforcement programs have been implemented in Australian States and Territories, with moves to do the same in New Zealand. Whilst there are some differences in drugs screened at the roadside, common to all jurisdictions is that (meth)amphetamine, THC and ecstasy (i.e., MDMA) are tested for; NSW and Queensland also test for the presence of cocaine and Tasmania has the capability to test for cocaine and opioids. In 2023 across Australia (excluding the Northern Territory) 471,217 roadside drug tests

were conducted with 11.4% being positive for one or more illicit drug; this translates to 52,776 vehicle controllers (Office of Road Safety, 2025). With the use of illicit drugs being associated with a significantly higher crash risk (Mulvihill et al., 2020), this high number of vehicle controllers detected with illicit drugs represents a clear threat to road safety.

In considering the public health harm of drug-driving, it must be recognised that the crash risk associated different illicit drugs differs, as does use in the community; both factors are important in determining the level of exposure and hence risk associated with drug use and driving (Liu et al., 2020). A further consideration are the determinants of drug-driving, including context and patterns of use and driving behaviour. Available data indicates that significant proportion of drug-drivers are repeat drug-driving offenders (e.g., 39% in NSW; Teperski et al., 2024; 25% in QLD, Mills et al., 2022). Whilst perceived risk of detection drug-driving has been shown to influence the decision to drug-drive, the link between substance use disorder and the misuse of drugs including 'binge use' and drug driving is also clear (Liu et al., 2020).

Recognising the above context and the complexity of managing drug-driving and repeat-drug-driving in particular, the aim of this research was to identify elements of a risk-based framework to manage drug-driving offenders. This follows the research teams' earlier research into the management of drug-drivers and the recognition that taking a sanctions-heavy approach was insufficient to manage drug-drivers, particularly where Substance Use Disorder is indicated and a pattern of repeat drug-driving offending is well-established. Hence, this Abstract and Presentation outlines the elements of a risk-based framework designed to manage drug-driving offenders post-offence based on current understanding of best practice.

Conference theme

The antecedents of drug-driving are complex, however the need to protect all road users from harm is clear. Adopting a risk-based public health approach that considers the wholistic health-based needs of drug-drivers where addiction is indicated is important both from a humanistic perspective, but also in terms of the longer-term reduction of drug-driving in the community. At the same time the important role of sanctions is recognised for their general and specific deterrence value, noting however the need for sanctions to be proportional to the offence committed. By placing these considerations together and balancing the need to protect all road users and make roads safer by addressing drug-driving, the work presented in this Extended Abstract aligns with the conference theme of equity.

Method

Three approaches were used to develop the risk-based framework to manage drug-driving offenders: 1) an extensive literature review of the efficacy of sanctions, behavioural change, and health-based clinical (i.e., therapeutic) interventions to manage drug-use behaviour and drug-driving specifically; 2) documentation of relevant clinical drug-based therapeutic services, with emphasis on therapeutic approaches in current use; 3). consultation with legal practitioners, experts in criminology, and addiction specialists to identify key considerations and parameters to be incorporated into the risk-based combined sanctions-therapeutic approach to manage drug-drivers post-offence.

This work was undertaken from 2020 to 2024 and is yet to be published. Reference was also made to the previous work of the research team that included one-to-one engagement with addiction specialists and persons with current lived experience with illicit drug use and driving; a review of crash risks and factors associated with drug-driving, and a large-scale community survey. This prior research was conducted in the 2015 to 2020 period and is published. Due to space restrictions material only relating to the risk-based framework is presented here. Discussion is focussed on the management of drivers testing positive to cannabis (THC) and/or (meth)amphetamine.

Results

Based on available research evidence and consultation with experts, and with the intention to reduce the incidence of drug-driving and repeat offending in particular, the concepts of risk and proportionality were identified as being the key underpinning principles of the post-offence management framework for drug-drivers. For risk, this relates to a) the risk of the offender re-offending and b) the crash risk associated with the drug(s) used. For proportionality, this is taken to mean that the post-offence response needs to be fair, just, and reasonable.

To develop a risk-based approach and proportionate response, the identification of drug-driving sub-groups, or cohorts, was identified as being a necessary prerequisite with these based on: a) Substance use parameters, including the drug(s) used (including alcohol, MDMA), the persons history of use (past, recent/present), and patterns of use (i.e., frequency, where, when), and b) overlaying traffic offences and other offending parameters including i) concurrent traffic offences; ii) concurrent other summary and indictable (non-traffic) offences; iii) prior detection of drug-driving; iv) prior traffic offences; v) prior other non-traffic offences. The inclusion of both traffic and non-traffic offences was considered

important as they point to additional levels of complexity in managing offenders, with these limited to those committed in the past 12 months. Whether a drug was detected due to involvement in a crash was considered relevant to the mode of referral for segmentation. Each parameter represents a decision point in the management of drug-driving offenders.

Recognising the higher crash risk associated with Meth(Amphetamine) related drug-driving relative to THC (cannabis) related drug-driving, these were treated separately in the establishment of risk tiers. A driver is detected with both MA and THC, the MA risk tier takes precedence. In total 9 risk tiers were established. Sanction, Behaviour Change, and Therapeutic management responses to be used given segmentation risk tier (Table 1). Along with the full range of available sanctions and current Behaviour Change Programs, the integration of efficacious and established clinical treatment interventions to manage Cannabis Use Disorder (CUD) and Methamphetamine Use Disorder (MUD), as well as misuse of drugs, is central to the framework. A central co-ordinating assessment and referral agency is required.

Table 1. Management responses (interventions) relevant to Drug-Driving, with elements based on Risk Tier

Sanctions	Behaviour Change Program	Therapeutic (clinical, health)
• Fines and/or Demerit points • Licence suspension or cancellation with time-steps that are proportional to risk; conditional licence permitted. • Police Cautions, Diversion Orders / Programs, Adjourned Undertakings • Drug Treatment Order, Community Corrections Order, Intensive Management • Home detention (curfew) • Prison	• Drug-driver Program • Intensive Drug Driver Program • Individualised one-to-one program delivery • Zero BAC if alcohol dependency evident (clinical) • E-monitoring	Requires assessment with streaming based on clinical need for substance misuse or dependence, and includes: • Brief Intervention; Counselling; Day Programs; Residential programs. • Substance withdrawal services • Rehabilitation (incl. outreach, pharmacotherapy)

The developed framework provides for a short, fast, administrative sanction for first-time drug-driving offenders without any prior or concurrent offences as the preferred management response (e.g., Tier 1, THC), through to a combined response that includes significant sanction-based responses, behavioural change program participation requirements, and health-based clinical (therapeutic) interventions ordered by the Court for drivers for drivers in the highest risk tier (i.e., Tier 9, MA). In defining the management response in this way, managing access to limited Court resources and avoiding participation in unnecessary interventions, particularly in the therapeutic domain, is important if the number of roadside drug tests were to further increase.

Benefits to road safety

Recognising the role that drug misuse and addiction plays underpinning continued drug-driving behaviour is an important step in developing a suite of interventions to address this risk. In developing a conceptual framework that is risk-based, incorporates sanctions that are proportionate, and seeks to manage underlying drug-use behaviours where required, this model has potential to reduce repeat drug-driving offending. By reducing repeat drug-driving, a reduction in the number of drug-driving related crashes over the longer term could be expected.

Implications for policy and/or practice

Present approaches to managing drug-driving offenders are heavily sanctions focussed, notwithstanding the requirement to complete a short-term multi-session (between 7 to 12 hours in total) behaviour change program. The framework outlined here offers a way to tailor a combination of sanctions, participation in behaviour change programs, and clinical (therapeutic) interventions to individual drug-driving offenders based on a range of risk-based parameters. Co-ordinated through a central referral agency capable of screening for substance use, this framework represents a step-change to the management of drug-driving offenders and offers promise in addressing the risk of repeat offending in particular.

Conclusions

The outlined risk-based framework represents the first step in developing a broader approach to managing drug-driving. In recognising the different crash risk associated with THC and (meth)amphetamine and incorporating of other factors such as offence history (driving / non-driving; past / concurrent) the opportunity to develop risk-based tiers for the purposes of intervention is possible. Extending this further to include the pattern of drug-use and Substance Use Disorder or drug misuse (i.e., binge use) offers a way to address deeper, underlying factors associated with repeat drug-driving. By taking a risk-based proportional approach to the management of drug-driving offenders – including first-time offenders - it is likely that the perceived legitimacy of the roadside drug-driving program would be strengthened whilst at the same time reducing the likelihood of repeat offending. The framework outlined here represents a first step,

and alignment with existing sanctions, Court-based services, and therapeutic services needs to be examined more fully to establish the settings for each risk tier, as does the likely benefit and costs, before implementation can become a reality. Having said this, the model could also be extended to other drugs in recognition of the different user, context of use, and risk profile associated with illicit drugs rather than the current generic approach to manage drug-driving behaviour if shown to be of benefit.

References

Davey, J. D., Armstrong, K. A., Freeman, J. E., & Parkes, A. (2020). Alcohol and illicit substances associated with fatal crashes in Queensland: An examination of the 2011 to 2015 Coroner's findings. *Forensic Science International*, *312*, 110190. https://doi.org/https://doi.org/10.1016/j.forsciint.2020.110190

Fitzharris, M., Lenné, M., Corben, B., Pok Arundell, T., Peiris, A., Liu, S., Stephens, A. N., Fitzgerald, M., Judson, R., Bowman, D., Gabler, H., Morris, A., & Tingvall, C. (2020). *Overview and analysis of serious injury crashes – crash types, injury outcomes and contributing factors, ECIS Report 1* (MUARC Report 343). Monash University. https://doi.org/10.26180/23305325

Liu, S., Dietze, P., & Fitzharris, M. (2020). MUARC Baseline Program to Assess the Impact of Drug Use on Road Safety: Report 3: Understanding Patterns and Motivations for Drug-Driving Behaviour: Community Attitudes Towards Addressing Drug-Driving in Victoria, Australia. MUARC.

Mills, L., Freeman, J., & Davey, J. (2022). A study into the nature and extent of drug driving recidivism in Queensland (Australia). *Journal of Safety Research*, *81*, 116-122. https://doi.org/https://doi.org/10.1016/j.jsr.2022.02.003

Mulvihill, C., Liu, S., & Fitzharris, M. (2020). MUARC Baseline Research Program to Assess the Impact of Drug Use on Road Safety: Report 1 – Review of International Literature on Drug-driving and Countermeasure Opportunities. Monash University. https://doi.org/10.26180/26974120

Office of Road Safety. (2025). *National Road Safety Data Hub – Drug Driving Enforcement Dashboard*. https://www.officeofroadsafety.gov.au/data-hub (Accessed 8 March 2025).

Schumann, J., Di Rago, M., Woodford, N., Glowacki, L., Fitzpatrick, J., Kelly, M., Beck, B., Drummer, O. H., Gerostamoulos, D., & Dipnall, J. F. (2025). Trends in alcohol, MDMA, methylamphetamine and THC in injured and deceased motor vehicle drivers and motorcyclists over a decade (2010-2019) in Victoria, Australia [Article]. *Injury Prevention*, Article ip-2024-045342. https://doi.org/10.1136/ip-2024-045342

Transport for NSW. (2022). *2026 Road Safety Action Plan: Toward Zero Trauma on NSW roads*. Transport for NSW. https://catalogue.nla.gov.au/catalog/8655471

Teperski, A., Boiteux, S., Brown, C. (2024). Trends in drug driving charges, roadside drug testing and drug use in NSW, 2008-2023. *Crime and Justice Statistics Bureau Brief No. 172*. NSW Bureau of Crime Statistics and Research. https://bocsar.nsw.gov.au/research-evaluations/2024/BB172-summary-trends-in-drug-driving-charges.html

Bottom-up approaches to achieving safe speeds

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Abstract
This workshop, the second in a two-part series on speeding, focusses on bottom-up approaches to speed management. It is imperative the community understands the importance of safe travel speeds. Traditional top-down policy making approaches have not sufficiently generated community support for speed management practices. This workshop includes a panel presentation showcasing bottom-up approaches (including community juries) and offers the opportunity to learn more about, and brainstorm ideas relating to, community engagement and advocacy opportunities and participatory decision-making processes in New Zealand and Australia to increase demand for, and understanding of, safe speeds. The workshop aligns with the conference *Evolution* theme because community understanding of road safety issues continually evolves. An evolution in current acceptance of speed limits and travel speeds that cause harm is needed if we hope to reach a place where every road user understands why safe travel speeds are at the core of a safe road system.

Social media post
Join this interactive workshop at ARSC2025 to learn about and create more ideas to help generate community groundswell support for safer speeds.

Introduction
This workshop is the second of a two-part series focusing on bottom-up approaches to speed management. A shift in public attitudes and perceptions around safe and acceptable travel speeds, and an increased public demand for safer speeds is needed, however, we lack a clear understanding of how to create this (Turner et al., 2014; Fleiter et al., 2016). It is imperative that the community understands the need for safe speeds. Given the limited success achieving this to date, new approaches are needed. Drawing from public health evidence, participatory decision making and community mobilisation are promising approaches. However, shifting attitudes towards speed requires increased understanding of complex information (e.g., the physics of crashes and how interventions can work together to improve safety outcomes). Community juries, a form of participatory research, can facilitate communication of complex evidence, aiming to elicit informed community perspectives (Street et al., 2014; Coppell et al., 2020). This session explores use of a variety of novel community consultation and engagement mechanisms, including the community jury process, and invites delegates to contribute experiences to the evolution of generating public demand for safe speeds.

Conference Theme
This interactive workshop relates to the conference theme of *Evolution*. Community understanding of various road safety issues has evolved over time. For instance, societal acceptance of drink driving has evolved over several decades to a point where that behaviour is now generally met with widespread community disapproval in Australia and New Zealand. The same can be said for issues such as restraint non-use (adult and child) and helmet non-use, noting however, that this is not the case in many other parts of the world. An evolution in community acceptance of speeds that cause harm is needed if we hope to reach a place where every road user understands why safe travel speeds are at the core of a safe road system.

Facilitator
Dr Judy Fleiter has extensive experience facilitating workshops and learning opportunities in the road safety field. She has moderated panel discussions, including a Keynote address session at the 2023 ARSC in Cairns, a panel session on road user behaviour at the 3rd Global Ministerial Conference on Road Safety in Stockholm (2020) and chaired one of the UN Road Safety Collaboration working groups on behalf of the Global Road Safety Partnership (GRSP) for several years in her role as Global Manager for GRSP. Judy was honoured to be awarded the 2023 ACRS Fellow and is currently serving on the ACRS Working Group to create a Body of Knowledge for Road Safety and on the LMIC Scholarship sub-committee for the annual Australasian Road Safety Conference.

Workshop leader

Dr Blair Turner has almost 30 years experience in road safety, and is project manager for the current update of the Austroads Guide on Safe Speed. He is lead author of a global guide on Speed Management and author of the WHO manual on this topic. He has conducted research and published widely on speed issues, including the effectiveness of interventions, the broader societal benefits from speed management, and methods for engagement with community and decision makers. He has helped develop policy on speed in Australia and internationally and has facilitated many workshops on this topic over his career.

Five panel members showcase examples of bottom-up approaches to generating ideas to better manage speeds and to generate greater public demand for safer travel speeds.

Panelists

Name	**Organisation**
Ping Sim	Auckland Transport
Chika Sakashita	Director of Global Programs, Global Alliance of NGOs for Road Safety
Diana Weekes	Road Safety Officer, City of Coffs Harbour
Val Stamper	Road Safety Officer, City of Sydney
Peter Varris	Executive Director, Infrastructure & Environment - City of Vincent, WA

References

Coppell, K.J., Paterson, H., Norton, J., Jeffs, E., & Hay-Smiht, E.J.C. (2020). Using a citizens' jury approach to determine a good nutrition resource for pregnant women. Public Health Nutrition. 23(11), 1916-1923. doi: 10.1017/S1368980020000452

Fleiter, J., Lewis, I., Kaye, S., Soole, D., Rakotonirainy, A., & Debnath, A. (2016). *Public demand for safer speeds: Identification of interventions for trial*: Publication no: AP-R507-16. Austroads Ltd, Australia.

Turner, S., Logan, D., Khoo, J., Bosher, S., & Trumper, H. (2014). Safer speeds: public acceptance and compliance. NZ Transport Agency research report 563. Wellington, New Zealand.

Street, J., Duszynski, K., Krawczyk, S., Braunack-Mayer, A. (2014). The use of citizens' juries in health policy decision-making: A systematic review, *Social Science & Medicine, 109*, 1-9.

Improving safety of young Western Australians: P.A.R.T.Y. program evaluation outcomes

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Abstract
The P.A.R.T.Y. program (Prevent Alcohol and Risk-Related Trauma in Youth) was introduced in Australia by Royal Perth Hospital (RPH) in 2006. Aiming to prevent alcohol, drug, and other risk-related crashes and incidents in youth, the 1-day injury awareness-building program targets Year 10-12 students and juvenile justice offenders in Western Australia. Only the offender-specific program has been evaluated (2012), so a more comprehensive evaluation is timely. The first phase of a multi-phase evaluation described here provided outcomes of interviews conducted with program presenters from external organisations. Various suggestions to enhance program structure and content included: additional topics to help young people understand how to keep themselves and others safe; a less formal setting being more conducive to learning, especially for the young offender cohort; more interactive learning sessions; and some method of follow up with participants (e.g., by teachers) to enhance program content impact over time.

Social media post
We interviewed presenters of an injury prevention program at the Royal Perth Hospital to find new ways to enhance the safety of young Western Australians.

Introduction
Adolescence is known as a time of exploration and experimentation which can lead to risky choices and associated behaviours, including risky road use. Many injury prevention programs exist to help reduce risk-taking and associated death and injury among young people. The Road Safety Commission provides funding support for the Prevent Alcohol and Risk-Related Trauma in Youth (P.A.R.T.Y.) program in Western Australia (WA). The P.A.R.T.Y. program, developed in Canada, was first introduced in Australia by the Royal Perth Hospital (RPH) in 2006 and now runs in various Australian states. It aims to prevent alcohol, drug, and other risk-related crashes and incidents in youth and was reportedly designed for adolescents aged 15-18 years and introduced to reduce the number of young people killed and injured in road crashes (Brockamp et al., 2015). In WA, it is a one-day injury awareness-building program with two audiences: 1) Year 10-12 school students and 2) juvenile justice offenders convicted by Court Magistrates and referred to undertake the program. In other parts of the country, the primary program focus is on school students and evaluation results have been fairly consistent, demonstrating some short-term positive impact on attitudes but with temporal decay (see Cameron et al. 2021 for Queensland; Francis et al., 2022 for NSW; McLeod et al., 2020; Gunn et al., 2022 for Victoria. For international examples see Brockamp et al., 2019; Koehler at al., 2022 for Germany, and Banfield et al., 2011 for Canada).

In WA, the offender-specific program differs to the one delivered to school students in that it includes additional content from a family impact speaker and information more tailored to drug use than is delivered to the school students. An evaluation of the RPH program focused on juvenile justice offenders' risk-taking behaviours and injuries showed positive results (Ho et al., 2012). From 2006-2010, 3,659 young offenders were convicted by Court Magistrates, of which 225 were referred to the P.A.R.T.Y. program (aged between 14-21 years). Surveys conducted before and immediately after program participation revealed that, overall, 57% of offenders reported they were more receptive to modifying their risk-taking behaviour after program exposure compared to 21% before exposure. Examination of WA Police offence data and Department of Health injury data found: a) the incidence of subsequent traffic or violence-related offences was significantly lower for those who attended the program (3.6%) compared to those who did not (26.8%; p=0.001); b) there was no incidence of injuries leading to hospitalisation for those who attended the program compared to 1.6% among those who did not (p=0.001); and c) there was no incidence of alcohol and drug-related offences for those who attended the program compared to 2.4% for those who did not (p=0.001). As that evaluation was conducted more than a decade ago, did not assess program impact on school students, and as the program is due to be expanded for greater regional reach in WA, it is timely to conduct a more comprehensive evaluation of the program in Western Australia. As such, a mixed methods evaluation is being undertaken in WA to collect program presenter

insights into program enhancement options, and to use data from pre- and post- surveys from participants and teachers to examine short- and longer-term program impacts. There is valuable information about program delivery and impact (short and longer-term) to be gained from program presenters (hospital staff and external organisations), participants, and those who support program attendance and outcomes (e.g., school teachers and juvenile justice support staff). Richer information from these stakeholder groups is of interest to better inform program content and delivery, allowing opportunities to enhance the P.A.R.T.Y. program. Part of the first phase of program evaluation in WA is described below - analysis of initial qualitative data collected via interviews with those who provide presentations to offender and school student cohorts at the RPH. Additional analyses may be available to report at the time of the 2025 conference.

Conference theme

This research presentation addresses the theme of *Evolution* in that it seeks to understand the impact of the P.A.R.T.Y program in Western Australia, as currently delivered, in order to assist the program to evolve into a more effective tool to help reduce risk-related trauma among young people. The evolving nature of the technological and social media landscapes available to young people today offer potential mechanisms for program content and delivery to evolve to address contemporary challenges and opportunities in injury prevention.

Method

Participants

A variety of external-to-RPH organisations provide input into the P.A.R.T.Y. program in the form of in-person presentations to the school student and juvenile offender cohorts. These include injury and disability services charities and non-profits, as well as individuals who provide a family impact statement (i.e., they have lived experience as a family member of someone who has sustained a serious injury in the past) or a personal impact statement because of a previous serious injury. In total, five groups/organisation representatives were invited to take part, of which four agreed and completed interviews.

Measures

A semi-structured interview format was used and an interview schedule was developed to guide discussion across key areas of interest for evaluation. Participants were asked about their history of involvement in program delivery, any observations about program content and current instructional methods, any changes made to their content over time, any changes they would like to make to enhance future delivery to help young people understand and/or manage risk taking and reasons for this, and whether they have any experience of a change in risk taking behaviour of participants as a result of the P.A.R.T.Y. program.

Procedure

Representatives from each external organisation that presented to the 2024 school student cohort and/or offender cohort were directly contacted by the Program coordinator on behalf of the research team and invited to participate in an interview. Each potential participant was provided with information about the research to afford them the opportunity to make an informed decision about participating. Interested presenters then made direct email contact with the research team to express willingness to participate in an interview lasting no more than one hour. Written consent was obtained before each interview commenced and this research received approval from The University of Western Australia Human Research Ethics Committee. The semi-structured nature of the interviews provided opportunity to explore a range of pertinent themes during analysis of interview transcripts, primarily: a) current program content and format, b) potential for change/enhancement of program content/structure, and c) program impact (participant experiences and behaviour change outcomes). An inductive thematic analysis was conducted based on interview notes and transcripts.

Results

There was large variation in the time that individuals (n=4) have been presenting a session at the RPH P.A.R.T.Y. program – from 3 months to 7 years, noting however that the person who had only been involved for 3 months was representing an organisation that had been providing a presentation to the program for many years. Participants reported that they aim to achieve a positive environment during presentations (PowerPoint) to encourage young people to feel comfortable making contact with their organisations if needed in future. In that sense, the P.A.R.T.Y. program was viewed as a promotional opportunity to reach an at-risk cohort to provide information before it is needed. When asked to describe the level of engagement possible with young participants in their current presentation, responses revealed strong desire for a more a much more interactive format, noting that they generally encourage open and honest conversations with participants to the extent possible in the current lecture-style format.

There was agreement that program structure could be enhanced, with a common response related to the formality of the presentation (classroom) structure and the desire for more interactive sessions, particularly in regard to the offender

cohort. In addition, a range of suggestions were offered regarding additional information and topics to be considered as well as alternative delivery styles that presenters deemed to be worthy of consideration. Another common response relating to how the program might be enhanced overall referenced a lack of knowledge among presenters about the overall content provided to program participants and any resources that they are given. None of the external program presenters reported having had any follow up contact with program participants, so were not able to provide any specific details about directly observed success or otherwise of the program impact. Finally, there was general consensus that some form of follow up discussion or activity with participants by those they continue to interact with (i.e., school teachers, parents, or juvenile justice support staff) would be of benefit to help reinforce the key messages covered in the one-off exposure to program content. This was described as likely to be of benefit because it could serve to remind participants of the salient messages and topics covered during the program, as well as provide opportunities for the young people to continue discussing risk taking and ways to mitigate risk in the future.

Implications for policy/practice

Educating young people about risks and how to mitigate/avoid them is an important undertaking. The findings reported above indicate that those with extensive experience presenting to the P.A.R.T.Y program at RPH in WA view the program as important and valued, but with opportunity to be improved. To our knowledge, this is the first example of external presenter feedback being used in a P.A.R.T.Y. program evaluation anywhere in the world. As such, it contains valuable information that has previously not been considered when programs are developed or reviewed and is especially timely in WA where the program is expanding for greater regional reach. The views shared provide an important step in improving current program delivery, since ongoing feedback is critical to ensure content remains relevant and so that contemporary information relevant to young people can be incorporated over time. A study limitation was that only four presenters volunteered to contribute to the interview process, however, this number will be supplemented with RPH staff presenter interviews and with survey results from students and teachers in the next research phase (which will be available by the time of the conference presentation). Research evaluations demonstrate that positive changes in risk-related attitudes, intentions and behaviours do follow participation in the P.A.R.T.Y. program. However, the consistent finding in the literature of temporal decay after program participation presents a significant issue for the program. Some researchers have called for the investigation of ways to enhance content retention over time, yet without recommendations on how best to do this. The findings presented here support that call and offer an opportunity for the program in WA to evolve and to be enhanced by the addition of a follow up component to boost content retention and program impact.

Conclusions

While additional research phases will provide more specific insights and conclusions, this first evaluation phase elicited the following recommendations:

1) Address the temporal decay in positive outcomes gained that occurs post program participation
    - booster programs and/or ways to connect to other road safety initiatives should be explored
2) Improve program participant engagement
    - improve group session setting to be less like a formal classroom
    - review ways to include more interactive elements
    - implement a no phone/ smart device use requirement
3) Enhance educational opportunities
    - review topics and amount of content, ensuring sufficient time for self-reflection and personalisation of learning
4) Provide presenters knowledge of the overall program content and specific feedback on their sessions
    - potential for presenters to scaffold and improve their presentation content
    - consider a group workshop to address this and allow presenters to meet each other

References

Brockamp, T., Koenen, P., Caspers, M., Bouillon, B., Köhler, M., & Schmucker, U. (2019). The influence of an injury prevention program on young road users: A German experience. *The European Journal of Trauma and Emergency Surgery, 45*, 423–429. DOI: 10.1007/s00068-018-0936-5.

Brockamp, T., Koenen, P., Wyen, H., Mutschler, M., Wafaisade, A., Maegele, M., Paffrath, T., Probst, C., & Bouillon, B. (2015). The PARTY program: A systematic approach to injury prevention for young road users around the world. *Journal of Injury and Violence Research, 7*(2), 89-90. https://doi: 10.5249/ jivr.v7i2.561

Cameron, C.M., Eley, R., Judge, C., O'Neill, R., & Handy, M. (2022). Did attending P.A.R.T.Y. change youth perceptions? Results from 148 Queensland schools participating in the Prevent Alcohol and Risk-Related

Trauma in Youth Program, 2018-2019. *Injury Prevention*, *28*(3), 218-224. DOI: 10.1136/injuryprev-2021-044224.

Francis, N., He, S., Harris, I.A., Curtis, K., D'Amours, S.K., & Frost, S.A. (2022). The Prevent Alcohol and Risk-Related Trauma in Youth (P.A.R.T.Y) program: An interactive injury prevention initiative in South-Western Sydney. *Injury*, *53*(9), 3030-3038. DOI: 10.1016/j.injury.2022.06.010.

Gunn, A., McLeod, J., Chapman, R., Ball, H., Fitzgerald, M., Howard, T., Cameron, P., & Mitra, B., (2018). Effect of the Prevent Alcohol and Risk-Related Trauma in Youth (P.A.R.T.Y.) Program among senior school students. *Emergency Medicine Australasia*, *30*, 209–213. DOI: 10.1111/1742-6723.12878.

Ho, K.M., Litton, E., Geelhoed, E., Gope, M., Burrell, M., Coribel, J., McDowall, A., & Rao, S. (2012) Effect of an injury awareness education program on risk-taking behaviors and injuries in juvenile justice offenders: A retrospective cohort study. *PLoS ONE 7*(2): e31776. https://doi:10.1371/journal.pone.0031776.

Koehler, M., Brockamp, T., Bamberg, S., & Gehlert, T. (2022). Change of risk behaviour in young people – the effectiveness of the trauma prevention programme P.A.R.T.Y. considering the effect of fear appeals and cognitive processes. *BMC Public Health, 22*, 595-608. DOI: 10.1186/s12889-022-12986-4.

McLeod, J., Ball, H., Gunn, A., Howard, T., Fitzgerald, M.C., Cameron, P.A., & Mitra, B. (2021). Impact of In-hospital and outreach models for regional P.A.R.T.Y. Program participants. *Emergency Medicine Australasia, 33*(4), 640-646. DOI: 10.1111/1742-6723.13715.

Examining speed-crash relationship in low- and-middle-income countries: Speed-Safety impact tool

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Abstract
Speeding is a leading cause of fatalities globally, particularly in low- and-middle-income countries (LMICs). The speed-crash relationship is well established using high-income countries (HICs) data but remains underexplored in LMICs. This study sought to bridge this knowledge gap by critically examining literature to propose a speed-safety impact tool relevant for LMICs. Out of 1,252 papers reviewed, 30 addressed the speed-crash outcome relationship in LMICs, yet only 5 exhibited robust methodological rigor. These studies confirmed that speed change contributes to an overall change in crash frequency and severity, although the extent and form of this relationship differs across the research. The review led to the development of a speed impact tool for LMICs based on the exponential model, which accounts for initial traffic speeds. This tool has undergone testing and refinement through feedback from experts and offers a provisional means to estimate speed-related crash outcomes in LMICs pending further targeted research.

Social media post
This study develops a speed-safety impact tool relevant for LMICs, providing a provisional model to estimate speed-related crash outcomes and enhance road safety in LMICs.

Introduction
The number of fatalities and serious injuries resulting from road traffic crashes remains a global challenge, especially in LMICs which account for about 92% of global road traffic deaths (WHO, 2023). One of the major causes of these deaths is speeding (excessive or inappropriate speed). It is estimated that speeding contributes to about 54% of fatalities worldwide, with 95% of these deaths occurring in LMICs (Fondzenyuy et al., 2024). However, effective speed management in LMICs is often hindered by limited capacities (budget, staff resources, specialized skills, and expertise) and a lack of applicable evidence on the relationship between speed and crash outcome (serious injuries and fatalities).

While the speed and crash relationship has been well established in literature using high-income countries' (HIC) data, it is still at rudimentary stages for LMICs. The most conventional models cited in the literature which link speed and crash outcome are the power (Elvik et al., 2004; Nilsson Goran, 2004) and exponential models (Elvik et al., 2019). However, these models were developed using HIC data and their applicability in LMICs to estimate crash outcome has not been well discussed in the literature. The questions of transferability to LMICs result from the differences in traffic mix and composition, road infrastructure available and land use configuration between HICs and LMICs. The traffic in LMICs is often composed of vehicles with non-uniform characteristics sharing the same road space, resulting in less homogenous flows with resulting effects on crashes. This research aimed to fill the gap in knowledge by investigating the existing relationship between speed and crash outcome in LMICs, comparing the findings with the exponential and power models, and proposing a speed impact tool applicable to LMICs. It outlines the existing gaps and identifies the next steps for research in this area specifically for LMICs.

Conference theme
This research aligns with the ARSC2025 theme of Equity by addressing the critical issue of road safety in LMICs, which suffer from a disproportionately high number of speed related traffic fatalities. By developing a speed-safety impact tool tailored for LMICs, the study ensures that road safety measures are informed by relevant data, promoting fair treatment, informed decision-making, and more inclusive transportation systems through effective speed management initiatives.

Methodology

The methodology consisted of two stages: a semi-systematic literature review and the development of a speed impact tool. The review, conducted from May to August 2022 and updated in January 2024, followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines for systematic reviews. The review identified studies that have examined the relationship between speed and crashes in LMICs, as well as in HICs (with a specific focus on the exponential and power models). Various search strategies were employed, including searching electronic databases through search engines (Scopus, Google Scholar and Science Direct) and reaching out to institutions for grey literature. During the analysis of the papers, particular attention was given to identifying the quantified impact of speed on crashes and determining the strength and direction of this relationship. Methods were critically reviewed, including sources of data (LMIC vs. HIC), the relationships form (e.g. power vs. exponential) and its suitability. Using the evidence from this review, a user-friendly Excel-based speed impact tool was developed and tested by selected experts in the field.

Results

In total, 1,252 papers were processed. Of these, the screening led to the identification of 30 papers that covered the relationship between speed and crash outcomes in LMICs, while 10 summarized the power and exponential models. After verifying the methodological rigor of the 30 studies, such as controlling for confounders and heterogeneity, only 5 robust studies were selected. The findings are summarized in the following sub-headings.

The power and exponential speed models (based on HICs data)

These models explain the relationship between speed and crash outcomes, such as fatalities or injury crashes. The power model, first developed by Nilsson, shows that the number of fatal crashes, fatal and serious injury crashes, and all injury crashes are respectively proportional to the fourth, third, and second power of the relative change in the mean speed of traffic (Nilsson Goran, 2004). The power estimates of the power model were later updated by Elvik et al. (2004), who performed a meta-analysis that included 460 estimates of the effects of speed changes on safety. In subsequent research the power model was further refined by Elvik to develop estimates for different traffic environments. Elvik (2013) reparametrized the power model by fitting exponential functions and observed that the exponential model fitted the data better and could be more substantiated than the power model. Elvik et al., (2019) carried out updated estimates of these models' using studies retrieved after the year 2000, which contained 31 estimates for injury crashes and 18 estimates for fatalities.

The speed and crash relationship in LMICs

Based on the review findings, studies from LMICs generally provided evidence of a positive relationship between crashes and mean speed. The more robust LMIC papers (Ang et al., 2020; Siregar et al., 2023; Ture & Tuydes, 2020; Vet et al., 2016; Wong et al., 2005) identified that speed increase result in a general increase in number of crashes as well as in crash severity. However, there was no substantial evidence for the strength or form of this relationship, as the available LMIC studies did not sufficiently account for various biases. LMIC research supported either the power or exponential models.. Hence, there was no conclusive evidence to dismiss the application of the power or exponential models in the LMIC context. It was therefore recommended that until further evidence is available, these models could be used to provide estimates of safety impacts in LMICs. With respect to this research, the exponential model has been chosen to develop a simplified model for LMICs. This choice is made because this relationship form took into account the initial speeds of traffic, as cited by Elvik (2013). The function of the exponential model developed is as follows (where Y denotes crashes, v speed, and subscripts 0 and 1 indicate the values before (0) and after (1) a speed change. β is the speed coefficient. The estimates of β are 0.08 for fatal and 0.06 for injury crashes, based on Elvik et al. (2019)):

$$\mathbf{Y_1 = Y_0 e^{(\beta(v_1 - v_0))}}$$

Development of a speed impact tool

Using the findings from the review, a simple Excel-based spreadsheet was developed using the exponential model, and the estimates (provided in the equation above). The tool can be accessed at the World Bank's Global Road Safety Facility website (https://www.globalroadsafetyfacility.org/ai_file_subscribe/file/1056) and is free to download. This tool was tested and refined based on initial feedback from experts in the field and users. The tool allows users to enter the initial mean speed of traffic, and then the speed after any given change (whether this is an estimate of the change or using actual data once the change has been made). Estimates are then provided regarding the change in fatal and serious injury outcomes. If available, information can be entered regarding the number of deaths and injuries before the change, and the tool will also provide estimates on the numbers expected after a speed change is made. However, the tool clearly states that the results are estimates based on research that has been conducted mainly in HICs, and that caution needs to be used when applying the tool in LMICs.

Benefits to road safety

The proposed exponential relationship and the simple practitioner Toolkit provides LMIC practitioners with means to inform speed management decisions until more targeted, robust LMIC research can be conducted and published.

Implications for practice and policy

The speed impact tool, and the model it is based upon, provide the most reliable estimates about the relationship between speed change and safety impacts. It simplifies complex real-world conditions and LMIC-specific factors that could interact with speed management interventions. However, future field validation of this tool in LMIC settings is essential given its high reliance on HIC data. It is recommended that the tool be used as the best available estimate of safety outcomes in LMICs (but also HICs), but that the appropriate caution and caveats be applied to the results. In addition, it is recommended that action be undertaken to fill the gap in knowledge on this important issue. This will involve the following:

- Raising awareness about this gap in knowledge and making it a priority to fill this gap through ongoing research conducted by academia, governments or developmental partners.
- Identifying projects where speed-related interventions are implemented, and data can be collected to provide information on the relationship between speed change and safety outcomes.
- Improving the quality of data, especially crash data, collected in LMICs to assist in such evaluations.
- Providing training to help increase knowledge about the appropriate methods to be used when conducting evaluations. And Providing funds to allow the collection, analysis and reporting of results for these evaluations.

Without these tasks, the gaps in knowledge are likely to remain, meaning that information on the effectiveness of speed interventions in LMICs will remain limited, and the relationships between speed change and crash outcomes in these countries will remain uncertain. This is likely to lead to bad decision making regarding the most effective speed management interventions to improve safety in LMICs.

Conclusion

The review critically assessed the available evidence for direction, strength and form of the speed-crash relationship from the perspective of LMIC application. A speed impact tool was developed for application in speed management initiatives.

References

Ang, A., Christensen, P., & Vieira, R. (2020). Should congested cities reduce their speed limits? Evidence from São Paulo, Brazil. *Journal of Public Economics*, *184*, 104155. https://doi.org/10.1016/j.jpubeco.2020.104155

Elvik, R. (2013). A re-parameterisation of the Power Model of the relationship between the speed of traffic and the number of accidents and accident victims. *Accident Analysis and Prevention*, *50*, 854–860. https://doi.org/10.1016/j.aap.2012.07.012

Elvik, R., Christensen, P., & Amundsen, A. (2004). Speed and road accidents: An evaluation of the Power Model. In *TOI report 740* (Vol. 740, Issue December). http://www.trg.dk/elvik/740-2004.pdf

Elvik, R., Vadeby, A., Hels, T., & van Schagen, I. (2019). Updated estimates of the relationship between speed and road safety at the aggregate and individual levels. *Accident Analysis and Prevention*, *123*(October 2018), 114–122. https://doi.org/10.1016/j.aap.2018.11.014

Fondzenyuy, S. K., Turner, B. M., Burlacu, A. F., & Jurewicz, C. (2024). *The Contribution of Excessive or Inappropriate Speeds to Road Traffic Crashes and Fatalities: A Review of Literature*. https://doi.org/http://dx.doi.org/10.2139/ssrn.4706224

Nilsson Goran. (2004). Traffic Safety Dimensions and the Power Model to Describe the Effect of Speed on Safety, Lund Institute of Technology and Society. *Traffic Engineering*.

Siregar, M. L., Tjahjono, T., Nahry, & Sumabrata, R. J. (2023). Speed heterogeneity and accident reduction in mixed traffic. *International Journal of Injury Control and Safety Promotion*, *0*(0), 1–6. https://doi.org/10.1080/17457300.2023.2172736

Ture Kibar, F., & Tuydes-Yaman, H. (2020). GIS-based evaluation of the speed limit increase on urban arterial traffic safety in Ankara. *Arabian Journal of Geosciences*, *13*(12). https://doi.org/10.1007/s12517-020-05486-5

Vet, J. M., Thierry, M. C., Horst, A. R. A. van der, Rahman, A. K. M. F., & (VTI), S. N. R. and T. R. I. (2016). The first integrated speed management program benefitting vulnerable road users in Bangladesh: results and implications for LMICs. 1(108), 21p. http://vti.diva-portal.org/smash/get/diva2:922501/FULLTEXT02.pdf%0Ahttps://trid.trb.org/view/1454139

WHO. (2023). Global status report on road safety 2023. https://www.who.int/publications/i/item/9789240086517

Wong, S. C., Sze, N. N., Lo, H. K., Hung, W. T., & Loo, B. P. Y. (2005). Would relaxing speed limits aggravate safety?: A case study of Hong Kong. *Accident Analysis and Prevention*, *37*(2), 377–388. https://doi.org/10.1016/j.aap.2004.09.008

Solving a wicked problem: achieving Vision Zero in logging transport

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Abstract

Allied Forensics Group (AFG) were contracted to undertake a holistic safety review of the log transport and distribution systems for Manulife Forest Management New Zealand (MFM NZ) following the recommendations provided in a 2018 safety review undertaken by George Rechnitzer & Associates (GRA). The previous 2018 review provided safety recommendations in core areas including high level management, road and site engineering, vehicles and equipment, load management, scheduling, driving, and communication and was underpinned by MFM NZ's aim of achieving Zero Harm in logging transport operations. As per the recommendations made in 2018, MFM NZ implemented a series of improvements with the intention of reducing incident risk. This current project, completed in 2025, evaluates the performance of MFM NZ after the 2018 report and makes recommendations for further reducing risk. This study describes a subset of the project team's findings in the context of a Vision Zero goal.

Social media post

The effect of Manulife Forest Management's Vision Zero commitment in the logging transport industry is demonstrated in this study.

Introduction

MFM NZ has committed to the ideal that all injuries and occupational illnesses are preventable and that all employees deserve the right to return home from work safe and healthy. Introducing and maintaining a safe transport environment to satisfy this commendable aim is a wicked problem that involves many contradictory factors and an ever-changing environment. Solving a wicked problem takes deliberate corporate leadership fostering a system of transparency and an environment that encourages collaborative solutions. Over the past five or so years, MFM NZ and their operators have now demonstrated a track record of zero fatal or serious injuries in log transport and distribution system operations. This exemplary performance has solidified their dedication to road safety at a corporate level. MFM NZ continues to evaluate potential improvements to further reduce any risks of a potential fatal or serious injury (FSI) as well as damage incurred from rollover crashes that continue to occur. This project, which evaluates the aspects and performance of the road safety management ecosystem for log transport and distribution systems, is demonstrative of a high-level commitment to safety as a core value.

Conference Theme

This abstract clearly addresses the conference theme of *evolution*. This study explores the development and implementation of Safe System and Risk/Harm reduction principles in a high-risk industry (logging transport) over a period of a decade. This work demonstrates not only the legitimacy of the Safe System concept when correctly applied, but also the effect of adopting a Vision Zero strategy at an organisational level.

Project Description, Objective, Scope and Methodology

Allied Forensics Group (AFG) were contracted to undertake a detailed safety review of log transport and distribution systems following the recommendations provided in a similar 2018 safety review by GRA. AFG assessed recommendations made by GRA in 2018 and the resulting performance achieved from 2018 to present. AFG found that from 2018 to 2024, MFM had either wholly or partially implemented at least two-thirds of GRA's 51 recommendations in areas shown in Figure 1, with the remaining one-third either determined impracticable or planned for future implementation. AFG also assessed the effectiveness of treatments and control measures implemented as well as an evaluation of the reasons why log transport operations continue to experience on-road incidents, mainly log truck rollovers, despite significant efforts to manage risk. The scope of this project included an assessment of the current performance of road transport systems in logging transport operations and, to the extent practicable, comparison of their safety performance with local and international industry benchmarks. The health and safety culture at corporate, subcontractor-, and supplier-levels were examined. Following AFG's performance review, AFG recommended a suite of

practicable measures underpinned by the hierarchy of control measures that would be expected to further reduce the risk of incidents and/or harm. A subset of findings describing performance are produced here.

The AFG safety review was underpinned by the commitment to Vision Zero and the Safe System Approach and the belief that no one should be killed or seriously harmed while carrying out transport tasks. The AFG review was guided by fundamental risk management principles and an understanding of the chain of responsibility. Understanding the factors that influence likelihood, severity and risk was a central theme for this project. With this knowledge, the AFG Team sought to evaluate recommendations and develop findings that were practicable and effective. Core focus areas were developed in alignment with the hierarchy of control measures with prioritisation of higher-level controls such as elimination, substitution, and engineering. Implementing "Administrative Controls" and "Personal Protective Equipment (PPE)" are considered the least effective control measures.



Figure 1. Key areas of improvement made by MFM NZ based on GRA recommendations.

Key Findings

MFM NZ commissioned external reviews evaluating organisational safety culture in 2016, 2019, and 2023 (Figure 2). The results indicate a significant improvement in workers' perception of the overarching safety culture with results in 2016 indicating a compliant culture, in 2019 a culture bordering on proactive, and in 2023 a culture that was proactive.

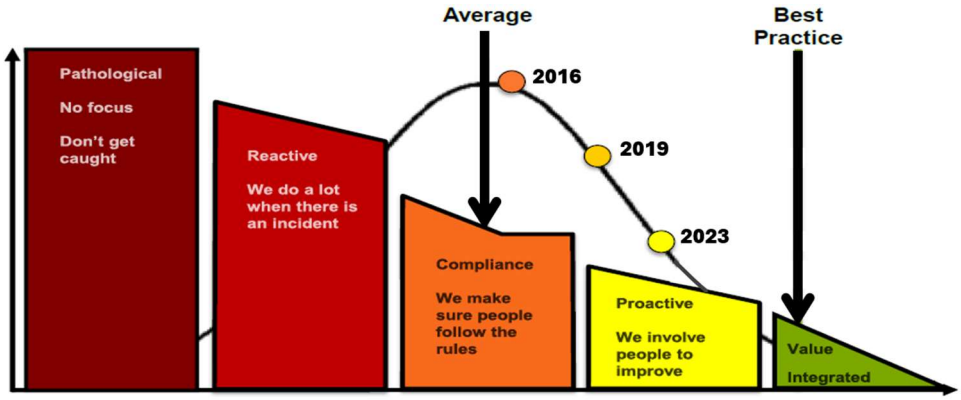


Figure 2. Results of external reviews of MFM NZ organisational safety culture 2016-2023. Source: MFM NZ

Commissioned by GRA in 2018 and by AFG in 2024 were *Safety Management and Commitment Surveys* aimed at measuring organisational commitment and performance against 14 evidence-based road safety management characteristics (Mooren, 2016). This type of survey gauges management commitment to good road safety practices (i.e., safe system alignment) and serves as an assessment of performance against these commitments. The survey results demonstrated marked improvement from 2018 to 2024 (Figure 3) in all areas for the importance placed by drivers on organisational safety aspects and their perception of the performance achieved by the organisation. Even more notably, the gaps between perceived importance and perceived performance had reduced considerably from 2018 to 2024, which demonstrates a clear alignment of safety culture intent and real-world outcomes.

Logging transport involves high rollover risk due to the inherent geometry of logging trucks and the highly variable timber loads they carry. There are continuous conflicting pressures between carrying maximum gross vehicle mass to optimise efficiency and lowering load heights to increase stability. The previous GRA 2018 report was commissioned with a core intent being the reduction in rollover crash risk. The present project involved an assessment of rollover performance prior to the GRA report in 2018 and subsequently additional recommended safety measures by MFM NZ were implemented. AFG analysed rollovers occurring from 2012 to 2023 involving logging operations. Our results indicate a clear downward trend in both the incidence of rollover crashes and the rate of rollover crashes (Figure 4).

AFG found zero FSI crashes occurred in the past 5 years, despite considerable complexity and risk involved in the logging transport industry.

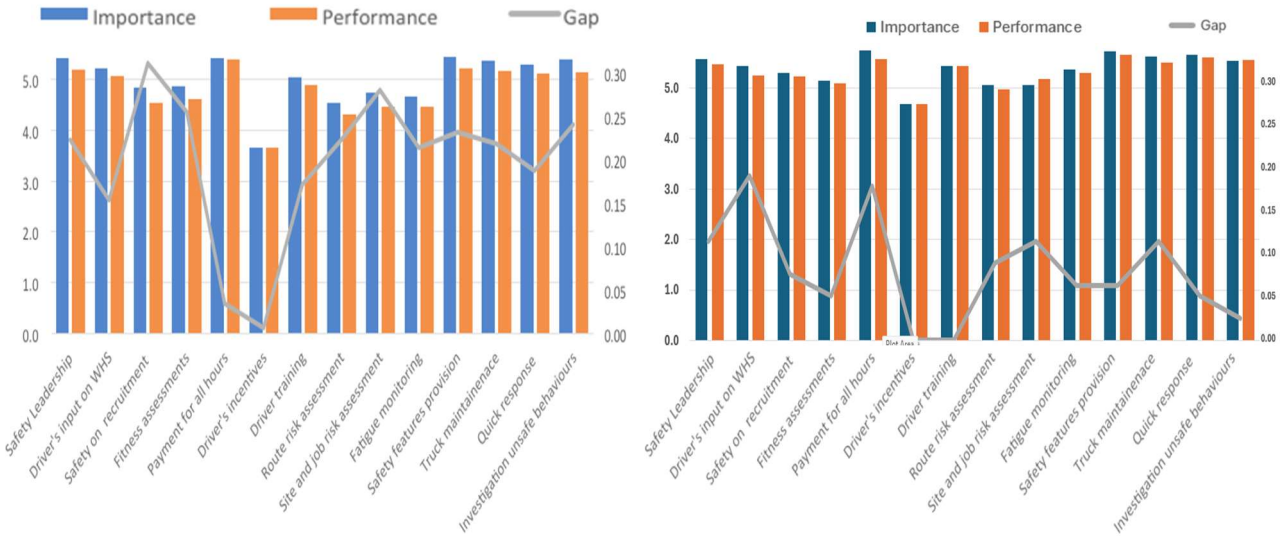


Figure 3. Survey results of log truck distribution drivers and managers safety perceptions (GRA 2018 on left, AFG 2024 on right)

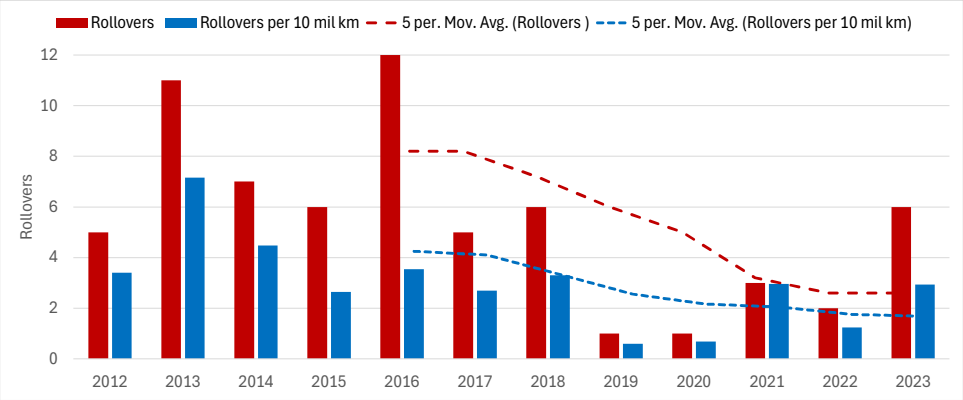


Figure 4. Rollover incidence and rate per 10 million km (2012 to 2023)

Implications for Practice

Industries who operate on the transport network play a significant role in reducing the risk of road trauma. This project demonstrates the effectiveness of evidence-based decision making that is aligned with proven frameworks such as the Safe System, Risk Management, and the Hierarchy of Control Measures. This high-level methodology can be applied to other high-risk transport industries who seek to reduce the crash risk inherent in road-based operations.

Conclusions

As a result of the treatments implemented, MFM have achieved ZERO FSI crashes in the past 5 years as well as a marked reduction in rollover incidence and an increased driver perception of safety. The results demonstrate the success of an organisational commitment to Vision Zero and the holistic effectiveness of safety measures implemented using the control hierarchy. Like many other entities operating in the road safety space in Australia and in New Zealand, the rate of reduction in crashes is plateauing, indicating there is more work to be done in the continued effort towards zero harm. AFG identified 27 further areas of improvement for consideration by MFM in future road safety planning and policy development.

References

Mooren, L., 2016. An evidence-based safety management system for heavy truck transport operations, PhD Thesis, Transport and Road Safety (TARS) Research Centre, School of Aviation University of New South Wales.

Reducing crashes with innovative lane guidance on managed motorway

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Abstract

Transurban identified a high incidence of rear-end collisions in one unique area on CityLink, particularly during uncongested periods. Rear-end collisions accounted for 83% of crashes. A review of lane guidance information was conducted, leading to installation of enhanced lane marking, signage, and pavement text. Post-installation, there was a 26% reduction in the overall crash rate and the rear-end crash rate, and the rate of lane sideswipes reduced by 41%. Serious injury crashes were eliminated. The treatments also reduced sudden braking and harsh steering. The results demonstrate the effectiveness of the innovative road safety engineering solutions and adherence to quality standards in enhancing road safety, aligning with the themes of Equity, Elasticity, and Evolution by promoting fair, adaptable, and evolving road safety systems.

Social Media Post

🚗 **Safety First!** 🚗 Transurban's enhanced guided lane markings, signage, and pavement text on the CityLink tollway led to a 26% reduction in crash rate, including a 26% drop in rear-end crash rate and 41% reduction in lane side-swipe crash rate. Serious injury collisions were eliminated! #RoadSafety #Innovation #Equity #Evolution

Background

Transurban observed a high number of rear-end collisions on a section of the Southern Link tollway, particularly during uncongested periods (e.g., inter-peak 11 AM to 3 PM), immediately upstream of the Punt Road and Batman Avenue exit ramp. In 2019, rear-end collisions accounted for 83% of the crashes during these times; higher than at similar decision points along CityLink. Transurban conducted a review of traffic, road safety and infrastructure, to identify potential contributing factors to the high rate of rear-end collisions in this area.

The section of the Southern Link tollway has four traffic lanes, was bordered by concrete barriers, includes a single lane entry ramp at Gibdon Street and ends at the Domain tunnel portal. The far-left lane becomes a trapped exit (exit-only) lane after the Cremorne Railway bridge, leading to the Punt Road and Batman Avenue exit ramps. Smart motorway technology includes an overhead Lane Use Management System (LUMS), dynamic speed control, real-time traffic volume recording, CCTV, and an Automatic Incident Detection System (AID), all operated from the Transurban control room, staffed 24/7. The section carries an average daily traffic of 70,000 vehicles. This section of road is unique, being a relatively long trapped exit lane with two exits and the mainline progressing into the Domain tunnel. This complexity influences risk at this location because drivers make late lane changes when they are unsure which exit to take, and if they realise they are unintentionally about to enter a tunnel.

Most crashes occur 400-700m before the Punt Road exit ramp, where vehicles bunch in Lane 3, causing localised congestion. As drivers round the horizontal curve and encounter the trap lane line marking, sudden merges into Lane 3 occur, leading to decreased vehicle spacing and increased collisions. Late lane changes by drivers in the right lanes further exacerbate congestion and unstable traffic flow, resulting in heavy braking and crashes. A review of CCTV footage on a typical Wednesday morning, between Church Street and the Batman Avenue/Punt Road exit, showed 191 vehicles changing lanes within a one-hour period, often from the far-left lane to the third-right lane or vice versa. These sudden lane changes were identified as a major risk for rear-end collisions and lane change crashes.

Conference Themes

The enhanced lane markings, signage, and pavement text provide clear guidance to all drivers, reducing the risk of collisions and ensuring safer travel for everyone, regardless of their driving experience, promoting fairness and equity. By tailoring solutions to the unique challenges of uncongested periods within the high-risk section, Transurban responded flexibly to varying traffic dynamics and variabilities, demonstrating an adaptability and an elasticity.

The project embodies evolution through the innovative engineering solutions applied. By continuously reviewing, updating and applying unique technical design guidelines, the initiative reflects a commitment to evolving road safety engineering practices.

Project Overview and Approach

A combined suite of design changes were made to the road environment to reduce late lane changes and improve road safety on 21 August 2021. The aims of the treatments were to provide more time for drivers to safely merge from Lane 4 into Lane 3 (and vice versa), improve vehicle spacing in Lane 3, improve lane discipline, reduce sudden lane changes, provide consistent early information to motorists, simplify decision making, improve traffic flow and reduce crash risk. The treatments installed were:

- Upgrade and extend trap line marking
    - upgrading the existing trap lane line marking to meet VicRoads standards and extending it through the preceding curve to a straight section.
- Install through lane arrows
    - Straight arrows in the adjacent through lanes were matched to the skewed arrows in the left trapped lane to inform drivers where that lane led.
- Pavement text
    - Thermoplastic pavement text showing upcoming destinations in advance of exit ramps was installed to provide early lane change advice
- Word stencils and special continuity line markings
    - Clear, simple lane guidance information was provided well in advance using large font with thermoplastic line markings.
- New sign ‘Left Lane Must Exit’
    - A new sign complemented the line markings, providing directive information to drivers. Placed in a prominent location, it optimised visibility and informed drivers about the upcoming exit

Evaluation method: Data collection and analysis

Data was collected on the number, type and severity of crashes occurring per month from July 2018 to mid-August 2021 (1146 days) when the treatments were installed, until December 2024 (1229 days after installation of the treatment). Data was also collected on the monthly traffic volumes on the section. The crash rate per 10 million vehicles was calculated as the number of crashes per month divided by the monthly traffic volume multiplied by 10 million. Poisson regression was used to estimate the reduction in crash rate after the treatments compared to before. Connected vehicle data from Compass IoT was used to investigate whether there were changes in driver behaviour, in terms of harsh braking and harsh swerving manoeuvres, in the six months after the treatments compared to before. A period of six months was chosen because the number and range of types of vehicles contributing connected vehicle data increases over time, and the restricted time period was chosen so the vehicle sample after the treatment would be comparable to the sample before the treatment.

Results and findings

The implementation of the proposed measures resulted in a 26% reduction in both the overall crash rate and the rear end crash rate, and a 41% reduction in the lane side swipe crash rate which were the crash types targeted by the treatment. Rear end and lane side swipe crashes together accounted for 94% of crashes prior to the intervention and 89% after. Other types of crashes were rare, both before and after the intervention. While the number of loss of control crashes increased from one to four, these numbers are too low to detect any effect. In addition, the four loss of control crashes after treatment were observed in the two right lanes which were farthest from the intervention.

In terms of injury severity, serious injury collisions (where someone was transported from the scene by ambulance for injuries sustained in the crash) reduced from six before, to zero after. Crashes in which no-one was transported by ambulance reduced from 66 to 57.

These reductions in crash rate did not reach the standard level for statistical significance ($p<0.05$). However, it is difficult to show a statistically significant effect of a localised treatment at a single location due to the relatively low number of crashes. Evaluations of treatments in the literature are generally conducted at multiple locations, with a combined higher number of crashes, and therefore have more power to detect an effect (e.g., Stephan et al., 2019; Transport for NSW, 2023). However, it was not practical or warranted to test the treatment at other locations because of the unique nature of the road segment and the pressing need for safety improvements at this one location, therefore statistical power could not be increased by using a larger sample size. In statistics, there is a trade-off between the type I

error rate (the chance of saying there is an effect when there isn't one) and the type II error rate (chance of failing to detect a true effect; Shreffler & Huecker, 2023). Given the low power to detect a change in crash rate with a localised treatments at one site with relatively few crashes (statistically speaking), it is acceptable to set the p-value at 0.10 (that is, a 10% chance of saying there is an effect when there isn't; Keppel, 1991). Thus, the observed 26% reduction in the overall crash rate is statistically significant at the $p<0.10$ level, The observed change in the rate of rear end and lane side swipe crashes is also in the expected direction.

Table 1. The number and rate of crashes before and after treatment installations

	Before **Number of crashes** **[Number of *serious injury crashes]** **(Crash rate per 10 million vehicles)**	**After** **Number of crashes** **[Number of *serious injury crashes]** **(Crash rate per 10 million vehicles)**	**Crash rate ratio (95% confidence interval, p-value)**
Total Crashes	72 [6] (11.03)	57 [0] (8.18)	0.74 (0.52-1.05, p=0.09)
Rear end crashes	52 [4] (7.97)	41 [0] (5.89)	0.74 (0.49-1.11, p=0.15)
Lane side swipe crashes	16 [1] (2.45)	10 [0] (1.44)	0.59 (0.27-1.29, p=0.19)
Loss of control crashes	1 [0] (0.15)	4 [0] (0.57)	3.75 (0.42-33.55. p=0.24)
Other types of crashes	3 [1] (0.46)	2 [0] (0.29)	0.62 (0.10-3.74, p=0.61)

* Serious injury crashes are defined as those where an occupant was transported from the scene by ambulance for injuries sustained in the crash

The relatively low number of crashes, and the difficulty in evaluating whether treatments at a single location reduce crashes, highlights the benefits of also looking at other measures of effectiveness. The analysis of driver behaviour using Compass IOT connected vehicle data showed significant road safety improvements, including a 50% reduction in harsh braking at the site location, and a reduction in median braking from 0.3g to 0.15g. As opposed to the crash analysis, which was conducted after a two-year period, the insights from connected vehicle data were evaluated after 6-months, giving greater and earlier confidence in the success of this initiative, which was later validated through real-world crash data.

Benefits to Road Safety

The measures were implemented to provide several benefits to road safety, including enhanced lane guidance and clarity, reducing the likelihood of sudden lane changes and increased vehicle spacing and smoother traffic flow, particularly during uncongested periods. The evaluation showed:

- A significant reduction in overall crash risk ($P<0.10$), and a reduction in the rate of rear-end collisions and lane sideswipes.
- Improved driver behaviour, with a decrease in sudden braking and steering actions.
- There have been no serious injury crashes in the 40 months post-installation

These benefits align with the principles of the Safe Systems approach, promoting a safer and more resilient road network.

Conclusion

Transurban's Southern Link Lane Guidance Improvements Project successfully implemented enhanced guided lane marking, signage, and pavement text on the tollway which led to a reduction in crash rate (particularly for rear end crashes and lane side swipes) and led to less harsh braking and swerving, indicating safer driver behaviours. While the treatment was only implemented on one unique and complex road segment and it is therefore difficult to generalise the results, the principles and strategies applied here could be implemented and tested at similar segments on other motorways, to further add to the research evidence. The positive outcomes observed post-installation underscore the importance of innovative engineering solutions and adherence to quality standards in achieving safer roads for all users.

References

Keppel, G. (1991). *Design and analysis: A researcher's handbook* (3rd ed.). Prentice-Hall, Inc.

Shreffler J, Huecker MR. Type I and Type II Errors and Statistical Power. (2023). In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK557530/

Stephan, K., Lawrence, B. & Newstead, S. (2019). Effectiveness of 40 km/h speed limits in reducing crashes on Melbourne roads with strip shopping and factors influencing effectiveness. Proceedings of the 2019 Australasian Road Safety Conference, 25-27 September, Adelaide, Australia.

Transport for NSW (2023). Evaluation of the NSW Pedestrian Protection Program. Summary Report. https://www.transport.nsw.gov.au/system/files/media/documents/2023/crs_evaluation_ped_protection_program.pdf

Can the induced hypocrisy paradigm reduce young drivers' phone use?

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Abstract
The induced hypocrisy paradigm posits that when inconsistencies between an individual's attitude and behaviour are highlighted to them, the resulting cognitive dissonance motivates behaviour change. This 2-part intervention ($N = 258$) applied an online version of the paradigm to young drivers' phone use. A series of 2 X 2 ANOVAs with condition (intervention, control) and either gender or licence type as the independent variables found various main effects: (1) intervention group reported significantly lower phone use behaviour than control group ($p = .046$); (2) females reported significantly higher dissonance than males ($p = .036$); (3) males reported significantly lower phone use behaviour than females ($p = .018$); and, (4) provisional licence holders reported significantly lower intention than open licence holders ($p = .025$). These findings show preliminary support for the induced hypocrisy paradigm and highlight the importance of considering gender and licence type in interventions targeting young drivers' phone use.

Social media post
This study applied a novel, online version of the induced hypocrisy paradigm, based on cognitive dissonance theory, to reduce phone use among young drivers. Preliminary support was found for this paradigm and for considering gender and licence type in intervention development.

Introduction
Despite having a general awareness of the dangers associated with phone use while driving as well as the associated legal penalties (Westlake Boyle, 2012; Bayer & Campbell, 2016; Gauld et al., 2016), young drivers aged 18 to 25 years continue to use their phone. Of note, 46.1% of young Australian drivers aged 17 to 25 years admit to using their phone in hand held mode while driving in a typical week (AAA, 2020). The sustained prevalence of this risky behaviour suggests that the current countermeasures are not working. It is therefore vital to look to alternate, innovative, and theory-informed approaches to reduce this risky behaviour.

This study addressed this challenge by applying a validated social-psychological paradigm of behaviour change, the induced hypocrisy paradigm, which is based on the concept of cognitive dissonance. This 2-step paradigm involves creating a state of cognitive dissonance among participants by asking them to promote the desired behaviour by writing a statement about the merits of not using a phone while driving followed by questions about instances when participants did use their phone while driving (i.e., past transgressions). When the individual is reminded of the times that they failed to practice the behaviour they advocated for in the statement they previously wrote, they are confronted with their own hypocrisy (i.e., a misalignment of attitude and behaviour). As a result, dissonance is induced, which can be reduced by changing behaviour to more closely align with their attitudes.

Induced hypocrisy studies typically use an in-person methodology. This in-person methodology, however, has the potential to produce feelings other than dissonance (e.g., guilt), which can lead to denial regarding the degree of engagement in the risky behaviour and subsequently hinder behaviour change. Denial may be especially evident among young people who are particularly averse to authority and being seen to do the wrong thing (Gingo et al., 2017).

To address this concern, the current study applied a novel, online version of the paradigm, previously developed by the research team (see Gauld et al., 2021) to test its effectiveness in reducing phone use among young, Australian drivers. Given past research has found both gender differences and licence type to be influential factors in the effectiveness of countermeasures targeting phone use among young drivers (e.g., Gauld et al., 2020), this study also investigated whether these factors impact the effectiveness of the induced hypocrisy paradigm.

Conference Theme
This study supports the 'Evolution' theme of the conference and, in particular, the 'safe people' component of the 'safe system' framework. By applying a newly developed online version of a novel approach utilising a social-psychological experimental paradigm of behaviour change, the findings provide insights into the effectiveness of the paradigm in the

context of phone use among young drivers. By highlighting the importance of considering gender differences and licence types in relation to this behaviour change paradigm, in general, this research adds to the 'ever-evolving' understanding of best-practice in relation to theory-informed countermeasures to reduce risky driving behaviours among young drivers.

Method

Participants (N = 258, 160F, 98M) aged 18 to 25 years (M_{age} = 21.62, SD = 2.17), owned a smartphone, and lived in Australia took part in this 2-part online study. At time 1, participants were randomly assigned to either the intervention or control group. In accordance with the induced hypocrisy paradigm, the intervention group was asked to write a pro-attitudinal statement about the merits of not using a phone while driving and then answered questions about times they have used their phone while driving (i.e., past transgressions). The control group did not write the pro-attitudinal statement; they only completed the past transgression questions. At time 1, all respondents responded to questions about the dependent variables of cognitive dissonance and intention to use a phone while driving in the next week. Time 2 (n = 100) was administered 1-week after time 1 and asked about phone use behaviour in the week between times 1 and 2.

Results

Preliminary analyses divided participants into 'frequent users' (i.e., have used phone while driving in the past week) (n = 224), 'infrequent users' (i.e., have used their phone while driving but not in the past week) (n = 34), and 'considerers' (i.e., have never used their phone while driving but have considered doing so) (n = 19). When comparing between levels of cognitive dissonance elicited, and in support of the induced hypocrisy paradigm, 'frequent users' reported significantly higher levels of cognitive dissonance than the 'considerers'. This finding suggests that young drivers who have not engaged in phone use while driving (i.e., the considerers) were significantly less likely to report experiencing cognitive dissonance from the intervention. Given the premise of the intervention is that cognitive dissonance is the motivator for behaviour change, and the 'considerers' do not engage in the undesired behaviour, subsequent analyses focused on those who reported having engaged in the behaviour of phone use while driving to some degree (i.e., the frequent and infrequent users).

In addition to analysing the effectiveness of the intervention, differences in relation to gender and licence type were investigated. For gender, a series of 2 (intervention, control) X 2 (female, male) ANOVAs were conducted with cognitive dissonance, intention, and self-report behaviour as the outcome variables. For cognitive dissonance, a gender main effect was found whereby females (M = 2.79, SD = 0.13) reported significantly higher levels of cognitive dissonance than males (M = 2.50, SD = 0.16), regardless of condition $F(1, 251) = 4.47$, $p = .036$; partial eta^2 =.017. For self-report behaviour at time 2, a condition main effect was found such that the intervention group (M = 2.96, SD = 0.24) reported significantly lower phone use while driving than the control group (M = 3.56, SD = 0.19) ($p = .046$), regardless of gender $F(1, 151) = 4.03$, $p = .046$; partial eta^2 =.026. A gender main effect was also found for self-report behaviour at time 2 such that males (M = 2.90, SD = 0.25) reported significantly lower phone use while driving than females (M = 3.62, SD = 0.17), regardless of condition $F(1, 151) = 5.76$, $p = .018$; partial eta^2 =.037 (see Figure 1)

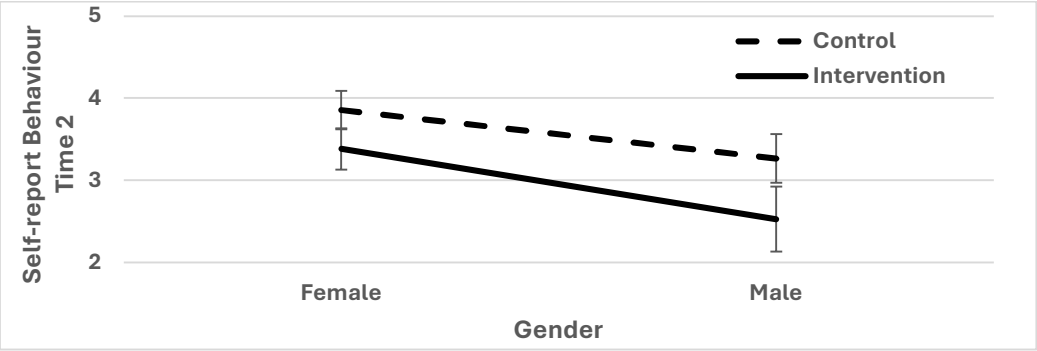


Figure 1. Results of 2 X 2 ANOVA with intervention group and gender on the outcome measure of self-report behaviour (n = 156)

For licence type, a series of 2 (intervention, control) X 2 (open licence, provisional licence) ANOVAs were conducted with cognitive dissonance, intention, and self-report behaviour as the outcome variables. For intention to use a phone while driving, there was a licence type main effect where provisional licence holders (M = 3.41, SD = 0.18) reported a significantly lower level of intention to use a phone while driving than open licence holders (M = 3.94, SD = 0.15) regardless of condition $F(1, 254) = 5.11$, $p = .025$; partial eta^2 =.020.

Benefits to road safety

This novel online version of the induced hypocrisy paradigm to reduce phone use among young drivers provides a brief, low-cost intervention that has the potential to reach a large number of young drivers. It could easily be incorporated into an educational webpage focusing on phone use among young drivers. Road safety stakeholders could then promote the intervention to young people to educate them about the dangers of mobile phone use while driving and to help reduce this risky behaviour.

Implications for policy or practice

The findings of this study have implications for road safety practice and policy. In relation to practice, this novel online version of the induced hypocrisy paradigm could be incorporated into road safety campaigns or educational webpages which specifically target young drivers who frequently use their phone while driving. The paradigm could also be applied to other risky driving behaviours (e.g., speeding). The gender differences found in this study contribute to the growing body of evidence which suggests that young male and young female drivers require different intervention approaches to reducing phone use. As such, future interventions should take these gender differences into account. In relation to policy, the finding that provisional licence holders have a lower intention to use their phone than open licence holders provides support for the stricter phone use while driving laws for provisional licence holders.

Conclusions

These results suggest that cognitive dissonance may play a role in influencing behaviour change in the context of phone use among young drivers. Specifically, in this study, a higher level of cognitive dissonance was elicited in the high risk group of young drivers who report engaging in phone use the most frequently. Arguably, these are the most important group of young drivers to target in behaviour change interventions. Of note, this novel online version of the induced hypocrisy paradigm was found to be effective in reducing self-reported phone use behaviour at the 1-week post intervention. The findings also highlight the importance of considering gender and licence type in future interventions targeting phone use among young drivers.

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References

Australian Automobile Association. (AAA). (2020). Drive in the moment. Comparative analysis: Australian drivers. https://www.driveinthemoment.com.au/knowledge-centre/

Bayer, J. B., & Campbell, S. W. (2012). Texting while driving on automatic: Considering the frequency-independent side of habit. *Computers in Human Behavior, 28*(6), 2083–2090. https://doi.org/10.1016/j.chb.2012.06.012

Delgado, M., Wanner, K., & McDonald, C. (2016). Adolescent cellphone use while Driving: An overview of the literature and promising future directions for prevention. *Media and Communication, 4*(3), 79–89. https://doi.org/10.17645/mac.v4i3.536

Gauld, C. S., Lewis, I. M., White, K. M., & Watson, B. (2016). Key beliefs influencing young drivers' engagement with social interactive technology on their smartphones: A qualitative study. *Traffic Injury Prevention, 17*(2), 128–133. https://doi.org/10.1080/15389588.2015.1047014

Gauld, C., Lewis, I. M., White, K. M., Watson, B. C., Rose, C. T., & Fleiter, J. J. (2020). Gender differences in the effectiveness of public education messages aimed at smartphone use among young drivers. *Traffic injury prevention*, *21*(2), 127-132. https://doi.org/10.1080/15389588.2020.1732948

Gauld, C., Watson, B., Lewis, I., White, K. & Pammer, K. (2021) An exploration of the feasibility and effectiveness of online and interview versions of the induced hypocrisy paradigm to reduce mobile phone use among young drivers. *Transportation Research Part F, 82,* 462 – 474. http://dx.doi.org/10.1016/j.trf.2021.09.015

Gingo, Matthew ; Roded, Alona D. & Turiel, Elliot (2017). Authority, autonomy, and deception: Evaluating the legitimacy of parental authority and adolescent deceit. *Journal of Research on Adolescence, 12*, 27 (4), p.862-877 https://doi.org/10.1111/jora.12319

Westlake, E. J., & Boyle, L. N. (2012). Perceptions of driver distraction among teenage drivers. *Transportation Research. Part F, Traffic Psychology and Behaviour, 15*(6), 644–653. https://doi.org/10.1016/j.trf.2012.06.004

Exposure-adjusted hospitalised injury rates in transport crashes by socioeconomic status

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Abstract

Injury rates, defined as the number of injuries per exposure, allow for comparisons of risk across groups. Due to a lack of robust exposure data for pedestrians and bicyclists, it is not currently known how injury risk varies by transport mode in Australia. Further, it is unknown how rates vary by sex, age and socioeconomic status. We used six measures of injury (emergency department presentations, hospital admissions, major trauma patients, pre-hospital deaths, in-hospital deaths, total deaths) and three exposure measures (number of trips, kilometres travelled, hours spent travelling) to calculate injury rates by age, sex, socio-economic advantage and transport mode for Greater Melbourne residents. We found that motorcyclists and bicyclists consistently had the highest injury rates; 223x higher and 37x higher than vehicle occupants per trip respectively. Further, men were injured at higher rates than women, and the lowest injury rates were observed for residents of the most advantaged areas.

Social media post

We calculated exposure-adjusted injury rates for residents of Greater Melbourne. Motorcyclists had 8x the injury rate of vehicle occupants, while pedal cyclists had 3 times the injury rate of vehicle occupants. Per trip, pedestrians had fewer injuries than vehicle occupants.

Background

It is well-established that injury rates vary by mode of transportation. However, to accurately quantify injury risk, we must account for variation in the use of different transport modes. The term ‘exposure’ is often measured as the time in which an individual has been exposed to a factor of interest. In transportation, this exposure pertains to the amount of travel that people undertake for each mode which is the number of potential opportunities for a crash to occur.

While exposure measurement, such as distance or time travelled, is commonly available and used in motor vehicle-based travel (Wegman, 2017), the availability of robust exposure data for bicyclists and pedestrians has limited comparisons of exposure-adjusted injury rates across all transportation modes. There are, however, some notable exceptions of studies that have compared traffic crash injury rates between travel modes after adjusting for exposure. These include comparing injury rates by mode of travel in the United States (Beck et al., 2007), injury rates in British Columbia, Canada (Teschke et al., 2013), road crash fatality rates in France (Bouaoun et al., 2015) and the International Transport Forum’s benchmarking of fatalities of 31 cities across the world (Santacreu & de Gouveia, 2018).

In addition to global evidence that injury rates vary by mode choice, studies from the United States have found that injury rates differ between socioeconomic status, race/ethnicity, and rurality (Raifman & Choma, 2022). There is also evidence from the UK that injury rates vary by gender (Aldred et al., 2021) with men posing a greater risk to others. Australian studies have looked at how injury risk varies by socioeconomic status and gender for new drivers (Mőller et al., 2021), but detailed exploration of exposure-adjusted injury rates with comparisons between transport mode and demographic characteristics are lacking, particularly in Australia. To address this knowledge gap, the aim of this study was to generate exposure-adjusted injury rates and explore how these injury rates vary between road user group, age, sex and socioeconomic status in Greater Melbourne, Australia.

Conference theme

The present study addresses the conference theme of **equity** by describing how injury rates vary by sex, age and socioeconomic level. Understanding how risk of injury varies by socioeconomic characteristics is necessary to clearly

articulate to policymakers the ongoing inequities in our transport system. By identifying these disparities, this study enables informed decision-making to create a safer and more inclusive transport environment.

Method

The present study is a retrospective review of death and injury data for road transport patients injured in Greater Melbourne between 01 July 2022 to 30 June 2024. Six outcome measures were used: emergency department (ED) presentations, hospital admissions, major trauma patients, pre-hospital deaths, in-hospital deaths and total deaths. ED presentations from the Victorian Emergency Minimum Dataset and hospital admissions from the Victorian Admitted Episodes Dataset were supplied to the Victorian Injury Surveillance Unit by the Victorian Department of Health.

Three measures of exposure were used; number of trips, kilometres travelled (KMT) and hours spent travelling. For brevity, the death outcome measures and the exposure measure hours spent travelling are not presented in this abstract but will be presented in October 2025. Exposure data was taken from the Victorian Integrated Survey of Travel and Activity (VISTA). VISTA is a survey of daily travel coordinated by the Victorian Department of Transport and conducted in Greater Melbourne across a random sample of households. The survey and resulting data are weighted to generate population-representative data. VISTA contains detailed trip stage data for trips that include multiple modes. Therefore, we are able to generate robust estimates of exposure for each travel mode. This exposure measurement is affected by cross-border flow in and out of Greater Melbourne, therefore we matched injury data and VISTA on residential postcode. The resulting injury rates can therefore be interpreted as the risk of an injury event for people residing in Greater Melbourne.

Data were analysed for the following categories: age (10-year age groups), sex (male, female), socioeconomic level (measured using the Index of Socioeconomic Advantage and Disadvantage (IRSAD), stratified by quintile) and mode (car driver / passenger, motorcycle rider / passenger, pedestrian, bicyclist, public transport).

Outcome

Between 01 July 2022 to 30 June 2024 there were 23,245 ED presentations, 18,332 hospital admissions and 1955 major trauma patients related to road transport injury, among people residing in Greater Melbourne. Over the same period there were 14.31 billion trips taken in Greater Melbourne, spanning 133.44 billion KMT. Table 1 presents these data broken down by sex, residential IRSAD and mode. Table 2 presents the number per million trips and million KMT.

Table 1: Number of road transport injury events among Greater Melbourne residents

	Emergency department presentations	Hospital admissions	Major trauma patients
Total	23245	18332	1955
Male	15051, (64.7%)	11700, (63.8%)	1472, (75.3%)
Female	8194, (35.3%)	6632, (36.2%)	483, (24.7%)
IRSAD 1 (most disadvantaged)	1445, (6.2%)	1347, (7.3%)	282, (14.4%)
IRSAD 2	1508, (6.5%)	1277, (7%)	255, (13%)
IRSAD 3	4572, (19.7%)	4189, (22.9%)	368, (18.8%)
IRSAD 4	7947, (34.2%)	5355, (29.2%)	469, (24%)
IRSAD 5 (least disadvantaged)	7773, (33.4%)	6164, (33.6%)	581, (29.7%)
Car driver / passenger	10411, (44.8%)	8029, (43.8%)	710, (36.3%)
Motorcycle rider / passenger	4180, (18%)	3872, (21.1%)	423, (21.6%)
Pedestrian	1726, (7.4%)	1686, (9.2%)	295, (15.1%)
Pedal cyclist	6604, (28.4%)	3783, (20.6%)	373, (19.1%)

There were 1.62 ED presentations, 1.28 hospital admissions and 0.14 major trauma patients per million trips. Motorcyclists had the highest injury rates with 229.30 emergency department presentations and 212.40 hospital admissions per million trips, followed by pedal cyclists with 38.21 and 21.89 respectively. These two road users are consistently the most at risk both on a per trip and per KMT basis for all event types. Per trip and per KMT, motor vehicle occupants had the next highest rate of transport injury related ED presentations and hospital admissions. Motor vehicle occupants had the lowest proportion of major trauma patients per hospital admission, which could be attributed to the external and internal protections afforded by a motor vehicle reducing the severity of injuries received while in a motor vehicle. Pedestrians had a lower per trip rates of ED presentations (0.55 vs 1.03) and hospital admissions (0.54 vs 1.02) than vehicle occupants, implying that walking is safer than driving on a per trip basis. This could be because walking trips are shorter than driving trips, a theory that is supported by the ED presentations, hospitalisation and major trauma rates being higher for pedestrians per KMT.

We then calculated rates by IRSAD which are presented in Table 3. In general, the lowest injury rates were seen among residents of IRSAD 5 (the most advantaged IRSAD), followed by IRSAD 1 (the most disadvantaged). This could be because most of Greater Melbourne have IRSAD 5, meaning that the exposure data for this IRSAD is less affected by the specific trip habits of those selected to participate in the travel survey.

Table 2: Unadjusted rates

	Events per million trips			Events per million kilometres travelled		
	Emergency department presentations	Hospital admissions	Major trauma patients	Emergency department presentations	Hospital admissions	Major trauma patients
Total	1.62	1.28	0.14	0.17	0.14	0.01
Male	2.09	1.62	0.20	0.21	0.16	0.02
Female	1.16	0.94	0.07	0.13	0.11	0.01
IRSAD 1	1.04	0.97	0.20	0.11	0.10	0.02
IRSAD 2	1.94	1.64	0.33	0.18	0.15	0.03
IRSAD 3	1.53	1.40	0.12	0.14	0.13	0.01
IRSAD 4	2.58	1.74	0.15	0.20	0.14	0.01
IRSAD 5	1.28	1.02	0.10	0.19	0.15	0.01
Car driver / passenger	1.03	0.80	0.07	0.09	0.07	0.01
Motorcycle rider / passenger	229.30	212.40	23.20	13.29	12.31	1.34
Pedestrian	0.55	0.54	0.09	0.70	0.68	0.12
Pedal cyclist	38.21	21.89	2.16	8.39	4.80	0.47

Table 3: Rates adjusted by IRSAD quintile for motor vehicle occupants, pedestrians and pedal cyclists

Road user type	IRSAD	Events per million trips			Events per million kilometres travelled		
		Emergency department presentations	Hospital admissions	Major trauma patients	Emergency department presentations	Hospital admissions	Major trauma patients
Car driver or passenger	1	0.83	0.72	0.11	0.07	0.06	0.01
	2	1.38	1.19	0.17	0.11	0.10	0.01
	3	1.07	0.97	0.07	0.09	0.08	0.01
	4	1.48	0.94	0.07	0.10	0.06	0.00
	5	0.72	0.54	0.04	0.08	0.06	0.00
Pedestrian	1	0.44	0.33	0.17	0.73	0.43	0.23
	2	1.06	0.79	0.42	1.15	0.85	0.45
	3	0.60	0.66	0.10	0.78	0.85	0.13
	4	0.89	0.87	0.12	1.12	1.09	0.15
	5	0.42	0.41	0.05	0.53	0.51	0.07
Pedal cyclist	1	21.54	9.76	2.11	8.78	4.03	0.87
	2	38.92	17.64	3.81	5.13	2.33	0.50
	3	47.25	28.72	3.01	18.15	11.03	1.16
	4	101.65	51.29	3.92	31.34	15.81	1.21
	5	26.18	16.14	1.53	5.11	3.15	0.30

Benefits to road safety

To effectively prioritise interventions to reduce transport injuries it is necessary to understand how injury risk varies between populations. This study provides essential evidence for policymakers and road safety practitioners on where to target prevention efforts. Further, this study highlights gaps in the collection of exposure data and highlights the need to collect Australia-wide trip data.

Implications to policy

Policymakers need to prioritise interventions to reduce injury rates among motorcyclists, pedal cyclists and those living in more disadvantaged areas.

Conclusions

Injury risk varies by sex, road user and relative socio-economic advantage. In order to achieve equitable injury outcomes interventions are needed to reduce injury rates in more vulnerable groups.

References

Aldred, R., Johnson, R., Jackson, C., & Woodcock, J. (2021). How does mode of travel affect risks posed to other road users? An analysis of English road fatality data, incorporating gender and road type. *Injury Prevention*, *27*(1), 71–76. https://doi.org/10.1136/injuryprev-2019-043534

Beck, L. F., Dellinger, A. M., & O'Neil, M. E. (2007). Motor Vehicle Crash Injury Rates by Mode of Travel, United States: Using Exposure-Based Methods to Quantify Differences. *American Journal of Epidemiology*, *166*(2), 212–218. https://doi.org/10.1093/aje/kwm064

Bouaoun, L., Haddak, M. M., & Amoros, E. (2015). Road crash fatality rates in France: A comparison of road user types, taking account of travel practices. *Accident Analysis & Prevention*, *75*, 217–225. https://doi.org/10.1016/j.aap.2014.10.025

Mőller, H., Rogers, K., Cullen, P., Senserrick, T., Boufous, S., & Ivers, R. (2021). Socioeconomic status during youth and risk of car crash during adulthood. Findings from the DRIVE cohort study. *Journal of Epidemiology and Community Health*, *75*(8), 755–763. https://doi.org/10.1136/jech-2020-214083

Raifman, M. A., & Choma, E. F. (2022). Disparities in Activity and Traffic Fatalities by Race/Ethnicity. *American Journal of Preventive Medicine*, *63*(2), 160–167. https://doi.org/10.1016/j.amepre.2022.03.012

Santacreu, A., & de Gouveia, P. (2018). Safer City Streets Global Benchmarking for Urban Road Safety. OECD Publishing.

Teschke, K., Harris, M. A., Reynolds, C. C. O., Shen, H., Cripton, P. A., & Winters, M. (2013). Exposure-based Traffic Crash Injury Rates by Mode of Travel in British Columbia. *Canadian Journal of Public Health*, *104*(1), e75–e79. https://doi.org/10.1007/BF03405659

Wegman, F. (2017). The future of road safety: A worldwide perspective. *IATSS Research*, *40*(2), 66–71. https://doi.org/10.1016/j.iatssr.2016.05.003

Linking trauma registries with crash data to advance road safety

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Abstract

Data linkage is valuable for the surveillance of road trauma. This project is the first time trauma registry data has been linked to police collected crash data and pre-hospital data in Australia to address gaps in surveillance. The aims of this study were to: 1) describe the relative contribution of each dataset to enhancing understanding of the causes and characteristics of serious crashes; and 2) use these data to identify clusters of pedestrian and bike crashes. Overall, linkage rates with either police or ambulance-reported data were 94.3%, though this varied between road user groups. We identified six pedestrian crash clusters and five bicyclist clusters. Increased disability burden per patient was associated with higher speed zones for bicyclists and heavy vehicle crash counterparts for pedestrians. Combining the identification of crash clusters with measures of disability burden allows effective targeting of interventions and prioritisation of investment towards crashes with the greatest burden.

Social media post

Linking trauma registries to police collected crash data provides new insights into crashes. We demonstrate how data linkage can be used to capture rich insights into the burden of injury for non-fatal crashes and how this evolves current monitoring and evaluation systems.

Introduction

In Australia, approximately 1200 people die annually from road traffic crashes and a further 40,000 suffer non-fatal injuries (National Road Safety Strategy 2021-30, 2021). In order to develop interventions to reduce the burden of injury it is necessary to monitor the epidemiology of road traffic crashes, injuries and fatalities.

Police crash records are the main source of crash data globally. However, there are limitations to police data. Specifically, only crashes attended by or reported to police are included in police crash reports, leading to under-reporting of crashes involving vulnerable road users and crashes with less severe injuries in police crash records (Watson et al., 2015). Further, police crash data typically classify injuries into broad groups which can be subject to both under- and over-estimation depending on the classification process used.

Hospital data is a potentially more accurate source of road trauma, as people with serious injuries will present at a hospital for treatment irrespective of police attendance at the crash. However, hospital data does not contain information about the characteristics of the crash, meaning hospital records cannot provide insight into the cause of crashes and crash events. For example, hospital records do not include the crash location, information about the roadway characteristics, pre-event vehicle movements, weather, lighting or the vehicles involved. Hospital data can be further complemented with trauma registry data. Some trauma registries collect follow-up data which can be used to monitor the amount of disability and reduced quality of life following injury (Gabbe et al., 2010) Trauma registries provide new opportunities in evaluations of road safety interventions by enabling the use of long term measures which allows the assessment of long-term disability averted by interventions (Gerhard et al., 2025). However, trauma registries do not contain detailed crash information, meaning that no single dataset contains both crash characteristics, injury data and disability outcomes.

Data linkage between police crash data, pre-hospital data and hospital data has been used in other jurisdictions to identify patterns in police attendance of road traffic crashes (Soltani et al., 2024). By combining data from multiple sources, it is possible to identify gaps in surveillance data of each of these sources. Previous data linkage studies in Australia include Watson et al who linked crash data from Queensland with hospitalisation data and emergency department data for the year 2009 (Watson et al., 2015). Similarly, the New South Wales Centre for Road Safety has

established processes to match crash data with hospital admissions for identification, monitoring and analysis of serious injuries. (NSW Centre for Road Safety, 2017). The need for linked crash and hospitalisation data has been further recognised by and a national project to link crash data and hospitalisation data has recently been completed by Austroads and delivered to the federal government (Harrison & Watson, 2023). Building on this work and in recognition of the importance of data linkage, the Federal Office of Road Safety is now creating an ongoing national linked dataset as part of the National Road Safety Strategy (Australian Government Office of Road Safety, n.d.). However, each of those projects' injury data ends after hospitalisation and do not consider longer-term injury outcomes.

Pedestrians and bicyclists are particularly vulnerable to injury and police attendance of crashes is lower in these groups in Australia (Harrison & Watson, 2023). Preventing pedestrian and bicyclist crashes is a key road safety priority. The present study will present the results of this linkage and an example of the applications of these linked data: a cluster analyses of crash characteristics for pedestrians and bicyclists and a comparison of clusters by different outcome measures.

Conference theme

The present study addresses the conference theme of **evolution** by identifying gaps in our current surveillance systems and advancing methods for of monitoring road trauma and evaluating interventions. Enhancing these systems will help prioritise prevention efforts towards the interventions that provide the greatest value. Additionally, as road safety interventions continue to reduce the number of fatal crashes it will be necessary to look beyond numbers of crashes and deaths to assess future interventions. Achieving this will depend on the evolution of existing data systems.

Method

In Victoria, data on all major trauma cases are recorded in the Victorian State Trauma Registry (VSTR), resulting in full capture of serious injuries. Patients are followed up at 6- 12- and 24- months post injury and provide data on their physical and mental health, pain levels and return to work outcomes. These data provide detailed, long-term health outcome data for major trauma patients. For this research VSTR data were linked to detailed crash data provided by the Victoria Department of Transport and Planning (DTP), pre-hospital data provided by Ambulance Victoria (AV) and supplementary crash data provided by Victoria Police. The DTP data contains crash characteristics including the vehicles involved, crash location, roadway characteristics, vehicle movements, and licence information of the patient. The AV data contain information at the patient's initial injury presentation and some basic crash data such as the crash location and whether the patient was wearing a helmet or a seatbelt. Supplementary crash data provided by Victoria Police includes historic driving offences and the Victoria Police member's opinion of the cause of the crash.

We conducted two k-modes cluster analyses of crash characteristics, one for pedestrians and one for bicyclists. We then calculated disability-adjusted life years (DALYs) for each patient in the VSTR. We calculated disability weights using the EuroQol five dimension (Herdman et al., 2011) which is collected 6- 12- and 24- months post injury. Finally, we compared each cluster by the number of patients, pre-hospital deaths, total deaths, DALYs and DALYs per patient.

Outcome

Preliminary results for data collected between 2007 and 2017 are summarised in this abstract. These linked data will shortly be updated to include data up to the end of 2023 and data from 2007-2023 will be presented in October 2025. Over the period of 2007 to 2017, there were 13,039 transport-related major trauma cases recorded in the VSTR. Of these, 11,259 cases met inclusion criteria and were included in this study. Overall, 68% of all road users were included in all three data sets: registry data, AV data and DTP data. Pedestrians had higher linkage rates with all three datasets (77%) relative to pedal cyclists (31%). Three quarters of women were included in all three datasets, compared to 65% of men. Linkage rates also varied by age; the age group 35-64 had the lowest linkage rate and age 85+ had the highest.

Table 1. Disability comparison by cluster for crashes involving pedestrians

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
Total injuries and deaths	300 (13.2%)	411 (18.1%)	439 (19.3%)	590 (26.0%)	186 (8.2%)	343 (15.1%)
Major trauma patients	280 (17.4%)	206 (12.8%)	386 (24.0%)	366 (22.7%)	66 (4.1%)	305 (19.0%)
Pre-hospital deaths	20 (3.0%)	205 (31.1%)	53 (8.0%)	224 (33.9%)	120 (18.2%)	38 (5.8%)
DALYs	3032 (7.9%)	9263 24.1%)	5975 (15.5%)	1017 26.4%)	4855 12.6%)	5200 13.5%)
DALYs per patient	10.11	22.54	13.61	17.24	26.10	15.16
Total deaths	68 (7.1%)	230 (23.9%)	112 (11.6%)	294 (30.6%)	131 (13.6%)	127 (13.2%)

Table 2. Disability comparison by cluster for crashes involving pedal cyclists

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Total injuries and deaths	158 (11.5%)	132 (9.6%)	243 (17.6%)	290 (21.0%)	555 (40.3%)
Major trauma patients	135 (10.6%)	112 (8.8%)	186 (14.7%)	286 (22.5%)	550 (43.3%)
Pre-hospital deaths	23 (21.1%)	20 (18.3%)	57 (52.3%)	4 (3.7%)	5 (4.6%)
DALYs	1729 (14.1%)	1554 (12.7%)	3575 (29.1%)	1891 (15.4%)	3528 (28.7%)
DALYs per patient	14.43	11.78	14.71	6.52	6.36
Total deaths	31 (18.0%)	22 (12.8%)	74 (43.0%)	13 (7.6%)	32 (18.6%)

We identified six clusters of pedestrian crashes: 1) Daytime intersection crashes on 50-60km/h arterial roads, hit from the left, 2) Midblock crashes on local roads, sometimes while boarding/alighting a vehicle, 3) Night-time midblock crashes on 60-80km/h arterial roads, hit from the left, 4) Daytime intersection crashes on arterials roads, hit from the right, 5) Daytime midblock crashes involving heavy vehicles on 2-4 lane arterial roads, 6) Crashes not attended by police (with unknown characteristics). Table 1 compares each cluster by health outcomes. Cluster 4 had the largest disability burden, followed by cluster 2.

We found five clusters of bike crashes: 1) Intersection crashes on 50-60km/h roads with vehicles travelling from a perpendicular direction, 2) Intersection crashes on 40-60km/h roads with vehicles from the same/opposing direction, 3) Midblock crashes on high-speed roads, where the bike rider is hit by a vehicle travelling in the same direction, 4) Single-vehicle crashes, not attended by ambulance or police, 5) Single-vehicle crashes, attended by ambulance but not police. Table 2 compares each cluster by health outcomes. Clusters 5 and 3 had the largest disability burden, cluster 3 had the largest disability per patient.

Discussion

This research demonstrates the feasibility and benefits of linking VSTR, DTP, TAC, Victoria Police and AV data, especially when considering geocoding crash locations. Most cases (94%) were linked to DTP and/or AV data – both of which provide geolocations of crash events. The addition of AV data is crucial in the 15% of cases that could not be linked to DTP data, but could be linked to AV data; providing provides a more comprehensive overview of crash locations than would be possible with a single dataset. Linkage rates across all data sources were high in motor vehicle occupants, motorcyclists and pedestrians. However, only 36% of VSTR pedal cyclist cases could be linked to DTP data, likely due to the high proportion of single bicycle crashes that were not attended by or reported to Victoria Police.

Higher pedestrian disability per patient was associated with heavy vehicle crash counterparts; demonstrating that while heavy vehicles were involved in 8.2% of crashes, collisions with heavy vehicles result in more serious injuries to pedestrians. Similarly, higher bicyclist disability was associated with midblock crashes on high-speed roads, where the bike rider was hit by a vehicle travelling in the same direction. Comparing the clusters by different outcomes allows the prioritisation of prevention efforts to be based on different metrics: if the goal was to prevent cyclist deaths, prevention efforts need to be directed towards mid-block crashes on high-speed roads (cluster 3), whereas if the goal is to prevent cyclist crashes overall then focus needs to be on improving data collection on single bicycle crashes (given that many of these crashes are not attended by police)in order to understand the circumstances of these crashes (clusters 4 and 5). The cluster analyses identified both pedestrian and bicyclist clusters with unknown characteristics due to variations in police attendance at certain crash types; highlighting where current knowledge gaps are.

Benefits to road safety

Using linked data has potential to improve the monitoring of road trauma and evaluation of interventions by accurately quantifying the long-term impacts of non-fatal crashes, which is not commonly considered in evaluations. Identifying crash clusters for pedestrian bike riders and comparing the health burden of each cluster by different health outcomes simultaneously provides insight into how crashes are the product of multiple interacting factors, and how intervention priorities may change based on various outcome metrics (e.g., the number of crashes vs the total disability burden).

Implications to policy

Leveraging the benefits of linking multiple datasets allows policymakers to target crash prevention efforts towards crashes with the largest disability; something that is not with traditional surveillance and evaluation methods. This ensures that road safety funding can be directed to the interventions that provide the greatest value.

Conclusions

Data linkage is an essential tool for improving injury surveillance systems. Bicyclists are underrepresented in police records of crashes. Complementing existing linked data sets with trauma registry data provides insight into the long-term health impacts of crashes.

References

Australian Government Office of Road Safety. (n.d.). *National Road Safety Data Hub*. Australian Government Office of Road Safety.

Gabbe, B. J., Sutherland, A. M., Hart, M. J., & Cameron, P. A. (2010). Population-Based Capture of Long-Term Functional and Quality of Life Outcomes After Major Trauma: The Experiences of the Victorian State Trauma Registry. *Journal of Trauma: Injury, Infection & Critical Care*, *69*(3), 532–536. https://doi.org/10.1097/TA.0b013e3181e5125b

Gerhard, R., Gabbe, B. J., Cameron, P., Newstead, S., Morrison, C. N., Clarke, N., & Beck, B. (2025). A scoping review on the methods used to assess health-related quality of life and disability burden in evaluations of road safety interventions. *Journal of Safety Research*, *92*, 459–472. https://doi.org/10.1016/j.jsr.2024.11.028

Harrison, J. E., & Watson, A. (2023). *A National Approach to Measuring Non-fatal Crash Outcomes* (AP-R599-23). Austroads.

Herdman, M., Gudex, C., Lloyd, A., Janssen, Mf., Kind, P., Parkin, D., Bonsel, G., & Badia, X. (2011). Development and preliminary testing of the new five-level version of EQ-5D (EQ-5D-5L). *Quality of Life Research*, *20*(10), 1727–1736. https://doi.org/10.1007/s11136-011-9903-x

National Road Safety Strategy 2021-30. (2021). Department of Infrastructure, Transport, Regional Development and Communications. https://www.roadsafety.gov.au/sites/default/files/documents/National-Road-Safety-Strategy-2021-30.pdf

NSW Centre for Road Safety. (2017). *Serious Injuries in NSW 2005 to 2015 Reporting on methodology and results*. Transport for NSW Centre for Road Safety. https://www.transport.nsw.gov.au/system/files/media/documents/2023/NSW%20Serious%20Injuries%202005%20-%202015_0.pdf

Soltani, A., Edward Harrison, J., Ryder, C., Flavel, J., & Watson, A. (2024). Police and hospital data linkage for traffic injury surveillance: A systematic review. *Accident Analysis & Prevention*, *197*, 107426. https://doi.org/10.1016/j.aap.2023.107426

Watson, A., Watson, B., & Vallmuur, K. (2015). Estimating under-reporting of road crash injuries to police using multiple linked data collections. *Accident Analysis & Prevention*, *83*, 18–25. https://doi.org/10.1016/j.aap.2015.06.011

Safe Active Travel to School: influencing the system in WA

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Abstract

Safe active travel to school is an enduring challenge for families and school communities. The Department of Transport (DoT) WA has led a collaborative government and industry working group to co-create and implement the Active Travel to School Roadmap 2023-2030 (the Roadmap) and system-level changes. The presentation will outline application of the social-ecological model to co-create and guide implementation of Roadmap initiatives. A case study of one Roadmap initiative, the TREK2School study partnership between Telethon Kids Institute and DoT WA highlights insights into travel behaviour, attitudes and perceptions of Perth primary and secondary school students, and their parents. The successes and lessons learnt from Roadmap implementation will be explored as well as how the group is addressing persisting issues such as poor connectivity, walkability, unsafe pedestrian crossings, vehicle speeds arounds schools and parental attitudes and perceptions.

Social media post

Unpack how the social-ecological model has been applied to create the Active Travel to School Roadmap in WA. Explore insights from the TREK2School study, challenges, successes, lessons learnt and the persistent challenges informing next steps for safe active travel to school in WA.

Introduction

Fewer Western Australian children walk and bike to school than ever before and nearly 2,000 children were involved in crashes while walking and bike riding to school in WA between 2006 and 2016 (Hobday et al., 2018). This momentous decline in active travel to school not only impacts the economy and transport network, but it also affects some of the most vulnerable members of the community. Children who are driven to school are more likely to be sedentary and have ongoing health problems throughout their lives, including overweight and obesity and have fewer opportunities to learn essential road safety awareness skills. (Trapp et al., 2013).

In 2021, the Active Travel to School Working Group was established to plan a way forward to enable more children to walk and ride to school in response to 'The Declining Rate of Walking and Cycling to School in Perth' paper (WA DoT, 2021) The working group reports to the WA Bike Riding Reference Group and comprises 11 government and industry members, 8 of whom co-created the Active Travel to School Roadmap 2023-30 (WA DoT, 2023). The Roadmap contains 24 existing and new initiatives for delivery over the next decade. Initiatives are grouped according to the four social-ecological factors: urban environment, policy and regulation, and individual and social factors. This acknowledges the causal, interacting and reinforcing links necessary to create cultural change and sustained road safety and active travel outcomes.

This presentation will provide participants with practical application of the social ecological model to achieve road safety and active travel to school outcomes, highlighting the importance of localised research through the TREK2 School Study, influence and collaboration as key enabling factors.

Conference theme

The issue of road safety for vulnerable road users, such as walkers and bike riders of all ages and abilities, is closely linked with the conference theme of Equity (Ingamells & Raffle, 2012; Dinh & Kubota, 2013). The TREK2 School study which will be featured as a case study in the presentation and demonstrates that many Perth schools (73.8%) were below the WA Planning Commission's target for a walkable catchment area. Neighbourhoods surrounding high SES schools were significantly more walkable than neighbourhoods surrounding medium and low SES schools (Gannett et al., 2024) This highlights the importance of modifying the built environment to increase opportunities for active travel, particularly in low and medium socio-economic areas to address equity and improve active travel and road safety outcomes.

Overview and Approach

Over the past 40 years the national rate of active travel to school has declined from 75% to 25%. In Perth, the rate is as low as 20% and one half of children travel to school by car despite living less than one kilometre away. Upon analysis of active travel to school data from the 2018 Perth Area Travel and Household Survey (PATHS) data cited above, DoT embarked upon research and collaboration to explore the objective and subjective nature of the problem. DoT placed high importance on developing a shared understanding and thoroughly engaged and consulted 17 state government agencies, industry representatives and peak bodies on drafts and final versions of the paper. 'The Declining Rate of Walking and Cycling to School in Perth' paper was released in November 2021 and defines the problem of declining rates and includes a summary of the benefits of addressing the problem, its underlying causes, and opportunities and challenges for reversing the decline.

The Roadmap was co-created utilising the framework of the social-ecological model by a dedicated Active Travel to School Working Group established by the across government Bicycle Riding Reference Group in 2022. Released in March 2023, the Active Travel to School Roadmap 2023-2030 aims to reverse the declining rate of walking and riding to school in Perth. The Roadmap aims to address barriers preventing active travel to school including:

- poor path accessibility
- traffic around schools
- safety
- distance
- parent/carer time constraints.

The Roadmap was endorsed at Director General and CEO level by the:

- Department of Transport
- Main Roads WA
- Public Transport Authority
- Department of Education
- Department of Health
- Road Safety Commission
- Western Australian Local Government Association
- Institute of Public Works and Engineering Australasia.

The TREK2School research project (TREK project) an initiative in the Roadmap replicates an original study from 2005-07 and was undertaken by the Telethon Kids Institute for DoT, through the Planning and Transport Research Centre (PATREC), from 2021-2024. The TREK project findings show the complex interplay among individual, social and environmental factors affecting active travel to school. Despite significant built environment, technology (mobile phones) and cultural changes, there are persisting barriers relevant for DoT and key stakeholders to consider when addressing the decline of active travel to school and improving road safety outcomes.

Results

Progress has been made on 15 of 24 initiatives of the Roadmap and the Active Travel to School Working Group is a strong example of inter-departmental collaboration, with a growing network of partner agencies and stakeholders involved in information sharing and problem solving across multiple business areas (DoT, 2023).

Along with strong results from business-as-usual initiatives across Working Group organisations, research work completed in 2023 will have a positive flow-on effect. In particular, the report from PJA on school transport planning gaps and completion of the TREK2School study provide important context and insight to support the completion of additional Roadmap initiatives going forward.

TREK2School Study revealed the car was the most common mode for trips to and from school (54%), with 45% of trips by active modes, mostly walking (25%) and bike riding (16%). The mean distance from school was 2.22km; 65% of students living within 2km. Proximity to school suggests potential for more active travel and most students (64%) want to walk and ride. Parents support more walking (78%) and riding (73%) by their children. Parents and students said safety concerns were a barrier, including risks associated crossing roads. Interventions selected by the most participants to support active travel were safe crossings, more paths, dedicated bike paths, improved bus/train services and stops and more shade.

Implications for policy and practice

The practical application of the social- ecological model to implementation of initiatives will inform further development in practice and application of models and highlight the importance of evidence-informed, intersectoral, interdisciplinary, and collaborative policymaking is needed to enable safe active travel to school (Barros, 2024). The case study example of the TREK2School Study provides insights into how students travel to primary schools, factors influencing these choices and potential interventions to increase safe active travel. Safe road crossings and more paths were rated highly by parents and students. These findings will inform efforts by state government agencies and local councils to enhance active routes to local primary schools.

References

Barros, P., Henrique Guerra. P., Khan, M., and César Fermino, R. (2024). Prospects for research, policymaking, and urban design practice on active travel to/from school, Journal of Transport & Health, Volume 38, 2024. Prospects for research, policymaking, and urban design practice on active travel to/from school - ScienceDirect

Dinh, DD., & Kubota, H. (2013). Drivers' perceptions regarding speeding and driving on urban residential streets with a 30km/h speed limit. *International Association of Traffic and Safety Sciences Research, 37(1),* 30-38. https://doi.org/10.1016/j.iatssr.2012.12.001

Gannett, A., Hooper, P., Saunders, J., & Trapp, G (2024). Investigating the walkability of primary, secondary and K-12 schools across metropolitan Perth, Western Australia. Geo Journal 89-53. Investigating the walkability of primary, secondary and K-12 schools across metropolitan Perth, Western Australia | GeoJournal

Hobday, M, and Meuleners, L, (2018) Child and adolescent pedestrians and cyclists in Western Australia: how safe are they? report prepared for the Road Safety Commission by the Curtin-Monash Accident Research Centre, Child and adolescent pedestrians and cyclists in Western Australia: How safe are they?

Trapp, G.S.A., Giles-Corti, B., Christian, H.E., Timperio, A.F., McCormack, G.R., Bulsara, M.K. & Villanueva, K.P. (2013). Driving down daily step counts: The impact of being driven to school on physical activity and sedentary behavior. Pediatric Exercise Science, 25(3), 337-346. Driving down daily step counts: the impact of being driven to school on physical activity and sedentary behavior - PubMed

Western Australian Department of Transport. (2020). Discussion paper: The declining rate of active travel to school in Perth. WA Department of Transport. https://www.transport.wa.gov.au/activetransport/active-travel-to-school.asp

Western Australian Department of Transport. (2023). Active Travel to School Roadmap 2023-2030. WA Department of Transport. https://www.transport.wa.gov.au/activetransport/active-travel-to-school.asp

Western Australian Department of Transport. (2024). Active Travel to School Roadmap 2023-2030: Progress Report. WA Department of Transport. https://www.transport.wa.gov.au/activetransport/active-travel-to-school.asp

Raising guidance for Queensland Raised Crossings

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Abstract
This extended abstract describes work undertaken to improve technical guidance around raised crossings in Queensland. The work helps address practitioner concerns around use of raised crossings in a variety of contexts including multi-lane and 60 km/h roads. The work included observational studies of crossings, engagement with practitioners and reviewing and drafting updates to guidance. The paper aligns with the conference themes of equity and evolution. The proposed treatment helps to support equitable access and safety for vulnerable users, by controlling motor vehicle speeds at crossings. The project shows how experiences with transformational, safe system treatments can be captured to expand their applicability and reach. The project also shows how treatments initially focused on addressing the needs of one user group can evolve and expand to meet the needs of different users.

Social media post
Queensland continues to invest in improving understanding of raised crossing operations and design, by capturing findings from observation research and case studies into technical guidance updates.

Introduction
In 2024, sixteen percent of road fatalities in Queensland were people walking, cycling and using personal mobility devices or mobility aids (TMR, 2025). These users face significant risk of death or serious injury if hit by a motor vehicle at more than 30 km/h. Pedestrians are most exposed to vehicles when crossing roads, and 27 % of pedestrian deaths and 56% of cyclist deaths occur at intersections (Office of Road Safety, 2021). Road crossings can also evoke fear in users. Parents and students assessed refuges and unprotected crossings at side roads or mid-block, as the riskiest types of crossings (Swaine et al., 2023).

Safe System principles are now referenced extensively in Austroads. The guides recognise 30 km/h as the safe system threshold for a crash between a pedestrian/cyclist and a motor vehicle. While the principles are well-established, more work is needed to endorse treatments that enact principles in different contexts. This is especially important for people walking and riding, as most pedestrian and cyclist fatalities occur on roads with speed limits of 50 km/h or 60 km/h.

Raised crossings provide priority to path users and are typically designed to reduce vehicle speeds at crossings by up to 20 km/h (Transport for NSW, 2025). This reduction in speed reduces both the likelihood and severity of crashes, establishing raised crossings as a transformational safe system treatment. Safety benefits of these crossings is reflected in their 63% Crash Reduction Factor (CRF) (Austroads, 2023). This exceeds other at grade crossings safety benefits, including signals (45%) and refuge crossings (56%). Raised crossings also have safety and accessibility benefits. Signalised crossings can cost 3-4 times as much as raised crossings. Median refuge crossings are relatively low cost. However, they do not control vehicle speeds to within safe system thresholds and feedback from communities and disability groups indicate they are not accessible for all users.

Conference Theme
This paper aligns with the Evolution theme, being the alignment of guidelines with the safe system.

Approach
This project sought to capture road design and operational data from existing raised pedestrian/priority crossings in Queensland, to support decision making around planning and design for future crossings. The project included two stages including an observation study and updates to technical guidance (see Figure 1).

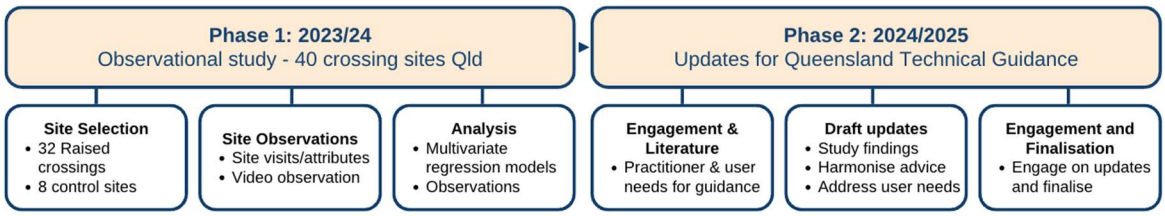


Figure 1. Process overview for the raise crossing program

The observational study considered 40 Queensland crossing sites. This included 32 raised crossings (21 at side roads and 11 midblock) and 8 control sites. Control sites included a refuge, at-grade zebra crossings and uncontrolled crossings at side roads (See Figure 2). Several crossings were on streets with more than one vehicle lane in the same direction, or a posted speed limit of 60 km/h, which is not supported in current practice (Australian Standards, 2025). Ramp gradients on raised crossings ranged from 1:542 to 1:9 (midblock sites) and 1:44 to1:6 (side roads).

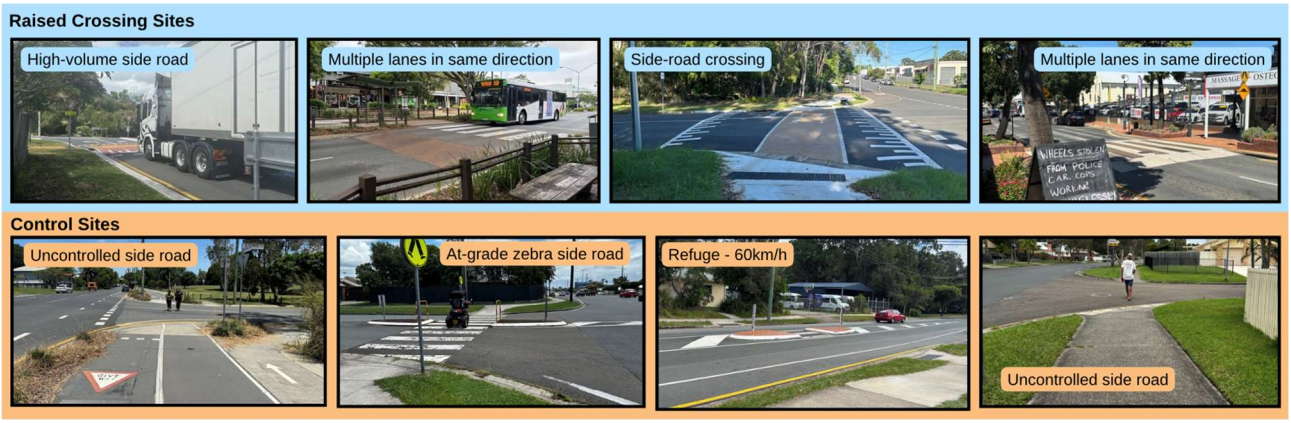


Figure 2. Examples of sites raised crossing sites and control sites from the study

Findings

Almost 1,500 interactions between path users and vehicles were recorded and analysed, with key findings shown in Table 1. The highest number of interactions were recorded at crossings near schools, town centres and a major Brisbane bikeway. Average motorist speeds at mid-block raised crossing sites were 18 km/h lower than control sites. Interaction severity was measured on a scale from 1 to 5, whereby 1 was 'no adjustment' of path and 5 was 'collision. The highest severity recorded was 'Near collision'. Two of these events were recorded, both at control sites. One was a refuge crossing on a 60 km/h street. The other was an at grade zebra crossing at a side road with an arterial road. No 'near collision' or 'major adjustment' events were recorded on mid-block raised crossings, including those on multi-lane roads, or roads with a 60 km/h posted speed limits.

Implications for policy and practice

Draft updates were to several guidelines were then developed capturing the most important study findings, feedback from stakeholders, information gathered from further research, and additional information and case studies. Connected vehicle data was also used to verify treatments not included in the observational study. Updates were workshopped internally with road safety, road design and walking and cycling teams before being shared externally. Table 2 summarises the most important content changes. The updates capture case studies and research demonstrating effective use of speed humps or speed cushions at crossings on 60 km/h roads. This is expected to help address safety and accessibility issues at these sites.

Updates also drew upon previous studies into multi-lane crossings and developed signage and line marking schematics to mitigate risks at these sites (see Figure 3).

Table 1. Overview of findings from literature review to inform curriculum for program

Crossing	Attribute/Element	Raised Crossing Sites	Control Sites
All sites	Range of vehicle volumes	52 - 9050 vpd	200 – 7,400 vpd
	Range of path user volumes	9 – 1,277 users per day	27-513 users per day
	How path users approach crossings	Vast majority of path users slowed or scanned the road before entering crossings at all sites	
	Highest interaction severity events	• Near Collision - 0 sites • Major adjustment – 3 sites (raised priority crossings)	• Near Collision - 2 sites (refuge, at-grade zebra at sideroad) • Major adjustment - 2 sites (midblock at grade zebra, untreated side road)
Midblock	Average motorist speed	25 km/h	43 km/h
	Impact of crossing attributes on motorist speed	Speed ↓ 2.3 km/h/ramp grade (°) Speed ↑ 0.6 km/h/m crossing	
	Interaction severity	1.53	1.82
	Impact of crossing attributes on vehicle speed	Speed ↓ 0.6 km/h/ramp grade (°) Speed ↑ 0.5 km/h/m crossing Speed ↑ 0.05 km/h/m sight distance	
	Average interaction severity	1.49	1.94

Following the observational study, interviews were conducted with practitioners and accessibility experts to understand priorities for improving guidance. Figure 2 summarises the focus areas for improvement identified in these discussions.

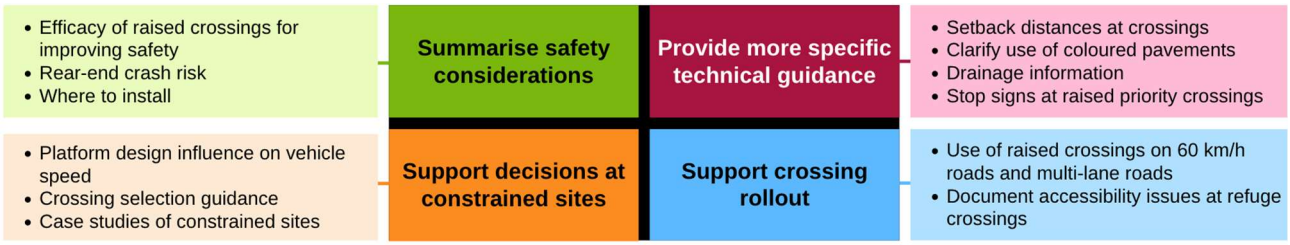


Figure 2. Summary of issues identified in interviews with stakeholders

Table 2. Key changes to Queensland crossing guidance

Guide	TMR Raised Priority Crossing Guideline	QGTM-6 Intersections, Interchanges and Crossing Management	MUTCD-10 Pedestrian Control and Protection
Key Content changes	Include findings from observational study, case studies, and background information to support planning and design decisions.	Describe benefits of different crossing treatments to capture accessibility issues and better align with guidance in AGRS.	Requirements raised pedestrian crossings. Replace *Posted Speed* with *Operational Speed* at crossing (85^{th}% < 50km/h). Remove requirement for no more than one lane of vehicles in any direction, and introduce requirement for Safe System Assessment and line marking arrangements to improve visibility at multi-lane crossings

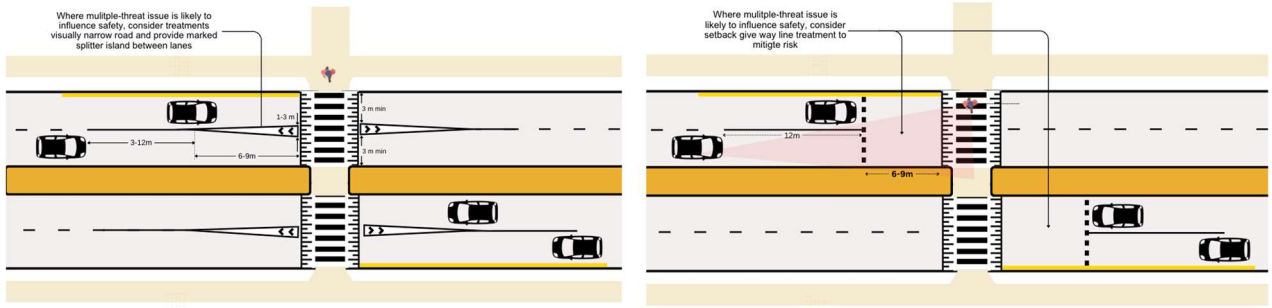


Figure 3. Extract from proposed updates - pedestrian crossing on multi-lane roads

Conclusions

Raised crossings are considered transformational safe system treatments because they reduce the likelihood and consequences of crashes occurring. These treatments can improve safety and accessibility in a broad range of contexts and address some of the challenges road authorities face with implementing crossings on roads to manage safety and accessibility issues for users. The proposed guidance changes will look to better align safe system outcomes for all road users at crossings.

References

Australian Standards (2025). 1742.10 Pedestrian control and protection.

Austroads (2023). Pedestrian crossing selection tool. *Austroads* Pty Ltd. https://austroads.gov.au/network-operations/active-travel/pedestrian-facility-selection-tool

Austroads. (2024). Guide to road safety part 3: Safe speed. *Austroads* Pty Ltd.

Office of Road Safety (2021). Fact Sheet: Vulnerable road users. Australian Government https://www.roadsafety.gov.au/nrss/fact-sheets/vulnerable-road-users (Accessed 2025)

Swain, R., Oswin, P., Truelove, V., & Larue, G. S. (2023). Children's and parents' perceptions on safe routes to schools: a mixed-methods study investigating factors influencing active school travel. *Journal of Urban Design*, *29*(2), 208–230. https://doi.org/10.1080/13574809.2023.2223517

TMR. (2025). Queensland road crash weekly report No 1404b -extracted 29/01/2025. Queensland Government

Transport for NSW (2025). Raised safety platforms – use at intersections. Accessed from https://standards.transport.nsw.gov.au/search-standard/

Understanding community views on road safety issues in WA

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Abstract
Community attitudes play a key role in determining both how people perceive safety on the roads and the extent to which governments take action to improve road safety. We conducted survey research across five years with 1,836 Western Australians, to understand community views on road safety issues in WA, and how to reduce the number of people killed and seriously injured (KSI) on our roads. Our survey research has found that people overwhelmingly believe driver related factors are the top contributors to KSI and believe that education and enforcement are the most effective solutions. Moreover, people believe other drivers are the problem and fail to recognise their own risky behaviour and fallibility. This focus on other drivers means that individuals are failing to consider road safety holistically and governments are not being held to account by the community on their obligation to provide a safe road system.

Social media post
Survey research seeking to understand community views on road safety issues in WA finds that people overwhelmingly believe driver related factors are the top contributors to death and serious injury on our roads, presenting a challenge to road safety practitioners and the Safe System approach to road safety.

Background
Community attitudes play a key role in determining both how people perceive safety on the roads and the extent to which governments take action to improve road safety. However, according to Job, Troung and Sakashita (2022), the community is often misled in its understanding of road safety, which still relies heavily on a road user responsibility and victim-blaming approach. This victim-blaming approach reinforces community misunderstandings of the Safe System and reduces demand on politicians to take a systems approach to road safety interventions. Compared to this road user centric mentality, there is a lower level of appreciation in the community for the impact that life-saving interventions from other elements of the road system can have (e.g., safer speeds, infrastructure and vehicles).

It is important to consider road users' attitudes and beliefs to achieve equitable safety outcomes. As noted in *Driving Change: Road Safety Strategy for Western Australia 2020-2030* (Road Safety Commission, 2020), it is necessary to balance what road users have to say with experience and qualified expert advice, to address the most significant road safety challenges. Where an imbalance exists between community beliefs and expert advice, herein lies the challenge for road safety experts to provide appropriate and holistic education in order to dispel common myths held by the general public about the road system.

Having a deeper understanding of community attitudes and beliefs can also be used to build education and awareness campaigns, and support for other evidence-based interventions such as shifting community attitudes towards safer speed limits, increasing support for investment into infrastructure solutions, and getting people into safer vehicles.

Conference Theme
This abstract relates to the ARSC 2025 theme of 'Evolution', including evolution of, and future challenges with, the Safe System, and will explore the community misunderstanding that responsibility for road safety lies with the road user and how we can address this challenge to change the rhetoric about the Safe System from being road user focused to thinking about the road system as a whole.

Approach
Our road safety Member Priorities Tracker is an ongoing survey which has been running each year since 2020, and explores participants' views on road safety issues in WA, and what could be done to reduce the number of KSI on our roads.

The survey is distributed to a random sample of approximately 10,000 of our Western Australian members around April each year and typically captures feedback from 300-500 members. The results are post-weighted by age to be broadly

representative of the WA population profile. Our road safety Member Priorities Tracker survey provides a time series of community attitudes and can be used as a research tool for government and industry.

Results and Findings

Where the survey questions have been asked across the five-year period (2020-2024), the results have been relatively stable over time, indicating that community perceptions have remained consistent. The key findings from the quantitative research, based on 1,836 respondents over the five-year period are:

- The vast majority [80 per cent] rate themselves as excellent or good drivers, with 67 per cent believing they are better or much better than other drivers on WA roads.
- Driver related factors (e.g., driver behaviour, driver mistakes and driver skills) are consistently rated as being the top three biggest contributors to KSI. On average over the last five-years:
    - 81 per cent included 'driver behaviour (e.g., not wearing a seatbelt, speeding, drink/drug driving)', 81 per cent included 'driver mistakes (e.g., due to inattention, fatigue)', and 70 per cent included 'driver skills (e.g., not knowing the road rules, poor driving ability)' in what they believe are the top three biggest contributing factors.
    - Comparatively, options that are also fundamentally related to the other Safe System pillars come out far lower. 25 per cent included 'high traffic speed' in their top three, followed by 20 per cent for 'road conditions', 15 per cent for 'road design', and 5 per cent for 'vehicle safety e.g., condition, safety rating, age'.
- Respondents are most likely to select tougher penalties for risky driving behaviours [54 per cent] and more road user education [51 per cent][1] as extremely or very effective ways to reduce fatalities and serious injuries on our roads.
- When it comes to the most effective interventions related to the Safe System pillars, 52 per cent of respondents across the 2021-2024 surveys selected safer road user interventions, 39 per cent for safer roads and roadside interventions, 4 per cent for safer speeds interventions and 4 per cent for safer vehicles interventions.
- Despite the focus on other drivers as a key contributor to road trauma, 83 per cent of respondents in the 2023 and 2024 surveys admit to having performed one or more high-risk illegal behaviours in the past year[2]. It's likely these figures are underreported.
- Consistent with the view that drivers are the biggest contributors to road trauma, 6 in 10 (61 per cent) respondents to the 2024 survey believe that road users have the most responsibility for addressing KSI on WA roads, far higher than the proportion selecting the WA Government (20 per cent), Australian Government (7 per cent), WA Police Force (5 per cent) and local WA councils/WA Local Government Association (5 per cent).
- 71 per cent of respondents believe that governments should do more to reduce KSIs on our roads, but only 34 per cent believe both sides of politics are working together to do so.

Qualitative free-text analysis shows members highlight concerns about risky behaviours such as speeding, driver inattention (e.g., using mobile phones while driving), and driving under the influence of alcohol or drugs, with other concerns including driver fatigue and aggressive driving (e.g., tailgating and unsafe overtaking).

In an effort to gain a deeper understand of member perceptions on road safety issues, we deployed an artificial intelligence chatbot in our 'Members Voice' community, to have confidential one-to-one discussions with more than 500 members. The findings from which would be presented at the conference.

Implications for policy and/or practice

Since the Member Priorities Tracker survey commenced in 2020, the strongest theme that has emerged is the belief that KSI is an issue which can largely be attributed to other drivers despite the majority of respondents having engaged in illegal and unsafe behaviours themselves. It is important to consider how to educate the community that humans are fallible and make mistakes, and that we must ensure that when this does happen, these crashes should not result in fatal or serious injuries. Designing a road system to protect the road user involves many layers of intervention beyond just road user interventions (e.g., infrastructure treatments, safer vehicles, speed limit reductions, and education and training).

[1] With the exception of 2020 where the option of selecting 'Tougher penalties for risky driving behaviours e.g., drink/drug driving' was not provided.
[2] *High-risk behaviours include behaviours such as driving over the speed limit, using a mobile phone, driving tired, failing to give way when merging, drink driving, driving without a seatbelt, not allowing a safe passing distance for cyclists and tailgating.

According to Job and Sakashita (2012), the Safe System approach may be actively resisted by the community, with suggestions that we are being "wrapped in cotton wool or living in a 'nanny state'" (p. 2). With these attitudes being prevalent in the Australian community, there is little political motivation to fully adopt a Safe System approach to road safety. The most effective way of addressing this issue is to provide education to the community in Safe System principles. Job and Sakashita (2012) recommend for the inclusion of Safe System principles in school programs on road safety to increase community understanding of road safety and demand on governments to effectively address the risks of the road system they operate.

Survey trackers are an effective way to identify the nature and prevalence of road safety misconceptions in the community and to monitor whether education activities are effective in shifting attitudes over time. Our Member Priorities Tracker results indicate that current road safety education is insufficient to address misconceptions around the Safe System. Until this is addressed, road safety interventions focused around education and enforcement are likely to remain the most popular with the community and hence will be attractive to decision makers.

Conclusions

Community attitudes play a key role in determining both how people perceive safety on the roads and the extent to which governments take action to improve road safety. Our annual survey research between 2020 and 2024 has found that people overwhelmingly believe driver related factors are the top contributors to KSI. They also tend to believe that the most effective solutions should focus on education and enforcement, rather than holistic solutions across all pillars of the Safe System. Changing community attitudes away from road user-centric victim-blaming approach and towards a more holistic view of road safety will take time. The most effective way of addressing this issue is to provide education to the community in Safe System principles, such as the inclusion of Safe System principles in school programs on road safety. Community research, engagement and education can help government and industry achieve a cultural shift away from blaming other drivers and build support for initiatives that will help reduce road trauma.

References

Job, R. F. S., & Sakashita, C. (2012). Combining safe system principles and road safety education in schools: An Opportunity for improved demand on road system operators and a broader understanding of risk and safety. *Australasian Road Safety Research, Policing and Education Conference, 2012, 4-6 October*, Wellington, New Zealand.

Job, R. F. S., Truong, J., & Sakashita, C. (2022). The ultimate safe system: Redefining the safe system approach for road safety. *Sustainability, 14*, 2978. https://doi.org/10.3390/su14052978

Road Safety Commission. (2020). *Driving change: Road safety strategy for Western Australia 2020-2030*. https://www.wa.gov.au/system/files/2021-07/Driving-Change-Road-Safety-Strategy-2020_2.pdf

Helmet quality and use behaviour among motorcyclists in Tamale, Ghana

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Abstract
In Ghana, it is mandated that all motorcyclists wear protective crash helmets as prescribed by regulations. However, the country does not have helmet standards, and the details of a prescribed helmet are not specified in the Road Safety Act. This study, therefore, examined the quality of helmets, use behaviour and associated factors among motorcyclists. A standard helmet inspection and evaluation form was used to assess the helmets. Helmets were classified as "quality helmets" if all evaluation criteria were met, such as shell, energy-absorbing layer, comfort liner, chinstrap, and compulsory labelling. 607 helmets were assessed; most (87%) were open-face helmets. 36% were second-hand, and all the helmets had hardcover shells. 4% had no energy-absorbing layer, 7% had no comfort liner, 15% had no chinstrap, and 90% lacked certification stickers. A few riders exhibited good helmet-use behaviour, with factors such as age, education level, license possession, and helmet ownership influencing proper use.

Social media post
Not all helmets offer real protection! putting riders at risk. It's time for a policy change to ensure that only certified helmets are sold in Ghana!

Introduction
Motorcycle use in Ghana has experienced a significant surge over the past two decades and has become the dominant mode of transportation in some parts of the country. Motorcycle registrations account for about 90% of all vehicles in the Volta, Upper West, Upper East, and Northern regions of Ghana (Afukaar & Damsere-Derry, 2019). With this change in the traffic mix, there has been a considerable rise in injuries and fatalities associated with motorcycle use. Motorcycle-related fatalities have nearly quadrupled, with a marked increase from 42 fatalities in 2000 to 915 fatalities in 2021 (Ackaah et al., 2022)

Helmet use has been recognised and accepted as an effective measure to prevent serious injuries and fatalities from motorcycle crashes (WHO, 2023). However, it is also well established that using poor-quality helmets reduces their effectiveness in preventing fatality and severe head injuries. Like other countries, the Ghana Road Traffic Act, 2004 (Act 683) mandates all riders and pillion riders to wear protective crash helmets as prescribed by regulations. However, the details of a prescribed helmet are not detailed in the Road Safety Act because the country does not have helmet standards and regulations for helmet importation. It is possible that even those using helmets are not being provided optimal levels of protection from appropriate, high-quality helmets.

Before our study, no study in Ghana had examined the quality of motorcycle helmets and use behaviour among those who own helmets. Our study, therefore, sought to fill these gaps in knowledge by evaluating the quality of motorcycle helmets and the use behaviour among motorcyclists.

Conference theme
Our study addresses the equity component of the conference theme. The study highlights disparities in access to quality helmets among motorcyclists in Ghana. By identifying these disparities, our study supports the need for policies that promote equitable access to quality helmets and regulatory standards to ensure that all road users have the means to protect themselves effectively.

Method
A cross-sectional study was conducted in the Tamale Metropolis among motorcycle helmet users. Respondents were recruited from randomly selected fuel stations and public places where motorcyclists usually stop between February and March 2024. Due to the low helmet use rate reported in the area, all motorcyclists who had helmets and stopped at the selected sites were approached and invited to participate in the study. Helmets used by the motorcyclists who accepted

and consented to participate in the study were taken and assessed using a standard helmet inspection and evaluation form (Hung et al., 2008). And the basic 8+2 photos of the helmets were also taken for further quality assessment. The criteria for the assessment were the presence of a hardcover/shell, energy-absorbing layer, comfort liner, retention system and compulsory labelling (name and address, size, date and certification sticker). Helmets were classified as "quality helmets" if all criteria were met. We also observed helmet use behaviour, such as wearing the helmet on the head, adjusting it correctly, chinstrap properly engaged, etc., as they approached the stop. . Data was summarised using frequencies and proportions. The overall proportion of quality helmets was reported with its 95% confidence interval. A chi-square test was used to assess the association between helmet quality and place of purchase. Helmet use behaviour was dichotomised as 0 “Bad” and 1 “Good”. A motorcyclist was assigned 1 when all preferred choices of the questions on use behaviour were selected and 0 if otherwise. Univariate and multivariable logistic regression were performed to identify factors influencing helmet use behaviour. Independently significant variables ($p \leq 0.05$) at the univariate level were added to the multivariable model. The automated stepwise approach was used to add variables to the multivariable logistic regression model until a parsimonious model was achieved. We computed confidence intervals at a 95% confidence level, and a p-value less than 0.05 was considered statistically significant for the final model.

Results

A total of 607 motorcyclists with helmet(s) were recruited for the study. A greater proportion of the motorcyclists were males (74.5%) and aged below 36 years (60.5%). A higher proportion of the riders had tertiary education (58.8%) and were self-employed/informal occupations (41.2%). Of the helmets we assessed, the majority (87%) were open-face, 6% full-face helmets, 5% module (chin bar flips up) and 2% half-face helmets. 36% of the helmets were second-hand (not new) when bought.

All the helmets had hardcover shells (6% damaged), 4% had no energy absorbing layer, 7% had no comfort liner (15.5% of those with comfort liners had damage), and about 15% had no retention system (12% of those with retention systems had damage). 79% had no name and address of the manufacturer, 76% had no size designation, 96% had no date of manufacture, and 90% had no certification sticker. Overall, the proportion of good-quality (standard) helmets was 34.7% (95% CI: 31.0% to 38.5%). Good quality helmets were associated with places of purchase ($p<0.001$). A greater proportion of helmets purchased from friends/colleagues (64.7%), general shops (59.1%), and street vendors (47.3%) were of good quality than those that came with motorcycles.

Regarding helmet use behaviour, 58% of the riders wore the helmet on their head, of which 84% were properly adjusted, and 56% had engaged the chinstrap correctly. 88% of the helmets were of acceptable fit for the riders, and 43% indicated they always wear them. Overall, 18% of the riders had good/proper helmet-use behaviour.

The logistic regression identified factors such as age (increasing), education (higher level), occupation (professionals), riders with licenses, helmet ownership and helmet state to significantly influence proper helmet use behaviour (Figure 1).

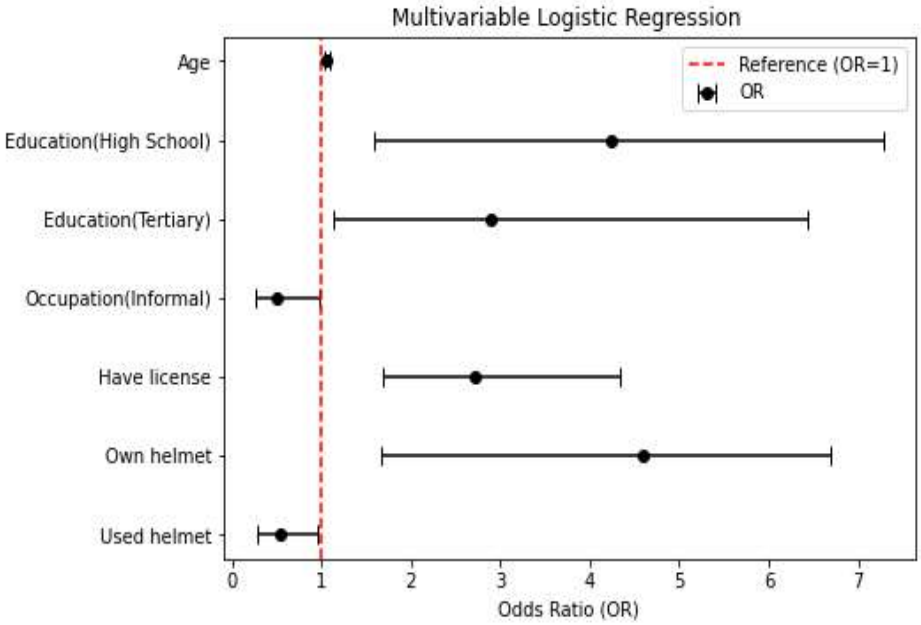


Figure 1: Multivariable logistic regression of factors influencing helmet use behaviour

Benefits to road safety

Ghana is currently planning to legalise the use of motorcycles for commercial purposes. As this is done, their use to carry passengers will increase, and they will need to be protected. The findings from this study will inform the development of helmet standards, importation guidelines, and interventions on the proper use behaviour for utmost protection.

Implications for policy and practice

The study highlights the urgent need for motorcycle helmet standards in Ghana. The national road safety authority, national standard authority, and other road safety stakeholders should develop, implement and enforce mandatory helmet standards to ensure that only certified, high-quality helmets are imported, sold, and used.

While helmet use is legally mandated, improper use (e.g., loose chinstraps, poorly adjusted helmets) reduces protection. Hence, law enforcement agencies and the road safety authority should ensure proper helmet use through targeted enforcement and awareness campaigns. When standards are developed, penalties for importing and using substandard helmets should be considered, alongside public education on identifying standard helmets.

Conclusion

Most motorcycle helmets in the Tamale area are of poor quality, highlighting a significant issue in the country's road safety measures. The large proportion of poor-quality helmets could be due to the lack of helmet standards in the country, which calls for the development and implementation of helmet standards. Therefore, there is a need for Ghana to develop and implement helmet standards, strengthen enforcement, improve public awareness, enhance affordability, and integrate helmet safety into licensing programs. Also, most riders had poor helmet-use behaviour, with age, education, occupation, riders with licenses, helmet ownership and helmet state influencing proper use. This also calls for public education and awareness on the proper use of helmets to enhance road safety for motorcyclists.

References

Ackaah, W., Agyeman, W., Larbi, J., & Larley, J. (2022). *Road Safety Crashes in Ghana Statistics 2021*.

Afukaar, F., & Damsere-Derry, James. (2019). Facilitation Services for Consultation on Motorcycles Operation in Ghana. In *ReCAP | Facilitation Services for Consultation on Motorcycles Operation in Ghana* (Vol. 1).

Hung, D. V., Stevenson, M. R., & Ivers, R. Q. (2008). Motorcycle helmets in Vietnam: Ownership, quality, purchase price, and affordability. *Traffic Injury Prevention*, *9*(2), 135–143. https://doi.org/10.1080/15389580701882607

WHO. (2023). HELMETS A road safety manual for decision-makers and practitioners.

Understanding inequity in pedestrian safety outcomes

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Abstract
Both Australia and New Zealand are falling behind in their progress to achieve road safety objectives, underscoring the urgent need for bold and transformative action. The purpose of this research is to inform and contribute to efforts to achieve Australia and New Zealand's road safety vision, with a focus on understanding pedestrian safety outcomes through an equity lens. This research is funded by Austroads, and is progressed through the Keeping People Safe When Walking Austroads project. The paper presents research insights on cohorts that are over-represented in pedestrian trauma and seeks to describe how and to what extent they are overrepresented. The implications of an equity lens in a Safe System approach for pedestrians, are also considered.

Social media post
Vision Zero for pedestrians. How does an equity lens help us better understand pedestrian safety for different groups. Would the Safe System approach benefit from inclusion of an equity lens, specifically for pedestrian safety? #PedestrianSafety #VisionZero #Equity

Introduction
Both Australia and New Zealand are falling behind in their progress to achieve road safety objectives, underscoring the urgent need for bold and transformative action. The purpose of this research is to inform and contribute to efforts to achieve Australia and New Zealand's road safety vision, with a focus on understanding pedestrian safety outcomes through an equity lens.

Progress in reducing pedestrian deaths has stalled in the past decade, with an average of 158 a year in Australia and a reduction only during 2020 and 2021, likely due to COVID-19 disruptions. Similarly, pedestrian hospitalisations plateaued between 2012 and 2021, at an average of 2,578 per year. Current road safety approaches will not achieve Australia or New Zealand governments' long-term road safety objectives – transformative actions are required. A growing and ageing population will only exacerbate the challenge.

The data analysis in this report finds that pedestrians made up 13% of road fatalities and 14.4% of hospitalisations in Australia between 2012 and 2021. In New Zealand, between 2017 and 2021, 9% of road trauma hospitalisations were pedestrians (Isles et al., 2024). The data analysis found pedestrians are more likely to die than other road users when seriously injured in a road crash. Nearly 6% of all serious and fatal pedestrian injuries in Australia result in death, compared to just under 4% for vehicle occupants.

The methodology includes analysis of road safety data for Australia, New Zealand and Queensland. This research seeks to identify groups that are over-represented in pedestrian trauma and describe how and to what extent they are overrepresented, and explore causal factors, seeking to explain why these groups are over-represented. Utilising newly available data, this report will provide the most comprehensive and nuanced picture of pedestrian safety for different groups in Australia and New Zealand produced to date.

Please note that the research project is in progress, and while this abstract reports primarily (but not only) on Australian pedestrian safety data, the presentation will include a comprehensive analysis of both Australian and New Zealand data, augmented by the Queensland data.

Australian Road Safety Data
The National Road Safety Data Hub aims 'to provide nationally consistent, timely and consumable data and information to support the prevention of fatal and serious injuries on Australian roads (Australian Government, n.d.). This data provides an understanding of crashes across Australia and is used to report progress against the 2021-30 National Road Safety Strategy. The Data Hub was first launched in 2024, before which no single, consistent dataset for road crashes in

Australia was publicly available. The data is collected by police and hospitals and collated at the federal level by the Office of Road Safety and Bureau of Infrastructure and Transport Research Economics (BITRE). At the time of writing in January 2025, it included:

- a dashboard displaying progress towards the National Road Safety Strategy
- fatality data (available from 1989 up to the end of 2024)
- hospitalisation data (available from 2011 to the end of 2021).

Further data about hospitalised injuries was provided by Australian Institute of Health and Welfare (AIHW) as a custom data request, covering the 10-year period 2013 to 2022 inclusive. Unless otherwise specified, these data sources form the basis for the analysis of Australian pedestrian trauma presented in this abstract.

New Zealand Road Safety Data

New Zealand fatality and serious injury data used in this analysis comes from the NZ Ministry of Transport website. The Open Data tool provides annual statistics for the period 1990 to 2023, while provisional road death data is updated daily and was accessed in January 2025. Data is based on crashes reported by the New Zealand Police.

What is equity and why does it matter for pedestrian safety?

Pedestrian inequity refers to the unfair and avoidable disparities in pedestrian safety shaped by personal circumstances or social and environmental factors. It is very difficult to separate inequity in pedestrian safety from broader social inequity. Many of the groups that face greater levels of pedestrian trauma are more broadly disadvantaged in society.

Equity in access to transport and equity in pedestrian safety are particularly intertwined. People without access to a private vehicle (whether voluntarily or involuntarily) may be forced to walk and so more likely to encounter pedestrian safety issues. This may impact their ability to travel, resulting in them being excluded from daily activities. Those with more choice may be deterred from walking by perceived or actual road safety concerns.

Equity is not the same as equality (Pereira & Karner, 2021) i.e., everyone being given the same resources and opportunity. Equity recognises the existing unequal distribution of resources, opportunities and responsibilities (drivers have a much greater potential to cause injury to others, for example) and aims to allocate them in a way that reduces the gap between advantaged and disadvantaged groups.

In considering inequity between modes of transport, walking has tended to be neglected compared to vehicles and so there is now a need to prioritise safe walking in road management to provide equity. Similarly, action is needed to address inequity of pedestrian safety outcomes between places and groups of people.

Differences in Pedestrian Fatalities and Serious Injuries

Older Australians

In Australia, people aged 60 or older are 2.5 times more likely to die in a traffic collision as a pedestrian than those under 60. The risk continues to increase through older age and is especially acute for those over 80 years old. Increasing physical and cognitive limitations may affect older people's mobility and safety, including their ability to select gaps in traffic that match their capacity, and these factors may make older people more likely to be hit by a vehicle. However, their physical frailty and resulting susceptibility to injury once they are hit is likely to be the most important reason for their over-representation in fatality and injury statistics. A study in Victoria found the fatality risk when walkers are involved in a crash is almost three times higher for people aged 75-84 and five times higher for people 85 or older (Mantilla & Burtt, 2016). They are at a significantly higher risk of injury in low-speed crashes than other adults. Older pedestrians also have the highest rate of hospitalisation but are not over-represented in injuries to the same extent that they are in fatalities.

Children and Young People

Road trauma in general is the leading cause of death for 1–14-year-olds in Australia (AIHW, 2024) and one of the top ten causes of death for this age group in New Zealand (Environmental Health Intelligence, 2024). Parental concerns around road safety are a contributing factor to the decline in walking rates amongst children. Although statistics generally do not account for exposure to traffic risks – young children in particular are unlikely to walk independently compared to older age groups. Children have particular risk factors associated with their smaller size and capacity to judge traffic. Very young children are particularly at risk of being injured or killed by slow-moving vehicles in off-road locations like driveways and car parks. People aged 17-25 are also about 1.5 times more likely to be hospitalised than the average for all ages.

Gender
In Australia, males are nearly twice as likely to be killed when walking than females and 30% more likely to be hospitalised, and the reasons for this require further analysis and exploration.

First Nations and Māori people
When adjusted for population, First Nations people are 3.7 times more likely to be killed as pedestrians than non-Indigenous people and 2.6 times more likely to be hospitalised. Higher rates of vehicle overcrowding, unlicensed driving and reliance on unroadworthy vehicles are key factors linked to overrepresentation in road trauma generally and may also impact pedestrian safety. Additionally, after crashes, slower emergency responses and reluctance to use healthcare services due to cultural and practical barriers further increase the severity of outcomes, emphasising the importance of preventative measures. For First Nations people there is likely to be an interrelationship with geography and socio-economic factors, but these connections are still being explored, and early indications are they may not be entirely as expected.

Māori New Zealanders are over-represented in road trauma generally, but most of the literature so far reviewed does not detail outcomes for pedestrians. However, a review of child and youth mortality data found that Māori children have nearly double the pedestrian fatality rates of non-Māori children.

People with disability
People with disability face a higher risk of pedestrian motor vehicle collisions, injuries and fatalities with the risks sometimes further compounded by age (children or older people). A nuanced understanding of the diverse needs of people with disability is essential for the development of effective road safety policies as the challenges and requirements vary widely between groups. Similarly, people with intellectual disability, autism or ADHD have unique challenges as they may have trouble with safe gap selection, and busy or complex environments.

Socio-economic status and Geography
There is a substantial degree of intersectionality or overlap of groups who may be disadvantaged or over-represented in pedestrian trauma. A notable example is that older people are much more likely to have disability or mobility limitations than younger people. There is also a strong association between socio-economic status and geography. Lower socio-economic areas are also associated with less safe walking conditions.

Jurisdictions, Remote and Regional Areas
The Northern Territory has a much higher rate of pedestrian fatality than other states, 6.5 times that of the rest of Australia when adjusted for population. Remote areas of Australia have a high rate of pedestrian injury – 16 per 100,000 population compared to 11 in major cities. Other regional areas have a lower rate of injury than major cities (7 per 100,000 people), but a similar rate of fatalities.

Falls
Falls in the street are a significant source of pedestrian injury, yet they are not recorded in road safety statistics. There is a high prevalence of falls amongst older people, which has critical implications for ageing countries. There is a strong case for including fall injuries that occur in the road network within road safety statistics, to the extent possible. The potential for falls and the need to avoid them should be a consideration in street design, construction and maintenance.

Implications of an equity lens in a Safe System approach for pedestrians

Though the Safe System approach represents a much-needed paradigm shift (Michael et al., 2021), there are still areas that would benefit from further developing and refining due to inherent weaknesses and limitations (Job et al., 2022). Consideration of equity is one of the most important ways to improve the Safe System approach to a level that is effective in achieving Australia and New Zealand's road safety vision where no one is killed or seriously injured.

Ensuring equity in safety outcomes within the Safe System approach, should involve prioritising pedestrians as road users unprotected against vehicles and recognising the specific risk factors that make certain groups of pedestrians more susceptible to injury than others. Efforts should also focus on understanding and addressing historical inequities in resource allocation, such as differences between inner-city and outer-suburb infrastructure and the uneven distribution of transport burdens across modes and cohorts.

The research indicates that from a pedestrian safety perspective, there are matters that warrant further consideration within the Safe System approach as listed below:

- Inclusion of equity in road safety outcomes as an objective in road safety policy, strategy and planning;
- Pedestrians are not inherently vulnerable but are made vulnerable by fast-moving heavy vehicles;
- Prioritising pedestrians as road users unprotected against vehicles.
- Pedestrians should never be exposed to forces that are not survivable or could lead to long-term disability,

even when they or other road users make mistakes or take deliberate risks;
- Target action to address the uneven distribution of road safety outcomes across modes, cohorts, time and place.
- Shift from [equal] shared responsibility in creating a safe system to a greater responsibility on system operators and systemic solutions such as safer speeds;
- Addressing differences between inner-city and outer-suburban pedestrian infrastructure;
- The 'promise' of safer vehicles for pedestrian safety is largely offset by the growing size/mass of vehicles;
- Including fleet/vehicle size/mass in the safer vehicles domain.

By embedding these considerations into planning, design and implementation, the Safe System approach can move beyond general safety improvements to deliver equitable outcomes. Failing to do so risks not only falling short of equitable safety goals but also reinforcing existing inequalities.

References

AIHW (Australian Institute of Health and Welfare) (2024) Deaths in Australia. https://www.aihw.gov.au/reports/life-expectancy-deaths/deaths-in-australia/contents/leading-causes-of-death

Australian Government. (Not dated). *Office of Road Safety*. National Road Safety Data: https://www.officeofroadsafety.gov.au/data-hub

Environmental Health Intelligence. (2024). Road traffic injury mortality [Surveillance Report]. Wellington: Environmental Health Intelligence NZ, Massey University. https://www.ehinz.ac.nz/assets/Surveillance-reports/Released_2024/2024-transport-injury-mortality-final.pdf

Isles S, Kean M, Dipnall JF & Beck B (2024) 'Temporal trends of transport-related injuries on New Zealand roads', *New Zealand Medical Journal*, 137(1592), 43–53. https://doi.org/10.26635/6965.6342

Job RFS, Truong J & Sakashita C (2022) 'The Ultimate Safe System: Redefining the Safe System Approach for Road Safety,' *Sustainability*, 14(5), 2978

Mantilla J & Burtt D (2016) Safer Road Design for Older Pedestrians, Victoria Walks, Melbourne. Version 1.1. August 2016

Michael JP, Wells NM, Shahum L, Bidigare-Curtis HN, Greenberg SF & Xu T (2021) 'Roadway safety, design & equity: A paradigm shift', *Journal of Transport & Health*, 23, 101260

Pereira RHM & Karner A (2021) 'Transportation equity' in R. Vickerman (eds) *International Encyclopedia of Transportation.* Vol. 1, p. 271–277

Re:act for Change: engaging young Australians to reduce road trauma

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Abstract

Young people are over-represented in road trauma around the world. Outcomes from delivering a road safety behaviour change program over the past decade have reinforced reaching or engaging young drivers and vulnerable road users is a significant barrier to changing that. To address this, Re:act staged national 'Deep Dives' to hear firsthand from Australians aged 17-25 about their attitudes towards road safety and how to effectively engage and raise awareness via road safety communications among a typically hard-to-reach but over-represented cohort – and change their behaviour. The events, which included representatives from government, industry and road and workplace safety agencies listening to and interacting with young Australians, also examined young people's attitudes and awareness around two keys risks: mobile phone distraction and seatbelt use. Outcome reports captured their insights and common themes.
This presentation will share direct insights from young people living in metropolitan and regional areas in five Australian states.

Social media post

In 2024 and 2025, Re:act conducted national 'Deep Dive' events in Melbourne, Sydney, Brisbane, Perth, Adelaide and in Regional locations for government and industry to listen to young people's views and attitudes on road safety and how to better communicate and engage with them.

Overview

Young people are over-represented in road trauma around the world. Outcomes from delivering a road safety behaviour change program over the past decade have reinforced reaching or engaging young drivers and vulnerable road users is a significant barrier to changing that. To address this, Re:act staged national 'Deep Dives' (see https://reactforchange.org/react-amplify for more information and outputs) to hear firsthand from Australians aged 17-25 about their attitudes towards road safety and how to effectively engage and raise awareness via road safety communications among a typically hard-to-reach but over-represented cohort – and change their behaviour. The events, which included representatives from government, industry and road and workplace safety agencies listening to and interacting with young Australians, also examined young people's attitudes and awareness around two keys risks: mobile phone distraction and seatbelt use. Outcome reports captured their insights and common themes.
This presentation will share direct insights from young people living in metropolitan and regional areas in five Australian states.

Summary of work

In 2024 and 2025, Re:act conducted national 'Deep Dive' events in Melbourne, Sydney, Brisbane, Perth, Adelaide and in Regional locations for government and industry to listen to young people's views and attitudes on road safety and how to better communicate and engage with them.

The road safety concern and research

Young people are over-represented in road trauma, with Australian 17-25 year olds recording the highest overall fatality and hospitalised injury rate of any age group, a fatality and hospitalised injury rate both approximately 75 per cent higher than the overall national rate (BITRE, 2025).

While an elevated propensity for risk-taking and inexperience are major factors in this over-representation, inability to engage young audiences with road safety messaging is also a significant contributing factor (Lewis, 2021; Rahman, 2025).

Qualitative and quantitative research conducted by Re:act (unpublished) with thousands of young people over the past decade has consistently reinforced that 'traditional' approaches to road safety campaigns, particularly those that leverage negative scare tactics, do not work for young audiences, and traditional channels do not reach them. In short, the campaigns are not visible where young people 'are'. The Deep Dives tested (and ultimately supported) these findings.

These outcomes are reinforced by research showing the value of peer-to-peer messaging in reaching young audiences (Lewis, 2016; Lewis, 2021; Hess, 2025).

Conference theme

The Re:act Amplify Deep Dive events outlined here align with the ARSC 2025 theme of Equity.

Young people, particularly 17-25 year olds, are over-represented in road trauma on Australian roads, in part due to the challenges in reaching them with effective behaviour change messaging. There is a disconnect between this over-representation and young people's under-representation in the road safety space, particularly in creating peer-to-peer behaviour change campaigns that resonate with their own age group. The Deep Dives went some way to addressing this inequity by giving young people a platform to share their thoughts, treating their views with respect, and providing direct access to government and industry road safety communication decision makers.

The approach was validated with positive feedback from all participants, with young people expressing gratitude for the opportunity to have their voices heard and road and work safety practitioners highlighting the value of the bringing their young stakeholders to the table.

This approach is supported by the safe system methodology. 'Education and information' and 'safe people' are cornerstones of the safe system approach, which recognises each road user, treats each equally, and facilitates informed choices to improve road safety outcomes for all.

Details of the work

The Re:act Amplify Deep Dive events bring together 17-25 years olds with industry, government and road and work safety agencies to share insights around young peoples' knowledge of and attitude to mobile phone distraction and seatbelt use as well as thoughts on how road safety communication could be more effective in influencing the behaviours of young Australians.

The first face-to-face Deep Dive events were held simultaneously in Melbourne, Sydney, Brisbane, Perth and Adelaide as well as an online event bringing together young people living in the regions. The young people were asked a series of questions, breaking into small groups with a Re:act industry partner to discuss the question before sharing their answers with the larger group. Answers were collated in each location, common themes that emerged across all groups were identified, and key findings and insights presented in a national Outcomes Report. The first Deep Dive was held in August 2024 with the second to be staged in August 2025. This presentation will draw on and present findings and insights from both events.

Outcome of the work

About 50 young Australians aged 17-25 and 20 road and work safety and industry partners took part in national Deep Dive events in August 2024. For the 2025 events, we expect higher participation numbers given additional recruitment avenues and increased interest following the success of the 2024 iterations. Information contained here is from the 2024 Re:act Amplify Deep Dives. As this program of work is ongoing, the presentation will also include findings from the 2025 event, to be held in August 2025.

Key findings from the 2024 event, which examined mobile phone distraction among 17-25 year olds as well as road safety communications, included:

- Phone use is universal: Mobile phone use as a driver or pedestrian is almost universal among young Australians, with 'music' and 'maps' the most common uses.
- Safe space: Inside a vehicle is considered a 'safer space' to use a mobile phone, pedestrians are more vulnerable than drivers.
- Risk is understood, but accepted: Young people understand there are risks associated with mobile phone distraction, however there is a trade-off depending on perception of risk; 'a quick tap' or texting while stationary at traffic lights is considered more acceptable. Most are less willing to compromise others' safety than their own.
- Age of vehicle: Where technology existed in newer cars to reduce direct interaction with mobile phones, it was widely used, however the majority drove older cars without such technology.
- Guilt and anxiety: Understanding the risk and potential repercussions but being unable to resist mobile phone use led to feelings of guilt, which increased if passengers were present. Drivers felt more pressure to answer repeated calls or calls from family or employers.

- Education is lacking: Road safety education is lacking once young people leave high school, primarily because it is not delivered on platforms or in locations relevant to young people, such as tertiary settings or social media. Importantly, social media 'can wait' and would not be a distraction while driving or walking.
- Relatable and realistic: Young people do not 'see' themselves or their age group in road safety campaigns, and feel excluded in discussions around effective campaigns, meaning they find it difficult to relate to messages.
- Prepared to speak up: While most young people would avoid direct confrontation, they are prepared to speak up if they are in a vehicle where the driver uses their phone.

Key takeaways included:

- While mobile phone use among pedestrians or drivers cannot be condoned, education is more likely to be effective for young audiences when it focuses on ways to minimise risk rather than stopping use entirely.
- Encourage, incentivise and support young drivers to purchase equipment for hands-free use or the newest vehicle they can afford, prioritising Bluetooth functionality where possible.
- Empower and skill passengers to speak up when drivers interact with their mobile phone.
- Educate peers, including family members and employers, to not contact young people when they are or are likely to be driving.
- Involve young people in developing road safety campaigns for their age group, both behind the scenes in designing messages that resonate as well as 'in front of the camera'.
- Leverage social media to deliver roads safety messages direct where young people 'are'.

Benefits to road safety

By providing a platform for young people to have a voice in road safety and bringing them together with those charged with keeping them safe on the roads, the Re:act Amplify Deep Dive events are at once engaging young Australians with road safety and building the knowledge of road and safety agencies around the most effective ways to create messages that resonate with this target audience and change their behaviour.

These outcomes translate to safer road users who are more aware of the risks of their behaviours, and understand the benefits and become advocates for the safer choices they incorporate into their actions. Re:act program evaluations support that these behaviours extend beyond the individual to influencing the actions of their friends and family.

In addition, we are engaging young and inexperienced drivers at the beginning of their driving journey, allowing us to ingrain safe behaviours - before bad habits are developed - that are sustained (and shared) over their lifetime as a road user.

Implications for policy and/or practice

The participation of government and industry road and workplace safety organisations in the Deep Dive, and sharing the outcomes with them, provide direct insights practitioners can incorporate into road safety and behaviour change campaigns aimed at young Australians, informing both messaging and the distribution channels chosen to reach the target audience. By amplifying the voices of young Australians in road safety, we help create a future focus of decision making moving forwards. If we can understand young people better, we can bridge the gaps in communicating with them to educate, raise awareness, and change behaviours of this over-represented age group.

Evidence supports peer-to-peer education as effective in reaching this typically hard-to-engage group (Buckley, 2013; Lewis, 2016; Lewis, 2021; Hess, 2025). They want to be listened to, not told what to do. They want to be understood, not have assumptions made. And they want to make a difference. First we need to listen to them. So by engaging young people to hear their perspectives and, thus, help inform government road safety agencies and organisations in the private sector, we have a much better chance of reaching 17-25 year olds and, ultimately, helping to reduce their involvement in road trauma.

Conclusions

Young people are over-represented the world over in road trauma. Engaging them with road safety and in developing road safety communication developed by and for them (peer-to-peer messaging) is a critical in ongoing efforts to reduce their involvement in road trauma.

References

Buckley, L., & Davidson, C. (2013). A psychosocial model of young adult passengers' intervening in unsafe driving of their friends. *Accident Analysis and Prevention*, 51, 98-103

Bureau of Infrastructure, Transport and Research Economics. (2025) National Crash Dashboard. BITRE, Canberra

Elrose, F., Lewis, I., Hassan, H., & Murray, C. (2022). Insights into the effectiveness of messaging promoting intentions to use connected vehicle technology. *Transportation Research Part F: Traffic Psychology & Behaviour*, 88, 155-167

Hess, A. C., Dodds, S., Jaud, D. A., Garnier, C., & Gergaud, O. (2025). Curbing Adolescents' Risky Drinking Behavior with Authenticity. *Journal of Public Policy & Marketing*. https://doi.org/10.1177/07439156241291476

Lewis, I., Watson, B., & White, K. M. (2016). The Step approach to Message Design and Testing: A conceptual framework to guide the development and evaluation of persuasive health messages. *Accident Analysis & Prevention*, 97, 309-314

Lewis, I., Watson, B., White, K. M., & Nandavar, S. (2021) Road safety advertising: what we currently know and where to from here. In Vickerman, Roger (Ed.) International Encyclopedia of Transportation. Vol. 7. [1st ed.]. Elsevier, pp. 165-170

Papakitsos, E.C., Korakidi, G., Vamvakeros, X., and Mavrakis, A. 2018. Planning educational activities for learning "road safety" Humanities and Social Science Research; Vol. 1, No. 2. doi.org/10.30560/hssr.v1n2p43

Rahman, M.A., Hossain, M., Mitran, E. & Sun, X. (2021) Understanding the contributing factors to young driver crashes: A comparison of crash profiles of three age groups. *Transportation Engineering*, Volume 5. https://doi.org/10.1016/j.treng.2021.100076.

Soltani, A. *et al*. (2025) Time-series projecting road traffic fatalities in Australia: Insights for targeted safety interventions. *Injury*, Volume 56, Issue 3, 112-166

Walker, C., Thompson, J. & Stevenson, M. (2017) Road trauma among young Australians: Implementing policy to reduce road deaths and serious injury, *Traffic Injury Prevention*, 18:4, 363-368, DOI: 10.1080/15389588.2016.1212189

The evolution of network risk assessment – where to from here?

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Abstract

Network risk assessments are critical for developing network safety plans, delivering effective road safety infrastructure programs, and setting safe speed limits. They serve an important role in educating the public about the safety of their road network. Methods for assessing risk at a network-level have evolved over time, from more complex KiwiRAP and AusRAP protocols to more simplified techniques like Infrastructure Risk Rating and LG Stars. However for many practitioners, particularly those in local government, the range of methods available is overwhelming and guidance on which method to use is lacking. Not all methods are created equal and many road environments are challenging to assess, for example at intersections and for urban street networks. This presentation aims to clear this confusion by reflecting on the evolution of network risk assessment to identify what needs to happen now to ensure network risk assessments are fit-for-purpose for the future.

Social media post

Network risk assessments have evolved from AusRAP/KiwiRAP to ANRAM, IRR and now LG Stars. What does the past tell us about the future? What needs to happen to make 'fit-for-purpose' network risk assessments available to all?

Introduction

Network risk assessments are critical for developing network safety plans and for delivering effective road safety infrastructure programs. They serve an important role in educating the public and politicians about the safety of the road network. Recognising the vital role of network risk assessments, the *Australian National Road Safety Action Plan 2023-25* identified the need to support state, territory and local governments conducting these assessments.

Since the first AusRAP and KiwiRAP assessments in the 2000s, several alternative corridor-based methods have emerged independently, often as streamlined modifications of these original Risk Assessment Program (RAP) protocols. For those governments new to risk assessment, particularly local governments, the options available are confusing. Guidance on which methods are most appropriate, or 'fit-for-purpose' for different situations is lacking. There are also concerns that some methodologies are not adequately assessing risks to vulnerable road users, or for networks where systemic risks are fatal and serious injury (FSI) crashes at intersections, rather than along mid-blocks.

This presentation aims to clear some of this confusion by reflecting on where we've come from, where we are now, and what needs to happen now to ensure network risk assessments are fit-for-purpose in the future.

What is a network risk assessment?

A network risk assessment involves using crash data or information about the road to map risk across all or part of a road network (corridors and/or intersections). There are two approaches to network risk assessment:

- Crash based approaches using crash or injury data. Outputs are expressed as either:
  - Crash/injury densities, also known as collective risk (e.g., crashes per kilometre)
  - Crash/injury rates, also known as personal risk (e.g., crashes per 1 million kilometres travelled).
- Proactive approaches use information about the road and roadside environment to calculate a risk metric. This approach measures personal risk because it assesses the risk to individual road users.

The primary output of a network risk assessment is typically a risk map showing variations in risk across a road network using defined thresholds like a star rating or a specified crash density metric.

Why are network risk assessments important?

As the title of the abstract implies, the purpose and relevance of network risk assessments has evolved over time. What started with risk mapping to garner public support for safer roads is now an integral part of network safety planning. A comprehensive network risk assessment not only identifies high-risk parts of a road network for infrastructure investment but can be used to develop road safety infrastructure programs, for setting safe speed limits, to model the impact of different safety countermeasures, and to assist with strategic 'vision zero' modelling.

Conference theme

Network risk assessment methods and their application have evolved over time and will continue to do so. With a recent focus on expanding assessments across local road networks it is now relevant to reflect on what's been done before and how network risk assessments should evolve to be fit-for-purpose for the future. The themes of elasticity and equity are also explored, recognising that new and more flexible approaches to network risk assessment may be required to understand risk for all road users (e.g., not just vehicle occupants), and for different types of road (urban, rural and low volume).

The evolution of network risk assessment – where have we come from?

The first network risk assessments in Australasia were undertaken through AusRAP and KiwiRAP in the mid-2000s. Around this time the first national road safety strategies were emerging and vehicle star rating schemes such as ANCAP had been successful in encouraging vehicle manufacturers to raise safety standards. It was hoped a road star-rating program would have a similar effect for road infrastructure (Metcalfe & Smith, 2005).

The RAP programs were rolled out across high-speed, high volume roads using risk mapping and star rating protocols. The risk mapping protocol used fatal and serious crash data to generate collective and personal risk metrics for rural, state-controlled road corridors. The star rating protocol was developed under the iRAP umbrella and involved analysing video of the road network to identify and code road design elements that influence the likelihood and severity of crashes. This generated a Road Protection Score or Star Rating Score which converted to a star rating ranging from 1-star to 5-star, where the higher the number the better the road (Metcalfe & Smith, 2005; Waibl et al, 2012).

The Australian National Risk Assessment Model (ANRAM) was developed in the early 2010s to help move beyond purely focusing on crash history (the traditional 'black spot' approach) for finding high-risk sites for treatment (Austroads, 2014). It uses predictive models to estimate the number of FSI crashes expected along corridors using RAP data as well as actual FSI crash data. A similar model was also developed using KiwiRAP data (Waibl et al., 2012). A powerful benefit of this new approach was the ability to model the effect of road safety treatments on FSI reductions, supporting improved optimisation of road safety infrastructure programs.

Until the mid-2010s the network risk assessment methods available were only applied to high-speed, high volume rural roads, and therefore largely limited to the state-controlled road network. The RAP and ANRAM protocols also required expensive and extensive data collection – putting these methods beyond the reach of most local governments. The first method to address this challenge was New Zealand's Urban KiwiRAP protocol which enabled crash risk mapping for local road networks. It included a new method for assessing intersections risk and developed risk maps for vulnerable road users (pedestrians and cyclists). Although still a reactive approach, it introduced 'severity indices' to modify crash data rather than relying on actual crash outcomes (Brodie et al., 2013). The NZ Transport Agency led the rollout of Urban KiwiRAP to most large local road networks in New Zealand.

The first proactive method developed for local roads was Infrastructure Risk Rating (IRR) which required only nine variables to calculate an IRR risk score. IRR was developed in New Zealand to support the implementation of the NZ Transport Agency's first Speed Management Guide. It was rolled out across all roads in New Zealand using an automated geospatial process (Zia et al., 2016). The IRR roll-out was also the first time (as far as the author is aware) that a network risk assessment was applied across an entire state jurisdiction, and for the purpose of implementing a safer speed program. The IRR methodology has been tested and made available for Australian roads (Austroads, 2019). It has been adopted in Victoria and Queensland to support speed limit setting.

In 2020, Austroads also published a simplified method for local roads using stereotypes for cross-sections and intersections (Austroads, 2020). Using AusRAP and ANRAM, a series of simplified stereotypes and cross-sections that users could match to their road network to estimate star ratings and predicted FSI rates. Guidance on how to use this method to develop a network safety plan was also provided.

Capacity building and the expansion of local road network risk assessments were supported in *National Road Safety Action Plan 2023-25.* However despite the availability of IRR and the stereotypes approach in Australia, most Local Government Areas (LGAs) still do not have the data, skills or capability to undertake their own risk assessments with these methodologies at a network level. To address this gap, the Western Australia Local Government Association developed LG Stars using a much simpler 'stereotype' approach with fewer star rating bands (WALGA, 2023).

Where are we now?

Momentum for AusRAP continues under the governance of Austroads and supported through actions under the *National Road Safety Action Plan 2023-25*. KiwiRAP, however, is largely inactive in New Zealand with the last performance tracking report issued in 2018, and no star ratings published since 2010. This may be due, in part, to being superseded by the national IRR rollout.

For LGAs however, the proliferation of network risk assessment methodologies developed independently of each other seems to have created uncertainty among practitioners about which method to use and how to apply them. Fundamental gaps in data, particularly traffic volumes, are a considerable barrier to starting a local road network assessment. LGAs may also be waiting for their state/territory to provide direction on where to start, while a lack of guidance on selecting a fit-for-purpose methodologies is currently lacking. As a result of these factors, a state of paralysis has emerged among many local, state and territory governments.

Where are we heading?

The presentation for this abstract will pose and address several questions about the future of network risk assessment, drawing from recent history and the authors' extensive experience in this space, including:

- What is a 'fit-for-purpose' network risk assessment, and what does this look like for local road networks?
- Are crash-based assessments still relevant? How are proactive and reactive approaches balanced when considering risk?
- What is the role of state/territory governments in supporting local road network risk assessments? Is it reasonable to expect each LGA to complete their own assessments, or should states and territories play a more active role in facilitating these assessments?
- What are some examples of successful network risk assessments – and what made them so successful?
- Why are network risk assessments for vulnerable road user risk, urban roads and intersections so challenging? What might methodologies tailored to these types of risk or road environment) look like?

A curious observation about 'fit-for-purpose' is that many of the simplified risk assessment methods were developed from RAP protocols originally intended for high-speed, high-volume rural roads. However many local road networks have very low traffic volumes, extensive intersecting roads and/or urban networks. While the RAP protocols have served us well in predicting risk in the rural environment, urban roads more dynamic with greater interactions between vehicles, public transport, pedestrians, cyclists, and other vulnerable road users. How well does a protocol developed for regional arterial roads translate to assessing risk across inner-city street networks?

Another consideration is what does a 'fit-for-purpose' network risk assessment look like for LGAs with very large, very low volume road networks, often with very few (< 3) FSI per year. A star rating assessment using LG stars might result in every road being classified as <1-star, and how useful is this for communicating risk, or for planning road safety investment? Also what purpose does a network assessment serve if the only feasible interventions for these roads are speed management and safety maintenance? Finally considering the potential FSI reductions for these roads is very low – should any support made available to LGAs (e.g., funding, training etc) be prioritised for LGAs with much higher rates of FSI crashes? If the ultimate goal is Vision Zero by 2050, then a targeted approach may be required.

Benefits to road safety

Having fit-for-purpose data about risk across road networks will enable states, territories and local road authorities to make informed decisions about investment in road safety infrastructure and speed management. This presentation aims 'lift the fog' surrounding network risk assessment and provide recommendations on how to proceed where the future seems murky. All practitioners involved in developing safer roads and safe speed limits will find value in this presentation, whether they are just starting on the assessment journey, or seasoned practitioners with extensive experience in assessment techniques.

References

Austroads (2014). *Australian National Risk Assessment Model*. Publication no. AP-R451-14. https://austroads.gov.au/publications/road-safety/ap-r451-14

Austroads (2019). *Road Risk Assessment, Case Studies and Engagement Guidance for Speed Management.* Publication no. AP-R587-19. https://austroads.gov.au/publications/road-safety/ap-r587-19

Austroads (2020). *Network Design for Road Safety (Stereotypes for Cross-sections and Intersections): User Guide. Publication* no: AP-R619-20. https://austroads.gov.au/publications/road-design/ap-r619-20

Brodie, C., Durdin, P., Minnema, R. & Tate, F. (2013). Urban KiwiRAP: Road Safety Assessment Programme. *Proceedings of the 2013 Australasian College of Road Safety Conference*, Adelaide, Australia. https://archive.acrs.org.au/files/papers/57%20Brodie_NPR.pdf

Metcalfe, J. & Smith, G. (2005). The Australian Road Assessment Program (AusRAP). *Proceedings of the 28th Australian Transport Research Forum*, Sydney, Australia https://australasiantransportresearchforum.org.au/wp-content/uploads/2022/03/2005_Metcalfe_Smith.pdf

Waibl, G., Tate, F. & Brodie, C. (2012). The development of a proactive road safety assessment tool – KiwiRAP. *Proceedings of the 2012 Australasian Road Safety Research, Policing & Education Conference.*

WALGA (2023). LG Stars – Safety Ratings for Local Government Roads Tool. Assessment Guide.

Zia, H., Durdin, P. & Harris, D. (2016). An Automated Process of Identifying High-Risk Roads for Speed Management Intervention. *Proceedings of the 2016 Australasian Road Safety Conference, 6-8 September, Canberra, Australia*. https://search.informit.org/doi/pdf/10.3316/informit.445102861641478

Zia, H., Durdin, P. & Harris, D. (2016). An automated process of identifying high-risk roads for speed management intervention. *Journal of Road Safety*, 27(4), 43–48.

Knowledge of changed e-scooter rules in Queensland

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Abstract
On 1 November 2022, the Queensland rules for e-scooters changed to permit riding in bike lanes on roads with speed limits of 50km/h or lower and to reduce the speed limit on footpaths to 12km/h. Online surveys of 4,842 e-scooter users and non-users were undertaken in 2023 and 2024. Only 50% of e-scooter users knew they were allowed to ride on the road on local streets with a speed limit of 50km/h. Almost half mistakenly believed e-scooters were permitted in bike lanes on 60km/h roads. Only 6.6% of e-scooter riders knew the correct speed limits for both footpaths and other locations. Fortunately, most participants underestimated the speed limits. Knowledge of speed limits was better for users, private e-scooter riders and those shared e-scooter riders who rode more often. There is a need to explore alternative approaches to public education regarding where e-scooters can be legally ridden and at what speeds.

Social media post
On 1 November 2022, the Queensland rules for e-scooters changed to permit riding in bike lanes on roads with speed limits of 50 km/h or lower and to reduce the speed limit on footpaths to 12 km/h. However, surveys show that knowledge of these rules is poor.

Introduction
E-scooters present an independent transportation option and can serve as a practical solution to the first/last mile problem. The Queensland Government legalised the use of a broad range of "e-rideables" (including private and shared e-scooters) in October 2018. In November 2018, Lime launched Australia's first electric scooter sharing program in Brisbane. Within two weeks of its introduction, over 50,000 rides on e-scooters were recorded (Booker, 2018). In the initial ten months, over 1.5 million rides took place (O'Malley, 2019). Pre-coronavirus, e-scooter trips averaged 5,400 trips per day, with daily trip numbers again increasing post-coronavirus restrictions (Brisbane City Council, 2021). The annual percentage growth rate of e-scooter trips was also reported to increase in Brisbane from 16% in 2021 to 89% in 2021-2022 (Brisbane City Council, 2022), further highlighting the popularity of this form of Personal Mobility Device (PMD).

As the usage of electric scooters has risen, so has concern regarding crashes and injuries linked to their use (Caldwell, 2019; Plummer, 2019). In 2019 (pre-COVID), approximately 20 injured e-scooter riders per month presented to the Emergency Departments of those Queensland hospitals then contributing data to the Queensland Injury Surveillance Unit. Despite monthly fluctuations, the general trend has been for an increase in these numbers since 2020, reaching an average of 106 presentations per month in 2023 (Drinnan & McKay, 2024). The increased number of injured riders and concerns about pedestrian safety led to government responses. On 1st November 2022, a package of Queensland Road Rule amendments for PMDs came into effect. These changes were intended to clarify how and where PMDs can be used in public spaces in Queensland, to improve the safety of PMD riders and the broader community. The changes included:

- A 12 km/h speed limit on footpaths;
- Increased penalties for speeding offences;
- Allowing PMDs to be ridden in some on-road bike lanes;
- Ensuring PMD riders obey general road rules, such as traffic lights and signs as well as turning and give way rules, in the same way as other drivers/riders;
- Broadening the type of helmet PMD riders can wear to include an approved motorbike helmet;
- Mandating PMDs with handlebars to be fitted with a bell; and
- Higher penalties for some high-risk offences committed by PMD riders.

To support the road rule changes, the Queensland Government rolled out a comprehensive communications campaign. This included social media advertising, billboards in key locations, and extensive online content on the TMR website and Streetsmarts. TMR also developed educational material for various stakeholders, including Queensland Police Service, schools and retailers. Brochures and business card sized handouts featuring a QR code link to Streetsmarts were also provided free of charge to the PMD industry, local governments and police for distribution to users.

The Queensland Government consistently maintains its efforts to raise public awareness about PMD safety and specific PMD rules. The rules on where to ride and speed limits are topics TMR regularly addresses through its StreetSmarts social media and digital channels. StreetSmarts reaches between 1 and 1.5 million road users every month through organic and boosted posts (social media paid adverts). In addition to online communication, the brochures and small handouts also continue to be proactively distributed to key community stakeholders.

The Department of Transport and Main Roads (TMR) commissioned the Centre for Accident Research and Road Safety – Queensland (CARRS-Q) to evaluate the effects of changes to the regulation of PMDs in Queensland. The evaluation will also make best practice recommendations for improvements to Queensland PMD regulations and other activities relevant to the PMD rules. The main objective of the project was to determine whether the PMD reforms were effective in improving road safety as measured by:

- Awareness of the rules;
- Acceptance of and compliance with the rules;
- Infringements related to PMD use over time; and
- Accidents and injuries related to PMD use over time.

This paper focuses on the first objective, awareness of the rules.

Conference theme

E-scooters have become a popular mode of transportation. Addressing the conference theme of Elasticity, this research sought to understand users and non-users' awareness of the Queensland PMD rules introduced on 1st November 2022.

Method

TMR in conjunction with an independent external market research provider (Footprints Market Research) conducted focus groups discussions to guide the development of a self-report survey. Surveys were conducted in October 2023, April 2024 and October/November 2024 of a total of 4,842 e-scooter users and non-users. The survey asked about perceptions of e-scooters, awareness of the rules associated with using e-scooters, and the perceived safety impacts of the new rules. The survey data analysed for this paper include:

- Demographics (e.g., age, gender, residence, e-scooter user or non-user)
- Self-reported behaviour (e.g., risky riding behaviours, parking of e-scooter)
- Knowledge of road rules.

Data were compared across the multiple timepoints to assess any changes in e-scooter user and non-user perceptions and awareness of road rules over time. All three surveys occurred after the changes in the rules on 1 November 2022 and thus provide an indication of knowledge of the new rules. There was no measure of knowledge of the earlier rules.

Questions 9a and Question 9b asked participants to nominate the speed limits for riding on a footpath shared with pedestrians (9a) and on separated paths, bicycle paths or local streets (9b). Thus, these questions measured knowledge of the speed limit rules. Question 12 presented a series of images and asked participants to select each of the paths/roads where they think it is permitted to ride an e-scooter. Thus, it measured knowledge of the rules related to where e-scooters are allowed to be used.

Results

Where e-scooters are allowed to be ridden

About 70-80% of e-scooter users correctly nominated that they are permitted to ride on pathways through parks, bike lanes separated from road traffic, and shared pathways. However, only 50% of e-scooter users reported that they were allowed to ride on the road on local streets with a speed limit of 50 km/h. The general pattern was the same for non-users, however, they generally demonstrated higher levels of knowledge, particularly for parks and shared pathways. Level of knowledge improved from 2023 to 2024 for users but not non-users. The illegal scenario of riding in a bike lane on a 60 km/h road was identified correctly by a smaller proportion of respondents, indicating room for improvement in public education regarding where e-scooters can be legally ridden. There were few marked differences in awareness of where riding was permitted among the private and shared e-scooter users and those who rode someone else's e-scooter.

Reduced speed limits on footpaths

E-scooter users and non-users were asked about the speed limit on footpaths. About 23% of users nominated 12 km/h (the correct value) and this percentage did not differ over time. However, the percentage of non-users who nominated the correct value declined from 15% in October 2023 to 11% in December 2024. The most common response selected

was 10 km/h (30% of users and 38% of non-users). Non-users were more likely to report that they did not know the speed limit (22% versus 6%). Users were more likely to overestimate the speed limit than non-users (41% versus 27%). Private e-scooter riders were more likely to nominate the correct speed limit (28%), followed by shared riders (24%) and riders of someone else's e-scooter (22%). A higher percentage of riders using someone else's e-scooter and shared e-scooters (30%) incorrectly selected 10 km/h as the speed limit, compared to private e-scooter riders (25%).

Respondents who rode five or more times per week were most likely to answer correctly (43%). A significant proportion of riders across all categories selected 10 km/h, with the highest proportions among infrequent riders. These responses are less concerning, as they reflect a belief in a more conservative speed limit, which may still indicate some level of caution or partial awareness. The same trend was observed for private e-scooters.

Speed limits in other locations
The speed limit on separated paths, bicycle paths, or local streets among e-scooter users and non-users remained at 25 km/h. Correct knowledge of the speed limit was relatively low among both users (19%) and non-users (11%). Most respondents underestimated the limit, frequently selecting 20 km/h or 15 km/h. Only about 13% of users overestimated the speed limit, and non-users were more likely to state that they did not know the speed limit than users.

Users who rode their own e-scooter generally displayed more accurate knowledge of speed limits on separated paths (30%) than riders of shared (19%) or someone else's e-scooter (16%). There was little difference in knowledge between frequent and infrequent riders. The majority of private e-scooter riders answered correctly, while shared e-scooter riders tended to select a lower value than the correct speed limit of 25 km/h.

Overall, only 6.6% of e-scooter riders knew the correct speed limits for both footpaths and other locations.

Benefits to road safety

This research benefits road safety by providing an insight into users and non-users' awareness of the current Queensland road rules for riding PMDs. This insight can help inform government agencies regarding the degree to which non-compliance needs to be addressed by public education or enforcement. The research also highlights the challenge of whether improved knowledge will necessarily result in safer behaviour, in the situation that road users mistakenly believe the limits are more strict than the actual rule.

Conclusions

The level of awareness of the Queensland road rules regarding where e-scooters can be ridden is generally poor. This study suggests that lack of knowledge of the rules may be a contributor to non-compliance by users and non-user perceptions that users are violating rules. It suggests that there is a need for alternative approaches to public education regarding where e-scooters can be legally ridden and at what speeds. The reach of traditional channels, while valuable, may not be sufficient to fully engage this specific group of road users. Innovative communication methods and platforms should be explored to better engage PMD riders and improve awareness of the rules.

References

Booker, C. (2018). E-scooter spruikers demand law change to allow footpath freewheeling. The Age. https://www.theage.com.au/melbourne-news/e-scooter-spruikers-demand-law-change-to-allow-footpathfreewheeling20181211-p50lfj.html

Brisbane City Council (2022). Citylink cycleway key findings report.

Brisbane City Council (2021). *Brisbane's e-mobility strategy 2021-2023.* https://www.brisbane.qld.gov.au/sites/default/files/documents/2021-06/20210623-Brisbanes-emobility-strategy_web-tagged.pdf

Caldwell, F. (2019). Fractures and head injuries: Scooter crashes becoming a 'regular occurrence'. Brisbane Times. https://www.brisbanetimes.com.au/politics/queensland/fractures-and-head-injuries-scooter-crashesbecoming-a-regular-occurrence-20190120-p50shv.html

Drinnan, E. & McKay, J. (2024). Reported e-scooter injuries on the rise at Queensland emergency departments. ABC Radio Brisbane. https://www.abc.net.au/news/2024-07-15/e-scooter-injuries-at-qld-emergency-departments/104090966. Posted 15 July 2024. Accessed 5 March 2025.

O'Malley, B. (2019). Lime scooters: 12,000 e-scooter helmets stolen in 10 months in Brisbane. The Courier Mail. https://www.couriermail.com.au/questnews/12000-%20escooter-helmets-stolen-in-10-months/newsstory/%207297c911e6fda3be0e37b13a53b80855

Plummer, F. (2019). The ups, downs and bruises of the electronic scooter craze. The New Daily. Accessed 5 March 2025. https://www.thenewdaily.com.au/news/national/2019/02/23/electronic-scooters-safety

Queensland Government (2024). Rules for personal mobility devices. Accessed 5 March 2025. https://www.qld.gov.au/transport/safety/rules/wheeled-devices/personal-mobility-devices.

Assessing safer methods of enforcement on high-speed roads

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Abstract

Since 1990, fifteen Australian Police Officers have died while conducting traffic enforcement on Australian roads. Many more have been injured, but all are acknowledged to have sacrificed their own safety for that of the broader community. These noble endeavours have no doubt contributed to the ongoing reduction of trauma on Australia's roads, but can we continue to justify this grave cost, or is it avoidable? This project aimed to identify safer enforcement practices across comparable international jurisdictions, and to forecast the 'future state' of traffic enforcement; one which leverages technology and automation to remove police officers from exposure to the deadly hazards of duty at the roadside, while ensuring public acceptance of alternative enforcement approaches.

Social media post

Since 1990, fifteen Australian Police Officers have died while conducting traffic enforcement duties. Can we continue to justify this grave cost, or is it avoidable? This project highlights evolutions in practice, technology, and policy which may prevent further trauma to those who protect us on the roads.

Introduction

Looking beyond Australian shores, this project aimed to discover innovative and automated methods for enforcement, striking equilibrium between the risk to police members and the delivery of an effective deterrent to poor road user behaviour. The findings will inform the revision of practices that are inherently dangerous, without the need to compromise on overall road safety, and enforcement, objectives. By avoiding these dangerous interactions in the first place, the motorists who are subject of roadside enforcement, as well as those who are passing the scene, stand to gain improvements in safety.

Conference theme

Police officers intercepting motorists in the emergency lanes of our highways is an entrenched practice across Australian and International jurisdictions. Since 1990, fifteen Australian Police Officers have died while conducting traffic enforcement on Australian roads. (National Police Memorial, 2025) This project challenged the notion that these conventional traffic enforcement methods, methods which have been employed for close to a century, still represent best practice for the delivery of road safety enforcement. The requirement for police officers to place themselves in harm's way on high-speed roads, in the very name of road safety does not accord with the principles of a Safe System, nor does it align with the philosophy of Vision Zero. Just as roads and vehicles continuously evolve, so should the practices that underpin compliance and regulation evolve and become safer.

The Safe System approach underpins Australian road safety strategy. This Safe System philosophy is based on four principles (Belin et al., 2012), and each of these four principles relates to police officer safety at the roadside:

I. Road users should not be killed or maimed by their roads. The economic benefit of traffic and mobility to cannot take place at the expense of the people. This informs our departure from using language such as ‘Road toll’ to describe the collective deaths that continue to occur on our roads and extends to the notion that those who enforce traffic laws should not be killed in the process.
II. Human beings are fallible; people will make mistakes. Therefore, our transport system needs to accommodate human error and unpredictability. The mere presence of flashing lights, or a rule requiring passing motorists to slow down, cannot guarantee officer safety at the roadside.
III. Human beings are fragile; there are physical limits to the forces a human body can tolerate. This principle has long informed the reduction of speed limits across the Australian road network, especially in areas where pedestrian activity is expected. In those pedestrian areas, speeds are restricted to 40km/h, recognising the exponential reduction in survivability of impacts at speeds above that limit. While efforts have been made to reduce the speeds of traffic passing emergency vehicles (*Road Safety Road Rules* (Vic)), outlying speed events continue to occur, exposing police officers to un-survivable forces.

IV. Importantly, all those with a role in designing, operating, managing, and using our transport system have a responsibility to reduce danger. This includes those who govern and enforce on the road network.

Project description

Awarded a fellowship to learn from global experience, the author travelled to the United States, Canada, United Kingdom, Sweden, and Germany during April and May 2024. Cities within these countries were selected based on two criteria: The host country, city, agency, or organisation must subscribe to the philosophy of Vision Zero, and a specific opportunity must exist for engagement with a project-relevant academic institution, organisation, or law enforcement agency.

The fellowship award offers Australian citizens the opportunity to travel overseas for up to eight weeks to learn more about a topic or issue that they are passionate about. The ethos is simple: Learn globally, inspire locally. Applications are assessed by experts from a range of disciplines with a strong focus on topics that demonstrate community benefit, and that the candidate has exhausted learning within Australia.

As part of the author's fellowship travel, they met with over 50 people working in the field of road safety including law enforcement officers, departmental officials, leading road safety academics and researchers, technology developers, automotive industry representatives, and road safety advocates. Investigation was conducted via field observation of law enforcement practice, demonstration of technological interventions, and semi-structured interviewing, both of which sought to inform three themes related to safety of police officers during roadside enforcement: Practice, technology, and policy.

Findings

This section summarises the key findings, according to the three research themes of practice, technology, and policy.

Practice

Law enforcement agencies, and road network operators across all studied locations perceived the risk of roadside collision as possible. Law enforcement officers in the United States generally perceived the risk as an unavoidable occupational hazard, while law enforcement officers in the United Kingdom, and European Union countries perceived the risk as one that could be managed. Most of the interviewed law enforcement officers in the United States knew an officer who had been killed at the roadside or had survived a roadside collision themselves. This was not the experience of law enforcement officers in the United Kingdom and European Union countries, where safety-led practices required officers to take intercepted vehicles away from high-speed roads, to off-ramps and laybys, using 'follow me' signage. Where relocation was not possible, officers made use of roadside guard rails and concrete barriers to shield themselves during the interaction.

Technology

Connected vehicle technology in emergency vehicles, was observed in two real-world vehicle-to-vehicle (V2V) communication cases: Alerting approaching motorists of the presence of a stationary emergency vehicle (Michigan, U.S.), and alerting road users of an emergency vehicle underway, and approaching (Frankfurt, Germany). The former leverages road users use of mobile navigation applications, such as Waze and Google Maps, to communicate the alert, whereas the latter required road users to be driving a modern vehicle already equipped with the technology. While these technologies may seem distant in their application, researchers at University of California, Berkeley, indicated that V2V communication does not require full fleet penetration to have observable effects on traffic behaviour. (Fishelson, personal communication, 17 April 2024).

Expanding the enforcement framework to allow police to enforce traffic offences detected via public submissions of video evidence, such as dashcam, creates new opportunities to enforce against unsafe behaviours on high-speed roads without the need for physical exposure to risk. This method also amplifies the general deterrent effect of enforcement, as every civilian dashboard camera becomes a policeable moment. This application of technology-based enforcement was observed in operation in South Wales Police, but is know to operate almost ubiquitously – in 43 jurisdictions – across the United Kingdom. Not only does this methodology make efficient use of police resources, it gives vulnerable road users a voice with almost half of all submissions to South Wales Police coming from cyclists, motorcyclists, pedestrians and horse riders. Where enforcement is not justifiable, the submissions provide valuable intelligence to identify 'hot spots' where near-misses (rather 'near-hits') are occurring.

Policy

Recognising the vulnerability of people at the roadside can inform policy design: A law enforcement agency might require their officers to take intercepted drivers to a safe location. A road network operator might seek legislation that permits the removal of an abandoned vehicle at the roadside or compel a vehicle's owner to seek recovery of a stricken vehicle within a prescribed timeframe. Policy solutions were observed operating in multiple jurisdictions, but only appeared to be effective in those locations, such as Sweden, where road users generally exhibited a culture of safety compliance.

Benefits to road safety

The project seeks to inform the evolution of practice, technology, and policy, but also seeks to encourage Australia's law enforcement and road management agencies, to constantly challenge the assumption that police need to intercept drivers on high-speed roads to achieve road safety objectives.

Conclusions

To deliver its important enforcement effect, a law enforcement agency must also ensure that the practices, technologies, and policies that support this effort are intrinsically safe to its personnel. The ubiquity with which United Kingdom's policing agencies can automatically enforce against road safety breaches reported to them by the public, is a worthy example of an initiative that partners the public with police to ensure that road networks receive a broad enforcement effect. Making Australia's roads safer cannot be at the cost of police lives, or we shall never achieve Vision Zero. By deliberately acknowledging the risk, police organisations can look to advancements across all three themes to aide in the continued delivery of enforcement on high-speed roads, without necessarily requiring a police officer to be there in the first place.

References

Belin, MÅ. (2021). The Swedish Vision Zero—An Advanced Safety Culture Phenomenon. In: Tiwari, G., Mohan, D. (eds) Transport and Safety. Springer Transactions in Civil and Environmental Engineering. Springer, Singapore. https://doi.org/10.1007/978-981-16-1115-5_1

Fishelson, J. (personal communication, April 17, 2024).

National Police Memorial. (2025). *Honour Roll*. National Police Memorial https://npm.org.au/honour-roll/

Road Safety Road Rules 2017 (Vic) Road Rule 79A.

Enabling Active Travel to School through Suitable Infrastructure

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Abstract

Walking and riding to school has declined in Australia from 75% of students in the 1970's, to 25% today. Half of all children that live within 1km of a school in Perth, WA travel to school by car, resulting in vehicle congestion and conflict between children and a growing vehicle fleet, negatively impacting road safety around schools. PJA (transport consultants) were engaged through WA Department of Transport Active Travel to School Roadmap and Working Group, to research how planning for active transport infrastructure has contributed to the decline in school active travel. The research reviewed WA State and Local Government policies, regulations, technical guidelines, and case studies. The research identified where policies and guidelines are misaligned, and where changes are needed in WA's development application process to encourage mode shift of young people away from private vehicles to active transport to promote healthier communities, reduce congestion, and improve road safety.

Social media post

Research by WA DoT looked at into how infrastructure planning has contributed to the steady decline in active travel to school. The objective was to identify where changes are needed in the development application process to encourage a mode shift to active travel to school.

Introduction

In 2021, the WA Department of Transport provided evidence into the declining rate of walking and riding to school both nationally, and in WA specifically (WA Department of Transport – The Declining Rate of Walking and Riding to School in Perth 2021). In response, the Department of Transport established the Active Travel to School Roadmap and Working Group with the objective of the Group being to identify and address existing barriers that may be preventing higher rates of active travel to school.

A key initiative of the Roadmap (Active Travel to School Roadmap) involved understanding the impact that active transport infrastructure has on active travel outcomes. To do this, the Department engaged PJA transport consultants to review existing WA State and WA Local Government planning policies, technical guidelines and application processes as it pertains to new developments or school expansions to identify any areas where improvements to the school planning application process should be made to promote an increase in the uptake of walking and riding to school. A sample of the guidelines include Liveable Neighbourhoods 2009: Element 8, Western Australia Department of Finance and Department of Education Primary School Brief and Secondary School Planning Guide Western Australia Planning Commission: Operational Policy 2.4 – Planning for School Sites (specifically sections 3.4, 3.5, and Appendix A), and Western Australia Planning Commission: Transport Impact Assessments – All Volumes.

Additionally, the process of development applications from proposal to approval and implementation of active travel facilities directly associated with school planning has been reviewed in relation to which WA State Government department has authority, the current requirements for active travel infrastructure for school planning and gaps or areas within the application process that could be improved in an effort to address the declining rate of active travel to school. Specific consideration was given to the part Local Government play in the approval process, and also in remedying any infrastructure related issue post construction.

The research included case studies which considered several primary schools that are located within the Metropolitan area or the wider Perth region. The case study schools were either new developments or expansions of existing sites with the review considering the project from inception and technical reporting stages, through to the development application and on-site installations. Several recommendations were borne out of the study, which were presented by PJA to the Department of Transport and associated stakeholders, such as Local Government Active Travel Officers.

Conference Theme

The project aligns with theme of the conference following:

- **Equity**: Enabling safe access to school for all children, and not dependent on by the availability of a vehicle
- **Elasticity**: promoting shifts in transportation modes for children that set habits to carry into adulthood
- **Evolution**: improving infrastructure requirements to enable the shift to active travel for school related travel.

Method

A review of WA State and WA Local Government processes and guiding documents for implementing active travel infrastructure associated with school developments was undertaken, for a new school development or expansion of an existing school. The aim was to identify any gaps in the process resulting in poor infrastructure outcomes and understand and address the specific challenges faced by Local Governments when dealing with shortfalls in infrastructure provision.

Several State Government and Local Government agencies are involved to a varying extent in the approval process for the development of new school sites and/or expansions of existing school sites. Although development applications are reviewed by different agencies, there is no clear definition as to who the governing body is for regulating the requirements and application of active travel infrastructure, specific to school sites.

To establish a process specific to school related active travel infrastructure requirements, firstly a review of the policies and guidance currently being referred to during the development application was undertaken. The review included local to WA guidance, national guidance from across Australia including technical design resources, and international best practices (an example of which are National Transport Authority of Dublin Safe Routes to School (SRTS) Programme; New South Wales Design Framework – Master Planning Guidelines; Queensland Department of Transport and Main Roads Planning for Safe Transport Infrastructure at Schools (2001); Queensland Department of Transport and Main Roads TN207 Planning for Safe Transport Infrastructure at Schools – Bicycle Parking (2022); Victoria Department of Education Building Quality Handbook (BQSH) – School Construction and Design Standards). Each document and process contained within was reviewed to identify gaps generally, and also in how it relates specifically to a school development and the provision of associated active travel facilities. This included examining the specific design elements incorporated into the approval process.

Following this, PJA held meetings with several Local Governments Active Travel Officers and planning teams to gain an understanding of their internal specific local government processes and discuss any issues that arise for them when considering a new school development and for any existing schools undergoing expansion. This included where the responsibility lay for improvements or implementation of active transport facilities to facilitate access to the school by active travel.

Finally, case studies of several primary schools were conducted. This involved reviewing development application submission documents and technical reports where available, and the physical facilities as installed on the ground. This identified the gaps in the overall process from inception of idea to on the ground construction, whereby the application did not follow the due process, or whereby the process did not adequately address active travel but aligned with the necessary policies and guidelines.

Following the review of the existing guidance, application process and real-life case studies, recommendations were provided to Department of Transport on potential improvements to policy and the application process that may encourage, and enable, more children to walk and ride safely to school through improvements in active transport infrastructure.

Results

In general, the WA planning guidelines place school developments as a consideration of area wide development, such as subdivisions and structure plans. A school development application goes through a range of stages in the application process, from deciding the location within a structure plan and subdivision, to the individual development application and associated impact assessments.

When considering the planning and development application process, each planning “stage” requires alignment across the range of policies and guidelines reviewed, with each subsequent stage generally accepting that the previous has been done to the acceptable level for approval unless specially highlighted. For example, at times active transport facility detail is referred to the next stage of development application process, but in reality is not picked up again (e.g.,

Structure Plan refers to the Subdivision stage, then the Subdivision stage refers back to the approved Structure Plan stage as providing overarching acceptance for the school related proposal). Furthermore, the approving authority of the application varies dependent on the stage of the development, which can cause elements of the design to fall away, or conditions set on items that had previously been addressed.

Referring to design and implementation, active transport needs are often addressed in a manner that is suitable to apply to all users, and not characterised to young people that are the predominant user group around schools. The ability for someone to safely walk or safely ride is applied in a standard approach, without reference to the walkable catchment, school enrolment zones, the design needs within those areas specific to school students. The current policies and guidelines leave open to interpretation the level of required active travel infrastructure for school sites and do not provide specific reference to the Safe System Principles and Low speed neighbourhoods. The case studies indicate that each school site reviewed generally adheres to the requirements to gain approval, and therefore suggestions that the gap thereby lies within the guidance documents themselves. Recommendations to address the gaps have been determined and presented for consideration.

Benefits to Road Safety

Providing a sufficient and safe active transport network specifically designed to cater for children walking and riding to school will encourage a mode shift away from private vehicle travel to school, reducing congestion and improving both perceived and actual road safety. Encouraging active travel in children will support the development of independent travel skills to navigate the road network and interact with vehicles at crossings, and improve road safety through education on how to travel the network as a vulnerable road user.

Implications for policy and/or practice

There is a potential to bring together the policies and guidelines, best practice and design specifics into a central platform. This needs to cover not only the development application for the school, but also be filtered through the structure plan and subdivision stages to ensure that the design of road network surrounding the school, connections to main attractors and placement of crossings and intersections, enables active travel as the targeted mode of choice, and not only seen as a reactive solution to traffic congestion and safety issues.

A school-based guide could be a standalone document, or, a section added into existing guidelines, targeted to each stage of the planning framework.

Conclusion

The current guidelines leave open to interpretation the level of required active travel infrastructure for school sites and do not provide specific reference to the Safe System Principles and low speed neighbourhoods. The case studies indicate that each school site reviewed generally adheres to the requirements to gain approval and therefore suggests that the gap lies within the guidance documents themselves.

Recommendations to address the gaps have been determined and presented for consideration, including potential are new or updated guidelines including those related to design to include the target user group, and streamlining of the development approval process. An example of the recommendations are as follows:

- New or updated guidance centred around facilitating active travel to school.
- Streamlining of approval processes for all school sites
- More input by Local Government Authorities into location
- A “Walk to School” scoring system, similar to the Walk Score ® (Walkscore.com)
- Active transport connections for a school should be presented as part of structure plan and subdivision stages due to the difficultly in implementing them in the later stages
- School capacity and accessibility when urban infill and densification is to occur to ensure adequate active transport connections
- Walkability of full school enrolment catchments should be considered
- Design should consider primary school aged children for such things as sight distance and walking speeds
- Safe System Principles and low speed neighbourhood terminology should be included in guidelines
- Education of safe walking and riding through programs such as Your Move (yourmove.org.au)

References

Driving Change Road Safety Strategy for Western Australia 2020 - 2030
Liveable Neighbourhoods 2009: Element 8
Western Australia Department of Finance and Department of Education Primary School Brief and Secondary School Planning Guide
Western Australia Planning Commission: Operational Policy 2.4 – Planning for School Sites (specifically sections 3.4, 3.5, and Appendix A).
Western Australia Planning Commission: Transport Impact Assessments – All Volumes
WA Department of Transport – The declining rate of walking and cycling to school in Perth (2021)

Influencing the school travel system for a healthier future

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Abstract
Active travel to school—such as walking, cycling, and scootering—has significantly declined in Australia and New Zealand over the past 40 years, contributing to increased car dependency and reduced health, environmental, and social benefits. The school travel system, which includes infrastructure, policies, and parental attitudes, influences how children travel to school. This work applies the Safe System Approach to school travel, while also considering an active travel objective to unlock significant health and environmental benefits for communities. A Venn diagram model illustrates the relationship between Safe System alignment and active travel promotion, highlighting areas of synergy and conflict. Key system components—such as speed limits, crossings, and parking—can be analysed to identify strategies that improve both safety and active travel. The findings emphasise a system-based, user-centred approach that balances safety and mobility needs, providing practical guidance for policymakers, urban planners, local government and school leaders.

Social media post
Safe System alignment of school travel needs to be considered alongside the objective of increasing active travel to school. Applying a user-centred approach, considering the ages and capabilities of the students that are travelling, and considering the journey from home to school are also important parts of the system.

Introduction
Active travel to school, such as walking, cycling and scootering, has declined significantly in Australia and New Zealand over the past 40 years. In the 1980s, a large proportion of children travelled actively to school, but today, most rely on their parents to drive them to school. Australia and New Zealand now have among the lowest rates of active travel to school in the world. This means children, as well as parents and communities are missing out on the numerous health, environmental, social and economic benefits of active travel.

Many factors influence how children travel to school, shaping whether they walk, cycle, take public transport or rely on private vehicles. The school travel system includes the network of transport options, infrastructure, policies and programs that provide for student journeys to school. The system falls within wider cultural trends and parent and child attitudes that also influence travel to school behaviour.

Applying a Safe System lens is a proven method to identify interventions that reduce deaths and serious injuries. Considering how the Safe System pillars apply to school travel yields the following examples:

- Safe Roads and Roadsides – designing roads to reduce crash risks, for example, providing raised pedestrian crossings on key routes to school.
- Safe Speeds – setting speed limits based on risk, e.g., 30km/h near schools and ideally on routes to school.
- Safe Vehicles – ensuring school buses are equipped with seatbelts and advanced safety features.
- Safe Road Users – educating children about road safety, e.g., teaching them how to cross safely, cycle skills training; and educating parents on safe driving and parking practices.

Strictly applying a Safe System approach could result in more children being driven to school because at an individual level this is a safer mode of travel. However, collectively this generates a negative feedback loop as the environment becomes less conducive to other modes, with consequent air quality and carbon emissions impacts.

Therefore, applying a Safe System approach must be considered alongside an objective of increasing active travel and reducing car dependency for children travelling to school in order to reap the physical activity and environmental benefits.

Conference theme

Children are particularly vulnerable in the road environment due to physical, cognitive, and behavioural factors that increase their risk of injury or fatality in traffic situations. Their smaller size, developing decision-making skills, and limited ability to judge speed and distance make them more susceptible to crash risks.

The work aligns with the Equity theme by taking a human-centred approach recognising the characteristics and capabilities of students themselves as well as their parents and caregivers.

Approach

The work firstly involved examining different school travel systems. One example is a simple school travel system model that was developed in New Zealand 15 years ago (Mackie, 2010). This system used a 'status diagram' approach and a traffic light method to denote the status of each element of the system, with red indicating areas of highest priority, amber indicating areas that are operating reasonably well, and green indicating areas that are currently functioning well. The aim was that the status diagram could be adopted for use at strategic and operational levels, however this was not progressed.

Secondly, components of the school travel system were identified and described in terms of their impact on the system. An example of some of the components and how they affect school travel are described below.

- Home to school distance – Children living close (within 1km) of a school are more likely to use active travel to get to school. More significantly, parents' perceptions of distance to school have a significant impact on whether children walk, scooter or cycle to school. New school site choices, school amalgamations and closures and school enrolment zones impact on the home to school distance and should be given more attention.
- Crossings in the vicinity of the school – Activity immediately outside a school is concentrated and intense and crossings are needed to get children and parents across the street safely whether they are travelling actively or using a car. The type of crossing needs careful consideration to account for the street context such as the traffic volumes and speeds, as well as the age and capabilities of the students (for example, older students can cross at priority crossings, whilst wardens or school patrols are more appropriate for younger students).
- Walking and cycling routes to school – Footpaths, crossings and cycle facilities (or lower vehicle speeds) should be provided within an active travel distance to school. The focus often tends to be facilities outside a school gate, but a wider area needs to be considered to facilitate active travel, especially if children are to travel independently to school.

Findings and benefits to road safety

A Venn diagram was developed to show how the contemporary school travel system should work towards both Safe System alignment and increasing active travel. The diagram shown in Figure 1 illustrates how components of the school travel system contribute to both a reduction in deaths and serious injuries and increasing active travel outcomes. The two interlocking circles are set against a background of cultural norms and trends, parent and caregiver views (for example, perceptions of safety for their child to travel independently) and student's ages and capabilities (for example, young children who are accompanied to school on foot with a parent are more likely to learn safe road user behaviour and therefore be able to travel independently when older).

This Venn diagram can be used to identify gaps or improvements that can be made to school travel components and highlights where aspects of school travel may work against both objectives.

Some examples of components that will likely fall into the different sectors are:

A- Barrier systems to prevent head on crashes on urban arterial roads. These treatments are Safe System aligned but do not assist or support more active travel.

B- Lower speeds around schools, e.g., school speed zones. Reducing vehicle speeds in the vicinity of schools supports both a reduction in deaths and serious injuries and makes streets easier to cross, and feel safer and more attractive for active travel. Ideally, vehicle speeds would be lowered on the entire journeys that children travel on foot or wheel.

C- On-site cycle and scooter parking. Providing secure, sheltered and convenient locations to store bicycles and scooters while children are at school enables active travel to occur but does not contribute to a Safe System outcome. This does not make it any less important to supporting a well-functioning school travel system.

D- Drop off/pick up (PUDO) or kiss-and-go areas. Generally, these induce car travel and result in more vehicles manoeuvring outside a school which is not conducive to active travel. Hence, the implications of providing dedicated drop off areas outside a school need to be considered carefully.

Although drop off/pick up areas outside a school tend to work against or at least not contribute to the two objectives, facilities such as Park and walk (i.e., where dedicated spaces for parking away from the school are identified, alongside safe walking routes to the school) could fall within 'B' as they remove moving vehicles from outside the school and give children and parents (if they accompany their children) a taste of active travel (Smith et al., 2022).

The presentation will include application of the Venn diagram to a number of case studies of existing schools, new schools, and school expansions. This will highlight the benefits of viewing school travel as a system so that all parts can be strengthened to support each other.

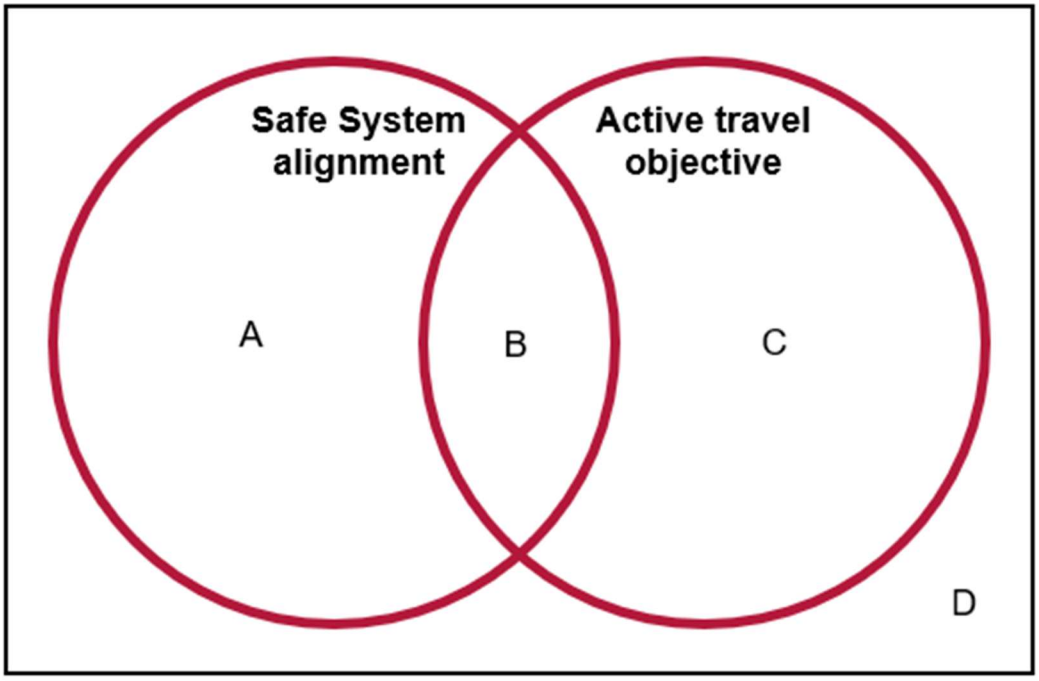


Figure 1. School travel system diagram

Implications for policy and practice

Firstly, it is helpful for practitioners to view school travel as a system, so that all components of the system are considered and can work and support each other.
Secondly, striving for Safe System alignment of school travel needs to be considered alongside the equally important outcome of increasing active travel to school. Applying a user-centred approach, considering the ages and capabilities of the students that are travelling is also an important part of the picture.

Conclusions

Safe System alignment of school travel needs to be considered alongside the objective of increasing active travel to school. Applying a user-centred approach, considering the ages and capabilities of the students that are travelling, and considering the journey from home to school are also important parts of the system.

References

Mackie, H (2010) Improving school travel systems. NZ Transport Agency research report 420 https://www.nzta.govt.nz/resources/research/reports/420/

Smith, M. et al (2022) Exploring active school travel in young children. Final report for Ministry of Social Development. https://www.msd.govt.nz/about-msd-and-our-work/publications-resources/research/growing-up-in-new-zealand/active-school-travel-in-young-children.html

Road Safety Ed Tech Disruption Disruptors - Barriers to Adoption

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Abstract

DriveAbout, an innovative EdTech platform for road safety education, has faced challenges in securing local adoption despite winning national accolades. This submission explores the barriers to local adoption and the impact on national expansion despite a road toll among the highest in Australia and a significant overrepresentation of Indigenous people. The DriveAbout digital platform has been slow to gain traction due to policy inertia, resistance from traditional educational paradigms, and poor understanding of the shift in preferred access to information. The submission highlights the importance of equity, elasticity, and evolution in advancing road safety education, emphasising the need for culturally competent approaches for higher vulnerability Indigenous and migrant road users. It also addresses the critical role of lateral thinking and collaboration with multiple stakeholders to drive change. By focusing on breaking down institutional barriers and collaboration, DriveAbout aims to revolutionise road safety education, improve outcomes, and save lives across Australia.

Queensland's Road Safety Governance Framework: using road safety management to drive the next step change in road safety

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Abstract

The Queensland Road Safety Strategy (2022-2031) sets a vision of zero serious road trauma by 2050 and ten-year targets to reduce fatalities by 50% and serious injuries by 30% by 2031. To help achieve these ambitious targets, the Queensland Road Safety Governance Framework has been developed as a transformative approach to road safety governance, designed to break down silos and drive coordinated, evidence-based decision-making and leadership. By fostering collaboration across government, industry, academia, and advocacy groups, the Framework ensures that road safety initiatives are aligned, transparent, and accountable. With a focus on strategic direction, targeted investments, and performance evaluation, the Framework demonstrates how effective governance practices and collaboration can help reduce road trauma and is Queensland's response to seven of the ten components of effective road safety management identified in the current Austroads project, Best Practice Guidance in Road Safety Management.

Social media post

A new governance framework has been established to drive the implementation of the Queensland Road Safety Strategy (2022-2031) through evidence-based decision making. Uniting government, industry, private organisations, advocacy bodies, and academia to reduce road trauma.

Background

As part of a broader national commitment, the Queensland Government introduced the Queensland Road Safety Strategy 2022-31 (the Strategy), which affirms a vision of zero serious road trauma by 2050 and aims to reduce fatalities by 50% and serious injuries by 30% by 2031. To achieve these ambitious targets, the Strategy called for a strategic leadership group to be created, with the Queensland Road Safety (QRS) Board established to focus on shared responsibility that stretches beyond the traditional transport sector and provides collaborative action and leadership across the government and the broader community, including effective management of road safety initiatives, and evidence-based decision-making. Road safety governance and management were identified at a national level as key areas for improvement across all jurisdictions, beginning with the *2018 Inquiry into the National Road Safety Strategy*. A key finding of the report pointed to implementation failure, resulting from various factors relating to governance, accountability and reporting. In this context, a reform of existing road safety governance practices in Queensland was a key consideration in the development of the Strategy. More recently, two Austroads projects, Charting a Path to Zero (SAG6365) and Best Practice Guidance in Road Safety Management (SAG6507) (both in progress) have emphasised the need for strong governance practices, further reinforcing the strategic direction established under the Strategy that aligns funding and resource allocation with a holistic approach to engagement, evidence and evaluation. The approach taken with the implementation of the QRS Governance Framework aligns with seven of the identified components for effective road safety management.

Purpose and Objectives of the QRS Governance Framework

The Framework provides the structural arrangements and operating mechanisms necessary for delivering against the Strategy. It outlines accountability and key decision-making factors and highlights specific roles and responsibilities of governance bodies and stakeholder groups. Key to the Framework is bringing together government, industry, private organisations, advocacy bodies and academia, to collectively combat road trauma, and support the Board in making evidence-based investment decisions. The key objectives of the Framework are to:

- Provide strategic direction for road safety in Queensland, aligned with the Strategy.
- Coordinate investment in QRS initiatives that contribute to achieving strategic targets and objectives, prioritising initiatives based on research and data, and working with key stakeholders.
- Evaluate the performance and outcomes of QRS initiatives and monitor the realisation of benefits.
- Ensure Camera Detected Offence Program (CDOP) expenditure complies with legislation and policies, is managed appropriately, and reflects optimal allocation of funds.

Table 1 shows the linkage between these components as part of the draft Austroads SAG 6507 Best Practice Guidance report and the QRS Governance Framework and how success is measured for each component.

Creating a comprehensive governance framework was crucial for ensuring transparency, leadership and effective decision-making among partner agencies regarding investments in road safety and challenging existing approaches to shift the trajectory of road trauma. The QRS Governance Framework (the Framework) was developed considering the strategic context, the need for improved road safety leadership, involvement of QRS Partner Agencies, extensive network of stakeholders influencing road safety and ensuring best practice in governance. The Framework's development integrated insights from previous governance experiences, highlighting the necessity for evidence-based investment practices aligned with strategy, enhanced coordinated oversight across the program's operations and road safety initiatives, and a transition from operational to strategic road safety management. The strategic context in which the QRS Governance operates is represented in Figure 1.

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- Evaluate the performance and outcomes of QRS initiatives and monitor the realisation of benefits.
- Ensure Camera Detected Offence Program (CDOP) expenditure complies with legislation and policies, is managed appropriately, and reflects optimal allocation of funds.

Table 1. Linkage between QRS Governance Framework and draft Austroads SAG 6507 Best Practice Guidance Report

Component from draft Austroads SAG 6507 Best Practice Guidance	Alignment to QRS Governance Framework	How success is measured
Focus on outcomes and continuous improvement	A Governance and Investment Framework developed as a transformative approach to road safety governance to deliver on the Strategy, designed to break down silos and drive coordinated, evidence-based decision-making that focuses on return on investment.	Program is working on enhancement of its performance reporting and development of key performance indicators aligned with national safety performance indicators.
Accountability and governance	A structure that incorporates specialised groups of cross agency and external stakeholder governance bodies, collectively driving the direction on achieving the Strategy's targets and objectives, supported by an established Program Management Office that manages all functions of the framework.	Annual Governance forum reviews and lessons learnt workshops, Program Executive feedback, and periodic surveys, demonstrate the criticality of the governance controls, an alignment in shared vision for the program and key priority focus areas, and identifies key areas for continuous improvement.
Engagement, collaboration and organisational culture	Key to the Framework is bringing together government, industry, private organisations, advocacy bodies and academia, to collectively combat road trauma, and support the Board in making evidence-based investment decisions.	Annual lessons learnt workshops, Executive feedback, and periodic surveys, provide the Program with the direction and parameters for continuous improvement.
Principle, evidence and data-driven action	The Research and Evaluation Advisory Group (REAG) is evolutionary in bringing together a large range of data sources and research to help drive analysis of the key issues in the road safety sector. The REAG is key to providing the Board with an in depth understanding of road crash statistics and trends from an inter-agency perspective that supports investment decision-making.	REAG will evaluate its performance on an annual basis in alignment with key KPIs identified, as well as support reporting on the key performance indicators identified for the Program.
Sustained funding and resource allocation	Integral to the effectiveness of the governance is the QRS Investment Framework. This Framework provides a structured and evidence-based process in how CDOP funds are allocated, driving robust and efficient investment decision-making that provides the highest return on investment.	Program is working on enhancement of its performance reporting and development of key performance indicators aligned with national safety performance indicators.

Component from draft Austroads SAG 6507 Best Practice Guidance	Alignment to QRS Governance Framework	How success is measured
Monitoring, evaluation and reporting	All major initiatives within the QRS Program are monitored and evaluated in alignment with the GOSPA Framework. This Framework is the overarching mechanism that drives evaluations of initiatives and supports performance management of the Program, monitoring whether the Program is on track.	Through combining initiative findings that collectively inform the State of Queensland Road Safety Report (completed at the end of each Action Period) which tracks progress of the Program.
Understanding interactions and interdependencies	The Governance structure ensures that road safety is a fundamental aspect of all activities across various agencies and external sectors. It helps identify interdependencies and fosters diverse perspectives, which are integrated into daily operations. This approach ensures a shared understanding of essential road safety principles and interventions	Program is working on enhancement of its performance reporting and development of key performance indicators aligned with national safety performance indicators.



Figure 1. QRS Governance and Delivery Context

Overview of the QRS Governance Framework

The Governance structure incorporates a group of governance bodies that provide a decision-making focus on achieving the Strategy's targets and objectives, including specialist and expert advice on road safety. The structure is supported by decision-making support and control functions through a dedicated Program Management Office (PMO). Informing the functions and operations of the governance bodies and the PMO is an interface with key stakeholder engagement groups which influence or have interests over the QRS strategic direction. The Governance structure draws together a broad range of initiatives being delivered across Queensland that influence road safety outcomes. Figure 2 depicts the current QRS Governance and support structure.

The QRS Board is the central decision-making body of the structure, providing whole-of-government strategic direction and leadership, oversight, and coordination of QRS governance responsibilities. The Board is supported by the CDOP and Road Safety Initiative and Investment (RSI&I) Committees who focus on the efficiency and effectiveness of the operations of the CDOP program and cross-agency coordination and delivery performance of road safety initiatives respectively. The Program Delivery Groups provide guidance, support, and advice on specific areas including enforcement coordination, research and evaluation, and Information Communication and Technology (ICT) matters, specific to ICT systems that underpin the CDOP. The Research and Evaluation Advisory Group (REAG) is key to ensuring a coordinated approach to insights into data and trends in the road safety sector that informs the strategic direction of the Program. This approach is evolutionary in bringing together a large range of data sources to help drive analysis of the key issues in the road safety sector. The Stakeholder Partnering and Academia Advisory Groups provide input and visibility of key road safety issues, trends, and initiatives outside the core QRS Program.

Integral to the effectiveness of the governance is the QRS Investment Framework. The purpose of the Investment Framework is to provide a structured and evidence driven process in how decisions over the allocation of CDOP funds are made, including assessing the mix of the program and considering investments from a range of lenses, that ensures

alignment to achievement of the targets of the Strategy. This new approach to managing road safety supports driving a broad collection of insights and intelligence collaboratively coming together to support driving a zero target of serious road trauma on Queensland's roads.

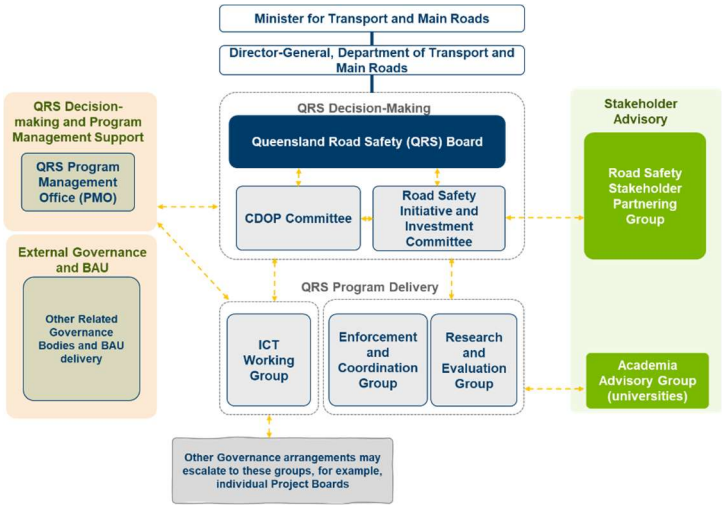


Figure 2. QRS Governance Framework

Aligning to the "Evolution" theme, the Framework design and implementation began in 2023 with continuous review and change management activities undertaken to further embed, enhance and mature the Framework, and ensure the continued maturity of road management leadership. The effectiveness of the Framework has proven to provide greater transparency, collaboration and improved understanding of road safety as evidenced by feedback provided by QRS Program Executives and stakeholders. It has also demonstrated effectiveness in providing better insights into the data and evidence that highlights trends, challenges and focus areas are in the road safety sector.

Conclusion

The QRS Governance Framework represents a comprehensive and collaborative approach to achieving improved road safety management and leadership to achieve the ambitious targets set out in the QRS Strategy. By integrating evidence-based decision-making, cross-agency collaboration, and stakeholder engagement, the Framework ensures road safety initiatives are effectively managed and implemented. The continuous review and enhancement of the Governance Framework will be crucial in maintaining its effectiveness and adaptability, ultimately contributing to the reduction of serious road trauma and the achievement of the vision for zero road fatalities and serious injuries by 2050.

References

Department of Infrastructure, Transport, Regional Development, Communication, Sport and the Arts. *Inquiry into the National Road Safety Strategy 2011-2020 September 2018.* https://www.roadsafety.gov.au/sites/default/files/2019-11/nrss_inquiry_final_report_september_2018_v2.pdf

Queensland Government (2022). *Queensland Road Safety Strategy 2022-2031.* https://www.tmr.qld.gov.au/Safety/Road-safety/Road-safety-strategy-and-action-plans/Strategy-and-action-plans

Equity in National Road Safety Strategies.

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Abstract
This paper describes the principle of 'equity' and investigates the extent to which it is incorporated in seven national road safety strategies. These strategies generally adopt the ethos that no road user should be killed or seriously injured, implying equitable processes and outcomes. However, they tend not to define equity and offer little guidance for operationalising it. It can be seen as an ethical and human rights imperative to build equity explicitly into national road safety strategies. Seven national road safety strategies were reviewed using ten human capacity and socio-economic characteristics. The range of activities associated with the strategies and their scope of application are described. The results indicate that the strategies barely incorporate equity, creating a risk that road safety management may not achieve the fair outcomes intended. The paper concludes with a clear path towards systemic changes which will result in more equitable foundations, strategies and practices.

Social media post
Equity is increasingly important to for road safety. Based on ethics, this paper reviews seven national road safety strategies against human capacity and socio-economic characteristics and found major gaps. A path for more equitable road safety management is clearly described.

Introduction
It has been argued that transport should be efficient, effective, safe, sustainable and equitable (Levinson, 2002; Litman, 2024). However, not all these principles are well applied, particularly in road safety (Manaugh et al., 2015; Doran, 2023). Equity is an emerging topic which has started to be incorporated in road safety (Litman, 2024). Its origins and foundations are in ethics and human rights which links to concepts of transport justice (Arnstein, 1969; Randall, 2019).

Recent national road safety strategies (NRSSs) have adopted the principle that no road user should be killed or seriously injured, which implies equitable processes and outcomes, and is consistent with the second Decade of Action for Road Safety (2021-2030) target of "leaving no-one behind". However, there are few definitions, very little guidance and almost no practice case studies available in relation to applying explicitly equity within NRSSs (Randall, 2019; Bruzzone et al., 2023).

NRSSs provide the strategic framework that directs road safety activities and the focus for action. So, incorporating equity into NRSSs is crucial for achieving just outcomes. Unless equity is included in high level strategies and other information and guidance, equity outcomes can only be sporadic and therefore inadequate.

This paper describes the principle of 'equity' (which is interlinked with ethics and justice) and investigates the extent to which it is incorporated in a cross-national set of seven NRSSs. The concept of equity is multifaceted, spanning procedural, recognition, distributive and restorative (Martens, 2016; Alway, 2024). There are also several different applications of equity including distribution of safety activities, engagement, resources, and policies (Cantilina et al., 2021). The focus of this study is on what is included in or omitted from NRSSs, affecting the degree to which road safety outcomes are equitable.

Conference theme
This paper falls significantly within the conference theme of Equity, which is generally accepted as fair treatment of all people such that their dignity is upheld, and they can make informed choices (Martens, 2016). It rests on accepting the inherent value of each individual and, in relation to road use, each road user category or sub-category. Equity is interconnected with the conference's other two themes of Elasticity (resilience and adaptability of road traffic systems and transportation modes, in the case of equitable outcomes) and Evolution (development and implementation of safe systems to address present and future challenges in an insightful manner) because the topic has not been well appreciated and applied, so the paper provides insights and clear directions to meet the challenge which already exists.

Method

The main method applied in this study is a desktop document review against an a priori framework of equity characteristics developed during earlier work, which was further refined by this larger author group on the basis of a literature and legislation review and team discussions. The core documents for analysis consist of a cross-national convenience sample of seven NRSSs which became publicly available within the past 10 years. They were selected partly based on the geographic location of members of the author group (i.e., Australia, the United States and South Africa) and partly based on having featured in the authors' previous work, being globally well known and/or being recognised for their aspirational nature. There was no attempt made to create a representative sample – for instance, to select a proportionate number of NRSSs from each world region, or to deliberately choose one or more from each of the categories Low-Income, Middle-Income and High-Income Countries. In a general sense, all the selected NRSSs espouse the Vision Zero philosophy (albeit not necessarily by that name, and with some differences) which holds that all road deaths and serious injuries are ethically unacceptable. They also, in some form or another, draw on the Safe System Approach (SSA) which has become a globally embraced method for operationalising Vision Zero.

Qualitative content analysis was performed to determine the degree to which the various equity characteristics featured in the NRSSs. The information was then used to develop over-arching conclusions about the degree to which the studied NRSSs, as a set, included or omitted these.

Finally, potential improvements for road safety management were considered and identified, using an equity lens. These opportunities were synthesised into a pathway for changes to road safety practice which could optimise equity outcomes.

Results

Literature and Legislation Review

The initial literature search looked broadly at documents which provided information and guidance on equity as a government policy. Then documents were added that related specifically to transport and road safety. Peer-reviewed research, government documents and the grey literature were searched and reviewed in relation to: Ethics, Equity, and Justice, such as definitions, differences and commonalities, including

- Characteristics of equity, such as personal and social differences, in legislation and policy,
- Equity in transport and road safety, including legislation and guidance material,
- Methodologies for assessing equity in transport and road safety, including examples.

This review provided a sound foundation and principles, and allowed for validation and expansion of earlier work on characteristics of equity and road safety activities and practice to which they are applied.

Qualitative Content Analysis of Equity in NRSSs

A sample of seven NRSSs were assessed according to the characteristics and activities identified in the literature:

- Commonly used characteristics of human capability – including physical and intellectual abilities and age which are typically included in disability discrimination policies and legislation,
- Socio-economic characteristics - including financial, genders, sexual orientation, marital status, migrancy, employment, culture, race, religion, belief, political, language, and indigenous background,

Each of the reviewed documents was searched for relevant key terms and the results summarised. Levels of inclusion of characteristics, activities and scope for each national strategy were reported on a descriptive scale from no mention through to extensive coverage.

The NRSSs were also examined for their range of activities, such as governance, engagement and outcomes, and their scope of application, such as the degree to which they focused on all users of transport, both government and private sector activities, all participants, and all parts of the road safety system.

The results of the study are organised and discussed under four headings:

1. Integrated study outcomes
2. Benefits to road safety
3. Implications for policy and practice
4. Limitations of the study

The results describe which of the studied NRSSs include equity characteristics and where they are not covered at all. Besides safety countermeasures, NRSSs can aim to improve processes, information, capabilities, evaluations, governance and other aspects of road safety management to improve the fairness of outcomes. The study illustrates

similarities and differences between different countries' NRSSs and provides overarching comments against the backdrop of country characteristics (e.g., income category, population size, prevailing road death rates). It reveals that some equity characteristics (e.g., indigenous status) are addressed more thoroughly while a wide range of equity characteristics are barely considered or not included at all. The large gaps revealed indicate that equity is not comprehensively included in road safety management, in the countries concerned.

Describing the gaps to be overcome enabled the development of a proposed path towards more equitable road safety management. This offers four thematic areas to consider during the development of NRSSs aimed at achieving more equitable road safety outcomes.

Outcome of the work

The study firstly provides a better understanding of equity characteristics relevant to road safety and helps solidify the theoretical foundation for equitable road safety practices. Analysis of a cross-national of NRSSs which became available in the last decade reveals that most equity characteristics are barely considered, and many are completely omitted. Given this, road safety management based on the selected NRSSs is at risk of creating fundamentally unjust outcomes in relation to the diversity of road user groups. The paper concludes with a clear path for road safety management to be more equitable, with a focus on:

1. The capability of people involved in road safety strategy development.
2. Improving the extent and quality of data and information about road users and their outcomes.
3. Management processes to assess, incorporate and evaluate equity outcomes.
4. Providing guidance and training for the development of equitable guidelines, standards, policies and activities.

Benefits to road safety

The introduction to the study provides a broad framing of equity issues which are informative for road safety policymakers, practitioners and researchers. The investigation identifies gaps in the consideration of a wide range of equity characteristics, which could result in inequitable road safety management. The paper concludes with a proposed pathway towards road safety management and NRSSs which are clearly aimed at producing fairer outcomes.

Implications for policy and/or practice

The paper identifies four thematic areas in which road safety policy and practice can be made more equitable: People, Information, Processes and Guidance. Together, these provide a holistic and systematic call to action to improve fairness in road safety outcomes

Conclusions

The paper's conclusions to improve equity outcomes in road safety are:

- Equity is important to achieve road safety objectives, consistent with the target of the second Decade of Action for Road Safety, namely "leaving no-one behind" in order to halve global deaths and serious injuries by 2030.
- Although the reviewed NRSSs incorporated certain elements of equity they varied widely in how well they did so – for instance, in relation to their coverage of the full set of equity characteristics identified by the authors.
- An understanding of equity and related concepts like ethics and justice must inform road safety policy and practice including the process of developing NRSSs.
- The field of applied ethics is particularly important, with a need for real-life case studies to be generated so that policymakers, practitioners and the public alike can grasp how equity and inequity manifest in road safety management and interventions.

References

Alway, H. (2024). Pedaling Towards Justice: Bridging the Gap in Bicycle Safety Through Equitable Community Engagement. Doctor of Social Science dissertation, Wilmington University, USA.

Arnstein, S.R. (1969). A ladder of citizen participation. *Journal of the American Institute of Planners*, *35*(4), 216-224.

Bruzzone, F., et al. (2023). The definition of equity in transport. *Transportation Research Procedia*, *69*, 440-447.

Cantilina, K., et al. (2021). Approaches and barriers to addressing equity in transportation: Experiences of transportation practitioners. *Transportation Research Record*, *2675*(10), 972-985.

Doran, B. (2023). A Just Now: Equity and transport in a changing climate: A white paper. MRCagney (NZ).

Levinson, D. (2002). Identifying winners and losers in transportation. *Transportation Research Record*, *1812*(1), 179-185.

Litman, T., (2024). Evaluating Transportation Equity Guidance for Incorporating Distributional Impacts in Transport Planning. Victoria Transport Policy Institute, Canada.

Manaugh, K., et al. (2015). Integrating Social Equity into Urban Transportation Planning: A Review of Metropolitan Transportation Plans in North America. *Transport Policy*, *37*, 167-176.

Martens, K. (2016). Transport justice: Designing fair transportation systems. Routledge.

Randall, L. (2019). "Coffins On Wheels": A Bioethical Study of Work Conditions, Driver Behaviour and Road Safety in the Johannesburg Minibus Taxi Industry. Doctor of Philosophy (PhD) in Bioethics and Health Law thesis, University of the Witwatersrand, South Africa.

Development of a retrofit motorcycle forward collision alert system

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Abstract
Motorcyclists in Malaysia face a heightened risk of crashes and injuries due to high motorcycle ridership and the absence of essential safety features in the widely used small engine motorcycle models, leading to a higher chance of collisions. Motorcycle rear-end crashes are particularly a major safety concern. A forward collision alert system for motorcycles (MCAS) was developed as a solution to improve motorcycle safety in Malaysia. This study presents the system's development, design optimisations, and performance evaluation based on controlled testing and a small-scale naturalistic riding study. Through design iteration and testing of three prototypes, this study successfully developed an improved MCAS prototype, demonstrating its potential impact as a retrofittable collision warning system. These positive results warrant further exploration of MCAS capabilities and its potential for large-scale implementation to improve motorcycle safety.

Social media post
Level up your ride! MCAS tech helps motorcyclists avoid crashes & promotes safe mobility. #LiDAR #motorcycle #safety #technology

Introduction
Motorcycle is a widely used mode of transport in Malaysia, either for leisure or work purposes. Data indicates that over 14 million motorcycles are registered in Malaysia, constituting 45.9% of the total vehicle population (Road Transport Department-Road Safety Division, 2020). Motorcyclists are the most vulnerable group on Malaysian roads with motorcyclists fatalities constituting more than 50% of the total number of fatalities (Abdul Manan & Várhelyi, 2012). Motorcyclists are also overrepresented in casualties resulting from rear-end crashes. A previous study reported that rear-end collisions were the most common type of heavy truck crashes in Malaysia, accounting for 30.1% of all cases, with motorcycle-truck rear-end crashes being the most prevalent at 55.9% (Hanowski et al., 2021). Nearly half (49.3%) of fatal rear-end truck-struck crashes occurred on two-way, divided highways and over 54% took place on roads with speed limits of 90 km/h or higher, highlighting the increased risk of high-speed collision and critical needs of pre-collision warning technology in motorcycle design. Despite the high toll of motorcycle casualties, the majority of motorcycles models sold in the local market are not equipped with safety technology to reduce the risk of a collision, as compared to passenger cars (Abdul Khalid et al., 2021). Addressing this gap, the present study developed a prototype of a pre-collision warning system for small displacement motorcycles ("MIROS Develops Detection Technology to Reduce Motorcycle Collisions," 2021). The system is called MIROS Motorcycle Collision Alert System (MCAS).

Conference theme
This research aligns with the Evolution conference theme by contributing to the evolution of a safe system through the development and testing of advanced rider safety technologies.

Method

Design of MCAS prototypes
The first prototype of MCAS was designed and programmed using the Arduino microcontroller platform. The MCAS system utilises a LiDAR distance sensor (maximum detection range = 180 m, accuracy = ± 15 cm) to detect hazards or obstacles. The main design objective was to achieve the highest safety impact and retrofittability capacity. In the first prototype, visual, auditory and automatic phone call alerts were incorporated into the design. A GSM module (SIM900A) was used to enable an automated phone-calling mechanism. The visual alert utilised light-emitting devices (LED) while the motorcycle's horn was used to generate auditory alert. The initial design incorporates an external rechargeable battery for power supply and manual on/off switch to minimise modifications to the motorcycle's original electrical system. The first prototype was first installed and tested on a 100cc (2007) motorcycle. The MCAS prototypes were developed and iteratively improved to address hardware and software challenges identified during testing.

Installation of MCAS on a motorcycle

The LiDAR distance sensor was securely mounted at a 90-degree angle to the motorcycle's front panel using a custom steel plate bracket. Installation on the 2007 model required cutting the plastic front panel to expose the sensor. In the first prototype version, the alarm control unit was enclosed in a weatherproof electrical PVC box with dimensions of 22 cm × 14 cm × 7 cm (8.66 in × 5.51 in × 2.76 in). Due to its dimension and the use of external rechargeable battery for power supply, a helmet box was required to store the alarm control unit of the first prototype. The GPS and GSM antenna were fitted on the top of the helmet box. The light emitting devices (visual alert) were fitted onto the motorcycle's instrument panel. Figure 1 shows the installation of MCAS main components on 2007 motorcycle model (A) and 2019 motorcycle model (B).



Figure 1. Placement of LiDAR distance sensor and LED-based visual alert

MCAS Alert Activation Mechanism

MCAS alerts were programmed to increase its intensity as the motorcycle gets closer to the hazard. In the initial design of MCAS, the lowest alert is a green colour LED. Assuming a trajectory change to a clear path is not initiated, the visual alert turns from green to amber and red colour and a more intense auditory alert follows. The automatic phone calling mechanism is initiated together with the auditory alert. This proximity-based adaptive alert was part of the first three versions of the MCAS prototypes.

MCAS Prototype Functionality and Effectiveness Test

To evaluate its performance, the MCAS prototypes were tested in both controlled environments and real-world road conditions. In the controlled tests, a rider started from a stationary position (0 km/h) and rode toward a fixed target placed 150–200 metres ahead. Additionally, real-world testing was carried out, where a test rider rode the motorcycles on actual roads. To capture proof of MCAS activation and analyse rider behaviour, the rider was equipped with a forward-facing action camera capable of recording both video and speed data. The testing of MCAS Version 1.0 and Version 2.0 was limited to controlled environment and road tests, whereas Version 3.0 was evaluated through a naturalistic riding study involving three participants who used MCAS on their personal motorcycles. Alert activation status, camera footage and GPS speed data were analysed to assess the system's effectiveness in detecting hazards and activating alerts at different riding speeds.

Results

The test data for Version 1.0 indicated an overall alert activation success rate of 72.8%. However, the continuous horn alert setting was deemed infeasible due to frequent false alerts and excessive sound volume, which also caused confusion for the tester. Additionally, the phone call alert had a low success rate of only 16.1%. An iteration was made in Version 2.0 with the inclusion of a global positioning system (GPS) module to set a minimum 30 km/h operating speed threshold for alert activation, aiming to reduce the false-positive rate, particularly in traffic congestion. Additionally, a higher-gain antenna was integrated into the GSM module to improve the success rate of the phone call alert mechanism. The second prototype was installed and tested on a 150cc motorcycle (2019 model). The test data indicate no significant operating issues thus proving a successful transfer of the technology to a newer motorcycle model. The Version 2.0 alerts activation success rate improved to 78.9% compared to Version 1.0. However, the phone call alert remained unreliable (46.8% success rate). Table 1 provides a detailed summary of the analysis results during Version 1.0 and Version 2.0 testing utilising 555 out of 164,286 recorded data points in which the MCAS alert system was triggered in response to objects or hazards detected within the motorcycle's forward path.

The third MCAS prototype was designed without the GSM module as it was determined to be unreliable. Further, a 12.8V flasher buzzer was repurposed to generate 70 dB sound output for the auditory alert to replace the automatic horn. Analysis of preliminary data post MCAS installation (average cumulative distance of 986 km per rider) showed an 84.1% success rate of MCAS Version 3.0. However, it also revealed limitations such as battery recharging issues and manual power activation. The manual activation was an issue because users had to open the helmet box to turn the

system on, and they often forgot to do so before starting their journey. MCAS insufficient response to sudden, close-range encroachments was also reported. Additionally, storing the control unit in the helmet box limited usability for food delivery and courier riders, negatively affecting user acceptance.

Improvement of MCAS design

The present study addresses key limitations of MCAS design based on testing and user feedback and the findings were used to develop MCAS prototype Version 4.0. To address the dimension issue of the control unit's storage, the design was optimised to reduce the dimension of casing to an 8.89 cm × 3.81 cm × 13.97 cm (3.5” x 1.5” x 5.5”), eliminating the need for a helmet box. The final Version 4.0 also introduced an automatic ignition-based power system and enhanced the alert mechanism with speed-based adaptation and a flickering red LED for improved visibility.

Table 1. The success rate of MCAS alerts and component activation

Speed (km/h)	Success Rate (%)					
	LiDAR (*N*=105)	GPS (*N*=105)	LED (*N*=105)	Horn (*N*=105)	GSM 2.5 dBi (*N*=102)	GSM 15.0 dBi (*N*=33)
20	89.66	89.66	72.41	82.76	17.39	100.00
30	67.86	67.86	60.71	57.14	7.14	83.33
40	81.82	81.82	77.27	77.27	27.27	83.33
50	100.00	100.00	100.00	100.00	27.27	-
60	100.00	100.00	85.71	100.00	33.33	14.29
70	85.71	85.71	85.71	85.71	0.00	0.00
80	100.00	100.00	100.00	100.00	0.00	0.00
Avg. (%)	89.29	89.29	83.12	86.13	16.06	46.83
SD (%)	12.06	12.06	14.34	15.85	13.83	46.77

Benefits to road safety

The present study demonstrates the potential of MCAS as a pre-collision warning system to improve rider safety. Figure 2 displays the instances of safe rider responses and collision avoidance actions recorded during the testing.



Figure 2. Instances of MCAS alerts activation and user’s collision avoidance

Implications for policy and/or practice

MCAS can enhance motorcycle safety by reducing rear-end crashes, making it suitable for policy adoption through regulatory mandates, tax incentives, or voluntary motorcycle star rating program.

Conclusions

In conclusion, the retrofittable collision warning system has demonstrated promising operational effectiveness. This study also highlighted the potential safety advantages of MCAS in mitigating traffic conflicts involving motorcycles, particularly those with small engine displacements.

References

Abdul Khalid, M. S., Zulkipli, Z. H., Solah, M. S., Hamzah, A., Ariffin, A. H., Amir, A. S., Mohd Jawi, Z., Ahmad, Y., Abu Kassim, K. A., & Khamis, N. K. (2021). A Review of Motorcycle Safety Technologies from the Motorcycle and Passenger Car Perspectives. *Journal of the Society of Automotive Engineers Malaysia*, *5*(3), 417–429. https://doi.org/10.56381/jsaem.v5i3.184

Abdul Manan, M. M., & Várhelyi, A. (2012). Motorcycle fatalities in Malaysia. *IATSS Research*, *36*(1), 30–39. https://doi.org/10.1016/j.iatssr.2012.02.005

Hanowski, R. J., Soccolich, S., Camden, M. C., Schaudt, W. A., Vilela, J. P., Ibrahim, M. K. A., Solah, M. S., & Abu Kassim, K. A. (2021). Truck struck rear-end crashes: Problem scope and an area of opportunity. *Proceedings of Heavy Vehicle Transport & Technology (HVTT16)*. https://hvttforum.org/wp-content/uploads/2021/10/Hanowski-Truck-Struck-Rear-End-Crashes-Problem-Scope-And-An-Area-Of-Opportunity.pdf

MIROS develops detection technology to reduce motorcycle collisions. (2021, February 2). *BERNAMA*. https://www.bernama.com/en/general/news.php?id=1927789

Road Transport Department-Road Safety Division. (2020). *Road Safety Statistical Book*. Malaysian Road Safety Department.

Effectively engaging with communities on the issue of speed

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Abstract
Consulting with the public and elected members on speed changes can be a sensitive issue. This project outlines a strategy for effectively communicating and engaging with both the public and elected members on lowering speed limits. The work was undertaken in 2024 and involved developing a communication strategy that met the needs of diverse audiences, preparing a digital campaign to enable greater input, devising a strategy to address negative feelings from elected members and the public, advising on the changing political landscape in New Zealand regarding road safety and speed management and developing materials to address changing priorities, and negotiating change with project staff.

Social media post
Consulting on speed changes can be a sensitive issue. This project provides a strategy for effectively engaging with the public and elected members on lowering speed limits.

Background
In 2024, Far North District Council sought public feedback on their Speed Management Plan, which proposed to lower the speed around all schools, marae, downtown, and in both urban and rural areas within the Russell-Kororāreka catchment area.
This was due to numerous community requests to investigate speed limit changes in the Russell-Kororāreka catchment area, and 34 crashes resulting in injuries, with 10 of those leading to death or serious injury in the previous five years. This, combined with a significant increase in walkers and cyclists using these routes, highlighted the need for safer speed limits. The project took place in a time when Central Government direction on speed management was changing.

During the period of the Land Transport Rule: Setting of Speed Limits 2022, Road to Zero was Aotearoa New Zealand's road safety strategy, with an aim to significantly reduce road trauma. The Road to Zero strategy underpinned the rule with an ambitious target of reducing deaths and serious injuries on the roads by 40 percent by 2030. Road to Zero was focused on implementing a range of interventions including safe and appropriate speed limits.

The Land Transport Rule: Setting of Speed Limits 2022 was replaced by the Land Transport Rule: Setting of Speed Limits 2024. The new rule introduced a new approach to setting and reviewing speed limits, with a focus on safety and economic impacts. It has reserved some speed limit reductions made since January 2020 and requires councils to consider cost-benefit impacts and consult with communities before setting new or reviewing existing speed limits.

Conference theme
The work aligns with the Equity theme engaging with a broad cross section of the community and taking onboard individual's views.

Project description
The objectives of this project were to:
- Effectively communicate with the public on the proposed speed limit changes
- Consult with a diverse public audience on the proposed speed limits and seek feedback
- Capture what was learned during the consultation period to support conversations with elected members and the public
- Close the engagement loop with the public, acknowledging feedback and providing next steps

Approach

Change management and communications approach was undertaken in a time when Central Government direction on speed management was changing. This required:

- Interpretation of the proposed changes to New Zealand's Setting of Speed Limits Rule
- Development of a consultation strategy that prioritised road safety but also acknowledged the proposed rule changes.
- Advice provided to council on the communications approach and materials developed to address changing government priorities.

The development of a consultation and engagement strategy using best practice guidance included:

- Simplified technical language to effectively communicate with the public to increase understanding
- Evidence based messaging addressing impacts to travel time as a result of reduced speeds
- Collaboration with advocates and road safety partners
- In-person and early engagement with community groups, schools, and iwi
- Digital campaigns to enable greater input from a diverse audience

Schools and hapū were individually invited to provide feedback. Public feedback was sought online and through in person drop-in sessions. The consultation campaign was promoted through the Council website, through social media and by engaging with advocates in the local community.

The messages developed for the web page and FAQs were evidence based and linked to the outcomes of the proposed speed changes. They provided information on the scope of the speed changes, locations, why they were being proposed and what impact speed changes may have on road users. The impacts focused on deaths and serious injuries and travel times.

Communication materials were developed to support the roll out of the consultation campaign. The materials produced included:

- Online consultation webpage on the Far North District Council website
- Online survey
- Frequently asked questions (FAQs) page
- Maps showing the proposed speed for each road in the catchment area
- Online interactive map showing the proposed speeds to allow for interactive and location specific feedback, the map at the close of consultation is shown in Figure 1

At the conclusion of the campaign two reports were produced capturing the consultation feedback, one for elected members and one for the public. The reports captured what was learned during the consultation period, acknowledged feedback, and supported future conversations with the public and elected members.

Findings

Leadership - Strong leadership, willingness and bravery demonstrated by Transport Council staff during a change in Central Government direction meant the programme was not derailed. A transparent communications approach was taken to ensure Elected Members and senior leaders understood the impacts of the changes to the Setting of the Speed Limit Rule, and a quick decision-making process allowed the consultation campaign to adapt with minimal disruption

Investment in communications - The investment in building a consultation strategy and engaging with the public at multiple stages laid a foundation for the community to be receptive to the changes proposed in the Speed Management Plan. This also provided Elected Members the confidence to support the Speed Management Plan.

Robust consultation and engagement strategy- Implementing a robust consultation strategy that laid out a step-by-step approach to the stages and type of engagement with key stakeholders and the public resulted in quick wins. Early engagement with schools, iwi and hapū and providing the public with a variety of channels to give feedback both online and in-person, resulted in an increased awareness and a diverse range of voices having their say.

Consistent and transparent communications - The consultation campaign received over 350 submissions. For a community with a small population size, this was considered significant feedback. With the delivery of consistent communications throughout the campaign, the public were aware of what they were providing feedback on and how

this would be used. Changes to the Settings of the Speed Rule were quickly and clearly communicated to the public and Elected Members, outlining impacts to the proposed speed limit changes which resulted in trust being maintained in the consultation process.

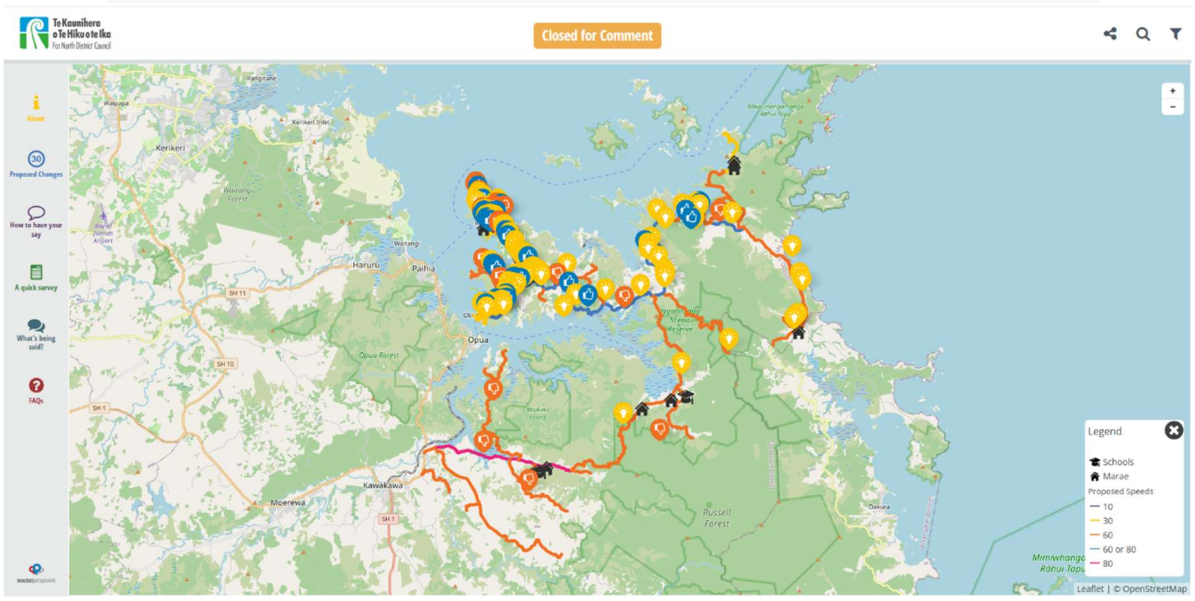


Figure 1. Online Interactive Map

Outcomes

Consultation reporting at the conclusion of the speed management consultation, resulted in elected members requesting a recommendation report for speed limit changes for the Russell/Kororāreka speed catchment. This will likely result in a speed management plan for the NZ Transport Agency's consideration and safer speeds for this catchment in the Far North of New Zealand.

Due to the detail included in the consultation and community support for safer speeds, Far North District Council is considering implementing lower speeds using 100% local funding as these speed changes are currently not able to be funded by Central Government. The outcome would not have been possible without the strength of the consultation effort.

References

Social Pinpoint (2025). Russell-Kororāreka Area Speed Consultation, https://nta.mysocialpinpoint.com/russell-kororreka-area-speed-consultation#/

Mobile notifications and crash risk at regional telecommunication coverage boundaries

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Abstract

Mobile phone notifications are associated with slower driver reaction times, even when the phone is not actively being engaged with. The Western Australia road network contains long stretches of road without telecommunication coverage, upon which re-entering coverage may cause a sudden influx of notifications. Using crash data from 2019-2024, telecommunication network coverage data, and road network data, this project investigated if there was an increased crash rate at sections of road where drivers are re-entering into telecommunication coverage. Key findings suggest that upon re-entering telecommunication coverage, crash risk rises and is sustained, rather than rising for a short distance following an influx of notifications. The project concludes that mobile phone distractions are a continuous risk in coverage, not just a temporary surge at coverage boundaries.

Social media post

Heads up, drivers! Our research in Western Australia reveals that as you drive from a non-telecommunication coverage area to a covered area, road crashes rise, and they are sustained as long as you are in a coverage area. Stay alert, maintain your focus on the road, and consider disabling notifications while driving.

Background

Driving is a complex task that demands concentration from drivers to reduce the likelihood of making mistakes that could lead to road crashes. Numerous studies have found that driver distraction plays a crucial role in causing tens of millions of injuries on roadways each year (Gazder & Assi, 2022). In Western Australia, the serious risks posed by distracted drivers was reported to have resulted in 14 fatalities in 2023, and between 2018 and 2022, it accounted for 542 deaths or serious injuries (Road Safety Commission, 2025).

Driver distraction can stem from in-vehicle and external influences. A major in-vehicle distraction is mobile phone usage, which is associated with a crash risk increase of two to twelve times (Antin et al., 2019). Drivers often become distracted when they receive notifications of messages, emails, and missed calls, which divert driver attention. The frequency and persistence of these notifications can amplify distraction. Although research exists on the impact of mobile phone usage on crashes, there are few, if any studies examining how the influx of mobile phone notifications contributes to increased distraction and ultimately, to crashes.

The road network in Western Australia features long stretches without telecommunication coverage. When drivers transition from areas without telecommunication coverage to areas with it, they may be inundated with mobile phone notifications, which could lead to crashes. This project explores the hypothesis that drivers entering into telecommunications coverage areas experience a higher risk of crash due to an influx of notifications banked from driving in a non-coverage area.

Conference Theme - Evolution

This project seeks to begin a dialogue on the passive distraction posed by mobile phones, further evolving our understanding of the risks that road users experience with ever-encroaching technology. Since 1973, mobile phones have transitioned from simple devices to smart, highly connected ones.

In the era of basic mobile phones, users could not receive emails or social media notifications. As mobile phones have increased in capability, the distractions they pose to drivers have increased dramatically. Consequently, mobile phones have evolved from relatively low-distraction tools to highly distracting devices for drivers, increasing the risk of road crashes – as practitioners and policymakers, our understanding of these increasing risks must evolve as well.

Methodology

Data Collection

Three core datasets were collected and integrated for this project; telecommunications coverage data, data for the regional road network in Western Australia and crash data recorded on that network.

Telecommunications coverage data for the 2024 Telstra 4G network was obtained from the ACCC Mobile Infrastructure Report (ACCC, 2024), and subset to Western Australia (WA) coverage. Network coverage comprises of thousands of polygon shape geometries across WA. Crash data was obtained from Main Roads Western Australia for crashes recorded 2019 to 2024. Crashes in the metropolitan region were excluded from analysis, as the metropolitan region has near complete telecommunication network coverage. Crashes at an intersection or without a recorded location were also removed. Crashes of all severity were included to test for an increased risk of crash, rather than just injury crashes. Network information and road vertex geometry were obtained from Main Roads for the WA road network.

Road Network Telecommunication Coverage

The Main Roads network is represented as edge paths (referred to as datums, a geometric collection of vertices) connecting nodes on the network. A datum's geometry consists of a set of two or more vertices - an ordered set of coordinates which spatially represent the datum's associated stretch of road. The vertex geometry for the road network was aggregated at the datum level to create a line geometry for the state road network (Figure 1, Left). The intersection of the road network line geometries was then taken with respect to the coverage polygon geometries, resulting in a raw line geometry indicating telecommunication coverage of the entire state route network.

Network Segmentation

Segmentation of the network was required to create a more granular representation of the network to compare road sections near boundaries more precisely. The length of datums – the distance between two intersection nodes - range from 10 metres long, up to more than 100 kilometres. Datums longer than 500 metres were split into $\mathbf{floor}(\frac{datum\ length\ (m)}{500})\mathbf{+1}$ subdatums. The geometric intersection of this granular datum network was taken with regard to the road network coverage, which was used to calculate the length of the subdatum containing coverage, which was used in turn to find the proportion of the subdatum with coverage. The vast majority of subdatums contained 0% or 100% coverage, with only a small number containing partial coverage. For the small number of partially covered subdatums, an arbitrary cut-off was made to determine if a subdatum had coverage was if it contained >20% coverage by length.

For each road, adjacent subdatums with the same true or false status of coverage were given the same 'coverage section ID', which is used to identify a stretch of road that has continuous coverage or non-coverage at the road level. Due to the presence of many shorter sections of non-coverage, that would have a negligible buildup of pending notifications, sections shorter than 10 kilometres in length (~5.5 minutes at 110 km/h) were excluded as coverage boundary points from the crash risk analysis (Figure 1, Right). At the road level, the distance of each subdatum to the nearest boundary was determined as the minimum of the distances to the previous and subsequent boundary (should they exist), a boundary being defined as a change from 'True' to 'False' coverage between subdatums, or vice-versa.

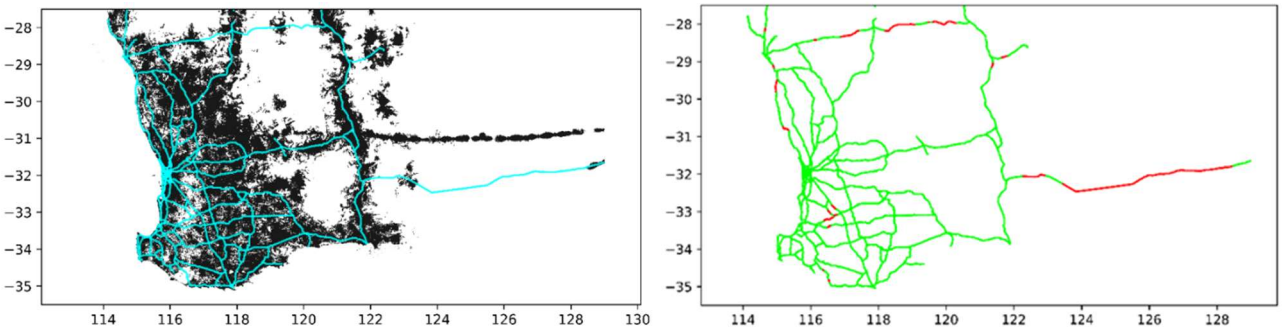


Figure 1. Left) A section of the WA telecommunication coverage (black) overlayed with the state road network (cyan). Right) Cleaned telecommunication coverage status of a section of the state road network. Green: Coverage. Red: No Coverage.

Crash Risk

Crashes were mapped to the respective subdatums based on the crash coordinates and the road network geometry. The crash data was aggregated by count at the subdatum level, giving the number of crashes at each subdatum. The

subdatums, now containing crash counts, were grouped into bands with cutoffs at 0, 1000, 2000, 5000, 10000, and 25000 metres from the nearest coverage boundary. Bands in areas with no coverage are represented as negative relative to the boundary, and bands with coverage are represented as positive relative to the boundary.

Findings

Road Network Telecommunication Coverage

In the raw road network telecommunication coverage, 5,805.94km (29.0%) of the 20,022.23km length of the state road network contained no telecommunications coverage. 696 stretches of road with no coverage were identified, ranging from 30 metres to 455 kilometres in length. This distribution was approximately exponentially distributed, with a median length of 1,474 metres, and a mean length of 7,595 metres. 90 were longer than 10km, and 6 longer than 100km.

Crash Risk

The crash rate in all distance bands with coverage was greater than the respective non-coverage distance band, suggesting that telecommunication coverage may be associated with crash risk (Figure 2). The crash risk of the positive distance bands with coverage all had similar values. This suggests that there may not be a temporary distraction due to an influx of notifications, but rather a constant increased crash risk in areas with telecommunication coverage due to distraction.

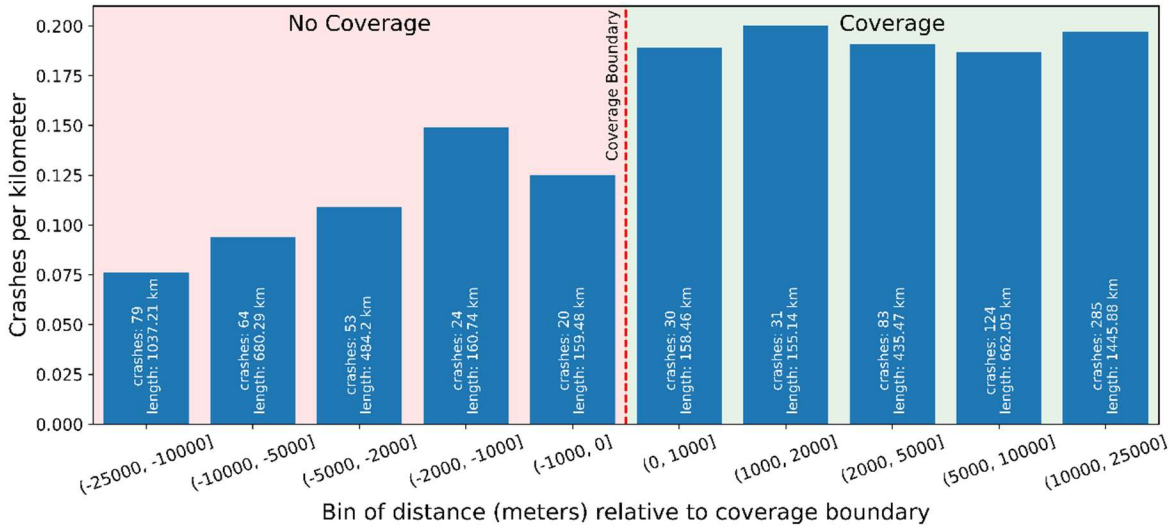


Figure 2: The crash rate of sections of road, banded by the distance relative to the nearest coverage boundary

While this study is not able to control for other road variables, opposite bands close to the coverage boundary, like (-1000, 0] and (0, 1000], on average have similar characteristics, being comprised of close sections of road, allowing a comparison. Bands further from the coverage boundary; (-25000, -10000] and (10000, 25000] likely contain other factors that coincide with coverage that affect crash rate. Most notably being that the band (-25000, -10000] likely mostly contains road far from townsites, while the band (10000, 25000] likely contains roads closer to development, and associated factors like increased traffic and more complex roads that influence crash risk.

Conclusion and Future Work

This project found that upon re-entering telecommunication coverage, crash risk rises and is sustained, rather than rising for a short distance following an influx of notifications, concluding that mobile phone distractions are a continuous risk in coverage, not just a temporary surge at coverage boundaries.

This work has been an early investigation into this area with many avenues for further work to more robustly understand the issue, including:

- factoring in the network coverage of the additional telecommunication providers - Optus and TPG
- factoring in the network coverage changing year to year and any association with crashes
- factoring in the travel direction of the crash vehicle

References

Antin, J. F., Lee, S., Perez, M. A., Dingus, T. A., Hankey, J. M., & Brach, A. (2019). Second strategic highway research program naturalistic driving study methods. *Safety Science*, *119*, 2–10. https://doi.org/10.1016/j.ssci.2019.01.016

Australian Competition and Consumer Commission. (ACCC). (2024). *Mobile Infrastructure Report 2024*. https://www.accc.gov.au/by-industry/telecommunications-and-internet/mobile-services-regulation/mobile-infrastructure-report/mobile-infrastructure-report-2024

Gazder, U., & Assi, K. J. (2021). Determining driver perceptions about distractions and modeling their effects on driving behavior at different age groups. *Journal of Traffic and Transportation Engineering (English Edition)*, *9*(1), 33–43. https://doi.org/10.1016/j.jtte.2020.12.005.

Road Safety Commission (2025). *Mobile phones and distractions*. Western Australian Government. https://www.wa.gov.au/organisation/road-safety-commission/mobile-phones-and-distractions#:~:text=Your%20next%20text%20message%20isn,looking%20at%20the%20road%20ahead

Monitoring safety performance indicators to enhance road safety in NSW

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Presenter: Sayantan Sen

Abstract
The 2026 Road Safety Action Plan sets NSW on a path towards zero road trauma by 2050, emphasising the need for a robust system to manage road safety performance. Safety Performance Indicators (SPIs) are an internationally recognised framework for monitoring key risk factors and guiding interventions. In 2020, Transport for NSW commenced a program of observational research to monitor three SPIs - seatbelt compliance in light vehicles, helmet and protective gear use among motorcyclists, and helmet use among bicycle riders. Findings have revealed consistently high compliance with seatbelt and motorcycle helmet use but declines in motorcycle protective gear use and bicycle helmet use. The 2025 study expanded NSW's SPI monitoring to include e-scooter helmet use, reflecting emerging micromobility trends. These studies support evidence-based policy refinements and ongoing efforts to reduce road trauma. Findings from the 2025 study and trends from the three studies will be presented, including lessons learnt.

Social media post
The 2026 NSW Road Safety Action Plan aims for zero road trauma in NSW by 2050. Transport for NSW tracks key Safety Performance Indicators, including seatbelt & helmet use, to guide policies & reduce road trauma, with recent findings highlighting some concerning behavioural trends.

Introduction
The 2026 NSW Road Safety Action Plan (RSAP) commits to ensure we continue our progress towards zero trauma, including the interim 2030 targets of reducing fatalities by 30 per cent and serious injuries by 50 per cent. Achieving these goals relies on a robust system for managing road safety performance, aligned with trauma outcomes. Safety Performance Indicators (SPIs) are an internationally recognised framework for effective road safety management. SPIs are critical measures of risk in the road system.

Ongoing monitoring of SPIs in conjunction with the tracking of road trauma outcomes inform strategic decision-making, enabling the reprioritisation of interventions where necessary to drive sustained reductions in road fatalities and serious injuries.

Transport for NSW (TfNSW) monitors a range of SPIs that sit within the 2026 RSAP. Since 2020, observational research has been conducted to measure and track three priority road user behaviours including,

- Seatbelt compliance in light vehicles
- Helmet and protective gear usage among motorcyclists
- Helmet usage among cyclists.

Recognising the emerging role of e-micromobility in the transport network, the scope of the 2025 study has expanded to include an assessment of helmet use among e-scooter users. This addition reflects the evolving nature of urban mobility and emphasises the importance of adapting safety measures to new transport trends.

Conference theme
This paper aligns with the sub-theme of "Evolution", as SPIs facilitate system-wide monitoring of road user behaviours and help to direct the evolution of safe systems interventions in NSW. The new focus on e-scooters in the 2025 study also reflects significant evolution in the transport network, and the need for investigation into evolving behavioural trends.

Method

TfNSW conducted research in 2020 to establish baseline SPIs, repeating this research in 2023 and 2025 to monitor the prevalence of key road user behaviours and assess change over this period.
The study was designed to assess compliance with key road safety measures, including:

- Seatbelt compliance among light vehicle drivers and passengers
- Helmet usage among motorcycle riders and passengers
- Protective gear compliance among motorcycle riders and passengers
- Helmet usage among bicycle riders
- Additionally, the 2025 study is monitoring helmet compliance amongst e-scooters, extending the scope of safety performance monitoring to emerging modes of e-micromobility.

The 2020 study was conducted at 31 sites across metro and regional NSW and provided baseline data for TfNSW on these behaviours. Observations were recorded for over 9,000 light vehicles, 2,700 motorcycles, and 2,900 bicycles (Transport for NSW, 2021).

The 2023 SPI study was a follow-up to the 2020 baseline research, expanding the observation locations to more than 40 sites across NSW, including regional and remote locations. This study incorporated methodological improvements informed by the 2020 study, including refinements to data collection tools, observations in remote locations, assessment of seatbelt use by back-seat passengers (where feasible), and the inclusion of food delivery riders. In total, over 10,000 light vehicles, 3,000 motorcycles, and 3,000 bicycles were observed (Transport for NSW, 2023).

The 2025 study builds further upon previous studies. Fieldwork observations commenced on 10 February and will be completed by 23 March 2025. Observations are being conducted at more than 48 sites, including 28 metro, 15 regional and 5 rural locations. Data collection has already recorded observations of over 17,300 light vehicles, 2,900 motorcycles, 3,500 bicycles and 1,600 e-micromobility as of 13 March 2025.

Results

Seatbelt compliance remained high in 2023 (99.2%), similar to 2020 (99.3%), with nearly all observed drivers and front-seat passengers wearing their seatbelt correctly fitted and adjusted. Compliance was higher among females in 2020 (99.5%) and metro drivers in 2023 (99.5%).

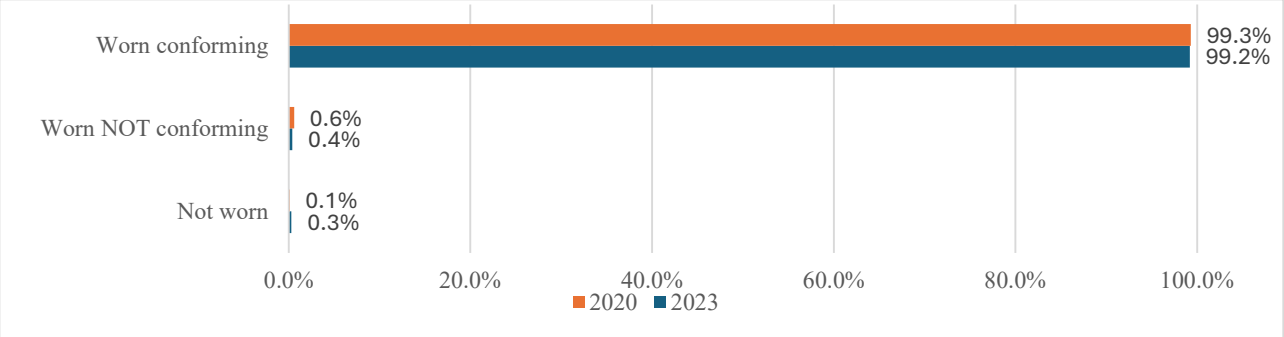


Figure 2. Seatbelt compliance rate in 2020 (n=9,299) and 2023(n=10,681)

Passengers or drivers in vehicles with provisional plates were significantly less likely to be observed wearing a seat belt correctly (97.9%) in 2023 compared to drivers and passengers in other vehicles (99.3%).

Motorcycle helmet compliance remained high at 99.9 per cent. However, full protective gear use declined from 13.6 per cent in 2020 to 11.6 per cent in 2023, with significant decreases in the use of protective upper body clothing (49.1% in 2023 compared to 58.7% in 2020) and gloves (52.2% in 2023 compared to 63.6% in 2020).

Bicycle helmet use dropped from 91.2 per cent in 2020 to 89.5 per cent in 2023, with the lowest compliance among teenagers (68.6%) and a sharp decline among children under 10 (86.5% in 2023 vs 95.5% in 2020). Among those wearing a helmet, 99 per cent had it fastened.

Findings from the 2025 research will be made available during this presentation and compared with the findings from the 2020 and 2023 research. Trends over time will be analysed and presented and the e-micromobility findings will be presented for the first time.

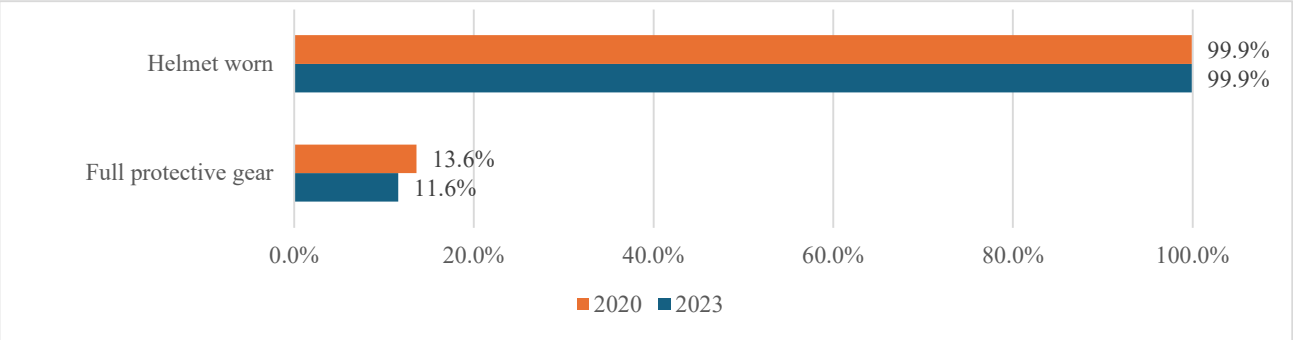


Figure 3. Motorcycle helmet compliance and protective gear worn rate in 2020 (n=2,714) and 2023 (n=3,009)

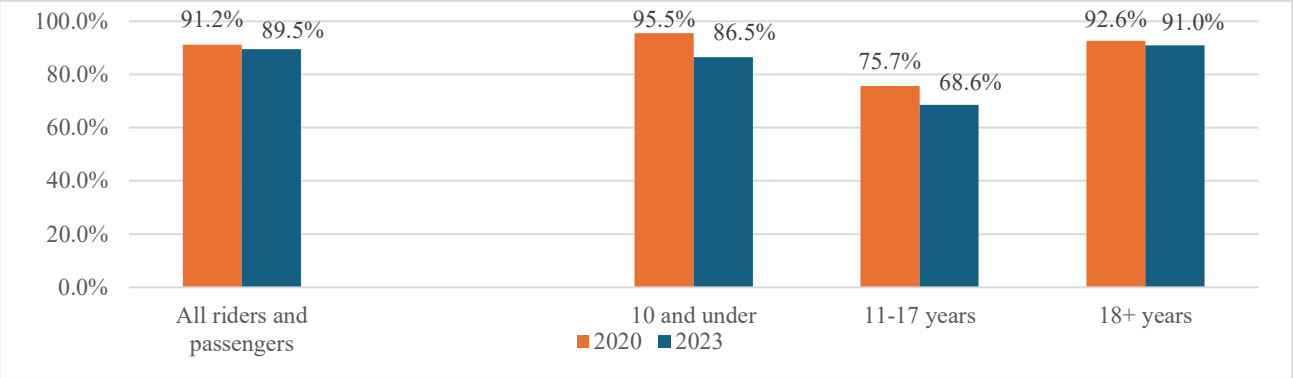


Figure 4. Bicycle helmet wear rate in 2020 (n=2,901) and 2023 (n=3,016)

Benefits to road safety

SPIs provide a critical measure of road user behaviours, supporting data-driven decision-making to reduce road trauma. High seatbelt and helmet compliance in 2020 and 2023 reflect strong adherence to safety measures. However, declines in protective gear use among motorcyclists and bicycle helmet compliance highlight areas for improvement. The 2025 study, which includes e-scooter helmet use, ensures SPIs continue to evolve with emerging transport trends. Ongoing monitoring of SPIs informs targeted interventions to enhance road safety and reduce fatalities and serious injuries across NSW.

Implications for policy and/or practice

SPIs monitoring provides valuable insights to guide policy and enforcement strategies. Declines in protective gear use and bicycle helmet compliance suggest opportunities for targeted education and enforcement efforts. Expanding SPIs tracking to include e-scooter helmet use in 2025 will help to ensure policies remain responsive to emerging transport trends. These insights enable TfNSW to refine safety measures, prioritise high-risk behaviours, and support continuous improvement in road safety outcomes.

Conclusion

The integration of SPIs into road safety monitoring provides a robust evidence base to inform targeted interventions and policy refinements. While high seatbelt and motorcycle helmet compliance demonstrate strong adherence to existing safety measures, declines in protective gear use and bicycle helmet compliance highlight areas for targeted interventions. The inclusion of e-scooter observations in 2025 reflects the need for adaptive safety strategies in response to evolving transport trends. By leveraging SPIs data to inform policy and enforcement, TfNSW remains committed to reducing road trauma and enhancing the safety of all road users.

This presentation will outline the findings and trends from the third iteration of this observational research, including lessons learnt from delivering the research, guidance for other jurisdictions considering commencing similar research and any emerging policy implications from the 2025 study.

References

Transport for New South Wales. (2021). *NSW Safety Performance Indicators Observational Study – Summary Report*. https://roadsafety.transport.nsw.gov.au/downloads/spi-observational-study-summary.pdf

Transport for New South Wales. (2023). Summary Report- Safety Performance Indicators (SPI) Observation Study 2023: An observation study of light vehicle drivers, motorcyclists and bicyclists. https://www.transport.nsw.gov.au/system/files/media/documents/2024/2023_safety_performance_indicators_observational_study_0.pdf

Equity and Safety within remote aboriginal communities

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Abstract
Around 20% of WA's population live in regional areas but regional WA accounts for approximately 40% of people killed or seriously injured on our roads. Additional focus is needed in regional areas to correct this imbalance. Approximately 62% of WA's Aboriginal population live in rural or remote areas and in addition to risks associated with regional road users, they are disproportionately exposed to and affected by road trauma. Changing current State Government practices to include road safety planning and road safety auditing into capital programmes within remote communities will serve toward addressing this imbalance. The project example used for this presentation is a WA first to undertake Road Safety Planning and Road Safety Auditing for an entire remote community street network

Social media post
Road Safety Auditing entire remote communities is a critical intervention for saving lives and closing the gap of the disproportionally high number of Aboriginal and Torres Strait Islander Road users hospitalised due to a road crash

Background
Driving Change 2020 to 2030 (u.d) notes that almost 40% of fatal and serious crashes happen on WA's regional and remote roads. Between 2015- 2019, 3,283 people were killed or seriously injured on rural roads. This means approximately 40% of crashes are in areas where only around 20% of the population live.

Approximately 62% of WA's Aboriginal population live in rural or remote areas and in addition to risks associated with regional road users, they are disproportionately exposed to and affected by road trauma. In 2016, the rate of fatal road injuries for the Aboriginal population in WA was 4.1 times higher than the rate amongst the non-Aboriginal population.

An Austroads report on road safety in regional and remote settings identifies the "need to align Aboriginal road safety initiatives with the 'Closing the Gap' campaign, since many of the factors underlying the disparity in Aboriginal and non-Aboriginal road injury can be linked to the former group's general socioeconomic disadvantage" (Austroads, 2019).

Ongoing difficulties associated with access to transport are commonly referred to as "transport disadvantage". As Australia has comparatively high levels of car ownership, difficulties associated with maintaining private transport (e.g., financial stress related to initial cost of purchase, as well ongoing costs such as petrol, insurance, car purchase and maintenance) could also be included in the overall definition of transport disadvantage.

Transport disadvantage is experienced by specific sub-groups in the population, for example, families with young children, people with a disability and Indigenous Australians. Transport disadvantage is also common in specific geographical locations such as outer-urban (or "fringe") areas, rural and remote Australia.

Rural and remote areas of Australia have low levels of public transport access. Some remote areas have relatively low levels of vehicle ownership. Transport options for Indigenous Australians in remote communities and communities located in fringe urban areas are limited. A significant proportion of Indigenous Australians living in remote areas have no access to public transport and one-third have no access to a car. Cars in remote indigenous communities are heavily used and, since they are often purchased second hand and used in rough terrain, maintenance is expensive, and they often have a short lifespan. Even outside of non-remote areas a significant proportion of Indigenous Australians have no access to public transport.

Conference theme
The project approach addresses the conference themes as follows:

- Equity – proactive road safety planning and auditing have the potential to provide significant road safety benefits to remote aboriginal communities who have a high proportion of people who do not drive or have access to a car and walk or ride (bikes and e-mobility) instead.

- Elasticity – in remote and regional communities driving is often the only option for long distance travel to towns. Ensuring safe roads within communities is vital to ensure the first and last miles of a trip and safe.
- Evolution – road safety auditing an entire remote community as part of new infrastructure projects is a step change that is needed for a proactive approach to improving road safety in regional communities.

Approach

This project sought to take a proactive approach to road safety in remote aboriginal communities. The project, led by the Department of Communities is for construction of new roads and drainage within Mowanjum Community. The project was led by a design approach to ensure roads were sealed and drainage was managed within a set budget.

This resulted in a lack of road safety foresight for the community residents and visitors, where new sealed roads would serve to increase traffic speed and poor driving behaviour. Sealing roads alone would be unlikely to have an impact on the disproportionate number of WA's Aboriginal population impacted by road trauma.

Broader Road Safety Planning through a Road Safety Audit process (in accordance with Austroads Road Safety Auditing guidelines) was commissioned with the aim to review the existing community unsealed road network and, the proposed detailed design for the new roads and drainage. This is a first of its kind proactive approach to road safety within a WA remote aboriginal community.

The approach included analysis of existing traffic volume and speed within the network to ascertain how the existing street network is used as well as analysis of where people are more likely to be walking and riding and key Place locations through land use and type review.

To commence the Road Safety Audit process and to compliment the traffic data analysis, on-line and in person stakeholder meetings were undertaken with the Mowanjum community CEO and board. This discussion highlighted key areas of road safety concern by the community along with confirmation of how the street network is used, hooning behaviour and areas of high pedestrian activity.

Review of the entire community network

The Road Safety Audit of the entire community road network presents the opportunity to be proactive to road safety by identifying potential road safety risk locations, both existing and those presented by the roads and drainage design. This approach enables a consistent road safety response across the network addressing potential risks a similar manner. It also enabled the identification of key locations of high Place value within the community where by the likelihood of pedestrian presence would be increased resulting in higher frequencies of interactions with vehicles. Figure 1 illustrates poor drainage that presents a road safety hazard for motorists in a location that is adjacent to a community public open space.



Figure 1. Poor drainage existing within the community

Benefits for Active Travel

The Road Safety Audit identified key road safety risks that are aligned to the Safe System approach noting the lack of connected footpaths proposed within the community as well as the poorly maintained footpath and lack of crossing facilities connecting the community to the nearby regional town. With often no access to motor vehicles, it was evident that both adults and children alike walk and ride (bikes and e-scooters). With speed limits proposed for the community

above the recognised Safe System threshold for safe active travel on road (≤30km/h), lack of connected footpaths present a real road safety risk for people walking and riding on the road. Figure 2 below illustrates a young girl using an e-scooter to access the local community centre using a road that has a speed limit of 70km/h.



Figure 2. Child on a e-scooter on road due to no footpath

Implications for policy and practice

During the road safety project, consultation with the local community elders and community CEO highlighted the need by the community for a safe transport network that allows children to walk and ride away from vehicles and for a street network that self-enforces a slow operating speed, with the community elders requesting a design that achieves 30km/h.

Numerous State Government agencies provide essential services to remoted communities, such as Department of Communities, Department of Housing, Department of Transport and Department of Education. However, road safety is overlooked, with siloed State Government agencies providing disparate services. Through this project, specifically by undertaking stakeholder meetings, along with discussion at both State and Local Government for the Kimberley region the project highlighted the lack of safe transport infrastructure to and within remote communities. The road safety review and road safety audit process has led to discussions to extend the broader remote community planning and design process, to garner opportunities to gain additional funding allocated to remote aboriginal communities to improve road safety outcomes including active travel infrastructure. This could be potentially led by Department of Communities who review all aspects of community need. Funding allocation can be considered through regional roads funds, road trauma trust account funds and DoT active travel grant funding allocations.

Conclusion

Embedding road safety within the planning and design process of regional community infrastructure projects (which is currently absent from the process) offer tangible road safety benefits and is a critical intervention for saving lives and closing the gap of the disproportionally high number of Aboriginal and Torres Strait Islander Road users hospitalised due to a road crash.

It is acknowledged that this requires additional funding and often there will be limitations as to what road safety interventions can be provided to offer a fully Safe System compliant response. However, ensuring road safety is considered through a project process will lead to safer outcomes for the community when compared to current practices that do not currently consider road safety. Interventions that are Safe System supportive treatments offer road safety benefits and are a step toward a fully Safe System treatment.

Next steps for this project are to continue discussions with State Government department (led by Department of Communities to ensure a change in policy to embed Road Safety into every project ensuring budgets allow for this.

References

Driving Change WA State Road Safety Strategy 2020 - 2030 (u.d). www.wa.gov.au/system/files/2021-07/Driving-Change-Road-Safety-Strategy-2020_2.pdf

Henley G & Harrison JE (2013) Injury of Aboriginal and Torres Strait Islander people due to transport, 2005-06 to 2009-10. Cat. no. INJCAT 161. Canberra: AIHW

Austroads Report (2019) National View on Regional and Remote Road Safety AP-R603-19, 2019. P.33.

Hidden in plain sight: analysis of e-scooter crashes in Victoria

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Abstract
This study analyses e-scooter safety implications following the 2022 introduction of a hire scheme trial in Victoria, Australia. As practitioners within a statutory third-party personal liability insurer, we examined crash data from February 2022 to December 2023, complemented by insights from specifically flagged police data from Q3 2024. Our objectives were to accurately identify e-scooter incidents, characterize affected demographics, injury patterns, and crash circumstances. Initial keyword searches yielded 890 potential incidents; manual review refined this to 250 verified cases, with 106 having associated insurance claims forming the primary study cohort. To address historical under-identification, a machine learning (ML) model (TF-IDF Logistic Regression) was trained on tagged Department of Transport and Planning data, achieving an AUC ROC of 0.98 after preprocessing (text normalisation, stop-word/police-phrase removal, TF-IDF vectorization). Potential dataset biases include underreporting of single-vehicle or hire-scheme incidents to police. Findings from the 2022-2023 claims data reveal intersections as predominant crash sites (61%) and young males as frequent victims. Notably, our 2023 claims data showed e-scooter riders sustained brain injuries at over twice the rate of cyclists (15% vs. 7% respectively). Preliminary analysis of Q3 2024-Q1 2025 police data indicates only 52% helmet use among e-scooter riders in crashes. These insights highlight urgent safety priorities and inform targeted interventions.

Social Media Post
Intersections are hotspots for e-scooter crashes, with fractures and head injuries prevalent among young males. A new ML model identifies accidents, underscoring the urgent need for enhanced helmet compliance. #RoadSafety #EScooters #HelmetSafety

Background
The rapid adoption of e-scooters as a sustainable urban mobility solution has significantly transformed transport landscapes globally, including in Victoria, Australia. However, the introduction of e-scooter hire schemes in 2022 raised critical concerns regarding road safety, infrastructure preparedness, and regulatory frameworks. Historically, detailed data on e-scooter-related incidents were scarce or misclassified within broader road user categories, presenting challenges in understanding the unique risks associated with this transport mode.

Our research addresses this gap by examining crash occurrences, rider demographics, injury severities, and crash conditions from February 2022 to December 2023. It compares these characteristics with other vulnerable road users, notably cyclists, using Victorian data to highlight distinctive safety challenges. While our 2022-2023 dataset could not differentiate between private and hire e-scooters, new police data collection methods initiated in Q3 2024 have begun to capture this detail, offering avenues for future comparative analysis. This study underscores the necessity of robust data collection and innovative analytical techniques to monitor emerging transport safety trends.

Conference Theme
Our research aligns closely with the conference themes: Equity: Acknowledging the rights and value of e-scooter riders as legitimate urban mobility participants, promoting fairness in policy and safety interventions; Elasticity: Emphasizing adaptability and resilience in transportation systems to safely integrate emerging transport modes like e-scooters, and; Evolution: Offering insights essential for advancing the Safe System approach, adapting existing safety measures, and comprehensively addressing human factors associated with active transportation.

Project Description and Approach
The primary analysis included internal crash data from February 2022 to December 2023, combining police reports, insurance claims, and hospital injury data. Initially, 890 records were extracted using keyword searches for variations of the term "e-scooter." A thorough manual review of accident descriptions refined this dataset to 250 verified e-scooter accidents. To ensure accurate injury and crash detail, the final analysis focused exclusively on 106 accidents linked directly to insurance claims.

Due to historical challenges in identifying e-scooters within broader datasets (often misclassified), we developed a machine learning model. The Department of Transport and Planning provided a tagged dataset, which we used to create and validate a TF-IDF Logistic Regression classifier. This model was trained on 2023 data and validated using 2022 data, achieving an AUC ROC of 0.98. The modelling process involved: (1) Ingesting text data and the target variable; (2) Normalising and cleaning text (e.g., lowercasing, removing punctuation); (3) Removing stop words, including common police report phrases (e.g., "vehicle 1," "driver at fault") and personal identifiers (names, registration numbers) to improve model generalisation and performance; (4) Vectorizing text with TF-IDF; (5) Training the logistic regression model; (6) Validating model performance (AUC ROC, precision, recall); and (7) Refining text preprocessing based on learning rates and coefficient evaluation. This ML approach proved effective for identifying e-scooter incidents in datasets where they were not explicitly flagged.

Additionally, specifically flagged police data collected from Q3 2024, featuring new fields for e-device specifics (e.g., ownership, power output), provided supplementary insights into emerging trends, particularly concerning helmet use and rider age demographics. This multi-modal data approach is crucial for understanding the accident population of new transportation users and can be adapted for other emerging road user types.

Results and Findings

Literature indicates e-scooter accidents often involve younger riders, potentially under the influence of alcohol (McGuinness et al., 2021), and that helmet use is significantly lower among shared e-scooter users compared to private users (Narelle Haworth et al., 2021). Consequently, e-scooter riders can suffer head trauma at higher rates than cyclists (Clough et al., 2023). The median age of e-scooter riders is also typically lower than cyclists (Burt & Ahmed, 2023). An Australia and Victoria-specific research focus is necessary due to legislative and environmental differences.

Our analysis of 106 verified insurance claims (TAC data) from February 2022 to December 2023 found that 73% involved riders aged 11–39, with males comprising 74%. Intersections were significant crash sites, accounting for 61% of accidents, with side-impact collisions being most frequent (24%). Overall in this cohort, fractures (31%) and head or brain injuries (15%) were predominant among these injured e-scooter riders.

Focusing specifically on our 2023 TAC claims data, which primarily captures incidents involving a registered motor vehicle, we compared e-scooter riders (approx. 50 claims) with cyclists (approx. 880 claims). Despite the disparity in sample sizes and the inherent underrepresentation of single-vehicle accidents (e.g., falling off an e-scooter or bike without other vehicle involvement), a critical finding emerged: e-scooter riders sustained brain injuries in 15% of their claims, more than double the rate for cyclists (7%). This Victorian finding aligns with literature suggesting lower helmet compliance contributes to higher head trauma rates in e-scooter cohorts. In contrast to these severe injuries, our broader 2022-2023 cyclist claims data showed cyclists more frequently suffered contusions and abrasions (24%) and fewer fractures (18%) compared to e-scooter riders. Information on helmet use within the 2022-2023 TAC claims dataset was limited.

Preliminary analysis of the improved police dataset from Q3 2024 to Q1 2025, which specifically flags e-scooter details, offers clearer insights into current trends. In this recent cohort:

- Helmet use was recorded as: 52% wearing a helmet, 33% not wearing a helmet, and 14% unknown.
- Regarding rider age, 14% of e-scooter riders involved in crashes were aged between 5 and 15 years, below the legal minimum age of 16 for hire schemes.
- This newer dataset also allows for the differentiation between private and hire e-scooters, although a comparative analysis is part of ongoing work.

The data gathering exercise demonstrated the value of data science approaches. The TF-IDF model worked well due to specific e-scooter mentions in accident descriptions once broader, noisy terms were removed. Future refinements could involve pre-trained large language models (LLMs) for text vectorization to potentially enhance contextual understanding and model performance.

Benefits to Road Safety

This research provides detailed insights into specific crash hotspots—particularly intersections—highlighting key intervention points. By understanding injury severity (higher rates of fractures and head injuries for e-scooter riders compared to cyclists in our claims data) and patterns, alongside emerging data on low helmet compliance (33% non-use in recent police data) and underage riding, targeted strategies can be developed. These include infrastructure upgrades, public awareness initiatives, and robust helmet usage campaigns to enhance rider safety and reduce crash risks.

Implications for Policy and Practice

The findings carry crucial implications:

- Reinforced public awareness and education campaigns: Emphasize helmet compliance (addressing the 33% non-use rate) and adherence to regulations, including age restrictions for e-scooter use (given 14% of recent crash-involved riders were underage).
- Targeted infrastructure improvements: Focus on intersections with clearer signage, consideration for dedicated lanes, and improved signalling.
- Enhanced enforcement: Address illegal underage riding and non-compliant helmet use.
- Data-driven insurance practices: Clarify insurance responsibilities for hire-scheme riders and utilize detailed crash data to ensure transparent and equitable injury coverage. Collaboration with hire schemes is needed to access their incident data for a more complete picture.

Limitations and Strengths

Strengths:

- Novel Application of ML: The study demonstrates a beneficial application of machine learning to identify e-scooter incidents in historical datasets where they were previously difficult to isolate.
- Key Local Comparative Finding: The study provides specific Victorian data highlighting a higher rate of brain injuries for e-scooter riders (15%) compared to cyclists (7%) within its 2023 claims cohort, contextualizing local risk.
- Multi-modal Data Integration: Combines refined historical claims data with emerging, specifically flagged police data to provide a more comprehensive view.
- Specific Insights from New Data: The Q3 2024 onwards police data provides crucial, up-to-date statistics on helmet use and underage riding, directly informing current safety concerns.
- Foundation for Future Analysis: The improved data collection methods post-Q3 2024, including private vs. hire flags, lay the groundwork for more detailed future research.

Limitations:

- Underreporting and Coverage Bias: Reliance on police and TAC insurance claims data (for the 2022-2023 cohort) may underestimate the true incidence and nature of e-scooter crashes. Victorian TAC legislation primarily covers accidents involving a registered motor vehicle, requiring a police report for a claim. This means that single-vehicle e-scooter accidents (e.g., falls) or those not involving a registered motor vehicle are likely underrepresented in our claims data. This bias also affects direct comparisons with cyclists, as both groups experience many single-vehicle accidents not captured in this dataset.
- Sample Size Discrepancy in Comparative Analysis: The specific 2023 comparison of brain injuries between e-scooter riders (~50 claims) and cyclists (~880 claims) involves significantly different sample sizes, warranting caution in generalising these proportions, though the observed difference is stark.
- Historical Data Gaps: The 2022-2023 dataset did not allow for reliable differentiation between private and hire e-scooters. While the ML model improved identification, it relied on text descriptions which may not always contain necessary distinguishing details.
- Severity Bias in Claims Data: The 106 claims analysed likely represent more severe incidents due to meeting thresholds for insurance claims.

Conclusions

The integration of e-scooters has undeniably reshaped Victoria’s transportation dynamics, highlighting distinct safety vulnerabilities, particularly at intersections and among younger demographics. By rigorously identifying e-scooter crashes and documenting the associated injuries and circumstances, this research provides a foundational basis for informed policy development, targeted public safety initiatives, and robust insurance coverage strategies, ensuring a safer integration of e-scooters into urban transport systems.

References

Burt, N. & Ahmed, Z., 2023. E-scooter attitudes and risk-taking behaviours: an international systematic literature review and survey responses in the West Midlands, United Kingdom. Frontiers in Public Health, Volume 11, pp. 2296-2565

Clough, R. A. et al., 2023. Major trauma among E-Scooter and bicycle users: a nationwide cohort study. Injury Prevention, Volume 29, pp. 121-125

McGuinness, M. J., Tiong, Y., & Bhagvan, S. (2021). Shared electric scooter injuries admitted to Auckland City Hospital: a comparative review one year after their introduction. *The New Zealand Medical Journal, 134*(1530), 21-29.

Haworth, N., Schramm, A., & Twisk, D. (2021). Comparing the risky behaviours of shared and private e-scooter and bicycle riders in downtown Brisbane, Australia. *Accident Analysis & Prevention*, *152*, 105981.

New apps and context considerations: young drivers' intended phone use

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Abstract

This study applied an extended Theory of Planned Behaviour (TPB) to examine psychosocial factors that may influence young drivers' (*N*=137) intentions to watch a video message and read a text message on a handheld smartphone while driving, and if their intentions differed when driving a vehicle with or without advanced driver assistance systems (ADAS). Twenty-nine percent of participants reported reading a text message while driving *sometimes to always*, and 6% reported watching a video message. Attitudes and subjective norms were significant positive predictors of intentions to perform these two behaviours. Perceived behavioural control and descriptive norms also significantly predicted intentions to read a text message while driving. Participants reported significantly higher intentions to use a smartphone when driving a vehicle with ADAS than without ADAS, although mean intention scores were low across all conditions. Further research is needed to understand young driver smartphone use as phone and vehicle technology evolves.

Social media post

Study indicates that watching video messages while driving appears to be far less prevalent than reading text messages by young people. Self-reported intentions to use a handheld smartphone while driving was slightly higher in a vehicle equipped with ADAS, but low overall.

Introduction

Despite the substantial risks for death and injury associated with using handheld smartphones while driving, 17–25-year-old Australians commonly self-report performing these behaviours (e.g., Gauld & Reeves, 2023; Oviedo-Trespalacios et al., 2016). Past research has focused on using a handheld smartphone to make or receive voice calls, send or respond to text messages or emails, or to access social media. However, smartphones also now commonly support video messaging. This research was guided by an extended Theory of Planned Behaviour (TPB; Ajzen, 1991), which predicts that attitudes (favourable or unfavourable beliefs), subjective norms (perceptions of important others), and perceived behaviour control (PBC; ease or difficulty of use) influence intentions, which in turn, predicts behaviour. Moral norms (one's perceptions of what they ought to do), descriptive norms (one's perceptions of what others do), and anticipated regret (thinking about how one would feel in the future performing a specific behaviour) were added as additional predictors as they have also been reported to influence intentions to use smartphones while driving (Gauld et al., 2017; Nicolls et al., 2022). This study extends upon previous research by examining young drivers' intentions to watch video messages while driving and how this behaviour compares to reading text messages while driving.

In-vehicle technologies also continue to evolve with the introduction into many vehicles of Advanced Driver Assistance Systems (ADAS). It is possible that inclusion of ADAS in vehicles may contribute to drivers' perceptions that they are able to engage in secondary, non-driving tasks. Thus, this study examined the extent to which ADAS, specifically lane keeping assist, autonomous emergency braking, and adaptive cruise control may influence young adults' intentions to watch a video message or read a text message while driving. Given that behaviour may change depending on the road environment, this study examined young drivers' intentions to use their smartphone across urban and regional roads. This study addressed three research questions: (1) how often do young drivers use their smartphone to watch video messages and read text messages, both in general and while driving? (2) can an extended TPB be applied to assess young drivers' intentions to use a handheld smartphone to watch a video message while driving and how does this compare to reading a text message while driving? and (3) does ADAS influence young drivers' intentions to use a handheld smartphone while driving?

Conference theme

Using a smartphone to watch video messages is an increasingly common behaviour among young people in Australia but the extent that young people watch video messages while driving is relatively unknown, and the psychosocial factors implicated in engaging in this behaviour are not well understood. Addressing the conference theme of Evolution, this study sought to examine the extent to which watching a video on a handheld smartphone while driving was prevalent among a sample of young drivers, what factors predicted intentions to perform these two behaviours, and how ADAS may influence young drivers' intentions to engage in distracted driving in urban and regional environments.

Method

Young Australian drivers (N = 137) aged 18-25 years (M_{age} = 19.69, SD = 1.94; 77% female) completed a 20-minute online questionnaire. Most drivers reported residing in Queensland (96%), with 85% of participants reporting either *only or mainly* driving on city or suburban roads. Participants completed all items which examined their demographics, current phone use, attitudes, PBC, normative influences (subjective, moral, and descriptive), anticipated regret, and intentions to watch a video message and read a text message while driving. All items were adapted from scales reported in previous studies (e.g., Armitage et al., 2022). Participants were also asked how likely they would be to use their smartphone to watch a video message or read a text message in a car with and without ADAS after reading short, written scenarios manipulating the presence/absence of ADAS and when driving in either an urban or regional environment (see Figure 1). To assist with acquiring complete survey responses and to reduce the time commitment required by participants, participants were randomly assigned to respond to the ADAS questions about driving in either an urban or regional environment. The study received ethics approval by the QUT Human Research Ethics Committee.

You are driving on a 100km/hr highway in an **urban environment.** The car you are driving has **no advanced technologies**.	You are driving on a 100km/hr highway in an urban environment. The car you are driving has lane keeping assist, autonomous emerging braking, and adaptive cruise control.
You are driving on a 100km/hr highway in a **regional environment.** The car you are driving has **no advanced technologies**.	You are driving on a 100km/hr highway in a regional environment. The car you are driving has lane keeping assist, autonomous emerging braking, and adaptive cruise control.

Figure 1. Written scenarios presented to participants.

Results

Participants were asked how often they used their smartphone to watch a video message and read a text message, both in general and in hand-held mode while driving. A total of 55.4% of participants reported watching a video on their phone either *daily* or *more than once a day*, with 85.4% reporting reading a text message on their phone *daily* or *more than once a day*. For watching a video message on a handheld smartphone while driving, 5.8% reported that they performed this behaviour *sometimes* to *always* (81.8% reported *never*). For reading a text message on a handheld smartphone while driving, 29.2% reported *sometimes to always* performing this behaviour (42.3% reported *never*).

Two hierarchical linear regressions were undertaken to assess the extent to which the standard TPB constructs of attitudes, subjective norms, and PBC (Step 1), and moral norms, descriptive norms, and anticipated regret (Step 2) predicted intentions to (i) watch a video message while driving and (ii) read a text message while driving. The standard TPB constructs significantly accounted for 55.4% of the variance in intentions to watch a video message while driving, $F(3,135) = 56.95$, $p <. 001$, with attitudes (B = .430, SE = .093, $p < .001$) and subjective norms (B = .596, SE = .077, $p < .001$) being significant positive predictors of intentions in Step 1. Including moral norms, descriptive norms, and anticipated regret in Step 2 did not significantly increase the amount of variance explained, R^2change = .025, Fchange(3,129) = 2.59, p = .056, but the overall model remained significant, $F(6,135) = 30.80$, $p < .001$.

For text messaging, the standard TPB constructs significantly accounted for 35% of the variance in intentions to read a text message while driving, $F(3,136) = 25.37$, $p < .001$, with attitudes (B = .404, SE = .116, $p < .001$), subjective norms (B = .420, SE = .118, $p < .001$), and PBC (B = .266, SE = .092, p .005) being significant positive predictors of intentions in Step 1. When the remaining variables were entered into Step 2, there was a significant increase in the variance explained in intentions, R^2change = .073, Fchange(3,130) = 5.60, p = .001, and the overall model remained significant, $F(6,136) = 16.80$, $p < .001$. At Step 2, attitudes (B = .287, SE = .115, p .014), subjective norms (B = .305, SE = .116, p .010), PBC (B = .211, SE = .091, p .022), and descriptive norms (B = .191, SE = .092, p .039) were all significant positive predictors of intentions to read a text message while driving.

Four paired t-tests were undertaken to assess if there were any differences in self-reported intentions to watch a video message or read a text message while driving an ADAS equipped vehicle separately for urban and regional environments. Table 1 shows that participants reported significantly higher intentions to use their smartphone to watch a video and read a text message when the vehicle featured lane keeping assist, autonomous emergency braking, and adaptive cruise control compared to the absence of ADAS, all with small to medium effect sizes. However, it is important to note that despite the significant results, all mean intentions scores ranged between 1.42 and 3.15 on a 7-

point scale, indicating that self-reported intentions to use a smartphone while driving were low across all conditions. Further, findings from four independent *t*-tests showed no significant differences in self-reported intentions to watch a video message or read a text message while driving a vehicle with and without ADAS on urban compared to regional roads ($p > .05$), suggesting that type of road environment did not significantly influence mean intention ratings.

Benefits to road safety

The way in which young adults use their smartphones to communicate with others is changing. The current study benefits road safety by examining the extent to which emerging behaviours, in this case watching video messages, may contribute to driver distraction. The findings showed that watching a video message while driving was less prevalent than reading a text message. Further, the study extended upon previous research by examining if a vehicle equipped with three types of ADAS would influence young drivers' intentions to use a handheld smartphone while driving compared to a vehicle with no advanced systems. While there were significant differences in intentions to read a text message and watch a video message in a vehicle with and without ADAS, self-reported intentions were low.

Table 1. Differences in intentions to use a smartphone in a vehicle equipped with or without ADAS in urban or regional environments

Intention		n	M	SD	t (df)	95% *CI*	p	d
Urban: Watch a video message	No ADAS	71	1.42	0.86				
	ADAS-equipped	71	2.00	1.41	-4.41 (70)	-0.84, -0.32	<.001	0.50
Urban: Read a text message	No ADAS	71	2.08	1.45				
	ADAS-equipped	71	2.82	1.82	-4.72 (70)	-1.04, -0.42	<.001	0.45
Regional: Watch a video message	No ADAS	64	1.45	0.99				
	ADAS-equipped	64	1.88	1.44	-2.86 (63)	-0.72, -0.13	.006	0.35
Regional: Read a text message	No ADAS	65	2.35	1.66				
	ADAS-equipped	65	3.15	2.08	-4.91 (64)	-1.13, -0.48	<.001	0.43

Note: Participants were randomly allocated to view either the two urban scenarios or the two regional scenarios.

Implications for policy and/or practice

The findings highlight the need to continue to educate young drivers on the risks associated with using a handheld smartphone while driving. While designed to improve driver safety, new vehicle technologies may also inadvertently increase driver distraction as drivers potentially perceive their ability to rely more on the vehicle and these assistance features than what may be the case in the absence of such features. As such, and consistent with the recommendations of previous research (e.g., Rejali et al., 2024), policymakers need to consider the impact that emerging communication modes and vehicle technologies, and their interaction, may have on driver distraction, particularly for the younger driving cohort. Given that the sample size consisted of young adults who mostly reported driving on urban and suburban roads, next steps include undertaking further research with a larger more representative sample size to further assess drivers' intentions to use a handheld smartphone while driving a vehicle equipped with ADAS on regional roads.

Conclusions

Despite efforts to reduce driver distraction, some young drivers still report using a handheld smartphone while driving. At present, engagement in video messaging while driving does not appear to be a prevalent behaviour of young drivers. However, young drivers may be more inclined to use a handheld smartphone in a vehicle equipped with ADAS than a vehicle without these systems. Further education about the risks associated with using a handheld smartphone is needed to continue to reduce young drivers' engagement in driver distraction.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211. https://doi.org/10.1016/0749-5978(91)90020-T

Armitage, S., Rodwell, D., & Lewis, I. (2022). Applying an extended theory of planned behaviour to understand influences of safe driving intentions and behaviours. *Transportation Research Part F: Traffic Psychology and Behaviour, 90*, 347-364. https://doi.org/10.1016/j.trf.2022.09.009

Gauld, C., Lewis, I., White, K., Fleiter, J., & Watson, B. (2017). Smartphone use while driving: What factors predict young drivers' intentions to initiate, read, and respond to social interactive technology? *Computers in Human Behavior, 76*, 174-183. https://doi.org/10.1016/j.chb.2017.07.023

Gauld, C., & Reeves, C. (2023). Normative influences on young drivers' illegal smartphone use: Applying an extended theory of normative social behaviour. *Accident Analysis & Prevention, 180*, 106904. https://doi.org/10.1016/j.aap.2022.106904

Nicolls, M., Truelove, V., & Stefanidis, K. (2022). The impact of descriptive and injunctive norms on engagement in mobile phone use while driving in young drivers: A systematic review. *Accident Analysis & Prevention, 175*, 106774. https://doi.org/10.1016/j.aap.2022.106774

Oviedo-Trespalacios, O., Haque, Md., King, M., & Washington, S. (2016). Understanding the impacts of mobile phone distraction on driving performance: A systematic review. *Transportation Research Part C: Emerging Technologies, 72*, 360-380. https://doi.org/10.1016/j.trc.2016.10.006

Rejali, S., Watson-Brown, N., Kaye, S-A., Senserrick, T., Oviedo-Trespalacios, O. (2024). Is it all about mobile phones? Exploring drivers' perceptions of government information and road rules on distracted driving. *Accident Analysis & Prevention, 208*, 107770. https://doi.org/10.1016/j.aap.2024.107770

MOVETech: Increasing coMpetency and confidence of Older drivers in AVTs

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Abstract
Advanced vehicle technologies (AVTs) can offer safety benefits for older drivers, however there is distrust and lack of familiarity. MOVETech was a randomised controlled trial (n=120) evaluating a training program to increase older driver competency and confidence in the use of AVTs. One classroom and an on-road driving session designed to develop skills using AVTs. Primary outcomes were Performance Analysis of Driving Ability (P-Drive) score, and on-road AVT competence. Secondary outcomes included confidence in AVTs. We recruited 119 drivers aged 65 years and older and 101 completed the trial. P-Drive (96.1±3.7 vs 96±3.7, p=0.91) and AVT competence scores (77±26 vs 73±21, p=0.4) were similar. Confidence in AVTs was also similar between the intervention and control groups. While the program did not differentiate performance it was feasible and well-received. Future work can focus on positioning for such programs as older drivers gain access to AVTs.

Social media post
MOVETech shows promise. On Road AVT training was provided to support older drivers, using a combination of group learning and on-road coaching. More research is needed to determine how programs can help older drivers realise the safety benefits of AVT.

Introduction
Advanced vehicle technologies (AVTs) are in-vehicle technologies that have been designed to improve road safety and reduce consequences of human error by providing information from the external road environment to influence the driver's control of the vehicle (Furlan et al., 2020; Regan et al., 2020). AVTs have the potential to reduce the effects of age-related declines in the visual, motor and cognitive systems on driving (Classen et al., 2019; Oxley et al., 2019; Furlan et al., 2020). For example blind-spot detection systems and reverse cameras can be helpful when there is reduced neck mobility (Gish et al., 2017), lane departure warnings and lane keep assist improve lane maintenance, and adaptive cruise control reduce cognitive load of maintaining speed while keeping a safe distance to the vehicle in front (Classen et al., 2019; Furlan et al., 2020; Regan et al., 2020).

There are limited programs available to teach drivers how to use AVTs. Many drivers report the main methods for learning about AVTs and how to use them was through trial and error, by accident, self-directed online learning, reading the owner's manual, or from the car dealership at point of sale (Eby et al., 2018; Regan et al., 2020). This is in contrast to older drivers having a preference for in-person education at the dealership (Regan et al., 2020). Further, dealerships often provide incomprehensive overviews or have inaccuracies in their explanation on AVTs (Regan et al., 2020). Other researchers have proposed that any training in AVT knowledge and skills is beneficial to driving performance compared to the absence of any training (Regan et al., 2020). The lack of accurate and easy access to AVT educational materials is a potential barrier for older drivers to realise the full safety benefits of AVTs to improve their driving safety and prolong driving ability. However, to maximise the benefits of AVTs, AVT training programs for older driver should be designed with their preference for in-person education.

The MOVETech (Increasing the co**M**petency and confidence of **O**lder drivers in the use of advanced **VE**hicle **TECH**nology) study evaluates an innovative educational training program designed specifically to teach older drivers how to use AVTs. The training program was developed with an expert panel of stakeholders (academics, educators, occupational therapists and older drivers) and piloted on drivers aged 70 years or over (n=8) in regional NSW. The pilot study resulted in positive outcomes with reports of increased willingness to purchase and trust in AVTs. With the promising results, the MOVETech study was developed to evaluate whether the educational training program was

effective in increasing older driver competence and confidence in the use of AVT and determine if it can be delivered across multiple sites in urban and regional NSW.

Conference Theme

This project aligns with the conference theme of *Equity* as the MoveTECH program was designed with input from consumers and stakeholders to ensure it was appropriate for older adult learners. The precise of the program is to build skills in older drivers to ensure they can feel confident to use AVTs and potentially gain safety benefit from new technology in cars.

Method

Study Design

The MOVETech study was a randomised controlled trial. Participants were randomised to the intervention (received the AVT training program) or control group (received a brochure on older driver licensing guidelines by Transport for NSW) in a 1:1 ratio. The target sample size was 120 and participants were recruited through presentations at community events, newsletters and on-line advertising. After expressing their interest via an on-line portal, the participants were telephoned and assessed for eligibility:

Inclusion criteria

- Aged 65 years and older, with an active and valid NSW Driver's license (Class C) and regular driver (at least 2-3 times per week)
- Has a car with driver assistance systems such as adaptive cruise control or lane keep assist
- Able to travel to sites/driving centres for study visits and meet the time commitment of the study (approx. 3.5 to 8.5 hours across several days)
- Consent to drive an unfamiliar vehicle and consent to use of a personal, comprehensively insured vehicle to perform a driving assessment
- Able to understand conversational English
- Double-vaccinated for COVID-19

Exclusion criteria

- Has a modified driver license which restricts attendance or completion of study activities, e.g., can only travel restricted distances from home by which the study sites or driving assessment route is not included

At the in-person baseline assessment, all participants completed a standard battery of functional assessments (visual, cognitive, and physical), and had their vehicle inspected to document any damage by an Occupational Therapy Driving Assessor (OTDA), prior to randomisation. Approximately one week after the in-person baseline assessment, participants completed a telephone interview, where a set of interviewer-administered questionnaires on socio-demographic characteristics, self-reported driving confidence, perceived AVT competence, and self-reported crashes and citations, were completed. At 3-months post-exposure to the intervention or control materials, participants completed a driving performance assessment using the standardised Performance Analysis of Driving Ability (P-Drive)(24) and on-road AVT competence, in their own vehicle with an OTDA and licensed driving instructor (DI), along with re-inspection of participant's vehicles to document any damage as part of their in-person 3-month follow up assessment. Within one week of the in-person assessment, the same set of interviewer-administered questionnaires at the baseline telephone interview, excluding the socio-demographic section, were re-administered over the phone with a research assistant.

Intervention

The intervention group received the AVT training program over two sessions. The first session was an in-person, interactive classroom education session aiming to familiarise participants with AVT, their safety benefits, risks, and correct use. Topics discussed were (1) Ageing and driving, (2) AVTs and their function, (3) The benefits of AVTs to drivers, and (4) The risks of AVTs to drivers. Online group sessions were made available when participants were not able to attend the in-person classroom session.

As soon as possible after the classroom session but on a separate day, participants attended the second part of the AVT training program, an individual on-road driving session. The on-road session occurred on a pre-planned route designed by the DI to activate as many of the AVTs onboard the dual-controlled vehicle. The first hour was dedicated to demonstrating the pre-planned route as well as to demonstrate and describe as many AVT as possible fitted to the vehicle. The second hour involved the participant driving along the same pre-planned route, and receiving on-road instruction on how to use the AVT, after a period of familiarization with the car. Further advice on AVTs installed in the

participant's personal vehicle such as location, set up, and adjustments, were provided at the end of the session, off-road. Participants randomised to the control group received a hard copy of "A Guide to Older Driver Licensing" by Transport for NSW.

Statistical Analysis

The P-Drive score was Rasch scored to transform onto an interval scale prior to analysis. The outcomes were compared between groups using linear regression for the continuous outcomes. These included dual primary outcomes, on-road driving performance and competence on AVT use, and secondary outcomes, self-reported driving confidence and perceived AVT competence. Count data (secondary outcomes, vehicle damage and crash involvement) were analysed using negative binomial regression models. All analyses were on an intent-to-treat basis and reported in line with the consort statement.

Results

Overall, the differences between the overall driving score (P-drive) and the specific competence in using AVTs between the intervention and control group were minimal and not statistically significant (Figure 1 and 2). Analysis of the mean P-Drive score revealed that the intervention group (score 96.07) scored similarly to the control group (score 96.16) (p=0.91). On-road AVT competence was slightly higher in participants in the intervention group (score 77.35) compared to participants in the control group (score 73.15), however the difference was not statistically significant (p=0.36). The median number of AVTs assessed was 14 out of a possible list of 25 AVTs. Participants from regional areas (score 83.06) scored higher than participants from metropolitan Sydney (score 73.72) (p=0.11), regardless of their allocated group.

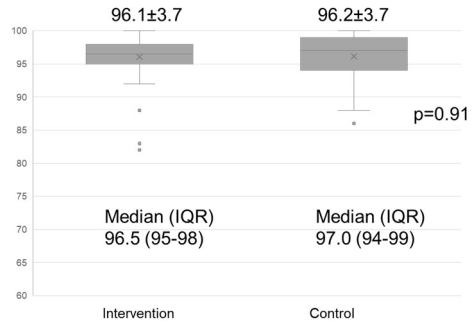


Figure 1. P-Drive scores (%) at 3 months

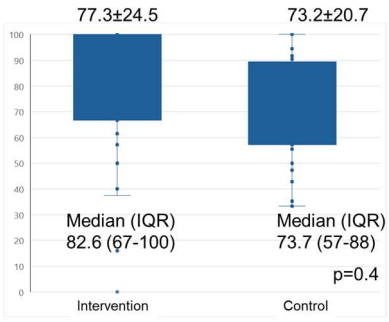


Figure 2. AVT Competence (%) scores at 3 months

The self-reported measures of confidence in AVT use were also similar between the intervention and control group. However, self reported confidence in use of AVTs (score 84.44) and competence in use of AVT's (score 83.36) was fairly high at baseline (score range 0-100).

Benefits to Road Safety

The benefits of AVTs to road safety have been demonstrated however making this a reality for older drivers depends on their uptake of vehicles with AVTs.

Implications for policy and/or practice

This study provides valuable direction for working with older drivers to enhance their use of AVTs. While there was no difference in the primary outcomes between the intervention and the control group in this trial, the program was acceptable and feasible to deliver. It is possible that there was lack of differentiation between the intervention and control group experiences, whereby the control group were also able to gain skills in AVT use through alternative means. The benefits of such a program in new vehicles at point of scale would be worth exploring.

Conclusions

While the program did not differentiate performance it was feasible and well-received. Future work can focus on positioning for such programs as older drivers gain access to AVTs.

References

Classen, S., Jeghers, M., Morgan-Daniel, J., Winter, S., King, L., & Struckmeyer, L. (2019). Smart In-Vehicle Technologies and Older Drivers: A Scoping Review. OTJR (Thorofare N J), 39(2), 97-107.

Eby, D. W., et al. (2018). Prevalence, attitudes, and knowledge of in-vehicle technologies and vehicle adaptations among older drivers. Accid Anal Prev, 113, 54-62. doi:10.1016/j.aap.2018.01.022

Furlan, A. D., Kajaks, T., Tiong, M., Lavalliere, M., Campos, J. L., Babineau, J., . . . Vrkljan, B. (2020). Advanced vehicle technologies and road safety: A scoping review of the evidence. Accid Anal Prev, 147, 105741.

Gish, J., Vrkljan, B., Grenier, A., & Van Miltenburg, B. (2017). Driving with advanced vehicle technology: A qualitative investigation of older drivers' perceptions and motivations for use. Accid Anal Prev, 106, 498-504.

Oxley, J., Charlton, J., Logan, D., O'Hern, S., Koppel, S., & Meuleners, L. (2019). Safer vehicles and technology for older adults. Traffic Inj Prev, 20(sup2), S176-S179. doi:10.1080/15389588.2019.1661712

Regan MA, Prabhakharan P, Wallace P, Cunningham ML, & Bennett JM. (2020). Education and Training for Drivers of Assisted and Automated Vehicles (AP-R616-20).

How wicked are speed management challenges? An experts' opinion study

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Abstract

Speed management, defined as coordinated efforts to mitigate the impact of speed within a road network, is critical for road injury prevention but remains a challenging policy domain. This study explored barriers and challenges for progressing speed management policies and practices through the lens of complexity science. Drawing on the literature on wicked policy problems, 33 semi-structured interviews with road safety experts and practitioners were undertaken and analysed via thematic analysis. Findings suggest that the barriers and challenges reported by interviewees hold elements in common with what the public policy literature defines as a wicked problem, showing elements of complexity, uncertainty and value divergence across the stakeholders involved. Framing speed management as a wicked problem not only presents opportunities for innovative policy approaches and cross-domain learning but also underscores the potential of utilising systems thinking and complexity science for the analysis of perennial road safety challenges.

Social media post

How wicked are speed management challenges? This study explores perceived barriers to advancing speed management, revealing striking similarities with 'wicked policy problems'. Rethinking speed management through complexity science could unlock new, more effective approaches.

Introduction

Speed management entails a coordinated approach to tackling the effects of traffic speeds on crash causation and road trauma (GRSF, 2023). As traffic speeds are directly related to both the occurrence and severity of road crashes, the implementation of speed management strategies is likely to bring considerable public health benefits. However, despite its potential, speed management is acknowledged as a policy area that has been and remains difficult to advance. A likely reason why road safety experts and practitioners worldwide face challenges in advancing speed management is the reliance on approaches that do not fully account for the problem's complexity. The Safe System Approach, widely adopted by governments worldwide, emphasises the need for evidence-based solutions. However, by framing speed-related challenges as discrete engineering challenges, it is likely they will be addressed in isolation rather than as part of a broader system. Complex policy problems are often manifestations of systemic issues, meaning that addressing individual components separately is unlikely to lead to meaningful or lasting solutions (Meadows, 2008). Certain complex policy challenges are called 'wicked' problems in the literature, and they require particular approaches (Head, 2022). If speed management was a wicked policy problem, adopting a reductionist approach is unlikely to aid policy advancement. Instead, systems thinking and complexity science may provide us with a different way of understanding where the impediments for advancing speed management lie, and help experts and practitioners alike imagine new paths for their resolution. This study aimed to explore barriers and challenges to speed management using the lens of wicked policy problem analysis.

Conference theme

The Safe System approach is grounded in ethical principles and evidence-based concepts, such as kinetic energy absorption thresholds. Aligned with the conference theme of *Evolution*, this presentation will challenge the notion that speed management can be advanced solely through engineering, technological, or scientific approaches. Instead, the position argued is that speed management shares characteristics with wicked policy problems. The literature suggests that these problems involve different stakeholder perspectives, values, and variables which cannot be measured, or for which measurement is impractical. For these reasons, these problems cannot be effectively addressed through a purely scientific or technocratic approach due to their strong social and political dimensions.

Method

This study employed a qualitative research design, using semi-structured interviews with 33 road safety experts and practitioners, primarily from Sweden (n=7) and Australia (n=23). Six participants provided a global perspective based

on their transnational experiences. An interview guide was developed to facilitate discussions on speed management policy and practice, with this abstract focusing specifically on challenges and barriers in the field. A purposive sampling approach was used to recruit participants. This approach ensured diverse perspectives from experts with in-depth knowledge of speed management, while snowball sampling was used to address gaps by encouraging participants to recommend additional interviewees. Interviews, conducted in English between June 2023 and August 2024, included participants from four broad stakeholder groups: government agencies at various levels, non-governmental organisations, industry representatives, and academic and research institutions. The final sample comprised engineers, decision-makers, senior bureaucrats, grassroots practitioners, economists, consultants, designers, urban and transport planners, and researchers. Ethical approval was obtained from the Ethics Committee (Approval number: 7155). The first author conducted and transcribed all interviews, which were then de-identified before analysis. Research notes were maintained to capture key ideas, reflections, and emerging connections between concepts. Thematic analysis was employed to examine the data corpus. An initial open coding phase allowed the first author to familiarise herself with the data and establish a preliminary understanding. A deductive coding approach was used, drawing on concepts from the wicked policy problems literature to guide interpretation. Codes were systematically organised into themes and sub-themes through an iterative process, ensuring internal consistency within themes and clear differentiation between them. Braun and Clarke's (2006) approach to thematic analysis underpinned the analytical process, with particular attention to its deductive application as refined in their later works (e.g., Braun & Clarke, 2022).

Results

Three main themes were generated which encompass challenges and barriers to speed management, focusing on uncertainty, complexity and value divergence dimensions. The following sections provide a brief explanation of these themes, while Table 1 provides an illustrative quote for each theme.

Theme 1: Challenges stemming from uncertainties

This theme captures the challenges and barriers associated with perceived uncertainties that were described as complicating progress in speed management. Some uncertainties were described as stemming from a lack of, or incomplete, information. Some participants highlighted a lack of information regarding the impact of certain countermeasures, which is often found when multiple interventions take place simultaneously, or when their effect is confounded by other variables not controlled for. Consequently, decision making is made harder given the challenges involved in assessing the relative effectiveness of different approaches to speed management. For instance, companies considering the implementation of voluntary speed limiters in their fleet operations were described as struggling to estimate their benefits in terms of crash prevention. The dynamic nature of social behaviour and technological advancements were identified as another source of unpredictability, which was described as influencing countermeasure effectiveness over time, requiring constant efforts to reassess strategies. Furthermore, some participants highlighted that certain decisions had been made without having had complete information on their ongoing impact, such as the influence of wider road widths on speeds. Uncertainties were also described as stemming from certain information not being disseminated more widely, or from the under-utilisation of available information, in both cases leading to sub-optimal decision making from different stakeholders. Last but not least, uncertainties around the effect of speed choice on road crash likelihood and severity was described as a barrier also affecting road users' decision-making.

Theme 2: Challenges stemming from complexities

This theme highlights the challenges in speed management that arise from the complexities of the system in which policy operates. Key factors include feedback loops, interconnections among system components, and emergent behaviours that shape policy outcomes. A recurring challenge mentioned by interviewees was the influence of public opinion on political decisions, often leading politicians to block or ignore stakeholder requests for progressive speed management policies. This negative feedback loop is compounded by a general lack of public understanding of the impact of traffic speeds on wellbeing. Participants also highlighted the fragmented nature of responses, as speed management spans multiple decision-makers, making effective coordination difficult. Some noted that decisions in seemingly unrelated areas, such as car insurance regulations, can significantly affect current speed management strategies. Additionally, measures that benefit other policy areas may introduce new challenges. For instance, the rise in electric vehicle adoption with associated greater vehicle weight was described as further challenging kinetic energy management. Speed choice, and the risks associated with excessive and inappropriate speeds, were described as being heavily influenced by the interaction across individual drivers and hence being shaped by social norms. Interviewees questioned the effectiveness of traditional countermeasures, arguing that these approaches target isolated system elements rather than addressing the broader systemic influences on driver behaviour.

Theme 3: Challenges stemming from value and interest divergence

This theme highlights challenges in speed management arising from the diverse perspectives, values, and interests of multiple stakeholders. Conflicting goals and priorities often make consensus difficult. Some speed management

countermeasures, designed to enhance ethical values related to safety and the protection of human life, were described as clashing with other ethical considerations such as equity. For example, interviewees noted that reducing speed limits in rural and remote areas is particularly challenging due to opposition from residents and local politicians. These stakeholders argue that lower limits could increase travel times, potentially restricting access to essential services and employment opportunities, thereby affecting social equity. Another challenge relates to the differing values assigned to key variables by professionals in the field. Transport engineers, for instance, were described by some as prioritising travel time efficiency over other considerations, influencing broader stakeholder perspectives. Some participants suggested that lower speed limits and average speeds are often assumed to increase travel time and reduce efficiency. However, they argued that a more comprehensive analysis considering multiple factors may challenge this assumption.

Table 1. Themes generated and illustrative quotes

Theme	Exemplary quote
1. Uncertainty	"…knowledge of what's effective changes all the time. We learn new things. Society changes. It learns how to avoid being caught for speeding" (Researcher, Australia)
2. Complexity	"One thing that I think it's important is that there is a responsible for the way that the street or the road is built or maintained, should also be in charge of setting the speed limits, because they go hand in hand" (Road safety advisor, Sweden)
3. Value divergence	"…the way the way we ascribe value to a speed limit is based on counting up all the seconds saved by every driver and passenger without really knowing what value is derived from those saved seconds and again, this is a theoretical saving as well, it's not necessarily realised the in practice" (Program manager, Australia)

Benefits to road safety

The literature on wicked policy problems has received a lot of attention from both practitioners and scholars in the last few decades (Lönngren et al., 2021), suggesting that the concepts discussed there have provided insight into new ways of understanding and approaching complex policy areas. While this body of the literature showcases many examples applied to public health issues, there has been limited application of this framework to the road safety field. Speed management has been recognised as a particularly difficult policy area within road safety. This study provides a first step in this direction by framing speed management as a wicked problem, which opens the door to viewing the field through a new complexity lens and inviting those interested to explore potentially innovative solutions.

Implications for policy and/or practice

This study highlights that there is a body of literature, centred on the analysis of policy problems that are particularly challenging, waiting to be explored by road safety practitioners. Given the relevance that progressing speed management policies holds, the importance of maximising cross-policy learning opportunities is stressed. Speed management is not alone in terms of the magnitude of the challenges involved. The wicked problems literature showcases different innovative approaches to tackling other complex policy areas from which road safety may be able to draw.

Conclusions

While speed management represents a promising approach for reducing road crash fatalities and serious injuries, there remain challenges in realising its full potential. This study explored challenges and barriers to speed management as reported by road safety experts and practitioners from different jurisdictions under the wicked problems lens. Results suggest that speed management indeed has elements in common with wicked problems, with challenges being reported associated with the three main dimensions of wicked policy problems, i.e., complexity, uncertainty and value divergence. Further research is needed to explore what innovative approaches to speed management might emerge from treating the issue as a wicked problem requiring a more adequate response.

References

Braun, V., & Clarke, V. (2022). Thematic analysis: a practical guide (1st.). SAGE.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, 3(2), 77-101. https://doi.org/10.1191/1478088706qp063oa

Elvik, R., & Nævestad, T.-O. (2023). Does empirical evidence support the effectiveness of the Safe System approach to road safety management? *Accident Analysis & Prevention*, 191, 107227. https://doi.org/https://doi.org/10.1016/j.aap.2023.107227

GRSF. (2023). Speed management framework. Global Road Safety Facility, World Bank Group. Retrieved 21/09/2023 from https://www.roadsafetyfacility.org/speed-management-hub

Head, B. W. (2022). Wicked problems in public policy: Understanding and responding to complex challenges. Springer Nature.

Hughes, B. P., Newstead, S., Anund, A., Shu, C. C., & Falkmer, T. (2015). A review of models relevant to road safety. *Accident Analysis & Prevention*, 74, 250-270. https://doi.org/https://doi.org/10.1016/j.aap.2014.06.003

Job, R. F. S., Truong, J., & Sakashita, C. (2022). The Ultimate Safe System: Redefining the Safe System Approach for Road Safety. *Sustainability*, 14(5), 2978. https://www.mdpi.com/2071-1050/14/5/2978

Lönngren, J., & van Poeck, K. (2020). Wicked problems: a mapping review of the literature. International Journal of Sustainable Development & World Ecology, 28(6), 481–502. https://doi.org/10.1080/13504509.2020.1859415

Meadows, D. H. (2008). Thinking in systems: A primer. Chelsea Green Publishing.

Developing a model for the safety impacts of mode shift

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Abstract
Many jurisdictions have targets to reduce vehicle travel and crashes, often in conjunction with shifting to sustainable transport modes. Reducing motor-vehicle-kilometres travelled can reduce crash risk in addition to emissions. However, our current understanding of these impacts is limited, due to the complex interactions between the various risk factors. This study investigated the effects of mode shifts on casualty crash rates, to develop a related model. It found that, while risk factors have been studied for individual modes, most did not explore multiple interactive relationships, and so tend to underestimate the full safety benefits of community-wide shifts from driving to walking, cycling and public transport. This research collated recent police and hospital crash data, and produced a spreadsheet model that enables testing of various mode-shift scenarios. However, more research is needed to evaluate how mode changes are likely to affect safety when other infrastructure and policy factors are accounted for.

Social media post
What are the safety implications of changing travel modes? Interacting effects include changed travel kms, extra "first/last mile" trips with new PT trips, and facility improvements affecting the use/risk of different modes. Recent research built a model to explore these effects.

Introduction
At the time this research was carried out, New Zealand had targets to reduce light vehicle travel by 20% by 2035 and also to reduce deaths and serious injuries by 40% from 2020 to 2030. This study (NZ Transport Agency, 2024) investigates how to integrate the planning to reach these two targets. Achieving them would require significant changes, including more compact and multi-modal community design, and a shift from using private motor vehicles to more resource-efficient modes, such as walking, cycling and public transport. We currently have limited understanding of how mode shift might impact road-safety outcomes.

This research sought to determine the actual and potential safety impacts of achieving mode shift from private motorised vehicles to public transport, active modes and micro-mobility, in conjunction with making changes to the overall volume of travel by all modes. It aimed to identify the individual and collective safety profiles of different travel modes, and the potential safety outcomes for different demographic groups that could arise from mode shift away from private motorised vehicles in New Zealand (NZ). The objectives were to:

a) identify and examine NZ and relevant international literature, especially in relation to countries whose transport systems are comparable to NZ's, to summarise what is known about the overall safety impacts of mode shift away from private motorised vehicles to whole journeys involving public transport, active travel or micro-mobility
b) determine the personal and collective safety impacts of different non-private vehicle travel modes across whole journeys and for different demographic groups in NZ
c) develop a model to enable mode-shift 'scenario testing' to calculate the potential road-safety outcomes of different levels and configurations of mode shift in NZ, at a national level and for a range of urban areas and demographics.

Note that this work did not consider any of the other potential impacts to people from these mode shifts, including health effects, environmental effects, and societal effects.
This presentation summarises the work undertaken and presents the final scenario model tool developed.

Relevance to Conference theme
Traditionally non-motor vehicle modes have been poorly served by transport safety efforts to date, resulting in higher overall casualty rates, particularly for active travel modes. This has often stymied efforts to encourage mode shift, due to a belief that casualty numbers will increase. However, the evidence suggests that, in the long run, a more sustainable transport system will lower casualty numbers – but a greater understanding of the interacting effects is needed to demonstrate this. The work summarised in this presentation will help support the Conference themes of:

- **Equity**: Providing fairer and safer access to the transport system for active and public transport users
- **Elasticity**: Making it easier to demonstrate the overall safety benefits of shifts in transportation modes
- **Evolution**: The development of suitable decision support tools to gradually create a more sustainable transport environment

Method

The research involved a series of tasks:

- A literature review of previous research on casualty data, travel mode usage data, risks per mode, the relationship of safety risk to quality of modal facilities, and the impact of mode shift on safety
- An analysis of personal and collective risks using updated New Zealand datasets collated for this research.
- Development of a spreadsheet model tool, and assessments of initial scenarios tested by the model

Results

Literature Review

This review was structured around the key components that will ultimately contribute to answering the main research questions, that is, the aspects of usage and safety for the various travel modes. Figure 1**Error! Reference source not found.** outlines that structure.

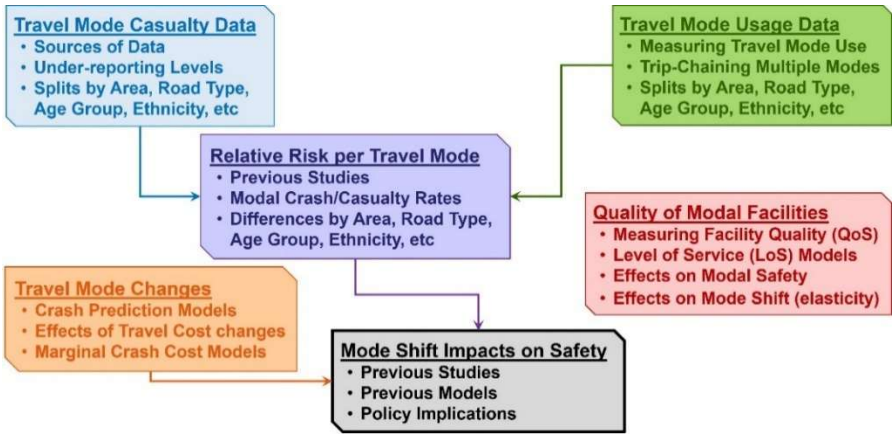


Figure 1. Structure of literature review topics

The literature review found that most areas of input to the model have been studied, with some broad academic consensus on relationships. However, most studies only considered a few modes and did not explore multiple relationships, and many failed to consider interactive effects, such as external risks to other travellers. Research in NZ is limited, particularly when it comes to non-motor-vehicle modes of transport. Newer modes of transport (such as micro-mobility) have been covered less, though there is a growing body of research in the NZ context.

Some key findings from the literature review include the following.

- Census data is inadequate because it only measures the primary commute modes. The Ministry of Transport Household Travel Survey (HTS) provides a good base for deriving modal usage.
- All sources of crash data have advantages and disadvantages, though all tend to have problems with under-reporting crashes that are lower in severity, and crashes not involving motor vehicles.
- Micro-mobility is a newer mode of transportation, and many datasets (for both usage and crashes) have only recently begun collecting data for these modes, or differentiating between them and related electric modes.
- In almost all cases, on a per-kilometre basis, the least safe modes of travel are by motorcycle, bicycle and other two-wheeled devices, and walking, while the safest tends to be public transportation.
- Conversely, if considering *external* risk (i.e., traffic fatalities caused by a mode), motor vehicles tend to have the worst safety outcomes, with public-transport risk being highly dependent on the context.
- While walking and cycling tend to have some of the highest per-km modal risks, higher walking and cycling mode share correlates strongly with better safety outcomes overall. This probably reflects the reduced risk to other road users, reduced total travel and risk exposure, and more caution by drivers around them.
- Providing safer mode-specific infrastructure (e.g., complete sidewalk networks, separated bicycle paths, lower roadway traffic speeds) improves safety, both for the mode in question and for all other modes.

- The safety-in-numbers effect has been confirmed by multiple studies, finding that increases in cycling result in reduced crash risk at an individual level. Some research also suggests that this may occur at a certain threshold.
- In almost every case study, reductions in total motor VKT cause similar reductions in crash casualties. Where infrastructure changes have been made, VKT reductions are associated with improved safety outcomes.

While many studies looked at the impacts of infrastructure on mode shift (to cycling in particular), and some studies use modelling techniques to estimate the safety impacts of cycling mode share increases, none were found that link all three together. That is, no research was found that answers the question of: *when improved safe infrastructure is the cause of an increase in cycling mode share, is there a negative or positive overall safety impact on the transport system?*

Data Analysis

To understand the safety impacts of mode shift, existing crash and casualty risk rates (per kilometre or hour travelled) were included in the model database. This required collation of several data sources:

- existing crash and casualty data (scaled for under-reporting)
- existing travel mode usage (kilometres or hours travelled)
- predictions of how risks change by exposure ("marginal cost" models)
- predictions of how risks change with improved physical environments or levels of service.

Six years of NZ hospital admission data and MoT Household Travel Survey data were used as the key data sources. Figure 2 illustrates how the various data sources have been combined.

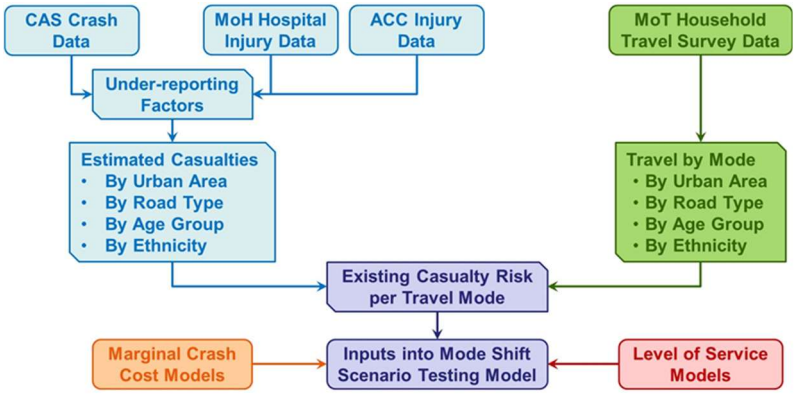


Figure 2. Data sources and combination process

Transport mode crash numbers do not typically operate linearly relative to usage. Therefore, the relative risk of each travel mode was adjusted to allow for likely changes when volumes change, using standard exponential crash prediction models. This also included adjusting for any concurrent changes in adjacent motor-traffic usage as well (i.e., reduction in motor traffic due to shift to other modes). In all cases, the chosen crash-prediction model exponents were less than 1, i.e., a doubling of VKT would lead to less than a doubling in crashes. This illustrates the "safety-in-numbers" effect commonly found in most active mode crash relationships in Australasia and around the world.

Model Development

Building on the above findings, an Excel spreadsheet-based model was developed to enable mode-shift scenario testing for various situations. An Excel model (without any underlying macro coding) was used for easy hosting and dissemination by the Client to other interested parties. The model allows users to select a combination of city/region and demographics, and adjust the future mode usage for this combination. Users can also adjust the overall amount of travel (VKT) to reflect any longer-term changes in transport policies. From this, the potential road-safety outcomes can be calculated, both in total numbers of deaths and serious injuries (DSIs), and by exposure (DSIs per km or hour travelled).

The above datasets were used as the key data sources. At national, urban area, and demographic sub-group levels, the model enables users to test what impacts changes in overall vehicle-kms travelled, mode share, and walking/cycling network levels of service will have on safety outcomes.

A simple model would just compare relative casualty numbers with travel usage for each mode to get a basic comparison of risk (e.g., DSIs per km or hour travelled). However, there are several other interacting and competing effects that were factored in to the model, including:

- non-linear changes in crash risk relative to volume changes
- changes in distances now travelled using new modes
- additional “first/last mile” travel modes used in conjunction with new public transport trips
- improvements to transport infrastructure that can both increase the use and reduce the risk of different modes

Conclusions

This research sought to determine the actual and potential safety impacts of mode shift from private motorised vehicles to public transport and active modes, in conjunction with changes to overall volume of travel by all modes. The development of the related model has resulted in a means of testing the safety impacts of different mode-shift scenarios. Not all potential factors identified were built into this initial model, so the research makes several recommendations for future enhancement of the model, and for strengthening the data underpinning it. For example, further consideration of the effects of speed and congestion on crash severity, splits between rural and urban risk, and the effects of improving pedestrian access to public transport stops. However, this model provides a starting point to scenario test the potential road safety outcomes of different levels and configurations of mode shift in New Zealand.

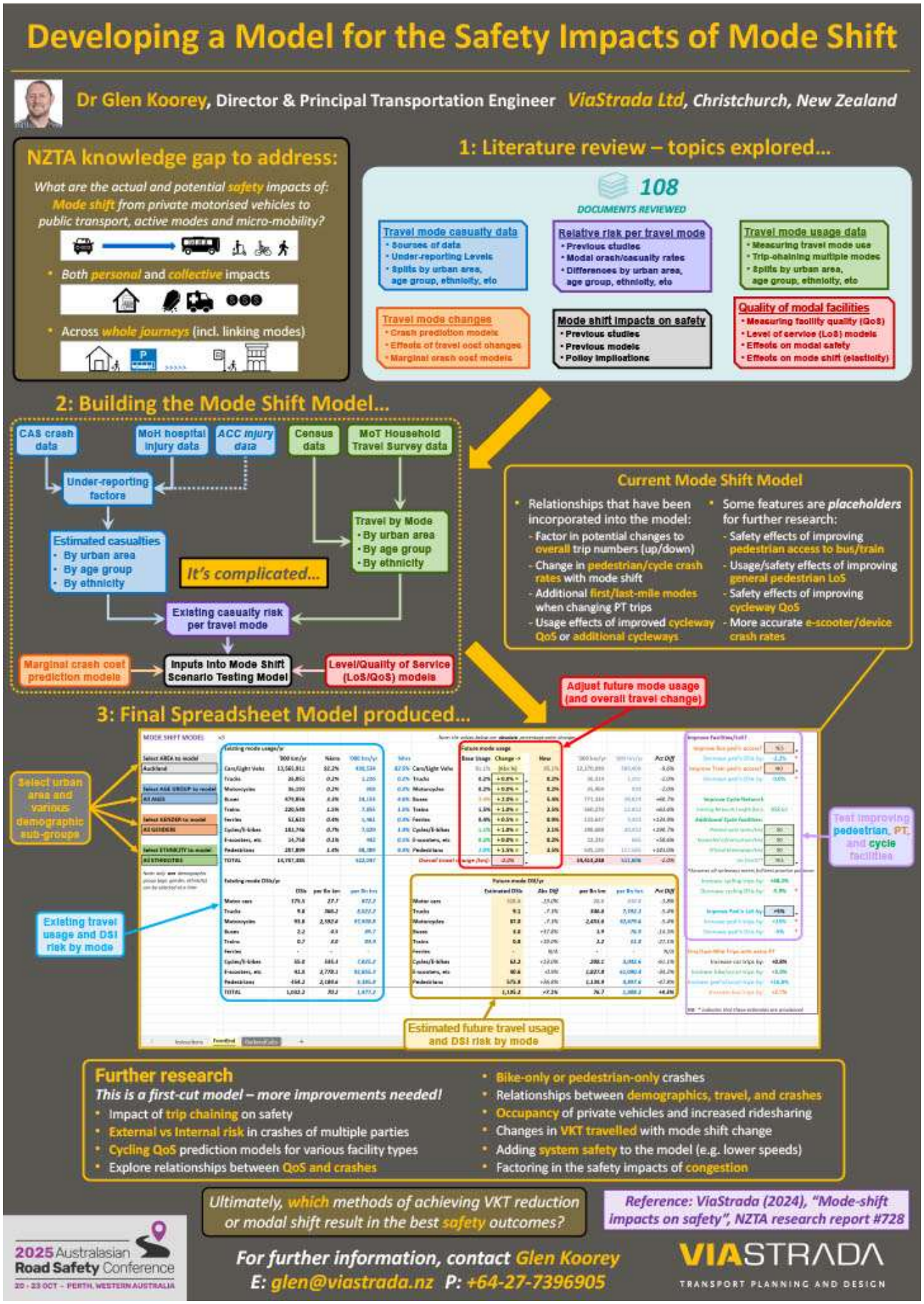
Benefits to road safety and Implications for policy and/or practice

This research improves the understanding about the complex interactions that occur when people shift travel modes, particularly for safety. The findings of this research should help jurisdictions to better make the case for encouraging sustainable transport modes by demonstrating the resulting safety risk improvement. In particular, it will help them identify what is the best mix of travel modes to achieve improved transport safety outcomes.

References

NZ Transport Agency Waka Kotahi (2024). Mode-shift impact on safety. *NZ Transport Agency Waka Kotahi research report 728*, 120pp. https://www.nzta.govt.nz/resources/research/reports/728/

Poster presentation



Minimum datasets for pedestrian safety

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Abstract

Traditionally pedestrians have been poorly served by transport safety efforts to date, particularly when it comes to providing safe walking street environments. The Austroads' funded project Keeping People Safe When Walking aims to help chart a path to zero pedestrian serious trauma, by establishing a greater level of understanding and insights into pedestrian safety risk, trauma, and cost-effective countermeasures. One of the tasks in this project has been to determine the minimum desired data required to progress pedestrian safety. This involved literature review, industry surveys, and interviews with state and city jurisdictions. From this work, the findings were summarised in a research report and inventoried in a separate data spreadsheet. A Practitioner Guide was also prepared, to provide practical advice for road safety practitioners at all levels about what pedestrian safety data is available and how best to collect and use it. This presentation summarises the outputs from this work.

Social media post

What minimum data sets are needed to progress pedestrian safety? Recent Austroads research looked at the role that pedestrian travel, crash, motor traffic, and path/crossing data play in creating safer pedestrian-friendly transport environments and produced practitioner guidance.

Introduction

The purpose of current Austroads project SAG6371 Keeping People Safe When Walking is to help chart a path to zero pedestrian serious trauma, by establishing a greater level of understanding and insights into pedestrian safety risk, trauma, and cost-effective countermeasures.

The project is being undertaken over three streams. Stream 2 builds on the initial review work of Stream 1 (Alavi et al. 2024a-d) to focus on areas of greatest value to Austroads members in delivering pedestrian safety outcomes. Five work packages are being delivered in Stream 2, including:

- Defining the minimum pedestrian data requirements to progress pedestrian safety
- Developing safety modelling tools to support Pedestrian Safety Strategies and Action Plans
- Strengthening the case for pedestrian safety interventions through safer speeds
- Strengthening key practitioner guidance, methodologies and tools
- Understanding inequity in Pedestrian Safety Outcomes

This presentation aims to provide an overview of the work to define a minimum dataset for pedestrian safety.

One of the challenges presented in assessing the safety of people walking (or using other means of footpath-based travel) is the relative paucity and inconsistency of data about the level of usage and the amount of harm occurring. Having a more consistent data set across jurisdictions would enable pedestrian safety objectives and targets to be monitored over time, and the development of policies, strategies and plans. It would also help to highlight areas of pedestrian safety concern that should be focused on.

There are also gaps in existing data that could be addressed, including gaining a better understanding of:

- Pedestrian travel data - including numbers of trips taken, distances and times travelled, locations of trips, demographics of travellers, trip purposes, and trip chaining with other travel modes
- Pedestrian crash casualty data - including the nature and relative severity of injuries, demographics of casualties, and other contributing factors (e.g., drugs/alcohol, weather/environment)
- Pedestrian environment data – including type and quality of pathway and crossing facilities
- Other path user data – including people with various impairments to travel (including mobility, sensory and cognitive impairments) and micro-mobility users on our networks (e.g., bicycles, e-scooters, skateboards, and other wheeled devices), including trips taken by each device.

- Other potential safety metrics - including motor traffic volumes and speeds, perceived walking safety and security, and single-party incidents like falls.

Furthermore, limited resources mean a minimum requirement is needed. It is acknowledged that, despite their value in understanding the pedestrian safety picture more clearly, collection of some of these data sets can be difficult due to limited resources (e.g., funding, staff and equipment) and difficulties in quantifying or measuring some attributes, or reconciling similar data from different sources. While in each case there is an ideal full list of pedestrian attributes that would be desired, this research aims to identify a minimum list of data attributes and their coverage that would allow the application of many of the key metrics for assessing pedestrian safety.

Conference theme

Traditionally pedestrians have been poorly served by transport safety efforts to date, particularly when it comes to providing safe walking street environments. Many roads feature high volumes of traffic travelling at unsafe impact speeds, with limited opportunities for pedestrians to safely cross (or in some cases even safely travel alongside the roadway). Many of these walking facilities also provide poor quality of service for less able pedestrians affected by physical, cognitive or sensory impairments. Understanding these issues can also be difficult, being hampered by a lack of good data around usage, perceptions, and incidents. It is no wonder therefore that many people choose not to walk due to perceptions of poor safety or accessibility.

The work summarised in this presentation will help support the Conference themes of: Equity: Providing fairer and safer access to the transport system for pedestrians of all abilities, and Evolution: The development of suitable support tools (in this case, data) to gradually create a more pedestrian-friendly environment

Method

A three-pronged approach was taken to the research: literature review, online industry survey, and selected jurisdiction interviews. The findings were summarised in a research report and inventoried in a separate data spreadsheet.

Literature review

The aim of the literature review was to develop an inventory of datasets currently available in Australia and New Zealand. From this, we have recommended the most suitable data sources to collect (including determination of a practical minimum data set) and suggest methods for obtaining the data, based on successful examples of their use elsewhere. Literature was identified from:

- documentation and data outputs from Stream 1 of this project
- databases including web searches of Austroads member websites (with datasets and measures directly posted or referred to in relevant reports), Google Scholar, data.europa.eu and the Transportation Research Record.
- the online survey and practitioner interviews (below) provided further links to relevant guidance and databases.

Industry surveys and interviews

An online survey was created and disseminated to a range of industry channels during Nov-Dec 2024. The survey included questions on usage of specific areas of data including pedestrian and vehicle volumes, injuries and crash, street/road/path environment, and any other datasets that respondents use. In addition, respondents were asked to identify any key data gaps in their work in pedestrian safety.

A separate series of contacts were identified working at a governing state or city agency in Australasia and interviews conducted with willing respondents in early Dec 2024. Interviews were conducted via videoconference, with one interviewer and between one and five transport professionals from each public sector organisation. Interview questions were similar to the survey; however, the format provided an opportunity for more conversational, detailed and in-depth discussion. Results were captured via written notes and online recordings.

Practitioner Guide

Based on the above findings, a Practitioner Guide was subsequently prepared. The purpose of this Guide is to provide practical advice for road safety practitioners at all levels about what pedestrian safety data is available and how best to collect and use it. The Guide is an easy-to-read document that presents and describes:

- the range of pedestrian data options available
- the importance or effectiveness ranking of these data sources
- the data availability, based on the above research exploration
- data accuracy, and collection/storage/analysis methods
- examples of their use (either through case studies or relevant reports)

Results

The literature review identified relative advantages and disadvantages in collecting or measuring each data source and discusses their relevance to monitoring progress towards zero pedestrian fatalities and serious injuries (including Safe System treatments and measures). Several examples of different strategies and plans developed by various jurisdictions were also identified and documented. The review also investigated the issue of non-traffic related pedestrian injuries (e.g., slips and falls) and its potential for additional data sources (e.g., Koorey 2023).

70 responses were received from the industry survey and 13 jurisdiction interviews were held. A wide variety of gaps in data were identified, with the two most identified gaps being pedestrian counts or movements (either not available or perceived as being of poor quality) and near-miss data (generally not captured as part of crash data). There was fairly good data available regarding traffic volumes/speeds, pedestrian crashes (although under-reporting remains an issue), and street infrastructure information. Some respondents discussed the potential for technological solutions such as smart cameras and crowd-sourced smartphone data to determine pedestrian movements (e.g., Mandal et al. 2024), although were still being tested. There was also common feedback suggesting that we already know what needs to be done to improve pedestrian safety outcomes and that we need to take action (such as improving street environments and pedestrian facilities), rather than collecting more data.

The Practitioner Guide primarily focuses on existing pedestrian data sources across several Australasian jurisdictions, many of which may also be fit for purpose in other jurisdictions too. However, we have also presented data sources used elsewhere in the world that may be applicable for Austroads members. While the focus of this Guide is on road-crash related pedestrian casualties (i.e., those pedestrians killed or injured from collisions with other road or path users), research using hospital admission data found that serious injuries to pedestrians due to “slips, trips and falls” (i.e., not involving other parties) often outnumbered those collisions involving other road/path users. This suggests that a strong focus on pedestrian safety should also examine the quality of the road and path environments.

For some jurisdictions, either limited by available resources or encompassing large and varying areas, it may be practically challenging to collect some of the data sets presented here. The alternative may be instead to collect some “proxy” measures that can provide indirect estimates of likely safety metrics, based on established relationships. Examples include public transport stop locations or busy commercial land uses as indicators of high pedestrian traffic. The Practitioner Guide provides some suggestions regarding these alternative data sources.

Prioritisation to determine minimum requirements

When thinking about what pedestrian safety data to collect, inevitably there are limitations to what can be collected. Practitioners need to assess the distinction between (1) “Ideal” data requirements, which could encompass a wide range of metrics, many of them presented in the Guide, and (2) “Minimum” data requirements, which would encompass a more limited range of metrics that still provides a sufficient indication of pedestrian safety levels.

Prioritisation of all potential data sets was undertaken in using criteria such as (1) ease of data collection and (2) effectiveness in achieving a Safe System. Typical measures (for example) would be the relative speed limits and observed speeds in different road environments, the presence of grade separation or priority crossings (particularly those with speed management measures such as raised platforms), and protective systems for keeping pedestrians safe from motor vehicles (such as safety barriers).

Benefits to road safety and Implications for policy and/or practice

The findings of this research should help jurisdictions to better focus on collecting data sets that are of most relevance to their objectives for improving pedestrian safety. In particular, it will help them identify what is the best use of their (often limited) resources in both monitoring the state of pedestrian safety and in improving the street environment to better provide for safe walking.

Conclusions

The research highlighted that there is still considerable work required to obtain even a minimum level of pedestrian safety data in some jurisdictions, especially when resources are limited. The Practitioner Guide will provide some useful advice on how to better obtain these. While the research has a focus on pedestrian safety, and pedestrian crash/casualty data is an important monitoring metric for that, it is likely that the greatest gains to achieving a Safe System pedestrian-friendly transport environment will come from improving the nature of the street network itself, e.g., through lower traffic speeds and volumes, and provision of better footpaths and safe crossing facilities.

References

Alavi, H., Turner, S., Martin, L., Zayerzadeh, A., & Strandroth, J. (2024a). Keeping People Safe When Walking: Stream 1 Report 1: Pedestrian Safety Problem and Project Methodology.

Alavi, H., Turner, S., Martin, L., Zayerzadeh, A., & Strandroth, J. (2024b). *Keeping People Safe When Walking: Stream 1 Report 2: Literature Review*.

Alavi, H., Turner, S., Martin, L., Zayerzadeh, A., & Strandroth, J. (2024c). Keeping People Safe When Walking: Stream 1 Report 3: Pedestrian Data Improvement Recommendations.

Alavi, H., Turner, S., Martin, L., Zayerzadeh, A., & Strandroth, J. (2024d). Keeping People Safe When Walking: Stream 1 Report 4: Recommended Pedestrian Safety Interventions.

Koorey, G. (2023). How do we measure Harm in Transport? *Transportation Group Conference 2023*, Tauranga. https://viastrada.nz/pub/2023/measure-trpt-harm

Mandal, A., Johansson, C., & Lindelöw, D. (2024). How useful are new data sources in pedestrian planning? Lessons from Umeå, Sweden case study. *Sustainable Transport and Livability, 1(1)*, https://doi.org/10.1080/29941849.2024.2321145

What is an optimal speed limit?

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Abstract

Recent New Zealand Government policy has introduced new Setting Speed Limit Rules that aim to increase or reverse many current lower speed limits, with the rationale being to improve economic efficiency. However, recent research and policy advice would suggest that, in many cases, a lower speed limit will be the more "optimal" one to choose. A review of State Highway speed limits found that optimum limits for most highways were <80km/h. And a recent economic assessment of several rural speed reduction options in Tasman District produced Benefit/Cost Ratios above 5:1. For urban areas, the benefits are less clear; however, there are likely to be other benefits there that are more difficult to accurately quantify, including health benefits from active mode shift, improved amenity, and reductions in air pollution and noise. This presentation summarises these investigations and offers some considerations for Road Controlling Authorities reviewing their own speed management networks.

Social media post

What speed limits are most optimal in terms of travel time, safety, and other transport parameters? Recent investigations suggest that lower speeds below 100kmh are best for rural roads, while the picture is less clear for urban networks unless other benefits are also considered.

Background

In late 2024, the New Zealand Government administration introduced a new *Setting Speed Limits Rule* (NZ Transport Agency, 2024) that reduced the ability for road controlling authorities (RCAs) to set lower urban and rural speed limits and required most of them to reverse many of the existing lower limits back to their previous speeds. In promoting the new Rule and subsequent planned speed limit reversals on state highways, the relevant Transport Ministers stated that *"the coalition Government is all about making it easier for people and freight to get from A to B as* ***quickly and efficiently*** *as possible, which will help drive* ***economic growth and improved productivity****"* (Bishop, 2025).

In aligning with this viewpoint of economic efficiency, the new Rule includes a requirement for RCAs to undertake a cost-benefit assessment of all speed limit changes, comparing the estimated safety impacts of the proposed change with the estimated travel time impacts and the estimated implementation costs. However, recent research elsewhere and policy advice by the author would suggest that, in many cases, a lower speed limit will be the more "optimal" one to choose. This presentation summarises these investigations and offers some considerations for RCAs reviewing their own speed management networks.

Conference theme

While there is often a simplistic "travel time costs vs safety benefits" tension when it comes to comparing different posted speed limits, this approach often overlooks the relative scale of each impact, and also the additional benefits (tangible and intangible) identified from introducing lower speeds. The work summarised in this presentation will help support the Conference themes of:

- **Equity**: Ensuring that non-motor vehicle users obtain benefit from the introduction of lower speeds, including improved safety and greater mode shift
- **Evolution**: The development of suitable decision support tools to help determine the most appropriate speed limits for different roads

Determination of Optimum Speeds – Previous research

An "optimum" speed limit is defined as providing maximum benefit from reduced travel times and minimises the costs of road trauma, environmental emissions and vehicle operating costs (it is notable that the requirement in the new Rule does not allow for emission or vehicle operating cost effects). In 2012, the NZ Transport Agency commissioned research (Cameron 2012, published in 2022) with the objective of calculating the optimum speeds for six categories of New Zealand state highways. The economic evaluation considered the effect of cruise speeds of each vehicle type (passenger cars and light, medium and heavy commercial vehicles) ranging from 70 to 130 km/h on:

- Crash frequencies and costs

- Travel time costs, including costs for the freight industry
- Vehicle operating costs
- Air pollution costs

With the subsequent update of the NZ economic parameter values for road crashes and travel times in 2021, Cameron revised his figures to reflect the increased values, particularly the roughly-threefold increase in the valuation of a fatal crash (Cameron 2024). The results of the analysis, shown in Table 1, confirm that no higher than **70km/h** is the optimum speed for heavy vehicles, and no more than **75km/h** for light vehicles on all but New Zealand's motorway standard roads.

Table 1. Current cruise speeds by vehicle type and estimated optimum speeds in 2012 and 2021 (Cameron 2024)

	Cruise speeds on straight sections of rural highway (km/h) 2012		Optimum cruise speeds (km/h) 2012		Optimum cruise speeds (km/h) 2021	
Road Category	**Cars and light commercial vehicles (LCV)**	**Heavy commercial vehicles (HCV I)**	**Light vehicles (Cars and LCVs)**	**Heavy vehicles (MCVs and HCVs)**	**Light vehicles (Cars and LCVs)**	**Heavy vehicles (MCVs and HCVs)**
Motorways/Expressways (divided four-lane) roads	99.1	92.5	105	80	95-100	80
High volume national strategic roads	93.9	87.7	85	70	75	70
Straight national and regional strategic roads	95.8	89.5	80	70	70-75	65-70
Winding national and regional strategic roads	83.6	78.4	75	65	65-70	60-65
Straight regional connector and distributors	95.7	89.4	80	70	70	65
Winding regional connector and distributors	79.7	74.9	65	55	60	55

The assessment of heavy commercial vehicles is an interesting case. Firstly, they are limited to a maximum open speed of 90 km/h; thus rendering any speed limits increases above that as not beneficial to them. Secondly, their larger size and aerodynamic impact mean that their fuel efficiency "sweet spot" speed is much lower than for passenger cars.

Nelson/Tasman Speed Management Review - Project Description

Separately, the author was commissioned by Tasman District Council to assess and report on the economic benefits of four urban and four rural options for the proposed Nelson/Tasman Regional Speed Management Plan (SMP) (Tasman District Council, 2024). This was to inform deliberations by the local Land Transport Committee. The options ranged from relatively minimal changes of the *status quo* to extensive reductions in speed limits across several areas.

Methodology

An economic assessment was undertaken using standard NZTA *Monetised Benefits and Costs Manual* parameters (Waka Kotahi, 2024) and associated safety evidence of the likely benefits and dis-benefits related to lowered travel speeds on some roads. For each road section in the Tasman-Nelson network, an estimate of the likely changes in speeds from the existing recorded mean speeds (from NZTA's MegaMaps database) was undertaken. From this, the benefit (or dis-benefit) values were determined for each SMP option in terms of:

- Expected reductions in **crashes and casualties**
- Expected impacts on **travel times**
- Expected changes in vehicle operating costs
- Expected changes in **vehicle emissions**

Previous research by Elvik et al. (2004) showed that, for each 10 km/h of speed limit decrease, an associated ~2.5 km/h decrease is observed in mean operating speeds. Similar findings have been observed in various studies in New Zealand; however, it is possible that greater speed changes could be observed. Based on this, "low", "mid" and "high" estimates of speed change were provided, and sensitivity testing for each benefit was undertaken, by adjusting the assumed speed changes, providing a range of values for all benefits measured. Additional information about other benefits of speed management that are harder to estimate quantitatively were identified to support the case for speed management.
Both theoretical and empirical approaches were used to estimate the likely impact on casualty numbers resulting from the changed operating speeds. These included two models by Elvik et al. (2019) and Nilsson (2004), as well as estimates based on observed safety outcomes from previous speed limit reductions across New Zealand.

For each road section, we assessed the relative changes in crash casualties, travel times, vehicle operating costs (VOCs), and emissions to derive Benefit/Cost Ratios (BCRs) for each option, as well as identifying other intangible benefits (particularly for urban proposals).

Findings

Unfortunately, none of the four urban speed management options achieved a positive nett benefit when all of the four economic variables are combined. This somewhat reflects that the VOC/emission impacts are not as positive at lower speeds and crash reduction impacts are less. However, it should be noted that in the urban area there are likely to be other benefits from speed management that are more difficult to accurately quantify; these include health benefits from active mode shift, improved amenity, and reductions in air pollution and noise. Many of these benefits have been recently well documented in several European towns by Yannis and Michelaraki (2024).

There were also limitations to the simple assessment method used in this study. The change in mean vehicle operating speeds on each street segment was the key dependent variable of this assessment. However, these will not capture all of the potential vagaries of each scenario (and therefore could not be specifically modelled), including:

- The differences in speeds during peak and off-peak times, due to the relative levels of congestion
- The delays involved in traversing each intersection (through geometry or intersection control), which are in addition to the calculated link length travel times, and are generally independent of speed limit changes
- Speed changes between one road segment and the adjacent one, and the subsequent effects on acceleration, deceleration, and speed-change cycle operating costs.
- The effects of gradients on speeds and VOCs/emissions

In that respect, a review of speed management options around Auckland that used urban network modelling (Flow Transportation 2022) is instructive, as it identified BCRs of **3:1 to 9:1** for permanent 30 km/h limits with modelled expected increases in travel times of only 12-15 sec per vehicle.

Unlike the urban options, three of the four rural speed management options produce strong positive BCRs, ranging from **5:1 to 9:1**, largely due to good expected crash reductions (comprising more than 95% of the benefits) and reductions in VOCs and emissions, all of which outweighed any increases in travel time costs by more than double. A follow-up task provided an economic assessment on four specific sections of rural roads, all currently at 100 km/h but proposed to be changed to 80 km/h. All routes demonstrated very good BCRs, well in excess of **10:1** for these speed reductions.
As might be expected, the estimated reductions in likely travel speeds from lower speed limits result in increases in travel times across the network, with resulting calculated dis-benefits. It should be noted though that, while collectively the total increases in travel times add up to a reasonably large figure for many options (and there are some individual segments with proportionately larger delays), the *relative* increases in travel times overall were negligible. For the rural options, the relative changes across the whole network were all less than **0.6%** while, for three of the urban options, the relative changes were less than **1.0%**.

Conclusions

The above analyses demonstrate differing findings when considering speed management options for both rural and urban road networks. When it comes to rural roads, it is far more economically optimal to introduce speed limits less than 100 km/h, due to the considerable savings in crash, VOC and emission costs that far outweigh any expected increases in travel time costs. It is likely that several higher rural speed limits end up getting reduced when full economic assessments of various highway segments are undertaken.

For urban areas, the benefits are less clear when considering a simplistic link-by-link assessment of changes in economic parameters. It is likely that more sophisticated traffic modelling of urban networks would provide a more valid assessment of the traditional transport metrics. In addition, consideration should be given to further investigating and quantifying other intangible benefits that arise from lower urban speeds, based on the evidence from Europe.

References

Bishop Hon. C. (2025). Speed limit reduction reversals begin. *New Zealand Government*. https://www.beehive.govt.nz/release/speed-limit-reduction-reversals-begin

Cameron, M. H. (2012). Economic analysis of optimum speeds on rural state highways in New Zealand. *Report for Waka Kotahi NZ Transport Agency* (published 2022). https://www.nzta.govt.nz/resources/economic-analysis-of-optimum-speeds-on-rural-state-highways-in-nz/

Cameron, M. H. (2024). Optimum speeds on New Zealand rural state highways: an update. *Proceedings of the 2024 Australasian Road Safety Conference*, Hobart.

Elvik, R., P. Christensen, A. H. Amundsen (2004). *Speed and road accidents. An evaluation of the Power Model*. Report 740/2004. Institute of Transport Economics, Oslo. https://www.toi.no/publications/speed-and-road-accidents-an-evaluation-of-the-power-model-article17882-29.html

Elvik, R., Vadeby, A., Hels, T., van Schagen, I. (2019). Updated estimates of the relationship between speed and road safety at the aggregate and individual levels. *Accident Analysis & Prevention*, 123 (2019), pp. 114-122, https://doi.org/10.1016/j.aap.2018.11.014

Flow Transportation (2022). High Level Economic Assessment of Strategic Approaches. Memo to Auckland Transport, 19 Dec 2022. https://at.govt.nz/media/1990950/auckland-transport-speed-management-plan-high-level-economic-assessment.pdf

Nilsson, G. (2004). *Traffic safety dimensions and the Power Model to describe the effect of speed on safety*. Bulletin 221. Lund Institute of Technology, Department of Technology and Society, Traffic Engineering, Lund, Sweden. https://portal.research.lu.se/en/publications/traffic-safety-dimensions-and-the-power-model-to-describe-the-eff

NZ Transport Agency (2024). *Land Transport Rule: Setting of Speed Limits 2024*. https://nzta.govt.nz/resources/rules/land-transport-rule-setting-of-speed-limits-2024/

Tasman District Council (2024). *Speed Management Review*. https://shape.tasman.govt.nz/speed-review

Waka Kotahi, NZ Transport Agency (2024), *Monetised Benefits and Costs Manual (MBCM)*, version 1.7.2, Nov 2024. https://www.nzta.govt.nz/resources/monetised-benefits-and-costs-manual/

Yannis, G.; Michelaraki, E. (2024). Review of City-Wide 30 km/h Speed Limit Benefits in Europe. *Sustainability 2024*, 16, 4382. https://doi.org/10.3390/su16114382

Australian parents' perspectives on teenagers use of Uber Teen

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Abstract
Uber Teen, a rideshare service offering independent transportation for teenagers, was launched in several Australian states and territories in April 2024. To explore attitudes and behaviours toward teenagers' use of rideshare services, both when accompanied by an adult and when unaccompanied, an online survey was completed by 652 Australian parents (mean age = 45.7 years, SD = 9.2 years; 58.7% female). Survey results showed that 62.6% of parents had used rideshare in the past three months, 46.1% with their teen, and 18.3% reported their teen using it unaccompanied. Key factors influencing unaccompanied use included prior rideshare experience, parent and teenager age, and parental driving lapses ($\chi^2(5) = 106.608$, $p < .001$). These findings highlight how safety, trust, and parental concerns shape these decisions, emphasising the need for enhanced safety features and driver screening to boost confidence in rideshare services.

Social media post
Australian parents have mixed feelings about Uber Teen: prior rideshare use, parent/teen age, and driving lapses shape their decisions. With 18.3% of teens using rideshare unaccompanied, safety policies are vital. Discover the future of teen ridesharing at #ARSC2025!

Introduction
Rideshare services have seen rapid growth across Australia, driven by their convenience, flexibility, affordability, and the perceived safety of traveling in professionally managed vehicles (Cheah et al., 2023; Koppel et al., 2025). These platforms enable individuals to hire a driver using their personal vehicle, providing direct transportation with options for varying passenger numbers and stops (Koppel et al., 2021).

Generally, rideshare services require passengers to be at least 18 years old, unless they provide a teen-specific option, such as Uber Teen, launched in Australia in 2024 (InDaily, 2024). Uber Teen allows teenagers to travel independently, offering features like real-time tracking, verified drivers, and parental controls. As of April 2024, Uber Teen operates in South Australia, the Australian Capital Territory, and Tasmania, enabling those under 18 to book the service through a family profile with parental oversight.

Despite the widespread use of rideshare services, there remains a gap in research concerning parents' attitudes towards their teenagers' use of these services, particularly when travelling without an adult companion. In contrast, numerous studies have examined parental views on teenagers using public transport in Australia, revealing that safety concerns significantly shape their attitudes. These concerns are balanced by parents' desire to foster their teenagers' independence and the convenience of the transport system (The Royal Children's Hospital National Child Health Poll, 2019). For instance, the 2019 poll highlighted safety issues such as crime, crashes, and bullying as primary concerns, while also emphasising the importance of independence and the practical aspects of public transport. Existing research on rideshare services has primarily examined overall usage trends and adult perspectives (Ehsani et al., 2021; Koppel et al., 2025), leaving a critical gap in understanding how parents perceive and regulate their teenagers' rideshare use. Addressing this gap is essential, as parental concerns directly impact teenagers' access to these services. Gaining insight into these attitudes can help inform policy, industry practices, and safety initiatives to ensure rideshare services are both accessible and secure for young passengers.

The current study aimed to investigate the use of rideshare services by parents and their teenagers (aged 13-17 years) in Australia. It explored parents' personal experiences with rideshare services and their attitudes and behaviours towards their teenagers' prior use of these services, both with and without an accompanying adult (other than the driver). Additionally, the study examined how factors such as parents' self-reported risky driving behaviours, technology

readiness, and intolerance of uncertainty influenced parents' decisions to allow their teenagers to travel unaccompanied in rideshare vehicles.

Method

Eligible participants were aged 18 years or older, resided in Australia, drove at least once per week, and had at least one teenager aged 13-17 years living with them who regularly travelled in a vehicle.

Participants completed a 20-minute online survey administered via Qualtrics. The survey comprised several sections, including: socio-demographic characteristics of parents (age, gender); parents' risky driving behaviours (Driver Behaviour Questionnaire [DBQ]). Additional sections included parents' driving characteristics (vehicle use, crashes, infringements, seatbelt use), their use of rideshare services (frequency, type of trips, reasons for non-use), teenagers' characteristics (age, gender, seatbelt use, and travel frequency with parents), teenagers' use and non-use of rideshare services (frequency, reasons for rideshare trips, seatbelt use), and parents' attitudes and behaviours towards teenagers using rideshare services unaccompanied (frequency, reasons for allowing/restricting rideshare use, and safety practices).

The online survey was promoted via the researcher's social media platforms, including Facebook, LinkedIn, and X (formerly Twitter). Participants completed the survey from July to August 2024. As an incentive, participants were entered into a draw to win one of five $100 gift vouchers.

Descriptive statistics were used to summarise participants' socio-demographic details, the characteristics of their teenagers, and their attitudes and behaviours regarding their teenagers' use of rideshare services, both when accompanied by an adult and when unaccompanied. A logistic regression model was developed to identify the factors associated with teenagers' unaccompanied rideshare use. All analyses were conducted using IBM SPSS v.28.

Results

The online survey was completed by 652 participants, with a mean age of 45.7 years (SD = 9.2, range 18–77 years). A majority of participants were aged 45-54 years (39.4%), and identified as female (58.7%). Participants provided details about teenager(s) (aged 13–17 years) in their household with the most recent birthday. Most teenagers were 17 years old (23.2%) and male (54.6%). Most travelled with the participant in a private motor vehicle 4-6 times per week (33.1%) and 'always' wore their seatbelt (91.9%).

All participants were licenced drivers. Most drove daily (64.0%) and 'always' wore a seatbelt as a driver (90.6%). Over the past two years, 86.0% had not been involved in a motor vehicle crash, and most reported no speeding (84.0%) or other driving infringements (96.3%).

Two-thirds of participants (66.0%) used a rideshare service in the past three months (Daily: 1.1%; 4-6 times per week: 3.5%; 2-3 times per week: 5.8%; 1 time per week: 9.0%; 1 time per month: 17.5%; < 1 time per month: 25.6%; Never: 37.4%). Among those who used rideshare services, 79.9% 'always' wore their seatbelt. Participants were more likely to wear a seatbelt in their private vehicle (86.5%) than in a rideshare vehicle (79.9%, $\chi 2(1) = 109.65$, $p < .001$). Common reasons for using rideshare services included convenience (48.5%), availability (31.4%), and lack of alternatives (30.6%). Participants who had not used a rideshare service in the past three months (n = 244) cited not needing it due to using their private vehicle (82.0%) or cost concerns (23.0%).

Among those who had used a rideshare service in the past three months, 46.1% (n = 188) reported traveling with their teenager. Most teenagers always wore their seatbelt (73.4%), although the rate was lower in rideshare services compared to private vehicles ($\chi^2(1) = 76.99$, $p < .001$). The most common rideshare travel situations included local and out-of-town trips, such as airport transfers (46.3%).

Only 18.3% of participants reported their teenager had used a rideshare service without an accompanying adult. The average age of these teenagers was 15.2 years (SD = 1.4). Teenagers who used rideshare services unaccompanied were significantly older (M = 15.52, SD = 1.31) than those who did not (M = 14.98, SD = 1.43), $t(650) = -3.762$, $p < .001$. Gender was not associated with unaccompanied use ($\chi^2(1) = 0.150$, $p = .699$).

A logistic regression model identified several factors associated with teenagers' unaccompanied rideshare vehicle use, $\chi 2(5) = 106.608$, $p < .001$, with the Hosmer-Lemeshow Goodness-of-fit suggesting good model fit, $p > .05$. The model explained 24.6% (Nagelkerke R squared) of the variance in teenagers' unaccompanied rideshare vehicle use. The model

correctly classified 82.5% of participants, and the ROC curve (0.789) indicated an 'acceptable' level of discrimination (Hosmer & Lemeshow, 2013). Factors associated with teenagers' unaccompanied rideshare use included:

- Participants who used rideshare services had 2.7 times higher odds of their teenager using a rideshare unaccompanied (OR = 2.715, 95% CI = 1.401, 5.262).
- Participants who used rideshare services with their teenager had 3.3 times higher odds of the teenager using it unaccompanied (OR = 3.272, 95% CI = 1.985, 5.39).
- For each additional year in participant age, the odds of their teenager using a rideshare unaccompanied decreased by 2.6% (OR = 0.974, 95% CI = 0.950, 0.998).
- For each additional year in teenager age, the odds of using a rideshare unaccompanied increased by 52.9% (OR = 1.529, 95% CI = 1.292, 1.81).
- For each point increase in the participant's lapses score, the odds of their teenager using a rideshare unaccompanied increased by 43.1% (OR = 1.431, 95% CI = 1.090, 1.879).

Discussion

The current study investigated Australian parents' and teenagers' use of rideshare services, focusing on the introduction of Uber Teen, a service for teenage passengers launched in 2024. The research explored parents' use of rideshare services and their attitudes toward teenagers using these services, both with and without an adult, to address the critical gap in understanding how parental concerns shape teenagers' access to rideshare services. Insights from this study can inform policy, industry practices, and safety initiatives to ensure rideshare services are both accessible and secure for young passengers.

Approximately 62.6% of participants reported using rideshare services in the past three months, a trend consistent with previous findings highlighting rideshare growth in Australia (Ehsani et al., 2021; Koppel et al., 2021). However, seatbelt use in rideshare vehicles (79.9%) was lower than in private vehicles (86.5%), suggesting a potential complacency in safety practices when using rideshare services, a finding also observed internationally (Jermakian & Weast, 2018).

Less than half of the participants (46.1%) who used rideshare services reported travelling with their teenagers. Teenagers were more likely to wear seatbelts in private vehicles (86.5%) than in rideshare vehicles (79.9%), emphasising the need for targeted safety education for both parents and teenagers (Lagrell, 2024). The findings align with past research indicating lower restraint use in rideshare vehicles (Koppel et al., 2021; Koppel et al., 2025). Safety education campaigns focusing on risk perception and seatbelt use could improve compliance among teenagers (Sharwood et al., 2023).

Only 18.3% of participants reported their teenager had used rideshare services without an accompanying adult. The introduction of Uber Teen in 2024, initially available in select states, may increase this figure over time. Factors influencing unaccompanied rideshare use included parental familiarity with rideshare services, past experiences using rideshares with their teenagers.

This study highlights the importance of enhancing safety features and building trust to support unaccompanied rideshare use by teenagers. Strategies such as real-time monitoring, GPS tracking, and targeted seatbelt safety campaigns are recommended to improve safety outcomes and boost parental confidence. As Uber Teen and similar services continue to expand, these measures can help ensure safer mobility for teenage passengers. Aligned with the ARSC2025 theme of ***Equity, Elasticity, and Evolution***, this research highlights the evolution of rideshare services in response to societal needs and emphasises the system's elasticity in addressing emerging safety challenges. Further research is needed to examine long-term trends and the broader impact of rideshare services on teenage transportation behaviour.

References

Cheah, I., Shimul, A. S., Liang, J., & Phau, I. (2023). Consumer attitude and intention toward ridesharing. In Relationship Marketing in Franchising and Retailing (pp. 3-24). Routledge.

Ehsani, J. P., Michael, J. P., & Gielen, A. (2021). Rideshare use among parents and their children. Injury epidemiology, 8, 1-3.Hosmer, D.W., Lemeshow, S., & Sturdivant, R.X. (2013). Applied Logistic Regression, 3rd ed.; John Wiley & Sons: New York, NY, USA.

InDaily (2024). 'Uber for Teens' launches in Australia. Accessed on July 25th 2024 at: https://www.indaily.com.au/news/2024/04/23/uber-for-teens-launches-in-australia

Jermakian, J. S., & Weast, R. A. (2018). Passenger use of and attitudes toward rear seat belts. Journal of safety research, 64, 113-119.

Koppel, S., Kaviani, F., Albanese, B., Mansfield, J., Baker, G., Connell, R., Sartin, E., Arbogast, K., Ehsani, J.P., Shannon, B., Zonfrillo, M.R., & Brown, J. (2025). Are child and teenage occupants appropriately restrained while travelling in rideshare vehicles? Journal of Transport & Health. 41, 101987.

Koppel, S., Peiris, S., Aburumman, M., Wong, C. W., Owens, J. M., & Womack, K. N. (2021). What are the restraint practices, preferences, and experiences when Australian parents travel with their children in rideshare vehicles? International journal of environmental research and public health, 18(17), 8928.

Lagrell, E. (2024). How can ridesharing be facilitated in car dependent practices? Insights from carless participants in organized leisure. Travel Behaviour and Society, 35, 100737.Peden, M., Koppel, S., & Womack, C. (2023). Traffic Injury Prevention, 24(4), 273-279. https://doi.org/10.1080/15389588.2023.2204092

Sharwood, L.N., Martiniuk, A., Foroushani, P.S., Seggie, J., Wilson, S., Hsu, J., Burns, B., & Logan, D.B. (2023). Intentions and willingness to engage in risky driving behaviour among high school adolescents: evaluating the bstreetsmart road safety programme. Injury prevention, 29(1), 1-7.

The Royal Children's Hospital National Child Health Poll (2019). Travelling to school: Habits of Australian families. Poll Number 13. The Royal Children's Hospital Melbourne, Parkville, Victoria.

Evolving roadside safety hardware: designing for the future

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Abstract

Roadway safety has been consistently evolving since the first automobiles drove off the assembly floor. Roadway departure crashes are a leading cause of fatalities, and roadside safety hardware is frequently the last line of defence for errant motorists. Industry professionals have updated the roadside safety hardware portfolio over the years to maintain compatibility with the constantly evolving vehicle fleet. The last few years have seen a rapid increase in the number of electric vehicle (EV) sales. Recent crash tests have shown the need for further research on the compatibility of current roadside safety hardware with EVs. These crash tests are a starting point in this investigation and highlight the need for additional collaboration, research, and planning for the next evolution of roadside safety hardware.

Social media post

Roadside safety hardware has evolved over the years to maintain compatibility with the constantly evolving vehicle fleet. Recent crash tests have shown the need for further research regarding the compatibility of current roadside safety hardware with electric vehicles.

Introduction

Roadside safety hardware is designed for crashworthiness with a wide range of vehicles, from small passenger cars to larger pickup trucks. Currently, the American Association of State Highway and Transportation Officials (AASHTO) *Manual for Assessing Safety Hardware (MASH)* (AASHTO, 2016) is an internationally recognized standard methodology for evaluating roadside safety hardware. The current version of *MASH* specifies test vehicle parameters which were developed from an analysis of vehicle sales and crash data from the early 2000s. It has been close to 20 years since *MASH* was first published, and the vehicle fleet has certainly evolved during this time. Vehicle manufacturers release new models each year, and these models frequently incorporate changes in vehicle geometry, drivetrain components, and safety technology. Therefore, there is a need to evaluate the current portfolio of roadside safety hardware for crashworthiness with respect to the new vehicle fleet, specifically electric vehicles (EVs). EV sales are steadily increasing, and little work has been done to investigate their compatibility with the existing roadside safety hardware portfolio. This extended abstract summarizes preliminary efforts to investigate this compatibility.

Roadside safety practitioners and researchers have updated the crash testing standards throughout the years, starting with guidelines prior to National Cooperative Highway Research Program Report 230 (Michie, 1981) and ending with the current version of *MASH*. However, the vehicle specifications within these documents are often outdated soon after the standards are implemented and new hardware is incorporated into state design standards. Consequently, the roadside safety community has always played catchup to vehicle manufacturers, which are producing new vehicle models each year. With the new emergence and high adoption rate of EVs, researchers have the opportunity to begin investigating the compatibility of EVs and roadside safety hardware. Thereby beginning the process of updating the roadside safety hardware portfolio before the majority of the vehicle fleet becomes electrified.

The Midwest Guardrail System (MGS) is a commonly installed longitudinal barrier, which successfully met *MASH* evaluation criteria for both tests 3-11 (Polivka et al., 2006) and 3-10 (Bligh et al., 2011) with traditional internal combustion engine (ICE) vehicles. Table 1 provides the standard *MASH* impact conditions for these two tests. One of the evaluation criteria within *MASH* for longitudinal barriers is structural adequacy; the barrier is required to contain and redirect the test vehicle. The test vehicle cannot penetrate, override, or underride the barrier. The MGS successfully contained and redirected both the *MASH* small car and pickup truck in previous testing.

Table 1. *MASH* impact conditions

Test Designation	Test 3-11 (pickup truck)	Test 3-10 (small car)
Vehicle mass, kg (lb)	2270 (5000)	1100 (2420)
Impact speed, km/h (mi/h)	100 (62)	100 (62)
Impact angle, degrees	25	25

The Midwest Roadside Safety Facility (MwRSF) at the University of Nebraska–Lincoln evaluated the MGS with *MASH* test 3-11 using a Rivian R1T weighing over 3175 kg (7000 lb), a significant increase from the nominal *MASH* pickup truck weighing 2270 kg (5000 lb). The researchers also evaluated the MGS with test 3-10 using a Tesla Model 3 weighing 1746 kg (3849 lb), also a significant increase over the nominal *MASH* small car weighing 1100 kg (2420 lb) (Bielenberg, 2025). In test 3-11, the w-beam rail ruptured soon after impact, which allowed the test vehicle to penetrate through the barrier. In test 3-10, the test vehicle wedged under the w-beam rail and underrode the barrier. In both tests, the structural adequacy criterion failed to be met, unlike in the ICE counterpart crash tests.

Conference Theme

The vehicle fleet is constantly evolving as manufacturers produce new vehicle models. Therefore, roadside safety hardware needs to evolve in parallel to maintain compatibility with the vehicle fleet. This extended abstract summarizes the initial efforts to study the compatibility of new electric vehicles and current roadside safety hardware.

Method

The Texas A&M Transportation Institute (TTI) desired to further advance the industry's knowledge on BEV compatibility with current roadside safety hardware. In pursuit of this goal, TTI researchers selected a thrie-beam guardrail system for evaluation with a BEV crash test. TTI researchers selected this thrie-beam system for BEV evaluation for two reasons. First, the thrie-beam rail is more robust and has a higher structural capacity than the w-beam system. A higher structural capacity would hopefully mitigate the rail rupture concerns exhibited within the electric pickup truck test performed at MwRSF. Second, the thrie-beam rail has a deeper (vertical direction) cross-section than the w-beam. This reduced the size of the gap between the bottom edge of the rail and the ground, which would mitigate the underride concern exhibited in the electric small car test. Additionally, this thrie-beam system successfully met *MASH* evaluation criteria for tests 3-11 and 3-10 when impacted with ICE vehicles in a previous project (Kiani, et al., 2021). Therefore, TTI researchers had a baseline level of understanding of the system's capabilities prior to performing a BEV crash test. For these reasons, TTI researchers evaluated the thrie-beam guardrail system with *MASH* test 3-10 using an electric vehicle.

Results

TTI researchers performed test 3-10 on the thrie-beam guardrail system with the Tesla Model 3. The test vehicle weighed 1768 kg (3897 lb) and nominally impacted the rail at 100 km/h (62 mph) and an angle of 25 degrees. The front of the test vehicle wedged itself under the bottom edge of the rail and lifted the rail vertically upward. Soon after, the upstream splice of the thrie-beam rail ruptured, allowing the test vehicle to penetrate through the rail (Figure 1). Because of this failure to contain and redirect the vehicle, the test failed to meet the *MASH* evaluation criteria.



Figure 1. Thrie-beam guardrail crash test with electric vehicle

The results of the tests showed that additional investigation into the compatibility between EVs and contemporary roadside safety hardware is needed. Several physical characteristics of EVs differ from ICE vehicles and contribute to the results of the preliminary crash tests. The first difference between the vehicle types is their weight, with EVs significantly heavier than their ICE counterparts. EVs can be upwards of 40% heavier than their ICE counterparts. However, this is not purely an EV concern. Sales data show the vehicle fleet is getting heavier each year. Consequently, designing for heavier EVs would also benefit the current vehicle fleet of heavier vehicles. The increase in weight is not

only a structural adequacy concern. Increasing the weight of the vehicle also increases the impact severity. Testing at TTI has shown increases in impact severity can increase occupant risk metrics measured in crash tests. Therefore, mitigation measures to absorb that additional energy are recommended.

Another difference in physical characteristics between EVs and their ICE counterparts is the center-of-gravity (CG) location. In ICE vehicles, the CG is relatively high because of the weight and location of the engine block and other associated drivetrain components. Conversely, EVs typically use a skateboard-like platform that locates the batteries at the floorboard of the vehicle. This significantly lowers the CG compared to ICE counterparts. This lower CG may contribute to the underride and rail uplift behaviours seen in the EV crash tests. Conversely, this lower CG can also provide a safety improvement in vehicle stability. The weight and location of the batteries decrease the possibility of rolling the vehicles during an impact.

The crush stiffness characteristics also differ between EVs and ICE vehicles. Without the engine block and other traditional drivetrain components, the EV front crush stiffness differs from that of their ICE counterparts during impacts. The floorboard deformation also differs between EVs and ICE vehicles. Most manufacturers design the battery packs to be very stiff to prevent damage to the batteries during an impact. This stiffness likely increases the structural loading on impacts with barriers. Additionally, the minimal crushing may also increase the occupant risk metrics typically measured during crash tests.

The crash tests discussed here were a first step to investigating the compatibility of EVs with roadside safety hardware. The results shown here involve a specific test vehicle, but researchers believe the results would be common among most—if not all—EVs. The results highlight the importance of this effort and provide the industry with the ability to further investigate EVs' compatibility with current roadside safety hardware and potentially implement retrofits before EVs take a majority of the vehicle fleet.

Benefits to Road Safety and Implications for Practice

The vehicle fleet is constantly evolving, and the roadside safety hardware portfolio needs to evolve as well. The EV share of the vehicle fleet is growing each year. According to the Bureau of Infrastructure and Transport Research Economics, there was a 112% increase in EV registrations between 2023 and 2024 (BITRE, 2024). The work highlighted in this abstract is a first step to investigating the compatibility of EVs with roadside safety hardware. Much more work is needed to fully investigate all the device categories and the unknown effects that EV characteristics will have on crashworthiness. Designing for EVs will also improve safety for the contemporary ICE vehicle fleet. With the weight of the vehicle fleet increasing, hardware that is designed for the increased weight of EVs will also likely improve crashworthiness for heavier ICE vehicles.

The roadside safety industry has historically lagged behind vehicle manufacturers. This preliminary work would allow the roadside safety industry to get ahead of the curve and begin evolving the hardware portfolio before EVs make up the majority of the vehicle fleet. Much more work and collaboration are needed across the industry to fully investigate EV compatibility with roadside safety hardware, and these discussed tests are a step in that direction.

Conclusions

Roadway safety has been consistently evolving since the first automobiles drove off the assembly floor. Roadway departure crashes are a leading cause of fatalities, and roadside safety hardware is frequently the last line of defence for errant motorists. Industry professionals have updated the roadside safety hardware portfolio over the years to maintain compatibility with the constantly evolving vehicle fleet. The last few years have seen a rapid increase in the number of EV sales. Recent crash tests have shown the need for further research regarding the compatibility of current roadside safety hardware and EVs. These crash tests are an important starting point in this investigation and highlight the need for additional collaboration, research, and planning. Historically, the roadside safety industry has had to catch up with evolutions in vehicle technology, and these crash tests provide an opportunity for the roadside safety industry to get ahead of the curve. Further research today will improve safety on today's roads and pave the path to the future.

References

American Association of State Highway and Transportation Officials (AASHTO). (2016). *Manual for Assessing Safety Hardware.* Washington, DC, USA.

Bielenberg, R. (2025). Evaluation of the Compatibility of Battery Electric Vehicles with Roadside Hardware. *Lectern Presentation*. Transportation Research Board Annual Meeting, Washington, DC, USA.

Bligh, R. P., Abu-Odeh, A. Y., & Menges, W. L. (2011). *MASH Test 3-11 on the 31-Inch W-Beam Guardrail with Standard Offset Blocks.* College Station, TX, USA: Texas A&M Transportation Institute.

Bureau of Infrastructure and Transport Research Economics. (BITRE). (2024). *Road Vehicles, Australia.* Canberra, Australia: Department of Infrastructure, Transport, Regional Development, Communications and the Arts.

Kiani, M., Kovar, J., Menges, W. L., Schroeder, W., Griffith, B. L., Wegenast, S., & Kuhn, D. L. (2021). *Design and Testing of MASH TL-3 Thrie-Beam Guardrail System (TGS) for Roadside and Median Applications.* College Station, TX, USA: Texas A&M Transportation Institute.

Michie, J. D. (1981). NCHRP Report 230: Recommended Procedures for the Safety Performance Evaluation of Highway Appurtenances. Washington, DC, USA: National Cooperative Highway Research Program.

Polivka, K. A., Faller, R. K., Sicking, D. L., Rohde, J. R., Bielenberg, B. W., & Reid, J. D. (2006). *Performance Evaluation of the Midwest Guardrail System—Update to NCHRP 350 Test No. 3-11 with 28" C.G. Height (2214MG-2).* Lincoln, NE, USA: Midwest Roadside Safety Facility.

User experience of GSR ADDW Regulations in Australian Heavy Vehicles

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Abstract
This study evaluates the applicability, relevance, and potential user experience of the General Safety Regulation (GSR) Advanced Driver Distraction Warning (ADDW) protocols in heavy vehicles. Utilizing a real-world dataset from a naturalistic driving study, potential alerts as would be generated by a GSR ADDW-compliant system were compared against distraction alerts as defined under the European New Car Assessment Program (Euro NCAP) Occupant Status Monitoring (OSM) protocols. ADDW distraction events were classified at a rate of 0.29 events per hour. Speed thresholding of alerts under GSR ADDW regulations aligned with expert rating of whether behaviours were considered safe or unsafe, with the relationship co-varying with whether drivers were engaged in vehicle turning manoeuvres. The research underscores the importance of data-driven policy making and continuous development of driver monitoring technologies to address emerging safety challenges.

Social media post
Our latest study evaluates the GSR ADDW protocols in heavy vehicles, using real-world data to assess their applicability and user-acceptability. Findings highlight the need for tailored solutions to enhance road safety, benefiting all road users.

Introduction
In 2023, testing protocols for Occupant Status Monitoring (OSM) were published by the European New Car Assessment Program (Euro NCAP). These protocols outlined distraction behaviours that must be detected in drivers of passenger vehicles to earn maximum safety points (Euro NCAP, 2022). In contrast to Euro NCAP, which prescribes a voluntary, performance-based safety rating system, the General Safety Regulation (GSR) is a mandatory safety regulation set by the European Union (European Commission, 2022).A key component of the GSR is the Advanced Driver Distraction Warning (ADDW) system and the mandatory legal standards that these systems must meet. These systems typically use camera-based Driver Monitoring System (DMS) technology to track a driver's eye and face movements, helping drivers stay focused on the road by monitoring their attention levels and issuing warnings if they become distracted. From July 2024, all new type-registered motor vehicles in the EU, including cars, trucks, and buses, will be required to have ADDW systems installed (European Commission, 2023).

Previous analyses have examined the prevalence with which Euro NCAP-defined distraction events occur in real-world heavy vehicle driving (Kuo et al., 2024).While the overall event rate between passenger vehicle drivers and heavy vehicle drivers was comparable, the distribution of glance locations differed between the two cohorts, with truck drivers spending proportionally more time glancing at the passenger side mirror and less time at defined non-driving related regions such as the center console. To date, the extent to which the mandatory GSR ADDW requirements may be applicable in a real-world heavy vehicle fleet in the Australian road context has yet to be examined.

Given significant interest and existing uptake of DMS technology across heavy vehicle fleets in Australia, (Higginson et al., 2019), there exists a unique opportunity for data-driven decisions on protocol implementation, maximizing applicability and user-acceptance. To assess the applicability, relevance, and user-acceptability of the GSR ADDW requirements in heavy vehicles, this analysis applied these definitions to a real-world dataset from a naturalistic driving study involving heavy vehicles.

Conference theme
The current submission directly addresses the conference themes of **Equity** and **Evolution.** While the rationale for how distraction behaviours are defined and regulated in passenger vehicles is firmly established in the road safety literature (Klauer et al., 2006; Tivesten et al., 2019; Euro NCAP, 2022), the extent to which these behaviours are applicable or user-acceptable in the context of heavy vehicles warrants further examination. Establishing this evidence base

contributes to fair and informed decision making on how these behaviours can be regulated in the heavy vehicle space, contributing to improved safety outcomes for all road users.

The discourse on regulating DMS is also representative of how regulation, technology, and safety science have co-evolved to address the driver distraction problem. The current submission directly targets the intersection of these domains, contributing to the growing knowledge base of the capabilities and limitations of these systems.

Method

Dataset

A naturalistic driving study was carried out using an operational trucking fleet as part of the Advanced Safe Truck Concept project, funded by the Cooperative Research Centre Projects (Lenné et al, 2018). Before recruitment, presentations were given to drivers and fleet managers to explain the project and participation requirements. Drivers were then individually approached to obtain informed consent.

A total of 10 Volvo prime-mover vehicles were equipped with Seeing Machines' automotive-grade driver monitoring system (DMS). The driving performance of 82 consenting drivers was monitored during their regular shifts over a period of up to 6 months. The DMS included a driver-facing infrared camera mounted on the dashboard above the centre console, recording continuously at 46fps while the vehicle ignition was on. The system tracked driver features such as head and eye position, glance location, and glance intersection with attention regions within the vehicle cabin (e.g., centre console, instrument cluster, etc.). Additionally, video data of the forward roadway, a wide-angle view of the vehicle cabin, and vehicle kinematic data were recorded. A total of 218 shifts, ranging from 5 to 12 hours in duration, were included in the analysis, totalling 1487 hours.

Analysis

DMS data was analysed for distraction behaviours as defined under Euro NCAP and GSR. To calculate representative event rate statistics, DMS data from when drivers were undertaking scheduled breaks from driving or when the vehicle was moving <10km/h were excluded from the analysis. Euro NCAP distraction behaviours, specifically Long Glance Away events, are operationalised as continuous off-road glances of >3s duration. GSR ADDW defines a variable off-road glance duration for different vehicle speeds: no warnings for vehicle speeds <20km/h; a 6.0s threshold for vehicle speeds between 20 and 50km/h; and a 3.5s threshold for vehicle speeds above 50km/h.

Results

1356 LGA events were classified across 82 participants (Table 1). On average, LGA events were classified at a rate of 0.91 events per hour, and ADDW distraction events were classified at a rate of 0.29 events per hour.

Table 1. LGA events per hour based on NCAP vs GSR thresholds

Behaviour	**Euro NCAP**	**GSR ADDW**
Between 10 - 20 km/h	3.0s threshold	N/A
LGA	Alerts per hour: **0.20**	N/A
Between 20 - 50 km/h	3.0s threshold	6.0s threshold
LGA	Alerts per hour: **0.24**	Alerts per hour: **0.03**
Above 50 km/h	3.0s threshold	3.5s threshold
LGA	Alerts per hour: **0.47**	Alerts per hour: **0.26**
Total		
LGA	Alerts per hour: **0.91**	Alerts per hour: **0.29**

To better understand the context under which these events occurred, a random subsample of video data was selected for manual review (Table 2). Previous analyses of Euro NCAP alerts in heavy vehicles have relied on DMS-classified glance regions to make an inference on whether events are potentially safe or unsafe (e.g., by comparing whether glances are predominantly to driving- or non-driving related regions). Whilst a gaze tracking-based approach enables efficient analysis of large amounts of data, this approach is limited in the amount of context that can be encoded. Conversely, manual video review enables a more meaningful interpretation of the data at greater resource cost. For the current analysis, 40 randomly selected event videos were reviewed by a road safety expert (independent of the project team) for whether the events constituted safe or unsafe behaviours.

Events that occurred at higher vehicle speeds were more likely to be considered unsafe. However, this effect was moderated by whether the event occurred during a turning manoeuvre, with lower speed events more likely to coincide with vehicle turns where drivers are looking off-road but to driving-related regions.

Table 2. Subjective rating of distraction events by speed and off-road glance threshold

	3.0 - 3.5 sec (N=21)	4.0 - 6.0 sec (N=19)
20 - 50 km/h N=18	'Safe': 6/10 Turning: 4/10	'Safe': 5/8 Turning: 5/8
> 50 km/h N=22	'Safe': 4/11 Turning: 1/11	'Safe': 2/11 Turning: 0/11

Benefits to road safety

The implementation of GSR ADDW protocols in heavy vehicles offers significant benefits to road safety. By continuously monitoring driver attention and issuing timely warnings, these systems can help prevent accidents caused by driver distraction. The complementary approach of a mandatory regulation coupled with a voluntary, points-based rating system offers manufacturers and technology providers flexibility in tailoring solutions that are acceptable to users while enforcing a minimum standard of protection. Overall, the widespread adoption of ADDW systems has the potential to create safer driving environments, not only for heavy vehicle operators but for all road users, contributing to a substantial reduction in road traffic accidents and fatalities.

Conclusions

This study highlights the critical need to evaluate the applicability and user-acceptability of distraction detection regulation within the context of real-world heavy vehicle operations. By leveraging a real-world dataset from a naturalistic driving study, it was observed that speed thresholding of alerts under GSR ADDW regulations aligned with expert rating of whether behaviours were considered safe or unsafe, with the relationship co-varying with whether drivers were engaged in vehicle turning manoeuvres. Mandatory requirements under GSR complement the voluntary, performance-based rating system proposed under Euro NCAP. Our findings underscore the importance of tailoring distraction detection systems to the unique driving conditions of heavy vehicles, ensuring that safety regulations are both effective and practical. This research contributes to the broader discourse on the evolution of driver monitoring technologies and their regulatory frameworks, ultimately aiming to enhance road safety for all users.

Acknowledgements

We acknowledge the funding received from the Commonwealth of Australia through the Cooperative Research Centre - Projects scheme and the cash and/or in-kind support provided by Seeing Machines, Monash University, Ron Finemore Transport and Volvo Group Australia. We also thank the extended team supporting this project: Fivaz Buys, Kyle Blay, Shafiul Azam, Gemma Hooper, David Moorhouse, Jeremy da Cruz, Tim Edwards and Rod Stewart at Seeing Machines; Timothy Horberry, Nebojsa Tomasevic, Brendan Lawrence, and Raphaela Schnittker at Monash University.

References

Euro NCAP. (2022). *Euro NCAP 2025 Roadmap: In Pursuit of Vision Zero*. Euro New Car Assessment Program.

European Commission. (2022). *Commission proposes new rules to improve road safety and reduce traffic accidents*. Retrieved from https://ec.europa.eu/commission/presscorner/detail/en/ip_22_4312.

European Commission. (2023). *Proposal for a regulation of the European Parliament and of the Council on the General Safety of Motor Vehicles*. EUR-Lex. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=PI_COM:C(2023)45234523).

Higginson, A., Dawson, D., & Sprajcer, M. (2019, December). *Research Report: Phase 2.Fatigue/Distraction detection technology use in the Australian road freight transport sector.* National Heavy Vehicle Regulator. https://www.nhvr.gov.au/files/202002-1120-phase-2-fatigue-distraction-detection-technology-australia.pdf

Klauer, S. G., Dingus, T. A., Neale, V. L., Sudweeks, J. D., & Ramsey, D. J. (2006). *The impact of driver inattention on near-crash/crash risk: An analysis using the 100-car naturalistic driving study data* (Technical Report DOT-HS-810594). National Highway Traffic Safety Administration. http://www.nhtsa.gov/DOT/NHTSA/NRD/Multimedia/PDFs/Crash%20Avoidance/2006/DriverInattention.pdf

Kuo, J., Mulhall, M., Shiferaw, B., Yang, S., Lenné, M. G., Fitzharris, M., & Wood, D. (2024). Applying European NCAP Driver State Monitoring Protocols to Heavy Vehicle Fleets: Prevalence of Distraction Alerts in Real-World Commercial Transport Operations. *9th International Conference on Driver Distraction and Inattention*.

Lenne, M., Kuo, J., Fitzharris, M., Horberry, T., Mulvihill, C., Blay, K., Wood, D., & Peden, M. (2018). The Advanced Safe Truck Concept project: a partnership program developing future integrated driver monitoring technology. In A. Hržić (Ed.), *25th ITS World Congress, Copenhagen, Denmark, 17-21 September 2018* (pp. 1-8). ERTICO - ITS Europe.

Tivesten, E., Victor, T. W., Gustavsson, P., Johansson, J., & Ljung Aust, M. (2019). Out-of-the-loop crash prediction: The automation expectation mismatch (AEM) algorithm. *IET Intelligent Transport Systems*, *13*(8), 1231–1240. https://doi.org/10.1049/iet-its.2018.5555

Assessment of Road Safety Performance using Indonesian Star Rating Method

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Abstract

The Indonesian government has adapted the globally recognized iRAP Star Rating method to better suit local road conditions through the Indonesian (INA) Star Rating method. While both methods share a similar concept, they differ in aspects such as the types of road users considered for rating, the definition of operating speed, and the range of speeds variables. The findings reveal that for segments with similar road attributes, the INA Star Rating is generally higher than the iRAP Star Rating. Higher iRAP Star Ratings correspond to lower average crashes per million vehicle-kilometres. In contrast, using the INA method, the average total and FI crashes per million vehicle-kilometres increase from 1-Star to 2-Star segments (for total crashes) or 3-Star segments (for FI crashes), after which they decrease. The iRAP method appears to provide more consistent results supporting the association that lower star ratings correspond to less safe roads.

Social media post

The Indonesian government has introduced its own standard for assessing road safety, known as the Indonesian (INA) Star Rating method. While it generally resembles the iRAP Star Rating method, there are differences in the variables used and the results when compared to real-world crash data.

Introduction

Safe road infrastructure is a key component of the Safe System approach, which the United Nations recommends for implementation by countries to achieve the goal of halving road traffic deaths and injuries set in the Decade of Action for Road Safety 2021–2030 (WHO, 2021). In 2017, the WHO established 12 Global Road Safety Performance Targets, with the third target stating that by 2030, all new roads should meet technical safety standards for all road users or achieve a 3-star road rating or higher. This target was later adopted in Indonesia's National General Plan for Traffic and Road Transportation Safety (RUNK LLAJ), as outlined in Presidential Regulation No. 1/2022 (GRI, 2022).

The Star Rating assessment, developed by the International Road Assessment Program (iRAP), is an objective measure used to evaluate inherent road safety risks, including crash likelihood and crash severity (iRAP, 2024). Several studies have found relationships between Star Ratings and road safety performance indicators, such as crash frequency, crash rate, and crash cost. According to McInerney and Fletcher (2013), as cited in iRAP, there was an almost 50% reduction in the cost of fatal and serious injury casualties per vehicle-kilometre travelled with each increase in the Star Rating. Study by Rahmita et al. (2020), showed a weak correlation between Star Rating and Star Rating Scores with crash frequency and crash rate based on a 10.6 km national road segment in Indonesia. In contrast, Ayuningtyas et al. (2024) found that Star Rating Scores had a relatively strong positive relationship with crash frequency and crash rate, suggesting that higher Star Rating is generally associated with lower crash frequency and crash rate. However, the relationship between Star Rating Scores and fatalities or fatality rate was weak. Furthermore, Ayuningtyas et al. (2024) recommended adapting the iRAP Star Rating methodology to Indonesian road conditions, as differences in the road environment and driver behaviour may affect the accuracy of the assessment.

As mandated by the RUNK LLAJ, the Indonesian Ministry of Public Works and Public Housing has issued a Star Rating assessment method specifically designed for Indonesian roads as an instrument to assess technical roadworthiness. This Indonesian Star Rating method (INA method), outlined in the Guideline No. 06/P/BM/2024 (PUPR, 2024), is essentially an adaptation of the globally recognised iRAP method, simplified to better reflect the conditions and characteristics of Indonesian roads. Similar to the iRAP method, star rating in the INA method ranges from 1 to 5, with a 5-Star road representing the highest standard. However, the differences between this method and the globally recognised iRAP method remains unclear. This research aims to evaluate the application of the INA method on selected segments of the Indonesian toll road network and to compare it with the iRAP method. The obtained Star Ratings and Star Rating Scores from both methods are then compared with the safety performance of the assessed segments.

Conference theme

This research aligns with one of the conference's theme components, namely Evolution. It reviews the adaptation of the globally recognized iRAP Star Rating method for Indonesia's condition (INA method) to develop safer road infrastructures, a key component of the Safe System approach.

Method

This research evaluates the road rating using INA method, as outlined in Guideline No. 06/P/BM/2024 (PUPR, 2024), and compares it with the iRAP method. Both methods were applied to calculate the Star Ratings of 101,5 km of four-lane two-way toll road segments. This research utilizes road and crash data from the year 2023. The Star Ratings and Star Rating Scores obtained from the two methods were compared and analysed to determine their relationships with the toll road safety performance, particularly in terms of the number of total and fatal-injury (FI) crashes.

The iRAP Star Rating and Star Rating Score (SRS) were generated using the ViDA online platform for every 100-metre road segment, whereas the INA Star Rating and SRS were calculated using a spreadsheet provided by Guideline No. 06/P/BM/2024. Both methods calculated the Star Rating and SRS based on coded road attributes. The SRS is a summation of crash type scores and represents the relative risk of fatality and serious injury for a specific road user. The crash type score is calculated by multiplying road attribute risk factors that account for the likelihood of a crash occurring (Likelihood), the severity level of a crash (Severity), the operating speed (Speed), the risk of being involved in a crash as a result of other users' road use (external flow influence - Flow), and the potential for an errant vehicle to cross the median (median traversability - Medtraverse).

$$Crash\ type\ score = Likelihood\ x\ Severity\ x\ Speed\ x\ Flow\ x\ Medtravers$$

SRS is apportioned to Star Rating bands to determine the Star Rating for every 100 metres of the road as in **Table 1** based on iRAP. A higher SRS indicates a more hazardous road. Even though the basic formulation used in iRAP and INA Star Rating are the same, the results of both methods could be different, which were assessed in this research.

Table 1. iRAP Star Rating and Star Rating Score (iRAP, 2022)

Star Rating Band	Star Rating Score (SRS)	Notes
★	22.5+	The most dangerous road
★★	12.5 - < 22.5	
★★★	5.0 - < 12.5	
★★★★	2.5 - < 5.0	
★★★★★	< 2.5	The safest road

In general, the INA and iRAP methods have almost similar road attributes and coding criteria. However, there are differences between the two methods. The INA method is limited to assess the Star Rating for vehicles occupants only, whereas the iRAP can evaluate the star ratings for all road users, including vehicle occupants, motorcyclists, bicyclists, and pedestrians. Additionally, there are differences in the definition, range, and coding for several variables, such as speed limit and operating speed. For example, the INA method uses mean operating speed, whereas the iRAP method uses the 85th-percentile speed. Additionally, the INA method caps the speed limit at a maximum of 100 km/h, while the iRAP method allows for a maximum speed limit of up to 150 km/h.

Results

The SRS calculated using the INA method tends to be lower (indicating safer roads) compared to the iRAP method, as shown in **Figure 1**. This is consistent with the Star Rating results, which show that higher Star Ratings are more frequently observed using the INA method. This discrepancy may be attributed to differences in the attributes and coding used to calculate the SRS of the two methods. However, there is one segment where the INA Star Rating is higher than the iRAP Star Rating. Further analysis revealed that this segment features a steep downgrade slope on the passenger side, a hazard not present in any other segment.

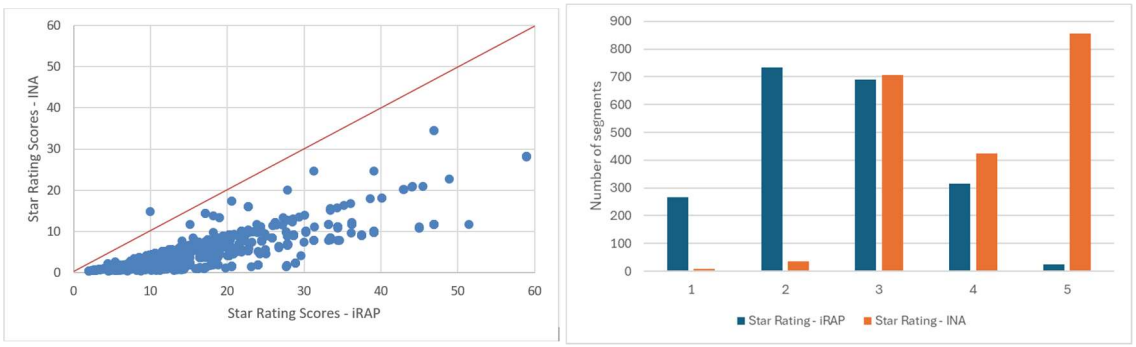


Figure 1. Comparison of SRS and Star Rating of INA and iRAP methods

The comparison of average total and FI crashes per million vehicle-kilometres segment between the INA and iRAP methods is presented in **Figure 2**, revealing notable differences between the results. The most significant discrepancies in the number of average total and FI crashes per million vehicle-kilometres segment are observed in the 1-Star and 5-Star segments. The figure also shows that the iRAP method exhibits a more consistent trend in relation to average total and FI crashes per million vehicle-kilometres, indicating that higher Star Ratings correspond to lower average crashes per million vehicle-kilometres. In contrast, using the INA method, the average total crashes per million vehicle-kilometres increase from 1-Star to 2-Star segments before decreasing from 3-Star to 5-Star segments. However, the average FI crashes per million vehicle-kilometres increase from 1-Star to 3-Star segments, after which they decrease. The iRAP method appears to provide more consistent results supporting the association that lower star ratings correspond to less safe roads (or higher crash rates).

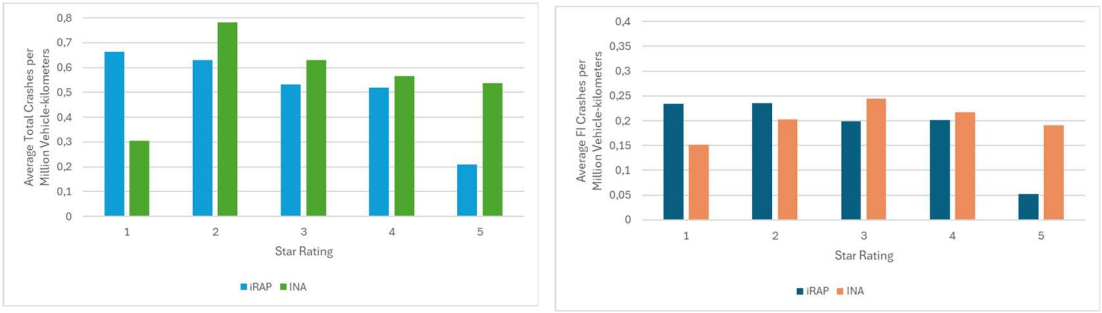


Figure 2. Comparison of total crashes and FI crashes of INA and iRAP methods

Benefit to road safety

Reducing fatalities and serious injuries is a global goal, with safer roads, including achieving a minimum 3-Star rating based on the iRAP method, being a key approach. While iRAP is widely used worldwide, Indonesia has adapted the method through the INA Star Rating method to better suit local road conditions. This research is valuable in assessing whether the adaptation of the iRAP method through the INA method can be used as a proxy to evaluate the road safety performance of Indonesian toll roads.

Implications for policy and/or practice

The research indicates that the results of the INA Star Rating method align with the safety performance of Indonesian toll roads. These findings could help the Indonesian government meet global standards for creating safer roads.

Conclusions

The iRAP Star Rating has been used globally as a standard for safer roads to reduce fatalities and serious injuries. The Indonesian government has adapted the globally recognized method to better suit local road conditions through the INA Star Rating method. While both methods share a similar concept, they differ in aspects such as the types of road users considered for rating, the definition of operating speed, and the range of speed limits and operating speeds. The findings reveal that for segments with similar road attributes, the INA Star Rating is generally higher than the iRAP Star Rating. Higher iRAP Star Ratings correspond to lower average crashes per million kilometres-segment. In contrast, using the INA method, the average total and FI crashes per million kilometres-segment increase from Star Rating 1 to Star Rating 2 (for total crashes) or Star Rating 3 (for FI crashes), after which they decrease. Further research is needed to conduct a sensitivity analysis of specific roadside hazards and other variables in both the INA and iRAP methods that most influence the SRS and Star Rating outcomes.

References

Ayuningtyas, K. N. S., Kusumawati, A., Pangestika, S. H., & Hadiyanti, I. (2024). The Relationships Between iRAP Star Rating Score and Various Safety Performance Indicators. *International Journal of Technology*, *15*(5). https://doi.org/10.14716/ijtech.v15i5.5726

GRI. (2022). Indonesian National Road Safety Plan

iRAP. (2022). *iRAP Coding Manual - Drive on the Left*. https://irap.org/irap-knowledge-base/download-irap-coding-manual-drive-on-the-left-edition-english/

iRAP. (2024). *iRAP Star Rating and Investment Plan Manual*. International Road Assessment Programme.

McInerney, R. E., & Fletcher, M. (2013). Relationship between Star Ratings and crash cost per kilometre travelled: the Bruce Highway, Australia.

PUPR. (2024). Guideline for Technical Instructions on Road Assessment using Star Rating. In (Vol. 11/SE/Db/2024). Jakarta, Indonesia: Ministry of Public Works and Housing.

Rahmita, D., Malkhamah, S., & Dewanti, D. (2020). Analisis Hubungan Hasil Penilaian Keselamatan Jalan dengan Tingkat Kecelakaan pada Ruas Jalan Pantura di Kota Tegal. *Journal of Civil Engineering and Planning*, *1*, 74. https://doi.org/10.37253/jcep.v1i1.801

WHO. (2021). *Global Plan. Decade of Action for Road Safety 2021-2030*. https://www.who.int/teams/social-determinants-of-health/safety-and-mobility/decade-of-action-for-road-safety-2021-2030#:~:text=In%20September%202020%2C%20the%20UN,deaths%20and%20injuries%20by%202030.

Applying connected vehicle speed data for AusRAP Star Rating assessments

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Abstract
Understanding operational speeds is critical for designing safer road networks. Connected Vehicles provides a new way of collecting dynamic, scalable speed insights that help proactively assess road network risk in AusRAP use cases. This session will explore how Connected Vehicle data was applied in an AusRAP project in Western Australia to understand operational speeds and apply star ratings for the state's entire road network. By integrating new data sources into AusRAP methodologies, we can evolve our safe system strategies, address past limitations, and improve protection for all road users.

Social Media Post
Discover how Connected Vehicle data is revolutionising AusRAP assessments in WA.

Introduction
Western Australia set a target to reduce road fatalities and serious injuries by 50–70% by 2030, aiming to eliminate these entirely by 2050. One key initiative is using AusRAP Star Ratings, which Main Roads Western Australia (MRWA) aims to apply to roads carrying 80% of the state's traffic by 2025. These ratings, on a scale from 1 to 5 stars, indicate a road's safety performance. A 5-star rating reflects the highest level of safety, with risk decreasing significantly as the star rating improves.

AusRAP is based on the globally recognised iRAP Star Ratings, endorsed by the United Nations. These ratings provide an objective way to assess safety by examining the physical characteristics of roads, traffic patterns, and speed data. This work is important because it allows for large-scale road safety star ratings, using an emerging dataset: Connected Vehicle speed data. Operational speeds is an important part of iRAP (International Road Assessment Program) assessment processes. Star rating scores are the sum of crash type scores, which are determined by 5 factors: likelihood, severity, operating speed, external flow influence, and median traversability (Figure 1).



Figure 1. Crash Type Scoring
Source: Main Roads Western Australia. 19th February 2025

Historically, operating speeds have been collected from tube counts sites. Operating speeds derived from Connected Vehicles are a unique dataset insofar as it is network-wide with the ability to view historical data that is road-matched to the underlying road infrastructure. For this particular project, Connected Vehicle data was obtained from Compass IoT (Compass).

Compass is a connected vehicle data aggregator. Compass' dataset comprises third-party Telematics Service Providers (TSPs) and data directly from vehicles themselves via Original Equipment Manufacturers (OEMs). They collect more than 5 million vehicle trips every month and over 90 million points every day, Australia-wide. More than 1.6 million vehicle trips are recorded every month in Western Australia alone.

The Compass dataset provided over 99% network coverage for the 198,002 road segments that were part of the assessment, including ramps, rotaries, and bus lanes. For the project, MRWA excluded heavy vehicles from the dataset and, for metropolitan areas, excluded congested time periods (i.e., AM/PM peaks from 8am-10am; 4pm-6pm), public holidays, and school holidays. Heavy vehicles were excluded because many are limited to 100km/h and this was felt to skew results downward in locations where private vehicles were travelling 110km/h. This ensured better alignment with private passenger movements rather than freight movements.

For the Project approximately 69.3 million attributes and attribute sub-categories were identified, recorded and tracked to enable Star Ratings to be generated for the road network. The project involved analysis of:

- 687 roads across eight management regions
- 16,043km of rural roads
- 3,121km og urban roads
- 835km of divided carriageway

Conference Theme

There are 3 ways this submission fits with conference themes of Equity, Elasticity, and Evolution:

1. By addressing road system resilience and future-proofing infrastructure by incorporating new and emerging data sets that can improve existing systems
2. By contributing to more robust Safe System approaches by providing data that can be applied to improve road safety for all road and road-side users, not just cars or motor vehicles
3. By providing leading indicators that can help reach government road safety targets of reducing fatalities and serious injuries on Australia roads, with the potential to repeat these benefits globally

Outcome of the Work

The project covered over 19,000km of national highways and state roads in Western Australia. It demonstrated the feasibility of large-scale Accelerated and Intelligent Road Assessment Program (AiRAP) safety coding, leveraging a combination of data sources—including real-world driving speeds from connected vehicles (Argus, 2025). AiRAP was developed by iRAP in 2019 as an extension of the original model to help improve access to and the application of emerging data sources such as LiDAR, telematics, Artificial Intelligence, and other data sources (iRAP, n.d). These insights support evidence-based decision-making and are a significant step toward meeting Western Australia's ambitious road safety targets.

Results and Findings

Speed data is a critical element of iRAP assessments. A combination of posted speed limits and operational speeds determine star ratings. The result of the project is that Connected Vehicle speed data has been demonstrated as a viable data source to map and measure operational speeds as an input in AusRAP star rating.

When compared with speed data collected from traditional tube count methods, Compass connected vehicle data was shown to have over 99% network coverage, including coverage on parts of the road network where tube count speed data cannot be collected due to limitations on where you can place the counters (i.e., connected vehicle data can measure speed through an intersection whereas tube counts can only be installed at a midblock). Connected vehicle data also allowed for passive data collection to measure changes dynamically and on dates where no formal counters were placed; information at short-term count sites is typically taken for 2-14 days and can vary in terms of it's availability.

The data also allowed for comparisons between MRWA's Integrated Road Information System (IRIS) speeds and Connected Vehicle speeds that more accurately reflected the speeds drivers may be doing, particularly around large rotary infrastructure (Figure 2).

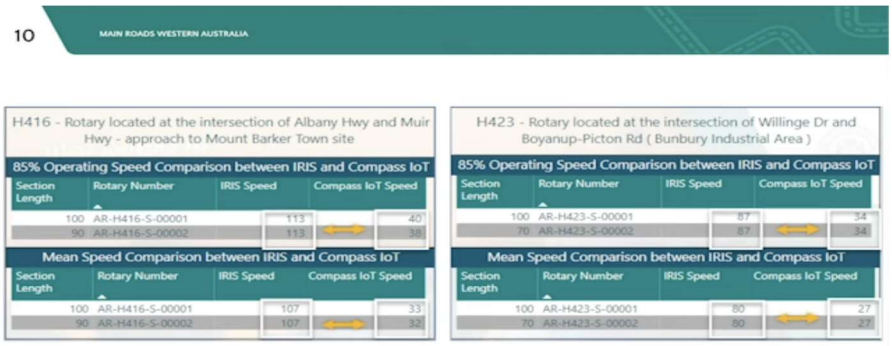


Figure 2. IRIS Speeds comparison with Connected Vehicle speeds at rotary locations
Source: Main Roads Western Australia

Compared to IRIS, Compass had 99.9% coverage compared to 90%. Despite the lower number of individual vehicles, the data had good speed profile alignment at 6 high volume Network Performance Sites (NPS), and a 2.2% penetration rate (Figure 3).

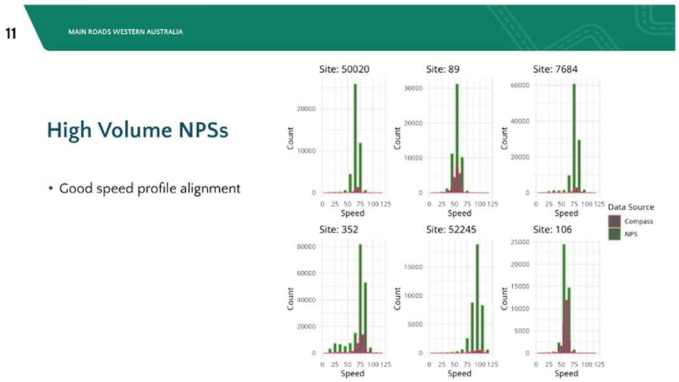


Figure 3. Comparison of Compass Speed data with Speed Counts at NPS
Source: Main Roads Western Australia

Similarly, the data had speed agreement typically within -/+10km/h (2 bands) and within -/+ 5km/h for higher volume NPSs (Figure 4).

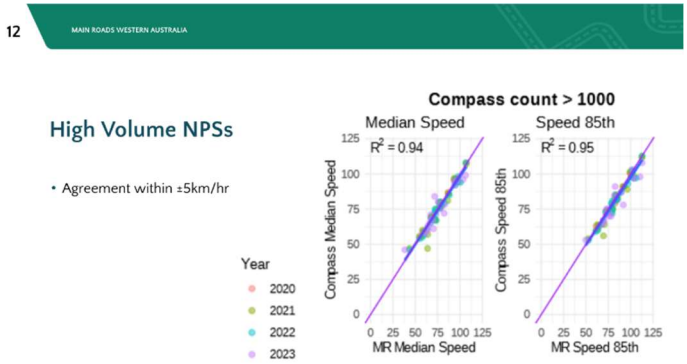


Figure 4. Comparison of Compass Speed data with Speed Counts at High Volume NPS
Source: Main Roads Western Australia

The project confirmed that connected vehicle speed data can be applied network-wide in AusRAP assessments. The method has also been adopted by the Road Safety Foundation in Wales, supported by the iRAP Global Technical Committee.

Benefits to Road Safety

Connected Vehicle data provides a passively collected and network-wide dataset that can both measure what is happening on the road network right now, as well as provide leading indicators into high-risk locations where a crash is likely to occur due to patterns of near-misses and friction loss. It benefits road safety by providing leading indicators of

high-risk locations, allowing practitioners to identify where a crash is likely to happen to mitigate it, and to effectively monitor before-and-after effects of any interventions.

Implications for Policy and/or Practice

There are 3 key implications for policy and practice:

1. A new, scalable, and reliable method of collecting operational speed data to include in iRAP road safety star rating systems.
2. The ability to collect data on parts of the road network that are incompatible with traditional methods of data collection, such as tube counts. For example, the ability to collect operational speed data on bus lanes, off/on-ramps, the middle of intersections, and rotaries.
3. New datasets that can be included in iRAP assessments in the future, such as g-force, braking, and swerving data.

Conclusions

Connected Vehicle speed data can be incorporated into network-wide AusRAP assessments for accurate operational speed measurements and network-wide star safety ratings. This is beneficial for AusRAP studies and road safety because connected vehicles provide a scalable, passively collected, and reliable method of collecting speed information on parts of the road network that are incompatible with hardware collection methods (i.e., roundabouts, the middle of intersections, and off/on-ramps, and; it provides new data variants that were not collected by other methods such as g-forces, braking, and swerving information.

References

Argus, F. (2025, February 19). *AusRAP Star Ratings: Operational Speed using Compass IoT* [Video]. Compass IoT Learning Hub. https://support.compassiot.com.au/en/fritha-mrwa

iRAP. (n.d.). AI-RAP. International Road Assessment Programme. https://irap.org/project/ai-rap/

Evaluating Ryda with content mapping and process reviews

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Abstract
This study reports on an evaluation of the Road Safety Education Limited's (RSE's) high school road safety education program, Ryda. The study, comprising content mapping and process reviews, provides insight into the extent to which the Ryda program content aligns with evidence-based conceptual underpinnings drawing upon appropriate pedagogies, behaviour change frameworks, and Good Practice Guidelines of road safety education. The evaluation also incorporated reviews of existing evaluation tools which RSE implements to understand the impact of the Ryda program. To enhance the robustness of the content mapping tasks, purpose-devised matrices operationalising the aforementioned pedagogies, frameworks, and guidelines were utilised. The findings supported the Ryda program and its associated resources aligning consistently and comprehensively with the key components as identified in the matrices. Specifically, the completed matrices highlighted the extent to which aspects crucial to influencing attitudinal and behavioural change were addressed by the Ryda program and its associated resources.

Social media post
Content mapping review of RSE's Ryda program shows it addresses crucial attitudinal and behavioural factors leading to positive road safety engagement by young people.

Background
Each year, statistics demonstrate that young people are over-represented in road crash and fatalities (BITRE, 2023). School-based road safety education programs focus on developing knowledge of risks and encouraging positive road user-related attitudes and behaviours among young people. As reported by Assailly (2017, p. s24), "…[road safety education] may have some positive effects if good practices are adopted, if it is part of a lifelong learning process and if transmits not only knowledge but also "life-skills" (or psycho-social competences)".

RSE provides the Ryda program to schools across Australia and New Zealand. Ryda is a whole-school approach which features a workshop comprising six different sessions held in small classroom sized groups. The sessions are led by a team of community sector specialists professionally trained to facilitate Ryda.

This research (commissioned by RSE and funded by the Queensland Government's Community Road Safety Grants program) was conducted by an independent research organisation. The project brief specified that impact and/or outcome evaluations were beyond the funding scope. The approach undertaken in the current research was nevertheless robust, comprising content mapping and process reviews which sought to:

- Identify appropriate pedagogies in road safety education together with Good Practice Guidelines on road safety education and map the Ryda program content against these to determine the extent of alignment;
- Review Ryda's existing evaluation tools, implemented with students and teachers, to determine how well they measure long-term knowledge, attitude and behaviour change; and
- Review Ryda processes from registration by organising teachers through to Ryda governance structures and approach to annual review to determine extent to which the program undergoes continuous improvement and may respond to regulatory, societal, or environmental changes.

Conference Theme
Addressing the conference theme of 'Evolution', this study is focused upon the important role played by school-based road safety education programs as a key countermeasure to encourage young people to adopt safe road user-related attitudes and behaviours. Independent robust evaluation of such programs are key to understanding their effects, and to gain insight regarding program elements that could be refined to optimise their potential benefits for road safety.

Method
To achieve the aims, the research comprised of four overarching tasks: (1) a literature review, (2) a review of Ryda program's content, (3) a content review of Ryda's existing evaluation tools including a sample of student and teacher

responses' to such tools, and, finally, (4) a quality assurance review in terms of how Ryda program content and processes are monitored and improved based on feedback. This presentation focuses upon tasks (2) and (3), although findings from the literature review are highlighted to the extent that they informed the development of two purpose-built matrices. These matrices guided subsequent mapping in these two tasks to ensure the robustness of such mapping in terms of drawing upon the extant evidence base. The first matrix underpinned the content mapping of program (2) while the second matrix underpinned the content mapping of the evaluation tools (3). The study received ethics approval by the QUT, Approval No: 8303).

Results

The literature review outlined recent evidence about road safety education, covering aspects such as the important role of theory in guiding program development and evaluation, identifying contemporary frameworks and guiding principles related to program content design, and providing examples of road safety programs that have been devised and/or evaluated in accordance with such frameworks. The first purpose-built matrix was developed consisting of constructs drawn from three key frameworks: (i) Queensland Government Transport and Main Roads' (TMR) Good Practice Guidelines on Road Safety Education (Qld Government, n.d), (ii) the Kraiger et al. (1993) framework of cognitive, skill-based, and affective theories of learning outcomes, and (iii) the Goals for Driver Education (GDE) framework (Bates et al., 2019), as well as attitudinal and behavioural constructs from social psychological models of behavioural prediction, including intentions and willingness as espoused within Ajzen's Theory of Planned Behaviour (TPB; Ajzen, 1991) and Gibbons et al.'s Prototype Willingness Model (PWM; Gibbons et al., 1998). The Extended Parallel Process Model (EPPM; Witte, 1992) was also included as a key conceptual framework that ascribes such a critical role to the provision of useable strategies in influencing behavioural change via education-based strategies (see Lewis et al., 2010). This matrix informed the mapping of the Ryda program content for its alignment with the evidence-base (Task 2).

To undertake Task (2), this matrix was produced within an excel spreadsheet with cells subsequently populated with commentary noting the presence and extent of inclusion of key constructs that were identified in Ryda program content. The size of this matrix precludes it being able to be incorporated herein but to illustrate, Figure 1 exemplifies the outcomes of the mapping exercise as it related to mapping the program against the TMR Good Practice Guidelines on Road Safety Education. Specifically, in the figure, the constructs in the upper-most row of the Figure are drawn from the TMR Good Practice Guidelines on Road Safety Education. The rows comprise the various Ryda program materials that were reviewed. This process was repeated for these same five Ryda program materials across key constructs from each of the aforementioned frameworks identified as having informed our purpose-devised matrix (and thus separate figures were prepared in relation to each of those frameworks). Through the colour-coding, Table 1 shows that key constructs as outlined in the TMR Good Practice Guidelines were identified as having been addressed within the various other Ryda program resources that were reviewed. The extent to which such aspects were addressed was reviewed further within detailed notes made in relation to each Ryda program material/resource.

Table 1. Visual summary of mapping of the Ryda program materials mapped relative to the TMR Good Practice Guidelines on Road Safety Education. Note: lower coverage of constructs in Pre-Ryda Discoveries is by design.

	Cognitive risk	Physical risk	Social environment risk	Speeding risk	Fatigue risk	Seatbelt risk	Distraction (non-phone/ device)	Alcohol risk	Drug risk	Mobile phone/ device risk
Facilitator's Training Manual										
Pre-Ryda Discoveries										
Ryda Revision Course										
Teacher Online Portal										
Other Website Resources										

To undertake Task (3), the second purpose-devised matrix was created based on key constructs identified in the TPB. PWM, and EPPM. This mapping task examined the extent the RSE's existing evaluation tools may be able to detect behaviourally-pertinent indicators of change in response to program participation (in the case of students, and the observation of the program and students' responses to it by attending teachers). Figure 2 overviews the outcomes of the content mapping of the RSE's various existing evaluation tools. The mapping revealed behaviourally-pertinent

indicators of change were identified across the various evaluation tools that RSE implement with students and teachers. Overall, the findings suggest that if a construct was not present in one survey, it appeared to be captured in another.

Figure 2. Visual summary of mapping of the Ryda evaluation tools

	Theory of Planned Behaviour					Prototype Willingness Model				Extended Parallel Process Model			
Survey	AT	SN	PBC	IN	Beh	PV	DN	PROT	WILL	SEV	SUS	RE	SE
Attending teacher													
Parent													
Student (2a post)													
Student (2b pre)													
Student (2b post)													
Student (2b follow-up)													

(AT = attitudes, SN = subjective norm, PBC = perceived behavioural control, IN = intentions, PV = perceived vulnerability, DN = descriptive norm, PROT = prototypes, WILL = willingness, SEV = perceived threat: severity, SUS = perceived threat: susceptibility, RE = perceived efficacy: response efficacy, SE = perceived efficacy: self-efficacy).

Benefits to road safety

Key road safety initiatives must undergo evaluation to understand whether they are functioning as intended and identify aspects requiring revision to optimise the benefits for road safety. This study, implementing content mapping and process reviews, provided insight into the extent to which, Ryda, a high school road safety education program, has been designed and is implemented in accordance with evidence-base. This evidence is key to on-going efforts to enhance education-based initiatives to reduce road trauma among young adults, an over-represented cohort.

Implications for policy and/or practice

Evaluation is key to understand how a road safety intervention or program is functioning and if indeed it is functioning as intended and whether revisions may be needed to optimise effects. With high-school road safety education comprising a long-standing and key component of efforts to prepare young people for interacting safely within the road system, it is key that research such as this is conducted to determine program effects.

Conclusions

While impact and outcome evaluations were outside of scope of the current research, RSE were committed to gaining insights into the Ryda program's alignment with the evidence-base. Thus, an independent research organisation was commissioned to assess Ryda's alignment with behaviour change models and contemporary guidelines of best practice in road safety education. With purpose-devised matrices incorporating key constructs from TMR's Good Practice Guidelines, Kraiger et al.'s learning outcomes framework, the GDE framework, as well as social psychological models of behaviour prediction including the TPB, PWM, and EPPM, the results highlighted the Ryda program's adherence to such frameworks with key constructs identified as being present and addressed across program resources.

References

Ajzen, I. (1991). The TPB. Organizational Behavior and Human Decision Processes, 50, 179-211.

Assailly, J. P. (2017). Road safety education: What works? *Patient Education and Counseling*, 100, S24-S29.

Bates, L., Hawkins, A., Rodwell, D., Anderson, L., Watson, B., Filtness, A. J., & Larue, G. S. (2019). The effect of psychosocial factors on perceptions of driver education using the goals for driver education framework. *Transportation Research Part F, 66*, 151–161.

Bureau of Infrastructure and Transport Research Economics (BITRE), 2023, *Road Trauma Australia 2022 statistical summary*. BITRE, Canberra ACT. https://www.bitre.gov.au/sites/default/files/documents/road_trauma_2022.pdf

Gibbons, F. X., Gerrard., et al. (1998). Reasoned action and social reaction: Willingness and intention as independent predictors of health risk. *Journal of Personality & Social Psychology, 74*, 1164-1180.

Kraiger, K., Ford, J.K. and Salas, E. (1993) Application of Cognitive, Skill-Based, and Affective Theories of Learning Outcomes to New Methods of Training Evaluation. *Journal of Applied Psychology, 78*, 311-328.

Lewis, I., Watson, B., & White, K. (2010). Response efficacy: The key to minimising rejection and maximising acceptance of emotion-based anti-speeding messages. *Accident Analysis and Prevention, 42*(2), 459–467.

Queensland Government. (n.d.). Good Practice Guidelines on Road Safety Education, Early Adolescence (12-15 years) ***AND*** Adolescence to Young Adulthood (16-24 years). Retrieved from *Good Practice Guidelines on Road Safety Education* - Dataset – Publications. Queensland Government.

Witte, K. (1992). Putting the fear back into fear appeals: The extended parallel process model. *Communication Monographs, 59*(4), 329–349.

The RACQ Streets Ahead program: An impact evaluation

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Abstract
Primary school children are vulnerable road users. School-based road safety education programs aim to reduce fatalities and injuries among youth by targeting knowledge and psychosocial risk factors. Despite their important role, many programs may not be subject to comprehensive, independent evaluations. The RACQ's Streets Ahead program targets primary school-aged children (with levels of the program specifically targeting different age groups). The program consists of interactive sessions delivered in Queensland primary schools by professional facilitators who are also qualified teachers. Informed by an extended Theory of Planned Behaviour, this study assessed the 'Level 4' program for Year 5-6 students using a cross-sectional survey with intervention (post-program) and control (baseline, pre-program participation) groups. Preliminary results indicate that participation strengthens attitudes, subjective norms and anticipated regret in key road safety scenarios with some impact also upon perceptions of behavioural control. These findings provide support for the program influencing some key behaviourally-pertinent constructs.

Social media post
Preliminary findings indicate attendance at a primary school-based road safety education program positively impacts students' subjective norms, anticipated regret, and attitudes towards road safety.

Introduction
School-based road safety education programs typically seek to increase road safety knowledge and target psychosocial factors that enhance attitudes and behaviours to reduce risk for young people (Lewis et al., 2021). Ultimately, these programs seek to reduce the number of fatalities and injuries of young people on our roads (Raftery & Wundersitz, 2011). Despite the important role these programs are intended to play in enhancing road safety among young people, comprehensive evaluations of such programs are relatively rare. The RACQ offers a suite of road safety education programs which they deliver across schools in Queensland; one of these programs, the focus of this presentation, is the RACQ's Streets Ahead program targeting primary school students. The Streets Ahead program is divided into four 'levels' covering Prep to Year 6 (see Table 1), with each level focusing on age-appropriate road safety behaviours and contexts. RACQ facilitators, who are also qualified teachers, attend primary schools in person and present the Streets Ahead program to groups of students. Programs run for 45 minutes and are purposefully devised to be informative and engaging, using a mixture of audio/visual stimuli and participant involvement, in accordance with evidence-based practice. While the RACQ's Docudrama program, one of the RACQ's high school programs has been evaluated (e.g., Lewis et al., 2021), the Streets Ahead program has not yet been investigated. Thus, as part of a larger program of research undertaken by an independent research team, the aim of the current study was to conduct an impact evaluation of the Streets Ahead program, to ascertain its impact upon key behaviourally-significant outcomes for program participants. At the time of writing, the overall program of research was ongoing and, as such, the focus of this abstract is based on preliminary results related to evaluation of Level 4 of the Streets Ahead program. The program of research will be finalised by mid-2025 and it is our intent is to present final results at the time of the conference.

Table 1. The Streets Ahead program levels

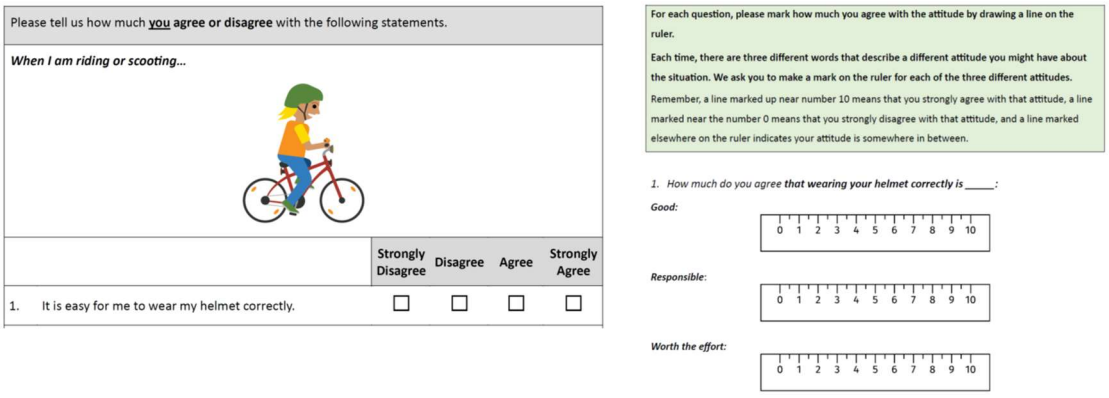
Program level	Year cohort	Program target age range (years)	Program focus
1	Prep-Year 1	5-7	Safe pedestrian, safe playing, safe passenger behaviours.
2	Year 2	6-8	Safe pedestrian, safe riding, safe passenger behaviours.
3	Year 3-4	7-10	Safe riding behaviours and bike maintenance.
4	Year 5-6	9-12	Safe passenger, safe pedestrian, and safe riding behaviours.

Conference Theme
This study contributes to the theme of Evolution through reporting the results of an impact evaluation of the RACQ's Streets Ahead program on program participants. With evaluation critical to ensuring key road safety initiatives, such as school-based road safety education programs, are achieving their intended objectives as well as identifying areas for

potential revision, this research seeks to optimise benefits for road safety. Additionally, the study addresses the Equity theme by investigating ways to ensure that children, who are vulnerable road users, receive road safety education that equips them with the knowledge and skills necessary to engage in safer road use behaviours.

Method

Participants consisted of primary school students attending schools in Southeast Queensland. A cross-sectional study design was implemented with responses gained via a self-report paper-based survey. For the Level 4 evaluation, schools were randomly allocated to a control group whereby student participants completed the survey *before* participating in the program and an intervention group comprising students who completed the survey *after* participating in the program. The surveys were administered by members of the research team using a verbal script to take students through the survey items. These data collection sessions occurred during school hours and at times convenient for the schools. The survey's design was underpinned by an extended Theory of Planned Behaviour (TPB; Ajzen, 1991). Students were asked to indicate that they consented to participate (following the research team having gained Principal consent as well as parental/guardian consent) and to select their age and gender. Next, the survey provided three large purpose devised images devised by a professional graphic designer that depicted road safety contexts applicable to young people: namely, 'when you are riding your bike or scooter', 'when you are a passenger in a car', and 'when you are walking near a road using a device, like a mobile phone or gaming device'. Survey items in the first context focused on helmet wearing behaviours, items in the second context focused on behaviours that distract drivers, and items in the third context focused on paying attention to surroundings. Participants were instructed to look at the image and then think about each context when responding. Using 4-point Likert-type scales (strongly disagree – strongly agree), items investigated subjective norms in relation to Parents, Teachers and Friends (2 items each assessing whether these important others would approve of the individual student engaging in the behaviour described), Perceived Behavioural Control (PBC; 2 items), and anticipated regret (2 items), Attitudes were investigated using visual analogue items which asked participants to mark a line on a 10cm 'attitude ruler' indicating the strength of their agreement with a statement such as, "*how much do you agree that wearing your helmet correctly is: good/responsible/worth the effort"* (3 items per context). Each item stem was repeated for each context. For statistical analyses, the length on the attitude ruler where a line was marked (e.g., 6cm) was converted into a score on 10-point scale (e.g., score of 6 out of 10). The study was approved by the [removed for blind review] Human Research Ethics Committee (Approval No: 7108) and the Queensland Government's Department of Education.



(i) Likert-type (ii) Attitude ruler

Figure 1. Example items from surveys: (i) Likert-type and (ii) 'attitude ruler' examples from level 4 survey.

Results

Eighty-one students were from one school and assigned to the intervention group while the remaining 47 students were from a second school and were assigned to the control group. Most participants (90%) were aged 10 or 11 years of age with 52% identifying as boys. Fisher-Freeman-Halton Exact Tests were conducted to compare proportions of age and sex between the experimental conditions, with no significant differences found in age (p = .542) or sex (p = .099). A series of independent groups t-tests were conducted to compare the intervention and control groups on the extended TPB variables in each context. The Benjamini-Hochberg procedure was applied to the alpha level to account for multiple tests. Several statistically significant differences between the group means were revealed (see Table 2). Subjective norms-Teacher and anticipated regret in relation to the 'while riding or scooting' context were significantly greater in the intervention group than in the control group. Attitudes, subjective norms in relation to both teachers and friends, and anticipated regret were significantly greater in the intervention group when considering the 'when you are a passenger in a car' context. Subjective norms about friends and anticipated regret were significantly greater in the intervention group relative to the control group in the 'when you are walking near a road using a device, like a mobile

phone or gaming device' context. Attitudes and subjective norms were also significantly higher in the 'device' context. In general, medium effect sizes were indicated where significant differences were found.

Benefits to Road safety

Primary school-aged children may experience harm on the roads due to their small stature, lack of visibility to others, and under-developed cognitive and perceptual capacity, as well as limited road safety knowledge, skills and experience (Horsnell et al., 2021). The current study benefits road safety by examining a prominent school-based road safety education program to gain a greater understanding of its impact.

Implications for policy and/or practice

Overall, the results suggest that attendance at the RACQ Streets Ahead Level 4 program is associated with some positive effects on key psychosocial factors including attitudes, subjective norms, and anticipated regret known to be important influences of intentions and subsequent behaviour. With differences detected between intervention and control group participants on such well-established predictors of intention, this evaluation offers insight into how the program is functioning in terms of its influence upon and potential strengthening of young people's beliefs. The findings highlight the importance of undertaking robust, theoretically-underpinned research evaluations to understand the effects of education programs as a key initiative intending to improve road safety of children and young people.

Table 2. Results of *t*-tests comparing Streets Ahead Level 4 intervention and control groups on TPB variables

	Intervention group mean (SD)	**Control group mean (SD)**	**t (df)**	**p**	**p-adj**	**d**
Riding and scooting/Helmet						
Attitudes	9.32 (1.35)	8.60 (1.97)	2.21 (69.51)	.030	.070	.5
Subjective norms -Parent	3.68 (.54)	3.57 (.54)	1.12 (126)	.265	.371	.2
Subjective norms – Teacher	3.39 (.57)	2.89 (.88)	3.90 (126)	<.001	.007	.7
Subjective norms – Friend	3.05 (.61)	2.78 (.89)	1.85 (71.16)	.068	.119	.4
PBC	3.66 (.49)	3.71 (.43)	-.61 (126)	.541	.541	-.1
Anticipated regret	3.24 (.72)	2.84 (.77)	2.95 (126)	.004	.014	.5
Intentions	3.73 (.51)	3.67 (.58)	.65 (126)	.514	.600	.1
Car passenger/Distract driver						
Attitudes	9.33 (1.37)	8.52 (1.75)	2.73 (79.09)	.008	.014	.5
Subjective norms -Parent	3.73 (.49)	3.56 (.59)	1.77 (126)	.079	.111	.3
Subjective norms – Teacher	3.39 (.63)	2.86 (.94)	3.47 (70.99)	.001	.007	.7
Subjective norms – Friend	3.15 (.62)	2.55 (.90)	4.02 (71.77)	<.001	.004	.8
PBC	3.46 (.60)	3.33 (.54)	1.19 (126)	.237	.277	.2
Anticipated regret	3.36 (.67)	2.90 (.67)	3.72 (126)	<.001	.002	.7
Intentions	3.41 (.76)	3.32 (.63)	.67 (126)	.503	.503	.1
Using device/pay attention						
Attitudes	9.33 (1.63)	8.38 (2.56)	2.28 (67.98)	.026	.046	.5
Subjective norms -Parent	3.74 (.50)	3.67 (.43)	.81 (126)	.422	.422	.1
Subjective norms – Teacher	3.44 (.67)	3.13 (.86)	2.33 (126)	.021	.049	.4
Subjective norms – Friend	3.30 (.61)	2.82 (.89)	3.31 (71.66)	.001	.007	.7
PBC	3.48 (.55)	3.24 (.71)	1.96 (78.49)	.054	.076	.4
Anticipated regret	3.33 (.66)	2.80 (.86)	3.67 (77.46)	<.001	.004	.7
Intentions	3.63 (.55)	3.45 (.65)	1.70 (126)	.092	.107	.3

Note. p = Conventional significance value; p-adj = Benjamini-Hochberg adjusted significance value; d = Cohen's d; Attitudes measured on 10-point scale; all other items measured on a 4-point scale.

Conclusion

This study is part of a larger program of research investigating school-based road safety education which has the potential to be of great benefit for road safety by influencing psychosocial factors implicated in the performance of both safe and risky road behaviours by youth. The findings, while preliminary, indicate that the RACQ Streets Ahead Level 4 program is associated with some positive impacts on primary school students who participate in the program. Overall, the findings highlighted that (with some variation across contexts), it was attitudes, subjective norms, and anticipated regret which significantly differed between intervention and control groups such that the intervention group reported more favourable and positive views towards safer behavioural options. Thus, the findings offer some support for the positive impacts of the program on well-established predictors of subsequent behavioural intention.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50* (2), 179-211.

Horsnell, G., Senserrick, T., & Twisk, D. (2021). Developing a scaffolded, structured approach to road safety education in schools. *Journal of Road Safety, 32*(2), 41–48.

Lewis, I., Watson, B., & Ho, B. (2021). Slow down! Get off that phone! The impact of a high school road safety education program in influencing whether a young person speaks up to a risky driver. *Transportation Research Part F, 78*, 353-368.

Raftery, S. J., & Wundersitz, L. N. (2011). The efficacy of road safety education in schools: A review of current approaches. *CASR Report Series (CASR077).*

Van Schagen, I. & Rothengatter, T. (1997). Classroom instruction versus roadside training in traffic safety education, *Journal of Applied Developmental Psychology, 18*(2), 283-292.

Victoria's "Safe Local Roads and Streets Program" for Local Governments

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Abstract
Victoria's ambitious road trauma reduction targets are challenged by the high rate of serious injuries on local roads, managed by Local Governments (LG). The Safe Local Roads and Streets Program (SLRSP) addresses this issue through a $210 million investment by the Transport Accident Commission (TAC). The program funds LGs to implement Safe System infrastructure upgrades, enhance local road safety capability, and receives support from the Department of Transport and Planning. SLRSP prioritises high-risk areas like high-speed local roads, intersections, and vulnerable road users, employing evidence-based and best practice Safe System interventions. The SLRSP represents a commitment to improving local road safety by building LG capacity through training, tools, and resources. Engagement with LG has focused on risk assessment and project prioritisation, with a phased rollout across all Victorian LGs. The program's evaluation will assess both short-term treatment effectiveness and long-term impacts on trauma reduction and TAC claims costs.

Social media post
The Safe Local Roads and Streets Program is investing $210m to improve local road safety in Victoria. This initiative will fund safer infrastructure, boost local government capabilities, and aim to reduce road trauma.

Introduction
The Victorian Government aims to halve road deaths and reduce serious injuries by 2030.

Victoria's local road network covers approximately 132,000 kilometres. Local Governments (LGs) are responsible for designing, building, and maintaining local roads and streets in their municipalities. With approximately 40% of MAIS 3+ (Maximum Abbreviated Injury Scale) injuries occurring on local roads, more investment is needed to improve the safety of local roads and streets and to help meet Victoria's trauma reduction targets.

In 2022, the Victorian Government approved the funding allocation of $210 million, through the Transport Accident Commission (TAC), to form the Safe Local Roads and Streets Program (SLRSP). The program is being delivered from 2023 to 2027, with:

- $200 million to fund LGs to start the transformation of local government road safety infrastructure,
- $10 million to grow local government capacity and capability, and
- Support from the Department of Transport and Planning (DTP) to assist local government to co-ordinate road safety activity at a community level.

SLRSP Objectives
The key objectives of the SLRSP are:

a. Implement Safe System transformation of LG roads and streets, resulting in a reduction in:
   - fatal and serious (MAIS3+) injuries on local roads.
   - TAC claims life costs.
b. Enhance or build Safe System capacity and capability in local government and other community-based organisations.
c. Provide robust, evidence-based infrastructure planning tools for self-use by local government.

Furthermore, the capacity of the 79 LGs across Victoria to improve the safety of their local roads varies considerably and is influenced by:

- The ability of LG engineers to identify the transformations required to improve safety.
- The willingness of LGs to prioritise Safe System treatments and transformations.
- Adequate funds to invest in transformational Safe System treatments.

- Community support for change, especially to speed settings.

The program objectives meet the conference themes of ‘equity’ and ‘evolution’ as:

- Equity: every LG in Victoria is provided guaranteed funding up to $2 million irrespective of their population, size of road network, road safety risk, etc. This ensures that the less-resourced LGs and their communities do not continue to miss out on funding opportunities by ‘means tested’ eligibility criteria.
- Evolution: the SLRSP builds on previous road safety programs by requiring every project to address crash severity in some way. Treatments that only reduce crash likelihood must be combined with treatments that reduce crash severity. In addition, the SLRSP provides support in the form of consultants to help councils with low resources participate in the program, and access to training courses to uplift capability so that they can operate more independently in the future.

Targeted Strategic Investment Areas

The focus on investment will be on the types of road and streets that have been shown to experience a substantial level of severe road trauma, such as high-speed local roads, all intersections and low speed and mixed-use roads and streets with vulnerable road users.

To support all LGs in Victoria to work on systemic and risk-based assessment of their network, and to invest in Safe System end states, each LG in Victoria is allocated $2 million in non-competitive funding for prioritised projects.

Program Rollout and Local Government Engagement

To provide tailored support to LGs, the SLRSP staged the rollout of funding across seven engagement rounds. The engagement rounds started from late 2023 and ended in March 2025. This allowed for the delivery of the program to improve over time and for LGs to be involved when they have capacity to deliver, especially after Victoria’s flood recovery program.

Local Government engagement round included an initial workshop to introduce the program, provide a high-level overview of road safety initiatives, and facilitate collaborative network risk assessments. This session also allowed participants to ask questions and provide feedback. To further support project development and minimise rework, follow-up mini workshops are conducted to check in, address challenges, and refine project outcomes.

A LG reference group was also established with LG representatives to guide program development and support.

Capacity and Capability Building

Program Development and Delivery Support

The program enables LGs to access project development consultants, directly engaged by TAC, to provide tailored support. This assistance is particularly valuable for LGs with limited resources or capacity to develop a substantial pipeline of road safety projects. The consultants also offer guidance and mentorship in delivering road safety interventions that may be new or innovative within an LG’s jurisdiction. Additionally, LGs can seek support from the DTP for tendering and construction, addressing delivery capacity constraints.

Capability Building

In addition, a series of subsidised Safe System Training sessions has been provided to LGs in parallel to the program. More than 150 LG officers have been trained to date. An ARSC Victorian LG Area scholarship backed by TAC provided opportunities for LG professionals to engage and network at the 2024 Australasian Road Safety Conference in Hobart. Road Safety, Speed Management and Active Transport master-class workshops will be conducted to support LGs in enabling community and stakeholder buy-in for transformative road safety projects.

Road Safety Tools

A series of tools was provided to LGs to enable them to identify and prioritise road safety risk locations, such as the LG Trauma Fact Sheets, Collective Risk Report, Infrastructure Risk Rating, Spatial Applications and Compass IoT.

This series of capability building initiatives and tools supports the LGs’ ability to implement transformative road safety infrastructure and demonstrate its benefits to their community and councillors.

SLRSP Projects

Working with LGs, typical interventions identified so far are:

a. Speed limit reviews and reductions to Safe System speeds, including area wide speed limit changes.
b. Improved pedestrian and cyclist safety such as wombat crossings, separated cycling infrastructure and traffic calming.
c. Intersection Improvements such as roundabouts and raised intersections.
d. Transformation of residential street with traffic calming, road dieting, 30-40 km/h zones in residential areas and improved safety around school zones.

Flagship Project – Yarra 30km/h Zone Trial

In 2018, the City of Yarra initiated a 30km/h speed limit trial in Fitzroy and Collingwood, driven by the goal of enhancing road safety, particularly for vulnerable road users like pedestrians and cyclists. The trial aimed to reduce fatalities and injuries, protect vulnerable populations, and yield environmental and community benefits, including reduced emissions, increased active transportation, and enhanced social connectedness. The positive results of this initial trial led the LG to propose a significant expansion of the 30km/h zone, encompassing major streets and tram corridors. This expansion is grounded in a pre-trial study that meticulously examined road safety strategies, community sentiment, and traffic data, ensuring a robust foundation for the project.

The expanded 30km/h zone trial is seen as a transformative step towards creating safer, more liveable urban spaces, potentially serving as a model for other cities. Its evaluation will encompass various aspects of road safety, travel times, community sentiment, and urban liveability, providing vital data for future urban planning and road safety policies. Beyond safety, the trial aims to improve urban life quality by fostering a calmer street environment, encouraging active transportation, and boosting local economies through increased foot traffic. The comprehensive evaluation of the expanded trial will be crucial in assessing the full impact of the 30km/h speed limit and informing future decisions.

Program Evaluation

The SLRSP Evaluation Framework provides a structured approach to assessing the program, employing both short-term and long-term evaluations. Short-term evaluations focus on immediate treatment effectiveness and alignment with Safe System principles, especially on new or novel interventions, allowing for timely program adjustments. Long-term evaluations measure the program's success in reducing TAC claims and eliminating severe injuries, utilising risk-based data like crash risk exposure and travel speeds to track progress. This dual approach aims to ensure both immediate and sustained improvements in local road safety.

Program’s Expected Benefits and Outcomes

By strategically investing in local road safety infrastructure and empowering LGs with increased road safety capability, the program aims to create safer local environments for their community. This will be achieved through the implementation of Safe System transformations, focusing on high-risk areas such as high-speed local roads, intersections, and low-speed mixed-use areas with vulnerable road users.

SLRSP is intended to generate valuable findings that will inform future road safety policy and investment strategies. The program emphasis on evidence-based interventions, cost-effectiveness, and Safe System principles will provide insights into effective road safety solutions and expects to reduce fatal serious injuries and TAC claim costs. By evaluating the program's impact and identifying innovative practices, the SLRSP will contribute to building capacity and capability in LGs and support the ongoing improvement of road safety across Victoria.

Findings and Learnings to date

The SLRSP has met with all 79 Councils separately to hold the initial introductory workshop. It was an opportunity to meet with Council officers in person and at their office to introduce the program, provide a high-level overview of road safety initiatives in Victoria, and to facilitate collaborative network risk assessments. Feedback from councils has been overwhelmingly supportive, with the program being seen as valuable and tailored to the needs of Councils.

80% of Councils opted for program support for project development, indicating limitations in internal resources as well as capability challenges for some.

The ability and desire to deliver the funded infrastructure in-house has been much higher, with only one Council so far opting to receive support from DTP to deliver their safety projects.

The Program has identified that Councils with road safety strategies, adequate resources, or those with just one road safety champion on-staff, demonstrate a greater capacity to develop and deliver high-benefit projects.

The types of treatments funded so far include raised priority crossings, local area traffic calming, compact roundabouts and area-wide and route-length speed limit reductions.

Seatbelt enforcement in NSW: evolving a life-saving camera program

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Abstract
Transport for NSW has adapted the world-first Mobile Phone Detection Camera Program to enforce seatbelt offences using the same cameras that are successfully driving down the rate of illegal mobile phone use in NSW. To reduce road trauma, Mobile Phone and Seatbelt Detection Cameras across NSW now detect whether drivers and passengers are wearing a seatbelt incorrectly, or not at all. While not the first jurisdiction to introduce automated seatbelt enforcement, NSW learned from others' experiences and adapted the program to suit NSW. With no warning period, penalties have applied for camera-detected seatbelt offences since July 2024. The infringement rate of drivers not buckling up correctly halved within six weeks. However, spikes in the number of passengers not wearing their seatbelt correctly have occurred each school holiday period. Public communications are evolving, and privacy measures being enhanced. NSW is sharing our experience, encouraging collaborative relationships across Australia and the world.

Social media post
Seatbelt Detection Cameras across NSW aim to reduce road trauma by encouraging drivers and passengers to wear their seatbelt correctly, Transport has built on the success of the mobile phone detection camera program and learned from other jurisdictions to evolve the program design throughout implementation and delivery.

Introduction
In NSW, each year on average there are around 32 drivers and passengers killed and 84 seriously injured who were not wearing available seatbelts (2019-2023). In NSW, the percentage of vehicle occupant fatalities where an available seatbelt was not worn has fluctuated between 13 per cent and 19 per cent between 2019 and 2023. Most deaths (86%) and serious injuries (65%) when not wearing an available seatbelt occurred in country areas (2019-2023). Aboriginal people were overrepresented in deaths (19%) and serious injuries (19%) in motor vehicles involving seatbelt non-use.

The 2026 Road Safety Action Plan committed to expanding the use of existing mobile phone detection cameras to enforce seatbelt offences. Mobile Phone and Seatbelt Detection Cameras (MPSDCs) complement Police enforcement to achieve sustained behaviour change as a part of the NSW Automated Enforcement Strategy for road safety. Various studies have identified that enforcement plays an important role in increasing seatbelt use, when coupled with sufficient penalties and the perception of a high likelihood of being detected (Raftery & Wundersitz, 2011). The program is designed to meet a target of more than 135 million annual vehicle checks, an average rate of around 20 checks per registered vehicle in NSW. To achieve this, up to 47 MPSDCs operate across NSW including fixed cameras and trailer-mounted transportable cameras that are frequently moved between enforcement sites. With no advance warning signs, the program aims to achieve general deterrence including by promoting that the cameras operate 'anywhere, anytime' to produce sustained behaviour change and reduce road trauma. Modelling by Monash University Accident Research Centre estimated the program will prevent 17-26 fatalities and 41-62 serious injuries over five years (Stephan & Allen, 2021).

Conference theme: Evolution
NSW was the first jurisdiction in the world to introduce mobile phone detection cameras in 2019. In 2020-21 camera testing was undertaken to establish that the camera system and existing processes, using artificial intelligence (AI) and three stages of human review, could be evolved to reliably detect seatbelt offences. Following testing, the then NSW Government committed to implement automated seatbelt enforcement as part of the NSW 2026 Road Safety Action plan. The current NSW Government passed legislation in November 2023 to enable automated seatbelt enforcement from mid 2024. During this time NSW observed the delivery of the Victorian Government's program and the Queensland Government's program allowing learning and adjustments to the NSW approach. Further evolution has occurred since introducing the NSW program, to respond to challenges as they arise.

When camera enforcement of seatbelt laws commenced in NSW on 1 July 2024, unlike other camera programs, there was no warning letter period as determined by the NSW Parliament. This is in recognition that mandatory seatbelt wearing has been a legislative requirement for over 50 years. Therefore, it was especially important to deliver a

comprehensive education campaign from early 2024 to educate the community about the commencement of seatbelt detection cameras, to provide plenty of time for people to adjust their behaviour before facing fines and demerit points for non-compliance. As well as developing targeted public education communications, Transport for NSW (Transport) liaised with the Queensland Government Department of Transport and Main Roads (TMR) to adapt their seatbelt detection advertising campaign to the NSW situation. Advice from TMR as well as the Victorian Government helped Transport to develop and enhance the seatbelt detection camera program in NSW. In turn, we have shared lessons learnt and program improvements with other jurisdictions, helping our collective understanding of best practice automated enforcement evolution.

The program was one of the first in NSW to be considered by the new AI Review Committee as part of the NSW Government's new AI Assessment Framework process. The Committee provided positive feedback on the project including that it was very well considered from an AI perspective and recommended ongoing performance monitoring.

Approach

Consistent with the road rules, the driver receives a fine and demerit points if they or their passengers are not wearing a seatbelt correctly. A seatbelt which is properly fastened and adjusted will have the lap portion across the hips and the sash across the chest and mid shoulder. In addition to public communications and the campaign, NSW includes a flyer with fines notices to clearly explain correct and incorrect seatbelt wearing with clear diagrams and provides a QR code and website link where more information can be found including in five other languages at: transport.nsw.gov.au/seatbelts.

To provide for medical exemptions, minor road rule changes were made and processes were developed so that people with a seatbelt exemption for medical reasons could chose to add their vehicle to a register so they don't receive a fine. Other processes were developed for other exempt vehicle types e.g., older vehicles that do not have seatbelts fitted are cross checked with the vehicle design rules to determine if a vehicle is required to have seatbelts; and exemptions for taxi drivers and bus drivers from requiring their passengers wear a seatbelt are also accommodated through business processes. Anyone who receives a fine and does not think they should have, can request a review of the infringement via the Revenue NSW website and may apply to have the matter determined by a magistrate in the NSW Local Court.

Post-implementation challenges and improvements have included new ways in responding to multiple unrestrained passengers and maintaining best practice privacy protections.

Results

It is expected that automated enforcement of seatbelt offences will help improve compliant behaviour, which will be observed in a declining infringement rate for seatbelt offences over time in a similar way to the success of NSW's mobile phone detection camera program. Automated enforcement of mobile phone offences in NSW using mobile phone detection cameras has resulted in improved compliance and a steady, continued reduction in the rate of mobile phone infringements (Lovesey et al., 2023) (Table 1).

Table 1. Number of vehicle checks, fines issued and infringement rates for camera-detected mobile phone offences in NSW.

Year	Period	Vehicle Checks	Fines Issued	Infringement Rate (%)	1 in X Vehicle Checks
1	1 Mar 2020 - 28 Feb 2021	76,919,156	169,311	0.22	454
2	1 Mar 2021 - 28 Feb 2022	83,536,289	159,011	0.19	525
3	1 Mar 2022 - 28 Feb 2023	121,937,861	203,978	0.17	597
4	1 Mar 2023 – 29 Feb 2024	144,053,297	195,213	0.14	734
5	1 Mar 2024 – 28 Feb 2025	140,774,468	140,257	0.10	1,004

Between 1 July 2024 and 28 February 2025, there were 93,786,875 vehicles checked and 92,812 fines issued for camera-detected seatbelt offences, which is 0.10% of vehicle checks resulting in a fine for seatbelt non-compliance. Overall, camera-detected seatbelt infringement rates have fallen from an average of one in every 672 vehicles detected (first two weeks of July 2024) to one in 1,184 vehicles detected (first two weeks of February 2025). Drivers have shown the greatest improvement. After six weeks of camera enforcement the infringement rate for drivers not buckling up correctly had halved and has remained steady between 0.03% and 0.04% of all vehicles checked.

However, in the first six months of enforcement, when over 71 million vehicles were checked, almost 60% of camera-detected seatbelt fines were for passengers not buckling up, or not buckling up correctly, despite not every checked

vehicle having passengers. Of the vehicles checked, 0.06% received a fine for a non-compliant passenger. During the Spring and Summer NSW school holiday periods in 2024 there were sharp increases in the number of fines issued to drivers for their passengers not wearing a seatbelt or not wearing a seatbelt properly. A challenge for influencing behaviour change of passengers is that the passengers themselves do not receive the fine for incorrect seatbelt wearing or not wearing a seatbelt, the fine is issued to the driver of the vehicle. NSW is currently evolving communications to encourage passengers to wear their seatbelt correctly and to ensure drivers know it is their responsibility.

Research conducted in 2024 among a representative sample of the NSW population showed that 75 per cent of respondents believed seatbelt detection cameras are an important measure in making our roads safer (Ipsos, 2024).

Every cent from fines from NSW road safety camera programs go directly into the Community Road Safety Fund. This funds important road safety initiatives such as road safety education in schools, flashing lights in school zones and safety infrastructure like audio tactile line markings.

Evaluation

The seatbelt detection camera program is being evaluated as part of the evaluation of the NSW Automated Enforcement Strategy for road safety. A post implementation review of the program identified that careful planning, effective communication and collaboration between different teams was integral to the successful implementation of the program.

Implications for policy and practice

NSW is sharing our experience in evolving the MPSDC program. Key program enhancements that have been identified or implemented include developing an exemptions process, revised approaches for incidents containing sensitive images and responding to issues such as multiple unrestrained passengers including unrestrained babies or children (e.g., on front passenger laps).

Conclusions

The MPSDC Program aims to reduce trauma on NSW roads by encouraging drivers and passengers to wear their seatbelt properly. The Program has enhanced our understanding of seatbelt offending and highlighted opportunities to further evolve public communications, particularly to explain correct seatbelt wearing. NSW will continue to evolve the program to realise the benefits that an automated enforcement program of this scale can provide, importantly saving an estimated 17-26 lives and preventing 41 – 62 serious injuries over the next five years.

References

Ipsos (2024) Road Safety Action Plan: 2024 Community Attitudes Report Prepared for the NSW Centre for Road Safety (CRS).

Lovesey, A., Barnes, B., Gavin, A, Willoughby, J., Millward, S., Wakelin, D., Baker, J. (2023) Mobile Phone Detection Camera Program: The New South Wales experience. 2023 Australasian Road Safety Conference.

Raftery, S. and Wundersitz, L., (2011) No restraint? Understanding differences in seat belt use between fatal crashes and observational surveys. Centre for Automotive Safety Research.

Stephan, K., Allen, T., (2021). Modelling the Trauma Reductions of Applying Mobile Phone Detection Cameras to Enforce Seatbelt Compliance in NSW. Monash University Accident Research Centre.

Transport for NSW (2022). *NSW Automated Enforcement Strategy for road safety.*

Transport for NSW *2026 Road Safety Action Plan Toward zero trauma on NSW roads.*

Utilising AI for network-wide school crossing safety assessments

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Abstract
The Victorian Department of Transport and Planning (DTP) is pioneering a data-driven approach to school crossing safety through the implementation of the *School Crossing Risk Assessment Framework*. This initiative, underpinned by the Safe System philosophy, aims to proactively identify and mitigate risks at school crossings, ensuring that no road user is killed or seriously injured. Following a successful trial in 2024, this program is now scaling to a network-wide deployment covering over 3,000 school crossings. This AI-powered technology enables large-scale collection of vehicle and pedestrian data, including volumes, speed, pedestrian dwell time, and high-risk incidents such as near-misses and drive-throughs. These insights will feed directly into DTP's risk assessment model, guiding evidence-based prioritisation of safety interventions.
This paper will share key findings from the initial deployment, discuss the challenges of scaling AI-based road safety solutions, and explore how these insights are shaping proactive risk management strategies for vulnerable road users.

Social Media Post
Victoria is setting the standard for school crossing safety with AI-powered risk assessments. Learn how data-driven insights are shaping safer roads for our children. #RoadSafety #AI #SmartCities

Introduction
School crossings play a critical role in protecting Victoria's most vulnerable road users—schoolchildren and crossing supervisors. However, traditional risk assessment methods rely heavily on historical crash data, failing to capture high-risk behaviours and near-miss events that indicate potential danger before incidents occur.

The Victorian Department of Transport and Planning (DTP) is addressing this gap through the School Crossing Risk Assessment Framework, an initiative applying AI-powered computer vision to collect in-depth data on vehicle and pedestrian behaviours and interactions. This large-scale program follows a successful trial and will now be implemented across more than 3,000 crossings over the next two years, marking one of the most extensive applications of AI in road safety globally.

Conference Theme Alignment: Evolution
This initiative represents a significant evolution in school crossing safety, transitioning from reactive crash-based analysis to proactive, data-driven risk assessment. By leveraging AI, DTP is leading the way in modernising road safety strategies and setting a benchmark for other jurisdictions.

Project Description
The project utilises high-resolution video analytics and AI-driven processing to extract critical insights into school crossing safety, including:

- Vehicle and pedestrian traffic volumes
- Vehicle classification and speed profiling
- Pedestrian dwell time and crossing behaviours
- High-risk interactions such as near-misses, drive-throughs, and failure-to-yield incidents
- Automatic extraction of video clips for risk assessment and policy development

The program spans metropolitan, regional, and rural school crossings, ensuring a consistent and equitable safety assessment across diverse environments.

Results and Key Insights

Early findings from the initial deployments indicate that AI-based detection is significantly enhancing the accuracy and objectivity of risk assessments. Preliminary data highlights:

- A high prevalence of near-misses that would have gone undocumented using traditional methods
- The impact of crossing design and traffic conditions on pedestrian dwell time and compliance
- The role of vehicle speeds in determining crossing risk profiles
- Emerging trends in non-compliance across different school types, crossing designs, and geographic locations

As full-scale implementation progresses, these insights will support DTP's efforts to prioritise interventions based on real-world risks, rather than relying solely on reactive crash data. Furthermore, DTP has indicated that safety treatments will be deployed based on these insights, with AI-powered monitoring used to evaluate their effectiveness over time.

Implications for Policy and Practice

The integration of AI-powered risk assessments into DTP's School Crossing Risk Assessment Framework is reshaping how road safety decisions are made. This data-driven approach provides policymakers with objective, scalable, and repeatable methodologies for identifying high-risk sites and implementing targeted safety treatments.

This initiative also offers valuable lessons for other jurisdictions seeking to modernise their approach to road safety. The ability to assess risk dynamically, rather than retrospectively, represents a paradigm shift in how governments can proactively protect vulnerable road users.

Conclusion

Victoria's AI-driven school crossing assessment program represents a landmark shift in road safety strategy, demonstrating how large-scale data collection and advanced analytics can drive real-world impact. By embedding AI-powered insights into policy and planning, DTP is setting a new standard for proactive risk management, with lessons that extend far beyond school crossings and into broader transport safety strategies.

As data collection continues, further insights on compliance patterns, rural vs metro comparisons, and the effectiveness of safety treatments will be presented at the conference, offering attendees an in-depth understanding of how AI is driving measurable improvements in road safety.

References

Victorian Government. (n.d.). School Crossing Supervisor Program. Retrieved from https://www.vic.gov.au/school-crossing-supervisor-program

Victorian Government. (2024). *Interim School Crossing Supervisors Subsidy Guidelines*. Retrieved from https://www.vic.gov.au/sites/default/files/2024-06/INTERIM-School-Crossing-Supervisors-subsidy-guidelines-Approved-_April-2024-2024.pdf

New Zealand's work-related road safety Harm Reduction Action Plan

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Abstract
In New Zealand, many road crashes involve people working on, or around, the road or travelling for work. To help reduce work-related road safety (WRRS) risk, a Harm Reduction Action Plan (HRAP) was developed that brings together the collective knowledge of the WRRS system. The HRAP includes two parts, an intervention stock-take and an Investment Decision Process (IDP) tool. Using the IDP, HRAP users follow a process to gather and evaluate evidence for WRRS interventions, and to compare across interventions. This begins with problem definition then moves through feasibility, testing, evaluation, and wider adoption. Following this process improves the likelihood of effective WRRS investment that may reduce deaths and serious injuries (DSIs) as well as improve return on safety investments through greater investment certainty, less rework during design and implementation, and fewer unintended outcomes. IDP testing has provided preliminary evidence for its effectiveness in supporting quality investment decision making.

Social Media Post
Vehicles are a major contributor to work-related deaths in NZ. Our Harm Reduction Action Plan helps work-related road safety stakeholders to make evidence-based investment decisions increasing the likelihood of crash reductions and potentially improving return on safety investments.

Background
In New Zealand, a significant number of road crashes occur in situations where one or more of those involved are either working on or around the road, or travelling for work (Tedestedt George et al., 2021, Mackie Research 2022). In fact, the biggest contributor to work-related deaths in New Zealand, outside of occupational disease, is vehicles. Vehicles account for 50% of all worker fatalities, with half of these occurring on public roads. Over a quarter of fatalities on the road are work-related (WorkSafe, 2023).

There is no formally agreed international definition of work-related road safety (WRRS). However, several studies indicate which road users, and road crashes should be considered as work-related (Adminaite, 2017, Lilley et al., 2020, Thorne et al 2022). They show that the lens for WRRS should be wider than a focus on heavy and commercial vehicles, and should encompass professional drivers, professional travellers (e.g., salespeople, plumbers), commuters, workers on the road, and third parties (others involved in WRRS crashes).

WRRS crashes are often complex and involve multiple system failures, many of which are also implicated in non-WRRS crashes, and in multi-party crashes, drivers travelling for work are less likely to have primary responsibility in fatal crashes than other parties (Thorne et al., 2022). Existing knowledge suggests that both government and industry are key to improving WRRS given the capacity that each has to drive change within the wider system.

With growing understanding of the WRRS problem, system 'actors' have shown an appetite for increased action to improve safety. Advances have included reconciling the road safety and occupational health and safety domains to share knowledge and skills under the Safe System and within a socio-technical context. It also involves providing tools to help in identifying the most effective and cost-effective interventions for improving WRRS, among a range of enticing possibilities.

Conference theme
This work aligns with the conference theme of Evolution, by providing direction and tools for moving the WRRS Safe System into application, feasibility, and evaluation so that harm reduction is ultimately more likely from investments.

HRAP development
A core need for the HRAP was to provide a decision-making process and potential WRRS interventions to those making investment decisions, from individual organisations making safety investment decisions, through to regulators seeking

to update legal requirements to improve safety in specific parts of the WRRS system. The intention was to help ensure that investment decisions were made robustly, transparently, and based on sound evidence, and hence providing the highest chance of harm reduction for a given investment. Therefore, the HRAP included two key parts:

- **Harm Reduction Interventions List**. A list of existing WRRS-specific interventions that have been adopted or proposed globally.
- **Investment Decision Process (IDP)**. A decision-making process built on the collective knowledge of the WRRS system that guides the user through a series of steps to evaluate WRRS investments.

This approach acknowledged existing knowledge and effort, while introducing rigour to the intervention process. A high degree of engagement with different road user groups and related stakeholders was adopted with these steps:

- Step 1. Introducing WRRS stakeholders to the HRAP project to inform and gather support and engagement for later stages of the work.
- Step 2: Completing a draft WRRS intervention stocktake and IDP for review and development with stakeholders.
- Step 3: Running HRAP development workshops enabling system stakeholders to test and refine the intervention stocktake and IDP.
- Step 4: Further HRAP refinement building on stakeholder feedback and testing of final HRAP with an expert WRRS group.

The draft intervention stocktake was developed through a review of WRRS data, technical reports, and literature. The team took an open approach to identifying interventions, acknowledging that some may be less mature than others yet potentially form part of the innovation lifecycle. A brief concise description of each intervention was developed, including relevant road user groups and references. This was refined and added to during the project through stakeholder review and testing.

The IDP is a decision-making process built on the WRRS system's collective knowledge about how enduring benefits are achieved for New Zealand road users. It acts as a tool for assessing the evidence supporting an intervention and its potential for uptake within the WRRS system in New Zealand. Models and theories that informed development included iterative design, sociotechnical systems, translational research, evaluation theory, diffusion of innovation, ecological systems, and Mātauranga Māori (Māori knowledge and frameworks).

The IDP was tested using scenario-based stakeholder workshops. Scenarios used for testing were:

- Professional drivers and other road users, particularly where professional drivers and other road users interact and interventions to improve the safety of both.
- Safe movement and delivery of freight, particularly factors and pressures in the supply chain and how they affect WRRS.
- Safe practice when driving for work, reducing risk of impairment and other unsafe practices.
- Working on and around the road, particularly within temporary traffic management.

During each workshop up to 12 stakeholders with specific expertise relevant to the theme completed a series of scenario-based exercises to test interventions using the IDP. Following workshops, the HRAP interventions list and the IDP were refined, and a final review was undertaken by an expert group.

IDP structure

The IDP has been deliberately developed so that it is usable for all parts of the WRRS system, from individual organisations to cross-sector working groups. As such, two IDP levels have been developed to provide different ways to engage with the process depending on the: time available, expertise at hand, type of decision required, and factors such as risk tolerance and budget. At both levels, the IDP supports the user in assessing interventions to:

- Describe and define the nature and size of the issue that requires intervention.
- Identify the mechanisms through which an intervention might improve safety outcomes.
- Assess the extent to which an intervention has been tested.
- Consider whether evaluation has proven expected safety outcomes and how the intervention might be implemented more widely.

IDP Level One (Figure 1) provides for a high-level, swift analysis of how much is known on the problem and any obvious strengths and weaknesses of a proposed intervention or set of interventions. This level is intended to ensure that key factors critical to assessing intervention performance are considered.

IDP Level Two provides for a more detailed analysis of interventions. It is intended to be undertaken by a group with WRRS system knowledge, with a range of sub-questions under each dimension. It is suitable for situations where more time is available to make intervention decisions, and where decisions are higher risk in terms of safety and level of investment.

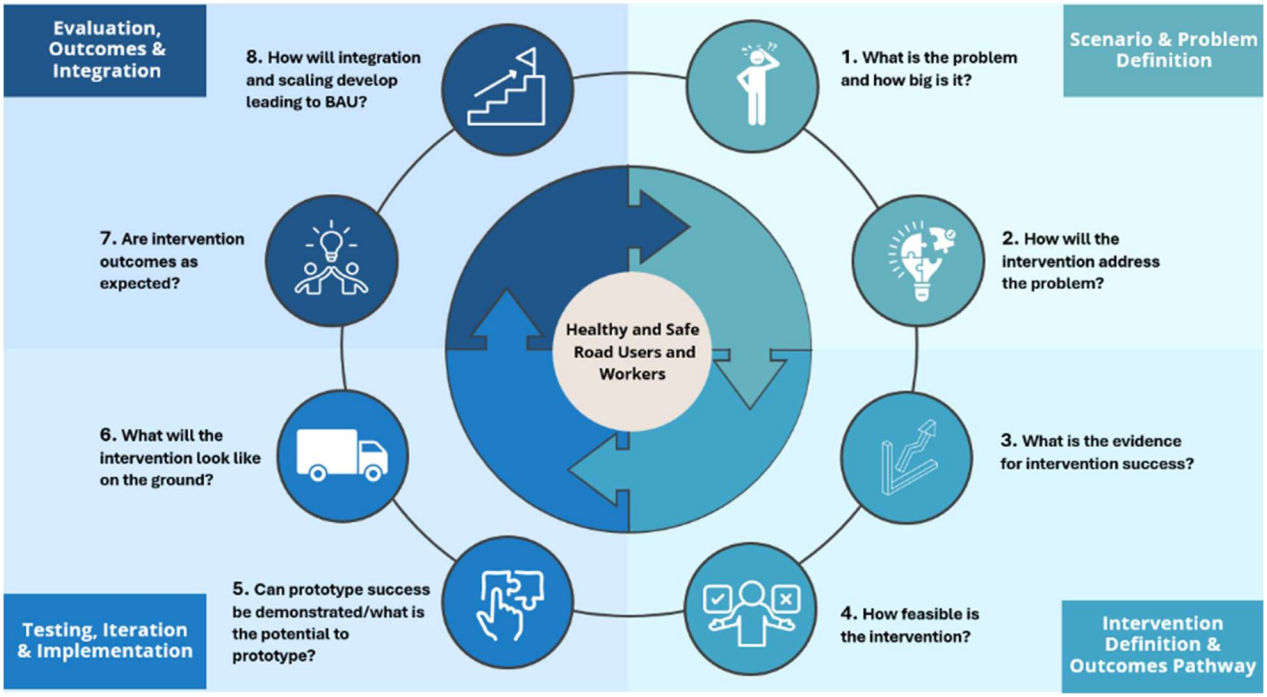


Figure 1. Level One version of the IDP

HRAP testing

Since publishing the HRAP, the IDP has been tested by various groups. For example, trialling a fatigue management intervention, a team of subject matter experts came together for a two-hour workshop to determine investment confidence. They discovered the importance of defining the problem statement, and by doing so it became clear the intervention was designed to address some aspects of fatigue but not all as initially thought. Further, they realised that workshop preparation was key, and the process is enhanced by prior research and having the right people, with diverse roles, in the room. Lastly, a linchpin in the intervention was found, revealing that investment in one part of the intervention would unlock the greatest return saving the group money and time in the long run.

Benefits to road safety and Conclusions

The HRAP provides a process for system actors to identify the most effective and cost-effective interventions for improvement in WRRS, along with a range of candidate interventions. The IDP improves the likelihood of DSI reduction, the return on investment, the accuracy of estimates, and ensures fewer unintended outcomes. Most importantly it improves goodwill and buy-in from the stakeholders involved, including end users and the wider community as they see transparency and rigour in investment decision making, as well as participation in the decision-making process. There was clear benefit from system actors participating in the development process – seen in the demand for the IDP on project completion. Our early experience with using the IDP has confirmed its value, pointing to key areas of questioning for WRRS interventions.

References

Adminaite, D. Jost, G., Stipdonk, H. & Ward, H., (2017). Tapping the potential for reducing work-related road deaths and injuries. ETSC PIN Flash Report 33. https://etsc.eu/wp-content/uploads/PIN_FLASH33-final.pdf

Lilley, R., Maclennan, B., McNoe, B. M., Davie, G., Horsburgh, S., & Driscoll, T. (2020). Decade of fatal injuries in workers in New Zealand: Insights from a comprehensive national observational study. *Injury prevention*, March 2020.

Mackie Research. (2022). Work related road safety: Problem definition review. A report prepared for NZTA NZ Transport Agency by Mackie Research: New Zealand.

Tedestedt George, C., Mackie, H., Ashby, L., Hirsch, L., Tappin, D., Lamm, F., Crawford, J., (2021). Managing vehicle-related risks from supply chain pressures. A report prepared for WorkSafe by Mackie Research: New Zealand.

Thorne, R., Tedestedt George, C., Raja, A., Blewden, J., Mackie. E., Li. E., & Mackie, H. (2022). Contextual factors in driving for work crashes: A systems analysis. A report prepared for the AA Research Foundation by Mackie Research.

WorkSafe New Zealand fatalities register as seen in the WorkSafe NZ Briefing to the Incoming Minister 2023. www.transport.govt.nz/assets/Uploads/Report/Road-to-Zerostrategyfinal.pdf

City of Salisbury Safe Journeys Action Plan: an integrated approach

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Abstract
A Safe Journeys Action Plan was developed for the City of Salisbury, applying an integrated approach that blends road safety and planning in tackling the key road safety challenges faced by Council; road crashes, speeding, hoon driving and school travel safety. Several fatalities occurred on Council's road network over the past five years, with significant concerns about speeding near schools and community perceptions of feeling unsafe while walking and cycling. The Plan proposes four key initiatives aligned with National and State road safety strategies, focusing on reducing fatalities and serious injuries for all road users, with actions that also aim to improve community liveability and sustainability by promoting active transport, reducing vehicle dependency, and creating safer and more inclusive public spaces. This paper supports the conference themes of **equity, elasticity** and **evolution** as the Plan supports the transformation of the local transport network to respond to changing mobility behaviour.

Social media post
Creating safer, more vibrant streets in Adelaide's northern suburbs! The City of Salisbury's Safe Journeys Action Plan combines data, community, and innovation to enhance road safety. Learn more about this collaborative effort.

Introduction
The City of Salisbury is aiming to be a city where every journey is safe, sustainable and enjoyable. Council proactively commissioned work to develop a 'Safe Journeys Action Plan' – an initiative designed to reduce road crashes, in particular those resulting in fatalities or serious injuries, boost active transport, and create a vibrant, liveable community. This paper discusses how an integrated, evidence-based approach assisted the development of achievable and implementable actions for the City of Salisbury and how these actions will benefit road safety.

Background
The City of Salisbury's vision to 2040 and beyond is to become "a progressive, sustainable and connected community" by creating a city that is welcoming, sustainable, promotes continual growth and drives innovation and business development.

Fostering a community that embraces innovative solutions and collaborative partnerships to enhance transport safety for all users and support sustainable transport options is central to the success of this vision. Over the past 20 years, there has been significant background work, investment and partnership between the City of Salisbury and the community, in creating a transport network that is safe and efficient, however, it was identified that more could be done in this space.

Over a 5-year period between 2019-2023, there were a total of 37 recorded fatalities within the City of Salisbury, 9 of which (~25%) occurred on the local road network. Additionally, based on feedback from Council stakeholders and community concerns, critical road safety issues such as crashes, speeding, perceptions of unsafe travel to and from school and hoon driving needed to be addressed through the development of a Road Safety Action Plan. Acknowledging the needs and importance of different transport users in creating a safer and more sustainable transport system, the plan was renamed to the City of Salisbury Safe Journeys Action Plan (hereby referred to as "the Plan").

Conference Theme
This work aligns with the themes of **equity** and **elasticity** by developing an integrated safety action plan that considers all transport users and provides key actions that allow for flexibility and adaptability in how the local road network responds to future disruptors and changing travel behaviours. This work also aligns with **evolution** as the City of Salisbury aims to build on existing targeted infrastructure works by using a network-wide approach which also explores opportunities beyond road infrastructure.

Details of the Project
Councils initial concerns of crashes, speeding, perceptions of unsafe travel to and from school and hoon driving were first analysed through an initial high-level literature review, examining national and international best practice

concerning road safety issues with sometimes limited guidance available, such as hoon driving and promoting safer travel to and from schools.
From a technical standpoint, in-depth crash analysis was undertaken, drawing on the National Transport Research Organisation's (NTRO) in-house national crash database to establish trends in fatal and serious injury crashes that have occurred within the City of Salisbury over the past 5 years. This was complemented with an AusRAP (Australian Road Assessment Programme) assessment, using a stereotypes approach, to measure of the level of safety which is 'built-in' to the road through more than 50 road attributes that influence risk for vehicle occupants, motorcyclists, bicyclists and pedestrians. The Star Ratings provide a simple and objective measure of the level of safety provided by the road infrastructure being assessed with 1-star being the least safe and 5-stars the safest.

A significant component of the project was comprehensive stakeholder consultation with Council stakeholders, Department for Infrastructure and Transport (DIT) and South Australia Police (SAPOL) to validate the outcomes of the literature review and crash trend analysis, as well as hearing their views on particular issues. The engagement sessions with DIT and SAPOL provided an opportunity to strengthen the partnership between State Government agencies and Council.

The findings from this background research validated Councils initial concerns. A set of targeted actions, which sit below **four key initiatives,** were proposed as part of the Plan (further detailed below). Extensive consultation was undertaken to ensure the actions and initiatives were achievable and met the needs of all departments within Council.

Results/Outcomes

The literature review, consultation and analysis identified several key findings for the Council area, including:

- High proportion of male drivers involved in crashes, in particular, more severe crashes
- High proportion of fatal crashes involving young drivers (21-25) and older drivers (70+ years old)
- 80% of fatal crashes occurred in 60 km/h or greater speed zones, despite only representing approximately 12% of the network
- Almost half of fatal and serious injury crashes occurred during dark (night) conditions, however, typically only 25% of driving occurs at night-time
- Almost half of the fatal vulnerable road user crashes involved elderly vulnerable road users (70+ years old)
- Fatalities and serious injuries (FSI) predominantly resulted from run-off-road, intersection and pedestrian crashes
- Most instances where the 85th percentile speed of vehicles (speed that 85% of vehicles are travelling at along a section of road) exceeds the posted speed limit by 8 to 25 km/h occur in industrial areas
- Several roads adjacent or near schools exhibited a high crash rate
- The people most likely to engage in dangerous anti-social hooning are males under 25 years of age, from a lower socio-economic background
- Hooning activities occur in groups in isolated locations with dedicated lookouts, making it difficult for police to catch offenders in the act of hooning

Based on the background research and stakeholder consultation, and understanding Councils ability to influence each Safe System pillar, four key initiatives were proposed as part of the Safe Journeys Action Plan, supported by 20 actions that can be feasibly implemented by Council. These initiatives are:

1. **Right Speed for the Right Environment:** The focus is on creating safer streets by adapting speed limits to suit specific environments considering Movement and Place, with an emphasis on implementing 40km/h zones to enhance road safety and liveability. Mobile radar speed signs will be deployed to address speeding hotspots, while traffic calming measures will be introduced near schools to protect vulnerable road users.
2. **Safer Infrastructure for Active Transport:** This initiative aims to improve conditions for cyclists and pedestrians by connecting missing cycling links and upgrading existing paths. Enhanced lighting along walking and cycling routes will boost safety and amenity, while an expanded CCTV network will help deter unsafe behaviour. Special attention will be given to creating safe routes for children travelling to and from school, complemented by additional school zone safety measures.
3. **Supporting Transport Mode Shift:** The City of Salisbury is committed to updating its Integrated Transport Strategy to promote alternative modes of transportation, with the goal of reducing car dependency and encouraging more sustainable travel options.
4. **New Solutions to Old Challenges:** To tackle persistent road safety issues, the city will pilot smart city technologies to improve traffic management. This forward-thinking approach involves exploring innovative

solutions to address long-standing road safety problems, leveraging new technologies and strategies to create a safer and more efficient transportation network.

Whilst not individually listed, each action is linked to the findings from the background research as well as to strategic performance indicators and actions under the National and South Australian Road Safety Strategies (Department for Infrastructure and Transport 2021 and Department of Infrastructure, Transport, Regional Development and Communications 2021), the key road safety issues identified by stakeholders, with high-level timeframe and cost estimations.
The Plan recognises the importance of strong community engagement. Each initiative and supporting action will be accompanied by targeted communications back to the community in explaining the purpose and benefits of each proposed action. The concept of "taking the community along the journey" plays a vital role in fostering a culture of safety understanding and responsibility among all transport users, particularly the younger population.

Benefits to Road Safety

The actions developed will target locations to reduce the frequency and severity of road incidents, as well as making sustainable active travel more viable, aligning with the initiative of safer infrastructure for active transport by creating safer routes for all users. The success of this plan will contribute to the State's overall road safety goals, creating a safer, more sustainable, and connected community in Salisbury and supporting South Australia's vision of zero lives lost on roads by 2050 (Department for Infrastructure and Transport, 2021).

The Plan embraces the use of new technologies and processes to enhance data-driven insights to effectively pinpoint and tackle longstanding road safety issues, ensuring a comprehensive and forward-thinking strategy. By focusing on these critical areas and utilising these insights, the City of Salisbury's goal is to create safer journeys, enhance community confidence in transport safety, and ultimately reduce road trauma for all transport users.

Implications for Policy and/or Practice

The Plan demonstrates what can be achieved by incorporating Safe System thinking with an integrated strategy and fostering a collaborative approach is used to tackle Council's road safety challenges. It is anticipated that the approach will have positive implications for policy and practice in several ways. Firstly, it moves beyond traditional road safety planning by adopting a holistic view of the transport system, considering the interactions between people, vehicles, and the road environment. This integrated approach will lead to more comprehensive and effective safety measures. The recommendations for a Network Safety Plan and Integrated Transport Strategy will also promote a more systematic and co-ordinated effort to proactively improve road safety across the network, rather than focusing on isolated locations.

Lastly, by incorporating Movement and Place considerations into road safety interventions, the Plan recognises the dual function of roads as both transport corridors and public spaces. This approach will help balance the need for efficient movement with the creation of liveable, safe environments, potentially leading to more context-sensitive and effective road safety solutions that enhance both mobility and community well-being (NSW Government, 2023).

Conclusions

The City of Salisbury's Safe Journeys Action Plan represents a comprehensive approach to enhancing road safety, reducing crashes, and fostering a safe environment, particularly around schools. This plan aligns closely with South Australia's Road Safety Strategy to 2031, supporting the State's targets of reducing lives lost by at least 50% and serious injuries by at least 30% on South Australian roads by 2031 (Department for Infrastructure and Transport, 2021).

The City of Salisbury's four key initiatives, derived from a Safe System approach—implementing the right speed for the right environment, developing safer infrastructure for active transport, supporting a shift in transport modes, and embracing innovation—complement the State's broader strategy and build on existing road safety improvements undertaken by Council **(evolution)**. These initiatives particularly resonate with the State's focus areas such as schools and local places, public transport, cycling and walking, and vehicles and technology.

Taking the community along on this transport safety journey is key to the plan's success. The City of Salisbury recognises that safety affects every member of the community, and programs to improve safety rely on strong partnerships between Council, SAPOL, local businesses, government and non-government services, community organisations and individuals. By fostering collaboration with community stakeholders, government agencies, and local businesses, the City of Salisbury is poised to implement these strategies effectively.

This collaborative approach not only maximises resources but also ensures that the initiatives are well-informed and tailored to the community's unique needs **(equity)**. As the city progresses with these initiatives, it remains committed to monitoring and evaluating their impact, ensuring continuous improvement and adaptation to emerging challenges and opportunities in road safety **(elasticity)**. The success of this plan will contribute to the State's overall road safety goals, creating a safer, more sustainable, and connected community in Salisbury and supporting South Australia's vision of zero lives lost on roads by 2050.

References

Department for Infrastructure and Transport (2021), *South Australia's Road Safety Strategy to 2031*.

Department of Infrastructure, Transport, Regional Development and Communications (2021), *National road safety strategy 2021-30*, 2021.

NSW Government (2023), Practitioners' Guide to Movement and Place.

Eyes on the road: THC impacts oculomotor activity during driving

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Abstract
With increasing access to medical cannabis, detecting cannabis-impaired driving remains a critical challenge. Biological THC tests fail to capture functional impairment, necessitating real-time detection methods. This randomised, double-blind, placebo-controlled, crossover trial evaluated driving performance and oculomotor behaviour in 20 healthy adults at 2- and 4-hours post-dosing with THC/CBD oils (2:2, 5:5, 2:32, 5:80 mg, or placebo). The 2:2 THC/CBD condition showed greater speed control and an increased fixation rate, compared to higher THC/CBD doses. Fixation duration also varied by time, with notable within-condition effects. No significant differences emerged in lateral vehicle control. Oculomotor changes preceded or paralleled subtle performance alterations, highlighting their potential as early indicators of THC effects. These findings inform development of driver-monitoring systems capable of indexing impairment beyond THC presence and stress the importance of dosing and time since administration in interpreting cannabis-related driving risk.

Social media post
Can medical cannabis impact visual attention while driving? Our study shows alterations in eye movement after acute dosing of 1:16 ratio THC/CBD medical cannabis products. These findings could guide intelligent driver technologies to keep roads safer. #RoadSafety #CannabisResearch

Introduction
Increasing legal access to medical cannabis has intensified the need to understand its potential effects on driving safety. Although biological tests can detect Δ9-tetrahydrocannabinol (THC) consumption, they do not reliably indicate real-time impairment (Ramaekers et al., 2021). Emerging evidence suggests that cannabinoids, particularly THC, significantly alter oculomotor activity, potentially impairing visual scanning and attention (Manning et al., 2023). Oculomotor activity encompasses eye movements essential for effective visual perception, including blinking, eyelid dynamics (blink duration, rate, velocity, and droopiness), and gaze behaviours (smooth pursuit, fixations, and saccadic activity; Khan & Lee, 2019). Smooth pursuit enables accurate tracking of moving objects, fixations maintain steady visual focus, and saccades rapidly shift the gaze to gather critical visual information efficiently (Schmitt et al., 2015).

Acute THC administration has been linked to alterations in smooth pursuit, blink frequency, and fixation duration, contributing to observed impairments in visual scanning efficiency and visual processing (Ploner et al., 2002; Ramaekers et al., 2009; Huestegge et al., 2009). Since driving relies on rapid and accurate visual feedback, THC-induced alterations in oculomotor function may compromise hazard detection and responsiveness (Cools & D'Esposito, 2011; Schmitt et al., 2015). These impairments are exacerbated by co-occurring factors such as inattention and fatigue (Mulhall et al., 2020; Tyson et al., 2021). Measuring oculomotor behaviours thus provides valuable, real-time indicators of cannabis-induced impairment that could elevate driving risk.

Conference Theme
Our work aligns with the theme 'Evolution'. Road safety initiatives must continually evolve to meet emerging challenges, such as the increasing prescribing rate of medical cannabis among drivers. Traditional detection methods relying on biological markers often fail to capture real-time functional impairment associated with cannabis use. By shifting from static biomarker tests to continuous, performance-based metrics, our research demonstrates how examining changes in oculomotor activity offers a dynamic measure of a driver's capacity to process visual information and respond to hazards. This approach advances detection strategies beyond mere THC presence, enhancing the ability to identify actual impairment. Embracing the evolving landscape of medical cannabis use, our work highlights how real-time driver-state monitoring technologies can fill a critical gap in roadside testing practices. Ultimately, this evolution from retrospective detection to proactive intervention helps shape future road safety strategies and ensures a nuanced, adaptive approach to managing cannabis-impaired driving.

Method

A double-blind, within-subjects, placebo-controlled, five-way crossover trial was conducted with a final sample of 20 healthy adults. Participants self-reported being novice cannabis users with previous cannabis consumption without observed adverse reactions and had normal or corrected-to-normal vision. Participants received five treatments administered sublingually in a randomised and counterbalanced order. Each treatment was prepared in a single-use opaque syringe, containing a standardised 1 mL dose of cannabinoid oil infused with a peppermint oil masking agent. The treatments included: (a) 2 mg THC / 2 mg CBD; (b) 5 mg THC / 5 mg CBD; (c) 2 mg THC / 32 mg CBD; (d) 5 mg THC / 80 mg CBD; or (e) placebo (bearer medium-chain triglyceride (MCT) oil only). The THC:CBD ratios (1:1 and 1:16) administered reflect common ratio formulations commonly prescribed in medical contexts, allowing exploration of whether varying proportions of CBD modulate THC's effects. Although the absolute THC doses used (2 mg and 5 mg) were low, this was intentional given the participant sample comprised cannabis-naive or infrequent users. These conservative doses ensured participant safety while enabling the investigation of ratio-dependent effects on performance and oculomotor behaviour in individuals without developed tolerance.

Driving performance was assessed approximately 2 hours (T1) and 4 hours (T2) post-dosing using the Forum8 driving simulator. The simulator featured a realistic car cabin with adjustable seats, dashboard, steering wheel, indicators, gear lever, brake, and accelerator. Road scenarios were presented on three integrated 42-inch monitors positioned in front of the driver, providing a 180-degree field of view, with synchronised speakers for auditory feedback and instructions. Driving data were recorded at a frequency of 200 Hz. Each driving session consisted of three tasks completed on a straight, bidirectional, four-lane highway designed to replicate Australian road conditions, where participants drove in the left lanes throughout. Driving outcome measures included standard deviation of lateral position (SDLP), standard deviation of speed (SDS), mean speed (MSP), steering variability (SV), and headway variability. Eye-tracking metrics included fixation rate (fixations per minute) and fixation duration (milliseconds per fixation), recorded using the Seeing Machines Driver Monitoring System (DMS), a driver-facing camera with a sampling rate of 46 Hz mounted on the simulator dashboard. These measures were derived from proprietary facial tracking algorithms validated for automotive-grade eye movement monitoring.

The simulated driving tasks included (1) Car-following task: Participants maintained a consistent headway distance behind a lead car, which accelerated and decelerated between 90 and 110 km/h every 30 seconds; (2) Standard highway driving task: Participants drove along a highway with a 100 km/h speed limit, utilising both lanes to overtake slower vehicles when necessary; (3) Dual attention task: Participants maintained a steady highway speed while simultaneously responding to randomly appearing 'letter' prompts (A–E) on their screen by pressing the corresponding button on the vehicle's central console, simulating common distractions such as phone notifications. Driving and oculomotor outcomes were analysed using linear fixed-effects models, with Time and Condition entered as repeated fixed factors. Compound Symmetry was selected as the covariance structure based on Restricted Maximum Likelihood Estimation, and planned Bonferroni-adjusted post hoc t-tests were used to compare outcomes across conditions. The study protocol was prospectively registered with the Australian and New Zealand Clinical Trials Registry (ACTRN12622001539729), approved by Swinburne University of Technology Human Research Ethics committee (20246915-18214) and conducted in accordance with Good Clinical Practice guidelines and the ethical standards of the Declaration of Helsinki.

Results

A significant Condition × Time interaction was observed for SDS during the highway task ($p < .05$), though no main effects were detected. Post-hoc comparisons showed that SDS was significantly lower at T2 in the 2 mg THC/2 mg CBD condition compared to the 5 mg THC/5 mg CBD condition ($F(4,80) = 3.233$, $p < .01$). Within the 5 mg THC/5 mg CBD condition, SDS was also significantly reduced at T1 versus T2 ($F(1,79) = 7.21$, $p < .01$). For MSP during the dual attention task, a similar Condition × Time interaction emerged ($p < .05$), without significant main effects. MSP at T1 was significantly lower than at T2 in the 2 mg THC/2 mg CBD condition ($F(1,72) = 11.094$, $p < .001$), with a trend toward lower MSP at T1 compared to the 5 mg THC/80 mg CBD condition ($p = .083$). A non-significant trend for reduced lateral vehicle deviation (SDLP) at T1 versus T2 was observed in the placebo condition ($p = .077$).



Figure 1. Participant visual fixations during a simulated highway driving task.
Source: Blair Aitken, Swinburne University of Technology (permission to use).

Fixation rate during the highway task showed significant main effects of both condition ($p < .001$) and time ($p < .05$), but no interaction. At T1, fixation rate was significantly higher in the 2 mg THC/2 mg CBD condition relative to the 2 mg THC/32 mg CBD condition ($F(4,78) = 2.895$, $p < .05$), and at T2, higher than in the 5 mg THC/5 mg CBD condition ($F(4,78) = 3.650$, $p < .01$). Fixation duration revealed a significant main effect of time ($p = .004$). At T1, participants in the 2 mg THC/32 mg CBD condition showed significantly longer fixations than at T2 ($F(1,78) = 5.950$, $p < .05$), while a similar trend was observed in the 5 mg THC/5 mg CBD condition ($F(1,78) = 3.428$, $p = .068$). Figure 1 displays visual fixation patterns during the simulated highway driving task.

Benefits to Road Safety

This study offers preliminary evidence that oculomotor metrics, particularly fixation rate and duration, may serve as sensitive indicators of cannabis-related changes in visual attention, even when traditional driving performance measures such as lateral control or mean speed show minimal or non-significant effects. Specifically, increased fixation rates and reduced speed variability in the 2 mg THC/2 mg CBD condition suggest potential compensatory mechanisms or enhanced visual monitoring under low-dose, balanced formulations. Conversely, changes in fixation duration and performance variability in higher-THC or high-CBD conditions highlight the nuanced effects of differing cannabinoid ratios. Although no significant differences were observed between active drug and placebo conditions for core driving measures, dose- and time-dependent effects emerged across the active conditions, indicating that impairment may be better captured through real-time attentional markers. As such, eye-tracking offers a promising avenue for augmenting current impairment detection methods, shifting the focus from retrospective THC concentration measures to dynamic, behaviour-based metrics that reflect momentary functional capacity. This has particular relevance for scenarios where drivers may appear unimpaired by standard field sobriety or biomarker tests but nonetheless exhibit subtle deficits in visual scanning and cognitive processing that could compromise driving safety.

Implications for Policy and/or Practice

The findings underscore the importance of moving beyond static biological thresholds (e.g., THC presence in blood or saliva) in road safety policy. Integrating oculomotor monitoring into roadside screening protocols or in-vehicle driver-state monitoring systems could enhance the specificity of impairment detection by capturing real-time alterations in visual attention and gaze behaviour. Such systems would be particularly valuable in distinguishing true impairment from residual THC presence in frequent or medicinal cannabis users, thereby supporting more equitable enforcement strategies. From a regulatory perspective, this study reinforces the value of further research into behavioural and physiological markers of impairment, which can inform the development of evidence-based guidelines for cannabis-impaired driving. Establishing thresholds based on functional impairment rather than presence alone may reduce the likelihood of penalising unimpaired drivers while improving detection of those at genuine risk.

Conclusions

The examined medical cannabis preparations produced limited performance-based effects on simulated driving performance but suggest a potential lower detection threshold of discerning alterations to eye-movements following oral consumption of low concentrations of combined THC and CBD. Understanding how medical cannabis preparations impacts oculomotor activity during driving, and how observed effects differ between therapeutic ratios, is crucial for determining the safety profiles of medical cannabis products and outlining their relevance to road-safety.

References

Cools, R., & D'Esposito, M. (2011). Inverted-U–shaped dopamine actions on human working memory and cognitive control. Biological Psychiatry, 69(12), e113–e125. https://doi.org/10.1016/j.biopsych.2011.03.028

Huestegge, L., Radach, R., Kunert, H. J., & Heller, D. (2009). Visual search in long-term cannabis users with early age of onset. Progress in Brain Research, 176, 383–398. https://doi.org/10.1016/S0079-6123(09)17622-4

Khan, M., & Lee, S. (2019). Oculomotor functions and their impact on driving performance: A review. Human Factors, 61(3), 467–492. https://doi.org/10.1177/0018720818819381

Manning, B., Downey, L. A., & Hayley, A. C. (2023). A systematic review of oculomotor deficits associated with acute and chronic cannabis use. Addiction Biology, 28(1), e13359. https://doi.org/10.1111/adb.13359

Mulhall, M. D., Cori, J. M., & Sletten, T. L. (2020). Sleepiness and driving: The role of sleep latency and time awake. Accident Analysis & Prevention, 144, 105620. https://doi.org/10.1016/j.aap.2020.105620

Ploner, C. J., Wess, O., & Schmitt, C. (2002). Effects of nabilone on smooth pursuit eye movements and visual perception. Journal of Clinical Psychopharmacology, 22(6), 569–573. https://doi.org/10.1097/00004714-200212000-00009

Ramaekers, J. G., Kauert, G., Theunissen, E. L., Toennes, S. W., & Moeller, M. R. (2009). Neurocognitive performance during acute THC intoxication in heavy and occasional cannabis users. Journal of Psychopharmacology, 23(3), 266–277. https://doi.org/10.1177/0269881108092393

Ramaekers, J. G., Mason, N. L., Kloft, L., & Theunissen, E. L. (2021). The why behind the high: Determinants of neurocognition during acute cannabis exposure. Nature Reviews Neuroscience, 22(7), 439–454. https://doi.org/10.1038/s41583-021-00466-4

Schmitt, C., Ferdinand, N. K., & Kray, J. (2015). The influence of cognitive control demands on oculomotor performance: An event-related potential study. Psychophysiology, 52(10), 1353–1363. https://doi.org/10.1111/psyp.12500

Tyson, P. D., & Schenk, C. H. (2021). Sleep deprivation and driving performance: The role of sleepiness, fatigue, and circadian rhythms. Sleep Medicine Reviews, 58, 101437. https://doi.org/10.1016/j.smrv.2021.101437

How alcohol consumption influences attitudes and behaviour towards risky driving

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Abstract

This study explored how patterns of alcohol consumption impact attitudes and beliefs towards drink-driving, and how these factors influence engagement in dangerous driving behaviours in a sample of 1,567 fully licensed drivers aged over 21 years from Australia, Canada, United Kingdom, and the United States of America. In all examined regions, problematic alcohol consumption was found to be highly predictive of dangerous driving attitudes and behaviours. Younger males in particular reported more risky patterns of alcohol consumption, displayed more permissive attitudes towards drink-driving, reported increased self-confidence in the ability to drive safely under the influence of alcohol, and reported more occasions of drink driving overall. Targeted psychosocial interventions for younger male drivers that directly challenge permissive attitudes towards drink-driving, highlight the role of peer influence, and underscore the risks associated with engaging in this type of behaviour may help to reduce alcohol-related harm in this vulnerable population of road-users.

Social media post

International survey finds younger males with problematic alcohol use hold more permissive attitudes and report greater occasions of drink driving than low alcohol consumers. Psychoeducational strategies should challenge risk perceptions to positively influence safe road use.

Introduction

Each year, over 1.2 million people will be killed in a road traffic crash – a rate of one death every twenty-six seconds on average (WHO), 2023). A further 2-50 million more people will suffer lifelong injury or life-changing disability every year, accounting for 808.9 age-standardised disability adjusted life years (DALYs) per 100,000 population (or 65.1 million DALY count per annum), representing the tenth leading cause for global DALYs in 2021 (Ferrari et al., 2024). Road trauma is recognised as the leading cause of death and non-fatal disability for young people aged 18-27 (WHO, 2023), overtaking disease and mental ill-health as the most common cause of preventable death in this age bracket. While significant progress has been made to reduce the global burden of road trauma through preventative and harm-reduction countermeasures, including enforcement and policy, as well as improved vehicle safety and road infrastructure, the burden attributed specifically to alcohol usage persists.

Driving under the influence of alcohol remains a key contributing factor in approximately 20% of all road traffic crashes (weighted global average, WHO, 2023), resulting in approximately 273,000 deaths each year (Vissers et al., 2018). This statistic is likely an underestimation due to underreporting of both crashes and casualties. Despite decades of enforcement and enactment of laws intended to reduce the burden of impaired driving, progress towards global road safety objectives in this pillar have plateaued. One possible explanation for this may reflect the underlying influence of individual, rather than population-level, factors. Specifically, whether, and to what extent, a drivers' personal circumstances, beliefs and attitudes might influence their approach to road safety practices and behaviours concerning alcohol usage. Alcohol consumption is positively correlated with instances of drink driving (Stephans et al., 2017); however, far less is known about personal qualities and attributes that may influence the likelihood for individuals who

consume alcohol to then engage in these types of risky driving behaviours and instances of drink driving. It is also unclear whether these associations are comparable across Western regions with largely similar approaches to community-level harm reduction, as seen in Australia, Canada, United Kingdom, and the United States of America. This study therefore sought to more comprehensively explore how pattens of alcohol consumption affect attitudes and beliefs towards drink-driving across several target regions, and how these influences dangerous driving practices including instances of drink driving to better inform global road safety strategies that target at-risk populations of drivers.

Conference theme
Evolution

Method
A survey jointly funded by Seeing Machines and the International Council of Alcohol and Drug Traffic Safety (ICADTS) of N= 1,567 licensed drivers was conducted across Australia, Canada, United Kingdom, and the United States of America. Participants completed a forced entry, branched logic anonymised online survey that was open for responses between February and May 2024.

Alcohol consumption was measured using the Alcohol Use Disorders Identification Test (AUDIT). The AUDIT consists of ten items used to examine the alcohol use across three main areas (alcohol intake, dependence, and adverse consequences) to identify risky consumption and abuse potential. Scores of ≥8 for men and ≥7 for women reflect hazardous drinking (Babor et al., 2018). Dangerous driving behaviours were assessed using the Dula Dangerous Driving Index (DDDI). Attitudes towards drink-driving and beliefs about one's ability to drive under the influence were assessed using the scale developed by Davey et al (2004). Total dangerous driving score was modelled against three factors of drug driving attitudes (favourable attitudes toward risks, unfavourable attitudes toward sanctions, and favourable peer attitudes). Multiple linear regressions were conducted to examine the relationships between AUDIT scores, attitudes towards drink-driving, and dangerous driving behaviours.

Results
Following stratification for demographic factors, males and younger respondents exhibited higher AUDIT scores and were more likely to hold permissive attitudes towards drink-driving overall. Higher AUDIT scores were moderately and positively correlated with more permissive attitudes towards drink-driving ($R^2 = .124$, $F_{(1,1065)} = 150.502$, $p < .001$), and increased confidence in the ability to drive safely under the influence of alcohol ($R^2 = .125$, $F_{(1,1065)} = 151.475$, $p < .001$). More permissive attitudes towards drink-driving were moderately and positively correlated with higher frequencies of self-reported dangerous driving behaviour ($R^2 = .108$, $F_{(1,1565)} = 189.620$, $p < .001$). Higher AUDIT scores strongly predicted higher self-reported dangerous driving behaviours ($R^2 = .315$, $F_{(1,1065)} = 489.940$, $p < .001$).

Benefit to road safety
Driving while intoxicated by alcohol is a known risk factor for injury and death on our roads. Understanding how individual patterns of alcohol consumption might interact with attitudes, behaviours and instances of drink-driving is essential to develop globally relevant messaging and targeted interventions that will reduce harm in vulnerable populations of drivers.

Implications for policy and/or practice
Problematic alcohol use is predictive of dangerous driving behaviours, with younger males displaying more permissive peer-related attitudes towards drink-driving. Challenging permissive attitudes towards drink-driving behaviour and addressing overconfidence in individuals' perceived drink-driving abilities, may help support the development of targeted psychoeducational interventions to reduce alcohol-related road-trauma.

Conclusions
Problematic alcohol use is predictive of dangerous driving behaviours, with younger males displaying more permissive peer-related attitudes towards drink-driving and more occasions of drink driving. Targeted interventions that challenge acceptability of drink-driving, emphasise the social undesirability of this behaviour and address overconfidence in individuals' perceived drink-driving abilities may help reduce alcohol-related road-trauma in this at-risk population of drivers.

References

Babor, T. F., Higgins-Biddle, J. C., Saunders, J. B., & Monteiro, M. G. (2001). *The alcohol use disorders identification test* (pp. 1-37). Geneva: World Health Organization.

Davey, J. D., Davey, T., & Obst, P. L. (2004). Drug and Drink Driving by University Students: An Exploration of the Influence of Attitudes. *Traffic Injury Prevention*, *6*(1), 44–52. doi:10.1080/15389580590903168.

Ferrari, A. J., Santomauro, D. F., Aali, A., Abate, Y. H., Abbafati, C., Abbastabar, H., ... & Bell, M. L. (2024). Global incidence, prevalence, years lived with disability (YLDs), disability-adjusted life-years (DALYs), and healthy life expectancy (HALE) for 371 diseases and injuries in 204 countries and territories and 811 subnational locations, 1990–2021: a systematic analysis for the Global Burden of Disease Study 2021. *The Lancet*, *403*(10440), 2133-2161. https://doi.org/10.1016/S0140-6736(24)00757-8

International Roads Assessment Program (iRAP) (2024). *Safety Insights Explorer* https://irap.org/safety-insights-explorer/

Stephens, A. N., Bishop, C. A., Liu, S., & Fitzharris, M. (2017). Alcohol consumption patterns and attitudes toward drink-drive behaviours and road safety enforcement strategies. *Accident Analysis & Prevention*, *98*, 241-251.

Vissers, L., Houwing, S., & Wegman, F. (2018). Alcohol-related road casualties in official crash statistics. The International Transport Forum

World Health Organisation. (WHO). (2023). *Road Safety Annual Report* P. OECD/ITF. https://www.itf-oecd.org/road-safety-annual-report-2023

Improving driver licensure through police and community services collaboration

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Abstract

The AWHI programme in New Zealand aims to improve driver licensing through community services and police collaboration. Recognising that first contact with police often occurs on the road, the initiative seeks to use these interactions to refer individuals to support services, addressing barriers like financial, geographic, and social challenges. AWHI, meaning "to help" in Māori, was created by two officers in 2018 to connect people needing help with wellbeing service providers. The program has made over 54,000 referrals, significantly impacting road safety and community wellbeing. It addresses issues such as accommodation, addiction, mental health, and driver licensing. The initiative promotes equity, aligning with the principles of the Te Tiriti o Waitangi (Treaty of Waitangi), and highlights the importance of licensure for employment, education, and health access. AWHI demonstrates the potential for police and community collaboration to break cycles of non-compliance and improve overall safety and opportunities for individuals.

Social media post

Barriers to licensure can be due to financial, geographic, and social challenges. A Police initiative that works with wellbeing service providers seeks to break these cycles and improve overall road safety and community wellbeing.

Background

It is well-recognised that “safe road users” is an essential pillar of Safe System. Undertaking the training and testing processes to attain a driver’s licence sets the safe road user platform for those driving motor vehicles. The driver licensing training and testing processes are not equitable for all, with challenges for many including financial, language, social, learning spectrums and accessibility.

In many instances a person’s first contact with police is on the road. Police are often the first to help in a situation, but what happens when that incident or offence is over? One of New Zealand Police’s overarching principles is to take every opportunity to prevent harm. While some roadside interactions may result in the person incurring fines, loss of driver licence or potentially criminal charges; what if police were able to utilise these engagements to promote and refer people in need to services which are also there to help improve their situation?

Being able to drive can be essential for a person’s livelihood, and also the health and education for them and their families. In Aotearoa New Zealand, there are many locations in which public transport is not only limited but may not even exist. Barriers to obtaining a driver licence can be due to financial, geographic, and/or social reasons. Previous research has highlighted that driving without a licence was more common among males, Māori, rural residents, and those living in areas of high deprivation (Begg et. al., 2012). Unlicensed driving contributes to unsafe roads for all road users and a breakdown of the safe system. Often the identification of drivers without ever having a licence occurs because of a crash or driving offence. How could the creation of a collaboration programme which enables police to link people who need support with government and community-based services providers break cycles of non-compliance and deliver road safety and wider benefits?

Conference theme

The Te Tiriti o Waitangi (Treaty of Waitangi) is the foundation on which Aotearoa New Zealand evolved to be where we are today. Equity is inherent in the tikanga or culture of Aotearoa New Zealand. The vision of New Zealand Police is to ensure everybody can be safe and feel safe. We strive for the outcomes of safe communities, safe homes, and safe roads. Policing affects individuals, communities, and the wider society. Licensure is disproportionately lower for populations historically marginalised from equal housing, education, and employment opportunities. AWHI supports and aligns with creating equity to all people in Aotearoa New Zealand.

Overview

Awhi in Te Reo Māori means to help. In 2018, two officers in the Bay of Plenty saw a need. They wanted to connect people needing help (PNH) with wellbeing service providers (WSPs) in their hapori - communities. They wanted to offer awhi – help, for any PNH. These officers created a voluntary referral process called AWHI. Through Police taking a person-centred approach, PNH are supported and empowered through an offer of awhi. Police see the person in the context of their whānau (family), hapori (community) and taiao (environment).

AWHI is an offer that is "as well as, not instead of" any other decision or action which may be taken. AWHI is not a supported resolution or an alternative intervention. Supported resolutions are an intervention for offenders which can be an alternative to the judicial system, but a record is kept on the person's file. AWHI can be offered to anyone 16 years old or more, regardless of their background. They may be a victim, an offender or anyone else the police encounter. A person needing help does not have to have been involved in an incident or to have committed an offence.
AWHI can be offered for a wide range of wellbeing service, multiple times. Referrals can be made in areas such as accommodation, addiction services, aged concern, budgeting, emergency management, family and whānau wellbeing, mental health, and road policing, such as for driving and licence-related matters. A referral can be made to one or more WSPs, or for one or more services, with some WSPs offering multiple services.

Findings

Over the last three years, there have been 54,179 referrals made for 39,974 people. As one person can have multiple referrals, there were 48,659 occasions in which referrals were made. Referrals by gender: female= 27,602 (20,092 persons), male= 26,519 (19,830 persons), unknown = 58 (55 person). A total of 2,104 services were referred.
People referred generally need to be over 16 years of age, although there was a small percentage (0.9%) of people in the data aged less than 16 years. The majority of those referred were 16-25 years (40.5%), followed by 26-35 years (30.5%) and 36-45 years (15.7%) over 45 years made up 12.3%.

Compliance is offered by Police officers when issuing and infringement notice in circumstances where there is a tangible remedy to the offence, such as obtaining a driver licence or a child car seat. The notice is cancelled if the issue is remedied. As AWHI is an offer that is "as well as, not instead of" enforcement, only 23% of referrals were made in association with compliance, with 77% of the referrals made without compliance offered. Road policing referrals contributed 28,111 referrals over this period, of which 34% were compliance related.

All police districts across New Zealand utilise the AWHI process. Areas which are known to have poor access to licensing facilities, primarily Northland (4761 referrals) and Bay of Plenty (4,160 referrals), highlight the inequity of access to licensing services and the associated consequences.

Officers and staff often have strong links with those they refer, as officers are all a part of the hapori (community). When officers are interviewed about using AWHI:

> "I think it's part of our values and our empathy, so we are trying to help make sure they don't come back for the same crimes…Even if I'm helping one person – I'm helping their family, the kids, their community."

While another officer, who had referred a young person to a driving program, told us that their whānau had three generations without a driver's licence. By achieving their driver licence, they become role models which inspired others in their whānau and friends to follow suit.

> "An AWHI referral can help to break that cycle. It can give them a licence, a job, money – an offer of help can change a person's life."

The link between identifying the need for driver's licence was emphasised by the story of David (not real name). David had been living rough in the bush with his dogs. An officer meet David as his dogs were unlicenced and Animal Control were needing to take them. After listening to his story, the officer saw that not having a driver's licence was adding to his issues. After David got his licence through working with the WSPs, he had also been able to find a place to live and could see his kids again.
The officer said:

> "It only takes two minutes to make an AWHI referral, but it opens up a world of opportunity and makes a lasting difference. I would encourage staff to keep the referrals coming!"

Another positive outcome has arisen from the wellbeing service providers. A provider which focuses on driver licensing, saw an opportunity to build on the licensing support work. This has included providing additional support for eye tests, helping whānau access ID, taking them to sit their restricted licence and in some cases, providing driver mentoring and a vehicle to sit their final test. All this not only helps whānau into employment, but it also helps keep people referred out of the justice system.

Benefits to road safety

Promotion of AWHI services in communities promotes services that enable driver to become licensed. While a safe system needs safe drivers, ensuring that people can obtain their licence enables more than just a personal convenience; it's a key to unlocking economic and social opportunities, fostering community development and social equity. When an officer stops a vehicle, they can provide AWHI referral services to the driver but also anyone else in the vehicle who may qualify for referral. This provides opportunities to have a wide effect on the community.

Future opportunities

While New Zealand was one of the first countries to introduce a graduated driver licence system, over the last 30 plus years we now know that non-licensing can become a social problem which can prevent people from gaining employment, as well as accessing education and health services. The AWHI program demonstrates that police, other government organisations, and community services can collaborate and work together to break down equity barriers and improve outcomes for people.

References

Begg, D., Sullman, M., & Samaranayaka, A. (2012). The characteristics of young pre-licensed drivers: Evidence from the New Zealand Drivers Study. Accident Analysis & Prevention, 45, 539-546. https://doi.org/10.1016/j.aap.2011.09.006

Implementation of The Safer Road Concept in Bandung City

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Abstract
In 2020, Bandung experienced 530 crashes, resulting in 124 fatalities. Most of these crashes occurred on arterial roads (38%), which had a fatality rate of 43%. Given these alarming statistics, significant efforts are required to enhance traffic safety. Improvements to the existing roads conditions are essential to achieving the principle of safer roads, which include being forgiving, self-explaining, and self-enforcing. This study focused on three roads with the highest crash rates: A.H. Nasution, Mochtar Kusumaatmadja, Pajajaran. Overall, our findings indicate that the roadside hazard management is inadequate. In addition to safety field observations, we conducted a survey to gauge road user' perceptions. Most respondents acknowledged ongoing road safety issues on the three roads, with 90% and 97% feeling safe while travelling through Mochtar Kusumaatmadja and Pajajaran. Conversely, only 50% of those surveyed felt safe on A.H. Nasution.

Social media post
In 2020, Bandung City saw most crashes occur on the arterial roads, with a high fatality rate of 43%. Therefore, implementation of Safer Road Concept in Bandung is essential to enhance traffic safety.

Introduction
The World Health Organization, reported in 2018 that the global road crash death toll has reached to 1.35 million annually making road crashes the leading cause of death among young people age 5–29. Improving road safety infrastructure in conjunction with systemic changes in transport and traffic establishments, enforcement strategies, signalling and technological measures can substantially improve road safety environment (Sanjeev, 2005). In Bandung City, 46% of traffic crashes occurred on city roads, with 38% on national roads and 17% on provincial roads. The fatality rate on arterial roads was particularly high at 43%. To achieve safer roads in Bandung City, existing roads must adhere to three key principles; they should be forgiving, self-explaining and self-enforcement. This study aims to plan the implementation of safe roads concepts in Bandung City and provides recommendations for the city government for necessary actions to create safer roads. Ultimately, this research seeks to reduce traffic crashes and improve road safety conditions in Bandung City.

Conference Theme
This paper aligns with the theme evolution safe system, since its exploring implementation of road safety concepts approaches and matches the safe street and neighbourhoods.

Safe Road Concept

1. The objective of the "forgiving roadside" concept is to avoid crashes of errant vehicles with potential hazards or to minimise crash consequences (La Torre, et al, 2012).
2. One of the leading principles regarding a "safe system approach" is the notion of Self-Explaining Roads (SER) which was first introduced by Theeuwes and Godthelp in 1995 (Theeuwes, 2021; Theeuwes, 2024). Self-explaining roads (SER) concept are roads that concept aims at delivering a road environment which matches users' expectation and in turn triggers safer behaviour, speed, manoeuvres, and interaction with other users (iRAP, 2010).
3. Self-enforcing roads means properly designed self-enforcing roadways can be effective in producing speed compliance and may contribute to less severe crash outcomes (Donnell, et al, 2018).

Method
This research aims to observe the implementation of safe roads practices in Bandung City, West Java, Indonesia. Bandung City was selected as the research location because it is one of the major cities in Indonesia. Of the 16 primary arterial roads, this study will focus on three roads based on the following selection criteria:

- Roads with the highest crash rates based on road length as reported from Bandung Road Safety Annual Report 2020
- Roads with significant roadside activities (e.g., schools, shops, markets, and pedestrians).

The three (3) selected road sections with the highest crash rates are:
1. A.H Nasution Road, with a crash rate of 11.46 per km
2. Prof. Dr. Mochtar Kusumaatdja Road, with a crash rate of 8.89 per km
3. Pajajaran Road, with a crash rate of 7.69 per km

Table 1. Crash Rates Data Bandung Road Safety Annual Report 2020

No	Road Name	Length (Km)	No of Crashes	Crash Rate/ Km
1	Jl. Soekarno Hatta	18,350	66	3,60
2	Jl. AH. Nasution	2,880	33	11,46
3	Jl Layang Pasupati (Jl. Prof Dr. Mochtar Kusumaatmadja)	1,800	16	8,89
4	Jl. PHH Mustofa	2,372	9	3,79
5	Jl Gedebage Selatan	3,400	7	2,06
6	Jl Pajajaran (Intersection Pasirkaliki-Cicendo)	0,650	5	7,69

Data Collection

Primary Data

1. Field observation, the first set of primary data will be collected through a survey of road characteristics and conditions at the research locations. A field survey will asses the existing on site conditions and evaluate whether the existing roads in Bandung City meet the criteria for safe roads.
2. User perception survey, User perception survey was gathered road users' perceptions of whether the selected roads align with the safe road concept. The survey was conducted through an online questionnaire via Google form and offline directly interviewing the users. The survey obtained 66 respondents in A.H Nasution; 37 respondents in Prof. Dr. Mochtar Kusumaatmadja; and 30 respondents in Pajajaran (Pasirkaliki intersection – Cicendo intersection).

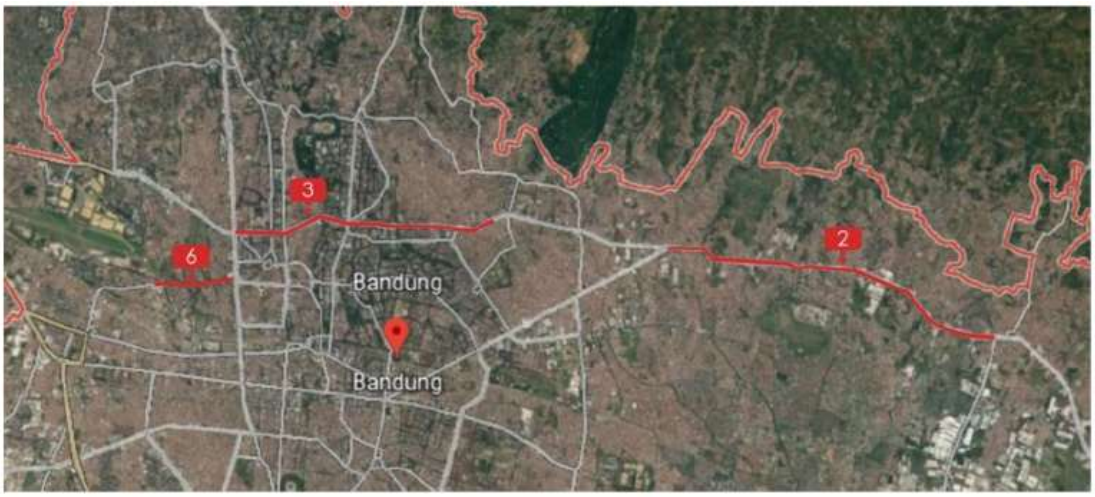


Figure 1. Research Location

Secondary Data

Crash data obtained from the West Java Regional Police of the Republic of Indonesia for Bandung City from 2016 to 2018 can be analysed as follows:

1. Traffic Crash Data Analysis on A.H. Nasution
   On Jalan A.H. Nasution Bandung, there were 115 recorded crashes between in 2016-2018. The majority of these incidents involved motorcycle, pedestrians and six-wheeled vehicles (light trucks). There were 35 fatalities during this period, and one main causes of these fatal crashes was the lack of pedestrian crossing facilities along A.H. Nasution.
2. Traffic Crash Data Analysis on Mochtar Kusumaatmadja
   From 2016-2018, there were 21 crashes reported on Mochtar Kusumaatmadja primarily involving passenger cars and motorcycle. This area experienced 4 fatalities, with the most common type of crash being collisions with the road median. Notably, incidents frequently occurred between at night to morning.
3. Traffic Crash Data Analysis on Pajajaran (Pasirkaliki intersection-Cicendo intersection)
   Between 2016-2018 there were 15 crashes reported involving motorcycle, four-wheeled vehicles and pedestrians. This result in 1fatality. The most common types of crashes included single-vehicle of motorcycle

and collisions between motorcycles and pedestrians. Contributing factors include the lack of pedestrian crossing facilities and inadequate lighting at night, as most crashes occurred during the nighttime.

Result

1. In the assessment of safety issues along the examined roadways, the following key findings were identified:
   - On A.H Nasution Bandung, the road does not comply with self-enforcement principle the condition of the road pavement condition is categorized as poor. Street lighting during night time is still inadequate, a significant number road signage and markings are either missing and damaged, and does not comply with forgiving road. There are still many hazards on the side of the road that can endanger road users. This road meets the principles of self-explained road (SER)
   - On Prof. Dr. Mochtar Kusumaatmadja, the road does not comply with self-enforcement principle the road pavement is exhibits significant bumps. Road signage are damaged and no longer visible and road markings are notably faded and street lights fails to function at night. This road meets the principles of self-explained road (SER)
   - On Pajajaran the road does not comply with self-enforcement principle, the road pavement condition is poor, insufficient street lighting, road signs are heavily soiled and poorly maintained, road markings are missing and does not comply with forgiving road which there are still hazards on the side of the road. This road meets the principles of self-explained road (SER)
2. From on the user perception survey, the following insights can be drawn:
   - On A.H Nasution, 50% of respondents expressed feelings of insecurity while passing this roadway, 79% of respondents stated that the condition of the road pavement is poor, Additionally, 67% indicated that traffic signs and road markings lack clear visibility, 83% acknowledged the inadequacy of street lighting at night, and a substantial 97% noted the presence of roadside hazards.
   - On Prof. Dr. Mochtar Kusumaatmadja, a notable 90% of respondents reported feeling safe while using this road. 73% of respondents characterized the pavement condition as good, while 87% affirmed the visibility of traffic signs and road markings, albeit many signs were obscured by stickers and some markings were missing or worn-out. Nonetheless, 80% recognised that the roadway poorly illuminated at night, 50% indicated the surface can be slippery during rained, and 79% deemed the flyover safe for travel.
   - On Pajajaran, an impressive 97% of respondents stated that they felt safe when passing Pajajaran, 70% of respondents stated that the road surface was poor, 70% of respondents stated that traffic signs were clearly visible, 80% of respondents stated that road markings are not clearly visible, 77% of respondents stated that the road was dark at night, 73% of respondents stated that the road surface was slippery when it rained, 40% of respondents stated that there were roadside hazards in the form of trees and utility poles, 7% of respondents stated that there were roadside hazards in the form of street vendors.

These findings emphasize the critical need for infrastructure improvements and enhanced safety measures across all examined roadways to address user concerns effectively.

Benefit to Road Safety

By implementing the recommendation suggested in this paper it is expected to contribute in reducing the number of traffic crashes, thereby improving road traffic safety conditions in Bandung City.

Implication for Policy and/or Practice

The study results could inform the development of policies and regulations aimed at Bandung City Government to take action in creating safer road in the three research locations and eventually asses to other roads and implement the safe road concept throughout the city.

Conclusions

Based on the analysis of the three research locations, it can be concluded that in Bandung City, the lowest road safety aspects are forgiving roads and self-enforcing roads. There is still a significant lack of roadside hazard management, as well as insufficient installation of traffic signs and road markings that could encourage road users to comply with regulations without the present of enforcement officials. Furthermore, the user perception survey revealed that many respondents identified ongoing road safety issues across the three roads studied. Specifically, 90% and 97% of respondents felt safe when travelling along Mochtar Kusumaatmadja and Pajajaran respectively. In contrast, only 50% of respondents expressed feelings of safety on A.H Nasution. These findings indicate that, although safety analysis clearly shows that most of the three research locations do not meet the qualifications to be classified as safe roads, users

still perceive them as safe. This discrepancy suggest that most users not fully understand the concept of what constitute a safe road.

References

Bandung City Government. (2020). Bandung Road Safety Annual Report 2020.

Donnell, E., Kersavage, K., & Tierney, L. F. (2018). Self-Enforcing Roadways: A Guidance Report. Federal Highway Administration, Report No. FHWA-HRT-17-098

iRAP (2010). Road Safety Toolkit, Bassingtoke.

La Torre F., Saleh P., Cesolini, E., Go yat Y. (2012) Improving Roadside Design to Forgive Human Errors. Pro-cedia – Social and Behavioral Sciences, 53, 235–244https://doi.org/10.1016/j.sbspro.2012.09.876.

Sanjeev Shami, 2005. "Reducing Accidents by Improving Road Safety Infrastructure," Working Papers id:119, eSocialSciences.

Theeuwes, J. Self-explaining roads: What does visual cognition tell us about designing safer roads? Cognitive research: Principles and implications, 6 (1) (2021), pp. 1-15

Theeuwes, J., Snell, J., Koning, T., & Bucker, B. (2024). Self-explaining roads: Effects of road design on speed choice. Transportation Research Part F: Traffic Psychology and Behaviour, 102, 335–361. https://doi.org/10.1016/j.trf.2024.03.007

Advancing cycling safety with sensor data and Safe System insights

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Abstract
Surf Coast Shire Council (SCSC), in collaboration with the Transport Accident Commission (TAC) and See.Sense, are applying real-time sensor data to inform targeted road safety interventions. Data from 50 cyclists, capturing braking, swerving, and hazard perceptions using See.Sense technology, is integrated with a larger dataset from the Light Insights Trial, to deliver a high-resolution understanding of cycling risk across the network. Insights are visualised in a scalable Core Insight Dashboard, enabling evidence-based identification of hazardous locations and validation of key cycling routes. This data-led approach strengthens infrastructure planning by providing objective evidence beyond traditional consultation methods and has already secured funding for priority projects. Findings are directly influencing road safety works, such as recent upgrades to Fischer Street, Torquay, where before-and-after analysis is evaluating the impact of new measures such as a Dutch-style roundabout. This model demonstrates the value of continuous cycling data to support strategic, safety-focused decisions in any local government context.

Social media post
Sensor data is transforming cycling safety! 🚴 🔍 Surf Coast Shire, TAC & See.Sense are using cutting-edge bike light data to detect risks and improve infrastructure. A data-led approach for safer rides and smarter planning. #RoadSafety #CyclingData #ARSC2025

Introduction
Surf Coast Shire Council (SCS) adopted a new road safety strategy in November 2022 which, in line with state targets, is working towards a 30% reduction in serious injury crashes and a 50% reduction in fatal crashes by 2030. With a growing population, growing tourist numbers and high operational speeds there is a critical need to implement safe system treatments on the local road network to achieve a meaningful reduction in serious and fatal crashes. However, there are significant challenges in rolling out safe system treatments due to funding constraints in a regional council setting, community acceptance, and compliance challenges where there is a low level of police enforcement.

In early 2023 an existing conditions Safe System Assessment was undertaken along the length of Fischer Street to help understand an emerging pattern of crashes and increasing risk due to growing traffic and vulnerable users on the corridor. Fischer Street is in Torquay, under the management of the Surf Coast Shire Council. and provides a key connection between the town centre and the educational and services precinct located in the north of Torquay. A high volume of vulnerable road users are present throughout Fischer Street and there are a high number of cross and T-intersections along the street with five of the intersections being controlled by roundabouts. There were 12 crashes on this section between 2017 - 2021 (5 serious, and 7 other), the majority of crashes occurring on high volume roundabouts along the route and involving conflict with cyclists.

Surf Coast Shire Council (SCSC), in partnership with the Transport Accident Commission (TAC) and See.Sense, is pioneering the use of real-time cycling sensor data to inform targeted safety interventions. The project has helped to validate the understanding of popular routes taken by cyclists and provided more detail than typically found in a community consultation. Additionally the swerving and braking data, combined with the perception report data is helping to identify hazardous areas for cyclists that can be prioritised.

Conference Theme
This project exemplifies the evolution of the Safe System approach by shifting from reactive to proactive safety planning. Historically, infrastructure decisions relied on reported crashes and anecdotal feedback, whereas this initiative leverages real-time cycling behaviour data to identify hazards before incidents occur.

By capturing braking, swerving, and surface conditions, the data enhances the ability to identify locations requiring intervention. This approach aligns with Safe System principles by ensuring that countermeasures address risk factors in a way that anticipates and mitigates potential cyclist harm, rather than reacting to past collisions. The methodology

supports evidence-based decision-making, integrates human factors by analysing cyclists' interactions with the built environment, and is scalable for implementation in other local government areas.

Project Description

The Surf Coast Shire Council (SCCC), in partnership with the Transport Accident Commission (TAC) and See.Sense, conducted a study leveraging sensor-based cycling data to enhance road safety and infrastructure planning. This work builds on the iMOVE Light Insight Trial (LiT), which ran in collaboration with Deakin University and collected data from 300 cyclists in the Surf Coast area using See.Sense smart and connected bike lights, starting in November 2021. To expand the dataset and provide deeper insights, an additional 50 participants were recruited in November 2023 to use See.Sense bike lights. The data collection is ongoing, with continuous analysis to support infrastructure improvements.

The project captures data on braking, swerving, road surface conditions, speed, dwell time, and route choices, offering a high-resolution understanding of cycling risk across the network. The dataset has been integrated with engineering analysis and historical crash data to identify high-risk locations. Insights are visualised through the Core Insight Dashboard, developed in collaboration with the TAC, providing a tool for assessing cycling risk and planning infrastructure improvements.

For each route examined, the analysis included:

- See.Sense sensor data, identifying high-risk locations through braking incidents, swerving events, and road surface conditions.
- Cyclist perception reports, which captured real-world feedback on near misses, unsafe interactions, and route challenges via user reports made by cyclists using the See.Sense app
- Casualty crash data, with a focus on cyclist-involved incidents, ensuring a comprehensive understanding of risk factors.

The project has already influenced safety upgrades on Fischer Street, Torquay, where road treatments were assessed using before-and-after analysis. Additionally, SCCC has commissioned further analysis on higher-volume and higher-risk routes in Torquay where no interventions have yet been planned, using sensor insights to guide future infrastructure decisions.

Results

The analysis confirmed that sensor-based cycling data is a powerful tool for proactive road safety planning, allowing authorities to identify and mitigate risks before crashes occur. The findings provided objective evidence of cycling hazards, validating previously known risk areas and uncovering new problem locations.

A key outcome was the ability to detect pre-crash risk indicators, such as high braking intensity and frequent swerving, which highlighted locations where crashes were likely if interventions were not implemented. Cyclist perception reports added critical context by detailing specific experiences, including interactions with vehicles, poor visibility, and unsafe road conditions.

The data directly supported funding applications for infrastructure improvements, leading to real-world safety interventions. On Fischer Street, Torquay, the project informed upgrades including extended roundabout centre islands, shared lane markings ("sharrows"), and raised pedestrian crossings. Before-and-after comparisons of cycling data are now being used to assess the effectiveness of these treatments.

Beyond Fischer Street, further analysis has been conducted on higher-risk cycling corridors in Torquay where no interventions have yet been planned. This additional work is helping prioritise future infrastructure investments by providing evidence-based recommendations on where improvements are most needed.

An independent consultancy has also been engaged to assess the impact of the new Dutch-style roundabout, providing further insights into how infrastructure changes influence cycling safety. Early results indicate that near-misses have decreased, and cyclist confidence has improved, demonstrating the effectiveness of data-led road safety interventions.

Significant performance improvements were observed across all tested areas, with lower values indicating better outcomes: Swerving ability improved notably, with values decreasing from 3.42 to 1.20, representing a 65% improvement—approximately 2.86 times better in this category. Braking performance also showed major gains, dropping from 5.67 to 2.81, a 50% improvement, or about 2.01 times better. Road surface handling became more

efficient, decreasing from 1.98 to 1.17, marking a 41% improvement and making the system around 1.69 times better on varying surfaces. The project's findings support a Safe System-aligned approach to cycling safety, demonstrating how sensor-driven insights can be used to develop targeted, evidence-based countermeasures. By incorporating these insights into standard transport planning processes, local governments can enhance road safety, secure funding for priority projects, and create safer, more connected cycling networks.

Benefits to road safety

The ability to identify risks before crashes occur represents a major step forward in cycling safety. By integrating connected cycling data into road safety strategies, authorities can develop more proactive interventions. The use of objective, data-driven evidence also improves funding allocation, ensuring that resources are directed toward the most critical areas.

The insights generated allow for Safe System-aligned countermeasures to be introduced, such as improved intersection treatments, surface repairs, and targeted speed management measures. Cost-effective infrastructure investments can be achieved by focusing on high-risk locations identified through data analysis. By reducing reliance on anecdotal evidence and incorporating real-time data, planners can ensure that safety improvements have the greatest possible impact.

Implications for policy and /or practice

The integration of sensor-based cycling data into road safety planning has significant implications for both policy development and practical implementation. By moving beyond traditional crash data and consultation methods, this approach enables authorities to proactively identify and address risks before collisions occur. Policies that incorporate real-time sensor insights can support more data-driven decision-making, ensuring that cycling infrastructure investments are targeted for maximum safety impact. Additionally, the use of perception reports alongside objective sensor data provides a holistic view of cyclist experiences, helping to shape safer, more inclusive road environments. In practice, this model offers a scalable and replicable framework for local governments, enabling them to improve cycling safety through evidence-based interventions, prioritised funding, and alignment with Safe System principles. By embedding this methodology into standard transport planning practices, policymakers can better support active travel goals, road safety strategies, and sustainable urban mobility initiative.

Conclusions

The Surf Coast Shire cycling safety project demonstrates a pioneering application of real-time cycling data to inform infrastructure planning and reduce road risk. The ability to implement Safe System-aligned countermeasures based on real-time hazard data ensures that interventions are targeted and effective. With early results indicating a measurable reduction in hazards and increased cyclist confidence, this model provides a scalable, evidence-based framework for improving cycling safety in any local government context.

References

Debnath, A., Le V., Medvedev, A., Soro, W., Lim, P. C., Creighton, D., Zaslavsky, A., Najdovski, Z., Johnstone, M., (2022). Light Insight Trial (LiT) Research Report. Available at https://imoveaustralia.com/wp-content/uploads/2023/06/Light-Insight-Trial-LiT-Research-Report.pdf (Accessed 11th March, 2025)

Keeping people safe when walking – improving guidance

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Abstract

This extended abstract presents an overview of key areas where improvements can be made in pedestrian safety guidance, including gaps in existing standards, guidelines, and methodologies. It explores opportunities to strengthen a systems-based approach to pedestrian safety planning, intervention selection, and evaluation. Through a combination of literature review and stakeholder engagement, this work identifies challenges practitioners face and highlights potential enhancements to national guidance. The findings presented in this paper will contribute to the ongoing evolution of pedestrian safety practices, informing future updates to relevant transport policies and standards.

Social media post

Interested in learning about the latest guidance relating to pedestrian safety? Austroads has commissioned a practitioner-focussed study to ascertain the gaps and opportunities regarding pedestrian planning, design and evaluation of treatments. #keepingpeoplesafewhenwalking

Introduction

The Austroads project SAG6371 Keeping People Safe When Walking is being undertaken over three streams as depicted below.

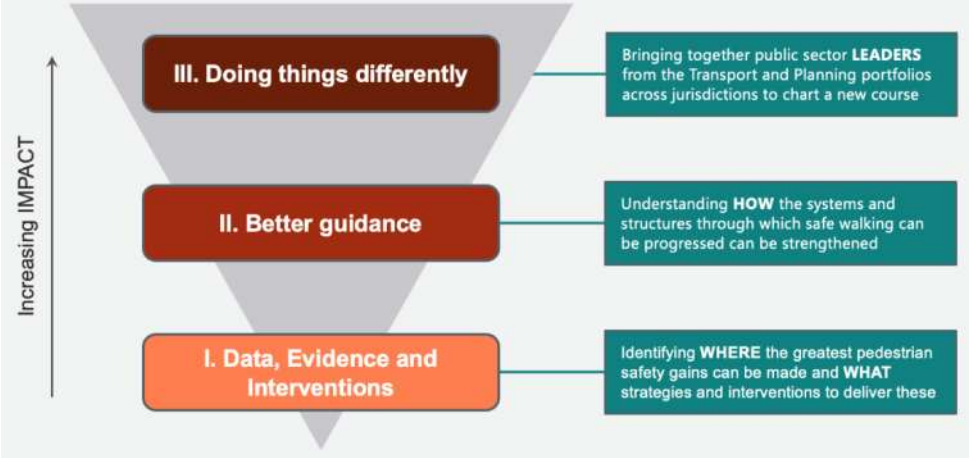


Figure 1. SAG6371 Streams

This project fits within Stream 2 ‘Better Guidance’. The focus of the Work Package is to support Austroads members’ pedestrian safety practice, through better transport guidance, approaches and methodologies. The overarching principle guiding this project has been to establish, document and analyse how practitioners across Australia and New Zealand develop pedestrian safety solutions. Investigating the gaps, inconsistencies and barriers practitioners face has enabled this project to recommend relevant, tangible changes to Austroads publications (and other resources).

The stakeholder engagement and literature review uncovered that jurisdictional supplements often offer improved pedestrian safety outcomes compared to the national standards / guidelines. To this end, to improve the safety of people walking there is appreciable evidence to update national guidance, approaches and methodologies. This evidence is further supported by the work completed in Stream 1.

The evidence is clear: Despite knowing how to make our roads and streets safe for pedestrians, especially the most vulnerable cohorts – children, the elderly, those with limited ability and First Nations people – Australia and New

Zealand lag and pedestrian safety is only marginally improving. We must accelerate the adoption of life saving pedestrian safety measures. (Austroads, 2025)

Conference theme

The 2025 Australasian Road Safety Conference Theme is *Equity, Elasticity and Evolution*. Whilst all three theme components apply to this project, the latter *Evolution* is the most pertinent. Pedestrian safety practices continue to evolve to reflect the latest research, policies and strategies. This project challenges past approaches and articulates current, best-practice measures to improve pedestrian safety.

Approach

There were two key methodologies employed to investigate, document and analyse pedestrian safety practices across Australia and New Zealand described below.

Literature Review

The literature review methodology was developed with a practitioner-focussed approach. In total, over 100 publications were analysed as part of the literature review. The predominant sources of literature were Austroads publications and guidelines from Australasian jurisdictions. The sources of the literature reviewed have been broadly categorised into the headings shown in Figure 2. The literature review focussed on reflecting on Austroads current publications, investigating stakeholder practices and examining pertinent Austroads research reports. This approach led to a comprehensive understanding of how practitioners currently reference guidelines when developing pedestrian safety solutions and embed insights from recent Austroads projects.

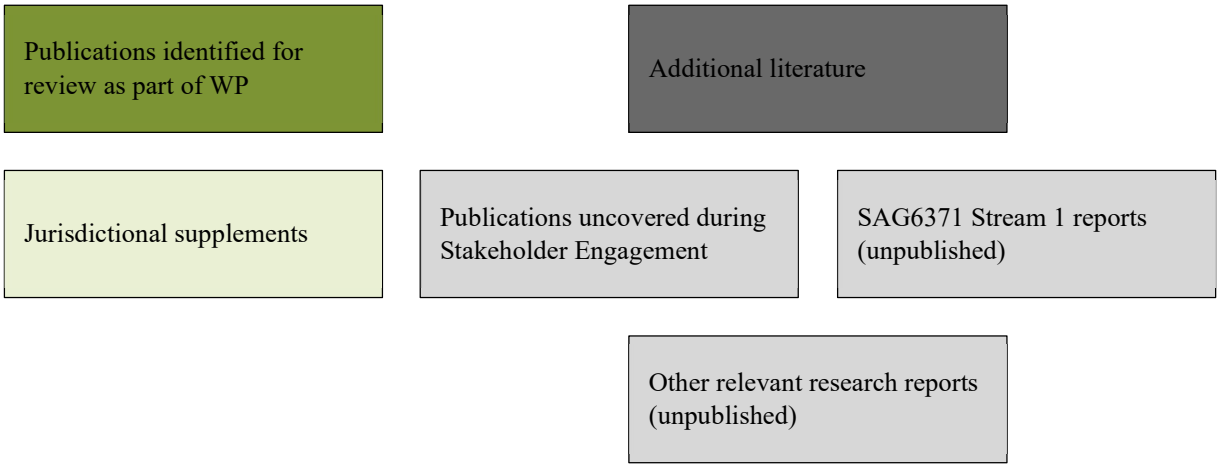


Figure 2. Literature review methodology

Jurisdictional supplements were reviewed where applicable. Several jurisdictions across Australasia offer their own supplements to the aforementioned Austroads publications. The purpose of the supplements is to provide additional context (for instance referring to specific jurisdictional strategies, policies and guidelines) and also articulate any changes (departures) from the Austroads publications. Practitioners commonly refer to both the Austroads publications and the jurisdictional supplement document – with the latter taking precedence where there are discrepancies in guidance. Including the review of jurisdictional supplements provided greater insight into current practices across Australasia.

Stakeholder engagement

The overarching objective for undertaking stakeholder engagement was to identify successful and effective strategies, practices, or approaches within the field of pedestrian safety. Key to achieving this goal was engaging with practitioners and subject matter experts. There were multiple avenues for engagement including workshops, online surveys and one-on-one interviews.

The focus of the stakeholder engagement process was to understand any risks, challenges, barriers, and lessons learned that road managers or government agencies have encountered, as well as the measures taken to overcome these challenges. These included institutional (including policy) barriers, as well as political and community opposition to implementing the desired changes.

The outcome of this process unveiled considered, pertinent and practitioner-derived gaps and opportunities within the field of pedestrian safety.

Outcome of the work

The outcomes of this project have not been detailed in this abstract.

At the time of writing, the specific outputs from this project are being peer reviewed by an Austroads Project Control Group. It is anticipated that this project will be finalised mid-August 2025. Thus, the October 2025 Australasian Road Safety Conference would be perfectly timed to discuss and disseminate the outcomes of this project.

At a high-level, some of the key themes that have emerged from this project include highlighting the relationship between vehicle impact speed and the human body's tolerance to forces, exploring how pedestrian demographics may influence design choices and strengthening the case for raised pedestrian crossing points.

Benefits to road safety

The focus of this project is improving the safety for people walking. The recommendations as part of this project provide practitioners enhanced guidance, tools and methodologies to help them plan, design and evaluate safe pedestrian treatments. The benefits to road safety are unequivocal.

Implications for policy and/or practice

The recommendations as part of this project will be considered and enacted into Austroads publications over time. There is not a single, set date for all publications to be updated based on this project, instead each publication will be revised gradually. The major changes would occur within the Austroads Guide to Road Design Set, Austroads Guide to Road Safety Set and Austroads Guide to Traffic Management Set.

Conclusions

A webinar has been tentatively pencilled in for early October 2025 to discuss the outcomes of this project. This webinar will be publicly available for anyone to access (free to join).

References

Austroads (2025). Keeping People Safe When Walking – Stream 1: Pedestrian Safety Problem and Project Methodology. *Austroads*, https://austroads.gov.au/publications/road-safety/ap-r727-25

Alcohol and driving: a study of drivers aged 18-25 years

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Abstract
Young drivers aged 25 and younger are disproportionately involved in road crashes, with multiple factors contributing to this over-representation—one of which is drink-driving. An online survey was used to collect data from 732 Victorian drivers aged 25 years and younger. The survey explored patterns of alcohol consumption and driving when they believed their Blood Alcohol Concentration (BAC) exceeded the legal limit in the past 12 months. Results showed that amongst young drivers who reported consuming alcohol at a 'High Risk' level, 70.6% had driven when they thought their BAC exceeded the legal limit, compared to 15.6% who reported consuming alcohol at a 'Low Risk' level. Logistic regression modelling showed the odds of self-reported drink driving were significantly higher for respondents with higher Alcohol Use Disorders Identification Test (AUDIT) scores. These findings highlight the need to develop effective policies to minimise the risks of harm to this group of drivers.

Social media post
Understanding alcohol consumption patterns and engagement in drink driving behaviour amongst those aged 18-25 is a critical step in enhancing road safety for young drivers

Introduction
Driving after the consumption of alcohol is a significant contributor to the occurrence of serious and fatal injury crashes (e.g., Pasnin & Gjerde, 2021; Høye & Storesund Hesjevoll, 2023). Whilst legal Blood Alcohol Concentration (BAC) limits vary between jurisdictions and licence types, the World Health Organization reported that 20 per cent of fatally injured drivers in developed countries had a BAC above the legal limit at the time of their crash (World Health Organization, 2023). The consumption of alcohol makes it difficult for drivers to meet the complex demands for safe operation of a motor vehicle (e.g., Brown et al., 2018), and increases engagement in other risky driving behaviours, such as speeding and reckless driving (e.g., Scott-Parker et al., 2014; Freeman et al., 2021). The relationship between alcohol consumption level and crash risk is also complex. Higher levels of alcohol consumption lead to greater levels of impairment, and subsequently crash risk. For example, in a meta-analysis, it was found that for every 0.02% increase in BAC level, the odds of fatal injuries in a motor vehicle crash increased 1.74 times (Taylor & Rehm, 2012).

To eliminate alcohol-related crashes, the most effective approach is for individuals to avoid driving after they have consumed alcohol. Research has therefore sought to identify whether there are specific driver characteristics that may lead to drink driving. For example, a study conducted in the United States found that drinking alcohol at problematic levels is a predictor of drink driving (Stringer, 2021). Whilst drivers of all ages are at-risk of crash involvement if they consume alcohol before driving, one group of particular concern is young drivers (generally those aged 25 years and younger). When compared to older drivers, a young driver with the same BAC level has a higher risk of being involved in a crash (e.g., Peck et al., 2008).

The current study examined whether patterns of alcohol consumption are related to self-reported involvement in driving when an individual believes their BAC is over the legal limit, amongst drivers aged 25 years and younger. Focus was given specifically to young drivers aged 18-25 years, given they are at high-risk of road trauma, particularly after they have consumed alcohol. This aligns the study with the ARSC2025 theme of ***Equity, Elasticity and Evolution***. Young drivers, by reason of their inexperience and continued cognitive development, are a group of drivers for whom additional measures are necessary to ensure they are not over-represented in serious and fatal injury road crashes. Research focused on this group of drivers has the potential to ensure ***equity,*** which may be indicated by a reduced number of young people being involved in serious crashes, ***elasticity***, to make the necessary changes to achieve this goal, and ***evolution***, to be adaptable and make changes as time progresses, to ensure strategies in place are best meeting the needs of young drivers.

Method

Individuals were eligible for this study if they were: 1) aged 18-25 years; 2) lived in Victoria, Australia; 3) currently or had in the 12 months prior to completing the survey, held a Victorian full or probationary driver's licence; and 4) had driven on Victorian roads at least once in the 12 months prior to completing the survey. An online *Qualtrics* survey was used to collect data. The *Qualtrics* online panel service was used to recruit survey participants. The research team provided details of the eligibility criteria to *Qualtrics*, who then sent invitations to individuals who had expressed interest in receiving surveys on topics that may be of interest and relevance to them. Participants who chose to complete the survey earned credit points in the panel system, which can be used to claim a reward of their choice. The research received university ethics approval.

The survey took participants approximately 25 minutes to complete, and included sections on socio-demographic characteristics (age, gender, educational achievement, employment status), distance driven on average per week across the three months prior, Alcohol Use Disorders Identification Test (AUDIT) (collects information on patterns of alcohol consumption and potential alcohol dependency), engagement in drink driving behaviour, as well as engagement in other illegal driving behaviours (e.g., speeding), and sanctions received for illegal driving behaviours, each in the past 12-months. The AUDIT consists of 10 items to determine whether an individual may be displaying patterns of problematic drinking behaviour. Based on their responses, a score is calculated to classify an individual as: 0 (no alcohol is consumed), 1-7 (Low Risk), 8-12 (Risky) and 13+ (High Risk) (Babor et al., 2001). Cut-off points are the same for all individuals, irrespective of socio-demographic characteristics such as gender and/or age.

Descriptive statistics were used to examine the socio-demographic profile of the study sample, their self-reported involvement in drink driving and other illegal driving behaviours in the past 12-months, any sanctions received for driving offences in the past 12-months, and AUDIT score. Drink driving behaviour was based on an individual's subjective judgement, where they were asked to indicate whether they **believed** they had driven when they thought they may have had an illegal BAC. No specific details were provided to assist individuals to estimate this (for example the number of drinks/type of drinks in a specified time period), as different individuals react differently to alcohol based on factors such as body mass. A logistic regression model was conducted to examine the relationship between age, gender, average distance driven in a typical week, AUDIT score and engagement in drink driving behaviour. Covariates were entered into the model using a stepwise method. All data analyses were undertaken in SAS Version 9.4.

Results

A total of 732 participants aged 18-25 years completed the survey in full. As shown in Table 1, most respondents were aged 24-25 years of age (n=241, 32.9%), and identified as female (n=492, 67.2%). Driving less than 100km per week was most frequently reported (n=284, 38.8%).

Table 1 Characteristics of study sample

Characteristics		**n**	**%**
Age Group (Years)	18-19	137	18.7
	20-21	161	22.0
	22-23	193	26.4
	24-25	241	32.9
Gender	Male	240	32.8
	Female	492	67.2
Average distance driven per week	Less than 100km	284	38.8
	At least 100km, but less than 200km	181	24.7
	At least 200km, but less than 400km	125	17.1
	400km or more	142	19.4

A total of 195 (26.6%) of participants reported driving when they believed their BAC exceeded the legal limit in the past 12-months. As shown in Table 2, there was a clear relationship between participants' AUDIT score and driving when they believed their BAC exceeded the legal limit in the 12-months prior to completing the survey. For those who scored 1-7 (Low risk) on the AUDIT (n=353), 15.6 per cent reported to have driven when their BAC exceeded the legal limit. Comparatively, for those scoring 13+ (High risk) on the AUDIT (n=126), 70.6 per cent reported to have driven when they believed their BAC exceeded the legal limit.

The binary logistic regression model was statistically significant, X^2 (10, n = 732) = 196.84, $p < 0.001$, explaining between 23.6% (Cox & Snell R Square) and 34.4% (Nagelkerke R Square) of the variance in self-reported drink driving in the past 12 months. The model correctly classified 79.6% of cases. As shown in Table 3, when adjusting for age,

gender, and distance travelled, the odds of self-reported drink driving were significantly higher for respondents with higher AUDIT scores. Specifically, compared to those who scored 1-7 (Low risk), those scoring 8-12 (Risky) had over 3 times greater probability of self-reported drink driving behaviour in the past 12 months, while those scoring 13+ (High risk) had over 13 times greater probability of self-reported drink driving behaviour in the past 12 months.

Table 2 AUDIT Score and self-reported engagement in drink driving in the past 12-months

AUDIT Score	Self-reported engagement in drink driving in the past 12-months			
	Yes		No	
	n	%	n	%
0	8	6.2	121	93.8
1-7 (Low risk)	55	15.6	298	84.4
8-12 (Risky)	43	34.7	81	65.3
13+ (High risk)	89	70.6	37	29.4

Table 3 Binary Logistic Regression on self-reported driving when individuals thought their BAC was above the legal limit, in the past 12-months (Adjusted Odds Ratios)

		Odds Ratio	95% CI Lower	95% CI Upper	*p*-Value
Age	18-19	Reference			
	20-21	0.86	0.45	1.63	0.638
	22-23	1.25	0.69	2.25	0.468
	24-25	1.93	1.10	3.39	0.023
Gender	Female	Reference			
	Male	1.58	1.05	2.38	0.029
Distance	Less than 100km	Reference			
	At least 100km, but less than 200km	1.94	1.17	3.20	0.010
	At least 200km, but less than 400km	1.71	0.98	3.00	0.061
	400 km or more	1.71	0.99	2.95	0.054
AUDIT Score	0	0.35	0.16	0.75	0.008
	1-7 (Low risk)	Reference			
	8-12 (Risky)	3.16	1.94	5.13	<0.001
	13+ (High risk)	13.35	8.12	21.94	<0.001

Conclusions

The results of this study highlight that high-risk patterns of alcohol consumption amongst young drivers are an issue of concern when considering factors that may contribute to engagement in drink driving behaviour. Studies such as the one described here offer a pathway for the journey Towards Zero, by identifying a group of drivers who may be at greater risk of engaging in drink driving behaviour, and therefore subsequently of serious injury and fatal crashes. By identifying a group of drivers for whom alcohol consumption is an issue and where the odds of driving with a potentially illegal BAC are greater, there is an opportunity to develop effective policies, that not only protect young drivers themselves, but all road users. These could include, for example, raising awareness of services to aid in addressing problematic patterns of alcohol consumption.

References

Babor, T., Higgins-Biddle, J., Saunders, J., & Monteiro, M. (2001). The Alcohol Use Disorders Identification Test: Guidelines for use in primary care. Second Edition. Geneva, Switzerland: World Health Organization. https://www.who.int/publications/i/item/WHO-MSD-MSB-01.6a

Brown, T. L., Lee, J. D., & Fiorentino, D. (2018). Effects of alcohol at 0.05% blood alcohol concentration (BAC) on low speed urban driving. *Traffic Injury Prevention*, *19*(sup2), S175–S177. https://doi.org/10.1080/15389588.2018.1532220

Freeman, J., Parkes, A., Armstrong, K., & Davey, J. (2021). Characteristics of Fatal Road Traffic Crashes Associated with Alcohol and Illicit Substances in Queensland (2011-2015). *Journal of Road Safety (Australasian College of Road Safety. Online)*, *32*(3), 4–14. https://doi.org/10.33492/JRS-D-20-00146

Høye, A. K., & Storesund Hesjevoll, I. (2023). Alcohol and driving-How bad is the combination? A meta-analysis. *Traffic Injury Prevention*, *24*(5), 373–378. https://doi.org/10.1080/15389588.2023.2204984

Pasnin, L. T., & Gjerde, H. (2021). Alcohol and drug use among road users involved in fatal crashes in Norway. *Traffic Injury Prevention*, *22*(4), 267–271. https://doi.org/10.1080/15389588.2021.1887854

Peck, R. C., Gebers, M. A., Voas, R. B., & Romano, E. (2008). The relationship between blood alcohol concentration (BAC), age, and crash risk. *Journal of Safety Research*, *39*(3), 311–319. https://doi.org/10.1016/j.jsr.2008.02.030

Scott-Parker, B., Watson, B., King, M. J., & Hyde, M. K. (2014). "I drove after drinking alcohol" and other risky driving behaviours reported by young novice drivers. *Accident Analysis and Prevention*, *70*, 65–73. https://doi.org/10.1016/j.aap.2014.03.002

Stringer, R. J. (2021). Deterring the Drunk Driver: An Examination of Conditional Deterrence and Self-Reported Drunk Driving. *Crime and Delinquency*, *70*(12), 3416–3441. https://doi.org/10.1177/00111287211054721

Taylor, B., & Rehm, J. (2012). The Relationship Between Alcohol Consumption and Fatal Motor Vehicle Injury: High Risk at Low Alcohol Levels. *Alcoholism, Clinical and Experimental Research*, *36*(10), 1827–1834. https://doi.org/10.1111/j.1530-0277.2012.01785.x

World Health Organization. (2023). Global status report on road safety 2023. World Health Organization, Geneva, Switzerland. https://iris.who.int/bitstream/handle/10665/375016/9789240086517-eng.pdf?sequence=1

Supporting Safe System through the Road and Roadside Safety Policy

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Abstract

The Department of Transport and Planning (DTP) Victoria introduced the new Road and Roadside Safety Policy in May of 2024. The policy was developed over a number of years, informed by a significant body of evidence around key systemic risk across the network. The policy presented a significant evolution in the way road infrastructure projects are approached, requiring that road safety focussed treatments be the default approach in several key areas where safety traditionally competed with other objectives. In circumstances where these default positions cannot be met, an exception process must be followed, which requires demonstration of how due consideration of alternative Safe System aligned treatments. While no formal evaluation of the policy has occurred, anecdotal evidence from early results show that the policy, now a standard requirement of DTP's external contracts, has been successful in enforcing these minimum standards in new projects.

Social media post

The new Department of Transport Road and Roadside Safety policy represents an evolutionary change in the approach to road safety in the state.

Introduction

In December 2020, the Victorian Government released the *Victorian Road Safety Strategy 2021- 2030*. The Road Safety Strategy aims to halve road deaths and reduce serious injuries by 2030 and put us on the path to eliminating road deaths by 2050. Given the asset life of new infrastructure, it is imperative that any new projects are highly aligned to the Safe System to achieve these targets.

The Victoria Department of Transport and Planning (DTP) Roads and Roadside Safety Policy ('the Policy') supports this aim by requiring additional minimum safety standards for all new infrastructure projects built on state roads and for them to have increased alignment with the Safe System principles to reduce the risk of fatal and serious injuries. The Policy came into effect in May of 2024. This paper presents an overview of the policy, its contents including the exception process, how it has been implemented into Departmental projects and early learnings/experiences.

Conference Theme - Evolution

The Policy represents a significant shift in the way road safety is approached on the Victorian state road network. By implementing a series of new by-exception minimum road safety standards, project teams are required to take a safety-first approach in their decision making. This ensures that typical road safety treatments that were often retrofitted once a road safety problem emerged at significant cost, are introduced included from the outset.

This change flips the traditional script of justifying why a safety measure should be included to one where the measure being included is the default position. Where it cannot be, suitable, principles-based justification needs to be provided as to why it cannot be accommodated, and what other supporting safety measures were considered to help combat residual risk and achieve the desired outcome of the policy requirement. This change will allow for a significant evolution in the transport network, ensuring that new assets, the impacts of which can last decades, are highly aligned with Safe System objectives and supportive of our 2030 and 2050 objectives.

Overview of the Policy

The Policy applies to all project that would impact arterial (state controlled) roads. It consists of four key sections:

1. Overview of DTP's position on Road Safety
2. Requirements around when to undertake a Safe System Assessment
3. Minimum road safety standards for road infrastructure
4. Policy exceptions

While sections 1 and 2 present relatively minor changes to existing Departmental positions, Section 3 in particular represents a significant shift in the way a number of state projects are approached, setting out the minimum road safety standards to be implemented on new projects in the form of policy positions across nine key areas:

- Right turns at signalised intersections
  - All right turns required to be fully controlled
- Left turns at signalised intersections
  - All slip lanes must be high angle
  - Raised crossings on slip lanes required in high pedestrian and cyclist areas
  - If no slip lane and space allows, fully controlled left turns should be used.
  - If a fully controlled left-turn cannot be provided, a pedestrian head start should be implemented.
- Urban uncontrolled intersections
  - No new uncontrolled right-turns or through movements permitted on 60km/h or higher speed roads
- Rural high-speed uncontrolled intersections
  - All are required to have splitter islands on the minor roads and channelised right-turns on the major road at a minimum unless volumes are less than 20 vehicles and hour
- Rural duplicated high speed road intersections
  - New wide median treatments are disallowed.
- Rural mid-blocks
  - High movement corridors are required to have continuous roadside and median barriers, audio tactile line marking and sealed shoulders
- Urban mid-blocks
  - Continuous barrier (median and roadside) on roads where speed limits exceed 80km/h
  - Targeted roadside barrier on roads with speed limits of 60km/h and 70km/h
- Strategic cycling corridors
  - All strategic cycling locations must have separated cycling facilities or operating speeds of 30km/h or lower.
- Motorcycle routes
  - Barrier protection (post protection or rub rail as appropriate)
  - Sealing of bell mouths
  - Sealed shoulders

Where these minimum positions cannot be met, the Policy outlines an exception process, requiring a principles-based approached outlining the various considerations that should inform any potential deviation from these standards. These are:

- Safe System principles
- Environment and cultural heritage
- Maintenance and operation
- Safe access
- Safe mobility
- Funding availability

The Policy also contains a guide on Safe System best practice, requiring that alternative measures aligned to the Safe System, or at least supporting the Safe System, be explored before any exception to the minimum standards be granted.

Policy Development

Countermeasure Selection

The minimum treatment policy positions were chosen based on three requirements:

- Countermeasures are considered good design and construction practice for safe road infrastructure;
- Countermeasures are often selected for retrofit as part of current safety programs, potentially demonstrating a cost saving from implementing them at project inception; and/or
- Countermeasures are often recommend based on Safe System alignment.

Economic analysis was conducted on each of the policy positions based on case studies of recent projects. This analysis identified that 5 of the 8 policy positions achieved positive benefit-to-cost ratios (BCRs). These were:

- Rural high-speed uncontrolled intersections
- Rural mid-blocks

- Urban mid-blocks
- Strategic cycling corridors
- Motorcycle routes

The three remaining policy positions were assessed to have negative BCRs due largely to the increased travel time imposed. These were:

- Treatment of right turns at signalised intersections
- Treatment of left turning vehicles at signalised intersections
- Treatment of urban uncontrolled intersections

However, traditional BCRs were considered not fit-for-purpose for assessment of road safety policy decision making. The accumulation of relatively minor increase in travel time at the individual level were shown to outweigh the benefits of trauma reduction, which is in direct conflict with the Victorian Government's road safety objectives. Given this, DTP opted to adopt all policy positions, despite the negative BCR suggested by these three positions based on traditional economic models.

Further details on the economic assessment of the *Treatment of Right Turns at Signalised Intersections* policy position, and the limitations of traditional economic models, is presented in Durdin et. Al (2023).

Consulted Parties

The policy underwent a through internal consultation, which included numerous workshops to inform the broader department of the proposed policy positions and receive their feedback. but not limited to:

- Road and Traffic Design
- Network Pipeline and Program
- Rural Surface Transport
- Metro Surface Transport
- Project Integration
- Major Road Projects Victoria
- Freight Victoria.

Policy Update Timeframe

The update to the policy commenced in June 2022 and was initially envisioned to be implemented by the end of the 22/23 financial year. However, through the consultation with the broader Department it became apparent there was a desire to better understand potential conflicts with broader Department objectives, particularly congestion impacts. This required significant additional investigative work to fully understand these risks, with the project timeframe revised and the policy ultimately launched in May 2024.

Policy Impacts

The policy has not been in effect long enough for an evaluation, however based on anecdotal experience from Road Safety Victoria, the policy is already seen good embedment within the Department, with it now forming part of the key requirements for new projects on the state road network.

While reception to the policy positions varies amongst areas of the Department, it has been universally praised for its directness, with teams appreciating the clear and concise requirements. Ambiguity typically associated with alternative road safety measures, such as treatments recommended in Safe System Assessments, is removed by setting out these minimum standards. Additionally, by having these standards set out as policy, it adds significant weight to practitioners arguing for safety interventions being introduced as part of works put forward by third parties, such as developers.

Further, as the policy is now embedded in all new projects, staff across the Department are now engaging early with members of Road Safety Victoria for road safety subject matter expertise, opening the door for a wider project review and opportunity for discussion on further improvements to road safety outcomes in projects, in line with Departmental safety objectives.

Conclusion

The Road and Roadside Safety policy represents a substantial step forward in the way road safety is approached on state road projects in Victoria. Through its implementation, the path of the state road networks evolution has been directed towards one that supports the 2030 and 2050 targets to provide a safe and equitable transport network for all Victorians.

Next Steps

The policy is intended as a living document, with reviews conducted on annual basis to ensure it aligns with current best practice within the Department. It is anticipated that the policy will be revised in the future to include areas such as:

- Safety management across the infrastructure project lifecycle
- Road Safety Auditing
- Fatal and serious injury crash review
- Further guidance around road infrastructure treatment selection
- Road Safety capability and competency
- Road Safety Performance Indicators
- Road Safety Innovation Projects

References

Durdin, P., Fernando, R, Hunter, C, & Sherwell, L. (2023). Incompatibility of traditional economic appraisal methods and Safe System outcomes *2023 Australasian Road Safety Conference, Cairns, Australia*

Rural compact roundabouts within the Mornington Peninsula

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Abstract
A significant amount of road trauma occurs at intersections. Roundabouts have long been considered a Safe System intersection treatment but can be expensive to construct, particularly in high speed environments. Two rural compact roundabouts in 80 km/h+ speed limit environments within the Mornington Peninsula have shown to be effective in achieving Safe System aligned performance, based on a high-level assessment of connected vehicle data, at a significantly lower cost than conventional reverse curve roundabouts. Effective yet lower cost roundabouts have the potential to assist in wider implementation of Safe System intersection treatments on the path to Vision Zero, accelerating transformation of the road network to be a Safe System where crashes are less likely, and death or serious injury are not the result when crashes occur.

Social media post
Two rural compact roundabouts in high speed limit environments within the Mornington Peninsula have shown to be effective in achieving Safe System aligned performance. Effective yet lower cost roundabouts have the potential to assist in wider implementation of Safe System intersection treatments to reduce road trauma.

Introduction
Despite only a small proportion of journey time spent travelling through intersections, a high proportion of crashes occur at them (over 40% of fatal and serious injury crashes within the Mornington Peninsula occur at intersections (Logan et al., 2020).

Roundabouts exemplify Safe System infrastructure by reducing intersection conflict points and limiting impact speeds to survivable levels (Woolley et al., 2018). However, they often require extensive civil works, utility relocations, land acquisition, and native vegetation removal, making them expensive and with long implementation timeframes. This is particularly the case in high speed environments (80 km/h+), where design standards require reverse curves and large central islands to create horizontal deflection to manage vehicle speeds, resulting in large footprints and high costs. Some recent State-managed roundabouts in high speed environments have cost over $8m (Transport Victoria, 2025).

To meet Vision Zero targets globally, Safe System infrastructure must be implemented widely, transforming the road network to be forgiving to prevent fatal and serious crashes. With limited funding, road authorities need cost-efficient treatments to address key crash types.

Compact roundabouts offer potential Safe System outcomes at significantly lower costs than traditional roundabouts, especially in high speed environments. Their design typically incorporates vertical deflection (such as Raised Safety Platforms) to gradually slow approaching vehicles, eliminating the need for reverse curves and allowing smaller central islands that still accommodate large vehicles. This reduced footprint minimises or avoids land acquisition, utility relocations, and native vegetation removal. Mornington Peninsula Shire in Victoria has explored, designed and constructed two rural compact roundabouts in high speed environments (80 km/h+) which is discussed in this paper.

Conference theme
The work discussed in the paper is an example of Evolution in terms of innovative road safety treatments, at a lower cost than conventional treatments, to assist in facilitating the wider implement of Safe System aligned infrastructure.

Project description

Pre-roundabout conditions
Intersections continue to be a source of risk and crashes within the Mornington Peninsula. Two rural high-risk cross intersections that were investigated, are the intersection of Merricks Road and Stanleys Road in Merricks, and the intersection of Hodgins Road and Stumpy Gully Road in Tuerong. The pre-roundabout conditions at each location are shown below in Figure 1.

Crashes had occurred at both locations, and it was recognised that both intersections are high risk and with the potential for future crashes. Each location had the following crash histories since 2012:

- Merricks Road/ Stanleys Road: Two serious injury crashes and three minor injury crashes
- Hodgins Road/ Stumpy Gully Road: Three serious injury crashes and one minor injury crash

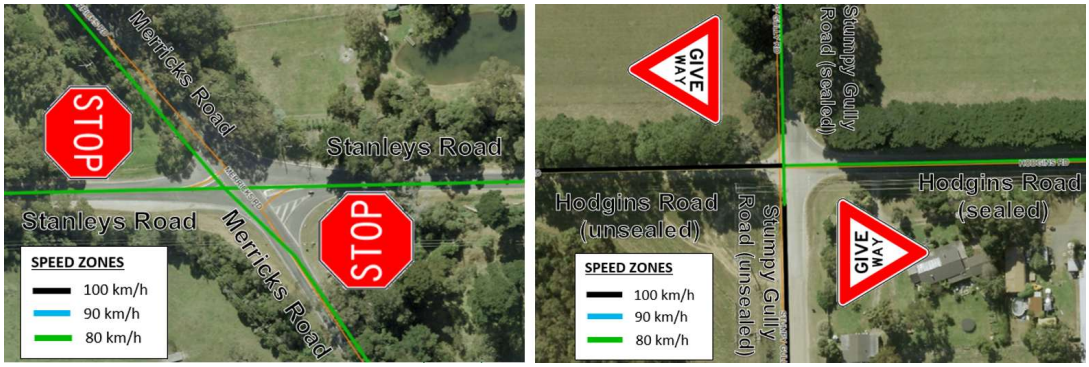


Figure 1. Pre-roundabout conditions at Merricks/Stanleys Roads (left) and Hodgins/Stumpy Gully Roads (right)

Solution development

Roundabouts were identified as the optimal treatment for both intersections. To address cost constraints and site challenges including narrow road reserves, utility services and native vegetation, innovative compact roundabout designs were developed. Traditional reverse roundabouts for 80 km/h+ environments would have required larger footprints, higher costs, and greater environmental impact.

Design considerations

A rural compact roundabout has previously been constructed in Lance Creek by Regional Roads Victoria. This roundabout cost $3.4 million (Regional Roads Victoria, 2020) which was beyond available funding for the Mornington Peninsula Shire rural roundabouts. The Shire developed more affordable designs, tailored to the context of these roads. Key design decisions included central island diameter, Raised Safety Platform specifications, platform spacing, truck turning movements, truck stability considerations, and signage. The design philosophy to achieve a gradual slowing of vehicles approaching the roundabout is shown in Figure 2.



Figure 2. Example of design to achieve gradual slowing of vehicles approaching roundabout

Results

The Merricks Road/ Stanleys Road roundabout reached completion in August 2023, and the Hodgins Road/ Stumpy Gully Road roundabout reached completion in July 2024. The below subsections discuss the key outcomes of the roundabouts so far. The completed compact roundabouts at each site are shown in Figure 3 below.



Figure 3. Completed rural compact roundabouts at Merricks Road/ Stanleys Road (left) and Hodgins Road/ Stumpy Gully Road (right)

While some practitioners believe innovative rural roundabouts may have disbenefits relative to conventional reverse curve designs, Mornington Peninsula Shire has recorded few issues with the two rural compact roundabouts. A small minority of residents dislike the aesthetic of Raised Safety Platforms and signage, and would prefer not to need to drive over platforms on departure. However, the vast majority most road users have provided no negative feedback.

Vehicle speeds

Compass IoT connected vehicle data has been used to assess the effectiveness of each roundabout in achieving Safe System threshold speeds entering the roundabout (summarised in Table 1). “Before” data spans 31 Jan 2022-31 Jan 2023 for Merricks/ Stanleys and 1 Jan 2023-1 Jan 2024 for Hodgins/ Stumpy Gully. The “after” period for both is 1 Nov 2024 -12 Mar 2025.

Table 1. Speed of vehicles entering the intersections at the Merricks Road/Stanleys Road and Hodgins Road/Stumpy Gully Road, before and after compact roundabouts

Roundabout approach direction	Mean speed entering conflict point (km/h)		85th percentile speed entering conflict point (km/h)		Percentage of vehicles entering intersection 50 km/h+	
	Before	After	Before	After	Before	After
Merricks Road/ Stanleys Road rural compact roundabout						
Eastbound approach	5.0	22.2	13.5	27.0	0%	0% (also 0% 40 km/h+)
Southbound approach	67.0	24.9	77.0	35.4	85%	0% (also 0% 40 km/h+)
Westbound approach	7.9	21.0	15.0	25.0	0%	0% (also 0% 40 km/h+)
Northbound approach	65.4	21.1	79.0	26.0	79%	0% (also 0% 40 km/h+)
Hodgins Road/ Stumpy Gully Road rural compact roundabout						
Eastbound approach	5.0	24.2	10.0	32.3	0%	0% (also 0% 40 km/h+)
Southbound approach	48.0	32.1	75.0	39.0	49%	0% (7.5% 40 km/h+)
Westbound approach	12.0	26.9	22.0	33.0	0%	0% (also 0% 40 km/h+)
Northbound approach	54.0	18.5	74.0	25.6	62%	0% (also 0% 30 km/h+)

Table 1 shows both compact roundabouts achieve mean and 85th percentile speeds at the conflict points that are well below the 50 km/h threshold for 90% survivability in right-angle crashes. No vehicles were recorded entering at 50+ km/h during the "after" period, with most approaches showing no entries above 40 km/h, demonstrating strong Safe System performance.

Costs

The total costs for each roundabout (including all design, project management, construction supervision and construction costs (excluding GST)) were:

- Merricks Road/ Stanleys Road roundabout: $1,375,000
- Hodgins Road/ Stumpy Gully Road roundabout: $1,650,000

Benefits to road safety

Preliminary evaluation using connected vehicle data shows that rural compact roundabouts can be an effective Safe System infrastructure treatment at significantly lower costs than conventional designs. This approach could enable wider implementation of trauma-reducing treatments, particularly on council-managed roads, and potentially on arterial roads. A comprehensive evaluation by the Victorian Department of Transport and Planning is currently underway.

Conclusions

Two rural compact roundabouts in high speed environments within the Mornington Peninsula have shown to be effective in achieving Safe System aligned performance, based on high-level assessment of connected vehicle data, at a significantly lower cost than conventional reverse curve roundabouts.

Effective yet lower cost roundabouts have the potential to assist in wider implementation of Safe System intersection treatments on the path to Vision Zero, accelerating transformation of the road network to be a Safe System where crashes are less likely, and death or serious injury are not the result when crashes occur.

References

Logan, DB., Corben, B., Healy DJ. (2020). Development of a road safety strategy for Mornington Peninsula Shire, 2021-2025. http://www.mornpen.vic.gov.au/TowardsZero

Regional Roads Victoria (2020). Project Evaluation Finding – Lance Creek Compact Roundabout.

Transport Victoria (2025). Myers and Coolart Road intersection upgrade, Bittern. Webpage. Accessed 14 March 2025. https://transport.vic.gov.au/news-and-resources/projects/myers-and-coolart-road-intersection-upgrade-bittern

Woolley, J., Stokes, C., Turner, B. & Jurewicz, C. (2018*).* Towards Safe System Infrastructure: A Compendium of Current Knowledge. Austroads Research Report AP-R560-18, 163pp.

Driving with bioptic telescopes: human factors, driver performance and safety

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Abstract
Bioptic telescopes (BTs) are assistive devices for people with low vision, being advocated for use when driving. BTs are mounted on the upper part of a person's glasses. The driver tilts their head down to look briefly through the BT when needing magnification to see objects on the road environment more clearly. Assessing Fitness to Drive Standards 2022 (AFTD) indicate a lack of sufficient evidence available to set standards for the use of BTs while driving. To support equitable and evidence-based licensing decisions, a university project team was engaged to use a human factors ergonomics (HFE) systems framework to review available evidence concerning the impact of drivers' use of BTs on their driving performance and road safety. Results concluded that available research is not adequate to address the factors that are important for determining the influence of BT use on driving performance and road safety in real-world driving environments.

Social media post
A human factors ergonomics (HFE) systems framework review of available evidence concerning the impact of drivers' use of Biotic Telescopes on their driving performance and road safety.

Background
Under the Road Safety Act 1986, the licensing authority must undertake its responsibility to ensure that all licensed drivers are medically fit to drive and have the necessary skills to drive safely. To do this they refer to the National driver medical standards, *Assessing Fitness to Drive 2022 (AFTD)* when developing policy which informs licensing decisions for assessing medical fitness to drive in their jurisdiction.

The subject of this work, bioptic telescopes, is a device that have been proposed for use by a small number of drivers in Australia who have permanent central field loss. (See Figure 1.) The 2022 *Assessing Fitness to Drive Standards (AFTD)* describe bioptic telescopes as follows: *Bioptic telescopes are devices used to compensate for reduced visual acuity. They are miniature telescopes typically mounted on the upper part of a person's glasses. Bioptics are used momentarily and intermittently when driving, the majority of which occurs at the corrected visual acuity provided by the person's glasses. The person drops their chin slightly to view through the telescope for magnification, then lifts their chin to view through their standard corrective lens.*



Figure 1: Example of a Bioptic telescope

The 2022 AFTD advises that there is currently insufficient evidence to set standards for the use of bioptic telescopes while driving. Drivers wishing to use bioptic telescopes are directed to their state or territory licensing authority to understand what is allowed in their jurisdiction.

This licensing authority's policy is that all notifications to medical review are considered on an individual basis, including those relating to the use of bioptic telescopes. To date, bioptic lenses have not been permitted in this

jurisdiction to enable a driver to be licensed who would otherwise not meet the vision standards, as outlined in the national 2022 AFTD standards.

Given the lack of evidence sufficient to set a Standard for bioptic telescope use in the 2022 AFTD standards update, the licensing authority engaged a university research team with expertise in human factors/ergonomics, orthoptics and occupational therapy driving assessment to address the identified human factors and safety research evidence gap to help inform the jurisdiction's fitness to drive policy on this issue.

Conference Theme

This project aligns with the conference theme of Equity.
The licensing system in this jurisdiction addresses each notification to medical review on a case-by-case basis, recognising the inherent value of each person, and the impact that licensing can have on access to their community. In order to make fair and equitable licensing decisions that balances driver mobility needs and community safety, fitness to drive policy is based on the AFTD Standards, medical advice and the best available evidence. Recognising that there is a lack of evidence to support decisions on the use of bioptic telescopes while driving, the licensing authority sought to address the identified human factors and safety research evidence gap to help inform an objective and evidence-based fitness to drive policy on this issue.

Project Description

The overall aim of this project was to consider whether drivers using bioptic telescopes (BT drivers) are able to "react to the driving environment in a safe, consistent and timely manner".
Two research questions were addressed:

1. What are the human factors essential for safe driving that need to be considered when introducing the use of BTs into the driving task in a dynamic/changeable driving environment?
2. What impact does the use of BTs have on driver performance in dynamic driving environments with different characteristics?

Method

To address Research Question 1, a Human Factors / Ergonomics (HFE) systems approach was used to formulate a hierarchical taxonomy of 'the human factors related to driving'; particularly safety-related factors that may be affected by a driver's use of a bioptic telescope (BT). Central to the HFE conceptual framework underpinning the taxonomy is the importance of all drivers having the *capacities and skills needed to cope safely with the various driving task demands they may encounter* during driving. These must be considered within the system in which they are operating, therefore a systems approach was adopted.

To address Question 2, two separate methods were used:

1. HFE task analyses of a broad range of driving task scenarios drawn from this state's urban, suburban and rural driving environments, supported by 'cognitive walkthroughs' of these driving scenarios

This approach assessed: "the match between the car drivers' capabilities and the demands of the actual driving task [which] determines the outcome in terms of a more or less safe driving behaviour" (Fastenmeier & Gstalter, 2007, p.953). Factors such as the effect (positive or negative) that the use of BTs has on hazard perception is an important example in this analysis. The effect on road safety of the introduction of BTs a range of common dynamic driving environment scenarios must be a central consideration, and this is addressed during the cognitive walkthroughs.

2. A systematic literature review of current research evidence based on taxonomy factors

Key to this review was the search for evidence relevant to factors identified in the taxonomy that are important for the dynamic (real-world) driving task while using bioptic telescopes. Sixty-two published articles met the criteria for inclusion in the systematic literature review. As part of this review, key content was extracted and organised in accord with taxonomy factors. The published evidence was mapped against the taxonomy to enable evaluation of the extent to which current evidence addresses each of these potentially relevant factors.

Findings

The variables to consider when introducing BTs into the driving task should be approached using the systems theory. The HFE task analysis places the human component central and considers it with respect to the highly dynamic driving task, the changing driving environment, and other systems. Broadly, the domains important for focus when introducing BTs are characteristics of the: driver, bioptic telescope (BT), vehicle, driving environment, the driving tasks required,

and other wider system factors such as legislation and licensing requirements.

There is a lack of research evidence available related to the use of Bioptic Telescopes while driving that address the different system characteristics that must be explored, as identified in the taxonomy, and as noted above.

Very little detailed information was found in the literature about driver characteristics known to affect driving performance and safety, apart from vision, for which the most reported details were of static visual acuity and clinically diagnosed visual impairment. There was relatively little mention of drivers' perceptual/cognitive functioning, which is unfortunate because functional measures such as the driver's 'useful field of view' (UFOV), which reflects an individual's information processing speed and level of 'spare' attentional resources, are strongly linked to crash risk.

The range of available literature that addressed relevant factors, identified in the taxonomy, produced mixed findings. It indicated that, use of a BT can enable the driver to decipher details of traffic signs and distant objects or hazards that they could not otherwise see clearly. However, the research found that safety benefits were often unclear. For example, when the BT is used to 'spot' details of an intersection or curve in the road ahead, this needs to be done before the vehicle is so close that driver action is needed, as BTs cannot be used when the driver must see the close environment. Therefore, both the practicability and value of using a BT while driving can be limited in most real-world driving situations. Additionally, it indicated that, in some instances, the use of a BT may increase crash risk, such as when the driver has the potential for degradation of steering performance while using the BT and also when driving at moderate to high speed *and when* there is a high potential for unexpected events/hazards requiring immediate responses from the driver due to the driver having a narrow focus, both visually and cognitively, when using BTs.

Benefits to road safety

This research has provided a taxonomy from a human factors/ergonomic perspective that identifies the factors that are important for driving performance, and that influence driving performance when bioptic telescopes are introduced into the driving task. This taxonomy can be applied to further research in this area, as it has identified the factors and variables that are relevant for further research focus to explore road safety benefits and disbenefits.

Implications for policy and/or practice

This work confirms that there is currently not sufficient evidence available, and very little relevant evidence has been conducted to date, to show safety benefits that will support a policy position that enables the use of bioptic telescopes while driving.

However, it is clear that further research on this topic is required, and this work has paved the way, via the development of a taxonomy of relevant factors for further exploration, to conduct targeted research to further develop a usable evidence base for the impact of the use of bioptic telescopes on driving performance, and the implications for road safety.

Conclusions

Current research available does not adequately address the factors that are important for determining the influence of the use of bioptic telescopes on driving performance when used in a real-world driving environment, and subsequently the influence of these assistive devices on road safety.

This research has produced a taxonomy that identifies the factors that are important for driving performance, and that influence driving performance, when bioptic telescopes are introduced into the driving task. This is an important resource that can be used as the basis for further research that is needed on this topic to add to the evidence base to support fitness to drive policy on this topic.

References

Austroads (2022) *Assessing Fitness to Drive*, 6th Edn., www.austroads.com.au

Fastenmeier, W., & Gstalter, H. (2007). Driving task analysis as a tool in traffic safety research and practice. *Safety Science*, *45*, 952-979.

Macdonald WA & Harrison WA, 'Construct validity of Victoria's new licence test', Proceedings, 2008 Australasian Road Safety Research, Policing and Education Conference, 10-12 November 2008, Adelaide, South Australia.

Stuckey . R., Vukicevic, M., Macdonald, W., Ross, P.,(2024*)* 'Driving with Bioptic Telescopes: human factors analysis and road safety evidence review', Report for Department of Transport and Planning, Victoria (Unpublished).

Sleep irregularity is associated with driving impairment during sleep deprivation

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Abstract
Irregular sleep is emerging as a risk factor for adverse health. The extent to which sleep irregularity affects driving performance is not well understood. Thirty-nine self-reported healthy sleepers (15 males, aged 31.0±11.6y) completed two weeks of home sleep monitoring using GENEActiv watches. Participants were provided a 9-hour in-laboratory overnight sleep opportunity, followed by ~29h of extended wakefulness. Linear mixed models analysed associations between time awake (60-minute drives at 1, 7, 13, 19, and 25h after waking) and sleep irregularity (standard deviation of sleep midpoint and total sleep time, based on home sleep data) on steering deviation on the AusEd driving simulator. An interaction between sleep irregularity and time awake on steering deviation was observed ($F(4,118.85)=3.74$, $p=.007$), such that greater irregularity in sleep midpoint timing was associated with poorer driving performance across extended wakefulness. Irregular sleep timing may increase driving impairments and should be considered in future fitness-to-drive studies.

Social media post
Irregular sleep timing and the duration of time awake is associated with driving simulator performance using data from a sleep/activity monitor. Sleep irregularity could be an important consideration for road safety.

Introduction
Excessive sleepiness increases the risk of a motor vehicle accident by 250% (Bioulac et al., 2017), with slower reaction times and poorer vehicle control that are comparable to alcohol intoxication apparent when drivers are sleepy (Lowrie & Brownlow, 2020). Miyata et al. (2010) have previously identified that insufficient sleep (<4 h) resulted in slower brake reaction time than after sufficient sleep (8 h). While the effect of insufficient sleep is understood to be substantial on driving performance, the degree to which irregular sleep affects driving performance is far less understood. Sleep irregularity refers to inconsistent patterns in sleep timing and duration. This can include variations in bedtime and wake time, which can be combined to determine the midpoint of sleep timing, and variations in the total amount of sleep obtained each night. Recent studies have shown that sleep irregularity is a significant risk factor for poor health, including a greater incidence of depression, anxiety, hypertension, and cardiovascular disease (Okuda et al., 2021; Chung et al., 2023; Scott et al., 2023). Theoretically, the loss of sleep resulting from irregular sleep behaviours may result in greater vulnerability to driving performance errors during periods of extended wakefulness. Understanding how sleep patterns affect susceptibility to driving errors has implications for road safety, and public health messaging around sleep in road users.

Conference theme
Evolution: This research aligns with the conference theme of evolution, identifying novel measures to determine road safety risk based on human behaviour.

Method
Thirty-nine self-reported healthy sleepers (15 males, aged 31.0±11.6 years) completed two weeks of at-home sleep monitoring using the GENEActiv. Sleep irregularity was calculated using the standard deviation (SD) of sleep midpoint time and total sleep time based on the data obtained from this device. Upon arriving at the sleep laboratory, participants were provided with a 9-hour overnight sleep opportunity based on their habitual bedtime, followed by approximately 29 h of extended wakefulness. During this time, participants completed the 60-minute AusEd driving simulator task (Desai et al., 2007) at 1, 7, 13, 19, and 25 h after waking (Figure 1). The task was designed to represent driving on a dual-lane highway at nighttime, whilst using low-beam lights and staying within a speed limit of 60-80km/h. Lane deviation from

the middle of the road was calculated for each drive. Data were collected between December 2021 and June 2023. Linear mixed models assessed associations between time awake (five drives conducted 6 hours apart) and sleep irregularity on driving simulator steering deviation, with participants specified as a random intercept.

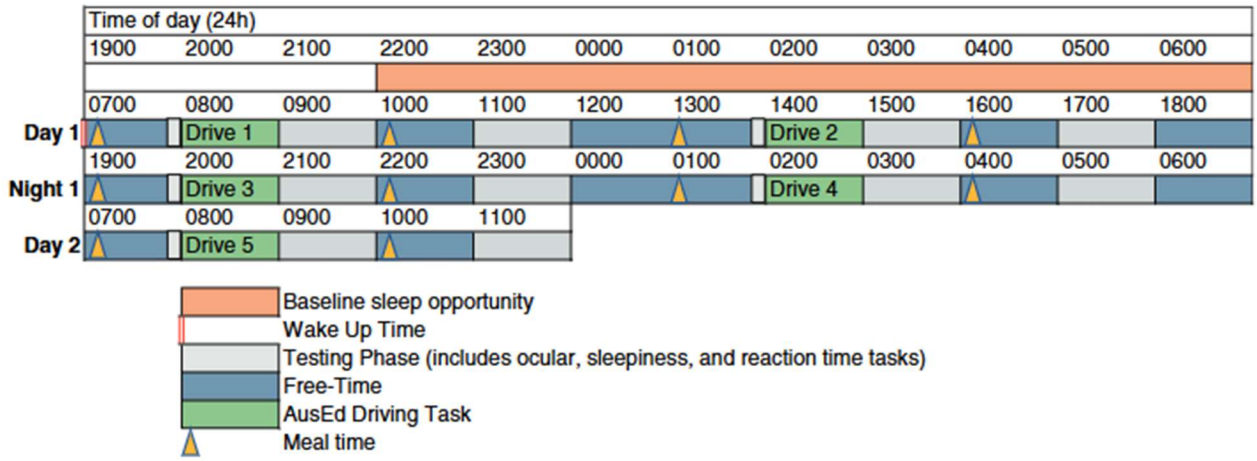


Figure 2: Overview of the 29-hr extended wakefulness protocol and timing of the 60-min simulated drives based on an individual with a wake-time of 07:00 hours

Results

Preliminary analysis showed an interaction between sleep midpoint irregularity and time awake on driving performance ($F(4, 118.85) = 3.74$, $p = .007$). For interpretability, participants were split into tertiles based on their sleep midpoint irregularity. As seen in Figure 2, greater irregularity in sleep midpoint timing was associated with greater driving impairment when sleep-deprived (i.e., >19 hours awake). No interaction effects were observed between irregularity in total sleep time and time awake ($F(4, 119.26) = 1.48$, $p = .214$), nor were main effects of irregularity in total sleep time ($F(1, 35.01) = 0.18$, $p = .678$) or irregularity in sleep midpoint observed ($F(1, 34.46) = 0.50$, $p = .483$). As anticipated, a main effect of time spent awake on steering deviation was observed ($F(4, 123.77) = 18.25$, $p < .001$), whereby greater time awake was associated with greater driving impairment.

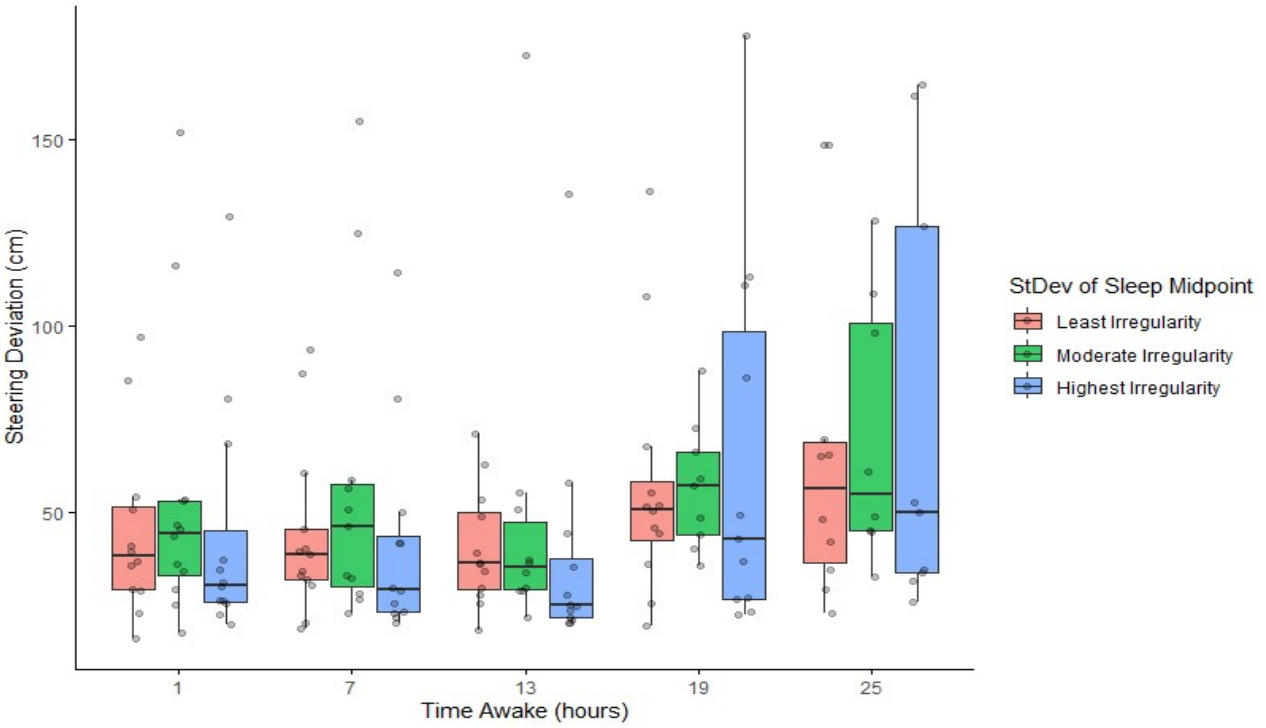


Figure 2: Steering deviation from the middle of the road (y-axis) across time awake (1, 7, 13, 19, and 25 hours; x-axis) by sleep midpoint irregularity split into tertiles

Benefits to road safety

These findings indicate that irregularity in sleep timing, but not irregularity of sleep duration, may exacerbate driving performance impairments when combined with a period of sleep deprivation. Specifically, individuals with irregular sleep timing exhibit the greatest lane deviation when driving beyond 19 h of wakefulness. Overall effects suggest that sleep deprivation also negatively affects a road users' ability to control their vehicle. Making road users aware of the effects of sleep irregularity and the risks that inconsistent sleep schedules pose may help to inform safe driving practices and, in turn, improve road safety.

Implications for policy and/or practice

Irregularity in the timing of sleep may need to be considered when determining fitness-to-drive, particularly for individuals required to drive after periods of extended wakefulness. It is acknowledged that a sample of healthy sleepers were recruited, meaning that the extent to which irregular sleep in sleep disordered populations—who may present higher risk of driving impairment—is not represented. The implications of this study are relevant for shift workers, who are exposed to irregular sleep schedules, and may be required to operate a vehicle after longer periods of wakefulness. Educational awareness programs promoting the potential risks of sleep irregularity on performance may help to minimise road accidents by informing decisions regarding driving. Further, encouraging organisations to consider best-practice rosters that support sleep regularity may be an important translational application.

Conclusions

Sleep irregularity may pose safety risks for drivers, particularly when coupled with extended time awake (>19 h). Irregularity in sleep as a predictor for subsequent driving impairment requires further investigation. Future research should consider indicators of sleep irregularity in broader adult populations to better understand the interplay between regularity and road safety metrics.

References

Bioulac, S., Micoulaud-Franchi, J. A., Arnaud, M., Sagaspe, P., Moore, N., Salvo, F., & Philip, P. (2017). Risk of Motor Vehicle Accidents Related to Sleepiness at the Wheel: A Systematic Review and Meta-Analysis. *SLEEP*, *40*(10). https://doi.org/10.1093/sleep/zsx134

Chung, J., Goodman, M., Huang, T., Wallace, M. L., Lutsey, P. L., Chen, J. T., Castro-Diehl, C., Bertisch, S., & Redline, S. (2023). Multi-dimensional sleep and mortality: The Multi-Ethnic Study of Atherosclerosis. *SLEEP*, zsad048. https://doi.org/10.1093/sleep/zsad048

Desai, A. V., Wilsmore, B., Bartlett, D. J., Unger, G., Constable, B., Joffe, D., & Grunstein, R. R. (2007). The utility of the AusEd driving simulator in the clinical assessment of driver fatigue. *Behavior research methods*, *39*, 673-681.

Lowrie, J., & Brownlow, H. (2020). The impact of sleep deprivation and alcohol on driving: a comparative study. *BMC Public Health*, *20*(1), 980. https://doi.org/10.1186/s12889-020-09095-5

Miyata, S., Noda, A., Ozaki, N., Hara, Y., Minoshima, M., Iwamoto, K., Takahashi, M., Iidaka, T., & Koike, Y. (2010). Insufficient sleep impairs driving performance and cognitive function. *Neuroscience Letters*, *469*(2), 229-233. https://doi.org/https://doi.org/10.1016/j.neulet.2009.12.001

Okuda, M., Noda, A., Iwamoto, K., Nakashima, H., Takeda, K., Miyata, S., Yasuma, F., Ozaki, N., & Shimouchi, A. (2021). Effects of long sleep time and irregular sleep–wake rhythm on cognitive function in older people. *Scientific Reports*, *11*(1), 7039. https://doi.org/10.1038/s41598-021-85817-y

Scott, H., Lechat, B., Guyett, A., Reynolds, A. C., Lovato, N., Naik, G., Appleton, S., Adams, R., Escourrou, P., Catcheside, P., & Eckert, D. J. (2023). Sleep Irregularity Is Associated With Hypertension: Findings From Over 2 Million Nights With a Large Global Population Sample. *Hypertension*, *80*(5), 1117-1126. https://doi.org/10.1161/hypertensionaha.122.20513

Virtual Reality training for multi-agency traffic incident management

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Abstract
Live training exercises aim to improve trainee confidence in performing correct procedures through simulation, although conducting live training can present several practical challenges. In the context of multi-agency Traffic Incident Management (TIM), live training requires significant resources such as access to roads, vehicles and actors. There are also several logistical challenges associated with having multiple trainees from different agencies attend a suitable training site. The recent introduction of affordable, reliable, and portable Virtual Reality (VR) headsets provides an alternative training method to live training that mitigate the cost and challenges associated with live training. This research explores the use of VR technology by developing and evaluating a multi-agency TIM VR training application. Results suggest that VR training requires similar levels of cognitive effort when compared with live training while also producing similar levels of self-efficacy and mental engagement.

Social media post
This research explores the use of VR technology by developing and evaluating a multi-agency TIM VR training application. Results suggest VR training provides similar levels of cognitive effort, mental engagement and self-efficacy when compared with live training.

Introduction
Traffic incident management (TIM) is important to ensure safe and efficient management of road network systems in response to traffic incidents. First responders, road authorities and other related agencies employ a wide range of techniques in a coordinated approach to control and manage traffic at incident sites to keep motorists and incident responders safe while efficiently managing traffic flows. Typically, TIM training is provided in real-world or simulated incident sites, which has some significant challenges, including the costs associated with training resources (e.g., roads, vehicles and actors) and trainee logistics (e.g., travel and accommodation costs to attend), as well as scheduling difficulties of multiple agencies. Such live trainings could also expose motorists and incident responders to unsafe traffic/road environments. Therefore, it is important to identify and validate alternative training methods.

Recent advancements in VR technologies have led to a rapid increase in the availability of consumer-grade, low-cost, easy to use, and portable VR headsets. Research suggests VR provides several benefits as a training tool, particularly where access to training environments are costly, difficult or impossible. VR has also been suggested to enhance scenarios that can already be replicated in the real-world, or those that are otherwise unsafe or ethically unjustified. For example, VR has been used for incident response training to teach firefighters how to respond to fire-related emergencies (Xu et al., 2014; Tao et al., 2017; Clifford et al., 2018), teach police officers how to perform collaborative searching tasks (Bertram et al., 2015) and decision-making (Zechner et al., 2023), and emergency medical technicians to perform tourniquet placement (Arif et al., 2023). While research has shown promising signs for the use of VR to deliver incident response training, few have focused on its use for training of response to traffic incidents. Where traffic incidents have been the focus of research, such as Czarnek et al. (2020) who explored VR training on standard rescue procedure to assist injured victims involved in a vehicle accident, or Lochmannová et al. (2022) and Berndt et al. (2018) who developed VR training for paramedics in accident reporting and triaging, they have had a single agency focus. This research aims to understand and evaluate the potentials of VR technology in multi-agency TIM training as a safer and more practical alternative to the traditional live training exercises.

Method
The research evaluates the effectiveness of two methods of multi-agency TIM training: live training and VR training. A mixed design was employed, which combined quantitative analysis of survey responses and qualitative analysis of interviews. A similar data collection process was followed for both training methods, with participants completing a pre- and post-training survey, followed by a semi-structured, group-based interview. The pre-training survey captured both demographic information as well as self-efficacy (baseline) and motivation scores of participants with respect to TIM. The post-training survey measured key constructs including self-efficacy, motivation (intrinsic, identified regulation, external regulation, and amotivation), situational interest (catch and hold), engagement, trainees' subjective

reaction to the training, cognitive load, and training duration preference. The interview grouped participants based on their agencies and captured their perception of the training, including its benefits, limitations, potential, and suggested improvements. A total of 25 participants undertook the live training and 19 participants undertook the VR training, among whom 14 participants undertook both training methods. Participants of live training were predominantly male (19 out of 25), while VR training was more balanced (10 out of 18 were male). The average age of participants is similar between the two groups (mean of 45 years for live training vs. 43 years for VR training).

Live training was conducted over two days and involved participants from emergency services and transport organisations. Live training simulated two TIM exercises; the first involved a two-vehicle crash in a regional area (Figure 1, 2.) which required occupant extrication, while the second exercise simulated a passenger bus and guard rail collision, causing a chemical spill, due to an evasive action in response to an insecure load. Both exercises were recorded using two 360-degree video cameras, which provided content to develop the VR training application. During both exercises, a pop-up tent was used as a communication hub for the exercise commander and call centre operators, with CB radio communication between agencies, and ambient sounds recorded for VR training. The VR training application was developed using the Unity3D game engine for the Meta Quest 2 Headset. VR training included several key design elements: 360-degree video and digital annotations, VR user interfaces, audio and synthesised narration, point-and-click interactions and assessment questions.



Figure 1. Overview of 360-degree video recording during live exercise



Figure 2. Participant perspective of VR training

Results

Figure 3 provides an overview of survey results, comparable results can be observed between live and VR training methods, with only slight observable advantages for VR training. Statistical analyses confirmed this observation, with no significant differences found between the two training methods besides Situational Interest—Catch, where VR training captured significantly higher initial interest of trainees compared to live training using the Mann-Whitney U test (Z = -2.362, p = 0.018).

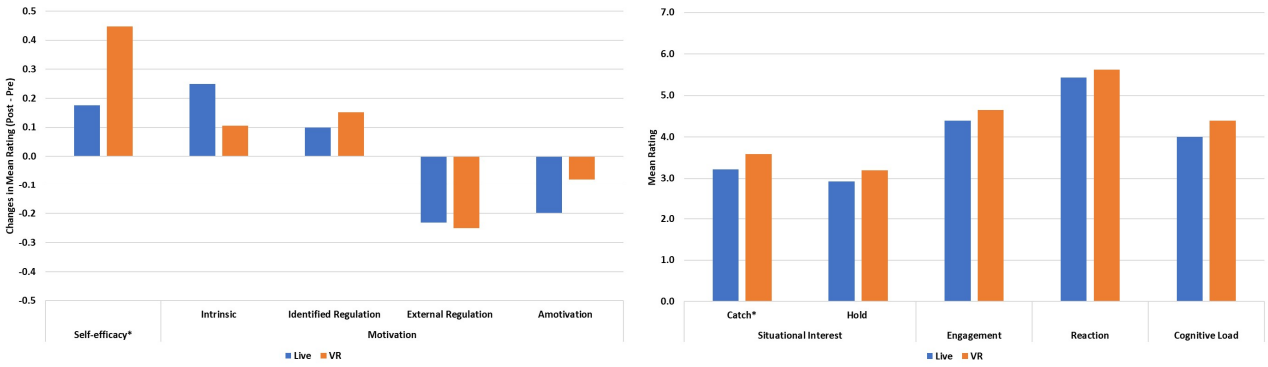


Figure 3. Mean ratings of survey measures with an Asterix (*) denoting statistically significant results

A 2x2 mixed-design ANOVA was conducted to examine the effect of time (pre and post) and training method (live and VR) on self-efficacy. A significant main effect of time was found (F (1,42): 8.345, p = 0.006, partial $\eta 2$ = 0.166), indicating self-efficacy improves significantly after either training. While the mean increase is higher for VR, the effect of training (i.e., both the main and interaction effect) on self-efficacy did not reach significance. A 2x2 mixed-design ANOVA was also conducted on categories of motivation, no significant main and interaction effects of time and training were observed. Despite this, a consistent mean pattern of self-determination improvement was observed for both live

and VR training. As seen in Figure 2, higher self-determination categories (i.e., intrinsic and identified regulation) increased from pre- to post-training for both training methods, while the lower self-determination categories (i.e., external regulation and amotivation) decreased.

While no significant differences were found between live and VR training with respect to Situational Interest–Hold, Reaction, and Engagement, VR training consistently showed higher mean ratings. Finally, no significant difference was found in cognitive load, suggesting comparable mental demand required. Regarding training duration, participants had varied views. Participants generally reported that duration for VR training (approximately 25 minutes) was 'ideal', while some suggested it was 'slightly' to 'moderately' too long. Interestingly, live training duration (approximately 45 minutes) was considered too short by most participants.

Several recurring themes were reported by participants during interviews. Firstly, VR training was suggested to benefit participants who had little to no practical experience in TIM. Participants also highlighted the value of inter-agency training in general, and the inclusion of CB radio communication in particular, as these help improve understanding with respect to roles, responsibilities and actions, especially for those who don't attend the incident site (e.g., call centre). Further improvements were also suggested, such as tailoring content towards specific agencies, adding more detailed information to improve authenticity and including features such as time-lapse, progress clock, top-down view, subtitles, and the ability to pause and rewind exercises.

Conclusions

Live training exercises provide valuable practice of TIM in response to varied simulated traffic incidents although can be costly and logistically difficult to run. This research investigated the use of VR technology to evolve existing TIM training by providing an alternative training method for live training exercises. VR training is developed using digitally annotated 360-degree videos, audio and text narration, assessment questions and VR point and click interactions that is then compared against live training. Results shows that VR training provided similar levels of self-efficacy and mental demand as live training exercise. VR training was also more time efficient than live training taking approximately 25 minutes for each exercise compared to approximately 45 minutes for live exercises. Interviews reported that VR training would benefit those with limited experience (e.g., novices) with several features suggested to improve engagement and understanding such as the ability to pause and rewind exercises.

Relevance to conference theme and road safety

VR training has practical implications on existing TIM training programs by providing a cost-effective, portable and repeatable training method that increases accessibility to simulated multi-agency training exercises. It would also contribute to improved training outcomes and measurable road safety benefits, such as faster incident response times, improved inter-agency coordination, or reduced secondary crashes, resulting in enhanced safety at incident response sites. This research contributes to the evolution of a safe system in incident management training.

Acknowledgements

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References

Arif, A., Felipes, R. C. S., Hoxhaj, M., Light, M. B., Dadario, N. B., Cook, B., . . . Jafri, F. (2023). The impact of the addition of a virtual reality trainer on skill retention of tourniquet application for haemorrhage control among emergency medical technician students: A pilot study. Cureus, 15(1).

Berndt, H., Wessel, D., Mentler, T., & Herczeg, M. (2018). Human-centered design of a virtual reality training simulation for mass casualty incidents. Paper presented at the 10th International Conference on Virtual Worlds and Games for Serious Applications (VS- Games), Sept 5-7, Würzburg, Germany.

Bertram, J., Moskaliuk, J., & Cress, U. (2015). Virtual training: Making reality work? Computers in Human Behavior, 43, 284–292.

Clifford, R. M., Khan, H., Hoermann, S., Billinghurst, M., & Lindeman, R. W. (2018). Development of a multi-sensory virtual reality training simulator for airborne firefighters supervising aerial wildfire suppression. Paper presented at the 2018 IEEE Workshop on Augmented and Virtual Realities for Good (VAR4Good).

Czarnek, G., Strojny, P., Strojny, A., & Richter, M. (2020). Assessing engagement during rescue operation simulated in virtual reality: A psychophysiological study. International Journal of Human–Computer Interaction, 36(5), 464–476.

Lochmannová, A., Šimon, M., Hořejší, P., Bárdy, M., Reichertová, S., & Gillernová, K. (2022). The use of virtual reality in training paramedics for a mass casualty incident. Applied Sciences, 12(22), 11740.

Tao, R., Ren, H.-x., & Peng, X.-q. (2017). Ship fire-fighting training system based on virtual reality technique. Paper presented at the Modeling, Design and Simulation of Systems: 17th Asia Simulation Conference, AsiaSim 2017, Melaka, Malaysia, August 27–29, 2017.

Xu, Z., Lu, X. Z., Guan, H., Chen, C., & Ren, A. Z. (2014). A virtual reality-based fire training simulator with smoke hazard assessment capacity. Advances in Engineering Software, 68, 1-8.

Zechner, O., Kleygrewe, L., Jaspaert, E., Schrom-Feiertag, H., Hutter, R. I. V., & Tscheligi, M. (2023). Enhancing operational police training in high stress situations with virtual reality: Experiences, tools and guidelines. Multimodal Technologies and Interaction, 7(2), 14.

AI enforcement evolution to improve road safety in Western Australia

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Presented by: Jason Csincsi

Abstract

Western Australia (WA) recorded its highest road fatality rate since 2016, with 173 deaths in 2024, disproportionately affecting regional areas. To address this, the WA Road Safety Commission partnered with Acusensus to deploy the Multi-function Enforcement solution, an AI-enabled enforcement system that simultaneously detects speeding, distracted driving and seatbelt non-compliance. Following a successful trial in 2022-2023, which captured nearly 8 million detections, WA launched a full enforcement program in 2025. This initiative enhances road safety equity by expanding enforcement to remote areas, ensuring all road users are treated fairly while enabling informed decision-making and long-term behavioural change. The program's caution notice period raises public awareness before enforcement begins. By collecting critical data, the initiative informs future road safety strategies, reducing dangerous behaviours and preventing fatalities. As the first system of its kind, the Multi-function Enforcement solution sets a new standard for AI-driven road safety enforcement.

Social media post

WA's new AI-enabled road safety program is tackling speeding, distraction and seatbelt non-compliance statewide. With 173 road deaths in 2024, this technology by Acusensus expands enforcement to regional areas, promoting safer roads and lasting change.

Introduction

In 2024, 173 people died on Western Australia (hereafter, WA) roads, the state's highest road fatality rate since 2016 (Murphy, 2024). These deaths are increasingly prevalent on the state's regional roads, where 89 people lost their lives in 2023 compared to the 69 deaths in metropolitan areas (*Mapping Fatal Road Crashes in WA| RAC WA*, n.d.). The reasons behind these road deaths vary, but due to regional roads being commonly inaccessible for consistent road safety monitoring, further effective means of data collection are needed in WA to determine the cause behind the state's crashes. This sentiment is echoed by the Australian Automobile Association (AAA) Managing Director Michael Bradley, who expressed that "improved data collection" is needed to understand "the factors causing the metro-regional disparity and greater Commonwealth road safety leadership" (Newsroom, 2023).

Despite the need to further understand the causes behind road trauma in WA, it is understood that road traffic crashes are commonly caused by the Fatal Five behaviours: speeding, impaired driving (drugs and/or alcohol), illegal seatbelt use, driver fatigue, speeding and distraction ("NRSPP Australia - Easter Road Safety," 2024). In an attempt to address the need for further data collection to gauge the causes behind WA's road fatalities, the Road Safety Commission has partnered with Acusensus to deploy the world's first multi-function enforcement program, which addresses three of the Fatal Five - distracted driving, seatbelt non-compliance and speeding behaviours - through a single platform. These transportable solutions were utilised in a trial in 2022 with positive results that provided further insight into the potential road trauma causes in WA, leading to a full enforcement program that commenced in 2025 with all three enforcement modules switched on. A full enforcement program allows further data collection to commence, whilst simultaneously encourages road users across the state to choose safe road safety practices.

This Multi-function Enforcement program in WA demonstrates the ARSC's 2025 themes of Equity, Elasticity and Evolution from its inception to its delivery. The theme of Evolution is applicable through the enhancement of the world's first distracted driving enforcement solution, whose capabilities have been increased to include speeding and seatbelt enforcement. Additionally, these systems are adaptable and resilient to differing weather conditions and have been tailored to include mobile point-to-point speed enforcement capabilities, allowing for state-wide deployment, including regional areas, exemplifying the theme of Elasticity. Lastly, the program supports equitable access as anytime, anywhere deployments of a transportable system such as the Multi-function solution empowers jurisdictions to recognise the inherent value of each person and road user. This allows enforcement to be available in typically

unreachable areas, promoting education of safer road practices in regional areas and encouraging changed behaviours statewide.

Producing the "Swiss Army Knife" of Cameras

Heads-Up Solution

The Acusensus Heads-Up solution is an artificial intelligence (hereafter, AI) enforcement solution detects and provides prosecutable evidence of drivers illegally using mobile phones. Operating autonomously 24/7 in all weather conditions, it revolutionised road safety in the world's first mobile phone camera detection program in New South Wales (NSW) in 2019 (Frost, 2019), becoming the first enforcement tool to address another of the Fatal Five since speed cameras were first introduced in Australia in 1985 (Delaney et al., 2005). Distracted driving enforcement proved to be effective following Heads-Up's initial deployment as within two years of NSW's Mobile Phone Detection Camera program, mobile phone use while driving dropped to 1 in 500 drivers, with a sixfold reduction in camera-detected offences from 2019 to 2022. This decline in illegal mobile phone use correlates with the state's reduction in road deaths from 0.9 deaths per 100,000 per annum from 4.4 to 3.5 (Economics, 2025). This represents a strong decline in road fatalities per 100,000 compared to the rest of Australia, where the road fatality rate increased from 4.9 to 5.0 (Economics, 2025).

Following the success of Heads-Up's NSW program, Acusensus expanded its solution into a comprehensive enforcement platform to target increasing driver behaviour, starting with illegal seatbelt use. This led to Queensland's (QLD) Mobile Phone and Seatbelt Detection program, where Heads-Up was utilised to detect simultaneous distracted driving and seatbelt non-compliance. Paralleling the results seen in NSW, QLD experienced a reduction in fatalities following the deployment of its simultaneous mobile phone and seatbelt enforcement program. Overall, the state experienced 276 fatalities due to road crashes in 2023, which is 23 fewer than the year prior, representing a 7.1 per cent decrease in one year (*2023 Weekly Road Fatality Report*, 2024).

Multi-function Enforcement Solution

Given the proven effectiveness of utilising enforcement solutions to reduce fatality rates, Acusensus expanded existing AI systems to extend their capabilities. This led to the development of the Multi-function Enforcement solution, a system designed to enable the supply of a single asset and installation that simultaneously addresses three of the Fatal Five – namely spot and/or average speed, seatbelt non-compliance and distracted driving. This system was created in collaboration between Acusensus and the WA Road Safety Commission, leading to a trial that occurred from July 2022 to February 2023. In support of this trial, WA police minister Paul Papalia described the technology as the "Swiss army knife of road safety cameras" (Le May, 2022).

Multi-function Trial in Western Australia

The Multi-function Enforcement solution trial between July 2022 to February 2023 saw WA lead the user case as the world's first to utilise multiple AI enforcement capabilities at once. In addition to enforcing speed, distracted driving and seatbelt non-compliance, the systems utilised in this trial were equipped with mobile point-to-point speed detection capabilities and utilised AI to classify heavy and towing vehicles in near real-time to apply a lower speed offence threshold to different vehicle classifications.

The data collected from this trial allowed Acusensus and the WA Road Safety Commission to identify and compare behaviours in regional and metropolitan areas, the prevalence of repeat offenders and the recording of multiple dangerous behaviours enacted simultaneously. These findings are significant, as they help illustrate the causes behind road trauma in WA, and how they could be addressed in the future program.

Mobile Point-to-Point Speed Enforcement

To ensure optimal road safety outcomes, the Multi-function Enforcement solution is equipped with several unique functions to cater to WA's unique road network. According to WA Road Safety Commissioner Adrian Warner, most deaths in the state occur on high-speed roads – "in the past ten years, about 60 per cent of motor vehicle fatalities occurred in regional areas and three-quarters on regional roads with speed limits 100km or more" (*'Terrifying' Images Capture Reality of WA Driving Behaviour*, 2025). These capabilities include mobile point-to-point speed enforcement and improved weather resilience functions, along with optimising the solution for rural deployments.

Multi-function utilises a mobile point-to-point speed detection module, which equips transportable trailers for point-to-point speed detection as an alternative to traditionally fixed systems. Speed is measured over a distance, improving enforcement efficiency as sustained speeding is discouraged as opposed to spot speed. This allows the WA Road Safety

Commission to monitor speed compliance over longer distances in areas where installing permanent infrastructure is not feasible. Furthermore, sustained speed compliance reduces the risk of accidents across the road network.

Resilience to Differing Weather Conditions

The Multi-function Enforcement solution's hardware has been designed, tested and validated to withstand extreme environments while maintaining its reliability, durability and longevity. These are factors that are pivotal to enduring regional deployments, where trailers need to run autonomously. The solution has been designed and proven to combat harsh environments and intense weather conditions such as heavy rain, direct sunlight, hot temperatures, dusty space, humid air and rough environments that require robust weather-resistant design and components.
Furthermore, the core of the Multi-function Enforcement solution is its AI-based software. The solution has been optimised to capture high-resolution images of driver offences 24/7, regardless of weather conditions. This capability is crucial for detecting illegal mobile phone use and seatbelt non-compliance, even in challenging environments such as sun glare or nighttime driving. The system's advanced sensor technology allows it to detect vehicles travelling at speeds up to 300 km/h without motion blur or distortion, ensuring accurate evidence collection.

Trial Results

Multi-function was deployed across rural areas in WA to address the disparity between metropolitan and regional areas when it comes to road safety. The challenges that come with regional deployments include ensuring optimal capabilities in areas where cellular connectivity is often unavailable. Low-reception areas have been historically the reason why it has been difficult to deploy, monitor and address road safety behaviours in rural locations. During this trial period, Multi-function made 7,916,963 detections, including the following key insights:

- 58,350 point-to-point (average) speed offences detected
- 265,873 spot speed offences detected
- 66,787 verified mobile phone offences
- 11,426 verified seatbelt offences (driver and front passenger).

Additionally, simultaneous offences were recorded - drivers who were displaying multiple dangerous behaviours simultaneously:

- 1,751 instances of distracted driving and speeding
- 479 instances of distracted driving and seatbelt non-compliance
- 226 instances of seatbelt non-compliance and speeding
- 17 instances of distracted driving, seatbelt non-compliance and speeding.

The Multi-function trial also tracked repeat offenders - people who repeated the same offences multiple times:

- Distracted driving - 8,121 instances of individuals repeat offending
- 187 instances of simultaneous offending - distracted driving, not wearing a seatbelt and speeding.

School Zones

Additionally, to optimise findings that highlight safer communities, Multi-function was deployed in school zones. Data analysis of school zones reveals elevated offence rates during school times when the 40 km/h speed limit is active. Speeding is significantly higher during school hours compared to regular speed limits. This is particularly pronounced in zones typically signed at 70 km/h, where the speeding offence rate during the 40 km/h school limit (17.17%) is vastly higher than outside school times 0.35 per cent. In 60 km/h zones, speeding during school hours (9.24%) is also higher than at regular speed (8.61%).



Figure 1. School Zones Infographic

Enforcement Program

In January 2025, WA commenced a full enforcement program utilising the Multi-function Enforcement solution. According to the announcement by the WA government, this program is "the most advanced in the country" (*Safety Cameras to Put Bad Driving Behaviour on Notice | Western Australian Government*, n.d.). The program is currently going through a caution notice period, where detected offenders receive warning letters before enforcement commences. Further impact of the program can only be analysed following program longevity, as seen in QLD and NSW programs, mentioned previously.

Conclusion

The WA enforcement program utilising the Multi-function Enforcement solution is an ongoing effort in an attempt to reduce fatalities across the state. The solution empowers the WA Road Safety Commission and the WA government with a means to collect data on dangerous driving behaviours statewide, helping authorities understand the magnitude of such behaviours, which could lead to further action such as long-term enforcement. Programs such as these discourage repeat offences and act as a tool for advocacy, educating WA residents state-wide that monitoring systems are utilised to improve road safety through behavioural change. Furthermore, the collection of such data is significant for understanding and preventing the causes behind road deaths and accidents, especially in regional areas, where enforcement and road safety education were previously sparse. This sentiment is supported by WA Road Safety Commissioner Adrian Warner, who says "There are over 2 million licensed drivers in WA. There is over 180,000 kilometres of public roads. Police can't be everywhere" (Greatrex, 2025).

As the WA program just began, it is difficult to gauge how driver behaviour has changed across the state. It is, however, understood that data collection programs, enforcement and increasing public awareness of road safety can deeply impact behaviours across the road network, leading to fewer deaths and accidents. For now, there is an understanding that: "This is about drivers changing their behaviour. We have a culture problem. We need to address it, and these cameras are the first step in doing that" - Adrian Warner (Hastie, 2024).

References

2023 Weekly road fatality report. (2024). https://www.publications.qld.gov.au/dataset/road-safety-statistics/resource/26a4d2f3-9a1f-45dc-82c7-0501916d0323?inner_span=True

Delaney, A., Ward, H., & Cameron, M. (2005). *History and Development of Speed Camera Use*.

Economics, B. of I. and T. R. (2025). *Road Deaths Australia—Monthly Bulletins*. Bureau of Infrastructure and Transport Research Economics. https://www.bitre.gov.au/publications/ongoing/road_deaths_australia_monthly_bulletins

Frost, A. (2019). *World's first smartphone detection camera launched Down Under*. Traffic Technology Today. https://www.traffictechnologytoday.com/news/incident-detection/worlds-first-smartphone-detection-camera-launched-down-under.html

Greatrex, C. (2025). *Millions of Aussie drivers warned as roadside cameras with $1,000 fines switch on today: "Alarming."* https://au.news.yahoo.com/millions-of-aussie-drivers-warned-as-roadside-cameras-with-1000-fines-switch-on-today-alarming-202618180.html

Hastie, H. (2024). *New high-tech cameras on Perth roads 'not revenue-raisers', safety tsar says*. https://www.watoday.com.au/politics/western-australia/new-high-tech-cameras-on-perth-roads-not-revenue-raisers-safety-tsar-says-20241230-p5l18o.html

Le May, R. (2022). *'Swiss Army Knife' of cameras to catch dodgy WA drivers*. The West Australian. https://thewest.com.au/news/crime/wa-to-use-new-swiss-army-knife-of-cameras-to-catch-appalling-dangerous-driving-behaviour-c-7582369

Mapping Fatal Road Crashes in WA| RAC WA. (n.d.). https://rac.com.au/car-motoring/info/state_wa-fatalities-map

Murphy, R. (2024). WA edges closer to highest road toll in years after seven fatalities in single weekend. *ABC News*. https://www.abc.net.au/news/2024-12-08/seven-deaths-on-wa-roads-over-the-weekend/104699296

Newsroom, A. A. A. (2023). New analysis reveals regional road trauma challenge. *Australian Automobile Association*. https://www.aaa.asn.au/2023/02/new-analysis-reveals-regional-road-trauma-challenge/

NRSPP Australia - Easter Road Safety: The Fatal Five. (2024). *NRSPP Australia*. https://www.nrspp.org.au/resources/easter-road-safety-the-fatal-five/

Safety cameras to put bad driving behaviour on notice | Western Australian Government. (n.d.). https://www.wa.gov.au/government/media-statements/Cook%20Labor%20Government/Safety-cameras-to-put-bad-driving-behaviour-on-notice--20241230

'Terrifying' images capture reality of WA driving behaviour. (2025). The West Australian. https://thewest.com.au/news/traffic/road-safety-commission-releases-shock-images-of-wa-drivers-while-pleading-for-safer-driving-over-easter-c-18389773

A look into road safety in the outback (East Arnhem, NT)

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Abstract

This project assesses critical road safety issues on 29 remote access roads in East Arnhem, NT. Frequent flooding, pavement defects, and debris/vegetation on carriageways pose severe risks and disruptions for vulnerable local communities, often increasing crash risk and post-crash care response time, forcing seasonal evacuations and reliance on air supply during emergencies. To perform the Road Safety Audit on a large number of frequently changing road environments, we employed video recording, georeferenced tagging of risk factors, and smartphone-based estimation of International Roughness Index (IRI) and bump locations. Key findings reveal significant seasonal variations in road conditions and hazards, highlighting the urgent need for targeted interventions. This work underscores the necessity for collaborative efforts among road safety researchers, practitioners, and policymakers to develop sustainable, data-driven strategies for improving road safety in remote areas, hence the quality of life for vulnerable local communities.

Social media post

Road safety in the outback! We conducted a Road Safety Audit on 29 remote access roads in East Arnhem, uncovering critical safety issues. Our findings highlight the urgent need for better infrastructure to protect vulnerable communities.

Introduction

The safety of vulnerable communities in remote areas is a significant concern, especially in regions like East Arnhem, Northern Territory, Australia. These areas often lack the infrastructure and resources to quickly address road safety issues, leading to frequent disruptions due to flooding, pavement defects, and roadside hazards (DITRDCA, 2021). Such disruptions greatly increase the travel risk and isolate local communities, making it difficult to access essential services and emergency aid. The rates for Aboriginal and Torres Strait Islander people in Remote and Very Remote areas were approximately twice as high as those for non-Indigenous Australians (Henley et al., 2019). Additionally, the changing road conditions in these remote areas, influenced by seasonal variations, require continuous monitoring and adaptive solutions to ensure road safety measures remain effective throughout the year.

Road Safety Audits (RSAs) provide a proactive approach to identifying and mitigating potential road safety issues before they result in accidents. This is particularly important in remote areas where emergency response times can be much longer. Currently, there is no overview of risk across the access road network in East Arnhem. To do this, we implemented a survey method that adapts to the road environment in remote areas. Our work aims to drive policy changes and increase funding for road maintenance and safety improvements in remote areas. The final goal is to enhance the safety and accessibility of remote roads, ultimately improving the quality of life for vulnerable communities.

Conference theme

This work aligns closely with the conference theme of equity, elasticity, and evolution. By recognising the inherent value of each road user and treating all fairly, we aim to ensure equitable access and dignity for remote communities. Our approach addresses the system's adaptability and resilience, emphasising the need for flexible and robust solutions to maintain safe and accessible roads under changing environments. Furthermore, this project contributes to the evolution of a safe system by exploring innovative data collection methods and providing insights into road safety challenges that require adaptive infrastructure solutions.

Approach

The implementation of this project followed a five-step process: preliminary investigation, site inspection, data processing, risk identification, and development of engineering countermeasures. During the site inspection, various data were collected, including video records from front and rear views with geo-references and voice-over, site photographs (Figure 3), estimated road surface roughness levels using World Bank's Roadlab Pro application (World Bank, 2015), and locations of identified risks. A GIS (Geographic Information System) survey app (Esri, 2024) was used to reference the location of identified risks, with geo-referenced photographs taken of significant risks. This information was used to produce a map showing high-risk locations.

Three main risk types were consistently identified across the assessed network: flooding, pavement defects, and debris/vegetation on the carriageway. Risk ratings are provided for each risk category on individual road as well as each community's road network as a whole, based on the "Guide to Road Safety Part 6: Road Safety Audit" (Austroads, 2022). To capture the scale of identified risk sections on each road, a risk density index was developed, which refers to the prevalence of identified risks on a given road in relation to the total road length, expressed as a percentage. The risk density index is calculated based on the formula shown in Equation 1 below. The result represents the percentage of the total road length where risks are present. For the purpose of calculating this index, individually identified risks (e.g., fallen trees) are considered to represent 5 metres, while risk sections (e.g., pavement defect sections or flooding sections) are measured in metres from start to endpoint. Risks of the same type within one kilometre of each other are considered to be part of the same risk section.

Equation 1. Calculating risk index

Risk Density Index = (Total Metres of Individual Risks + Total Metres of Risk Sections) / Total Road Length (m)

Table 1. Risk Density Index Category

Risk Density Index (% of total road length with risks present)	**Risk Density Index Category**
<1	N/A
1 – 15	Low
15 – 40	Medium
40 +	High



Figure 3. Site photos

Results

The project has successfully captured the risk across the access road network in the East Arnhem Region. Table 2 below shows a summary of the severity of observed risks (risk rating) across the assessed road network of an area, and the overall risk density index. A set of recommendations were then provided for each risk category and risk rating.

Table 2. Risk Index category

	Debris/vegetation	**Flooding**	**Road surface**	**Risk density index**
	Fallen tree/branch on carriageway, other significant debris on carriageway, or in proximity	Water on carriageway which increases risk of stranding and run-off road crash	Damage, erosion, or other defects in road surface	% of total network in each area with risk present
Local areas	Risk Rating			
Galiwinku	Low	Medium	High	40%
Gapuwiyak	Low	High	High	29%
Gunyangara	Low	N/A	Low	11%
Milingimbi	Low	Low	Low	69%
Ramingining	Low	Low	Medium	11%
Yirrkala	Low	Low	N/A	4%

An interactive map was also produced with all identified risks and estimated IRR across the survey network (Figure 4).

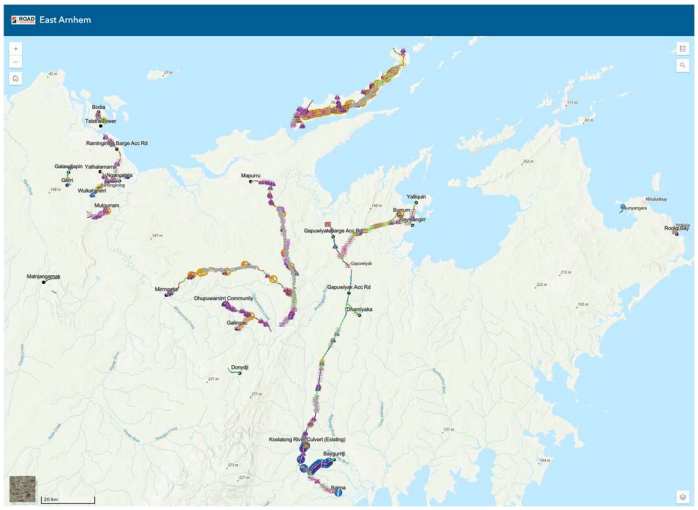


Figure 4. Map of identified risks and estimated IRR across the survey network

Conclusions

In conclusion, this project has highlighted significant road safety issues on remote access roads in the East Arnhem Region. These hazards pose severe risks to vulnerable local communities. By employing a comprehensive five-step process, we were able to systematically assess and document these risks. Our findings underscore the urgent need for continuous monitoring and adaptive infrastructure solutions to enhance road safety and accessibility in remote areas. This work not only aims to improve the safety of these communities but also raises awareness for road safety practitioners, researchers, and policymakers to tackle the road safety issues in remote areas of Australia.

References

Austroads. (2022). Guide to Road Safety Part 6: Road Safety Audit. https://austroads.gov.au/publications/road-safety/agrs06

Department of Infrastructure, Transport, Regional Development and Communications, issuing body. (2021). National road safety strategy 2021-30 – Factsheet: Regional road safety. https://www.roadsafety.gov.au/nrss/fact-sheets/regional-road-safety

Esri. (2024). ArcGIS QuickCapture. https://www.esri.com/en-us/arcgis/products/arcgis-quickcapture/overview

Henley, G., Harrison, J., & Avefua, S. (2019). Injury of Aboriginal and Torres Strait Islander people due to transport, 2010–11 to 2014–15.

World Bank. (2015). "Smartphone App Innovation Fund – Big Data for Development Revamping Road Condition and Road Safety Monitoring." Report No. 98194, prepared by ROAD LAB. World Bank, Washington, DC.

Evolving safety training for gig-economy delivery bicycle riders

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Abstract
Riding a bicycle or e-bike can involve considerable risk of severe injury or death. In 2023, people riding bicycles accounted for 3% of all road fatalities in Australia and 20.7% of road hospitalisations in 2021 (National Road Safety Data Hub, 2024). These figures are of particular concern for people using bicycles or e-bikes for delivery services within the gig economy as a person who rides a bicycle for work purposes may be likely to spend more time on their bicycle than others (Napper, 2023). This means they are more exposed to the risks of cycling. This project seeks to address these concerns by adapting traditional safety training methods to create more engaging, scalable, and accessible road safety education tailored for delivery riders in the gig economy. It does so by using human-centered design principles. It is important to recognise however, that while safety training plays an important role, road safety risks are complex and require a comprehensive approach. This must include improvements across the entire system, encompassing roads, vehicles, speed management, infrastructure, and road user behaviour.

Social media post
Evolving safety training for gig economy delivery riders. Using human-centered design and data analysis to develop scalable, accessible, and engaging scenario-based learning for gig economy delivery riders.

Introduction
The nature of the gig economy presents several key challenges when considering traditional safety training. Based on information provided by Uber, delivery riders are independent contractors, have complete autonomy over their schedule, and have no designated sign-in or out locations. They also can come from culturally and linguistically diverse backgrounds and may be temporary residents of Australia and New Zealand. Geographically, they are spread across over 100 towns across the region (Uber Eats Australia, 2025). These factors make it challenging to use traditional safety training methods.

Traditional safety training methods—like click-and-scroll e-learning modules or endless PowerPoint presentations—can be disengaging and often fail to inspire real behaviour change. These approaches tend to assume all learners have the same needs, backgrounds, and experiences, which undermines their effectiveness (Merriam & Bierema, 2013; Holton et al., 2015).

What's more, they rarely reflect the actual challenges learners face in the real world. When training lacks relevance and real-world context, learners are less likely to retain information or apply it on the job (Kolb, 1984). Research shows that adults are more engaged when they understand why training matters to them personally, and when they can see a direct link to their daily experiences and goals (Deci & Ryan, 1985). Active learning strategies, especially interactive and accessible, have also been shown to improve retention and performance (Freeman, et al., 2014). Outlined below is the approach taken to address these challenges and the development of the delivery rider safety training.

Project description
Based on the challenges mentioned above, there were several key areas that needed to be incorporated into how safety training is developed and implemented for gig economy delivery riders:

- Training needs to be easily accessible and adaptable for delivery riders, as they operate across a wide geographic area and on varying schedules.
- Training needs to consider the ease at which people can become delivery riders. This means it should be readily available to meet the high demand and frequent onboarding of new delivery riders.
- Training materials must be designed to be effective and engaging for a culturally and linguistically diverse audience.
- Training needs to be about both knowledge and skill acquisition.
- Training needs to be relevant to the specific risks that gig economy delivery riders are exposed to and be based on their level of understanding, making it more likely to influence behaviour change.

The following explains how we addressed these key areas to develop the safety training program.

Accessibility and scalability

To improve scalability and accessibility, the safety training was designed to meet several criteria. These included:

- Designed for use within the Uber Driver app, to be shared with Uber delivery riders during onboarding.
- Designed to work on mobile devices in both portrait and landscape orientations.
- Integrated with both a voice-over and subtitles to aid in comprehension and for those watching without volume turned on. This also enables language translations to be built into the training content.
- Created to be easily understandable by using live-action videos, animations, and graphic overlays.

Data analysis and subject-matter expert input

We analysed past data from Uber to understand common scenarios that could result in incidents and injuries to delivery riders. We then corroborated the findings with subject-matter experts and identified mitigation strategies. This resulted in the identification of learning outcomes relevant to gig economy delivery riders. These included,

- **Basics of riding on the road network:** Understanding core concepts for riding safely (staying alert, staying visible, sharing intentions, and staying calm), and reinforcement of basic road rules and common infrastructure (riding on the left, common road signs, interpreting traffic lights, prohibited road types).
- **Common hazards of riding on the road network:** Identifying common hazards across different types of infrastructure (including dooring, getting cut off, pedestrians, obstacles / debris), making appropriate choices of roads to ride on, and knowing how to use lane positioning (including what to be mindful of in each position).
- **Navigating more complex scenarios**: Understanding correct techniques for signalling and head checks, understanding how to safely navigate junctions (roundabouts, intersections with traffic lights, right of way).

Consultation with delivery riders and demographics review

We reviewed delivery rider demographics and directly engaged in consultation with delivery riders to inform content, and to ensure the key takeaways were relevant and meaningful to the delivery riders themselves. Delivery riders were also engaged to test the wording used, to make sure we achieved a good level of comprehension.

Several delivery riders also featured in the “A Day In the Life” video where they shared personal tips on how they stay safe while delivering. This video aimed to drive awareness and relatability for delivery riders viewing the content.

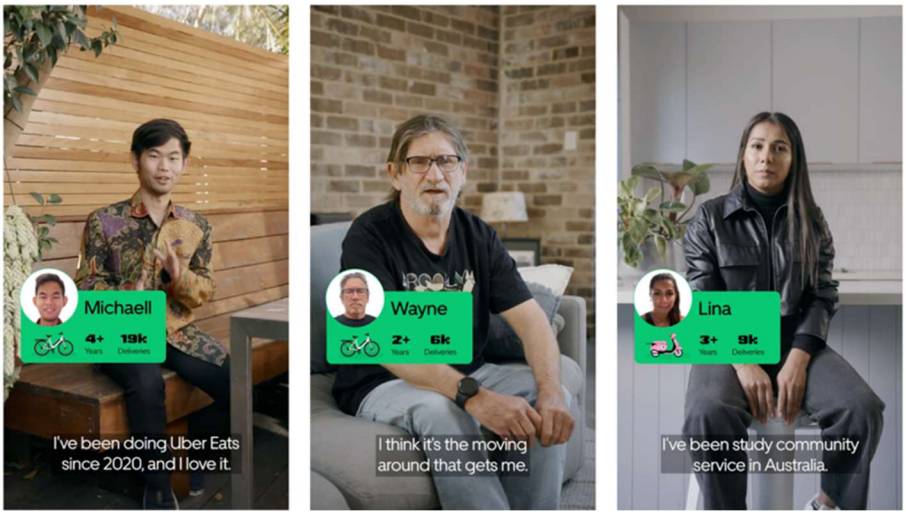


Figure 1. Screengrabs of the “A Day in the Life” video featuring delivery riders
Source: Uber Australia (reproduced with permission)

Engaging and interactive format

For this safety training to be retained and behaviour to shift, it needed to engage. We know from research that active participation boosts retention, and when learning is relevant, interactive and accessible, it is more likely to drive real behaviour change (Freeman et al., 2014; Bersin, 2018).To do this, we used a scenario-based approach to help promote active participation and improve retention of critical safety knowledge and skills. The modules were also designed to progressively increase in complexity, building on knowledge as the learner progressed.

The engaging and interactive elements built into this experience included:

- Bite-sized, real-world common scenarios with simulated decision making
- Ability for delivery riders to immediately apply the skills they were learning through knowledge checks
- Storytelling from delivery rider peers to bring safety concepts to life

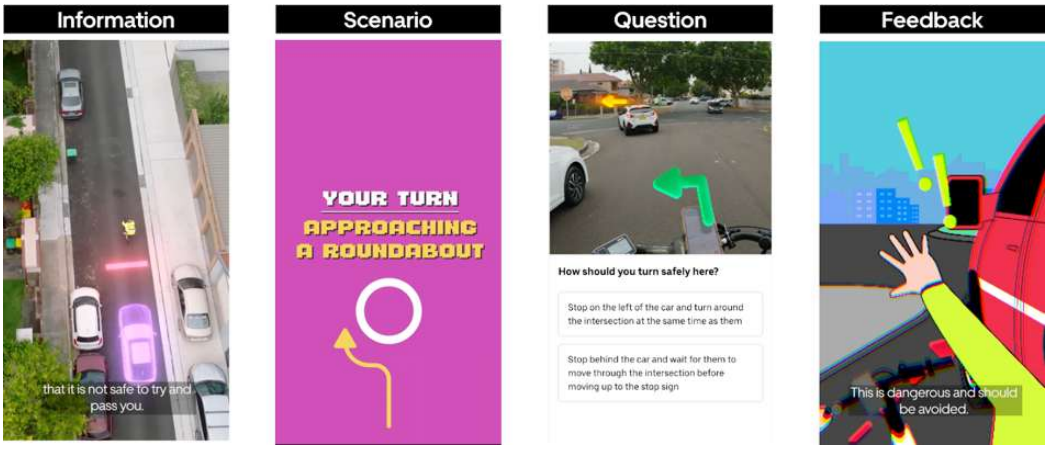


Figure 2. Screengrabs of the scenario-based approach
Source: Uber Australia (reproduced with permission)

Conference theme

The booming gig economy presents an opportunity to evolve safety systems for gig workers. This project aims to do so for safety training, by adapting traditional methods into more engaging, scalable, and accessible education that suits new ways of working.

Benefits to road safety practice

The benefits to road safety practices include,

- An approach to safety training that is scalable and widely accessible
- Safety training principles that can be used to develop more nuanced, engaging education designed to improve both knowledge and skill acquisition

Conclusion

This project sought to address key challenges we identified with traditional safety training by using human-centered design principles. The education was designed to be more engaging, scalable, and accessible for gig economy delivery riders. The training is currently being shared with Uber delivery riders, and future plans include evaluating its impact on safety and behaviour change.

References

Bersin, J. (2018, June 3). A new paradigm for corporate training: Learning in the flow of work. Retrieved from JOSH BERSIN: https://joshbersin.com/2018/06/a-new-paradigm-for-corporate-training-learning-in-the-flow-of-work

Deci, E. L., & Ryan, R. M. (1985). Intrinsic motivation and self-determination in human behavior. Springer.

Freeman, S., Eddy, S. L., McDonough, M., Wenderoth, M., Smith, M. K., Okoroafor, N., & Jordt, H. (2014). Active learning increases student performance in science, engineering, and mathematics. Psychological and Cognitive Sciences.

Holton, E., Knowles, M., & Swanson, R. A. (2015). The adult learner: The definitive classic in adult education and human resource development (8th ed.). Routledge.

Kolb, D. A. (1984). Experiential learning: Experience as the source of learning and development. Prentice Hall.

Merriam, S. B., & Bierema, L. L. (2013). Adult learning: Linking theory and practice. Jossey-Bass.

Napper, R. (2023). Napper cycling typology: Identifying and understanding different bicycle trip purposes. Transportation Research Interdisciplinary Perspectives.

National Road Safety Data Hub. (2024, June 18). Road crashes involving cyclists. Retrieved from National Road Safety Data Hub: https://datahub.roadsafety.gov.au/safe-systems/safe-vehicles/road-crashes-involving-cyclists

Uber Eats Australia. (2025, April 8). Uber Eats primed to tap $45 million revenue boost in major regional expansion . Retrieved from Uber Newsroom: https://www.uber.com/en-AU/newsroom/eatseverywhere-2/

Wlodkowski, R. J. (2008). Enhancing adult motivation to learn: A comprehensive guide for teaching all adults (3rd ed.). Jossey-Bass.

The lived experiences of individuals responsible for unintentional road trauma

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Abstract
The psychological impacts of road crashes are well-documented. However, little research has been conducted with the individuals responsible for these crashes. These individuals are likely to suffer significant psychological harm, especially if the crash was unintentional and resulted in another person's injury or death. This study aimed to address this gap by qualitatively investigating the lived experiences of individuals responsible for unintentional road trauma. In-depth interviews were conducted with 23 individuals in Australia, New Zealand, United States, United Kingdom, and Canada, who were responsible for a crash that resulted in the injury or death of another person/s. Sixteen participants took part in a follow-up interview one year later. Participants reported experiencing significant post-trauma outcomes after the crash and provided insights on policies and recommendations that could help support others experiencing a similar happening. This study provides support for the establishment of organisations that may offer specific care to this population.

Social media post
Understanding the lived experiences of those who are unintentionally responsible for a road crash to gain insights into how best to support these individuals.

Introduction
Road trauma is a global public health concern, with more than 1.35 million road deaths recorded each year on the world's roads (WHO, 2018). Beyond the substantial economic burden, road trauma imposes profound and lasting human costs on the individuals involved, their families, and the broader community. For instance, studies have found survivors of road trauma to experience significant mental health outcomes after a crash, such as anxiety (Smith et al., 2007) and post-traumatic stress disorder (PTSD; Fekadu et al., 2019). However, much of this research has either focussed on the victims of crashes or has not specified whether the participants included were also at fault in causing the crash. While this omission does not negate the valuable contribution of such research to the field, it may be that those deemed to be the at-fault or responsible party for a crash could experience significant psychological trauma, especially if the crash was unintentional and resulted in another person's injury or death. Unfortunately, very little is known about the impact of road trauma from the perspectives of these individuals.

Few studies have attempted to investigate the psychological consequences experienced by those responsible for crashes. For instance, Lowinger and Solomon (2004) found 76.3% of convicted males who inadvertently caused another person's death to have met the probable PTSD cut-off, while Merecz et al. (2012) found 11 percent of those responsible for a crash that caused road traffic injuries or fatalities to have met the same threshold. While such research offers quantitative data about the potential prevalence of PTSD amongst these individuals, very little can be gleaned about how these individuals are making sense of, and moving through, these complex traumatic situations. Such insights may not be adequately captured via quantitative studies alone. A qualitative methodological approach such as Interpretative Phenomenological Analysis (IPA; Smith et al., 2009) can be valuable when exploring complex and emotionally laden topics, as it provides the researcher with a detailed account of an individual's subjective experience (Smith & Osborn, 2015). Currently, there is only one published qualitative study which has used IPA to explore this phenomenon. Rassool and Nel (2012) investigated the lived experiences of five drivers in the United Kingdom who were responsible for a crash that occurred unexpectedly and resulted in another person's death. In this study, the researchers found participants' sense-making of this life-changing moment was impacted by intrusive thoughts and dissociative experiences synonymous with PTSD, as well as symptoms and feelings of powerlessness over the event. Some participants struggled to cope with the trauma of causing a death, and others experienced a shift away from their established sense of self to a changed sense of self which was confusing, fragmented, and unfamiliar, and significantly impacted their interactions with others. Instances of post-traumatic growth (PTG) were also evident, with participants recognising their strength in enduring adversity and feeling greater empathy for others (Rassool & Nel, 2012).

Taken together, the abovementioned studies provide some insights into the significant post-trauma outcomes experienced by individuals responsible for unintentional road trauma. Nonetheless, they also highlight the paucity of research conducted in this area. Additionally, it is apparent that most of the studies are quantitative in nature and do not delve deeper into what life is like for these individuals. While Rassool and Nel's (2012) study was the first of its kind to explore the lived experiences of this population, the cross-sectional nature of their study makes it difficult to develop a deeper understanding of how the participants made sense of the traumatic event over time. Thus, based on this extant evidence, this study uniquely contributes to this area of research by using an in-depth, qualitative approach, namely IPA, to provide detailed insights into the aftermath of these events as told by the individuals themselves. Additionally, this study took Rassool and Nel's (2012) research one step further by using a longitudinal research design to explore how individuals make sense of these traumatising events over time. In doing so, this overall research will provide a voice for this group of individuals, offer insights into their coping and sense-making processes over time, and enable the future development of more targeted and focussed interventions to support them on their journey of healing.

Conference theme

In accordance with the Safe System Approach, contributing factors extend beyond just the driver or road user. However, despite these principles, and as evidenced by the results from this study, many individuals still internalise responsibility for their crashes and are experiencing profound psychological and social consequences as a result. Hence, we believe this research aligns with the first component, Equity, as it highlights the need for psychological support for all road users affected by crashes, including those who perceive themselves as having contributed to the crash. This research also addresses the third component, Evolution, as it provides support for a Safe System approach that acknowledges human fallibility and advocates for shared responsibility in road safety.

Method

This study used a longitudinal IPA approach to develop a rich and deeper understanding of the lived experiences of individuals responsible for motor-vehicle crashes which have resulted in an unintentional road trauma. IPA has theoretical underpinnings in phenomenology (i.e., offering a detailed examination of an individual's subjective perspective of an experience or object, hermeneutics (i.e., making sense of the individual's perspective through interpretative work), and idiography (i.e., analysing each case in great detail before moving to the next one) (Smith & Nizza, 2022). In other words, this study aimed to gain a close and detailed understanding of what it is like to be an individual responsible for unintentional road trauma from the point of view of a person who has had this lived experience. Post-trauma outcomes were explored, particularly regarding both the negative effects of the event as well as experiences of PTG. Given the study's focus on how individuals navigated the aftermath of their crashes rather than their causes, participants were invited to share as much or as little about their crash as they felt comfortable during the interviews. While many provided some details, the researchers have refrained from speculating on these accounts to avoid misrepresentation, and have included only mentions of other drivers or road users where appropriate.

In-depth, semi-structured interviews were conducted with 23 individuals who have been responsible (or perceived responsibility) for a motor-vehicle crash which has resulted in unintentional death (n = 20), and/or injury (n = 3), of another person/s. Those injured (fatally or not) were a passenger in the participant's own vehicle (n = 4), a road user in another vehicle (n = 9), or a pedestrian (n = 7). The term 'motor-vehicle crash' included any crash involving automobiles or cars, trucks, motorcycles, buses, and motorized bikes. Participants resided in Australia (n = 3), New Zealand (n = 3), United States (n = 15), United Kingdom (n = 1), and Canada (n = 1), and were recruited through snowball sampling, the university's participate in research website, a media pitch on the local radio, as well as through the email/social media channels of organisations who provide support to those impacted by road trauma. Recruitment targeted individuals who met the basic inclusion criteria and self-identified as being responsible for a crash resulting in death and/or injury. Small sample sizes are accepted by IPA as they can yield valuable insights about a phenomenon.

While the initial plan was to recruit participants solely in Australia, persistent recruitment challenges required the research team to expand efforts globally. The researchers recognise that jurisdictional differences can influence how crashes are experienced by individuals. This study, however, was primarily concerned with a human's lived experience of this event, not the geographical or juridical context in which the experience occurred. Example questions from the first round of interviews included, "*Can you describe for me what life has been like for you since the collision?*", and "*What supports are available to you now?*". Given the longitudinal nature of this study, a second round of in-depth, semi-structured interviews were conducted with participants one year after the first interview, to determine if there has been any change over time (e.g., *"It's been a year since we first spoke, can you describe for me how you're doing now?"*). Sixteen participants were involved in a follow-up interview: Australia (n = 1), New Zealand (n = 1), United States (n = 13), and United Kingdom (n = 1). Both rounds of interviews took 1 hour to complete, were conducted in-person or online between 2023 to 2025, and audio-recorded for transcription purposes. Participants were offered an

online gift voucher ($100AUD) after each interview. This study received ethics approval by the Queensland University of Technology (Approval No: 5817).

Results

Data analyses are on-going, but themes from the first round of interviews identified at the time of writing are posttraumatic stress, changed self-schemas, restoring the karmic balance, and coping with the trauma. Particularly, most participants reported experiencing significant physical and emotional manifestations of stress after the crash, such as hypervigilance (e.g., being constantly on guard while driving), intrusion (e.g., replaying of events over and over again), and hyperarousal (e.g., crying, sleep disturbances, etc.). Many participants described grappling with changed self-schemas, such as being branded as 'perpetrator' or a 'villain' by others, and the shattering of moral beliefs and assumptions they held of themselves and a benevolent world. Several participants also spoke about their desire to restore the karmic balance. While many worked towards this goal through atoning for the harm they have caused (e.g., helping others, working in healthcare, etc.), others lived lives in fear of karmic payback (e.g., afraid to love someone in case they are taken away from them) and punished themselves through self-destructive behaviours because they did not believe they deserved to live a good life (e.g., getting involved in bad relationships, feeling ashamed when not thinking about the crash). A few participants coped with the trauma through cognitive sense-making behaviours, such as learning to accept what happened and finding ways to move forward in their life. Others suffered silently (i.e., put on a brave face) and struggled with the cognitive dissonance that arose from being involved in such a complex event (i.e., it was unintentional, but they still 'did it'). Further, most participants moved through the trauma through reflecting on positive psychological changes that they experienced as a result of the struggle with what happened. For instance, several noted feeling greater compassion for their fellow beings, a strong desire to help others, and an increased appreciation for the little things in life. Finally, a good support system was found to be critical in helping participants cope with the trauma. This support predominantly came from family, friends, first responders, therapy or counselling, and finding communities of people who share similar lived experiences, such as The Hyacinth Foundation (an organisation providing support for those have unintentionally killed or seriously injured others).

Regarding the second round of interviews, most participants described themselves as doing well since the first interview. The participants reporting doing more positively seemed to have been engaging in significant work on the healing of their trauma in the past year, such as leaning on a community of people who share a similar lived experience (e.g., Hyacinth Foundation), as well as confronting their fears and sharing their story with more people. When asked about policies and recommendations that could help individuals in a similar situation, all participants who were aware of the Hyacinth Foundation noted that connection to this organisation allowed them to find a sense of community and be among people who understand what it is like to live this experience. Most participants also reported that access to therapy or counselling is instrumental in helping individuals process the trauma and find coping strategies to manage any potential triggers that may arise in the future (e.g., anniversary of crash, driving-related anxiety).

Benefits to road safety

Road safety research is driven by the fundamental need to reduce the social, psychological, and financial burden of road crashes, which is often done by helping individuals to function well in the aftermath of crashes. By recognising that all those involved in road crashes may need assistance following such a traumatic event, this research seeks to not only potentially reduce any stigma for individuals who unintentionally caused a crash but also seeks to identify ways in which recovery may be assisted through the provision of resources.

Implications for policy and/or practice

The findings derived from this research could provide mental health professionals, correctional services, and other relevant government agencies with insights about how best to address the needs of individuals who have been unintentionally responsible for a road crash where another person/s have been seriously injured or killed. The research findings also further corroborate the need for more services and organisations such as The Hyacinth Fellowship (as based in the US) to directly support those unintentionally responsible for road trauma in Australia and across the world.

References

Fekadu, W., Mekonen, T., Belete, H., Belete, A., & Yohannes, K. (2019). Incidence of post-traumatic stress disorder after road traffic accident. *Frontiers in Psychiatry*, *10*, 519. https://doi.org/10.3389/fpsyt.2019.00519

Lowinger, T., & Solomon, Z. (2004). PTSD, guilt, and shame among reckless drivers. *Journal of Loss and Trauma, 9*(4), 327-344. https://doi.org/10.1080/15325020490477704

Merecz, D., Waszkowska, M., & Wezyk, A. (2012). Psychological consequences of trauma in MVA perpetrators-Relationship between post-traumatic growth, PTSD symptoms and individual characteristics. *Transportation*

Research Part F: Traffic Psychology and Behaviour, 15(5), 565-574. https://doi.org/https://doi.org/10.1016/j.trf.2012.05.008

Rassool, S. B., & Nel, P. W. (2012). Experiences of causing an accidental death: An interpretative phenomenological analysis. *Death Studies, 36*(9), 832-857. https://doi.org/10.1080/07481187.2011.610559

Smith, B., Mackenzie-Ross, S., & Scragg, P. (2007). Prevalence of poor psychological morbidity following a minor road traffic accident (RTA): The clinical implications of a prospective longitudinal study. *Counselling Psychology Quarterly, 20*(2), 149-155. https://doi.org/10.1080/09515070701403679

Smith, J. A., Flowers, P., & Larkin, M. (2009*). Interpretative phenomenological analysis: Theory, method and research* (1st ed.). Thousand Oaks, CA: SAGE Publications Ltd.

Smith, J. A., & Osborn, M. (2015). Interpretative phenomenological analysis as a useful methodology for research on the lived experience of pain. *British Journal of Pain, 9*(1), 41-42. https://doi.org/10.1177/2049463714541642

Smith, J. A., & Nizza, I. E. (2022). *Essentials of interpretative phenomenological analysis* (1st ed.). Washington, DC: American Psychological Association.

World Health Organization (WHO). (2018). *Global status report on road safety 2018*. World Health Organization. Retrieved from https://www.who.int/publications/i/item/9789241565684

Integrating Fatigue Detection: A Framework for Safer Roads

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Abstract
Fatigue is a leading cause of road crashes, particularly among professional drivers. Fatigue detection technologies (FDTs) are emerging as key tools to mitigate fatigue-related risks, yet selecting and implementing the "right" system can be challenging. This multi-methos study explored the barriers and enablers of FDT adoption from end-users of FDT placed at different levels of road transport organisations (drivers, middle managers, executives), and identified key dimensions for an evaluation framework using the Delphi method with industry experts and fatigue scientists. Sixteen dimensions were identified as critical for assessing FDT effectiveness, providing a structured approach for organisations and individuals to make informed decisions around FDT implementation. This work contributes to the evolution of a safer system by ensuring that safety innovations are effectively integrated into road transport.

Social media post
Fatigue detection technology is gaining traction in road safety, but which systems work best? Our research identifies key barriers and enablers for successful use, and a framework to guide best practice. Safer roads start with better choices! 🚗 💡 #RoadSafety #FatigueDetection #AAA

Introduction
Fatigue is a major contributor to road crashes in Australia and the world over, particularly among professional drivers who are vulnerable to distraction and sleepiness (ATC, 2011). Recently, in-vehicle FDTs have gained traction as mitigative systems for driver fatigue-related risks. FDT use a range of measures, including physiological signals from the eye and brain, to detect signs of fatigue and assess fitness to drive (Sikander & Anwar, 2019). Some FDTs are now integrated into vehicles as standard "safety features," making them an increasingly central component of road safety. Despite their growing adoption, independent FDT testing and validation varies significantly. With over 80 commercially available systems (Cori et al., 2021), selecting the most suitable for individual drivers and organisations is a complex task, made even more so by the lack of independent evaluations of their effectiveness (Cori et al., 2021) and best practice guidance for their implementation within workplace health and safety frameworks. This study aimed to identify the key dimensions for assessing FDTs and develop a structured evaluation framework to help consumers—from fleet managers to everyday drivers—make informed decisions about selecting and implementing the FDT most appropriate for their needs. The objectives were to: (1) identify barriers and enablers for effective FDT adoption from a range of end-users with lived experiences of these systems within their organisations; and (2) determine the key dimensions of an evaluation framework with a diverse stakeholder panel of subject matter experts including industry-based end-users and fatigue scientists.

Conference theme
This study addresses the theme of *evolution* of a safe system by examining the development and implementation of FDT and identifying key dimensions for their effective adoption. By developing a structured evaluation framework, it supports informed decision-making for diverse stakeholders, ensuring safety innovations are integrated effectively. The study also has resonance with the *equity* theme by addressing a lack of independent guidance, enabling all road users—regardless of expertise or role—to make informed choices about FDT adoption for their specific road safety contexts.

Method
A qualitative multi-method design was used to collect data over two phases (Figure 1).

In Phase 1, in-person or virtual semi-structed interviews were conducted with existing users of FDT from road transport organisations at different levels (drivers, middle managers, executives) to explore their perspectives on FDT in relation

to its purpose; usability; impacts on behaviour and end-user acceptance; implementation; data use and management; and integration in policy and procedure. Data were analysed inductively (i.e., without predefining codes) using NVivo, first via descriptive coding (Saldaña, 2021), and then using the constant comparative method through thematic analysis (Braun & Clarke, 2006). In Phase 2, an iterative approach was used to identify key dimensions of an FDT evaluation framework. This included six internal development workshops (up to 7 members of the interdisciplinary research team) to establish an initial set of dimensions using insights drawn from Phase 1 findings. Once developed, the Delphi method was used to collect data through a questionnaire on Qualtrics. Delphi is a systematic method for gathering and refining the opinions of experts in their field and facilitating communication over several rounds (Trevelyan & Robinson, 2015). In the first round, experts provided specific insights for dimension inclusion (yes, unsure, no); responses were compiled, deidentified, and shared with the whole cohort in the next round, allowing revision based on collective feedback in successive rounds until opinions converged (>75% agreement). Recruitment occurred via snowballing with some industry experts from Phase 1. Fatigue scientists were recruited from existing research networks and contacts. The final set of dimensions were categorised into an evaluation framework. Ethics approval was granted for the study.

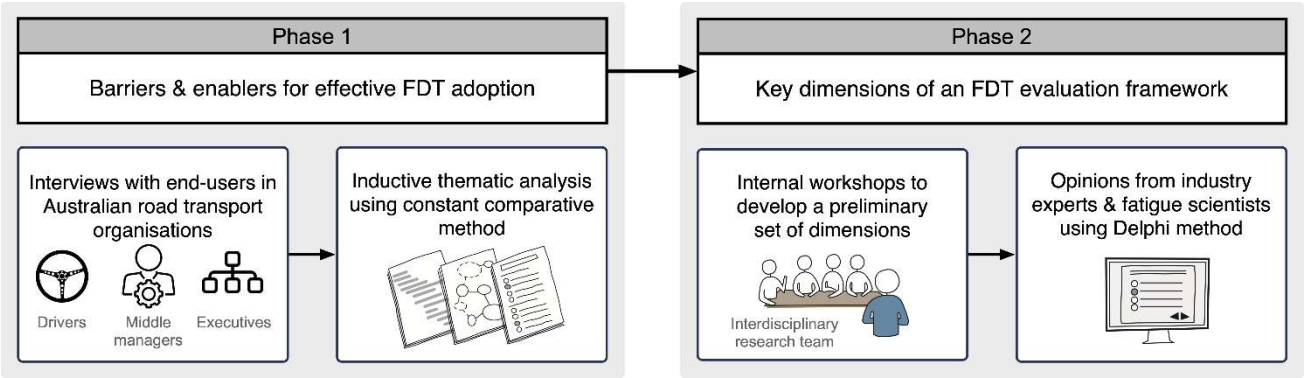


Figure 1. Overview of study design.

Results

Barriers and enablers for effective FDT adoption

A total of 28 end-users were recruited from six different Australian road transport organisations (drivers $n = 17$; middle managers $n = 7$; executives $n = 4$). The age ranged from 29 to 70 years (51.6 ± 9.8 years) and 82% were male ($n = 23$). Time in current role ranged from 1 month to 35 years (8.3 ± 9.0 years). For drivers, experience in professional driving ranged from 4 years to 40 years (23.6 ± 12.6 years). Vehicle fleet size for organisations ranged from 3 to 350 vehicles.

Six barriers of driver acceptance and organisational implementation of FDT were identified along with 7 enablers (Figure 2). Prevalent barriers included *limitations of the technology*, with factors such as FDT producing too many false positives and capacity to malfunction. *Misinformation and poor communication* entailed factors such as privacy and surveillance and data misuse. *Negatively valanced experiences* referred to factors eliciting negative feeling about FDT, including additional workload, upset and annoyance from false positives, and stress. Prevalent enablers included *effectiveness*, with factors such as FDTs facilitating discussion of risk-taking, satisfaction with device reliability, and FDT use leading to behaviour and habit change. *Reassurance* referred to feeling safe, and assistance with managing work pressures. *Incidental benefits* referred eponymously to factors such as management receiving alerts and reports, elimination of non-compliant behaviour, lowered costs, and the capacity for FDTs to record footage of the road ahead. Analysis also revealed key factors (i.e., themes) for overlapping barriers and enablers, drawing attention to a dynamic quality in perceptions and beliefs, and inherent complexity in the end user experience of FDTs.

Key dimensions of an FDT evaluation framework

Internal workshops produced an initial set of fifteen dimensions, helped by the qualitative depth and richness of factors elicited from Phase 1. From this, it became apparent that not all elements of the framework would be easy to consider objectively, thus, inappropriate to evaluate FDT itself (e.g., cultural and “big brother” impacts). A total of 38 participants were identified and contacted to take part in the Delphi, with 29 completing round one. A total of 3 rounds were required to refine the dimensions and achieve agreement on the final set of dimensions with a total of 21 participants completing the third round (38% female, mean age 48.0 ± 12.4, 52% in an industry role, 48% in a scientific role)—a relatively low level of attrition compared to similar published Delphi protocols (Foster et al., 2020).

A final set of 16 dimensions were identified and categorised into 3 distinct categories of an evaluation framework: (1) *Device Efficacy* (6 dimensions); (2) *Device Features* (6 dimensions); and (3) *Implementation Burden* (4 dimensions).

Final dimensions in Device Efficacy included (with percentage agreement for each): the rate of *False Negatives* (96%) and *False Positives* (96%); how "early" fatigue is detected by the FDT relative to a potential fatigue-related error, near-miss, or vehicle crash (i.e., *Detection Latency,* 88%); the *Quality of Validation Studies* (100%) based on considerations like independency and assessment in real-world scenarios; the *Reliability* (100%) of identifying fatigue events consistently across various of circumstances; and how quickly the organisation and/or user becomes aware when the FDT is not working (i.e., *Notification Time for Device Failure,* 92%). Dimensions in Device Features included: demonstrating *Cost-Benefit* (90.5%) through return on investment in terms of monetary value and/or risk reduction; the ease of *Availability* (81%) in obtaining the FDT for a diverse range of organisations and user types; the forwards and backwards *Compatibility* (81%) of the FDT; the level of *Data Visibility* (84%) to relevant stakeholders with considerations such as privacy and data handling practices; *Data Security* (96%) in relation to the manner the FDT collects, transmits, and stores data; and the likelihood of driver resistance from the FDT being perceived to intrude in the their work environment (i.e., *Intrusiveness,* 81%). Lastly, dimensions in the Implementation Burden category included: the extent to which the FDT diverts driver focus away from their primary tasks and activities (i.e., *Additional Driver Workload,* 92%); the extent to which additional bureaucracy, resourcing and administrative requirements for introducing the FDT into vehicles and operations is reasonable (i.e., *Administrative Burden,* 96%); the amount of training end-users need to successfully use the FDT (i.e., *Training Load*, 90.5%); and the level and quality of assistance and customer service an FDT manufacturer/supplier provides to their user (i.e., *Vendor Support*, 84%).

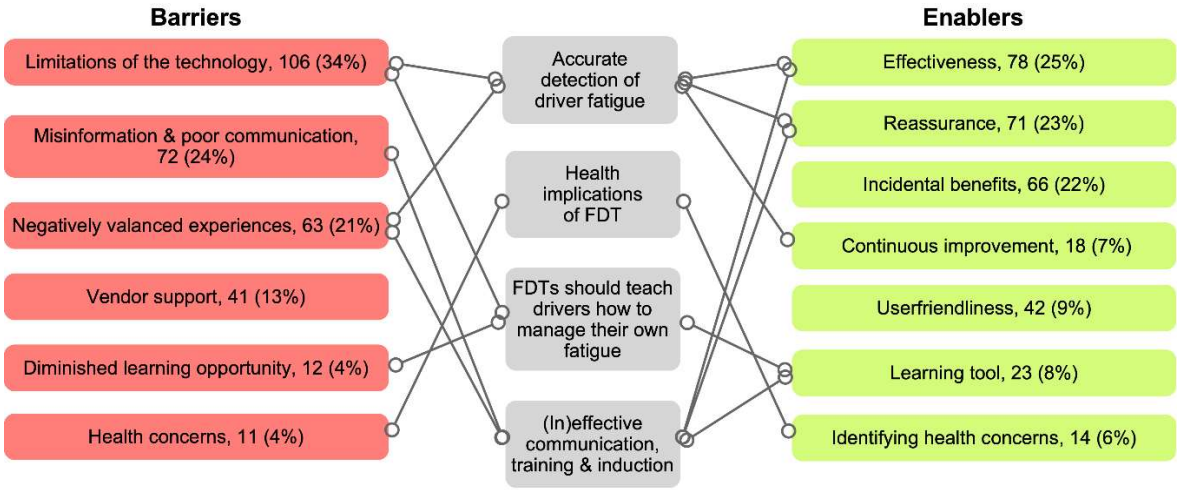


Figure 2. Barriers and enablers of driver acceptance and organisational implementation of FDT.
Note: Numbers indicate frequency of coded statements and percentage of the total for each.

Benefits to road safety

By identifying key barriers and enablers of FDT adoption, this research helps improve implementation strategies, ensuring FDT is effective, accepted and trusted. The evaluation framework provides a structured guide for selecting the right FDT, enhancing safety outcomes for all road users. This work supports informed decision-making, fostering the equitable and effective use of safety technologies in fleet management and everyday driving.

Implications for policy and practice

The results implicate that there is no "one size fits all" type of FDT, meaning that choices need to be made about what consumers most value. The barriers and enablers identified through this study can be used to underpin change management guidance for the acceptance and organisational implementation of FDTs. The four themes characterising overlapping barriers and enablers can be packaged, alongside the 16 key dimensions to offer practical guidance about how to integrate FDT into a workplace and integrate it as part of everyday practice. Importantly, the *Device Efficacy* components of the evaluation farmwork can be used to develop ANCAP-style criteria by which FDTs can be judged.

Conclusions

This study identified barriers and enablers for implementation of FDTs in fleet settings across a range of end-users, and established 16 key dimensions of an evaluation framework through which current and future FDTs could be assessed in Australia. This work may form the basis for future development and selection of accurate FDTs, alongside guidance to implement FDTs effectively to ensure maximal improvement in road safety outcomes for all drivers.

References

Australian Transport Council. (ATC). (2011). *National Road Safety Strategy 2011-2022*.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology, 3*(2), 77-101.

Cori, J. M., Manousakis, J. E., Koppel, S., Ferguson, S. A., Sargent, C., Howard, M. E., & Anderson, C. (2021). An evaluation and comparison of commercial driver sleepiness detection technology: a rapid review. *Physiological Measurement, 42*(7), 074007.

Foster, C. J., Plant, K. L., & Stanton, N. A. (2020). A Delphi study of human factors methods for the evaluation of adaptation in safety-related organisations. *Safety Science, 131*, 104933.

Saldaña, J. (2021). The coding manual for qualitative researchers. Sage.

Sikander, G., & Anwar, S. (2019). Driver Fatigue Detection Systems: A Review. *IEEE Transactions on Intelligent Transportation Systems, 20*(6), 2339-2352.

Trevelyan, E. G., & Robinson, P. N. (2015). Delphi methodology in health research: how to do it? *European Journal of Integrative Medicine, 7*(4), 423-428.

Preventing low-speed vehicle runovers of children through collaboration

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Abstract
Low-speed vehicle runovers involving young children are a significant road safety issue in Australia, particularly in home driveways. Despite advancements in vehicle technology, the incidence of these tragic events has increased over the past two decades. Transport for NSW's *Kids and Traffic* Program, delivered in partnership with Macquarie University, has been proactive in addressing this issue. The Program developed the Driveway Safety Display Kit to raise awareness about the dangers of low-speed vehicle runovers and the importance of the active supervision of children. Recent enhancements, including a redesigned kit and instructional and social media videos, have improved the program's reach and impact. These efforts, supported by various stakeholders, emphasise the need for a coordinated, grassroots approach to prevent child road trauma. While technological advancements are valuable, they cannot replace the necessity for close and active supervision of young children to ensure their safety around vehicles.

Social media post
Low-speed vehicle runovers are a critical road safety issue in Australia, especially in home driveways. Transport for NSW and the *Kids and Traffic* Program's Driveway Safety Display Kit raises awareness about these dangers. Remember, active supervision of children around vehicles is essential to prevent tragedies.

Background
Transport related injuries remain a leading cause of death in children under 14 years of age in Australia (AIHW, 2024). While low-speed vehicle runovers involving young children continue to be a significant road safety issue across Australia, most jurisdictions do not report on them as the majority of incidents occur off-road. Tragically, many low-speed vehicle runovers happen in home driveways with the driver responsible for injuring or killing the child being a parent or family member. Though improvements have been made in vehicle technology, such as the fitting of reversing cameras and motion sensors, the number of off-road low-speed vehicle runovers involving young children has increased in the past two decades. Driveways were the location of around a third of all child pedestrian deaths in Australia between 2001 and 2019 (Williamson et al., 2023). Like drownings, these casualties are often the result of a combination of factors; an inquisitive and naive young child, an open door or gate, a busy or distracted carer or a lack of communication about supervision responsibilities between present adults (NSW Child Death Review Team, 2022).

Almost 25 years ago, Transport for NSW's Kids and Traffic, Early Childhood Road Safety Education Program, began working with a range of stakeholders on the 'Children Killed and Injured in Driveways Project Steering Committee'. The Committee was established following concerns from the NSW Child Death Review Team about the incidence of low-speed vehicle runovers. As an active member of this committee, Kids and Traffic, worked with the Motor Accidents Authority and the City of Ryde to develop an interactive 'Driveway Safety Display Kit' to highlight the difficulty drivers have in seeing small children behind vehicles. The display contains four toddler sized statues placed at 2.5-metre intervals behind the vehicle. Since launching the kits in 2002, they have been used to help raise family and community awareness of the risks to children of low-speed vehicle runover. Displays have been conducted by a wide variety of stakeholders in NSW and beyond including:

- Farmsafe
- NRMA
- Youthsafe
- Georgina Josephine Foundation
- Kidsafe
- Royal Children's Hospital QLD
- Local Government Road Safety Officers throughout metropolitan, regional, rural and remote NSW.

In addition, the Kids and Traffic team has shared the display with thousands of educators and families at early childhood education and care services across the state and as part of multiple sector conferences and forums.

Transport has consistently recognised and supported the issue of low-speed vehicle runovers through social media campaigns, and the development and distribution of educational materials for families and the community. Transport has provided funding for specific projects such as the Driveway Safety Display Kits through Kids and Traffic, and through its Community Road Safety Grants Program.

Conference theme

Equity. This paper acknowledges children's vulnerability as pedestrians and the need for families and communities to have equitable access to engaging, relevant tools to ensure they are responsible for their children's safety. All families require information to raise awareness, make informed decisions and act to help protect children.
Evolution. This paper aligns with an evolving safe system approach by integrating 'safer people' through education, 'safer vehicles' through design, and 'safer roads/environments' through housing and designated safe play areas for children away from vehicles.
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Project description

Transport funds the Kids and Traffic Program which is delivered in partnership with Macquarie University. The Program is part of an enduring, shared-governance collaboration with Transport, NSW Department of Education, Association of Independent Schools NSW, and Catholic Schools NSW. The Kids and Traffic Program provides professional learning workshops, educational resources, advice, support and advocacy to early childhood education and care services. The Program supports collaborative grassroots action to prevent child road trauma. Last year, the Program reached more than 4500 early childhood services across NSW.

In 2022, Transport and Kids and Traffic reviewed the materials available to promote driveway safety and highlight the dangers to children of low-speed vehicle runovers. The need was identified to improve and diversify the range of community resources. It was recognised that due to the space required to set up the Driveway Safety Display Kit (approximately 15 metres), many early childhood services were unable to accommodate the display onsite thus missing the unique opportunity to communicate this important messaging to families. Stakeholder feedback also indicated that changes could be made to the setup of the display to improve efficiency and increase audience impact.

In 2023, Transport and Kids and Traffic began a project to address these issues. Project components included:

3. redesign and production of the revised Driveway Safety Display Kit as an activation and engagement tool for Transport's delivery partners and third party borrowers.
4. design and production of an instructional video to ensure safe and successful use of the kit – to be used by Transport's delivery partners and third party borrowers.
5. design and production of a series of short videos showcasing the kit in use, including audience responses – to be used in Kids and Traffic workshops, shared with early childhood services and families, and used across Kids and Traffic and Transport's social media channels.
6. redesign of processes and procedures for disseminating the kits across NSW, in particular through Transport's Local Government Road Safety Program network – including trialling strategies for use.

Outcomes

While some elements of the project continue into 2025, project components achieved at the time of writing include:

1. Successful redesign, production and use of the new Driveway Safety Display Kit – trialled at 15 different locations to date. Stakeholder feedback suggests the addition of a targeted banner and measurement mat have increased efficiencies in set up and audience engagement (See Figure 1 and 2 for a comparison view of the old and new kit inclusions).
2. Filming of the instructional video took place in July 2023 with production completed in February 2024. The video link is included in the draft User Manual and borrower agreement for third party borrowers. This resource supports the safe set up and use of the display at varied sites.
3. The showcase and social media videos were produced in early 2024. Throughout 2024 the showcase video and associated driveway safety messaging was included in more than 260 *Kids and Traffic* workshops reaching thousands of educators, families and students. A shortened version of this video was created specifically for social media around Low-speed Vehicle Runover Awareness Day in April 2024. It was the top performing Facebook post on Transport's Road Safety NSW page in 2024 with 1.4 million people reached, 1.8 million video plays and 51,000 engagements. Sentiment was positive with people commenting how important the message was and sharing their own safety tips.

4. The redesign of processes and procedures for disseminating the kits across NSW is ongoing with collaboration between Transport's *Kids and Traffic* and Local Government Road Safety Officer programs. *Kids and Traffic* and City of Sydney Road Safety Officers continue to trial innovative strategies across diverse audiences including Council's heavy vehicle fleet drivers. These practice examples will be a useful addition to the User Manual.



Figure 1. Driveway Safety Display Kit set up at Connect 5 Mobile Preschool Coonabarabran (2015)
Source: Kids and Traffic



Figure 2: Driveway Safety Display Kit set up at City of Sydney Alexandria Depot (2024)
Source: Kids and Traffic

Benefits to Road Safety

Increasing community awareness of the risks to young children of low-speed vehicle runovers has definite road safety benefits. Children are vulnerable road users, and for young children, who do not have the skills and understandings to keep themselves safe, the community are responsible for protecting them from harm. Active supervision of children by adults has been identified as crucial to preventing low-speed vehicle runovers (Williamson et al., 2023). The interactive nature of the Driveway Safety Display clearly demonstrates to the audience the blind spots that exist around vehicles and the potential for a small, fast moving child to be unseen by a driver. The introduction of the Driveway Safety Display Kit video has increased the reach of the important message of the necessity for close and active supervision of young children. Transport is able to leverage the strengths of its longstanding Road Safety Education and Local Government Road Safety programs to further reach audiences across NSW through the dissemination of the Driveway Safety Display Kit.

Implications for policy and practice

Low-speed vehicle runovers involving young children continue to impact families and communities across the country. Though improvements to in-vehicle technologies to increase rear visibility continue to evolve, these cannot be relied upon to be the silver bullet to prevent these tragedies occurring in the future. In fact, these technologies can cause drivers to become complacent to the very real risks. Promoting community awareness of the importance of close and active supervision of young children around moving vehicles is paramount. Transport's collaborative driveway safety project has highlighted the benefits of education sector and local government stakeholders, such as City of Sydney, working together to reduce child road trauma. A coordinated approach targeting families and communities is crucial to preventing low-speed vehicle runovers. Until we have vehicles that see, sense and actively respond by braking when vulnerable road users are present anywhere around a vehicle, we need to ensure children are protected by their families and the wider community through close and active supervision.

Conclusions

The issue of low-speed vehicle runovers involving young children remains a critical road safety concern in Australia, particularly in home driveways. Despite advancements in vehicle technology, the incidence of these tragic events has increased. Transport for NSW and the *Kids and Traffic* Program, in collaboration with various stakeholders, have been proactive in addressing this issue through initiatives like the Driveway Safety Display Kit. The recent redesign of the kit and the production of instructional, showcase and social media videos have enhanced the program's reach and impact. These efforts have been instrumental in educating families, educators, and communities about the critical need for vigilance around vehicles. The ongoing collaboration between Transport, *Kids and Traffic*, and local government road safety officers underscores the importance of a coordinated, grassroots approach to preventing child road trauma. In conclusion, while technological advancements are valuable, they cannot replace the necessity for close and active

supervision of young children. The continued efforts of road safety programs and community awareness campaigns are essential in mitigating the risks and ensuring the safety of vulnerable young pedestrians.

References

Australian Institute of Health and Welfare. (AIHW). (2024). *Deaths in Australia.* Retrieved from https://www.aihw.gov.au/reports/life-expectancy-deaths/deaths-in-australia

NSW Child Death Review Team. (2022). *NSW Child Death Review Team Annual Report 2021-22*. Retrieved from https://www.ombo.nsw.gov.au/reports/annual-report/nsw-child-death-review-team-annual-report-2021-22#summary

Williamson, A., Koch, F.C., Boufous, S. & Olivier, J. (2023). *What do we know about the causes of child pedestrian fatalities in Australia?* Retrieved from https://www.littlebluedinosaur.org/research/

Driving change: safer transport solutions for Cambodian factory workers

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Abstract
Cambodia's exporting garment and footwear factories employ more than 870,000 workers, the majority of whom are women, who are the bedrock of the national $10.7 billion industry. However, one-third of these labourers face significant health and safety risks during their daily commutes due to overcrowded and unsafe transportation, often in open trucks without proper seating. These risks not only endanger workers' lives but also affect their families and communities. In response, the AIP Foundation has collaborated with government and industry stakeholders to implement safety programs in over 50 factories and three special economic zones across Cambodia between 2019 and 2024. These initiatives aim to improve driving behaviour among transport providers and encourage the adoption of safer vehicle options. As a result, the programs have successfully enhanced drivers' knowledge and behaviour, leading to a measurable transition from high-risk vehicles to safer alternatives, ultimately improving commuting safety for workers.

Social media post
In Cambodia, over 870,000 workers, mostly women, power the $10.7B garment industry. Many face unsafe commutes in overcrowded and dangerous vehicles. Through our commuting safety programs, safer transport and better driving behaviours improve workers' safe journeys. #CommitToLife

Conference theme
Our programs directly contribute to the theme of Elasticity by enhancing the adaptability and resilience of Cambodia's transportation system for factory workers. By promoting the transition from high-risk vehicles to safer alternatives, we emphasize flexible and sustainable commuting solutions that ensure equitable access to safe transportation. Through collaborative efforts, policy advocacy, and behavioural change interventions, we support shifts in transportation modes that improve worker safety while ensuring the long-term stability of the system.

Background
Despite its economic significance, road safety for garment and footwear workers in Cambodia remains an overlooked issue. According to the National Social Security Fund (NSSF), over 270,000 workers rely on collective transportation daily, with 54% traveling in unsafe flatbed cargo trucks. In 2022, the sector recorded 3,275 road crashes, affecting 4,056 workers - equivalent to more than 338 workers per month when commuting to and from work (NSSF, 2022). These incidents not only jeopardize worker safety but also impact the well-being of approximately 2 million dependents (ILO-BFC, 2016).

Project description
To facilitate workers' access to safer, seated passenger vehicles operated by qualified drivers, the AIP Foundation partnered with key stakeholders to implement three road safety programs across over 50 factories and three special economic zones in 10 provinces from 2019 to 2024. A multi-faceted approach was adopted, including:

- Feasibility study on options to facilitate the transition to passenger transport vehicles;
- High-level advocacy meetings;
- Factory engagement meetings and information sessions – focusing on the transition to safer and seated passenger vehicles;
- National workshops to discuss the possibility of transitioning to safer passenger vehicles;
- Speak up Campaigns through the Speak Up Champions at target factories and through social media to raise awareness, observe drivers' behaviours, and address worker road safety concerns;
- Training programs to enhance the safe driving knowledge, attitude, and behaviour of transport providers and encourage the adoption of safer vehicle options;

- Data-driven evaluation by developing a built-for-purpose measurement app to track fuel savings and assess changes in driving behaviour;
- Field Visit the transition from trucks to safer vehicles;
- Transport modes and driving license observations and documentation at target factories;
- Workshops sharing Best Practices and Experiences.

Results

During the programs, 45 high-level meetings were organized, engaging approximately 500 relevant government and non-governmental stakeholders at the national and sub-national levels, media associations, and trade unions. Three Policy Briefs were developed to inform stakeholders of possible solutions and encourage high-level joint action activities. The programs successfully collaborated with more than 50 factories and special economic zones to develop and implement action plans, sustainable policies, practice changes, and impact monitoring toward the transition to safer transportation for workers.

A total of 2,646 collective transport drivers across target factories and special economic zones received training on safe driving, fuel efficiency, and vehicle safety. Prior to the intervention, although drivers had a strong foundation in attitudes toward commuting safety, their knowledge and practices required improvement. After the training, positive changes were observed.

Regarding the eco-safe drivers' training, the percentage of drivers with 'excellent knowledge' (a score of 8 or above) increased by 20%. Other training interventions focused on key road safety risk factors led to a significant improvement in raising awareness among transport providers, with more than 90% of drivers achieving a good level of commuting safety knowledge after the training. Furthermore, adherence to safe commuting practices, as self-reported by drivers, increased from 50% to 61%.

Data collected via a purpose-built app on drivers' phones confirmed behavioural changes, with 68% of drivers reducing fuel consumption, saving an average of 2.93 litres per 100 km driven.

A substantial shift towards safer transportation was also observed in target factories. Factory data revealed that the number of standing trucks declined from 78.2% at baseline to 47.3% at endline. Meanwhile, safer alternatives such as buses, vans/minibuses, and seated trucks increased by 12.6%, 14.5%, and 3.8% respectively. Additionally, the proportion of overloaded vehicles dropped from 81.7% to 33.4% after three years of intervention.

Along with other initiatives, our efforts have driven notable improvements in road safety among workers. After three years of intervention, the proportion of workers involved in road crashes declined by 43.1% since 2021, of which serious injuries dropped by 74.3%. The number of fatalities fell from 8 to only 1 case at target factories.

Implications for policy and practice

These efforts contribute to the pathway of legislative policy change in Cambodia, aiming to foster safe commuting for workers. By demonstrating the feasibility of transitioning from high-risk vehicles to safer alternatives, our initiatives provide an evidence-based foundation for issuing new policies and scaling them nationwide. Recently, the Cambodian government announced its commitment—among other priority actions—to facilitate the use of safer and more comfortable vehicles for worker transportation by 2027. Additionally, the government has instructed relevant bodies and stakeholders to hold meetings and take necessary actions to improve transportation standards in terms of both safety and comfort, ensuring better protection for factory workers across Cambodia.

Conclusion

The successful implementation of this initiative highlights the critical role of structured interventions in enhancing road safety for Cambodia's garment and footwear workers. By fostering collaboration among stakeholders and promoting the adoption of safer transportation methods, the program has demonstrated measurable improvements in worker safety. These findings reinforce the need for continued investment in sustainable transport solutions, which can serve as a model for other manufacturing regions facing similar challenges.

References

Better Factories Cambodia. (2016). *Op-ed: Better Factories Cambodia and its 15-year journey.* Better Work. https://www.betterwork.org/op-ed-better-factories-cambodia-and-its-15-year-journey/

National Social Security Fund (NSSF). (2022). Report on Annual Achievements 2022 and Action Plans 2023 of Road Traffic Safety Team for Worker Prevention (RTSTWP)

Views on age-based licensing from older drivers, families and caregivers

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Abstract
In 2008, New South Wales (NSW) reformed its age-based licensing system to balance the continued independence and mobility needs of older drivers. However, little is known about how older drivers perceive and navigate this system. This study addresses this through focus groups with older drivers (n=34) and families and caregivers (n=15) in NSW. All transcripts were transcribed verbatim with inductive-deductive coding using The Integrative Public-Policy Acceptance Framework completed in NVivo V.12. Overall, both groups expressed support for the age-based licensing system. They accepted the medical and on-road driving assessments as important components that help older drivers remain safe. However, older drivers' engagement with modified licences was low and families and caregivers wanted more support from general practitioners and the licensing authority. The results highlight the need to improve communication of the licensing regulations to older drivers and families and caregivers to ensure continued support and confidence in navigating the system.

Social media post
Older drivers and their families and caregivers support age-based licensing regulations but engagement with the licensing system can be improved through more transparent communication.

Introduction
New South Wales (NSW) has an ageing driving population. The proportion of licence holders aged 80 years and older doubled from 2% in 2010 to 4% in 2024 with over 1.7 million older drivers going through the licensing renewal system each year (BITRE, 2024). With more older drivers on the road, it is vital that there is a licensing system that recognises the changes in both the licence holder profiles and transport needs of older adults. NSW has attempted to create such a system when it reformed its age-based older driver licensing system in 2008 to include more flexible options for continued independence and mobility of older drivers and a clearer pathway to driving retirement. An evaluation of NSW licencing data from 2005 to 2014 found that the proportion of 85-year-olds who held a modified licence restricting driving radius increased from 2.1% before the 2008 reforms to 11% afterward (Transport for NSW, 2018). Age-based licensing for older drivers exists in many jurisdictions around the world. Previous research has shown healthy older adults are more inclined to support the introduction of regular fitness to drive medical tests for licensing than those who score worse on health assessments (Thorslund et al., 2017). Similarly, policymakers and clinicians have proposed that testing is needed to keep the oldest drivers (i.e., those aged 90 years and older) safe (Adler & Rottunda, 2010). However, literature on how older drivers interact with the age-based licensing system is limited. Addressing this gap is crucial to developing and evolving the age-based licensing system to be one that is appropriate for older adults. This study therefore aims to examine how older drivers, and their families and caregivers perceive and engage with the NSW age-based licensing system after the 2008 licensing reforms. Data from this study comes from a larger evaluation conducted by the NSW government, examining the impact of the licensing changes on older drivers, their families and key stakeholders.

Conference Theme
This work aligns with all three conference themes. Older drivers and their families and caregivers are two groups most affected by the age-based licensing system. The results allow researchers and policymakers to better understand the challenges and impact the licensing system has on older drivers and their families and caregivers. This may facilitate the development of future policies in an adaptable system that equally supports the mobility and independent needs of all older adults.

Method

Focus groups were conducted with older drivers and family members and caregivers residing in three areas in NSW: Coffs Harbour (19 participants), the Hills District (18 participants) and Canterbury (12 participants). Older drivers could participate in the focus groups if they either held a current NSW driving license and were still driving or had recently stopped driving at the time of recruitment. All families and caregivers in the focus groups were at least 45 years old and had an older family member or were caring for an older individual who was a driver or who had recently stopped driving. Recruitment was through community services, councils and senior groups, and flyers in key locations such as community centres, shopping malls and government services offices. The focus group facilitators used a discussion guide that asked open-ended questions on the awareness, norms, and impact and attitudes the participants may have on the age-based licensing system and other facilitating factors such as alternative transport, consequences of cognitive decline, and quality of life. All focus groups were audio-recorded and transcribed verbatim. All transcripts were imported into QSR International NVivo V.12 qualitative data analysis software to be coded by two researchers independently. All transcripts were first coded inductively with preliminary themes created. The transcripts were then re-coded deductively using components of the Integrative Public-Policy-Acceptance Framework to create additional themes by a third researcher. This framework was chosen as it provides a holistic view of why the public may or may not accept certain policies by integrating key psychological determinants, such as trust and fairness, with desire for government support as the key motivational component (Grelle & Hofmann, 2024). All themes from both the inductive and deductive coding steps were then combined and reviewed by all authors before finalisation.

Results

There were three major themes that emerged from the thematic analysis of the focus groups with older drivers.

Older drivers' support age-based licensing, but unclear communication can cause confusion

This theme aligns with the "problem awareness", "support seeking characteristics", "policy quality" and "policy compliance" components of the Integrative Public-Policy Acceptance Framework. The majority of the participants supported the medical and driving assessments, and accepted these components as essential to ensure individuals are still capable of driving safely. They complied and engaged with these tests as they were aware of possible changes to their driving skills due to age; *"I agree with the assessments because you're endangering other lives as well, sometimes you think, you think you're okay but somebody else needs to confirm that." [Group 4; Participant 3].* However, even though some participants felt that the driving test, was *"very friendly, user friendly" [Group 2, Participant 1]*, others found it to be stressful. This anxiety may be because many have never had to take driving tests before, so being asked to complete one to retain their licences after driving for most of their lives is a foreign concept; *"He got his licences at the end of the war, so he didn't even have to go for a test then. So suddenly being tested when you're 85, it's a bit stressful, and he didn't like the stress." [Group 6, Participant 3]*. When prompted by the facilitator that the modified licence was an option for those who were uncomfortable with taking the driving assessment, confusion on how to obtain a modified licence and how its distance-based restrictions were set was raised by at least one participant in all focus groups, thereby showing that engagement with rules on modified licences is low; *"I've heard different kilometres mentioned by different people. Is there some sort kilometre distance?" [Group 6; Participant 2]*.

Age-based licensing is imperfect but needed because not all unsafe drivers stop by themselves

This theme aligns with the "support seeking characteristics", "desire for government support", "policy quality" and "policy acceptance" components of the framework. All participants felt that for most of the time, the medical and driving assessments are rigid enough to pick up on those who may not be able to gauge declines in their own driving skills; *"You're never going to stop the occasional driver who shouldn't be driving, getting behind the wheel, so I'm in favour of fairly strict testing, because I think you've got to try and pick up" [Group 3 Participant 3].* However, participants held mixed views on how well they thought the system appropriately identifies and assesses those with cognitive decline with some feeling that the tests were not robust enough; *"... reaction time is what was needed because that's what you use when you're driving and that's what its supposed to be about. Not whether you can count backwards in threes or nines or sevens or whatever." [Group 5, Participant 5].* Participants also held reservations about general practitioners' capability to appropriately test and link cognitive decline to safe driving ability; *"... and I think doctors – it's a bit difficult to say as they don't take their responsibility as seriously as they might, but I suspect that might be the case." [Group 3, Participant 4]*.

Age should not be the only criteria as everyone "ages" differently

This theme aligns with the "desire for government support", "policy quality" and "policy acceptance" components of the framework. The belief that age is not a good indicator of an individual's ability to safely drive was brought up in all focus groups. Even though participants agreed that testing older drivers was a good thing, they did not understand why testing starts at 75 years old. Many pointed out that health, particularly cognitive health, varies between individuals

regardless of their age; *"It shouldn't be any particular age because everybody isn't the same at that age are they. Some people are more slower and some not." [Group 1, Participant 3].* This is why some participants felt that the rules discriminated against older drivers and that the assessments should start at an earlier age; *"There's a lot younger that aren't really on the ball that much. I think there should be more tests for the younger ones periodically." [Group 1, Participant 2].* Because changes to health differs for everyone, some participants also felt the 2-year gap between each driving assessment was too long as one participant pointed out; *"I think after 85 years, your reaction time is sort of diminishing at a very sharp angle. I think they should really do it every year." [Group 5, Participant 3].*

Two major themes emerged from the thematic analysis of the focus groups with family members and caregivers.

Recognition that family and caregivers contribute to implementation of the age-based licensing system.
This theme relates to the "problem awareness", "desire for government support" and "policy compliance" components of the Integrative Public-Policy Acceptance Framework. All family members and caregivers understood that the regulations of the age-based licensing system were created to keep older adults safe on the roads. They therefore felt that they play a major role in creating a safer road environment by helping older drivers navigate the licensing process and addressing their mobility needs after driving retirement. Family members and caregivers intervened to make sure that the older driver stopped driving if they had concerns for their safety *("They have been to the doctor's as in they my sister and her husband and the family and everyone, begging them to take his licence off. They've been to the licensing people saying; please take his licence off him." [Group 3, Participant 4*) and provided tips on how to pass the on-road driving assessment if the older adult would like to keep their unrestricted licence *("I'll try and talk him around and try and explain to him the rules of roundabouts because that was by biggest concern with him…" [Group 2, Participant 2*]). However, some did find it difficult to intervene as approaching the topic of licensing incorrectly can lead to family disruptions; *"… like in your case, you could have had a mother that disowned you at 90 something all because she lost her licence." [Group 3, Participant 1]*. Supporting the older adult after they stop driving can also *"curtail some of my social activities" [Group 4, Participant 2]* with participants feeling like they have no choice but to drive the older adult around, particularly if public transport and alternative transport options are poor. Participants therefore wanted more engagement from general practitioners and the licensing authorities to create a more holistic licensing system where the responsibility of keeping older adults safe is more evenly shared.

Desire for evidence and a clear rational for age-based licensing
This theme falls into the "Policy quality", "Policy acceptance" and "Policy compliance" components of the framework. All participants mentioned that while they supported the age-based licensing system, they would like more transparency on evidence showing how these laws have impacted safety for older drivers. Such evidence would also determine whether they continue to support the licensing system or not as *"I think statistics need to have shown that its better, worse or indifferent" [Group 1, Participant 2]* and *"It would be interesting to see the evidence because for all the reasons we talked about before when older drivers don't tend to driver as far and tend to be a bit more cautious. I don't know if they really do represent the risk we perceive to be the risk." [Group 1, Participant 3]*. Because there is also a lack of information on how the age-based licensing laws were created, some participants felt that the rules may be prejudiced against older drivers. Public condemnation may have fuelled the creation of the system therefore making older drivers more targeted than younger-aged drivers who commit the same errors; *"And I think that was a bit of a knee jerk reaction and sure there's older drivers that do some silly things like putting your foot on the accelerator instead of the brake but, God, young people do it too." [Group 4, Participant 2].*

Benefits to Road Safety

This study benefits road safety by providing researchers and policymakers a better understanding of how and why older drivers and their family and caregivers, who are the groups most affected by age-based licensing, perceive and navigate the licensing system. Results highlight that engagement can be improved through better communication about what is expected from them and how the policies were created. Age-based licensing has been in NSW for many years and will continue to play a vital role in keeping older drivers safe on the road as the driving population continues to age. The areas of improvement outlined in this study may be used to update communication strategies to support ongoing implementation of the age-based licensing system to maximise benefits for all older adults and their families.

Implications for policy and/or practice

This study highlights the need for regular communication about policy development and changes to all stakeholders to enhance engagement and understanding with policy implementation. From the perspective of older drivers and their families there is good general support for current age-based licensing but scope for enhancing programs supporting those trying to navigate the system.

Conclusion

This study shows that older drivers and their families and caregivers are accepting but have constructive suggestions about implementation of age-based licensing in NSW, after the 2008 reforms. However, older drivers' confusion about modified licences, highlights the complexity and need for ongoing support for engagement with this type of licence and pathway to driving retirement. Older drivers also voiced their concerns about the system's ability to account for health differences between individuals. Families and caregivers wanted more transparency on the evidence used to create the age-based licensing system and its impact on road safety so that they can increase their understanding of the policies. They also voiced their preference for more engagement from general practitioners and the licensing authority to help keep older drivers safe. The findings from this study may help develop communication channels aimed at making the age-based licensing system an easier system to navigate for all older drivers and their families and caregivers.

References

Adler, G., and Rottunda, S.J. (2010). "Mandatory testing of drivers on the basis of age and degenerative diseases: Stakeholder opinions." *Journal of Aging & Social Policy,* 22.3

Bureau of Infrastructure and Transport Research Economics. (2025). *Australian Infrastructure and Transport Statistics—Yearbook 2024*. Bureau of Infrastructure and Transport Research Economics. https://www.bitre.gov.au/publications/2025/australian-infrastructure-and-transport-statistics-yearbook-2024

Grelle, S., & Hofmann, W. (2024). When and why do people accept public-policy interventions? An integrative public-policy-acceptance framework. *Perspectives on Psychological Science*, *19*(1), 258-279.

Thorslund, B., Strand, N., & Willstrand, T. D. (2017). Attitudes among older drivers towards medical assessment at renewal of driving license in Sweden. *European transport research review*, *9*, 1-8.

Transport for NSW, Centre for Road Safety. (2018). https://www.transport.nsw.gov.au/system/files/media/documents/2023/Older%20Driver%20Licensing%20System%20Evaluation.pdf

Youth actions turn grass-roots ideas into practice

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Abstract
Youth's opinions are often not heard when road infrastructure upgrades, even those affecting them directly, for example, around their school zones, which leads to modifications that may not meet their needs. This abstract discussed the effectiveness of youth engagement in road safety planning within AI&Me: Empowering youth for safer roads project under the funding of Fondation Botnar and FIA Foundation. The project sought ideas from youth aged 13 to 22 to develop the Youth Engagement App (YEA) at the inception of the project until they could provide recommendations to government decision-makers based on evidence that they collected via YEA and Star Rating for Schools. As a result, 22 schools were modified, 13 of which used the local government's own fund.

Social media post
Youth voices are key in road safety! The AI&Me project, funded by Fondation Botnar & FIA Foundation, empowered young people (ages 13-22) to shape safer school zones in Vietnam with the YEA. 22 schools were modified, with 13 funded by the local government. #CommitToLife

Background
Road traffic injuries are the leading cause of death for children and young adults aged 5–29 years (WHO, 2023) with approximately 1,700 children between the ages of 5 and 19 dying each year in Vietnam as a result of traffic crashes between 2011 and 2020 (Luong et al., 2023). Despite this, road safety measures, which should be made to protect youth from fatalities, often fail to meet their actual needs as youth are frequently excluded from the planning and implementation processes due to policymakers viewing planning and policy-making as adult responsibilities (ITF, 2024). The United Nations Convention on the Rights of the Child 1989 states that all children possess the right to express their views openly on any matter that impacts them, provided they have the capacity to form their own opinions. They have the right to participate and be heard in any judicial and administrative proceedings affecting them (Article 12). Involving youth in the decision-making process means policymakers can understand their needs and apply their innovative ideas to create contextually relevant and effective road safety measures (Bohdidi et al., 2024). The aspirations of youth must be considered in the formulation of today's transportation systems, as they will be the future users and inheritors of it (ITF, 2024).

Conference theme: Equity
The AI&Me: Empowering youth for safer roads project (AI&Me project) strives to empower youth to become active stakeholders in road safety initiatives. This approach shifts the paradigm from youth being passive beneficiaries to them having a genuine voice in advocating for and collaborating with local authorities on lifesaving road upgrades and modifications. By incorporating youth's perspectives into every project step, the needs of youth for safer school zones are directly addressed.

Project description
The AI&Me project utilized the International Association for Public Participation Public Participation Spectrum as a framework to encourage and enable youth to actively share their perspectives and suggestions for enhancing safety in school zones.

Results
- 1,468 young people attended the pre- and post-training surveys, which showed that their knowledge, attitude and behaviours on road safety increased from 55.8% to 82%, 42.1% to 58.6% and 39.6% to 57.1% respectively. Due to these changes, the youth were able to enhance their capacity to speak up with government about their road safety concerns.
- Of the 106 schools assessed, 98 received a 1- or 2-star rating. 22 schools were modified, 13 of which used the local government's own fund.

1.	Informing	Youth were provided information on project descriptions and given training on road safety and safe school zones to emphasize their roles and responsibilities in road safety. Youth were able to improve their ability to voice their road safety concerns to policymakers as a result of the knowledge they acquired.
2.	Consulting	During focus group discussions and interviews, youth expressed their expectations to develop a youth app named YEA and provided their feedback on upgrading the app. Via the YEA, youth contributed their opinions on the conditions of infrastructure and traffic around their school zones to identify the highest risk locations for Star Rating for Schools (SR4S) assessment.
3.	Involving	Youth participated in collecting data for the SR4S assessment at the highest risk locations, which were identified based on opinions submitted by their peers through the YEA.
4.	Collaborating	Youth leveraged the results from the YEA and SR4S to devise their own solutions, which they subsequently presented to government decision-makers in a youth forum. They also showcase results and connected with the government regarding road safety issues in their areas using the Citizen portal embedded on the local government's websites. Additionally, they participated in a communication campaign, such as joining the music video making titled “Youth act for safer roads” to spread the message about the importance of voicing road safety concerns to government policymakers.
5.	Empowering	The government implemented the modifications based on the recommendations in the submitted reports and plans, which included youths' recommendations for school zone modifications.

Implications for policy and/or practice

The project's outcomes demonstrated that the approach was sustainable, as young people were able to comprehend the project's workings and recognize the value of their ideas. Not only are their voices heard, but also their ideas are invested to address their concerns on road safety around their school zones. For communication, youth can proudly promote their achievements to other people in the community as an Ambassador.

Following the project completion, Ho Chi Minh City, Vietnam, a participating province of the project, conducted further research into the results from the YEA and SR4S assessments. The city committed to allocating its infrastructure maintenance budget to improvements at 53 additional schools.

Conclusions

The abstract shares some experiences in engaging youth to actively participate in the project activities, not just as beneficiaries but also as spokesperson to present their concerns and solutions to the government and turn their ideas into practice. To enhance youth's capacity to spearhead effective grassroots change campaigns in Vietnam, the next step will be to address existing skills and knowledge gaps to conduct their own projects.

References

Bohdidi, Z., Cherif, E. K., El Azhari, H., Bnoussaad, A., & Babounia, A. (2024), *Enhancing Road Safety Decision-Making through Analysis of Youth Survey Data: A Descriptive Statistical Approach. Safety*, *10*(2), 45. https://doi.org/10.3390/safety10020045

IAP2’s Public Participation Spectrum (2018), International Association for Public Participation, https://iap2.org.au/resources/spectrum/

ITF (2024), *Youth on the Move: Young People and Transport in the 21st Century*, International Transport Forum Policy Papers, No. 128, OECD Publishing, Paris. https://www.itf-oecd.org/sites/default/files/docs/youth-transport-21st-century.pdf

Luong Mai Anh, Nguyen Quang Thuc, Do Thi Diep (2023), *Death Data due to road traffic accident from the medical system record of health sector*, Health Environment Management Agency, Vietnam Ministry of Health.

UN 1989, *Convention on the Rights of the Child*, Article 12, https://www.unicef.org/child-rights-convention/convention-text

WHO factsheet, *Road Traffic Injuries* (2023), https://www.who.int/news-room/fact-sheets/detail/road-traffic-injuries

An investigation of vehicle-bicycle lateral interactions using computer vision data

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Abstract
This study models lateral interactions between vehicles and cyclists in shared road environments, focusing on passing distances and factors influencing cyclist evasive manoeuvres. Using computer vision techniques, cyclist and vehicle trajectories were extracted from video footage at eleven locations in Vancouver, British Columbia. Traffic conflicts were identified and evasive manoeuvres made by cyclists were used to quantify safety. The study uses an accelerated failure time (AFT) survival model to quantify the probability of an evasive manoeuvre occurring at different passing distances and incorporates covariates such as speed, acceleration, and yaw. The results indicate that 29% of lateral interactions occur at distances below 1m and 69% below 1.5m. Additionally, higher vehicle speeds were found to be statistically significant within the model, suggesting a need for speed limits in shared road environments. This proof-of-concept study supports existing policy on minimum distance passing distance laws.

Social Media Post
How close is too close? Our study used computer vision to analyse vehicle-cyclist passing distances and found that 29% of cyclists-vehicle interactions occur under 1m, while 69% occur under 1.5m. Higher vehicle speeds are associated with more evasive manoeuvres by cyclists.

Background
Safety concerns are a significant barrier to increasing cycling adoption (Pearson et al., 2023). While surveys have frequently been used to assess perceived safety, fewer studies have directly quantified the risk associated with vehicle-cyclist interactions (Beck et al., 2019). In shared facilities between cyclists and vehicles, passing movements frequently occur. These movements are characterized by different safety levels associated with a given lateral distance, often resulting in an evasive manoeuvre once a critical minimum distance is reached causing driver or cyclist discomfort. These passing interactions may adversely affect cyclist safety and have been identified as a significant concern among cyclists (Kay et al., 2014). Existing passing distance laws have been passed in multiple jurisdictions, with various legal passing distances ranging from 1m to 1.5m. The adequacy of these standards remains uncertain.

Unprotected road facilities expose cyclists to complex lateral interactions, where speed differentials between motorists and cyclists increase the likelihood of high-severity conflicts. Traffic conflicts serve as surrogate measures that allow for risk to be quantified without relying on historical crash data. A traffic conflict arises when one or more road users take evasive actions to avoid a collision, often involving sudden and powerful braking or swerving, resulting in a negative change in acceleration. While prior research has largely focused on these interactions occurring at intersections, mid-block interactions between vehicles and cyclists have often been overlooked. Therefore, this study seeks to investigate mid-block interactions between vehicles and cyclists to explore the factors influencing lateral interactions and inform policy on safe passing distances.

The objective of this study is to model the lateral interactions between motorists and cyclists using trajectories extracted from video data to identify the most significant traffic parameters and to quantify the relative risk at different passing distances. Previous studies have shown that factors such as vehicle type, evasive actions, two-wheeler grouping, and yaw rate ratio positively impact lateral distances between drivers and cyclists. Conversely, exposure to heavy vehicles and speed differences have a negative impact on lateral distances (Guo et al., 2020).

Conference Theme
This study aligns with the “Equity” theme by addressing the safety of vulnerable road users who are disproportionately affected by collisions. Rather than using perceptions of safety, this study seeks to use evasive manoeuvres and passing distance to obtain objective measures of safety, using a quantifiable metric to provide recommendations for policies that protect cyclists and promote a more equitable road space. Additionally, this work contributes to the “Evolution” goal by

advancing the methodology used in road safety practice. While traditional road safety approaches rely upon historical crash data, the use of computer vision to capture near-misses represents a departure from traditional reactive techniques towards more proactive approaches. Lastly, this work aims to promote shifts in transportation modes towards cycling by enhancing cycling safety, aligning with the objective of "Elasticity".

Method

This study utilizes computer vision techniques to extract the trajectories of cyclists and motorists from video footage obtained at eleven urban locations in Vancouver, British Columbia. State-of-the-art deep-learning-based computer vision algorithms, such as YOLOV8 and StrongSORT, were used for the detection, classification, and tracking of road users in the video footage (Redmon et al., 2016). Road user trajectories were extracted including their spatial positions and instantaneous velocities. A camera calibration procedure was used to transform the image coordinates onto a two-dimensional plane as detailed by (Ismail et al., 2013). Traffic conflicts were then calculated by using time-to-collision as a conflict indicator, with a threshold of 5 seconds (Hayward, 1972). These conflicts were then manually filtered to ensure that they adequately represented lateral distance interactions. The lateral distance between different road users was then calculated, with adjustments made to ensure the correct calculation of edge-to-edge lateral distance. Parameters such as absolute speed difference, cyclist and vehicle yaw rate, cyclist and vehicle velocity, and cyclist and vehicle acceleration were collected to be used as covariates in subsequent analysis.

The critical lateral distance resulting in an evasive manoeuvre, assumed to be the 10^{th} percentile lateral distance during the interaction, was identified for every conflicting vehicle-cyclist pair. The 10^{th} percentile was selected as this was the typical distance at which an evasive manoeuvre occurred based on the observed data. These data were then analysed to identify the distribution of critical lateral distances as well as the percentiles associated with 1m and 1.5m.

To identify the risk associated with different lateral distances, survival analysis was performed measuring the duration until an evasive manoeuvre is taken for conflict scenarios. Rather than modelling time-to-event, this study represents duration distance-to-event within the survival framework (Liu et al., 2022). Failure is defined as the point where an avoidance manoeuvre occurs, specifically where the distance reaches the critical lateral distance. Thus, the probability of a lateral interaction not yet occurring at a given distance, d, is represented by the survival function S(d), which defines the probability that no evasive manoeuvre occurs beyond a certain distance. The corresponding hazard function h(d) describes the instantaneous risk of failure at a given distance. This can therefore be used to evaluate the risk associated with different passing distances.

To investigate the influence of various covariates derived from traffic parameters on the safety of road users and the failure time of the lateral distance, a parametric accelerated failure time (AFT) duration model was used (Liu et al., 2022). This allows covariates to be represented within the model as a linear function. Several candidate distributions, namely a Log-Logistic AFT, Log-Normal AFT, and a Generalized Extreme Value AFT, were fitted to the data, and the distribution is used to identify the probability of failure associated with a given lateral distance. Each of these models has a hazard function, h(d), which is used to assess the risk associated with a given value of distance, d. The model with the best log-likelihood was selected.

Results

After analysing and cleaning the data, 187 hours of data were used, with 64 representative lateral cyclist interactions being identified. This resulted in a total sample size of 911 data points. Multiple variables extracted from the trajectories of vehicles and cyclists were considered in the model. The average critical lateral distance for the studied locations in the dataset was found to be 1.35m with a standard deviation of 0.47m. Several distributions were fitted to the data, and the Generalized Extreme Value (GEV) distribution was found to be the best-fitted distribution for critical lateral distance without incorporating other covariates. The lateral distances of 1m and 1.5m correspond to the 29th and 69th percentiles, respectively. Thus, setting a minimum passing distance of 1.5m would help prevent 69% of critical lateral distance interactions.

To determine factors associated with higher interaction risk at lower critical lateral distances, several accelerated failure time (AFT) models were fitted, and the model with the highest log-likelihood, a Log-Normal distribution, was selected for survival modelling. The significance of the yaw rate, speed, and acceleration of both road users on the results were examined. Table 1 illustrates the significant parameters of the Log-Normal model and their corresponding coefficients that represent the lateral interactions between vehicles and cyclists. According to the model, vehicle speed is found to be significant, indicating that higher speeds are associated with lower critical lateral distances. Thus, if the overtaking vehicle is traveling at a higher speed, the probability of an evasive manoeuvre occurring increases at lower lateral

distances. In addition to the significance of speed, the model estimates that at a 1m passing distance, 50% of cyclists will have taken an evasive manoeuvre, while at 1.5m, only 40% will have done so.

Table 1. Log-Normal distribution model coefficient values.

Value	Coefficient	Std. Error	z	p
(Intercept)	3.83722	0.49321	7.78	7.2E-15*
Absolute Velocity Difference	-0.0207	0.10860	-0.19	0.849
Cyclist Velocity	0.00511	0.02302	0.22	0.824
Vehicle Velocity	-0.07134	0.02968	-2.40	0.0160*
Cyclist Acceleration	0.13518	0.09814	1.38	0.168
Vehicle Acceleration	0.18174	0.10080	1.80	0.071
Cyclist Yaw Rate	0.45173	0.40338	1.12	0.263
Vehicle Yaw Rate	0.10813	0.30973	0.35	0.727
Log(scale)	0.48846	0.10041	4.86	1.1E-06*

* Denotes statistical significance

Benefits to road safety

Quantifying a minimum passing distance based on critical lateral distance, a distance where cyclists exhibit few evasive manoeuvres in relation to factors of passing motor vehicles, is critical in ensuring traffic laws provide the intended actual and perceived safety benefits. A better understanding of unprotected bike riding environments and vehicle factors, such as speed and acceleration, that lead to evasive manoeuvres is critical to improving safety.

Implications for policy and/or practice

This proof-of-concept study calls into question the validity of the actual and perceived safety of a 1m cyclist passing distance. Namely, this study suggests that both in terms of actual and perceived safety, a 1.5m cyclist passing distance is safer than a 1m distance. Moreover, it suggests that higher vehicle speeds increase the risk of interactions, indicating a need for lower speed limits on roads without protected cycling infrastructure to enhance cyclists' safety.

Conclusions

This study applied survival modelling techniques to model cyclist evasive manoeuvres at various lateral passing distances using an accelerated failure time model to quantify the probability of an interaction at different lateral distances. The results indicate that a 1m passing distance, assuming full compliance, would eliminate 29% of critical interactions while 1.5m could prevent 69% of critical interactions. An analysis of the covariates indicates that higher vehicle speeds reduce critical lateral distances, supporting the need for speed limits in shared facilities. While this proof-of-concept study provided important insights, the low sample size may limit generalizability. Future research should incorporate data from a wider range of locations to address sample size limitations. The scope should also be expanded to consider rider demographics and other environmental factors to refine the model and better inform policy.

References

Beck, B., Chong, D., Olivier, J., Perkins, M., Tsay, A., Rushford, A., Li, L., Cameron, P., Fry, R., Johnson, M., (2019). How much space do drivers provide when passing cyclists? Understanding the impact of motor vehicle and infrastructure characteristics on passing distance. *Accident Analysis & Prevention*, (128), 253-260.

Guo, Y., Sayed, T., & Zaki, M. H. (2020). Examining two-wheelers' overtaking behavior and lateral distance choices at a shared roadway facility. *Journal of Transportation Safety & Security*, *12*(8), 1046–1066.

Hayward, J. (1972). Near-miss determination through use of a scale of danger,. *Highway Research Record*, *384*.

Ismail, K., Sayed, T., & Saunier, N. (2013). A methodology for precise camera calibration for data collection applications in urban traffic scenes. *Canadian Journal of Civil Engineering*, *40*(1), 57–67.

Kay, J. J., Savolainen, P. T., Gates, T. J., & Datta, T. K. (2014). Driver behavior during bicycle passing maneuvers in response to a Share the Road sign treatment. *Accident Analysis & Prevention*, *70*, 92–99.

Liu, Y., Alsaleh, R., & Sayed, T. (2022). Modeling lateral interactions between motorized vehicles and non-motorized vehicles in mixed traffic using accelerated failure duration model. *Transportmetrica A: Transport Science*, *18*(3), 910–933.

Pearson, L., Gabbe, B., Reeder, S., & Beck, B. (2023). Barriers and enablers of bike riding for transport and recreational purposes in Australia. *Journal of Transport & Health*, *28*, 101538.

Redmon, J., Divvala, S., Girshick, R., & Farhadi, A. (2016). *You Only Look Once: Unified, Real-Time Object Detection* (arXiv:1506.02640). arXiv. https://doi.org/10.48550/arXiv.1506.02640

Reckless to Responsible – Shifting Gears Road Safety Session

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Abstract

South Australia Police (SAPOL) Road Safety Centre (RSC) identified a gap in the lack of suitable services available to police when establishing an undertaking for a young offender who had committed a traffic offence. In 2022 RSC formalised a process to deliver road safety sessions as part of an undertaking to a youth during a formal caution or family conference. Consultation occurred with stakeholders and as a result the Reckless to Responsible - Shifting Gears Road Safety Session was developed. The session is delivered by a SAPOL road safety educator - one on one with the young offender. From 21 June 2022 - 30 November 2024 292 young offenders were referred to the road safety program. From the 292 young offenders, 189 complied with the undertaking and attended a road safety session with 103 choosing not to comply. The program has now been extended to regional areas of South Australia.

Social media post

In 2022 South Australia Police developed the Reckless to Responsible - Shifting Gears Road Safety Session for young offenders. This program has helped curve the behaviour of a first-time traffic offender, encouraging them not to reoffend and think about the consequences of the driving behaviours.

Conference theme

The Reckless to Responsible – Shifting Gears Road Safety Session aligns with the Equity theme, recognising the inherent value of each person or road user, and treating all fairly, enabling equity, dignity and informed choices.

Background

The program provides young traffic offenders with the opportunity to discuss road safety issues with a SAPOL road safety educator in an attempt to modify their behaviour and have them drive responsibly on our roads, ultimately reducing the risk of a fatality or serious injury crash.

The South Australia Police (SAPOL) Road Safety Centre (RSC) works 'to contribute to a reduction in the frequency and impact of road injury, trauma and deaths in South Australia'.

Family conferences first commenced in 1994 and occur when a youth admits the commission of an offence that is minor but not more than trivial. If the matter is not sufficiently serious to warrant a prosecution but the youth has already previously had a formal caution, the matter may be referred for a family conference. Matters are also diverted out of court for family conferences. RSC identified a gap in the lack of suitable services available to police officers when establishing an undertaking for a traffic offending youth.

The Metropolitan Fire Service (MFS) Road Awareness Program (RAP) allow juvenile offenders to attend their program. This is done by the offender attending a programmed public road safety session that they offer four times a year. This was the only diversion program available for young offenders.

After meeting with Youth Diversion Sergeants from Adelaide Youth Prosecution, RSC sought approval to deliver a suitable road safety session for young traffic offenders. It was proposed that the session would be presented by a road safety educator, one on one (a parent/guardian would be present), at the Road Safety Centre. This would ensure the privacy of the young offender and would occur on a needs basis. This initiative supports:

- The South Australian Road Safety Strategy to 2031 – young drivers and riders with a focus on those living in regional or remote areas: Reducing the over-representation in road crashes.
- The South Australian Police Road Safety Action Plan 2023 -2026 – priority two 'Focusing on road safety for people aged 16-24 years'.

SAPOL's road safety educators are experienced in delivering road safety sessions to all age groups. They have previously presented similar sessions, one on one, to young people who are under the Guardianship of the Chief Executive.

The sessions are tailored to the young person's offending and address the Fatal Five, the Graduated Licensing Scheme, choices, risks and consequences and appropriate road safety videos already featured in the SAPOL road safety school programs. The session are approximately 90 minutes and was based on the current Year 11 – Driver Awareness Program Road Safety Session.

It was anticipated that each year approximately 20 to 30 young people aged between 13-17 years are required to agree to an undertaking relating to traffic offending (statistics were provided by Youth Diversion Sergeants). These numbers were based on referrals at the time. This service was made available to metropolitan areas in South Australia initially. The concept was supported by Paul Tate, Senior Prosecuting Solicitor, Adelaide Prosecution Unit. Mr Tate believed such a program would be beneficial to young offenders.

The concept was further supported by Linda Polito, Family Conferencing Team, who has stated that they lacked suitable programs to refer young offenders to.

In January 2022, approval was given for RSS to explore the opportunity to deliver road safety sessions as part of an undertaking at a formal caution or family conference. Referral guidelines were developed in consultation with key stakeholders. The first young offender session was delivered on 21 June 2022 at the Road Safety Centre.

The feedback received from RSC members has been good with some positive engagement taking place with some young offenders. RSC has received positive feedback from parents/guardians who attended sessions with a young offender. Traffic Services Branch Administration has also provided positive feedback, with the workload being manageable as a result of the changes.

In September 2023 RSC were further approved to expand the young offender's program to regional areas across South Australia. RSC regularly attend Local Service Areas (LSA's) to provide road safety education and whilst on their regional road safety trips have made availability to deliver these sessions to young offenders living in the LSA's. This is done in consultation with the LSA Crime Prevention Sections and is scheduled into the road safety educator's regional road safety schedule.

This initiative has provided a great opportunity to influence young offenders with a positive police engagement experience and to promote the importance of road safety within the community.

Shifting Gears Road Safety Session

In this one-on-one session road safety educators have a conversation with the young offender ensuring they have a comprehensive understanding of the potential consequences for their behaviour on the road. This session includes a road safety video produced by RSC which highlights the story of Nicholas Holbrook who died in fatal crash, the vehicle he was in was driven by his best mate. This video features the stories of the police officers and Metropolitan Fire Service officers who were first on scene, the triple zero calls, police radio transmissions and Nick's parents, Glynis and Michael Holbrook. What makes this video so powerful is the commentary from the offending driver Philip Wright.

During the session road safety educators speak to the fatal five causes of road trauma including drink and drunk driving, speeding, distraction, seatbelts, and dangerous road users. There is further information discussed regarding the importance of obtaining the appropriate driver's licence, taking risks, making the right choices and the consequences of offending.

At the conclusion of the session, the young offender has the opportunity to participate in the RSC Fatal Five Virtual Reality Experience. During the virtual reality (VR) experience the participant is the driver of a vehicle who has just caused a serious injury crash, and they remain trapped in the vehicle as emergency services work around them to treat them and extract them from the vehicle.

RSC have found that the one-on-one session provides the opportunity for a conversation rather than a lecture, this allows the young offender to open up about their offending and for the road safety educator to have an honest conversation about offending and the consequences. The ability to have the VR experience provides a practical experience to reinforce the road safety messages discussed.

Findings

This program was established through key stakeholder meetings which ensured that we had received all feedback both positive and negative from those that would be impacted by the introduction of the Reckless to Responsible – Shifting Gears Road Safety Session.

This program has exceeded all expectations with the number of participants engaging in the program. It was originally anticipated that between 20-30 young people would be referred to this program. As a result of the positive feedback regarding the program from SAPOL's Youth Diversion Sergeants and the Court Administration Authority the numbers of referrals increased substantially.

From 21 June 2022 - 30 November 2024 292 young offenders were referred to the road safety program. From the 292 young offenders, 189 complied with the undertaking and attended a Reckless to Responsible - Shifting Gears Road Safety Session with 103 choosing not to comply. Those that did not attend when scheduled were provided a second opportunity to attend. If non-compliance still occurred, the matter was referred back to Prosecution/Court Administration Authority.

In September 2023 the road safety session was expanded to include regional young offenders across the state. Between July 2023 and November 2024, 177 young offenders attended a Reckless to Responsible – Shifting Gears Road Safety Session. 165 were conducted in metropolitan Adelaide with a further 12 conducted regionally across South Australia,

From 1 January 2024 to 30 June 2024, 47 young offenders attended this session with only two being arrested/reported for traffic offences since attending the Reckless to Responsible - Shifting Gears Road Safety session.
Our goals have well and truly been met with the introduction of this program. It is unique and there is no other service provided to young traffic offenders like this in South Australia. The number of referrals received from SAPOL Prosecution, and the Court Administration Authority show that they also belief that we are achieving results in this space.

Benefits to road safety

Any opportunity that we have to influence a young person's behaviour on the roads benefits our road safety goals. This initiative algins with the South Australia Road Safety Strategy to 2031 through the priorities of:

- Road user behaviour: supporting and enforcing safer roads user behaviour.
- Young drivers and riders with a focus on those living in regional or remote areas: reducing the over-representation in road crashes.

It further algins with the South Australia Police Road Safety Action Plan 2023-2026 – Priority Two: 2 Why we are focusing on road safety for people aged 16-24 years.

It is anticipated that this program will continue to grow, particularly in regional South Australia.

More than e-scooters: road safety education supporting children's independent travel

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Abstract

Children travelling independently in early secondary school are vulnerable in the event of a crash, regularly rely on substandard infrastructure and generally lack age appropriate road safety training. This paper describes an education program to help address this **inequity** by teaching road safety survival skills for students walking, riding or scooting. The program incorporated a rapid literature review, focus interviews with parents, community survey, curriculum development and Virtual Reality production. A pilot was conducted with 100 year eight students in December 2024. Additional programs for 500 students are scheduled for 2025. Initial findings suggest that road safety education, focused on developing hazard perception skills and mitigating risky behaviours, can be effectively delivered in early secondary school, supporting students at a time when they are likely to start walking, riding, or scooting independently. Initial surveys indicate the program can improve knowledge and reduce students' intentions to engage in risky behaviours.

Social media post

Safe beyond the gate is a road safety education program for students in early secondary school, to equip them with them knowledge and survival skills to keep safe when walking, riding or scooting between the home and school gate.

Introduction

In 2018, legislation was passed enabling a broad range of e-mobility devices to be used in Queensland. Along with this use, has come harm. Since November 2018, there have been 4,233 e-scooter presentations to emergency departments, 545 of these presentations involved a child under 15 (Drinan & McKay, 2023). One emergency nurse summed up the harm she sees from e-mobility devices, as follows.



'a significant amount of kids come into the hospital with serious head injuries, some don't make it out, and plenty of others are seriously injured from scooter accidents' (Emergency Nurse, 2024).

Approximately 54% of secondary school students in Australia walk, ride or catch public transport to school, compared to 34% of primary school students (Royal Children's Hospital, 2019). Many of these trips are undertaken independently and in risky environments where young people are at risk of life changing or life ending injuries from crashes with motorised vehicles. These users are at a double disadvantage: they often rely on poor quality walking and cycling infrastructure, and they lack road safety training that provides knowledge and skills to support them. This highlights inequities in investments in infrastructure and training for this young user cohort.

Research into road safety education has found that suitably designed programs can reduce risk of harm for young road users (Horswill et al., 2021). Research has also identified a need to develop training programs for e-scooter riders to mitigate risk to riders and others (Useche et al., 2022; Zhang et al., 2024).

The *Safe Beyond the Gate* education program has been developed to provide young people with road safety training to support walking, riding or scooting in complex traffic environments. The program incorporates Virtual Reality (VR), videos, interactive activities and lesson-based learning covering key survival skills for young people walking, riding or scooting. Hazard perception skills and risky behaviours are key content areas identified in previous research and incorporated into licensing programs for other users such as motorcycle riders. The program content also aligns with elements of the Australian curriculum for Years 7-8. This ensures student's time is used effectively and, like other road users, they have access to appropriate road safety education to support their safety.

Approach

The project is divided into five delivery phases as shown in Figure 1. Phases1-3 were completed in 2024, and Phase 4 is underway as of January 2025. Phase 5 is due to be completed by January 2026.

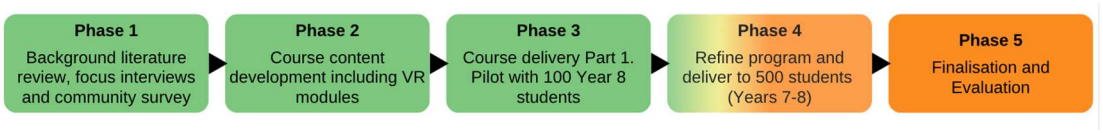


Figure 1. Process overview for the 'safe beyond the gate program'

The first phase included a rapid literature review to identify appropriate content, messaging and delivery formats for the program. Enquiry questions for the review are shown in Table. 1. The review focussed on the concepts of *young people, evaluation, education, and transport mode*. Transport mode initially focussed on cyclists, pedestrians, drivers and scooters. After initial research, an additional focus on motorcycle riders was included, as learnings from licensing may be applicable to e-scooter riders. To understand local experiences with e-scooters, five focus interviews with parents of teenage e-scooter riders, and a community survey were conducted. The survey collected experiences from road users who had experienced a close call with an e-scooter rider, including people walking, riding or travelling in a car. Figure 2 shows examples of the types of information collected from community members. The *Safe beyond the gate* curriculum was then developed to incorporate the evidence-based strategies identified in the review, and local examples of hazards and scenarios that cause harm or fear for riders or others.



Figure 2. Examples of data collected from community survey identifying local issues with e-scooters

In December 2024 a pilot program was delivered including two, 2.5 hr session to 100 year eight students. The project is now in phase four and has approximately 500 students signed up from three secondary schools in the Sunshine Coast.

Findings

Table 1 provides a concise summary of the literature review enquiry questions and findings. An important learning was that education can negatively impact safety if it encourages early adoption of risky modes. To address this issue, content was developed for parents and students to explain the risk profile of scooters compared to other transport, and the program focus was expanded to walking, riding bikes and scooters (see Figure 3 for program content examples).

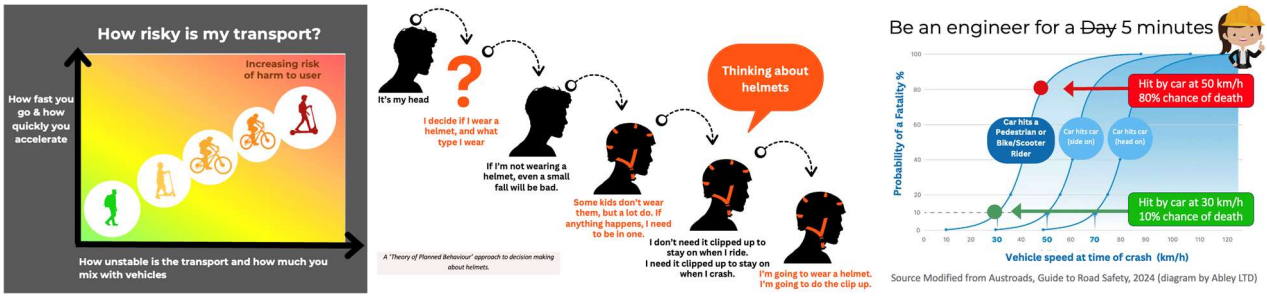


Figure 3. Examples of curriculum content around risk for different modes, risky behaviours and crash forces

Evaluation

The program is still in its infancy with data available from 17 participants and teachers who attended the 2024 course. Evidence of program efficacy includes:

- Results from a student survey undertaken on the day/day after the program describes self-reported perceptions of behaviour before and after program (see Figure 4). This indicates an improvement in the percentage of students who are very likely to exercise safer behaviours in response to common hazards and risk factors
- Positive teacher feedback 'it was an engaging program for students and the varied activities kept them interested'. 'Overall an exceptional program'. Teacher who attended the first course
- The first school to participate in training has booked in again for 2025.

Other learnings from the initial pilot program that will be considered when refining and tailoring the program include:

- Adapting the program to be delivered in different formats, including 2 x 1-hour sessions for *life skills* class.
- Incorporating additional video footage to replace stills of hazards. Short videos of police enforcement or confiscation of illegal equipment were powerful and inspired questions.
- VR was entertaining and engaging and was well received. Students were very engaged with hazard bingo and snap card games. They also engaged well in group work about supporting peers to wear helmets.
- Elements of the course align with Australian Year 7 and 8 curriculums. There may be opportunities to build in extended assessment tasks to compliment the delivery, align with the curriculum and engage deeper learning.

Table 1. Overview of findings from literature review to inform curriculum for program

Enquiry Question	Findings	
What are critical elements of road safety education programs for young users?	• Features to ensure program does not encourage early adoption of e-scooters • Developing hazard perception skills as featured in current licensing programs • Educational approaches such as the 'Theory of Planned Behaviour'	
What are the specific risky behaviours, hazard perception skills, risks and issues that impact e-scooter users, which they need to be informed about?	Common hazards	Common risky behaviours
	• Road intersections, crashes not caused by scooter and opening doors • Rider failing to give way • Surfaces, obstacles, blind corners • Busy paths, oncoming users and driveways	• Not wearing a helmet • Riding too fast • Alcohol/drugs • Not looking out for others • Riding wrong side of road
What can we learn from reviewing existing models for road safety training and licensing in Australia?	• Motorcycle licensing programs are well researched. Elements may be suitable to support children's independent mobility. • There are parallels between the types of risky behaviours and risk that motorcycle, e-bike and e-scooter riders face.	
What content should the program cover and how might it be structured to optimise impact?	• Survival skills to keep safe when walking, riding or scooting in urban areas. This addresses early adoption issue and expands program relevancy. • Interactive and VR learning around hazard protection skills, keeping others safe on paths, riding on roads and road rules. • Explicit learning around road rules, common hazards, risky behaviours, consequences of crashes, effectiveness of helmets, batteries and safety equipment, risk profile of scooters, and taking care of others.	

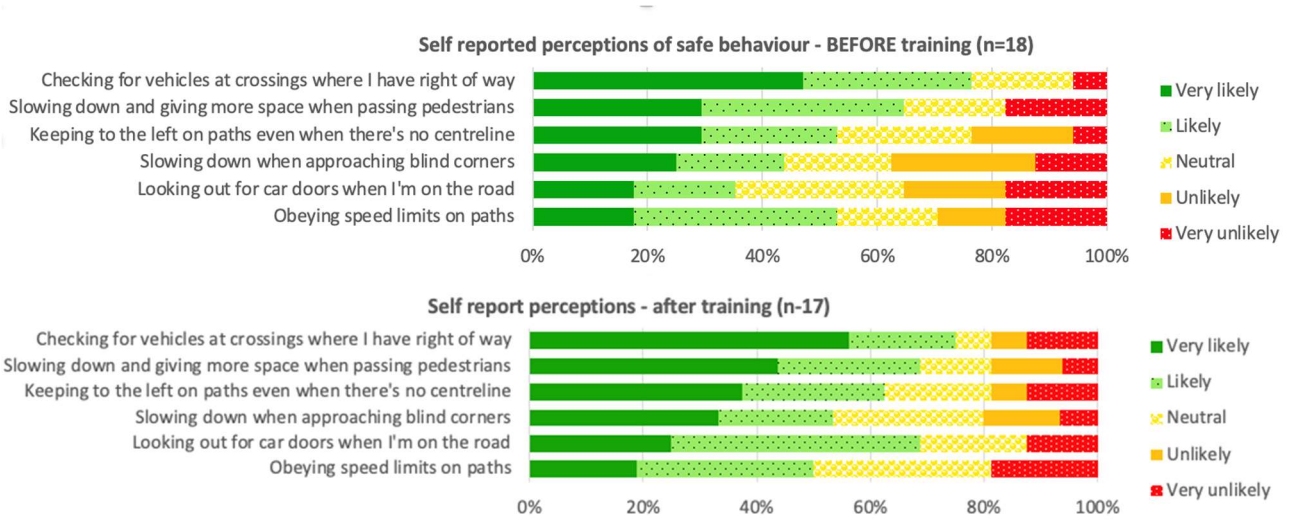


Figure 4. Self-reported perceptions of safe behaviour from students (2024)

Conclusions

There is a gap in existing road safety education around early secondary school years when students start travelling more independently. These users are vulnerable to serious injury type crashes. This project shows road safety education can be delivered in schools, to support students to identify hazards and avoid risky behaviours when walking, riding or using public transport. Initial results show promising outcomes on self-report behaviour.

References

Ashish, & Mhaske, S. Y. (2023). Road Safety Audit (RSA) guidelines of selected nations – a comparative review. *Journal of Road Safety*, *34*(4), 42–50. https://doi.org/10.33492/JRS-D-23-209291

Drinan, E., McKay, J. 2024). ABC News. Retrieved from. https://www.abc.net.au/news/2024-07-15/e-scooter-injuries-at-qld-emergency-departments/104090966

Hidayat, E., Lange, D., Karlovsek, J., & Kim, J. (2023). Variables Affecting the Risk of Vehicle Collisions in Australian Road Tunnels. *Journal of Road Safety*, *34*(4), 20–30. https://doi.org/10.33492/JACRS-D-22-00032

Horswill, M. S., Hill, A., Bemi-Morrison, N., & Watson, M. O. (2021). Learner drivers (and their parent-supervisors) benefit from an online hazard perception course incorporating evidence-based training strategies and extensive crash footage. *Accident Analysis & Prevention*, *161*. https://doi.org/10.1016/j.aap.2021.106340

Royal Children's Hospital National Child Health Poll (2019). *Travelling to school: Habits of Australian families*. The Royal Children's Hospital Melbourne. https://www.rchpoll.org.au/wp-content/uploads/2019/02/20190207-travelling-to-school-habits-of-australian-families.pdf

Useche, S. A., Gonzalez-Marin, A., Faus, M., & Alonso, F. (2022). Environmentally friendly, but behaviorally complex? A systematic review of e-scooter riders' psychosocial risk features. *PLOS ONE*, *17*(5), e0268960. https://doi.org/10.1371/journal.pone.0268960

Zhang, Y., Nelson, J. D., & Mulley, C. (2024). Learning from the evidence: Insights for regulating e-scooters. *Transport Policy*, *151*, 63–74. https://doi.org/10.1016/j.tranpol.2024.04.001

E-scooter riders in Victoria

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Abstract
People who ride e-scooters see them as a convenient, cost effective, fun and environmentally friendly way to travel; to those who do not, e-scooters are dangerous and should be strictly controlled if not completely banned. Ongoing research suggested that around 7% of Victorians aged 18-90 have ridden an e-scooter, increasing to 17% for those aged 18-25. A stand-alone study exploring e-device use among young people aged 16-25 was commissioned in 2023 and replicated prior to the introduction of e-scooter legislation in Victoria in late 2024. Topics covered included usage, understanding of rules, and crash history. The study was expanded to include people aged 26+ in 2024 and will be replicated for a third time during 2025 to determine whether there has been an increase in understanding of rules and regulations around e-scooter use and whether there have been any significant changes in use since the study was first commissioned.

Social media post
E-scooter riders in Victoria – what do they do and what do they know?

Introduction
E-scooter use in Victoria became official in February 2022 with the introduction of a trial hire scheme in select Local Government Areas (LGA) in Victoria. Privately owned e-scooter use commenced even earlier, with e-scooter riders showing up in injury data as early as 2017, and the first recorded death of an e-scooter rider in Victoria occurring in 2022. Nine e-scooter riders have been killed on Victorian roads since 2022 (as at March 2-25).

As part of the Transport Accident Commission's (TAC) broader social research program, regular research is conducted with Victorian drivers and motorcycle riders - this research also explores alternative modes of transport among Victorians including use of e-scooters. Since 2022, close to 8,000 Victorian drivers and motorcycle riders were surveyed as part of this ongoing research. This general research suggests that around 12% of drivers (Wallis Social, 2024) and around 17% of motorcycle riders (IPSOS, 2024) will regularly ride an e-device, with about 7% specifically riding e-scooters. These studies showed most e-scooter riders were younger (aged 18-25) and male. In light of these findings, a report was commissioned to explore e-device attitudes and behaviours among Victorians (16+), including ownership, usage patterns, safety knowledge and behaviours as well as exploring crash and injuries.

An online survey was conducted in 2023 among Victorians aged 16-25 in order to understand e-device usage and behaviours. This was replicated in 2024 and extended to 'all Victorians aged 16+' (Wave Three will be conducted in April 2025 utilising the same approach as for 2024).

Conference Theme
Elasticity – e-scooter use in Victoria is increasing year on year, with e-scooters being a favoured alternative mode of transport

Approach

Sample and survey
Because of the relatively unknown nature of the e-device rider population, a 'Market Sizing" sample was collected to determine the incidence of riders in the community, then boosted to ensure a sufficient number of riders was available for analysis (500 aged 16-25 in both waves, and an additional 500 aged 26+ in Wave Two). Approximately 1,100 Victorians were sampled overall in Wave One, and 2,200 in Wave Two.

The sample comprised both e-device users and non-users to determine the prevalence of e-device use in Victoria and evaluate the appetite of current non-users to use e-devices in the future. Participants were divided into two streams:

- E-device Riders
- Non E-device riders

E-device riders were aged 16+ and reported riding an e-device in the last two years. The non-e-device riders completed a short 2-3 minute survey to gauge general attitudes to e-devices. This sample was broadly representative of the general population as a whole and weighted to be representative of the population. E-device riders completed the full survey. Because of the relatively unknown nature of the e-device rider population, there were no demographic quotas applied (for e.g., age, sex, location) applied to the selection of "e-device riders" with e-device users split into two further categories: 'Owner' and 'User' (hire or borrow).

Selected Results

Significance Testing: Comparisons between sub-groups were significance tested at the 95% confidence interval. Analysis may include discussion of non-significant findings where there is a trend evident in responses or to illustrate maximum/minimum response by subgroup.

Table 1 E-device use, Victoria

Device type	Metro	Regional	Total
Any e-device	29%	23%	28%
E-Scooter	22%	18%	21%
E-bike	18%	12%	16%
E-Skateboard	3%	1%	2%

Close to a third of Victorians surveyed had ridden an e-device in the last two years, with e-scooters the most popular of the e-devices. Young people are the main users of e-devices, with 48% of 16-26 year olds riding an e-device in the last two years. In comparison, use of e-devices falls to about a third (31%) of 26-39 year olds and 19% of those aged 50-59. There has been a significant increase in use of e-devices among 18-20 year olds, rising from 43% in 2023 to 48% in 2024. Additionally, e-device users tend to be male, employed full time, located in Metro Victoria and are more likely to hold a motorcycle licence compared to the general population.

Attitudes to e-devices

Overall, young people (16-25) have significantly more positive attitudes toward e-devices whether they use them or not compared to those aged 26+, with 82% finding e-devices convenient, compared to 72% of those aged 26+. Looking at e-device users, this increases to 91% regardless of age. Non users aged 26+ are significantly less likely to consider riding an e-device on Victorian roads is safe (23% compared to 34% of 16-25 year old non-users). However, only half (51%) of users find riding on the road to be safe.

E-Scooters

Relative Safety

Survey participants were asked to compare the relative safety of e-scooters in relation to driving, walking and riding a bicycle, with participants agreeing that riding an e-scooter is less safe than driving and walking (80% find it less safe) however, about half feel riding an e-scooter is on par with riding a bicycle (47%). Again, non-users are more likely to feel riding an e-scooter is dangerous compared to walking and driving (83%).

One in three e-scooter riders ride on the road, with most preferring to ride on (off-road) shared paths or in bike lanes, with close to half riding on a dedicated path. E-scooter riders feel safest on a bike path (78%), followed by a footpath (74%) and then a shared path (54%). They feel least safe on the road in a normal car lane (18%). Despite feeling less safe there, e-scooter riders mainly ride on shared paths or on the road in bike lanes. Most e-scooter riders prefer to ride on roads with a speed limit of 60km/h or less, with very few riding on higher speed roads.

Rules and Regulations

Less than half (44%) of the general population agree they understand the rules and regulations that apply to e-scooters, this increases to 81% for owners and 70% of users of e-scooters. Participants were presented with eight true/false statements relating to rules and regulations for e-scooters, with participants responses ranging from 92% correct relating to helmet laws, down to 7% correct for understanding the speed at which riders are allowed to ride. E-scooter users had a greater understanding of the rules that apply to them, however, still had very low understanding of the speed at which they are allowed to ride. Understanding of the rules applicable to e-scooter riders did not change between 2023 and 2024.

Frequency of riding

Most e-scooter riders are not frequent riders, with only 7% riding monthly or more. However, of the people who have not ridden an e-scooter in the last year, almost a quarter (23%) expect to ride one in the future. People aged 16-25 are significantly more likely to ride at least monthly (21% compared to 12% aged 26-39 and 5% aged 40+). Similarly, 67% of young people indicated they would like to ride an e-scooter in the next 12 months, compared to 53% of 26-39 year olds and 28% of 40+.

Reasons for riding
Most e-scooter riders ride for fun or exercise (83%) or to go to social activities (48%). E-scooters are also popular among commuters (to work or school) with 38% using an e-scooter for at least one leg of their commute.

Helmet use
While 93% of e-scooter riders know they are required to wear a helmet while riding their e-scooter, only 71% will always wear a helmet. The most compliant cohort are those aged 40+ (82%) and the least compliant cohort are aged 18-20 (51%). People who ride hire e-scooters are less likely to wear a helmet compared to owners, and people who do not wear a helmet justify their decision as it was only a short, low speed trip.

Crashes and injuries
Most people (82%) who ride e-scooters have not had a crash or fallen while riding their device. Most people who *have* had a crash have either dropped or fallen off their device or crashed into a tree or a pole or other roadside infrastructure. Of the people who have crashed, about a quarter (22%) have crashed with a person or vehicle. Those aged 40+ and non-owners are least likely to have had a crash. However, the 40+ cohort are slightly more likely to crash with a person or vehicle.

Where a crash has resulted in an injury, 73% of the crashes resulted in injury to the rider themselves, and 27% of the time to another person. In most instances, the injured person did not require medical treatment, however, about one in six required urgent medical attention in hospital.

There was a significantly higher incidence of crashes among those who had done illegal behaviours during or before riding (for example, using a mobile phone, drinking alcohol, using illegal drugs), with close to half of people who crashed reporting an illegal behaviour while riding.

Impact on Road Safety

Self-reported usage of e-devices has doubled over the last few years, and the legalisation of private e-scooters will continue to increase access to and use of these devices, with this research suggesting a 60% increase year on year in the proportion of people aged 16-25 who own an e-scooter. Prior to conducting this research, we had limited understanding of the types of people who use e-devices, particularly e-scooters, and limited knowledge of user understanding of the rules and regulations applicable to e-scooter users. The two waves of this study have given the researchers some insight into the attitudes and behaviours of e-device users, along with an insight into their crash and injury experiences.

Limitations of this research

This research was conducted with a proprietary research panel, meaning participants are those who have self-selected to participate in research of this nature.

Conclusions and future research

This research gives an indication of the proportion of Victorians who use e-devices, along with their understanding of rules that apply to their use. Additionally, e-scooters are seen to be less safe than walking (the most direct alternative). Less than half of all Victorians are confident and accurate in their knowledge of e-scooter rules and regulations, indicating that further education in this area is needed. The TAC ran an information campaign informing e-scooter riders of the rules and regulations applicable to e-scooters immediately after fieldwork took place for Wave Two. Wave Three of this work will be completed in the next three months.

References

IPSOS (2024). *Motorcycle Monitor.* TAC. https://www.tac.vic.gov.au/road-safety/statistics/about-tac-surveys/road-safety-and-marketing-surveys#motorcycle-monitor

Painted Dog (2024). E-Device User Research. (Unpublished report prepared for the Transport Accident Commission, Victoria)

Wallis Social (2024). *Road Safety Monitor*. TAC. https://www.tac.vic.gov.au/road-safety/statistics/about-tac-surveys/road-safety-and-marketing-surveys#road-safety-monitor

RoadWise Refocused: supporting Local Governments differently

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Abstract
The Western Australian Local Government Association (WALGA) is uniquely placed to represent and support Local Governments. As system designers within the safe system framework, Local Governments have a strategic and operational role in road safety and are well positioned to translate safe system principles into practice. With competing demands, a broad range of responsibilities and lack of resources most Local Governments will need support to optimise their contribution to road safety. During 2023-2024, WALGA refocused and redesigned the delivery model of the RoadWise program to better align with a systems approach and respond to the context and needs of Local Governments and their opportunities to deliver effective, best practice road safety that contributes to global, national and state road safety objectives. The change in delivery model is producing results that indicate more efficient use of limited resources and is more effectively supporting Local Governments towards better practice road safety.

Social media post
WALGA's RoadWise has evolved, with a refocused model that delivers road safety support to Local Governments differently.

Introduction
The National Road Safety Strategy (Commonwealth of Australia, 2021) recognises and prioritises the need to support Local Governments "to embed and deliver road safety into their business as usual" (p.15). Prior, the Road Safety Taskforce (2019) in reviewing national road safety governance arrangements concluded that the Local Government sector "is not sufficiently engaged or resourced to deliver road safety" (p.4).

Models of engagement and support for Local Governments vary across Australasian jurisdictions. Distinctively, in Western Australia (WA), the Western Australian Local Government Association (WALGA) has been funded and involved in working with Local Governments and their communities to contribute to the implementation of national and state road safety strategies, since RoadWise was established in 1993-94 for that purpose. WALGA as an independent, not-for-profit organisation has extensive experience representing Local Governments, understands the needs of the sector, has a skilled workforce to build the capacity of Local Governments and has a unique, non-regulatory relationship with Local Governments.

In WA, Local Governments manage 87% of the public road network, where 34% of travel occurs but more than half (56%) of all Killed and Serious Injuries (KSIs) happen (WALGA, 2025). Each year Local Governments collectively spend more than $1 billion on repairs, maintenance, renewal, upgrades, and expansion of the local road infrastructure in WA. Forty-six percent (46%) of that investment comes from Local Governments' own source revenue (WALGA, 2024) An important opportunity to leverage investment that maximises safety considerations. Besides managing roads, Local Governments perform several other functions, that contribute to the application of best practice safe system principles, including land use planning and urban design, community leadership, as employers and as fleet operators and managers. Local Government and community road safety are often used interchangeably, and historically the focus of WALGA's RoadWise was entwined with community action through local level partnerships. The approach was anchored in community engagement and participation with a primary focus of influencing road user behaviour. A narrow scope that does not adequately enable the integration of safe system principles into local policy and practice, particularly considering the enormous task of transforming the legacy local road network towards safe system standard.

These and other factors, led to WALGA redesigning and refocusing the RoadWise program, including:

- WALGA's strategic intent, place within the sector and position within road safety, existing expertise, and the size of the operational task;
- Disruptions to the traditional community-based activity;
- The potential for duplication of effort, there being many other agencies and organisations active in the road safety community engagement and/or education space;
- Consistent and ongoing calls for the need to support Local Governments in road safety; and

- The advantages of engaging the sector for the road safety benefits that will accrue from building the capacity and capability of Local Governments in their various functions.

Conference theme

This paper describes the **evolution** of WALGA's RoadWise. From a program of community-based campaigns and projects focused on road user behaviour, to a funded service, providing direct engagement and support to Local Governments in their strategic and operational roles in road safety. The purpose of this **evolutionary** change is to build an informed and committed sector with safe system principles integrated into the way the local road network is governed and managed, thus better enabling Local Governments to make an effective contribution to the achievement of global, national and state road safety objectives and targets.

Project description and approach

Previously, the delivery or operating model of WALGA's RoadWise was based on eight Road Safety Advisors (RSAs) to support the 137 mainland Local Governments and their communities across an area of 2.5million square kms, working with local road safety committees to take action for road safety. This meant that resources were spread very thinly, allowing only a limited level of support to Local Governments and their communities across vast geographical distances. In addition, there was no preconditions for Local Government to commit to regular engagement and involvement. Further, the benefits and achievements of the traditional program delivery model which revolved around building community capacity and mobilising community resources had been eroded over time, or momentum lost by things such as liability and volunteering concerns, competing community issues and disruptions such as COVID when typical local road safety activities such as awareness raising through displays and demonstrations at community events were suspended.

Prior to this WALGA, and others (Woolley & Crozier, 2018) had recognised, was pursuing a more strategic position in road safety, by focusing on the role of Local Governments and the significant contribution to road safety that Local Governments can make, given more resources, targeted support and meaningful engagement. A new model was developed.

Table 1. Features of the changes in delivery model

Evolution in…	Old delivery model	New delivery model
Target audience	RoadWise Committees	RoadWise Councils
Approach	Responsive to community needs or demands	Proactive support for Local Governments
Influence	Focus on road user behaviours (system users)	Focus on safe system approach in the context of Local Government (system designers)
Method	Community participation and action	Building Local Governments' capacity and capability

The RoadWise Councils initiative was launched in August 2023. Local Governments spread across rural, remote, and urban areas of WA, were invited to register as a RoadWise Council. Initial selection was based on the existing level of engagement and preparedness to commit to road safety. To register as a RoadWise Council, the Local Governments were required to demonstrate a commitment to road safety and regular engagement, with either a formal signed 'Declaration' (by the Chief Executive Officer and Shire President or Mayor) or a 'Resolution' of the full Council, providing authority and longevity for the decision. The benefits to those Local Governments that register as a RoadWise Council include:

- A guaranteed minimum amount of support hours from an assigned Road Safety Advisor (RSA),
- Use of branding to promote, to their communities, their commitment to work towards better road safety outcomes,
- Direct access to WALGA's road safety services, tools and resources, training opportunities, and
- Eligibility to participate in the new RoadWise Recognised initiative. (NB this is the subject of a separate abstract)

The model has been designed to be scalable, as a way of managing resources and meeting WALGA's commitment to RoadWise Councils, such that the number of Local Governments that can be registered at any point in time is capped. This is dependent on the number of RSAs employed at the time, which in turn is reliant on available funding. Each RSA is assigned up to ten (pro rata for part-time RSAs) RoadWise Councils from one of eight regional groupings of Local Governments. This ensures a reach into urban, rural and remote areas of the state. This allows for each RSA to provide a minimum of one week, per quarter of direct support to each RoadWise Council.

Road Safety Advisors (RSAs) use the RoadWise Framework to work with RoadWise Councils to plan, implement, monitor, report and communicate the delivery of local road safety activity. The Framework supports a holistic and systematic approach and is designed to guide RoadWise Councils through the important governing and management functions and responsibilities. Within the safe system approach Local Governments have strategic and operational roles, including as: road managers, planning authorities, employers and fleet managers, and community development and leadership. The Framework is aligned to contemporary safe systems thinking and principles and is tailored to the Local Government context and functional areas. With the aim of helping translate best practice theory into action, it brings together the roles and responsibilities of Local Government relevant to road safety with the key elements of the safe system approach.

In this way the RSAs use the Framework to work with RoadWise Councils to plan and deliver locally driven systems-based interventions to reduce and ultimately prevent road deaths and serious injuries. This is further reinforced and encouraged through the implementation of the RoadWise Recognised initiative which has been designed to guide and motivate Local Government road safety effort towards best practice.

Results and conclusions

During the first year to 1 August 2024, 71 Local Governments engaged in the new model by registering as a RoadWise Council. By comparison, this exceeds the previous model of engagement and support which reached a peak of 68 RoadWise Committees. In addition, there are currently 15 Local Governments that have requested to be included in the waitlist to become a RoadWise Council.

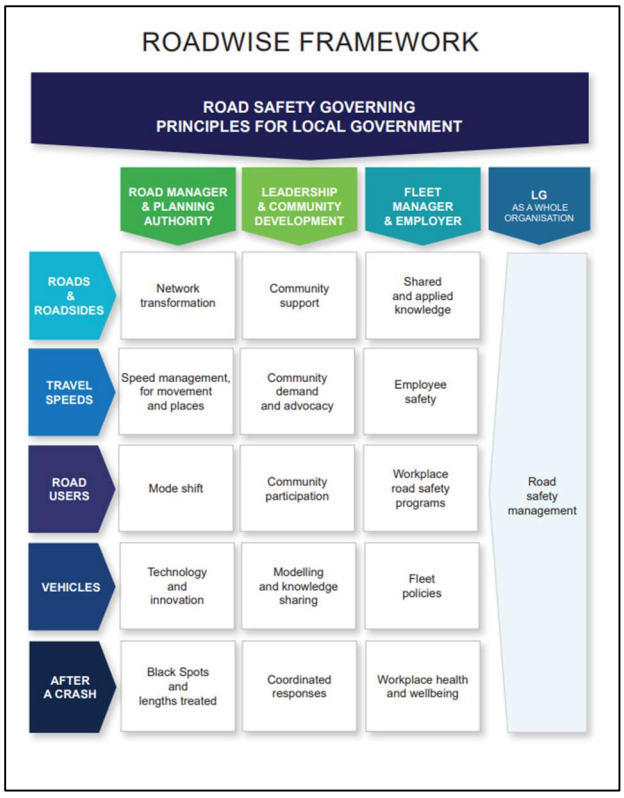


Figure 1. RoadWise Framework

More than 80% of those registered RoadWise Councils are consistently recording road safety activity, each quarter, that aligns with national and state road safety strategies, with more than 600 activities reported to date. The majority, about 70%, of that activity is associated with measures to improve the safety of roads, community engagement is the next most common, followed closely by management functions and then fleet and workplace road safety policies and interventions. More than 2,600 hours of RSA support were allocated during that period.

Looking to the future, a survey instrument is in development, for the purpose of evaluating the process and impact measures of the new RoadWise Councils model. It is anticipated that results from that survey will be available in the second half of 2025.

These preliminary results are a positive indication that the change in the RoadWise delivery model and focus has been effective in engaging and supporting Local Governments and in shifting influence from community-based action and road user behaviour to building Local Governments' institutional functions towards safe-system-aligned policy and operations. The new model more efficiently uses limited resources (personnel) in a highly focused manner to support and motivate Local Governments towards better practice in managing the safety performance of the local road network.

References

Commonwealth of Australia (2021). National Road Safety Strategy 2021-30. *Department of Infrastructure, Transport, Regional Development and Communications, Canberra*. https://www.roadsafety.gov.au/sites/default/files/documents/National-Road-Safety-Strategy-2021-30.pdf

Commonwealth of Australia (2019) Review of National Road Safety Governance Arrangements Final Report. *Department of Infrastructure, Transport, Cities and Regional Development, Canberra*. https://www.roadsafety.gov.au/sites/default/files/2019-11/stp_review_of_national_road_safety_governance_arrangements.pdf

Western Australian Local Government Association (2025). 2018-2022 Road Safety Performance on Local Government Roads. *WALGA RoadWise, Perth.* https://www.roadwise.asn.au/roadwise-councils/best-practice-in-road-safety/road-safety-performance-report.aspx

Western Australian Local Government Association (2024). Road Assets and Expenditure Report 2022-2023. *WALGA, Perth. 20240618-LG-Road-Assets-and-Expenditure-Report-2022-2023-website.pdf*

Jeremy Woolley, and John Crozier (2018). Inquiry into the National Road Safety Strategy 2011-2020, September 2018. 20240618-LG-Road-Assets-and-Expenditure-Report-2022-2023-website.pdf

Filling in Vietnam's legal gap with public-facing media campaigns

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Abstract
In the beginning of 2021, Vietnam National Assembly was voting on revising the traffic laws, which have become outdated since the last revision in 2008, resulting in the underlying cause of traffic crashes. To strengthen road traffic laws and reduce road crashes by targeting the five most critical behavioural risk factors, AIP Foundation, supported by the Global Road Safety Partnership, has worked with related government agencies and organizations, specifically focusing on enhancing children's road safety. By building a public-facing media campaign, AIP Foundation directly targets the public audience and decision-makers to influence them on the importance of road safety regulations. In June 2024, Child Restraint System regulation has officially passed by the majority of Vietnam National Assembly. This regulation displayed that Vietnam has been consecutively developing and updating road safety laws, and on the path to complete the 5 risk factors map road with contributions from AIP Foundation.

Social media post
In 2024, Vietnam passed a regulation for mandatory Child Restraint Systems (CRS) starting in 2026, following years of media campaigns by AIP Foundation. This is a crucial step in strengthening road safety laws and protecting children on the road. Together, we can fill the legal gaps!. #RoadSafety #ChildProtection

Background
Vietnam is home to more than 99 million people, representing 6.3 million cars and 74 million motorbikes registered by December 2023. Vietnam is experiencing rapid urbanization and motorization which outpaces infrastructure change. Every year, an estimated 24,970 people die as a result of road crashes and another 499,400 are seriously injured (WHO, 2018), accounting for an estimated $3 billion USD annual loss to GDP, making road safety an imperative priority for both public health and economic development.

In terms of a legal framework on road safety, the Road Traffic Law is the highest decree legal document in the field of road safety in Vietnam. The first Road Traffic Law was passed by the Socialist Republic of Vietnam's 10th National Assembly meeting on June 29, 2001. The National Assembly of Vietnam passed Road Traffic Law 23/2008/QH12 (amended) on November 13, 2008, and it went into effect on July 1, 2009. Legal protections that address the underlying causes of the traffic crashes remain outdated, since the last comprehensive revision to Vietnam’s Road Traffic Law 2008.

The project, which began in 2021, came at a critical time when the National Assembly was voting on revised traffic laws. This was an opportunity to advocate for the improvement of road traffic policies, including stronger mandates for national and local government agencies to legislate, implement, and enforce action on critical road safety risk areas. Given that road safety is a deeply intersectional, interconnected issue, some policymakers may struggle to identify where specifically impactful policy changes can be made. To deliver targeted interventions, this project prioritized the top 5 behavioural risk factors which have the most outsized effect in minimizing road crashes. These are drink-driving, speeding, helmets, seat belts, and child car seats.

Method
A targeted strategy, which emphasizes the importance of trustworthy data and persuasive messaging in influencing traffic behaviours among Vietnamese has been employed for the campaign. With the raising number of car users, the Hanoi University of Public Health conducted research to assess the need for child protection during car transportation. The results were designed into a fact sheet to communicate the findings effectively. At the same time, the AIP Foundation carried out a public survey on a major national online news to evaluate public awareness of five key risk factors. The survey of 3,276 participants pointed out that 91% supported the use of child restraint systems and opposed the idea of children sitting in the front seat of a car.

These findings informed the campaign's strategy, so, a capacity-building workshop for journalists focused on traffic safety was organized in collaboration between AIP Foundation, the National Traffic Safety Committee and the Transportation Newspaper. The workshop equipped Vietnamese journalists with the capacity in clarifying different angles in road safety stories and the role of editorial framing. The workshop is the first step of the campaign to come closer to the targeted audience, when press writers were approached with not only technical tips but also new traffic definitions, knowledge and terms, such as Safe System Approach.

Subsequently, seminars and talk shows were held, engaging key drafting appraisal agencies, including experts and traffic-related government organizations to underscore the necessity of **child restraint systems**. At the above-mentioned events, government key drafting agencies were able to be engaged with useful and trustworthy facts of a society problem, which might not be thought of often.

The final rushing phase included a three-month media campaign on AIP Foundation's social media platforms and direct engagement to the National Assembly in order to amplify the issue with the public audience and decision-makers the necessity of **child restraint systems**. To effectively reach the decision makers, AIP Foundation has worked with the People's Representatives' Newspaper to develop a catalogue filled with the program's collected traffic data and information, while inviting the National Legislatures agencies to attend road safety seminars to strengthen the alarming and necessity of the problem.

Conference Theme

The campaign aligns with the principles of elasticity by addressing the adaptability and resilience of the transportation system, particularly in relation to child safety. As transportation modes evolve, with increasing car usage in Vietnam, it is essential that the system adapts to ensure equitable access to safety measures for all individuals, particularly vulnerable populations like children. By promoting the widespread adoption of child restraint systems, the initiative not only strengthens the resilience of the transportation safety framework but also advocates for shifts in public awareness and behaviour, encouraging safer, more sustainable transportation practices. This focus on adaptability underscores the importance of flexible, equitable safety measures that can evolve in line with changing transportation trends, ensuring that all segments of the population benefit from enhanced road safety.

Results

The communication campaign focused on raising awareness about child safety in cars has shown to be highly impactful, significant outreach was achieved.

A consecutive series of events and articles were conducted in diverse forms. There were a total of 15 seminars, workshops and talk shows, alongside the development of an in-depth study and two online polls, highlighting the importance of child restraint systems. The campaign also generated 103 articles, radio, television broadcasts, and also with widespread dissemination through AIP Foundation's social media channels. This extensive media coverage reached an estimated 5,574,581 viewers and listeners, with 360 key beneficiaries, including journalists, road safety experts, government officials, and National Assembly members.

The campaign's influence extended to drivers on major roads across Vietnam by educating these drivers on child safety and the importance of restraint systems, the campaign has contributed to a broader shift in public awareness and behaviour. With the hit-line titles directing pointing out that Vietnam needs to protect children by the car restraint system with an official law, and this is particularly crucial for Vietnam's future as the country experiences a rapid increase in vehicle ownership and road usage. The work that has been done through these communication efforts laid the foundation for stronger and more resilient traffic safety policies, ensuring that Vietnam's evolving transportation system is adaptable. In the long term, these efforts are expected to contribute to a safer and more equitable road safety culture, benefiting both current and future generations of road users in Vietnam.

The campaign has directly contributed to:

1. **Tailoring Safety Regulations to Local Needs:** The requirement that children under 1.35 metres must sit in the rear seat ensures that children are placed in a safer position, reducing the risks of injury from airbags and front-end collisions. The factsheet with researched information, in collaboration with the University of Public Health, has effectively highlighted the importance of this adjustment, making it clear to the public why these regulations are tailored to the body sizes and physical characteristics of Vietnamese children, and how they contribute to a safer transportation system.

2. **Raising Awareness of Age-Appropriate Restraint Systems:** The regulation that children under 4 must be secured in a child seat designed for their age and size is directly in line with global best practices for child passenger safety. However, implementing such measures requires a cultural shift in public understanding of child restraint systems. Through the campaign, which included workshops, media outreach, and direct engagement with key stakeholders, Vietnamese citizens have been made aware of the necessity of child seats and the life-saving potential of these devices. This creates a more informed public that is better prepared to comply with the new law.

3. **Creating a Safer Future for Vietnamese Children:** These new regulations and the campaign's outreach efforts together will contribute to a significant reduction in child injuries and fatalities in road traffic accidents. Given that motor vehicle collisions are a leading cause of injury and death in children worldwide, especially among those traveling unrestrained, this law marks a significant step forward in protecting Vietnamese children on the roads.

Through these concerted efforts, the campaign successfully reached and educated the target audience, leading to the passage of the proposed law, which was approved by a majority in the National Assembly in June 2024. By adapting the law to reflect the specific physical needs of Vietnamese children, the campaign not only addresses immediate safety concerns but also fosters a long-term shift in transportation culture. This focus on body size, age, and the use of appropriate restraint systems is essential for ensuring that road safety evolves in a way that protects all road users, particularly the most vulnerable.

Implications for policy

The comprehensive approach of the campaign played a pivotal role in shaping public opinion and informing key policymakers about the necessity of child protection measures in cars. By combining research, public engagement, and media outreach, the initiative successfully highlighted the importance of child restraint systems, building widespread support for the policy. This grassroots awareness, paired with expert testimony and media advocacy, directly influenced the National Assembly's decision, resulting in the passage of a law that will enhance child safety on the roads and set a strong precedent for future traffic safety reforms.

- **Article 9 - Vietnam Law on the Road Traffic Safety Order:** " Children under 10 years old or under 135 centimetres, who is being ridden on a 5-chair-seat car is not allowed to sit on the front row; children under 4 years old have to be carried by the child restraint system (except business cars). Riders have to have the responsibility to check and have the seatbelt on for the children in the car".
- **Article 49 of the Road Law:** There must be seats, beds, seat belts, seat belt anchors in accordance with regulations: with clear instructions for installing seats and seat belts for children in cars carrying up to 9 people

Conclusion

In conclusion, the campaign has significantly advanced child road safety in Vietnam by raising awareness about new regulations tailored to the physical needs of Vietnamese children. Through extensive outreach, including workshops, media campaigns, and strategic partnerships with key stakeholders, the initiative has fostered a culture of safety and compliance with new laws regarding child restraint systems. These efforts not only protect vulnerable children on the roads but also lay the groundwork for a safer, more resilient transportation system in Vietnam, ensuring that both current and future generations benefit from safer road environments.

References

Hoàn thiện pháp luật nhằm bảo vệ trẻ em khi tham gia giao thông. (2025, March 13). *Tạp chí Xây dựng Đảng*. https://xaydungdang.org.vn/nhan-quyen-va-cuoc-song/hoan-thien-phap-luat-nham-bao-ve-tre-em-khi-tham-gia-giao-thong-21535

World Health Organization. (WHO). *Global Status Report on Road Safety 2023*. WHO; 2023. https://iris.who.int/bitstream/handle/10665/375016/9789240086517-eng.pdf?sequence=1

Event Data Recorders (EDRs): unlocking crash data for research

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Abstract
Event Data Recorders (EDRs) are specialised data acquisition systems installed in vehicles that capture objective pre-crash data and post-crash data. This data can include speed, delta-v (indicator of crash impact severity), brake/ accelerator pedal status, steering wheel angle, seat belt use, and information about activated safety systems. Research by the Centre for Automotive Safety Research (CASR) shows that EDR data reveals key crash factors, including speeding, seat belt non-use, and lack of pre-impact braking. While several international jurisdictions have adopted EDR mandates and other important vehicle safety features, Australia constantly lags behind, demonstrating a lack of equity in vehicle safety across the globe. Mandating EDRs in Australian vehicles and ensuring data accessibility, could significantly advance road safety, emergency response, crash analysis capabilities and could facilitate improved equity in Australian vehicle safety.

Social media post
Event Data Recorders (EDRs) capture key vehicle data before and after crashes: speed, delta-v, brake/accelerator use and more, supporting crash analysis, justice and road safety. Despite global progress, Australia still lacks EDR mandates. It's time to catch up!

Introduction
Event Data Recorders (EDRs) are data acquisition systems equipped in vehicles that capture objective pre-crash information and crash-information. These systems constantly monitor various vehicle sensors and record key data if a crash or other significant event is detected. When an event occurs, EDRs can record pre-crash data such as vehicle speed, and post-crash data such as delta-v (a measure of crash severity). The data captured by EDRs varies by vehicle make, model, and year. Some EDRs record additional pre-crash details, including brake and accelerator pedal status, steering wheel angle, seat belt use, and information about activated safety systems (e.g., airbags or seat belt pretensioners).

EDR data is particularly valuable for road safety research and crash analysis because it provides objective vehicle information, such as travel speed, impact speed and driver actions, which are difficult to obtain through other means. This data helps crash investigators reconstruct crash sequences, identify contributing factors, and improve vehicle safety systems. It also supports law enforcement and insurance fraud investigations by offering an objective account of events before and during a collision. In legal settings, EDR data, presented with expert testimony, has been used as compelling supplementary evidence to clarify crash dynamics and driver behaviours preceding crashes.

EDR data can be accessed in Australian vehicles using two commercially available tools: the Bosch Collision Data Retrieval (CDR) tool and the Collision Sciences toolkit. The Bosch CDR tool has been available in Australia for many years, whereas the Collision Sciences toolkit is a more recent addition to the market. Both tools connect to the vehicle's OBD-II port to retrieve EDR data.

Figure 1 shows the electronic internals of an EDR and lists some of the variables it can contain. It also shows a picture of a laptop, and a Bosch CDR tool plugged into a crashed vehicle.
Figure 2 presents a sample of an EDR download, showing that at 4.85 seconds before impact, the vehicle was travelling at 132 km/h, with the service brake engaged (brake oil pressure: 0.91 MPa) and 0 degrees steering input. Data was recorded at 0.5-second intervals until the collision detection trigger, which occurred under hard braking (brake oil pressure: 10.42 MPa), reducing the vehicle's speed to 53 km/h at impact with a steering input of -231 degrees. The longitudinal crash delta-v is also shown, peaking at 9 km/h, 90 milliseconds after impact.

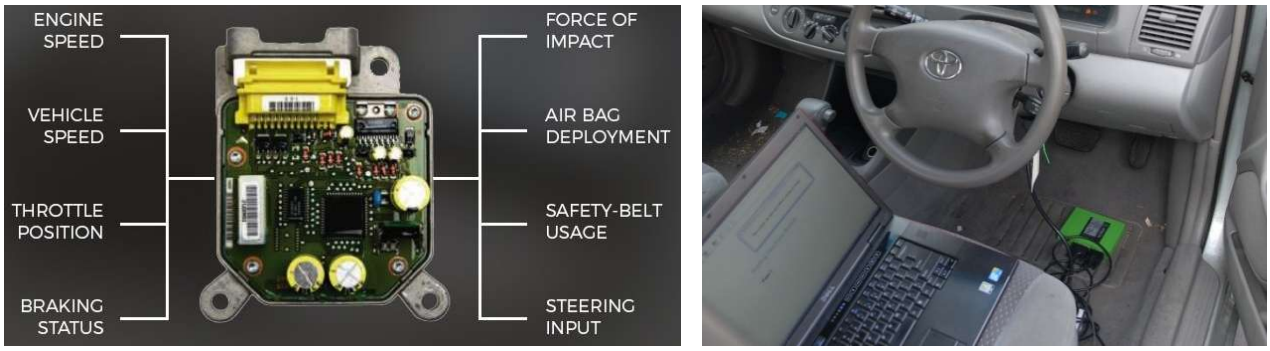


Figure 1. Electronic internals of an EDR and the variables it can contain, and a photo of a laptop and a Bosch CDR tool plugged into a crashed vehicle

Time (sec)	-4.85	-4.35	-3.85	-3.35	-2.85	-2.35	-1.85	-1.35	-0.85	-0.35	0 (TRG)
Vehicle Speed (MPH [km/h])	82 [132]	80.2 [129]	78.3 [126]	75.8 [122]	72.7 [117]	66.5 [107]	62.1 [100]	54.1 [87]	46.6 [75]	38.5 [62]	32.9 [53]
Accelerator Pedal, % Full (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percentage of Engine Throttle (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Engine RPM (RPM)	4,000	3,800	3,700	3,600	3,400	3,100	2,900	2,900	2,600	2,200	2,100
Motor RPM (RPM)	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid
Service Brake, ON/OFF	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON
Brake Oil Pressure (Mpa)	0.91	0.91	0.00	1.73	2.30	3.65	4.18	8.06	9.94	10.18	10.42
Longitudinal Acceleration , VSC Sensor (m/sec^2)	-2.082	-2.369	-0.861	-2.656	-3.948	-4.737	-8.398	-6.245	-6.030	-4.307	-8.973
Yaw Rate (deg/sec)	0.49	0.49	0.00	0.49	0.00	-0.98	-2.44	-6.34	-17.57	-6.83	-7.81
Steering Input (degrees)	0	0	0	0	0	0	-15	-33	-75	-135	-231

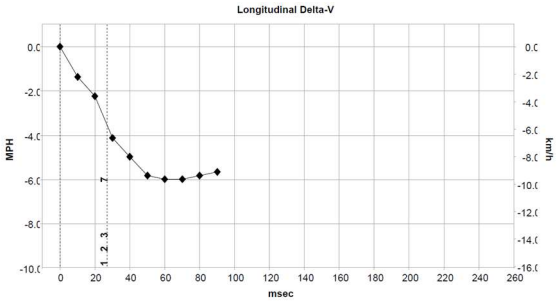


Figure 2. Example of EDR pre-crash data (top) and post-crash data (bottom)

Summary of research in Australia using EDR data

The Centre for Automotive Safety Research (CASR) was the first Australian research institution to use EDR data enhanced with police data and has published several reports based on a reasonably representative sample of crashes in South Australia. Key findings include:

- Speeding: In a study of 804 crash-involved vehicles (Elsegood et al., 2024), 26.4% (n=109/412) of bullet vehicles (generally the vehicle with more kinetic energy) involved in a crash were speeding, while 41.5% (n=86/207) of drivers in free-speed crash-involved vehicles (those freely selecting their travel speed) were speeding.
- Elimination of speeding: If Intelligent Speed Adaption (ISA) (a vehicle technology designed to prevent speeding) was installed in all vehicles, using a sample of 215 vehicles, the technology was predicted to reduce serious injuries in Australia by 17.6%, or 7,040 per year (Doecke et al., 2021).
- Seat belt use: In the sample of 804 crash-involved vehicles, 2.9% (n=12/407) of drivers were unbuckled and 9.7% (n=3/31) of left-front-seat passengers were unbuckled at the time of their crash (Elsegood et al., 2024).
- Pre-impact braking: Analysis of a sample of 170 bullet vehicles found 32.9% (n=56) did not apply any braking prior to a crash (Elsegood et al., 2020).
- Injury risk and delta-v: Analysis of a sample of 421 occupants injury outcomes found that there was a considerably higher injury severity outcome (treated or admitted to hospital) occurred for higher delta: a 20 km/h delta-v resulted in a 23.3% injury risk, compared to 60% injury risk at 40 km/h delta-v (Ponte et al., 2021).
- Intersection crashes: From a sample of 88 vehicles involved in multi-vehicle crashes at intersections with 50 km/h or 60 km/h speed limits, intersections with roundabouts were found to have the lowest serious injury risk (Doecke et al., 2025).

CASR also analysed a sample of 271 vehicles involved in crashes investigated by the Victoria Police's CRMIU (Doecke & Elsegood, 2024). The sample mostly included vehicles involved in severe crashes, and while the fatal cases were reasonably representative of fatal crashes in Victoria, the serious injury cases in the sample may be biased toward cases involving illegal activity, such as speeding. Speeding was found to be a factor in 52.1% (n=36/69) of bullet vehicles involved fatal crashes and 68.4% (n=52/76) of bullet vehicles involved in serious injury crashes.

The Monash University Accident Research Centre (MUARC) investigated crashes occurring between 2014 and 2016 in Victoria through their Enhanced Crash Investigation Study (ECIS) (Fitzharris et al., 2020). They originally anticipated EDR data would be available in 50% of crash-involved vehicles. However, of the 400 crash-involved vehicles, 334 were examined, and 36 (9.0% of 400) had a successful download using the Bosch CDR tool.

Currently, CASR and Nihon University (Japan) are collaborating on developing a machine learning model that estimates delta-v from images of crashed vehicles using EDR data from Japan and Australia. This model is intended to enhance injury prediction in the absence of Advanced Automated Crash Notifications (AACN) systems. In the event of a crash, AACN systems notify emergency services of the location and crash severity, enabling them to dispatch appropriate resources to the scene without delay.

Timeline of EDRs (worldwide development and legislation)

The following events are particularly interesting, highlighting the different areas of the world where EDRs have been introduced into legislation. The events include:

- 1970: Development of Crash Recorder Model 3300 in the United States (an early vehicle-mounted crash recorder).
- 1990: General Motors (GM) introduced EDRs to their fleet (Chidester et al., 2001).
- 1994, 1999: GM updated their EDR design to include more variables (Chidester et al., 2001).
- 1997: Ford introduced EDRs to their fleet (Chidester et al., 2001).
- 2006: The US mandated accessible data from all EDR-equipped vehicles manufactured from 2010.
- 2006: In the US, 64% of new vehicles were equipped with compliant EDRs.
- 2019: European Union mandated equipping of EDRs in all new vehicles from 2022.
- 2021: The United Nations Economic Commission for Europe (UN ECE) mandated equipping of EDRs in all new vehicles from 2022 under Regulation Number 160. Australia is a signatory to the UNECE 1958 Agreement, which allows for the adoption of UNECE regulations as alternative standards within the ADRs.
- 2022: In the US, 99.5% of new vehicles were equipped with compliant EDRs.
- 2025: No EDR regulation in Australia

In Australia, there is no current legislation mandating the equipping or accessibility of EDRs. Recent unpublished research (Doecke et al., unpublished) has shown that in 2021, 29.6% of Australian-registered vehicles are equipped with accessible EDRs through the Bosch CDR tool, and 44.5% of them are accessible through the Collision Sciences toolkit. It was also predicted that in 2034, 38.0% of vehicles would be accessible through the Bosch CDR tool, and 69.7% accessible through the Collision Sciences toolkit.

Discussion

EDRs are extremely valuable data acquisition systems that provide objective information on the prevalence of speeding, seat belt use and driver behaviours immediately before a crash. In an ideal world, EDRs would be widely deployed and easily accessible. Globally, jurisdictions that prioritise road safety have either mandated EDR installation through regulations or ensured accessibility to the recorded data. Additionally, EDRs are increasingly integrated with advanced automated crash notification systems, which allow for faster crash reporting and data transmission to emergency services. This real-time data, including vehicle speed and crash severity indicators, helps emergency responders use injury prediction models to improve their response time and preparation for serious crashes.

Australia constantly lags behind in vehicle safety standards, and this has been demonstrated time and time again, with various important vehicle safety features that being a standard feature overseas but for the same vehicle make, model and year equivalent in Australia, the various features are an optional extra or not available at all. This highlights the safety inequity for Australian road users in comparison to overseas road users when potentially life-saving technologies are not widely adopted. The absence of EDR regulation in Australia (despite the UN ECE Regulation 160 applying from 2022) further demonstrates this issue of inequity despite Australia's purported efforts for international harmonisation. Australia should mandate the installation of EDRs in new vehicles and allow data access to all vehicles with EDRs already equipped without further delay or hesitation.

References

Chidester, A. B., Hinch, J. & Roston, T. A. (2001) Real world experience with Event Data Recorders. In: Proceedings of the 17th International Technical Conference on the Enhanced Safety of Vehicles (ESV) Conference, June 4-7, 2001, Amsterdam, Netherlands.

Doecke, S. D., Raftery, S. J., Elsegood, M. E., & Mackenzie, J. R. R. (2021). *Intelligent Speed Adaptation (ISA): benefit analysis using EDR data from real world crashes (CASR176)*. Adelaide: Centre for Automotive Safety Research.

Doecke, S. D., & Elsegood, M. E. (2024). Event Data Recorders (EDRs) and high severity crashes: a summary of data collected by Victoria Police (CASR237). Adelaide: Centre for Automotive Safety Research.

Doecke, S. D., Elsegood, M. E., & Ponte, G. (2025). *Speeds in intersection crashes using EDR data (CASR227)*. Adelaide: Centre for Automotive Safety Research.

Doecke, S. D., Elsegood, M. E., & Ponte, G. (unpublished). *Event Data Recorders (EDRs) in Australia: history, prevalence, and benefits*. Adelaide: Centre for Automotive Safety Research.

Elsegood, M. E., Ponte, G., Doecke, S. D., & English, I. M. (2024). *Collection and analysis of EDR data from crash-involved vehicles: 2023 summary report (CASR240)*. Adelaide: Centre for Automotive Safety Research.

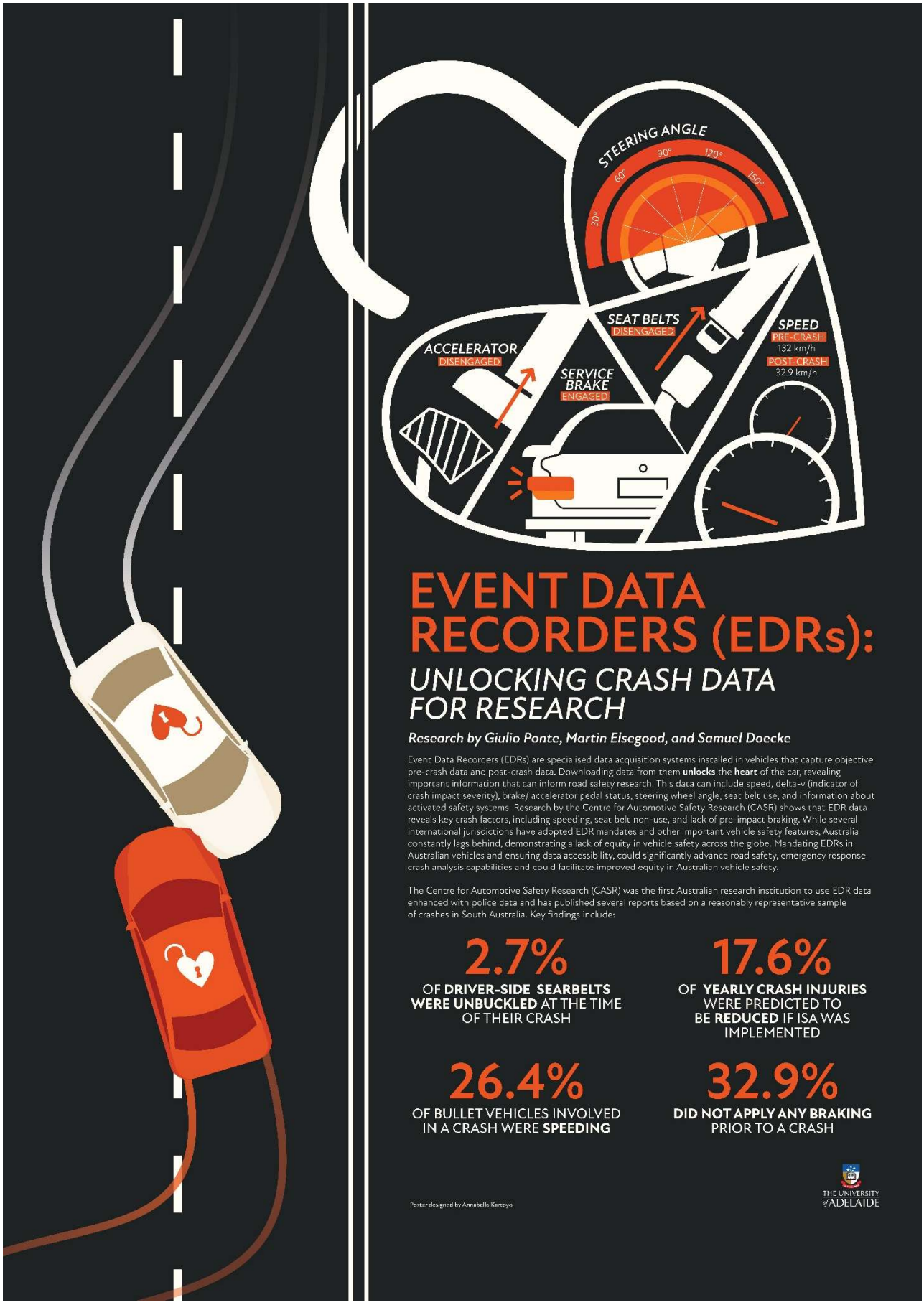
Elsegood, M. E., Doecke, S. D., & Ponte, G. (2020). *Pre-impact braking in crashes: insights from event data recorders (EDRs) (CASR171)*. Adelaide: Centre for Automotive Safety Research.

Fitzharris, M. P., Lenne, M. G., Corben, B., Pok Arundell, T., Peiris, S., Liu, S., Stephens, A., Fitzgerald, M., Judson, R., Bowman, D. M., Gabler, H.C., Morris, A., & Tingvall, C. (2020). *Overview and analysis of serious injury crashes – crash types, injury outcomes and contributing factors, ECIS report 1*. Melbourne: Monash University Accident Research Centre.

Ponte, G., Elsegood, M. E., & Doecke, S. D. (2021). *Injury risk and delta-V - insights from event data recorder information and reported injury outcomes.* 2021 Australasian Road Safety Conference, Melbourne, Australia, 28-30 September 2021.

Poster presentation

Winner, Best Poster, People's choice



Risk inequity in the safe systems approach to road safety

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Abstract
The core of the Safe System approach to road safety is human vulnerability and how much crash-related impact energy can be tolerated. The human body cannot withstand direct vehicle impacts above 30 km/h but increased protection, such as being inside a safe vehicle, helps manage crash energy and reduce injury risk in crashes. Regardless of protection, injury likelihood still increases with increasing impact speed, and this is dependent on pre-crash travel speed and speed limit compliance. Therefore, the speed limit set on a road is critical to reducing crash injury risk, and while the Safe System considers speed limits and injury risk in the context of different crash types and a population-level injury tolerance, it often overlooks inequities and other key risk factors such as the age of the injured and time to medical care. This research applies a multi variable occupant injury prediction algorithm to demonstrate how injury risk is stratified and varies with age and emergency transport time, offering an approach to a more equitable Safe System approach.

Social media post
There are many factors that contribute to the risk of a serious injury. Some of these are obvious, like speed, but age and emergency transport time to hospital also play a significant role in injury risk.

Background
An unacceptably high number of serious and fatal injuries are occurring as a result of road crashes. Road safety strategies, action plans and targets aim to reduce these serious crashes by using a safe system's approach to road safety. A safe system acknowledges human vulnerability and fallibility, and that the transport system should be considered holistically so that each component has redundancies, and failures should not result in death or serious injury. Traditionally the safe system approach declared that vulnerable road users and occupants in vehicles experiencing a side impact with a fixed object could not tolerate crash speeds greater than 30 km/h; occupants in vehicles experiencing a side-impact collision with another vehicle could not tolerate crash speeds greater than 50 km/h; and occupants in vehicles experiencing a head-on collision could not tolerate crash speeds greater than 70 km/h. Considerable efforts have been undertaken to improve vehicle safety in recent decades with the development and evolution of vehicle pre-crash technologies such as lane keep assist systems, emergency brake assist systems and autonomous emergency braking that assist drivers in avoiding a crash or lowering vehicle speed and energy if a crash is inevitable. Vehicle energy management structures have also evolved considerably, leading some to believe that the limits of vehicle crashworthiness improvement have been reached, so safety focus needs go beyond vehicle protective mechanisms.

Doecke et al. (2020) examined EDR data from the US for vehicle to vehicle crashes and determined the relationships between impact speed and risk of AIS3+ injuries, and found that the most severe vehicle-vehicle crash type was head-on collisions with the 1% risk of AIS3+ injury occurring at 28 km/h and a 10% risk occurring at 53 km/h. Doecke et al. (2018) examined fatality rates by speed limit and for head-on collisions, 50 km/h speed limits result in a fatality rate of 1 in every 100 crashes, while speed limits of less than 50 km/h would be needed to achieve a 1 in 1000 fatality rate. For hit fixed object crashes the 1 in 100 and 1 in 1000 fatality rates occurred at 60 km/h and <50 km/h respectively. For simplicity and easy policy application, these injury risk relationships consider the most significant predictor of injury being speed but does not address the complexity of inequalities in crash parameters that also contribute to injury risk. Dean et al. (2023) in assessing injury risk examined AIS2+ injury risk with respect to impact speed and delta-v, as well as two age range relationships age <65 and 65+.

Nishimoto et al. (2024) developed an injury prediction algorithm for use in an advanced automatic crash notification system, using South Australian mass crash data (17,784 injured occupants) along with serious injury hospital data (785 injured occupants), and found that variables such as speed limit, crash type, restraint use, occupant age and transport time from crash location to trauma centre were all statistically significant injury risk factors, particularly for drivers. These are all important additional parameters that need to be considered in a more equitable safe systems approach to road safety.

The purpose of the current study was to demonstrate the variability in injury risk in addition to speed, and this was done by examining single vehicle crashes with fixed objects (such as trees, utilities poles and other roadside furniture). This crash type results in considerable numbers of injuries and fatalities each year for both drivers and passengers and in which injury risk is not very well understood. In South Australia, over the last 10 years, 41% of fatalities and 37% of serious injuries suffered by car drivers resulted from crashes with fixed objects.

Method

The present study used the logistic regression coefficients from Nishimoto et al. (2024) for hit-fixed-object crashes to calculate the probability of serious injury or greater (according to police reported classifications where the threshold for serious injury admission to hospital) to produce an injury risk matrix based on driver age (range), speed limit and the effect of emergency transport time from crash location to trauma centre. Objective crash data derived from event data recorders of crashed vehicles were also examined to establish context between impact speeds within various speed limits.

Results

The coefficients for the logistic regression equation (derived from Nishimoto et al., 2024) are shown in Table 1, and for this research the probability of a police reported serious injury (PSI) or greater was calculated using the logistic regression equation (Equation 1), P(Y= PSI), where PSI is 'admitted to hospital' or 'fatal', under the conditions: a seatbelt restrained driver, involved in a single vehicle hit-fixed-object crash type, during daylight and not raining. The variable crash parameters were speed limit, age range and emergency transport time from crash location to trauma centre. As most hit-fixed-object crashes (93%) occurred in speed limits zoned 50 km/h (19%), 60 km/h (23%), 80 km/h (18%), 100 km/h (22%) and 110 km/h (11%), the results are presented with these speed limits. to reflect actual crash by speed limit exposure. A speed limit of 40 km/h is also included for reference.

Table 1. Logistic regression coefficients from Nishimoto et al. (2024)

Risk factors		**Coefficients**
Intercept		-4.688
Speed limit	[km/h]	0.025
Single / to Vehicle	Single	-0.634
	to Vehicle	0.000
Crash type	Head on	2.597
	Side swipe	0.980
	Roll over	2.624
	Right turn	1.127
	Hit fixed object	2.870
	Right angle	1.390
	Rear end	0.000
Lighting	Daylight	0.000
	Night	0.579
Seatbelt	Fitted, worn	-1.430
	Fitted, not worn	0.000
Occupant age (years)	16-17	-0.371
	18-54	0.000
	55-64	0.305
	65+	0.844
Weather	Not raining	0.000
	Raining	-0.149
Transport time (minutes)	0-60	0.000
	61-90	0.460
	91-120	1.184
	120+	1.592

Equation 2

$$P\,(Y = PSI) = 1/[1 + e^{-(\beta_0 + \beta_1 x_1 + \ldots \beta_i x_i + \ldots \beta_n x_n + \beta_{TT} x_{TT})}]$$

Table 2 demonstrates that there is an increase in police reported serious injury risk not only as speed limit increases, but also as driver age increases and emergency transport times to trauma centres increase. There are no scenarios for any

driver in a crash with a fixed object where the police serious injury risk is less than 1%. However, there are scenarios for each age group where the serious injury risk is less than 10%, except for 65+ year old drivers where, even in a 40 km/h speed zone and with an emergency transport time of less than 60 minutes, the serious injury risk is 11.7%.

Nishimoto et al. (2024) used speed limit as a proxy for transport system energy in the absence of crash data that provides impact speed or delta-V information. However, unpublished preliminary data from just over a thousand event data recorders (EDRs) in Australia, demonstrates that there is considerable variation in impact speed (and hence impact energy) within defined speed limits (see Figure 1). This variation is aggregated within Nishimoto's model, but a better prediction model would be derived if objective injury data was available for every injured person and if event data recorder reported impact speed and delta-v was available and accessible for every vehicle. An attempt was made to calibrate the model with objective data AIS3+, but the confusion matrix resulting from an injury comparison between police reported data and actual injury data indicated that the police false negative rate was quite high, inferring that when police reported a non-serious injury, there was a 55.5% probability that it was an AIS3+ injury.

Table 2. Probability of a police reported serious injury or fatality based on varying age, transport time and speed limit

Age range (years)	**16-17**				**18-54**				**55-64**				**65+**			
Transport time (minutes)	0-60	61-90	91-120	120+	0-60	61-90	91-120	120+	0-60	61-90	91-120	120+	0-60	61-90	91-120	120+
Speed limit (km/h)	Police reported serious injury risk (admitted to hospital or fatal)															
40	3.8	5.9	11.4	16.2	5.4	8.3	15.7	21.9	7.2	10.9	20.2	27.5	11.7	17.4	30.2	39.4
50	4.8	7.4	14.2	20.0	6.9	10.4	19.4	26.5	9.1	13.6	24.6	32.9	14.6	21.3	35.8	45.6
60	6.1	904	17.6	24.3	8.7	13.1	23.7	31.8	11.4	16.9	29.6	38.7	18.1	25.9	41.9	52.0
80	9.8	14.7	26.2	4.8	13.6	20.0	34.0	43.7	17.6	25.3	41.1	51.2	26.8	36.7	54.5	64.3
100	15.3	22.3	37.2	47.1	20.8	29.4	46.2	56.3	26.3	36.1	53.8	63.6	37.9	49.1	66.6	75.0
110	18.9	27.0	43.3	53.4	25.3	34.9	52.5	62.4	31.5	42.1	60.0	69.3	44.0	55.5	72.0	79.4

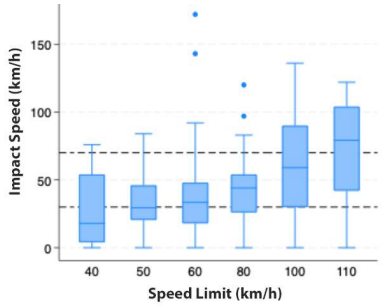


Figure 1. Box and whisker plot of impact speeds for vehicles involved in collisions across different speed limits

Discussion

This research demonstrates that injury risk is not a singular value, even within a specific crash type. Multiple factors influence injury outcome, which must be considered within an equitable safe system approach. Additionally, the findings emphasize that a safe system must account for human injury tolerance limits, particularly in an aging population, while also optimizing emergency transport times to trauma centres. The injury risk model used in the present study did not explicitly incorporate medical conditions as a causal or injury-modifying factor, as this information is derived from hospital level data and consequently not well defined within police crash reporting systems. While older drivers do indeed have an increased medical-condition related crash causation risk and an elevated injury risk as a result, medical condition related crashes apply to the entire driving age range (Baldock & Raftery, 2024), so this is somewhat incorporated in the presented risk matrix. The injury risk matrix nonetheless presents opportunities for risk mitigation, including:

- Reducing speed limits (e.g., from 50 km/h to 40 km/h in urban areas and on high-speed roads with significant roadside hazards, sharp curves and long crash response times).
- Systematic removal of roadside hazards, especially those close to road edges, and creating clear zones to reduce crash severity in road departures.

- Encouraging drivers to use safer vehicles (particularly older drivers) equipped with lane-keep assist and autonomous emergency braking optimized for hit-fixed-object crashes, while ensuring these safety features remain activated.
- Improving post-crash response systems to facilitate earlier emergency medical response and faster transport to trauma centres through:
    - Increased deployment of automated crash notification systems, particularly for older drivers with reliable telecommunications infrastructure
    - Efficient transport networks for emergency vehicles through congestion management, priority lanes, or additional air vehicles

Addressing these factors holistically will reduce crash-related injury risks and enhance road safety. While this research focused on the 'ideal' scenarios (daylight, seatbelt worn, not raining), injury risk increases further for night-time crashes, during wet weather and for unbelted drivers, and these are other factors that need further consideration for an equitable safe system. Some of the risk mitigation strategies listed above, and other risk mitigation strategies for different crash types, are already regulated in other countries but not in Australia, despite the aim to harmonize with UN regulations. To truly advance road safety in Australia and meet the road safety targets proposed, it is important that Australia starts to adopt the safety measures that have already been adopted or regulated elsewhere and to align with safety measures that are already used abroad with more haste, to ensure more equity within our road safety system. Additionally, the importance of correctly identifying serious injuries and the exchange of data between government agencies is critical for meeting road safety targets, because without correct identification of serious injuries it will never be properly know if the targets are being met.

References

Dean, M. E., Lubbe, N., Fredriksson, R., Sternlund, S., & Gabler, H. C. (2023). Assessing the applicability of impact speed injury risk curves based on US data to defining safe speeds in the US and Sweden. *Accident Analysis & Prevention*, 190, 107151. https://doi.org/10.1016/j.aap.2023.107151

Baldock, M. R. J., & Raftery, S. J. (2024). *A cross-sectional study of the prevalence of medical conditions as contributors to road crashes in South Australia*. *Traffic Injury Prevention*, *25*(1), 1–9. https://doi.org/10.1080/15389588.2024.2389205

Doecke, S. D., Kloeden, C. N., Dutschke, J. K., & Baldock, M. R. J. (2018). Safe Speed Limits for a Safe System: The Relationship Between Speed Limit and Fatal Crash Rate for Different Crash Types. *Traffic Injury Prevention*, 19(4), 404-408.

Doecke, S. D., Baldock, M. R. J., Kloeden, C. N., & Dutschke, J. K. (2020). Impact speed and the risk of serious injury in vehicle crashes. *Accident Analysis & Prevention*, 144, 105629. https://doi.org/10.1016/j.aap.2020.105629

Nishimoto, T., Kubota, K., & Ponte, G. (2024). A vehicle occupant injury prediction algorithm based on road crash and emergency medical data. *Journal of Safety Research*, 91, 410-422, doi.org/10.1016/j.jsr.2024.09.015.

The relationship between the Safe System and risky road use

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Abstract
Despite being a widely used concept, the Safe System approach to road safety is not frequently measured. Furthermore, there is no known examination of the relationship between the road user perceptions of safety and behaviours. This study, using validated measures of the perceptions of the Safe System and measures of driving behaviour derived from the Driver Behaviour Questionnaire, examines this relationship. Perceptions of the safety of the road system were assessed against driving behaviours in two groups: those who engage in unsafe road behaviours and those who do not. The results showed that those reporting that they engage in high-risk behaviours have a higher perception of road safety compared to those who don't engage in risky behaviours. This finding demonstrates that road users adjust their risk-taking behaviour according to their safety perceptions, consistent with Risk Homeostasis Theory.

Social media post
Road safety is everyone's responsibility! Measuring perceptions of road safety shows that risky drivers often see the road as safer than non-risky drivers. Let's challenge our perceptions and promote safer driving!

Introduction
The Safe System approach, which promotes that it is unacceptable for people to be killed or seriously injured on the road, is widely used within the Australian road safety context. This approach acknowledges that road users will make mistakes and therefore the system should be designed in such a way to prevent deaths and injuries (Green et al., 2023). The four original pillars of the Safe System are roads, vehicles, people and speeds. Post-crash care has been more recently added as a fifth pillar (Green et al., 2022).

The Safe System approach focuses on the shared responsibility of road users, road practitioners, transport authorities and enforcement agencies to maintain safety while accepted that people make mistakes (International Transport Forum in Green et al., 2024). Given this, it is important to measure road users' perceptions of the Safe System. This study uses a validated, reliable scale (Potter & Bates, 2024) to explore the relationship of road users' perceptions of the Safe System, i.e., that the road transport system could effectively accommodate human mistakes without any deaths or serious injuries. This study aims to examine the differences in road user safety perceptions based on participants self-reported engagement in unsafe road behaviours.

Conference Theme
This study is important because it helps provide the evidence to evolve the Australian road system and make it safer. Without a clear understanding of road user perceptions, the evolution of the Safe System approach is not possible.

Method

Participants and procedure
A market research company recruited participants to complete an online survey who were road users within Queensland. Participation in the study was voluntary and anonymous. The Griffith University Human Research Ethics Committee provided ethical approval for this study (GUHREC 2024/753). There were 2,013 road users in the sample. Table 1 below provides the gender and age of the sample.

Measures
Participants completed the five questions within the Safe System Scale: (1) If there is a crash on the road, the people involved are unlikely to be seriously injured (2) The way the roads are built mean that people are able to have a crash without serious injury (3) The way vehicles are built mean that people are able to have a crash without being seriously injured (4) The speed that people travel on the roads mean that they are able to have a crash without serious injury and (5) People use the road in such a way that they are able to have a crash without serious injury. Participants responded on a 5-point scale from (1) strongly disagree to (5) strongly agree. Responses were combined to create a mean scale.

Table 1. Sample Descriptives (N = 2013)

Variable	Group	Frequency %	%
Gender	Male	955	47.4
	Female	1053	52.3
	Other	5	0.2
Age	17-29	414	20.6
	30-39	396	19.7
	40-49	328	16.3
	50-59	362	18.0
	60 and above	513	25.5
Residence Location	Greater Brisbane	1016	50.5
	Gold Coast	264	13.1
	Sunshine Coast	150	7.5
	All Other	583	29.0

To examine the differences between road users who engage in unsafe behaviours (or otherwise) and the Safe System Scale score, participants also responded to driving behaviour measures derived from the Driver Behaviour Questionnaire (Stephens & Fitzharris, 2016). Additional measures were included to examine mobile phone misuse and driving under the influence. Participants were asked to self-report engaging in unsafe behaviours over the past two years on a 1 to 5 scale, with 1 representing 'never', 3 representing 'occasionally', and 5 representing 'nearly all the time'. A comparison between those who self-reported engaging in unsafe behaviours versus those who did not was undertaken. For the purpose of analysis, all items were dichotomized to compare those who had never reported engaging in the relevant driving behaviour (Group 1) with those who report engaging in the relevant driving behaviour more often than never (Group 2). The mean score of the Safe System Scale for Group 1 and Group 2 was compared using a series of independent samples t-tests.

Results

Overall, participants moderately disagreed that transport system could effectively accommodate human mistakes without any deaths or serious injuries (m=2.44, sd = .87). As shown in Table 2, with the exception of those who self-report engaging in low-level speeding, people who engage in risky driving behaviours tend to perceive that the system can effectively accommodate human mistakes better than those who do not engage in these behaviours. In most cases, where there was a statistically significant result, the effect size was small. However, there was a statistically significant difference with a large effect size when comparing Safe System Scale scores of participants engaging in high-risk behaviours. These high-risk behaviours include: those who drive while not wearing a seatbelt and those who speed at 41 or more kilometres per hour over the speed limit (see Table 2). Statistically significant differences between Safe System Scale scores were also observed for those engaging in speeding at 31 to 40 kilometres per hour over the speed limit and for those who drove under the influence of drugs or alcohol. These differences both displayed a medium effect size.

Benefits to road safety

Despite being a relatively abstract concept, the Safe System is used to underpin the work of policy makers and practitioners (Green et al., 2024). This study has used a validated scale to identify the relationship between perceptions of the Safe System and driving behaviour. The results indicate that individuals who have higher perceptions of the safety of the system engage in riskier driving behaviours. In some cases, such as high range speeding, not wearing a seat belt and driving under the influence, there is a large gap between those who engage in these behaviours and those who do not in their perceptions of the Safe System.

One explanation for this is Wilde's Risk Homeostasis Theory (Wilde, 1982). He proposed that humans have a natural level of risk that they are willing to take and that this is adjusted according to the risk that they currently perceive. There is therefore a distinction between a person's ability to be safe and their willingness to do so (Wilde, 1982). It is important to note that Wilde's theory has been criticised by several people (Hedlund, 2000). Despite this, Hedlund (2000) states that risk compensation is important for people working in the injury prevention space to consider. He suggests that when safety professionals introduce countermeasures they prioritise those measures that are invisible to people as well as considering the system effects of the change.

Table 2. Differences in perceptions of the Safe System Score based on driving behaviour

Behaviour		Group	n	M	SD	t	p	d
Speeding	1 to 10*	Never	347	2.56	1.01	2.52	.012	.17
		Yes	1666	2.42	0.84			
	11 to 20	Never	1116	2.37	0.81	-4.32	<.001	.19
		Yes	897	2.54	0.84			
	21 to 30*	Never	1618	2.37	0.84	-7.24	<.001	.40
		Yes	395	2.74	0.93			
	31 to 40*	Never	1759	2.37	0.84	-8.70	<.001	.58
		Yes	254	2.92	0.94			
	41+*	Never	1791	2.36	0.83	-11.24	<.001	.79
		Yes	222	3.09	0.92			
Not Courteous*		Never	632	2.25	0.91	-6.47	<.001	.33
		Yes	1381	2.53	0.84			
Disregard Speed		Never	972	2.36	0.89	-4.01	<.001	.18
		Yes	1041	2.52	0.85			
DUI*		Never	1658	2.37	0.83	-7.78	<.001	.45
		Yes	355	2.79	0.96			
Race from red		Never	1267	2.36	0.88	-5.85	<.001	.27
		Yes	746	2.59	0.84			
Run red/yellow*		Never	1000	2.40	0.90	-2.34	.019	.11
		Yes	1013	2.49	0.84			
Tailgate		Never	1424	2.35	0.86	-7.68	<.001	.38
		Yes	589	2.67	0.87			
Unbelted		Never	1840	2.37	0.83	-12.44	<.001	.99
		Yes	173	3.20	0.92			
Use mobile		Never	1401	2.35	0.86	-7.11	<.001	.34
		Yes	612	2.65	0.88			
Drive tired*		Never	587	2.37	0.93	-2.15	.032	.11
		Yes	1426	2.47	0.85			
Show Aggression*		Never	609	2.38	0.92	-2.09	.037	.11
		Yes	1404	2.47	0.85			

*Levene's test for equality of variances was significant, equal variances are not assumed. For Cohen's d effect size .2 = small, .5 = medium, .8 = large. The 10% split for the whole sample size is 201.3. Glass's Delta is used when equal variances not assumed.

Implications for policy and practice

This study has several implications for policy and practice. Policy makers need to consider the possibility that the public may adjust their driving behaviour if they hold a perception that the road system is safe, for example, those with higher safety perceptions engage in high-risk behaviours such as high-level speeding, not wearing a seatbelt or driving under the influence of drugs and alcohol. As a result, policy makers and practitioners need to carefully consider how 'safe' they promote the road system to be. By highlighting improvements in safety, there may be an inadvertent increase in road users engaging in high-risk behaviours while using the road.

Policy makers and practitioners should ensure that interventions that target this behaviour do not indicate that the road system is safe. When interventions are introduced, the impact on the system as a whole should be considered in case road users transfer their risky behaviours elsewhere.

This is the first time that a study has considered the public perception of the Safe System and its relationship with behaviour. Therefore, more research is required to understand why this relationship exists. Research is particularly needed to understand why those engaging in risky behaviours (high range speeding, driving under the influence and not wearing a seatbelt) perceive the system as safe. This research should attempt to identify the direction of the relationship.

Conclusions

Using a validated scale, this paper explores road users' perceptions of the Safe System and the relationship between those perceptions and road users engaging in unsafe behaviours on the road. In line with Risk Homeostasis Theory, the results demonstrate that those road users who perceive the road system to be safe report engaging in high-risk behaviours such has high-level speeding, not wearing a seatbelt and driving under the influence of drugs and/or alcohol.

These findings demonstrate that caution should be taken in promoting safety improvements to avoid unintended risk taking.

References

Green, M., Muir, C. & Oxley, J. (2024). What is the purpose? Practitioners' perspectives of the Safe System approach to road safety in Australia. *IATSS Research*, *48*(1), 84-99.

Green, M., Muir, C., Oxley, J. & Sobhani, A. (2023). When policy hits the road: Safe System in Victoria's policy environment. *Accident Analysis and Prevention*, 189, 107129. doi: 10.1016/j.aap.2023.107129

Green, M., Muir, C., Oxley, J. & Sobhani, A. (2022). Safe System in road safety public policy: A case study from Victoria, Australia. *IATSS Research*, *46*(2), 171-180. doi: 10.1016/j.iatssr.2021.11.006

Hedlund, J. (2000). Risky business: Safety regulations, risk compensation and individual behaviour. *Injury Prevention*, 6(2), 82-89.

Potter, C. & Bates, L. (2024). *Measuring the Safe System approach: A validated scale*, Australasian Road Safety Conference, Hobart, 30 September – 3 October.

Stephens, A., & Fitzharris, M. (2016). Validation of the Driver Behaviour Questionnaire in a representative sample of drivers in Australia. *Accident Analysis & Prevention, 86*, 186-198. https://doi.org/10.1016/j.aap.2015.10.030

Wilde, G. (1982). The theory of risk homeostasis: Implications for safety and health. *Risk Analysis*, 2(4), 209-225.

Gender mainstreaming in road safety: a policy framework for equity

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Abstract

Despite making up nearly a third of fatal and serious injuries on roads in Australia, there are significant gaps in our understanding of the issues surrounding the road trauma of women and gender-diverse individuals. The information is hidden in our datasets, but road safety research and policy generally focuses strongly on aggregated data or on men. This paper builds the case that the lack of gender disaggregated data and a workforce that lacks diversity leads to a heightened risk that road safety policies and investment decisions fail to support women and gender-diverse individuals. To make meaningful strides towards Vision Zero, policymakers must develop frameworks for gender mainstreaming at all stages of the policy and planning lifecycle. By understanding and addressing gender biases, we can create a safer road system for everyone.

Social media post

Women make up nearly a third of serious road injuries in Australia, yet their experiences are often hidden in the data. Without gender-specific insights and diverse voices in planning, road safety policies risk failing women and gender-diverse individuals. It's time to design a safe system for everyone.

Background

A safer road network not only saves lives but is a critical factor in ensuring economic and social empowerment, poverty eradication and safety from gender-based violence, particularly for women and gender-diverse people. Road safety is recognised as a basic human need due to the implications that an incident can have in all other aspects of life. While men are more likely to die in crashes, women often bear the long-term consequences—taking on caregiving roles or additional work. Women and gender-diverse people from immigrant and First Nations backgrounds may face even greater burdens. All genders have diverse needs and use transport infrastructure differently depending on their social roles, economic status or preferences. Australia's Vision Zero target aims for no deaths or serious injuries by 2050 (Commonwealth of Australia, 2021). Yet interim targets remain unmet, and gender disparities persist. For example, in NSW in 2023, men were involved in over three times as many fatal crashes as women[1], despite being roughly half the population (NSW Centre for Road Safety, 2025).

The reasons why men are more likely to die or be seriously injured behind the wheel are well documented. Studies have shown that on average men drive further distances than women and are considerably more likely to engage in risk-taking behaviour compared to women, such as speeding, driving under the influence of drugs or alcohol, or not wearing a seatbelt. However, the issues that relate to women and gender-diverse individual's road trauma are considerably less explored. The lack of gender-disaggregated data limits our understanding of the full spectrum of crash involvement.

Transport workforce figures show the Australian transport sector is the third most males dominated sector behind construction and mining, currently women make up around 27.4% of Australia's transport workforce. Only 4.5% of transport CEOs are women, well below the Australian average of 20%. This lack of diversity highlights the importance of gender analysis to ensure that policy and investment all genders.

Approach

Through analysis of gender-disaggregated crash data, and reviewing travel characteristics and injury outcomes, and guidance on gender consideration in transport policy across Australia and internationally, this paper aims to highlight that disaggregating gender data is the key to delivering evidence-based policy that provides equitable safety outcomes.

[1] Note, data used in this abstract is described as pertaining to 'women' or 'females', which may not fully represent trans women or non-binary peoples.

Findings

Mobility and crash patterns differ by gender. The mobility patterns for women and gender-diverse individuals are different to men, which may influence their risk profiles and unequal benefits or impact of infrastructure and other investments on improving the safety of their journeys at the times they take them. A City of Sydney council study has reinforced previous research that shows women are undertaking complex journeys that involve multiple stops, which may involve running errands and taking care of children and others enroute to work or school (City of Sydney, 2020). Women are also more likely than males to walk to their destinations and in most cities, use public transport (Goel et al., 2023), making them more likely to be vulnerable road users. They are also more likely to be passengers. Mobility patterns are reflected in road trauma data, whereby the profile of men and women road trauma differs by road user type. As shown in Figure 1, more women are likely to be a driver, a passenger and pedestrian, while men are more likely to be a motorcyclist or pedal cyclist as highlighted in data collected by the NSW Centre for Road Safety.

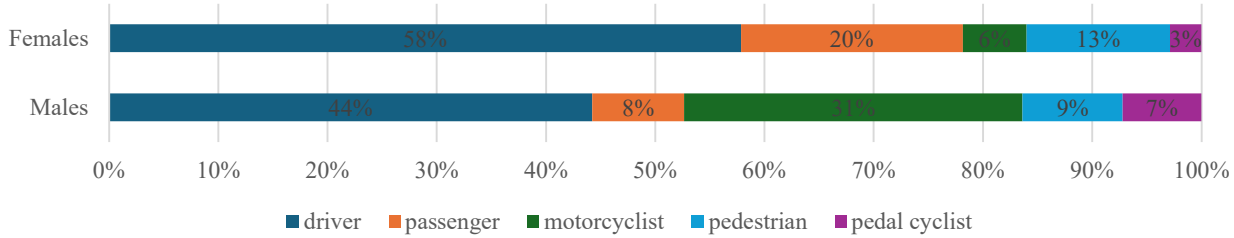


Figure 1. NSW 5-year data (2019-2023), number of people killed or seriously injured by road user group. Source: NSW Centre for Road Safety (2025).

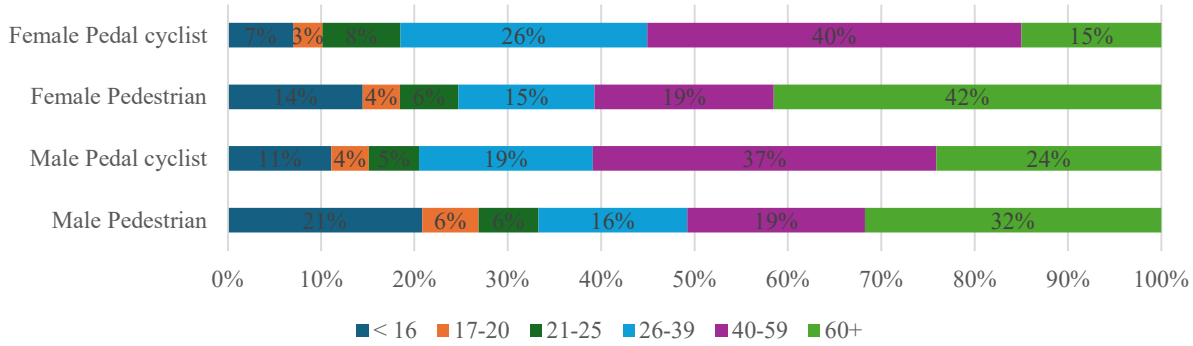


Figure 2. NSW 5-year data (2019-2023), number of people killed or seriously injured by age, by vulnerable road user group. Source: NSW Centre for Road Safety (2025).

Figure 2 highlights that as pedestrians, the total number of FSI for males and females is similar, but the profile of gender differs across the lifecycle, with a larger proportion of women over 60 years of age killed or seriously injured as pedestrians than men. Furthermore, cycling road trauma is significantly higher for males than females, and again there are lifecycle differences.

Injury outcomes differ by gender. Women are 47% more likely to sustain serious injuries in a belted crash compared to a man in the same crash, and 71% more likely to be moderately injured (Perez, 2020). Women are also almost twice as likely as men to be trapped in a vehicle after a traffic collision, and sustain different patterns of injury, according to a recent study of UK injury data (Nutbeam et al., 2022). Furthermore, Vehicle Crashworthiness of cars have been until recently typically designed using car crash test dummies based on the 'average' male body, meaning that vehicle design and safety features are largely tailored to the features of men. Following Astrid Linder's development of a female crash dummy in 2018 (Linder, 2018), the Australasian New Car Assessment Program (ANCAP) have invested in developing a female crash dummy based on the 5th percentile of women, i.e., representing only the smallest 5% of women. Further investment to better understand injury outcomes is critical to address the gender bias in vehicle occupant safety.

Conference theme: Equity

This paper challenges policy practitioners to take an equitable approach by applying gender mainstreaming to road safety – data, analysis and solutions. There is clear evidence that in those areas where data on women is not considered, this has disadvantaged women as in the case of car crashworthiness and higher injury rates for women car occupants.

Implications for policy and/ or practice

The implication of this brief overview of gender, is that road safety policies, preventative measures and interventions often fail to address road safety issues that relate to individuals of all genders or create inequity in road safety outcomes, such as vehicle technology. Current data collection and analysis methods assume similar mobility and safety impacts and outcomes for all user types and at all points across their lifetime. There is not explicit framework to collect sex-disaggregated data throughout policy and planning. This impacts on equity of investment decisions, for example state and national governments do not prioritise walking and cycling paths. (e.g., the Australian Government's National Active Transport Fund to build new cycle and walking paths over four years is worth about 1.2% of what the Commonwealth spends on roads every year). And local roads or places are not uniformly zoned safely at 30km/h.

While steps are being taken towards gender equity in transport in various Low- and Middle-Income countries and the EU, Australian road safety policies are falling behind.

We are calling for a gender mainstreaming framework to be applied to policies and planning in road safety, in line with the United Nations Sustainable Development Group (UN SDG) and key international guidance and practices in transport policy. This approach aims to mainstream "*a gender perspective is the process of assessing the implications for women and men of any planned action, including legislation, policies or programmes, in any area and at all levels. It is a strategy for making the concerns and experiences of women as well as of men an integral part of the design, implementation, monitoring and evaluation of policies and programmes in all political, economic and societal spheres, so that women and men benefit equally, and inequality is not perpetuated"* (UN SDG, 2019). An explicit road safety gender policy and planning framework in Australia would ensure gender is considered at all stages of the policy and planning lifecycle. Table 1 outlines the key features of gender mainstreaming and guidance materials to support developing a framework for road safety policies. This more equitable approach which considers the needs of women (lower speeds on local roads, active transport) and gender-diverse individuals also provides a stronger case for adopting safe system strategies.

Table 1. Key features of Gender Mainstreaming and examples of guidance to support road safety policy.

Gender Mainstreaming Priorities and Actions	Guidance to apply to road safety policy and planning
Sex aggregated data - Research and evidence to inform policy development and planning	Toolkit for mainstreaming and implementing gender equity 2023 (OECD) Women in Infrastructure, selected stocktaking of good practices for women in infrastructure 2021 (OECD) Gender Analysis Toolkit for Transport Policies (ITF) Guide on Integrating gender into infrastructure development in Asia and the Pacific – Transport and Roads 2019 (UNWomen/UNOPS) Gender Impact Assessment Guidelines 2024 (NSW Treasury) for infrastructure projects Draft NSW Guide to gender-inclusive placemaking Gender analysis toolkit (Qld Gov) Draft South Australian Public Transport Diversity and Inclusion Framework (SA Gov)
Gender analysis - Understand qualitative differences relating to women and men	
Political context - Understand individual country situations	
Consultation - Ensure both women and men are consulted	
Involvement - Ensure both women and men are involved in program/policy design/planning	
Objectives and indicators – Reflect anticipated changes and benefits for both women and men	
Capacity - Consider rights-holders and duty bearers to mainstream gender	

Conclusions

As policymakers strive to make progress towards Vision Zero, the steps that can be taken to reduce the death and serious injuries of all genders, should not be ignored. There is a wealth of existing information on women in road trauma that remains untapped: policy makers can address this gender bias. Reporting on and considering disaggregated gender-based data will support un-biased decision-making and evidence-based policy development.

References

Australian Bureau of Statistics. (2021). *Population: Census*. ABS.

City of Sydney. (2020). On the go: How women travel around our city: A case study on active transport across Sydney through a gender lens.

Criado Perez, C. (2020). Invisible Women: Exposing Data Bias in a World Designed for Men. Vintage.

Department of Infrastructure, Transport, Regional Development and Communications. (2021). National Road Safety Strategy 2021-30. In https://www.roadsafety.gov.au/sites/default/files/documents/National-Road-Safety-Strategy-2021-30.pdf

European Transport Safety Council. (2013). Risk on the roads: a male problem? The role of gender in road safety. National Road Safety Partnership Program.

Goel, R., Oyebode, O., Foley, L., Tatah, L., Millett, C., & Woodcock, J. (2023). Gender differences in active travel in major cities across the world. Transportation, 50(2), 733–749. https://doi.org/10.1007/s11116-021-10259-4

Linder, A. (2018). Eva, the female crash test dummy [Video]. TedX. https://www.ted.com/talks/astrid_linder_eva_the_female_crash_test_dummy.

NSW Centre for Road Safety. (2025). Interactive crash statistics. https://www.transport.nsw.gov.au/roadsafety/statistics/interactive-crash-statistics.

Nutbeam, T., Weekes, L., Heidari, S., Fenwick, R., Bouamra, O., Smith, J., & Stassen, W. (2022). Sex-disaggregated analysis of the injury patterns, outcome data and trapped status of major trauma patients injured in motor vehicle collisions: a prespecified analysis of the UK trauma registry (TARN). BMJ Open, 12(5), e061076. https://doi.org/10.1136/bmjopen-2022-061076

United Nations Sustainable Development Group. (2019). Gender Mainstreaming. United Nations. https://unsdg.un.org/download/1470/7407.

Deconstructing ambiguity in road safety performance indicators

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Abstract
Road safety performance indicators (SPIs) are important metrics for jurisdictions when targeting and achieving outcomes to reduce the risk of injury on the road network. With an increasing focus on proactive road safety requiring increasingly complex analyses of the network, performance indicators will need clear guidance for data practitioners reporting on these metrics. Main Roads Western Australia reports on the National Road Safety Strategy 2021 – 30 lead indicator of "Share of travel on all national highways and on the high speed network (≥ 80 km/h) covering 80% of travel recognized as 3-stars (or equivalent risk rating) or better". For practitioners implementing this indicator, the use of a percentage subset introduces structural ambiguity in interpreting the SPI and calculating the result. This project dissects this SPI and discusses the need for prescriptive language to ensure reporting is meaningful and consistent across jurisdictions.

Social media post
Road safety performance indicators (SPIs) are important metrics for focusing our efforts to reduce road trauma. As the complexity of our targeting increases, road safety data practitioners need a shared, prescriptive language for ensuring consistency in understanding and application of analytics across jurisdictions.

Introduction
Road safety performance indicators (SPIs) are important metrics for focusing jurisdictions on targeting and achieving outcomes to reduce the risk of injury on the road network. While succinct statements are useful in the context of a strategic document, road safety data practitioners need clear and precise guidance to implement these indicators accurately and consistently with other jurisdictions.

Main Roads Western Australia (Main Roads) reports on the National Road Safety Strategy 2021 – 30 (Department of Infrastructure, Transport, Regional Development and Communications, 2021) lead indicator of "Share of travel on all national highways and on the high speed network (≥ 80 km/h) covering 80% of travel recognized as 3-stars (or equivalent risk rating) or better."

While the statement conveys a broad intent within the Strategy, it is ambiguous for creating consistent subsets of road networks as interpretation for when to apply the *Top 80% MVKT* subset could vary. An action for Main Roads to investigate these interpretations arose from Austroads' AusRAP Community of Practice (CoP) meeting (March 2024), leading to a project focusing on analysing a suite of interpretations to inform consensus-building for this SPI.

Conference Theme – Equity and Evolution
Equitable access to safe roads for as many people as possible underpins the metric of "Share of travel on all national highways and on the high speed network (≥ 80 km/h) covering 80% of travel recognized as 3-stars (or equivalent risk rating) or better." Having a clearer direction on working with this statement in the context of a road network opens up key areas of analysis to ensure that deficiencies in the network are addressed where speed and travel exposure are high.

This work also contributes to the evolution of road safety and the safe system; as road safety continues to integrate more proactive indicators and analyses, practitioners must have the means for ensuring that data pipelines are comparable across jurisdictions and contributing to the maturity of thought and language required to operate with evolving concepts of assessing risk on the network proactively.

Project Description

Road Network Data
Western Australia's road network data was analysed to produce results for three possible interpretations of the 'share of travel' SPI, utilising data from WA's Integrated Road Information System (IRIS) database and network LIDAR data collected and processed through the iRAP VIDA online application to produce iRAP star ratings. The resulting

composite network included features for 18,954 km of star-rated network with vehicle travel of 45,138.06 million vehicle kilometres travelled (MVKT) based on LIDAR delivered in 2023.

Data engineering was undertaken using Spark SQL to aggregate cumulative MVKT for groups within each interpretation of the SPI. Results were visualised in Power BI with a focus on illustrating the clear deconstruction of a star-rated road network into the relevant components explicitly.

Safety Performance Indicator interpretations

Interpretations of the SPI were generated based on syntactically examining the structure of the SPI wording and constructing set statements to convey each interpretation. The CoP also requested further analyses utilising urban and rural strata as potentially valuable changes to the SPI, but these were not representative of the SPI as written but rather supplementary analysis for discussion. Eight analyses were conducted for the CoP, with three using the explicit wording of the SPI as written. Candidate interpretations were selected when each logical component (the national highway network, the high speed network, and an 80% subset clause) were included. The option of having "recognised as 3-stars" as a logical component was considered but discarded from the understanding that this is the result and not a function of the network.

Table 1. Sentence deconstruction for interpretations of the 'Share of travel' SPI and resulting sets

Interpretation		Sets
ID	**Deconstruction**	
1	Share of travel on **(**all national highways**)** and **(**on the high speed network (≥ 80 km/h) covering 80% of travel**)** recognized as 3-stars (or equivalent risk rating) or better.	Share of travel on: All National Highways (NLTN) + Top 80% subset of the Non-NLTN High Speed Network
2	Share of travel on **(**all national highways and on the high speed network (≥ 80 km/h) covering 80% of travel**)** recognized as 3-stars (or equivalent risk rating) or better.	Share of travel on: Top 80% MVKT subset of: (All NLTN + the Non-NLTN High Speed Network)
3	Share of travel on **(**all national highways**)** and **(**on the high speed network (≥ 80 km/h) covering 80% of travel recognized as 3-stars (or equivalent risk rating) or better**)**.	Share of travel on: All national highways (NLTN) + Top 80% MVKT subset of: Non-NLTN High Speed Roads rated 3 stars or greater

Findings

The intent of this work is to quantify how each interpretation provides variance in the SPI result and inform discussion of which combination of sets best represents the intent of the SPI. The length of star-rated network and MVKT for each interpretation was calculated and is summarised below, with interpretations 1 and 3 accounting for similar proportions of network by kilometre, while interpretation 2 accounted for a far lower length of network but similar MVKT to the other interpretation sets.

Table 2. Length and MVKT resulting from each interpretation of the 'share of travel' safety performance indicator

Interpretation		Length (km)		Million Vehicle Kilometres Travelled (MVKT)	
ID	**Description**	**Length (km)**	**% of Network**	**MVKT**	**% of Network**
1	(All NLTN) and (80% of the Non-NLTN High Speed Network)	6,591.73	34.89%	30,826.71	68.29%
2	80% of (All NLTN and the Non-NLTN High Speed Network)	1,034.32	5.47%	27,256.23	60.38%
3	(All NLTN) and (80% of the Non-NLTN High Speed Network rated 3 stars and above)	6,301.47	33.35%	28,836.10	63.88%

Each interpretation of the SPI was visualised using decomposition charts in Power BI to illustrate how the rated network can be deconstructed into meaningful sets achieving varying lengths and travel on the network. Categorical nodes were incorporated to provide further clarity of individual breakdowns of the star-rated network before the

resulting subset is achieved. Figure 1 provides an example of using a decomposition chart to illustrate the hierarchical components featuring in interpretation 1.

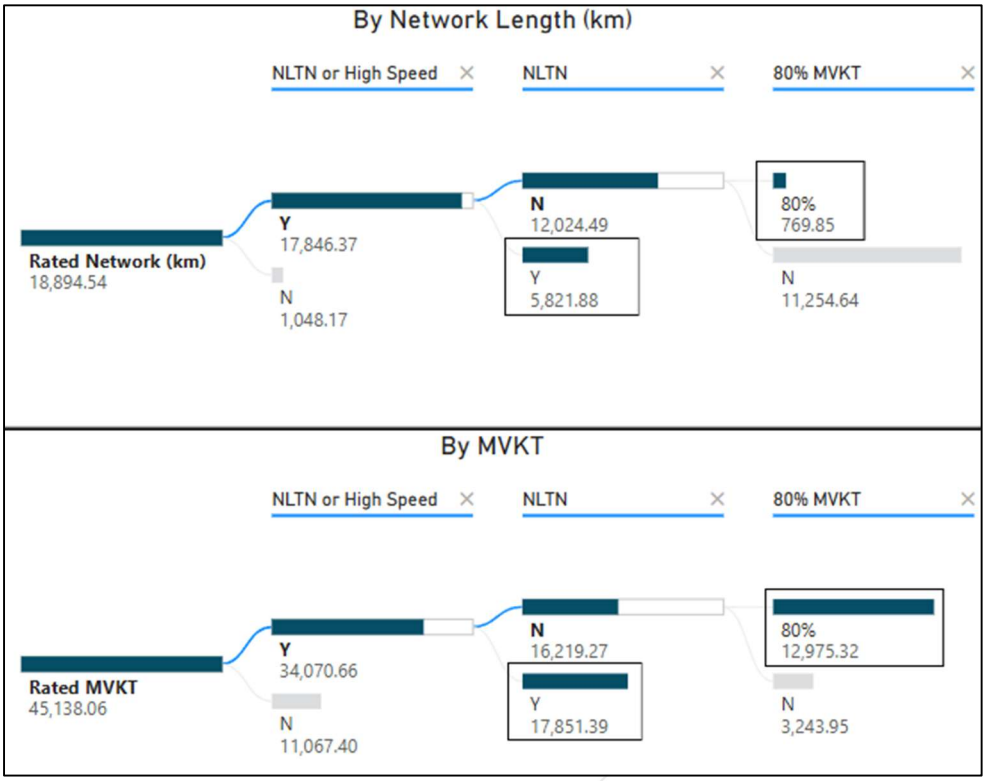


Figure 1. (All NLTN) and (80% of the Non-NLTN High Speed Network)

In this interpretation, all National Land Transport Network (NLTN) are returned in the resulting network subset. The remaining network is explicitly defined as NLTN = "N" and further subset for the top 80% of MVKT. The two sets are combined to form the resulting SPI subset.

Expression of hierarchical set members can also be achieved through use of nested statements. For Interpretation 1, the decomposition chart shows:

- The proportion of the rated network representing the combined NLTN and Non-NLTN High Speed network
- For the NLTN:
  - All NLTN is included
- For the Non-NLTN High Speed Network:
  - The top 80% cumulative MVKT is included

Nested statements provide clearly defined, non-overlapping sets and subsets for inclusion in the final indicator set. Further to this, there are existing conventions for set expression in mathematics that could be considered, such as taking the union or intersection of network subsets, using the axioms of set theory (Bagaria, 2023).

Conclusion

Road safety performance metrics are becoming increasingly complex and in need of accompanying language to ensure that data practitioners are interpreting these metrics meaningfully and consistently.

Different options exist for the clear articulation of business rules to generate subsets of a road network. Charts that convey discrete groups within a hierarchy, such as decomposition charts or decision trees provide a visual mechanism for illustrating how a network can be deconstructed into clear, explicit sets. Use of nested statements with no overlap between sets can be an efficient *pseudocode* method for conveying sets and more formally we may consider mathematical set language such as the use of unions and intersections to prescriptively discuss discrete hierarchical components of a network.

References

Department of Infrastructure, Transport, Regional Development and Communications. (2021). *National Road Safety Strategy 2021-30.* Commonwealth of Australia. https://www.roadsafety.gov.au/sites/default/files/documents/National-Road-Safety-Strategy-2021-30.pdf

Bagaria, Joan, (2023). *Set Theory*. Stanford Encyclopedia of Philosophy. https://plato.stanford.edu/archives/spr2023/entries/set-theory/

Identifying safety features for tramway implementation in Bogor, Indonesia

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Abstract

The planned tramway system in Bogor presents an opportunity to enhance urban mobility. However, ensuring safety is crucial for its successful implementation, particularly in preventing tram-vehicle collisions, pedestrian crashes, and operational hazards. Despite the global adoption of tramways, Indonesia lacks research on tram safety, making it essential to identify best practices for a safe and efficient system. This study employs a Systematic Literature Review (SLR) following the PRISMA protocol, analysing common tram crashes, infrastructure designs, and road characteristics from selected tramway systems in Melbourne, Constantine, Gdańsk, and Turin, along with insights from Indonesia's historical tram network. Current findings highlight the three safety measures namely vehicle characteristics, road characteristics, and tram stop design. It will provide recommendations aim to support policy development and urban transport planning, ensuring that Bogor's tramway system is safe, efficient, and sustainable, contributing to safer public transport in Indonesia.

Social media post

How can Bogor safely integrate a tramway system? Find the insights and recommendations for a safe and sustainable tramway for Bogor through our research.

Introduction

Safety is a fundamental necessity, including in the transportation sector. Globally, the World Health Organization (WHO) reports that road traffic injuries are one of the leading causes of death, particularly among young people aged 15-29. In Indonesia, traffic crashes are the third leading cause of death, and in 2024 alone, the number of crashes has increased eightfold compared to 2023 (Mardianti, 2024). This alarming trend highlights the urgent need to raise awareness and implement preventive measures to curb the rising number of traffic crashes in the future.

As a satellite city supporting the Indonesian capital Jakarta, Bogor has plans to implement tramway systems to facilitate urban mobility. Known as the "City of a Million Angkots" referring to its ubiquitous public minibus, Bogor has also recently introduced a Bus Rapid Transit service. The potential addition of tram infrastructure raises questions about how the city will manage traffic amidst the introduction of this new system and the continuous growth of motorised vehicles year after year. Undoubtedly, tramway systems are an essential component of urban public transportation, offering a sustainable and efficient mode of travel. However, it also raised concerns on the high frequency of collisions between trams and vulnerable road users, particularly pedestrians (Lackner et al., 2022). Therefore, the technical aspects and features of tramway systems must be carefully considered to prevent crash risks, especially in cities like Bogor, Indonesia.

The implementation of tramway systems in Bogor city requires a comprehensive understanding of safety measures in order to ensure the prevention of crashes and enhance overall system reliability. While tramways are increasingly being adopted worldwide and were once part of Indonesia's transport network a century ago, research on tram safety in the Indonesian context remains limited. This study aims to review the history and reasons behind the discontinuation of tram systems in Indonesia as a reflection on the planned reintroduction of tramways in Bogor and. Additionally, it seeks to identify safety features from tramway systems in different countries and assess their suitability for Bogor's transport environment. By addressing these aspects, this research contributes to the development of a safer and more sustainable tramway system in Indonesia.

Conference Theme

Aligns with the Evolution theme, the research explores the development and reintroduction of a tramway system in Bogor through a safety-focused approach. It examines the historical context of tram discontinuation in Indonesia, allowing for a reflection on past challenges and how they can inform safer, more sustainable transport planning today. Additionally, by identifying proven safety features from international tramway systems and assessing their applicability to Bogor's transport environment, the research contributes to the advancement of road safety strategies in Indonesia.

This aligns with the evolution of a Safe System approach, ensuring that the implementation of new transport modes prioritises pedestrian protection, intersection safety, and seamless integration with existing infrastructure. By bridging historical insights with modern safety standards, this study supports the continuous improvement of urban transport systems, helping cities like Bogor adapt to changing mobility needs while enhancing road safety for all users.

Method

In order to identify the key safety features for tramway implementation in Bogor, this paper conducts a Systematic Literature Review (SLR) guided by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) protocol. This is to ensure a structured and transparent approach to identifying safety features for the planned tramway. Literature review method allows for a comprehensive examination of existing research and case studies on tramway safety, ensuring that findings are relevant and applicable to Bogor's urban transport environment.

It will be conducted using several academic and professional databases, including Google Scholar and Scopus. The search terms used included tramway safety, tram crashes, tram collisions, public transport safety, urban tram systems, tramway infrastructure safety, cycling safety in tram corridors, and pedestrian safety in tram corridors. The study applied criteria for the selecting research published within the last 15 years to ensure relevance, with a focus on tramway safety, crash prevention, and transport planning in cities with similar urban and traffic conditions to Bogor.

The review process consists of three main stages: identification, screening, and inclusion. Initially, all collected materials will be screened by title and abstract to remove irrelevant sources. The information from the selected studies was systematically extracted using a data extraction table, with details such as study title, year, country, safety measures, identified challenges, and policy recommendations. The findings will be analysed through a comparative approach with selected cities, categorising tramway safety features into three main areas: common tram crashes and safety risks, infrastructure design considerations, and road characteristics in urban context. Despite the structured approach, certain limitations exist in this study. Public awareness is currently limited to the fact that tramway systems are planned for construction in Bogor City, with four corridors proposed for future operations. However, the planning process details have not yet been published publicly. Furthermore, data regarding the specific corridor locations and their proximity to areas with high crash risk prevalence is not readily accessible to the general public at this stage. This lack of fully disclosed planning information poses limitations on conducting a comprehensive analysis within the scope of this paper.

Result and Discussion

From 1869 to the early 1960s, tramway systems have played a major transportation role across four major urban cities such as Jakarta, Surabaya, and Semarang. However, each city's tram network was eventually dismantled for varying socio-political, technical, and infrastructural reasons. As the capital city, Jakarta, the tramway system perceived as outdated and no longer represented the symbol of modern mass transit systems appropriate for urban settings. Additionally, there were weaknesses in management, as a fleet of outdated tram vehicles continued to be utilised despite frequent breakdowns (Indrajaya, 2021). The tram company's finances were negatively impacted by maintenance issues due to the city's inconsistent electricity supply. Furthermore, the existence of city buses is thought to be more consistent with the intended urban concept of Jakarta. In the wake of Indonesia's independence from colonial rule around that time, some independence activists in Surabaya viewed trams as reminders of Dutch colonial rule that required to be changed. This perspective encouraged efforts to introduce other alternatives that were more nationally (Yahya, 2015). Meanwhile in Semarang, the increasing number of people shifting to private vehicles, the deterioration of the tram infrastructure, and the introduction of policies declaring that trams were incompatible with the city's growing traffic were the reasons for the elimination of the tram system (Saraswati & Purwanto, 2022).

These historical cases underscore the importance of clear and sustained government support for the successful reintroduction of tramway systems in cities like Bogor. To avoid repeating past failures, it is essential that the tramway is developed as a long-term, future-oriented, and sustainable solution to urban mobility challenges. Strong political commitment and a consistent vision are critical to ensuring that the system remains a strategic component of the city's transport infrastructure. Therefore, the planning and implementation of the tramway must consider multiple factors, including infrastructure readiness, urban growth trends, public acceptance, and integration with existing modes of transport. While it is natural for urban dynamics to evolve over time, the government's long-term commitment to the tramway system must be maintained to ensure continuity and avoid premature discontinuation due to shifts in political priorities or urban policy.

According to the literature review conducted, there are three safety measures that need to be considered, namely vehicle characteristics, road characteristics, and tram stop design. Emphasis on selecting the type of tram floor plays a role in the occurrence of tram crashes. Low-floor and older trams are associated with higher crash fatality risks due to greater kinetic energy and reduced braking performance (Naznin et al., 2016). While low-floor trams are typically favoured for accessibility and ease of boarding, this insight raises concerns about the trade-off between inclusivity and safety, especially if upgrades in braking systems and crash prevention technologies are not prioritised. However, when considering the existing road characteristics of Bogor, the use of low-floor trams remains the most suitable option. Bogor's road geometry and the need for barrier-free access for a wide range of passengers, including the elderly and people with disabilities, make low-floor vehicles a practical choice.

Road characteristics also play an important role. High traffic volume and tram lane types affect crash severity. Although congestion may help reduce crash severity due to lower speeds, full-time tram priority lanes are associated with more serious crashes. This is likely because trams operate at higher speeds to maintain schedules, especially when there is no physical separation from other traffic (Naznin et al., 2018; Guo et al., 2023). This suggests a need to balance operational efficiency with safety by incorporating physical separation and better intersection control mechanisms. Moreover, conflicts with turning vehicles, limited visibility, and a lack of public awareness about tram right-of-way highlight the importance of integrating tram infrastructure with comprehensive traffic education and enforcement policies. When it comes to tram stops, both their location and design play a crucial role in shaping safety outcomes. Stops placed after intersections or at the end of slopes are preferable to minimise delays and operational issues (Pyrgidis, 2021). Platform stops, bay stops, and elevated pavement stops are found to be safer than traffic island stops, with platform stops reducing pedestrian injury crashes by up to 43% (Naznin et al., 2016; Tubis, 2019).

In the context of Bogor, stop placement can also be strategically aligned with existing public transport modes, such as bus and angkot (minibuses). This approach not only enhances multimodal integration but also has the potential to reduce costs in tramway system development, by utilising current transit nodes and minimising new infrastructure needs. It is important to emphasise that these findings are still preliminary results, and many aspects require further exploration and detailed study. Nevertheless, it is evident that contextual adaptation remains essential to ensure that safety measures are effectively aligned with local conditions and needs.

Benefits to Road Safety

This research contributes to road safety by identifying key measures to prevent tram-related crashes and ensure the safe integration of trams into Bogor’s transport network. By analysing common tram crashes globally, it aims to identify infrastructure designs suited to Bogor’s Road characteristics and urban environment. The recommendations from this research will contribute to a well-regulated and well-designed urban transport system, with the goal of enhancing road user protection, reducing crash risks, and promoting a more sustainable public transport environment in Bogor.

Implications for Policy and/or Practice

In the planning process for a tramway system, several factors must be considered, with safety being a key priority. This research highlights the importance of safe infrastructure design and effective traffic management to ensure the successful integration of trams in Bogor. The safety aspects discussed in this paper aim to help Bogor develop a safe, efficient, and sustainable tramway system, serving as a model for future urban transport planning in Indonesia. These insights are drawn from both existing tramway systems worldwide and past tramway experiences in Indonesia.

Conclusion

This study highlights the importance of safety considerations in the implementation of Bogor’s planned tramway system. By analysing common tram crashes globally and evaluating best practices from selected international tram networks, this research identifies key infrastructure and traffic management to ensure a safe and sustainable tramway. The findings emphasise the need for deciding vehicle characteristics, road characteristics, and tram stop design to minimise crash risks and enhance road user protection. The study’s recommendations provide a framework for policymakers and urban planners to integrate tramway safety into Bogor’s transport strategy. By adopting international best practices while adapting them to local conditions, Bogor can establish a well-regulated, efficient, and safe tramway system that serves as a model for future urban transport projects in Indonesia.

References

Guo, Y., Liu, Y., Xiao, H., & Ye, J. (2023). Explore the collision safety of tram and passenger vehicle under disparate right of way. In *Sixth International Conference on Traffic Engineering and Transportation System (ICTETS 2022)* (Vol. 12591, pp. 711-721). SPIE.

Indrajaya, D. W. (2021). Trem di Jakarta 1869-1962: Moda Darat Favorit Warga Ibu Kota Tempo Dulu. Penerbit Kompas.

Lackner, C., Heinzl, P., Rizzi, M. C., Leo, C., Schachner, M., Pokorny, P., ... & Klug, C. (2022). Tram to pedestrian collisions—Priorities and potentials. *Frontiers in future transportation*, *3*, 913887.

Mardianti, D. L. (2024). *Korlantas rilis data kecelakaan lalu lintas 2024: Naik nyaris 8 kali lipat, korban jiwa 27 ribu*. Tempo. https://www.tempo.co/hukum/korlantas-rilis-data-kecelakaan-lalu-lintas-2024-naik-nyaris-8-kali-lipat-korban-jiwa-27-ribu-1181721

Naznin, F., Currie, G., & Logan, D. (2016). Exploring the impacts of factors contributing to tram-involved serious injury crashes on Melbourne tram routes. *Accident Analysis & Prevention*, *94*, 238-244.

Naznin, F., Currie, G., & Logan, D. (2018). Exploring road design factors influencing tram road safety–Melbourne tram driver focus groups. *Accident Analysis & Prevention*, *110*, 52-61.

Pyrgidis, C. N. (2021). Railway transportation systems: design, construction and operation. CRC press.

Saraswati, R. S., & Purwanto, L. M. F. (2022). Jejak Sejarah Trem Kota Semarang 1881-1840. *Jurnal Arsitektur Kolaborasi*, *2*(1), 10-17.

Tubis, A., Rydlewski, M., & Budzyński, M. (2019). Safety assessment of tram stops. *Journal of KONBIN*, *49*, 431-458.

Yahya, S. K. (2015). Naskah Sumber Arsip Perkeretaapian di Indonesia (SK Yahya, Ed.). *Jakarta: Arsip Nasional Republik Indonesia*.

A review of Hazard Perception Test characteristics and safety outcomes

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Abstract
A thorough literature review addressing the use and effectiveness of Hazard Perception Tests (HPTs) for novice drivers was undertaken. The review provides a critical commentary of current literature to identify the characteristics of HPTs, including the different approaches to Hazard Perception Testing and how hazard perception is measured. The review also considered evidence regarding links between Hazard Perception Testing and safety outcomes (e.g., crashes), procedural aspects of hazard perception (e.g., instructions, number of times the test can be taken and the inter-test interval), interventions for improving hazard perception, and the potential use of HPTs to identify individuals who may have an increased risk of crashing.

Social media post
A thorough literature review providing a critical commentary on the characteristics and effectiveness of HPTs for novice drivers.

Introduction
The majority of all crashes can largely be attributed to an error on the part of the human driver (Dingus et al., 2016). The introduction of HPTs into licensing systems in recent years reflects a recognition that higher order skills such as visual search and hazard perception are more critical to safe driving than the vehicle handling skills that were traditionally emphasised in driver education and training (Isler & Starkey, 2012). The rationale behind the tests is that novices who do not respond appropriately to video hazards may not respond appropriately to real on-road hazards and therefore may have a higher risk of crashing. Furthermore, it was anticipated that including hazard perception testing in the licensing process would encourage learners and instructors to focus more on scanning for, and detection of, hazards during training.

Hazard perception can be defined simply as the "ability to read the road and anticipate forthcoming events" (McKenna et al., 2006, p2). This encompasses the detection of hazards, the appraisal of the threat posed by the hazard, and the selection of an appropriate response (Grayson et al., 2003). The ability to perceive threats and respond appropriately is perhaps one of the most important skills a driver can develop and deficiencies in this ability have been identified as a risk factor for crashes (Boufous et al. 2011). Differences in hazard perception have been observed across different driver demographics with inexperienced drivers and crash involved drivers demonstrating poorer hazard perception than experienced and crash-free drivers (Scialfa et al., 2011; Horswill et al., 2020).

This literature review was the first task completed as part of the Austroads Hazard Perception Test evaluation project investigating the effectiveness of different HPT frameworks used across Australia. A better understanding of how hazard perception is measured will be useful for the development of guidelines to support effective implementation of HPTs in the licensing process.

Conference theme
This work fits withing the Evolution theme, providing insights into the association between HP testing and safety outcomes. The findings of this work will be used to develop guidelines for the effective implementation of HPT in the licensing process.

Method
A comprehensive literature review was undertaken to identify the characteristics of HPTs as they relate to measurement and response styles, test instructions, format (e.g., video, CGI, still image), and test item selection. The review also investigated the validity of HPT and examined the links between HPT performance and safety. Literature regarding the development or evaluation of HPTs, or which was otherwise relevant to other aspects of the review were obtained from the *Scopus, Web of Science, PsycINFO, and Transportation Research Information Database (TRID)* academic databases, with preference given to literature published in 2013 or later. Older research was included where appropriate. Only research published in English with full-text available was included.

Discussion

The literature review identified the characteristics of tests used to measure hazard perception skill and identified the benefits and limitations of these. The primary measure for the validity of a hazard perception test is the ability to distinguish between groups based on age and/or driving experience such that older or more experienced drivers have better hazard perception than younger or novice/less experienced drivers.

HPT characteristics

The primary method for measuring hazard perception is using a test comprising a traffic scene and measuring the amount of time it takes the person to identify the hazard (reaction time), the accuracy of hazard detection (correctly identifying the hazard), or the ability to predict how the traffic scene will unfold. The two main test formats are the Hazard Perception Test, which is primarily based on reaction time and accuracy, and the Hazard Prediction Test, which draws on the individual's ability to predict how the traffic scene will unfold. Each approach is described and the benefits and limitations discussed. Both approaches have been found to provide a valid assessment of hazard perception skill. Studies comparing these approaches have produced mixed findings, though there is some indication that some hazard items are better measured using reaction time while others are better measured by the hazard prediction protocol. HPTs may be enhanced by the inclusion of multiple response types.

Hazard Perception Testing involves the use of video or still images (i.e., pictures) of traffic scenes taken from the driver's perspective. Modern HPTs primarily use video clips. The effectiveness of video and CGI (Computer Generated Imagery) clips and still images were investigated, identifying the limitations and benefits of each approach. As driving is undertaken in a dynamic environment, video/CGI based HPTs are considered more ecologically valid than still images. While it has been suggested that video is the more valid than CGI, HPTs based on both formats have been found to be valid measures of hazard perception based on the ability to distinguish between novice and experienced drivers.

HPT test items or scenarios are generally selected (video or still image) or designed (CGI) based on the opinions of experts such as researchers, traffic psychologists, and driving instructors. The selection or design of hazards for inclusion in the test are often determined based on crash data or other specified hazards (e.g., vulnerable road users) Video clips are reviewed against criteria such as the presence of an unambiguous hazard, video clip quality, and the presence of cues necessary to predict hazard onset. Experts also determine the onset of response time windows or occlusion points. Tests are generally pilot tested and refined and validated by comparing the performance of novice versus experienced drivers. Video clip lengths were found to range from 7-60 seconds and one study employed a 10-minute clip comprising multiple distinct hazardous events.

Test instructions are an important consideration as they provide the definition of hazards and describe the circumstances for which a response is required. As individuals may differ in what they consider a hazard it is important to provide unambiguous definitions of what constitutes a hazard, with many HPTs defining hazards as the presence of a "traffic conflict" that may result in a collision if no action is taken. It follows then that only hazards conforming to this definition are included and potentially exclude other important hazards (e.g., change in road surface, presence of animals, etc.). Instructions should also detail how to make a response and discourage cheating by describing inappropriate responses and the consequences of such.

HPT validity

There are two primary methods for assessing the validity of a HPT to measure hazard perception skill. First is to compare the performance on the HPT with another established measure of hazard perception skill or some other relevant construct (e.g., crash involvement). The second method is to assess differences in HPT performance between groups who are assumed to differ in hazard perception ability. Of these, the latter is the most common approach adopted. Throughout the literature studies following either the Hazard Perception or Hazard Prediction paradigms using either video (real or CGI) or still images have demonstrated the ability to distinguish between novice and experienced drivers based on measures of reaction time or accuracy.

Safety outcomes of HPT

Few studies have examined the real-world safety outcomes of HPTs. Three studies have investigated the association between HPTs and crash outcomes. In the UK, drivers licensed after the introduction of HPT to the licensing process reported 3% fewer hazard perception related crashes than those licensed prior to the introduction (Wells et al., 2008). In Australia, Boufous et al. (2011) found that drivers who passed the HPT on their first attempt, those requiring three or more attempts (i.e., failed twice previously) were found to have a 1.83 times greater risk of crashing. More detailed analysis identified that among those failing at least twice, males had an increased crash risk of 2.5 times, while no increase was observed for females, and young drivers from remote areas demonstrated a 5.5 times increase.

Furthermore, Horswill et al. (2015) found that for a sample of young Queensland drivers, every second increase in hazard perception score was associated with a 10% and 21% increase in self-reported retrospective and prospective crashes. Another study looking at the association between HPT performance and hard braking events found a negative relationship between HPT score and hard breaking, such that poorer hazard perception was associated with an increase in hard braking events (Botzer et al., 2019). These studies suggest that performance on a HPT is related to safety outcomes.

Conclusions

Several methods have been used to measure hazard perception, with the primary methods being the presentation of hazardous scenarios via a video clip and recording either reaction time or ability to predict what happens next. While there are some exceptions, the preponderance of evidence suggests both approaches are valid methods for assessing an individual's ability to detect hazards in the road environment. A common criticism of the standard HPT based on reaction time measures is that it is insufficient to determine the stimulus (hazard) to which the person has responded, while other factors such as sensitivity to risk can influence results. The Hazard Prediction Test is purported to overcome these issues by requiring the subject to predict how the scenario unfolds and may yield a more pure measure of hazard perception skill, though is also not without limitation. Modern HPTs use video clips with both real-world footage and CGI clips proving suitable to assess hazard perception, though some argue that test items should be based on real examples of hazards rather than scripted. Performance on HPTs has been associated with crash involvement, suggesting drivers who pass the HPT on the first attempt have a lower risk of crashing than drivers who require at least three attempts to pass, particularly males and drivers from remote areas, though the evidence is limited.

References

Botzer, A., Musicant, O. & Mama, Y. (2019). Relationship between Hazard-Perception Test scores and proportion of hard-braking events during on-road driving: An investigation using a range of thresholds for hard-braking. *Accident Analysis & Prevention*, *132,* Article 105267.

Boufous, S., Ivers, R., Senserrick, T. & Stevenson, M. (2011). Attempts at the practical on-road driving test and the hazard perception test and the risk of traffic crashes in young drivers. *Traffic Injury Prevention*, *12*(5), 475-482.

Dingus, T.A., Guo, F., Lee, S., Antin, J.F., Perez, M., Buchanan-King, M. et al. (2016). Driver crash risk factors and prevalence evaluation using naturalistic driving data. *Proceedings of the National Academy of Sciences of the United States of America, 113,* 2636-2641.

Grayson, G.B., Maycock, G., Groeger, J.A., Hammond, S.M. & Field, D.T. (2003). *Risk, Hazard Perception and Perceived Control*. Transport Research Laboratory (TRL).

Horswill, M.S., Hill, A. & Jackson, T. (2020). Scores on a new hazard prediction test are associated with both driver experience and crash involvement. *Transportation Research Part F: Traffic Psychology and Behaviour*, *71*,98-109.

Horswill, M.S., Hill, A., & Wetton, M. (2015). Can a video-based hazard perception test used for driver licensing predict crash involvement. *Accident Analysis and Prevention, 82,* 213-219.

Isler, R.B. & Starkey, N.J. (2012). *Driver education and training as evidence-based road safety interventions.* Australasian Road Safety Research, Policing and Education Conference, 2012, Wellington, New Zealand.

McKenna, F.P., Horswill, M.S., & Alexander, J. (2006). Does anticipation training affect drivers' risk taking? *Journal of Experimental Psychology: Applied, 12*(1), 1-10.

Scialfa, C.T., Deschênes, M.C., Ference, J., Boone, J., Horswill, M.S. & Wetton, M. (2011). A hazard perception test for novice drivers. *Accident Analysis and Prevention, 43*(1), 204-208.

Wells, P., Tong, S., Sexton, B., Grayson, G., & Jones, E. (2008). (Road Safety Research Report No. 81). London: Department for Transport.

Intelligent Transport Systems evolution for cyclist safety: a VR approach

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Abstract

Cyclists remain among the most vulnerable road users, and safety concerns often deter people from cycling. This research addresses cyclist safety through the lens of Evolution and Elasticity, exploring how evolving Intelligent Transport Systems (ITS) can adapt to protect cyclists. We use virtual reality (VR) simulations to measure cyclists' perceived safety in various traffic scenarios, including those with advanced ITS interventions (e.g., connected vehicle alerts and smart infrastructure). This approach provides a lower-risk, controlled environment to assess behaviour, physiological responses, and subjective safety. Expected results include identifying which technologies and road designs most enhance cyclists' sense of safety and reduce conflict risk. The findings will inform evidence-based strategies and policies – from infrastructure design to vehicle technology – to build a more resilient, cyclist-friendly transport system.

Social media post

How can we make cycling safer? Our #ARSC2025 study uses virtual reality to test Intelligent Transport Systems that protect cyclists. By measuring cyclists' safety perceptions in VR, we're paving the way for adaptive, tech-driven solutions for safer streets.

Introduction

Cycling is integral to sustainable transport, yet cyclists face disproportionate risk on the roads (Shories et al., 2024). In Europe, nearly half of road accidents involve vulnerable road users like cyclists (Shories et al., 2024), and similar trends are seen worldwide. Safety concerns—particularly the fear of crashes—are a well-documented deterrent to cycling (Costa et al., 2024). If individuals perceive cycling as unsafe, they are less likely to choose it (Costa et al., 2024). This challenges road safety and public health. Road safety strategies are increasingly turning to Intelligent Transport Systems (ITS) to protect cyclists and encourage greater uptake of cycling. ITS encompass advanced technologies such as connected vehicle communication, smart traffic control, and sensor-based driver assistance, all aimed at preventing collisions and improving traffic management. For example, connected vehicle technology can create "digital visibility" between cars and bikes, alerting drivers and cyclists to each other's presence even when physical sightlines are blocked. This kind of innovation aligns with global road safety initiatives – the European Union highlights connectivity and new technologies that allow vehicles to "talk" to other road users as key to future safety gains (Shories et al., 2024). However, when introducing new technologies and road designs, we must consider human factors – notably, how cyclists perceive and respond to safety measures. Perceived safety can influence behaviour (e.g., route choice, speed) and actual safety outcomes (Costa et al., 2024). Therefore, understanding cyclists' perceptions is key to designing effective interventions. Traditional methods (surveys, on-road studies) to gauge perceived safety can be slow, resource-intensive, and potentially risky.

This research addresses that gap by leveraging virtual reality (VR) simulations as an innovative tool to study cyclist safety in a realistic yet safe setting. Evolution is reflected in how we explore developing a safer system through cutting-edge technology. The Safe System approach to road safety is evolving – moving beyond conventional infrastructure solutions to incorporate digital and connected technologies that proactively prevent crashes. Our study provides insights into the next generation of cyclist protection measures by examining evolving ITS solutions (like V2X-based warnings and intelligent infrastructure). We also advance new measures and human-factor insights by using VR to observe cyclist behaviour and feelings in response to these innovations, offering a window into future challenges and opportunities for cyclist safety. Elasticity is evident in our research's adaptability and resilience focus. A core aspect of elasticity is ensuring the transport system can adapt to the increasing presence of cyclists (and other vulnerable users) while maintaining safety. Our approach uses VR to flexibly simulate various scenarios – from low-traffic streets to complex urban intersections – to test how well different technologies and designs accommodate cyclists. This flexibility mirrors the transport system's need to adjust dynamically (e.g., adjusting signal timing when cyclists are detected or vehicles automatically slowing when a bike is nearby). We are examining how adaptive ITS interventions can make the road

environment more resilient to human errors and accommodate mode shifts toward cycling. By focusing on cyclists' experiences and responses, the study promotes equitable access – a key component of elasticity – ensuring that safety improvements account for all riders, regardless of age, gender, or experience.

Method

This study employs a mixed-method approach centred on immersive VR simulation to measure cyclists' safety perceptions under various conditions. We developed a VR cycling simulator that allows participants to experience realistic road scenarios without real-world risk. Participants (recruited to include a diverse range of cycling experience and demographics) ride a stationary bicycle or simulator rig equipped with a VR headset, immersing them in 360° virtual environments. These environments are modelled after urban streets, intersections, and roadways, and we introduce controlled variables such as traffic volume, vehicle behaviour, infrastructure type, and technology features.

Critically, we integrate advanced ITS elements into the VR scenarios. For example, in some simulations, participants encounter connected vehicles that issue forward-collision warnings or audible alerts to the cyclist or intersections that use smart sensors to give cyclists priority signals. Traditional conditions serve as baseline comparisons in other scenarios. This allows us to isolate the effects of each intervention on the cyclist's experience. Scenarios will be structured in an e-stated preference survey to measure the elasticity of each variable.

During each simulated ride, we collect multiple forms of data: **Behavioural data:** How does the cyclist ride in each scenario? We track metrics like speed, lateral position (distance from curb or cars), stopping distance, and any evasive manoeuvres. These behaviours indicate the cyclist's comfort and confidence. **Physiological responses:** We use wearable sensors to monitor stress and arousal indicators, such as heart rate or skin conductance. Elevated stress responses can signal when a cyclist feels in danger. This provides an objective correlate to self-reported safety perception. **Subjective perceptions:** Immediately after each scenario, participants complete a brief survey or interview describing how safe they felt, their concerns, and how effective they found any safety technology present. This perception of safety is our key outcome measure, captured on a Likert scale and through open-ended feedback.

Combining these methods gives us a comprehensive picture of perceived safety and actual behaviour. The VR approach offers a lower-cost, lower-risk way to study bicyclists' perceptions compared to field studies. It also ensures every participant experiences similar conditions, improving the consistency of comparisons. Where applicable, we supplement the VR findings with other methodologies – for instance, comparing our VR outcomes with available real-world data (crash or conflict statistics) to see if perceived danger hotspots in VR match actual risk hotspots on real roads. This triangulation with external data and past studies helps validate the VR simulation's realism and relevance.

Results (Future Expected)

While the data collection will be conducted soon, we anticipate several key findings based on preliminary observations and literature. Firstly, we expect scenarios incorporating dedicated cycling infrastructure and vehicle alerts to yield significantly higher perceived safety ratings than scenarios without such measures. This aligns with prior simulator studies showing cyclists feel more confident on physically protected bike lanes than painted on-road bike lanes (Ayad et al., 2024). In our VR study, participants encountering a virtual separated bike lane or an early-warning from a turning car are likely to report feeling notably safer. We also foresee corresponding behavioural effects: for example, more consistent cycling speeds and fewer sudden stops when protective measures are present, indicating reduced anxiety.

Secondly, differences in perception among rider groups are expected. Consistent with earlier findings that female cyclists tend to feel less safe than males in mixed traffic (Ayad et al., 2024), we anticipate our data will reflect varying comfort levels. Our diverse sample may reveal that certain technologies (e.g., an overt vehicle-to-cyclist alert) provide disproportionate benefits to those who typically feel less safe, thereby narrowing the perception gap. We also expect less experienced cyclists to derive greater perceived safety improvements from ITS interventions than seasoned riders, who might already be confident in traffic. Thirdly, we expect the integration of ITS to show promise in objective safety improvements. For instance, if our simulation includes a connected car that warns a cyclist 4 seconds before a potential collision, we anticipate far fewer simulated crashes or close calls in that scenario. This echoes evidence from recent studies: a 4-second V2X warning to cyclists offers a potentially 98% reduction in collision risk in reconstructed crash scenarios (Shories et al., 2024). Our VR platform should similarly demonstrate fewer conflict events when such early warnings or smart controls are active. By analysing the physiological data, we also expect to identify which moments in each scenario are most stressful for cyclists, highlighting specific conflict points (e.g., a car passing too closely) that future ITS solutions should mitigate.

Overall, the expected results will provide nuanced insight into which technological and design interventions most effectively enhance cyclists' subjective and objective safety.

Benefits to Road Safety

The findings from this research promise several practical benefits for road safety. Most directly, our results will guide the implementation of ITS solutions that can save lives and prevent injuries among cyclists. By pinpointing effective measures – such as bike-mounted collision warning devices or adaptive traffic signals – we offer evidence for deploying these interventions more widely. For example, if VR simulations show that a particular alert system significantly reduces close calls, city transport agencies and product developers can advance that technology towards real-world use with greater confidence.

Another benefit lies in how this work advances the Safe System approach for vulnerable road users. Traditionally, Safe System principles emphasise safe roads, safe speeds, and vehicle design to protect humans. Our study extends these principles by showing how intelligent, connected systems can be layered to reduce crash likelihood further. In a fully realised form, a cyclist-aware ITS could mean that drivers are proactively warned of bicycles, vehicles automatically adjust their behaviour around bikes, and infrastructure dynamically responds to keep cyclists safe. Such a system prevents collisions and reduces the precursors to collisions (sudden braking, swerving), creating a calmer traffic environment for everyone.

Importantly, there is a safety-in-numbers effect: as cycling becomes safer and more people choose to bike, drivers grow more accustomed to sharing the road, which can further reduce crash rates. Our work can indirectly encourage cycling uptake by helping to overcome fear and improve perceived safety. A virtuous cycle may result in safer conditions leading to more cyclists, improving overall road safety and community health. Furthermore, the methodological innovation of using VR as a testbed can become a model for future road safety evaluations. It offers a proactive way to evaluate safety measures before large-scale implementation, potentially catching unintended consequences or optimal configurations early. This means safer, evidence-based rollouts of new road designs or technologies, ultimately reducing trial-and-error on real roads.

Implications for Policy and Practice

Our research suggests several actionable steps for policymakers and practitioners aiming to enhance cyclist safety: Integrate ITS in Cycling Policy: Transportation authorities should consider policies that support or mandate connected vehicle technology and cyclist detection systems. Policy frameworks at national and city levels can accelerate the adoption of these life-saving technologies.

Invest in Intelligent Infrastructure: Urban planners and road authorities should invest in infrastructure that is physically safer for cyclists but also communicative and adaptive. Smart traffic signals that recognise cyclists and give them safe crossing time or electronic signage that warns motorists of cyclists at blind intersections are examples of infrastructure aligning with our findings. Funding for pilot projects in this realm can validate their impact in the real world, following the promising trends observed in VR.

Incorporate Perceived Safety in Design Guides: Road design standards often focus on measurable safety outcomes (crash rates), but our study highlights the importance of perceived safety. Agencies could update design guidelines to emphasise features that make cyclists *feel* safer – such as protected lanes, lower urban speed limits, and precise separation from traffic – since these features encourage ridership and reduce stress. As our results likely reaffirm (e.g., high perceived safety on protected lanes (Ayad et al., 2024), dedicating space for cyclists and calming traffic are key.

Use VR Simulation in Planning: We recommend incorporating VR simulation testing into planning new cycling infrastructure or technology. Before building a new type of bike lane or deploying an alert system, authorities can simulate it with target users (cyclists and drivers) to gather feedback on safety perception and behaviour. This approach can identify potential issues and improvements in a controlled environment, refining solutions before implementation. Such practice could be formalised in policy as part of project evaluation cycles.

Education and Training: Finally, there are implications for road safety education. The immersive experiences from VR could be used to train cyclists and drivers. For cyclists, experiencing hazardous scenarios in VR could improve defensive riding skills. VR can increase empathy for drivers by showing a cyclist's perspective in traffic, underlining why certain driving behaviours (like maintaining distance) are critical. Policymakers in safety education might develop VR-based modules to include in licensing or cycling courses, leveraging the heightened awareness these simulations

can foster. By adopting these policies and practices, stakeholders can create a proactive and inclusive transport ecosystem. The focus shifts from reacting to cyclist crashes to preventing them through design and technology—fully embodying a safe and elastic system that adjusts to protect everyone.

Conclusion

Cyclist safety stands at the forefront of modern road safety challenges, demanding innovative solutions. This abstract presented a study that harnesses the evolution of Intelligent Transport Systems and cutting-edge VR methodology to enhance cyclist safety. By focusing on perceptions of safety as well as tangible risk, we acknowledge that a truly safe system must address both the reality of crashes and the public's confidence to use cycling as a mode of transport. Our work is grounded in the themes of Evolution – integrating new technological advancements into the Safe System paradigm and Elasticity, promoting an adaptable, resilient transport network that can safely accommodate growing cycling activity.

Although our results are forthcoming, the anticipated insights point toward a future where vehicles, infrastructure, and road users are interconnected in a safety net. This future is one where a cyclist can ride knowing that drivers are aware of them (through connectivity), that the infrastructure is responsive to their presence, and that the city has been designed for their protection. Such an environment prevents crashes and empowers more people to choose cycling without fear. The implications for policy and practice underscore a shift to proactive safety management – employing VR tools to inform decisions, updating policies to embrace technology, and centring the experience of vulnerable users in road design.

References

Ayad, L., Imine, H., De Crescenzio, F., & Lantieri, C. (2024). Bicycle simulator use to evaluate safety risks and perceptions for enhanced sustainable urban mobility. *Sustainability, 16*(22), 9786. https://doi.org/10.3390/su16229786

Schories, L., Dahringer, N., Piram, U., Raut, A., Nikolaou, S., Gragkopoulos, I., Tsetsinas, I., & Panou, M. (2024). Safety performance assessment via virtual simulation of V2X warning triggers to cyclists with models created from real-world testing. *Sustainability, 16*(2), 610. https://doi.org/10.3390/su16020610

Poster presentation

VRStreetLab: A Virtual Reality Platform for Evaluating Smart Cycling Infrastructure in Australia

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Research Centre for Integrated Transport Innovation (rCITI)

Introduction

Cycling offers a sustainable mobility option, but safety challenges persist. VRStreetLab provides a controlled, cost-effective environment for testing smart cycling infrastructures before implementation.



Objective

1. Identify and assess smart cycling infrastructures.
2. Implement them in VRStreetLab.
3. Evaluate behavioural and safety impacts.
4. Deliver policy and design recommendations.

VRStreetLab

Our initiative addresses the objectives through smart cycling infrastructures, evaluated through a novel VR Transport simulator platform: "VRStreetLab", leveraging on the existing technologies at TRACSLab@UNSW.







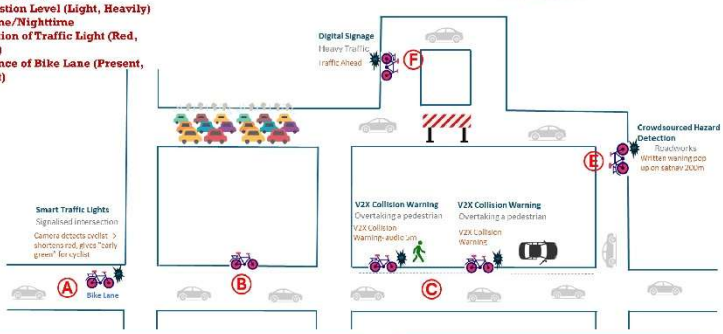
Safety Technologies

	Technology
Infrastructure-based	Smart Traffic Lights Digital Signage Smart Road Surfaces
Vehicle/cyclist-based	V2X Collision Warning Crowdsourced Hazard Detection
Vehicle-based	Intelligent Speed Adaptation (ISA) Automated Emergency Braking (AEB)
Cyclist-based	Augmented Reality (AR) Navigation Bicycle-Mounted Intelligent Lighting



Context variables

- **Congestion Level (Light, Heavily)**
- **Daytime/Nighttime**
- **Condition of Traffic Light (Red, Green)**
- **Existence of Bike Lane (Present, Absent)**



Expected Impacts

- Safer cycling through data-driven design
- Cost-efficient infrastructure evaluation
- Evidence-based policy recommendations

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Integrated training to improve young drivers' hazard and speed management

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Abstract
Deficiencies in Hazard Management (HM) and Speed Management (SM) skills have been identified as leading contributing factors in the overrepresentation of young drivers in road crashes. While various studies have introduced training methods to improve these skills, few have examined the positive impact of each skill on the other. Hence, the main aim of this study is to examine training effects of integrated HM and SM training in enhancing both HM and SM skills. The study was conducted in a simulated road environment, with participants tested immediately after receiving training interventions. Results revealed that skill-specific training effectively enhanced the targeted skill (i.e., HM training positively affected HM skills), but did not generalise to the counterpart skill, with one exception, being the Integrated HM and SM training. These findings highlight the potential for integrated training to be part of driver education and the licensure system. Implementing this approach may contribute to a reduction in crash involvement among young novice drivers, ultimately improving road safety.

Social media post
Integrated hazard and speed management skill training to enhance young novice drivers' ability to manage hazards and speed on the road.

Introduction
Young drivers aged under 25 at the early stage of their solo driving are overrepresented in car crashes in NSW. This is despite this group constituting only 14 percent of all licence holders (TfNSW, 2025). Lack of two critical driving skills, 'Hazard management' (HM; the ability to avoid adverse consequences from hazardous road features) and 'Speed management' (SM; the ability to judge the appropriate speed according to road conditions), are identified as leading causes of road related crashes (Clarke et al., 2006; Horswill et al., 2015).

HM and SM skills generally take years to develop through exposure (i.e., daily driving). Training has the potential to shorten the time it takes to acquire these skills (Deery, 1999). For example, Zhang et al. (2022) found that expert commentary relating to hazard identification improved young drivers' HM skills. Feedback focusing on speeding behaviour and potential consequences (i.e., monetary punishment, and safety implications) positively impacted young drivers' SM behaviour in several speed zones (Molloy et al., 2018).

Currently, there are a few studies that investigate training to improve both drivers' HM and SM skills. Horswill et al. (2022) found that trained drivers reduced their heavy braking (i.e., HM) and speed-related behaviour (i.e., SM) in the naturalistic driving study after receiving multiple training packages. The training was specific to HM and SM skills (see Horswill et al., 2022). However, it has been argued that in both the HM and SM situations, participants adopted a reduced speed technique, as advocated in the HM training. It remains unknown if the situation or circumstance was different, and speed reduction was not required to manage the hazard, participants' response would be appropriate. Given this backdrop, this study aims to investigate the training effects of integrated HM and SM training on improving the HM and SM skills of young novice drivers.

Conference theme
This research is in the light of 'Evolution'. The study could support the sub-component of safe system, like 'Safe People'. This single training may benefit formal and informal driver training to improve critical driving skills: HM and SM skills among at-risk road users like young novice drivers.

Method
A total of 108 young novice drivers aged 18 - 25 (M = 19.51, SD = 1.78) participated in the study. All participants held a valid Australian provisional driver's licence for less than three years (M = 1.21, SD = .63). Participants were recruited

from the University of New South Wales (UNSW), Sydney. The study was approved in advance by the UNSW Human Research Ethics Advisory Panel.

The experimental design comprised a 6 x 2 mixed repeated measure design. The between-groups variable contained six groups: (1) Control (Filler video and Drive without hazards), (2) Combined feedback (Filler video, exposure to hazards, and receive speeding feedback: numbers of time over the speed limit, maximum speed, speeding penalties, and safety implication; Molloy et al. (2018)), (3) HM commentary training with combined feedback (HM Commentary Training video, and Commentary Training, including HM (perception, projection, and action) and feedback; Horswill et al. (2022)), (4) HM commentary training with perception and projection feedback (HM Commentary Training video, and Commentary Training, including perception and projection feedback), (5) HM commentary training with perception and projection feedback (HM Commentary Training video, and Commentary Training, including perception feedback), and (6) Integrated HM and SM training (HM Commentary Training video, and Commentary Training, including Speeding feedback). Repeated measure variable was the two testing occasions: Baseline and Immediate post-test.

The data were collected in a demographic questionnaire and a fixed driving simulator. The questionnaire assessed personal information (e.g., sex) and driving history (e.g., type of licence, total driving hours). Participants' SM and HM skill performance were measured in the driving simulator. The simulated road environment included nine hazardous events, three from each of the following categories: Behavioural Prediction (BP), Environmental Prediction (EP), and Divided Focus and Attention (DF) hazards (see Crundall et al., 2010). These hazards were systematically placed along 21 km within three zones (50 km/h, 60 km/h, and 80 km/h).

All participants completed the Participant Information and Consent Form followed by the demographic questionnaire. Following the receipt of instruction about the simulator, participants completed the Baseline, Intervention (according to their randomly assigned group), and the immediate post-test drive. Two dependant variables featured, namely (1) Percentage of travelled distance before braking to avoid hazard (HM skills) and, (2) Percentage of time over the speed limit (SM skills). Data was analysed through a mixed-repeated ANOVA (6 x 2) using IBM SPSS version 29. Post-hoc Tukey HSD (Honest Significant Difference) was conducted when a statistical significance was identified. Alpha was set at .05 and adjusted to maintain the familywise error (stated when adjusted).

Results

In terms of HM skills, the mixed repeated measures analysis revealed a Time by Group interaction in all hazard types. For ease of illustration, only the result for the BP hazard, located in all three speed zones is represented. Post hoc analysis failed to reveal a significant difference between groups at baseline. There was, however, a significant difference between groups in immediate post-test (F (5, 102) = 10.28, $p < 0.001$, $\eta_p^2 = .34$). Tukey HSD revealed that the HM Commentary Training groups had significantly lower percentage of travelled distance before braking with BP hazards than the Control and Combined feedback (except with HM commentary training with perception group) groups (see Figure 1). There were no other statistically significant differences.

In terms of SM skills, the mixed repeated measures analysis revealed a Time by Group interaction in all speed zones. For ease of illustration, only the result for the 60 km/h speed zone is represented. Post hoc analysis failed to reveal a significant difference between groups at baseline. However, there was a significant difference between groups in the immediate post-test (F (5,102) = 7.98, $p < 0.001$, $\eta_p^2 = .28$). Tukey HSD showed that both the Combined feedback and the Integrated HM and SM training had significantly lower percentage of time over the speed limit in the 60 km/h speed zone than the Control and HM training groups (see Figure 2). There were no other statistically significant differences.

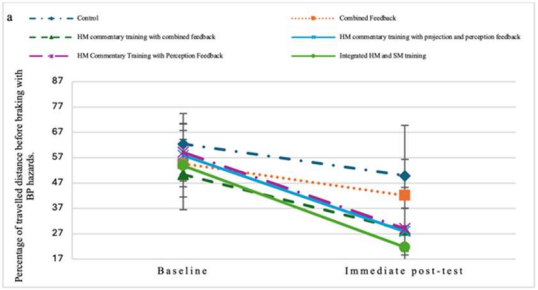


Figure 1. Percentage of travelled distance before braking and standard deviation for the Time by Group interaction with BP hazards;

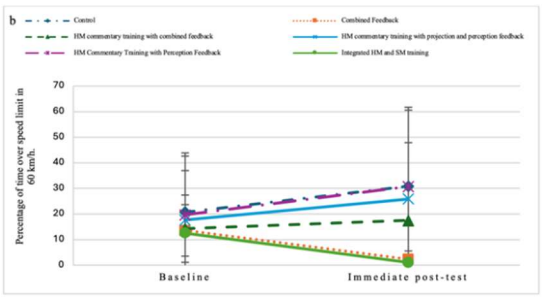


Figure 2. Percentage of time over speed limits and standard deviation for the Time by Group interaction in the 60 km/h

Benefits to road safety

The findings of this study may contribute to a novel approach for enhancing young novice drivers' HM and SM skills concurrently. If young drivers can develop these skills to a level comparable to experienced drivers early in their solo driving journey, it could reduce crash rates associated with on-road hazards and excessive speed.

Implications for policy and/or practice

The study's findings could inform training programs and licensing systems by encouraging the integration of targeted training components. These enhancements should improve young drivers' ability to recognise on-road hazards and adhere to speed limits, ultimately improving road safety.

Conclusion

The findings indicate that HM commentary training improved participants' HM skills with all hazard types. For example, HM skill training groups had a significantly shorter travelled distance before braking in response to behavioural prediction (BP) hazards compared to the Control group. In contrast, no significant difference was observed between the Control and Combined Feedback groups. These results align with Crundall et al. (2010), who found that trained drivers responded to hazards earlier than untrained drivers after undergoing commentary training.

The Combined feedback group exhibited less time over the speed limit in all speed zones (e.g., 60 km/h) compared to the control and the HM skill training groups. This supports findings from previous studies (e.g., Molloy et al., 2018, 2023), which demonstrated that speeding feedback effectively reduced SM behaviours. However, the results revealed no cross-training effects, meaning improvement in HM skills did not generalise to SM skills, and vice versa. Notably, the Integrated training led to significant improvements in both skills among its trained young novice drivers, performing comparably to those receiving skill-specific training. This aligns with Horswill et al. (2022), who found that multifaceted training, incorporating HM and SM components, effectively enhanced these skills across drivers with varying experience.

Together, these findings highlight the benefits of integrating HM and SM training to concurrently enhance both skill sets in young novice drivers, at least in a simulated driving environment. However, further research is needed to evaluate its effectiveness in real-world conditions, including varying environmental factors (e.g., weather) and cognitive workload demands that mimic real-life driving scenarios.

Reference

Clarke, D. D., Ward, P., Bartle, C., & Truman, W. (2006). Young driver accidents in the UK: The influence of age, experience, and time of day. *Accident Analysis & Prevention*, *38*(5), 871-878. https://doi.org/https://doi.org/10.1016/j.aap.2006.02.013

Crundall, D., Andrews, B., Van Loon, E., & Chapman, P. (2010). Commentary training improves responsiveness to hazards in a driving simulator. *Accident Analysis & Prevention*, *42*(6), 2117-2124.

Deery, H. A. (1999). Hazard and risk perception among young novice drivers. *Journal of Safety Research*, *30*(4), 225-236.

Horswill, M. S., Hill, A., Buckley, L., Kieseker, G., & Elrose, F. (2022). An online hazard perception training course reduces heavy braking, speeding, and over-revving rates during everyday driving. *Transportation Research Part F: Traffic Psychology and Behaviour*, *87*, 54-68. https://doi.org/10.1016/j.trf.2022.03.018

Horswill, M. S., Hill, A., & Wetton, M. (2015). Can a video-based hazard perception test used for driver licensing predict crash involvement? *Accident Analysis & Prevention*, *82*, 213-219. https://doi.org/10.1016/j.aap.2015.05.019

Molloy, O., Molesworth, B., Williamson, A., & Senserrick, T. (2023). Improving young drivers' speed compliance through a single dose of feedback. *Transportation Research Part F: Traffic Psychology and Behaviour*, *95*, 228-238.

Molloy, O., Molesworth, B. R. C., & Williamson, A. (2018). Cognitive training interventions to improve young drivers' speed management behaviour: Effects, implications, and perspectives. *Transportation Research Part F-Traffic Psychology and Behaviour*, *55*, 325-340. https://doi.org/10.1016/j.trf.2018.03.001

TfNSW. (2025). *Young drivers*. Transport for NSW (TfNSW). Retrieved March 2025 from https://www.transport.nsw.gov.au/roadsafety/young-drivers

Zhang, W. H., Wang, Y. J., Feng, Z. X., Zhu, S. Y., Cui, J. Q., Hao, W., & Wang, C. (2022). A method to improve the hazard perception of young novice drivers based on Bandura's observational learning theory: Supplement to expert commentary training. *Transportation Research Part F-Traffic Psychology and Behaviour*, *85*, 133-149. https://doi.org/10.1016/j.trf.2022.01.005

Attentional capture in mixed traffic environments

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Abstract
It is well established that the majority of road crashes are caused by human error, and automated vehicles (AVs) promise to reduce these incidents by lessening human demands. As AVs become integrated on our roads, a mixed traffic environment is inevitable, raising questions about how the presence of AVs affects the driver's behaviour. Forty drivers navigated both mixed and human traffic environments in a simulated driving study. Fixation durations on target vehicles and hazards during key road events were measured. Results revealed significantly longer fixation durations in the mixed traffic environment. Additionally, significant interaction effects were found, where the effect of traffic environment on fixation duration differed depending on the road event. These findings indicate that introducing AVs may alter how drivers allocate attention, emphasizing the need to adapt road safety systems and policies to ensure a safe transition. Trust is a potential explanation for the findings and an area for future consideration.

Social Media Post
Love them or hate them, automated vehicles are on their way! But will we behave differently around them? Our research says yes! Understanding how human drivers interact with automated vehicles is key to ensuring a safe transition to a mixed traffic environment.

Introduction
Driving a vehicle is one of the most dangerous activities that people engage in on an everyday basis. Vehicle driving automation systems that perform part or all of the dynamic driving task (DDT) on a sustained basis have the potential to fundamentally change road transportation as we know it. Vehicles with driving automated systems are regarded as the ultimate solution to road crashes (Anderson et al., 2014), through the reduction of human input (known to be the primary cause of road crashes (Dingus et al., 2016)).

Driving automation systems are an emerging technology in the automotive industry and are broadly classified across 6 levels of driving automation (SAE International, 2021). Levels 1 and 2 of driving automation refer to cases where the human driver continues to perform part of the DDT while the driving automation system is engaged (commonly referred to as "driver support" features). Levels 3 to 5 of driving automation refer to cases in which the automated driving system (ADS) performs the entire DDT on a sustained basis while it is engaged (referred to as automated driving features or ADS-equipped vehicles). For the purposes of this abstract, we will use the term AVs to refer to ADS-equipped vehicles. The introduction of vehicles with driving automation systems will be gradual, and so will the level of automation. A mixed traffic environment, where human drivers and other road users share the road with AVs is inevitable (Shieben et al., 2019). A safe mixed traffic environment is imperative, and as such, it is important to understand road users' perceptions of and behaviours around AVs.

The majority of literature on AVs has focused on the perceptions of intended users of AVs (e.g., Schoettle & Sivak, 2014) and/or driving behaviours of AVs users (e.g., Jamson et al., 2013). However, little is known about how other road users will respond to AVs in the road environment, despite suggestion that attitudes towards AVs may differ depending on the type of road user (Hulse et al., 2018). Recent studies have begun to explore the attitudes towards and/or behaviours around AVs from other road users, such as pedestrians, cyclists and motorcyclists (e.g., Jayaraman et al., 2018; Pammer et al., 2021). However, to our knowledge, no studies to date have investigated how the presence of AVs in the driving environment, that is, a mixed traffic environment, will influence other drivers' behaviours, leading to the aim of the present study.

One driving behaviour that may change with the presence of AVs is gaze behaviour. In the context of driving, gaze behaviour refers to how a driver's eyes move and focus on various visual stimuli within their environment while operating a vehicle. Gaze behaviour plays a significant role in ensuring safety, maintaining situational awareness, and performing driving tasks effectively (Stapel et al., 2020). One key aspect of gaze behaviour is fixations. During a fixation, eyes are stationary and hold target visual stimuli in the field of vision, allowing the intake of detailed visual information. Fixations during driving enable drivers to process crucial information about the road environment (e.g.,

traffic signs, hazards, other vehicles, etc.), and adjust their behaviour accordingly to perform driving tasks safely (Lappi, 2022). Fixation duration has also been related to attitudes and perceptions of AVs (Walker et al., 2018). The present study aimed to investigate whether drivers' fixation duration towards hazards and other vehicles in a simulated study varied under different traffic environments, including mixed traffic and human-only traffic conditions.

Conference Theme

This study supports the Evolution theme of the conference. It explores how driver behaviour, specifically gaze behaviour, changes in a mixed traffic environment with AVs. This directly relates to the evolution of a safe system, as it examines how human drivers interact with emerging AV technologies in the traffic environment and what implications this has for road safety. By investigating fixation duration in different traffic environments, the findings provide insights into some human factors that will shape the safe implementation of AVs in real-world settings. It investigates future challenges such as the gradual integration of AVs and their impact on road user behaviour, highlighting the research's relevance to the development of safe systems in an imminent mixed traffic environment.

Method

In 2021, 40 Australian drivers participated in a simulated driving study. All participants were fitted with Tobii Pro Eye Glasses 3, to measure eye movements. The study's two conditions (mixed and human traffic) were counterbalanced. For each condition, participants were instructed about the type of vehicles they would be encountering. In the mixed traffic condition, participants were told that they would encounter a mixture of AVs and human-driven vehicles and were given a definition of AVs. In the human traffic condition, participants were told that they would encounter all human-driven vehicles. Functionally, all vehicles were programmed to perform in the same manner so that any differences in the eye-tracking behaviour of participants could be attributed to attitudes and/or perceptions and not due to performance. During each condition, participants experienced two events in a city environment (pedestrian crossing and a right-hand turn at traffic lights). Both events had an equal number and equivalent saliency of hazards. The driving task took approximately 30 minutes in total. Fixation duration on the target vehicle and hazards was calculated using Tobii Pro Lab Software. It was then converted to a total percentage of the time spent navigating the road event to account for differences in driving speed.

Results

Two two-way repeated-measures ANOVAs were conducted to examine the effect of traffic environment (mixed, human) and road event (right-hand turn, pedestrian crossing) on fixation duration towards vehicles and hazards. The ANOVA on fixation duration to vehicles (see Figure 1a) found a significant main effect of traffic environment, where vehicle fixation duration was significantly longer for the mixed traffic compared to human traffic, $F(1, 39) = 19.483$, $p < .001$, $\eta^2 = .114$. However, a significant crossover interaction effect was found, $F(1, 39) = 14.639$, $p < .001$, $\eta^2 = .006$. This indicates that the type of road event can inversely influence fixation duration under different traffic environments.

The ANOVA on fixation duration to hazards (see Figure 1b) found a significant main effect of traffic environment, where vehicle fixation duration was significantly longer for the mixed traffic compared to human traffic, $F(1, 39) = 27.009$, $p < .001$, $\eta^2 = .100$. It also found a significant main effect of event, where fixation duration was significantly longer on hazards at pedestrian crossings than right-hand turns, $F(1, 39) = 36.998$, $p < .001$, $\eta^2 = .133$. However, a significant spreading interaction effect was found, $F(1, 39) = 28.643$, $p < .001$, $\eta^2 = .139$. This indicates that in a human traffic environment, there was equally high fixation duration towards hazards under both road events. However, in a mixed traffic environment, there was similarly high fixation duration towards hazards at a pedestrian crossing, but significantly lower fixation duration towards hazards at a right-hand turn.

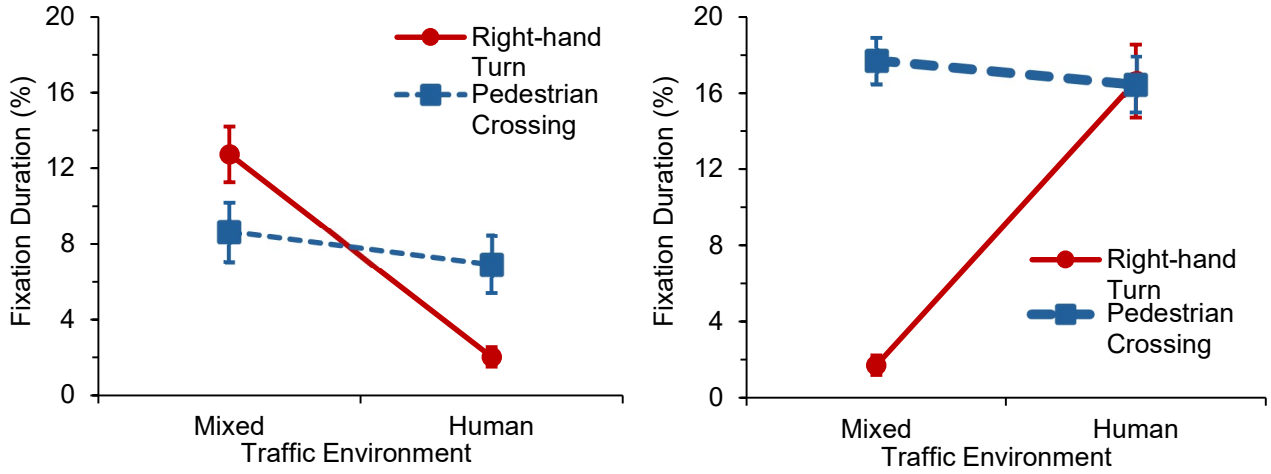


Figure 1. Results of 2 (traffic environment: mixed, human) × 2 (event: right-hand turn, pedestrian crossing) repeated measures ANOVA on fixation duration (%) to (a) vehicles and (b) hazards.

Benefits to Road Safety and Implications for Policy and/or Practice

This study investigated how the presence of AVs in a mixed traffic environment influences drivers' fixation duration towards vehicles and to hazards. Drivers showed significantly longer fixations on other vehicles in mixed traffic compared to human traffic, and this varied depending on the type of road event. These findings suggest a possible increase in visual attention or uncertainty directed at AVs, which may divert drivers' focus from other important elements of the road environment. This has major safety implications, especially for navigating complex road events where misallocated attention may cause drivers to over-monitor vehicles in mixed traffic conditions, at the expense of other critical visual targets. This concern is reinforced by our findings on hazards. While fixation on hazards remained high at pedestrian crossings across both conditions, it declined significantly during right-hand turns in the mixed traffic scenario. This pattern points to a potential attentional shift or distraction caused by the presence of AVs, which may increase crash risk in situations that require higher cognitive and perceptual resources.

These findings carry broader implications for infrastructure design and driver training. For instance, road environments could be modified to better accommodate human-AV interaction, such as through the implementation of dedicated AV lanes, visual indicators to signal ADS usage, or dynamic signage that provides drivers with context-aware information about nearby AVs. From a training perspective, education programs should evolve to include modules on AVs, human-AV interaction, and how to manage attention appropriately across increasingly complex and changing environments. Public awareness campaigns will be essential to prepare all road users for the demands of a mixed traffic environment. Together, these strategies will be essential in ensuring a safe and effective transition towards a mixed traffic future.

Conclusions

To the author's knowledge, this is the first study to investigate how the presence of AVs in a mixed traffic environment influences drivers' gaze behaviour, specifically fixation duration towards vehicles and hazards. Using eye-tracking technology in a simulated driving environment, the study's findings suggest that behaviour may differ with the introduction of AVs, compared with current knowledge of driver behaviour.

While our sample size is small, the use of a within-subjects design enhanced the study's statistical power and control over individual differences. By having each participant experience both traffic conditions and road events (with use of counterbalancing and randomisation), we were able to directly compare gaze behaviour within the same individuals, thereby reducing variability and increasing the reliability of our findings. Additionally, the controlled nature of the driving simulation ensured consistency in the driving environment across participants, allowing us to isolate the effects of perceived traffic environment on behaviour.

One limitation is that the sample comprised primarily of young drivers, with an average age of 25 years and approximately 8 years of driving experience. This may not fully represent the broader driving population, particularly older or more experienced drivers, who may respond differently to AVs due to varying levels of experience, confidence, and adaptability to new technology. However, it is worth noting that young drivers are consistently overrepresented in crash statistics and are known to exhibit poorer levels of hazard perception and situational awareness. As such, the

findings from this study raise important concerns about the potential safety implications of navigating a mixed-traffic environment for this high-risk group where increased cognitive demands may further increase their driving risk.

Future research should target a more diverse sample to better understand how different populations may interact with AVs in mixed traffic environments. Next steps will aim to investigate the factors that may account for the study's findings, such as investigating what attitudes may be related to the change in driving behaviour, with trust towards AVs being a key area of interest. Additionally, incorporating other aspects of AVs, such as varying design features, communication cues, or differing levels of automation, could also provide deeper insight into how gaze behaviour shifts as AVs are introduced into the road environment.

References

Anderson, J. M., Nidhi, K., Stanley, K. D., Sorensen, P., Samaras, C., & Oluwatola, O. A. (2014). *Autonomous vehicle technology: A guide for policymakers*. Rand Corporation.

Dingus, T. A., Guo, F., Lee, S., Antin, J. F., Perez, M., Buchanan-King, M., & Hankey, J. (2016). Driver crash risk factors and prevalence evaluation using naturalistic driving data. *Proceedings of the National Academy of Sciences*, *113*(10), 2636-2641.

Hulse, L. M., Xie, H., & Galea, E. R. (2018). Perceptions of autonomous vehicles: Relationships with road users, risk, gender and age. *Safety science, 102,* 1-13.

Jamson, A. H., Merat, N., Carsten, O. M., & Lai, F. C. (2013). Behavioural changes in drivers experiencing highly-automated vehicle control in varying traffic conditions. *Transportation research part C: emerging technologies*, *30*, 116-125.

Jayaraman, S. K., Creech, C., Tilbury, D. M., Yang, X. J., Pradhan, A. K., Tsui, K. M., & Robert Jr, L. P. (2019). Pedestrian trust in automated vehicles: Role of traffic signal and AV driving behavior. *Frontiers in Robotics and AI*, *6*, 117.

Lappi O. (2022). Gaze Strategies in Driving-An Ecological Approach. *Frontiers in psychology*, *13*, 821440.

Pammer, K., Gauld, C., McKerral, A., & Reeves, C. (2021). "They have to be better than human drivers!" Motorcyclists' and cyclists' perceptions of autonomous vehicles. *Transportation research part F: traffic psychology and behaviour*, *78*, 246-258.

Society of Automotive Engineers (SAE) International. (2021). Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles (J3016_202104).

Schieben, A., Wilbrink, M., Kettwich, C., Madigan, R., Louw, T., & Merat, N. (2019). Designing the interaction of automated vehicles with other traffic participants: design considerations based on human needs and expectations. *Cognition, Technology & Work*, *21*, 69-85.

Schoettle, B., & Sivak, M. (2014). *A survey of public opinion about autonomous and self-driving vehicles in the US, the UK, and Australia.* University of Michigan, Ann Arbor, Transportation Research Institute.

Stapel, J., El Hassnaoui, M., & Happee, R. (2022). Measuring driver perception: Combining eye-tracking and automated road scene perception. *Human factors*, *64*(4), 714-731.

Walker, F., Verwey, W., & Martens, M. (2018, June). Gaze behaviour as a measure of trust in automated vehicles. *In Proceedings of the 6th Humanist Conference* (pp. 1-6).

Distracted driving beliefs and behaviours and the association with rules

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Abstract
Distracted driving remains a significant road safety concern, even in countries with advanced road safety systems. This study investigates drivers' beliefs and behaviours regarding distractions, alongside their perceptions of current related legislation to provide a deeper understanding of the factors shaping their views on rules. Participants (N=494) completed an online survey. The findings revealed a moderate level of engagement with both technological and non-technological distractions. Participants perceived a higher risk associated with non-technological distractions and reported more control over technological distractions. Furthermore, while drivers acknowledged current rules as effective, many identified gaps, particularly in regulating hand-held technologies and in-vehicle infotainment systems, highlighting the need for more comprehensive legislation. Further, the engagement with non-technological distractions and positive attitudes toward both forms of distractions were negatively associated with the perceived effectiveness of rules. These findings highlight the importance of evolving road safety policies to improve public awareness and compliance.

Social media post
Drivers engage with both technological and non-technological distractions but see non-technological distractions as riskier while feeling more in control of technology use. While most find current rules effective, many support stronger legislation to address emerging risks.

Introduction
Distracted driving remains a significant global road safety challenge and is consistently identified as a leading cause of crashes, even in countries with advanced safety systems. The term is broadly defined as any activity that diverts attention from the primary task of driving (Regan et al., 2011). To mitigate this issue, governments implement various countermeasures, including the dissemination of official information and the establishment of road rules. However, existing evidence suggests that these measures may not provide drivers with a comprehensive understanding of distracted driving. Recent research has highlighted that existing information and road rules inadequately address the issue, neglecting several aspects of driver distraction such as safety guidelines and engagement with external and internal distractions (Rejali et al., 2024b). Current public resources focused on mobile phone use while often overlooking other forms of distraction such as using wearable devices. This scope contributes to confusion regarding which behaviours are legal or illegal, leaving gaps in public awareness (Rejali et al., 2024a). Moreover, some drivers may hold inaccurate beliefs about safety, leading them to engage in distracted driving or exploit loopholes in road rules without fully understanding the associated risks (Rejali et al., 2024a). Studies also revealed that there is a need for clearer and more effectively communicated legislation concerning distracted driving in Australia (Kaviani et al., 2021). However, quantitative evaluations of drivers' perceptions of road rules remain limited in the literature. Additionally, while previous studies have primarily focused on mobile phone use or a narrow range of distractions when investigating distracted driving beliefs and behaviours, a comprehensive investigation of distraction sources and their relationship with perceptions of road rules has not been widely explored. To fill these gaps, the current study has two major contributions. First, this study examined drivers' beliefs and behaviours regarding technological and non-technological distractions to provide a better understanding of how drivers perceive and engage in distractions. Second, this study assessed drivers' perceptions of existing distracted driving rules and explored how these perceptions relate to their behaviours and beliefs, offering insights on the factors shaping their views on rules.

Conference theme
This study aligns with the conference theme of evolution by providing a greater understanding of drivers' perceptions of the current distracted driving rules and their relationship with drivers' behaviours and beliefs about distraction. The findings contribute to an evolving understanding of road safety and highlights the need for shifting public attitudes toward distracted driving.

Method

A total of 494 participants residing in Queensland, Australia (M = 39.27 years, SD = 15.10) completed an online questionnaire, with 49.6% identifying as male and 50.4% as female. Most participants held a full licence (70.9%), while others had provisional (8.7%), learner (5.1%), or international licences (15.4%). In addition to demographic and background information, the questionnaire comprised three sections. First, an expanded version of the Susceptibility to Distracted Driving Questionnaire (Feng et al., 2014) was developed to assess drivers' behaviours and beliefs (attitudes, perceived control, perceived risk, and social norms) regarding technological and non-technological distractions. Second, guided by the policy acceptance framework (Pierce, 2014), drivers' perceptions of the effectiveness, fairness, freedom, and complexity of road rules were examined. To gain greater insights, open-ended questions were included to assess participants' perspectives on the effectiveness, coverage, and understandability of current rules. Ethical approval for the study was granted by the [university name removed for blind review] Human Research Ethics Committee (approval number: 8999).

Results

Regarding the first contribution of this study, the results indicated that on a 7-point scale (1= Never/strongly disagree, 7=Always/strongly agree), mean engagement with both technological (M = 2.97, SD = 0.90) and non-technological distractions (M = 2.96, SD = 1.02) was slightly below the mean, with no significant difference between the two forms $t(492) = 0.36$, $p = 0.71$, $d = 0.01$. Among technological distractions, listening to or adjusting audio systems was most prevalent (M = 4.01, SD = 1.64), followed by using display monitors, navigation systems, or communication devices (M = 3.81, SD = 1.56), and adjusting comfort settings (M = 3.63, SD = 1.45). For non-technological distractions, interacting with passengers and children was the most frequent (M = 3.70, SD = 1.53), followed by looking at fixed external objects like billboards (M = 3.33, SD = 1.45) and focusing on road incidents (M = 3.29, SD = 1.44) (See Figure 1). Participants reported a moderate level of positive attitudes toward engaging with distractions, with significantly higher attitudes toward technological distractions (M = 3.67, SD = 1.02) than non-technological distractions (M = 3.53, SD = 1.18), $t(492) = 4.10$, $p < 0.01$, $d = 0.18$. Perceived risk levels were above the median, with significantly higher risk attributed to non-technological distractions (M = 4.65, SD = 1.23) compared to technological distractions (M = 4.49, SD = 1.09), $t(492) = 4.55$, $p < 0.001$, $d = 0.20$. Perceived control over distractions was moderate, with significantly higher control reported for technological distractions (M = 3.73, SD = 1.13) than non-technological distractions (M = 3.45, SD = 1.19), $t(492) = 8.18$, $p < 0.001$, $d = 0.36$. Participants also perceived that other drivers frequently engage in distractions, with significantly higher perceived social norms for technological distractions (M = 4.50, SD = 1.28) than non-technological distractions (M = 4.38, SD = 1.46), $t(492) = 3.45$, $p < 0.001$, $d = 0.16$.

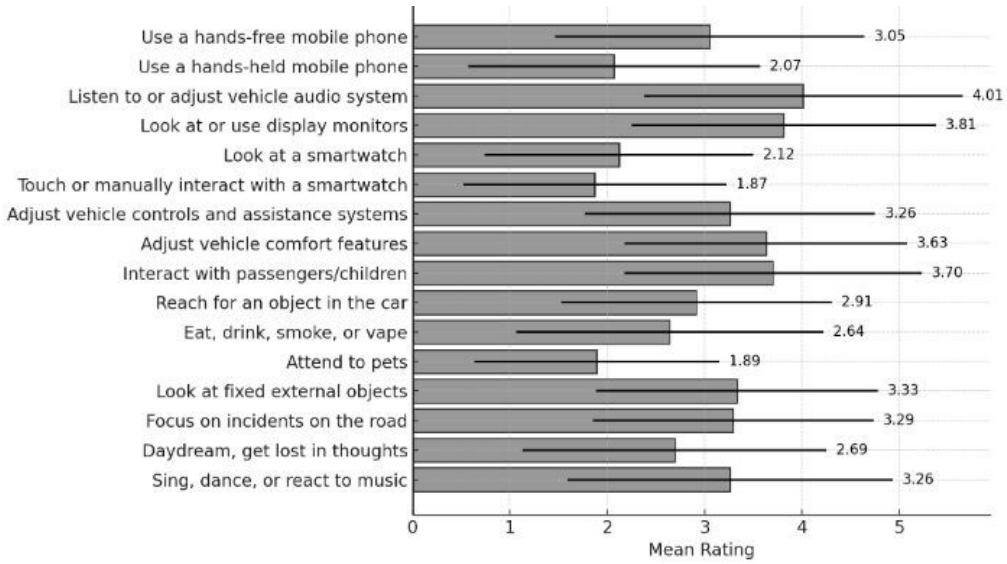


Figure 1. Mean ratings for engagement with distraction sources (on a 7-point scale)

Regarding the second contribution of this study, participants generally perceived the effectiveness of current distracted driving rules on a 7-point scale (1 = Strongly disagree, 7 = Strongly agree) as above the median (M = 4.60, SD = 1.55) and considered them fair (M = 5.46, SD = 1.19). They rated the rules as moderately complex (M = 3.37, SD = 1.53) while also allowing a degree of freedom while driving (M = 5.07, SD = 1.48). The results also showed that 66.59% (N = 329) believed that more comprehensive distracted driving legislation is necessary. A logistic regression analysis examined whether perceptions of effectiveness, fairness, freedom, and complexity, along with background factors, were

associated with support for more comprehensive legislation. A lower perceived effectiveness of current rules was significantly associated with a higher perceived need for comprehensive legislation, B = -0.14, SE = 0.07, Wald = 3.62, $p < .05$, Exp(B) = 0.86. Additionally, a higher perceived complexity of current rules was positively associated with the perceived necessity for more comprehensive legislation, B = 0.27, SE = 0.08, Wald = 9.17, $p < .01$, Exp(B) = 1.31.

A qualitative analysis of open-ended questions examined drivers' perceptions of the effectiveness, coverage, and clarity of current distracted driving rules. Regarding effectiveness, 46.76% (n=231) of participants responded, with three main perspectives emerging: 30.07% (n=71) believed the rules were fully effective, 61.47% (n=142) considered them moderately effective but suggested improvements, and 7.79% (n=18) viewed them as ineffective, arguing that certain distractions, such as hands-free technology, were not adequately addressed. Among those suggesting improvements, key concerns included the failure to keep pace with emerging technologies, limitations in enforcement, and the need for better education on distractions. On coverage, 45.14% (n=223) responded, with 30.49% (n=68) considering the rules sufficient, particularly for mobile phones, while 69.50% (n=155) identified gaps in addressing less obvious distractions, such as in-car infotainment systems. In terms of clarity, 42.30% (n=209) responded, with 37.79% (n=79) finding the rules clear, arguing that any confusion stemmed from a lack of awareness, while 56.76% (n=130) pointed to ambiguities, particularly around hands-free phone use and the definition of distracted driving. Many participants highlighted the need for clearer guidelines to address these grey areas.

To understand the relationship between beliefs and behaviours regarding distracted driving and perceptions of related road rules, four hierarchical regression analyses identified factors shaping perceptions of effectiveness, fairness, freedom, and complexity. Based on the results, engagement with non-technological distractions (β= -.259, p=.001) and positive attitudes toward both technological (β= -.284, p=.002) and non-technological (β= -.283, p=.003) distractions were negatively associated with the perceived effectiveness of rules. Further, perceived freedom was lower among younger adults (β= -.208, p=.001) and those with prior crashes (β= -.133, p=.002). In addition, perceived complexity was higher for probationary (β= -.096, p=.047) and foreign license holders (β= -.124, p=.011), but lower for females (β= -.166, p=.001).

Benefits to road safety

These findings provide insights for improving road safety by highlighting gaps in current distracted driving rules. The results suggest that while many drivers recognise the effectiveness of existing laws, they also identify limitations in addressing emerging technologies, enforcement consistency, and public awareness. By refining regulations to cover a broader range of distractions and providing clearer guidelines, policymakers can improve compliance and reduce distraction-related crashes.

Implications for policy and/or practice

The findings have several policy and practical implications. Policymakers may consider updating distracted driving regulations to cover emerging technologies to address evolving risks. Clearer guidelines on hands-free device use and distraction definitions can reduce ambiguity (Rejali et al., 2025). Given the more favourable attitudes toward technological distractions, targeted public awareness campaigns are essential to shift perceptions. Additionally, the high perceived risk of non-technological distractions suggests that current messaging should emphasise their risks more clearly. The significant support for more comprehensive legislation shows the demand for clearer, more inclusive policies that cover a broader range of distractions. Strengthening education on the risks of distracted driving and refining road rules to keep pace with evolving in-vehicle technologies could be important in enhancing road safety.

Conclusions

This study describes drivers' beliefs and behaviours regarding distracted driving and explains how they shape perceptions of related road rules. The findings highlight that while current regulations are perceived as somewhat effective, they fail to comprehensively address some forms of distraction, particularly those related to emerging technologies. The results indicate a public demand for clearer and more inclusive legislation to improve awareness and compliance.

References

Feng, J., Marulanda, S., & Donmez, B. (2014). Susceptibility to driver distraction questionnaire: development and relation to relevant self-reported measures. *Transportation research record*, *2434*(1), 26-34.

Kaviani, F., Benier, K., Robards, B., Young, K., & Koppel, S. (2021). "Does that mean I can't use my phone to pay when I'm in the Maccas drive thru?": Younger drivers' uncertainty and attitude toward smartphone law and punishment. *Accident analysis & prevention*, *160*, 106314.

Pierce, T. (2014). Extending the technology acceptance model: Policy acceptance model (PAM) The George Washington University].

Regan, M. A., Hallett, C., & Gordon, C. P. (2011). Driver distraction and driver inattention: Definition, relationship and taxonomy. *Accident analysis & prevention*, *43*(5), 1771-1781.

Rejali, S., Kaye, S.-A., Watson-Brown, N., Senserrick, T., & Oviedo-Trespalacios, O. (2025). Drivers' perceptions of improving official information and road rules for distracted driving: Enhancing content, design, and delivery. *Transportation research part F: traffic psychology and behaviour*, *110*, 148-162.

Rejali, S., Watson-Brown, N., Kaye, S.-A., Senserrick, T., & Oviedo-Trespalacios, O. (2024a). Is it all about mobile phones? Exploring drivers' perceptions of government information and road rules on distracted driving. *Accident analysis & prevention*, *208*, 107770.

Rejali, S., Watson-Brown, N., Kaye, S.-A., Senserrick, T., & Oviedo-Trespalacios, O. (2024b). Is official information about distracted driving enough? A critical investigation of Government-provided information and road rules in Australia. *Safety science*, *175*, 106519.

Evaluating zigzag pavement marking for speed reduction at pedestrian crossings

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Abstract

This study evaluated the effectiveness of zigzag pavement marking as a treatment to improve pedestrian safety at crossings. Main Roads Western Australia implemented the treatment at four sites with different crossing types, paired with four control sites. Three video surveys were conducted over a six-month period to measure vehicle approach speeds: before treatment installation, two weeks after installation (first after), and three months after installation (second after). The study found that only one site showed evidence of speed reduction due to the markings, which was not maintained at follow-up. Two sites demonstrated no effect, while one site exhibited increased approach speeds. The evaluation does not provide compelling evidence that zigzag line marking will reliably reduce vehicle speeds at pedestrian crossings. Given the challenges of controlling for various factors in field-based trials, future evaluation of such treatments could benefit from driving simulation studies where conditions can be systematically controlled.

Social media post

Study finds zigzag road markings before pedestrian crossings may not consistently reduce vehicle speeds - highlights need for context-specific safety treatments and further investigation using driving simulation #RoadSafety #PedestrianSafety

Introduction

Main Roads Western Australia receives numerous pedestrian safety concerns annually regarding poor driver behaviour and lack of compliance at pedestrian crossings. In response to these concerns, zigzag pavement marking was proposed as a treatment to improve give-way compliance by providing additional advance warning for road users approaching pedestrian crossings. While this treatment has been implemented in various jurisdictions, its effectiveness in improving pedestrian safety has not been systematically evaluated.

The study aimed to evaluate whether zigzag pavement marking could effectively improve pedestrian safety by reducing vehicle approach speed at pedestrian crossings. This research is particularly important given the increasing focus on vulnerable road user safety and the need for evidence-based infrastructure treatments.

Conference Theme

This work addresses both the Equity and Evolution components of the ARSC2025 theme. From an equity perspective, it focuses on protecting vulnerable road users by evaluating infrastructure intended to improve pedestrian safety at crossings. From an evolution perspective, it contributes to the development of safe systems by providing evidence about the effectiveness of zigzag line marking – a treatment that, despite its use, lacked robust evaluation. The findings challenge assumptions about treatment effectiveness and provide insights to guide future development of pedestrian crossing safety measures.

Method

Site Selection and Study Design

Four types of pedestrian priority crossings were selected for the trial:

- Un-signalised zebra crossing on slip lane with give way control
- Un-signalised zebra crossing on free-flow slip lane
- Un-signalised zebra crossing mid-block
- Signalised crossing mid-block

Each crossing type had one treatment site and one matched control site, creating eight sites in total (Table 1). Sites were randomly assigned as trial or control sites, with matching based on similar attributes where practicable.

Evaluation Measure and Data Collection

Originally it was expected that pedestrian/vehicle interactions would be used to assess any safety improvement offered by the zigzag marking. However, pilot data collection suggested that pedestrian/vehicle interactions were rare and would result in insufficient data to enable reliable interpretation within a time span that would make the evaluation practicable. For this reason, it was decided to use vehicle approach speed as a measure of safety. Vehicle approach speed is intuitively and theoretically compelling as a measure of safety and as a proxy for negative pedestrian/vehicle interactions. Slower approach speeds will result in greater crossing time for pedestrians, shorter stopping distances for vehicles and less severe outcomes in the event of any negative interaction.

Table 1 Trial sites

Site No.	Crossing Type	Site Location
1a	Zebra Crossing on slip lane, Give Way Control	Plain St/Wellington St
1b	Control Site (No treatment)	Amelia St/Wanneroo Rd
2a	Zebra Crossing on free flow slip lane	Mitchell Fwy/Hepburn Av
2b	Control Site (No treatment)	Ocean Reef Rd/Mitchell Fwy NB on-ramp
3a	Zebra Crossing mid-block	Harvest Tce near Parliament Pl
3b	Control Site (No treatment)	Monash Ave near Williams Rd
4a	Signalised Crossing, mid-block	Curtin Av near Forrest St
4b	Control Site (No treatment)	Charles St near Selkirk St

Vehicle approach speed at entry to the pedestrian crossing was measured using video analytics (VA), with data collected over three periods:

- Initially (before installation)
- After approximately 2 weeks
- After approximately 3 months

Videos were collected during a two-hour window (7am to 9am) on typical weekdays (Wednesday or Thursday). To ensure data quality:

- Only vehicles with greater than 2-second headway were included
- For signalised crossings, only vehicles not affected by red lights were analysed
- Measurement lines were consistently positioned across all surveys.

Speed Estimation and Results Validation

Vehicle approach speed at entry to the pedestrian crossing was estimated from the video using a proprietary video analytics program. At each site, four measurement lines (A, B, C, D) were delineated based on identifiable landmarks. The speeds calculated at Line C were selected for analysis due to their tendency to yield the most accurate results.

In most cases, Line C was positioned at entry to the pedestrian crossing, as illustrated in Figure 1a. However, at some sites, Line D was situated at the entry to the pedestrian crossing instead of Line C (Figure 1), a decision influenced by camera angles or measurement challenges, as exemplified in Figure 3. It is noteworthy that the consistent placement of these lines was maintained for each site across all surveys, ensuring that variations between sites do not impact the before-and-after comparison of individual sites.



Site 3a Harvest Tce, West Perth



Site 2a Mitchell Fwy/Hepburn Av, Greenwood

Figure 1 Examples of measurement lines in relationship to the crossing

The VA results were validated against a handheld radar which has a certified accuracy of ±2km/hr. Measurements were taken at four sites, 2a, 3a, 4a, and 4b. The sampled vehicles were matched one-by-one so each of them had two estimated speeds, one from the radar and the other from our VA program.

The equivalence test was used to find out the degree of similarity between them. It tells us how much discrepancy we need to accept if we want to treat the two datasets as equivalent. If we pool readings from those four sites together and accept a ±0.7km/hr error, the radar and VA results can be treated as equivalent. However, if we look at individual sites, and average the equivalence tolerance margins between them, the average error will be ±2.78km/hr, with Pearson's R values ranging from 0.87 to 0.98. The radar tends get higher readings than VA for some sites and lower for others. The pooled comparison has lower tolerance because individual site errors cancel each other out.
Neither radar or VA is 100% accurate and we do not know which is more correct since a range of factors could affect their accuracies. Given that the radar has an accuracy of ±2km/hr, our equivalence tolerance results suggest that the VA has estimated speeds close to it and the level of accuracy is deemed satisfactory, given that changes smaller than our margin of error would likely be insignificant for the scope of this study.

Results

Travel speed from approximately 34,000 vehicles was captured over the duration of the evaluation period. Their travel speed at entry to pedestrian crossings was analysed for four treatment-control site pairs. Key findings include:

- Only one site (Site 1 slip lane with give-way) showed initial speed reduction ($p < .01$), which was not maintained at follow-up.
- Two sites (Site 2 free flow slip lane; Site 3 mid-block zebra crossing) showed no significant effect.
- One site (Site 4 signalised mid-block) showed a small increase in approach speeds after treatment ($p < .01$).
- Aggregated results indicated a small but statistically significant ($p < .01$) increase in approach speeds at treatment sites, suggesting that, overall, there may be a small safety disbenefit due to the zigzag line marking treatment if rolled out unselectively.
- Analysis of safe system speeds (proportion exceeding 30 km/h) showed no significant improvement (figure 2). For pedestrian treatments, it is particularly important to consider not just how mean speed is affected, but also the extent to which safe system speeds are achieved. For that reason, the number of approaches that exceeded the pedestrian safe system speed (30 km/h) was assessed. As can be seen, the proportion of approaches that exceeded 30 km/h appears to have increased from the before to the after period by more at the treatment sites than at the control sites. However, this difference is not significant ($p > .2$), so using the 30 km/h criterion, there is no evidence of any safety improvement or disbenefit due to the zigzag line marking at these sites.

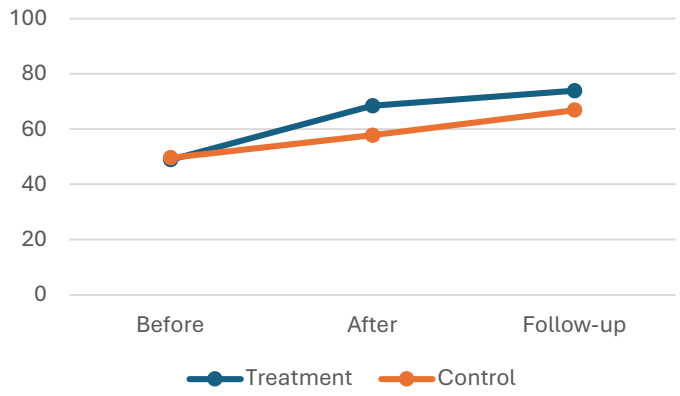


Figure 2 Aggregate speed (left) and Safe System Speed analysis

Benefits to road safety

This evaluation provides evidence-based insights into the effectiveness of zigzag line marking as a pedestrian safety treatment. The results from the evaluation of this trial of zigzag line marking on approach to pedestrian crossings does not provide compelling evidence that such markings will reliably reduce pedestrian crossing entry speed. The findings highlight the importance of context-specific solutions and the need for robust evaluation of road safety treatments before widespread implementation.

Implications for policy and practice

The study recommends:

- Caution in widespread implementation of zigzag line marking as a standard treatment
- Need for site-specific assessment before installation
- Investigation of alternative treatments for pedestrian crossing safety

Conclusions and Recommendations

The results from the evaluation of this trial of zigzag line marking on approach to pedestrian crossings does not provide compelling evidence that such markings will reliably reduce pedestrian crossing entry speed. This does not mean that zigzag line marking cannot be effective at certain sites.

The study faced several methodological challenges, including imperfect matching between control and treatment sites (particularly near a hospital) and camera positioning issues that affected data collection. These limitations, combined with external factors like traffic patterns and nearby intersections that could influence vehicle speeds, may have impacted the reliability of the results and contributed to the negative outcome of the trial.
The difficulties and limitations of field-based trials, noted above, can be overcome by other methods for testing the effectiveness of treatments. Driving simulation affords a cost effective and methodologically robust approach to testing infrastructure treatments. It is recommended that a driving simulation study to systematically assess if and when zigzag line marking and other potential treatments are effective for slowing vehicle speed at pedestrian crossings, and which treatments are most effective for this purpose.

Willingness to speed: A motonormativity effect?

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Abstract

Walker et al. (2024) coined the term 'motonormativity' to refer to an unconscious cognitive bias relating to car ownership and car use, such that car-based activity is viewed as an unremarkable social norm. They argue that motonormativity prohibits policy makers, health practitioners, and drivers from objectively and rationally assessing risks associated with car use. In the current study we were interested to make an exploratory investigation into whether there was any evidence consistent with the idea that willingness to speed would display the character of a motonormativity bias. Consistent with a motonormativity bias, when comparing willingness to speed with willingness to eat at a restaurant where food hygiene standards may be compromised, we found that drivers were much more willing to speed in most situations than to accept unsafe food practices even though speeding is riskier.

Social media post

Are people rational about the risk associated with speeding? We found evidence that, even though speeding is objectively riskier than eating at a restaurant where food hygiene standards may be compromised, people are more willing to speed than eat at the restaurant.

Introduction

Even low-level speeding increases crash risk. For example, travelling at 65km/h where the limit is 60km/h approximately doubles the crash risk (Cameron, 2013). Gavin et al. (2010) reported very high levels of low-level speeding in NSW (around 40% in 60 km/h zones) and estimated that low level speeding contributes to around 50% of speed-related fatal crashes. Interestingly, although drivers seem to appreciate, in some sense, that speeding is risky, nevertheless, they see it as socially acceptable and engage in it frequently (Job et al., 2012). There are many elements that may contribute to this somewhat paradoxical situation, but one that hasn't been investigated thus far is the influence of what has been termed 'motonormativity'.

Walker et al. (2024) coined the term 'motonormativity' to refer to an unconscious cognitive bias relating to car ownership and car use, such that car-based activity is viewed as an unremarkable social norm. Walker and colleagues argue that motonormativity prohibits policy makers, health practitioners, and drivers from objectively and rationally assessing risks associated with car use. These risks include poor health outcomes from exposure to vehicle emissions and reluctance to adopt active travel habits (e.g., walking, cycling). To test this idea, Walker et al. (2024) asked a sample of 2,157 UK adults questions relating to driving and a parallel set of questions based on other behaviours, with the word 'driving' substituted as follows in these examples: '*People shouldn't **drive** in highly populated areas where other people have to breathe in the **car** fumes*' and '*People shouldn't **smoke** in highly populated areas where other people have to breathe in the **cigarette** fumes*'; and '*It's okay for a delivery **driver** to bend a few health and safety rules in order to keep their business profitable*' and '*It's okay for a **chef** to bend a few health and safety rules in order to keep their business profitable*'. Results demonstrated that 75% of the sample agreed that people 'should not smoke', but only 17% agreed that 'people should not drive' in areas where others must breathe in the fumes, demonstrating a substantial difference in how participants viewed the comparative risk of different forms of air pollution (Walker et al., 2024).

In our study we were interested to make an exploratory investigation into whether there was any evidence consistent with the idea that willingness to speed is also influenced by a potential motonormativity bias.

Conference theme

The investigation of normativity is a significant ***evolution*** in thinking about why people speed and may provide a genuinely new insight that could guide policy and messaging about safe travel speeds

Method

A representative sample of 2,279 participants was recruited by a social marketing company that conducts 6-monthly road safety surveys in Western Australia. All respondents were registered as panel members and invited to complete an online survey about speeding-related topics of approximately 20 minutes duration. Participants received incentive

points for survey completion that could later be redeemed for a range of products. Respondents were excluded from participating if they or any of their family members worked in the following roles: advertising or media, market research, police service or organisation involved in road safety. Other exclusionary criteria used were: aged 17 or below, did not live in Western Australia, and the following licence types - learner, moped, or not licensed.

In the section of the questionnaire of interest here, participants were asked to report how willing they were to speed in certain circumstances as well as to eat food in their favourite restaurant when their health might be at risk: '*Imagine you are in your favourite restaurant on a very busy Friday night. The kitchen staff are finding it hard to keep up with all the orders. Meals are taking a long time to reach diners. The chef decides to cut corners and not follow all the usual hygiene measures when preparing meals tonight. How willing would you be to eat the food, knowing that corners have been cut and your health could be at risk?'* Response options ranged from *Never* to *Always* on a 5-point Likert scale. This 'rushing chef' question was asked of all participants before any speeding questions in an attempt to allow unbiased answers to a non-road use question. For comparison purposes, willingness to exceed the speed limit under various conditions was assessed using a Likert scale (1 = Never, 2= Rarely, 3=Sometimes, 4= Often, 5= Always, 0 = Not applicable). The following conditions were assessed: *Running late, to keep up with flow of traffic, no pedestrians around, daydreaming or not paying full attention to driving, tired and need to stay alert, believe no risk of being caught by police*, and *when traffic is light*.

Results

Overall, 50.6% (n = 1152) of the sample were female, while 49% (n = 1117) were male and 0.4% (n = 10) were non-binary or preferred not to say. In terms of age group, 19.8% of respondents (n = 450) were in the 17–29-year age group, 52.6% (n = 1197) were in the 30–59-year age group, and 27.7% (n = 631) were in the 60+ year age group.

Consistent with previous research, a large proportion of the sample admitted to speeding. With respect to a 60 km/h road, 30.3% of participants reported driving 1–5 km/hr over posted speed limit (often to always), 8.4% of participants reported driving 6–10 km/hr over the posted speed limit, and 2.6 % of participants reported driving 11+ km/hr over the posted speed limit.

For the motonormativity question, answers were re-coded into never/rarely (1–2), sometimes (3), and often/always (4–5). Willingness to exceed the speed limit was mostly frequently reported when participants intend to keep up with the traffic flow ("often to always": 20.75%, "sometimes": 31.69%), followed by when they are running late ("often to always": 14.40%, "sometimes": 32.94%) (see Figure 1). Most participants (83.32%) reported that they would never or rarely eat food when corners have been cut and their health could be at risk. Interestingly, in all stated circumstances, willingness to speed was higher than eating food when corners were cut, except when participants were tired and needed to stay alert. Table 1 displays the results of performing Wilcoxon signed-rank tests to determine whether there was a significant difference in participants' ratings between willingness to speed and willingness to eat at favourite restaurant when usual hygiene measures had not been followed.

Conclusions

These results are consistent with the hypothesis that, like judgements about other aspects of driving (Walker et al., 2024), willingness to speed may also be influenced by a motonormativity bias. Drivers reported a greater willingness to speed in most situations presented in the survey than a willingness to accept unsafe food practices. An important exception to this is driving when tired. While a motonormativity bias is a plausible explanation of these results there may be other potential explanations. This was an exploratory examination of the topic to investigate if there was any merit in pursuing the concept of motonormativity to provide insight into why low-level speeding is so prevalent, despite the risk it poses. Confirmation that a motonormativity bias is the correct interpretation of willingness to speed requires a dedicated survey containing multiple, carefully constructed questions designed to tap into this bias. Whatever the explanation for these results, it is striking that despite speeding being objectively riskier than eating at a restaurant where food hygiene rules are not always followed, people reported much greater willingness to speed than to eat at the restaurant. In one sense this should not be a surprise as there is a body of research demonstrating that people are quite poor at assessing where the real health risks in their life lie (Brown, 2014). On the other hand, this conflict does not often appear to have been leveraged to try to change risky behaviour in road safety thus far, and so recognition of this fact opens a potential new avenue for behaviour change.

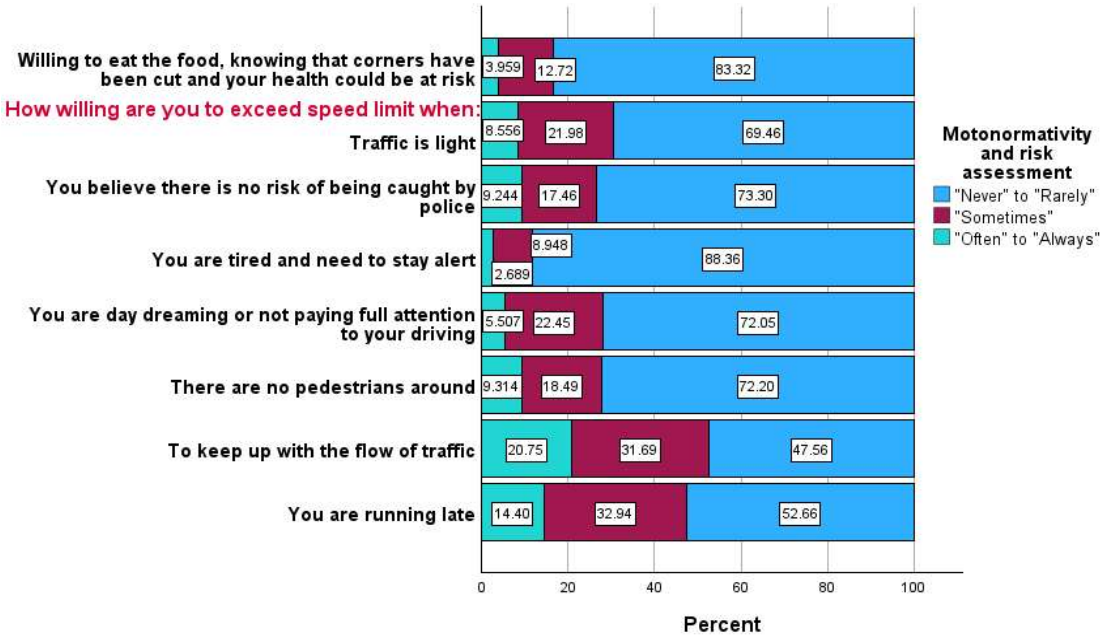


Figure 1. Participants willingness to speed compared to willingness to eat at a restaurant when food hygiene is compromised

Table 1. Participants willingness to speed compared to willingness to eat at a restaurant when food hygiene is compromised

Reason for speeding	Wilcoxon signed-rank test
Participants were **more** willing to speed if "**They are running late**" than "Willing to eat the food, knowing that corners have been cut and your health could be at risk"	Z= -21.119, $p < 0.001$
Participants were **more** willing to speed "**To keep up with the flow of traffic**" than "Willing to eat the food, knowing that corners have been cut and your health could be at risk"	Z= -23.967, $p < 0.001$
Participants were **more** willing to speed if "**There are no pedestrians around**" than "Willing to eat the food, knowing that corners have been cut and your health could be at risk"	Z= -9.897, $p < 0.001$
Participants were **more** willing to speed if "**They are daydreaming or not paying full attention to your driving**" than "Willing to eat the food, knowing that corners have been cut and your health could be at risk"	Z= -7.853, $p < 0.001$
Participants were **less** willing to speed if "**They are tired and need to stay alert**" than "Willing to eat the food, knowing that corners have been cut and your health could be at risk"	Z= -4.821, $p < 0.001$
Participants were **more** willing to speed if "**They believe there is no risk of being caught by police**" than "Willing to eat the food, knowing that corners have been cut and your health could be at risk"	Z= -9.730, $p < 0.001$
Participants were **more** willing to speed if "**Traffic is light**" than "Willing to eat the food, knowing that corners have been cut and your health could be at risk"	Z= -11.362, $p < 0.01$

References

Brown. V.J. (2014) Risk Perception: It's Personal. *Environ Health Perspect.* Oct;122(10):A276-9.

Cameron. M. (2013) Use of Kloeden et al's relative risk curves and confidence limits to estimate crashes attributable to low and high level speeding. *Journal of the Australasian College of Road Safety* – Volume 24 No.3, 40-52.

Gavin, A., Walker, E., Murdoch, C., Graham, A., Fernandes, R., Job, R.F.S (2010) Is a focus on low level speeding justified? Objective determination of the relative contributions of low and high level speeding to the road toll. *2010 Australasian Road Safety, Research, Policing and Education Conference*, 31 August – 3 September 2010, Canberra, Australian Capital Territory.

Job, S., Sakashita, C., Mooren, L., Grzebieta, R. (2012) Community Perceptions and Beliefs Regarding Low-level Speeding and Suggested Solutions. *Annual Meeting of the Transportation Research Board*: Washington DC, USA.

Walker, I., Tapp, A. & Davis, A., (2024). Motonormativity: how social norms hide a major public health hazard, *International Journal of Environment and Health*, 11(1), 21 – 33.

Comprehensive resources supporting informed decisions around medicinal cannabis and driving

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Abstract
The effects of medicinal cannabis on drivers prescribed this treatment is an important road safety consideration. In 2021, a Victorian Government Medicinal Cannabis and Safe Driving Working Group recommended increasing information for patients who drive and supporting prescribers to appropriately consider patient driving needs throughout the treatment process. In 2023, a Department of Transport and Planning (Victoria) project extended this work by researching updated evidence, identifying available resources, and forming an expert health practitioner group for technical advice when developing a resource package on medicinal cannabis and driving. The expert group identified the need for a comprehensive guidance resource that could form the basis of education and consistent messaging for clinicians and patients. The resources comprise a comprehensive 'Medicinal Cannabis and Driving Decision Support Resource' and Patient Factsheet. The resources have practical implications, including the ability to integrate with medicinal cannabis clinical guidelines and education to elevate conversations around driving.

Social media post
New resources help health professionals and patients to be informed of driving implications when considering medical cannabis treatment. These resources improve road safety by ensuring driving needs are at the forefront when determining if medicinal cannabis is an appropriate treatment option.

Background
Medicinal cannabis use is increasing in Australia, with around 18,000 patients using unregistered medicinal cannabis products in 2019 to over one million patients up to January 2024 (AHPRA, 2024). Medicinal cannabis is commonly prescribed for pain (refractory to other therapeutics), mental health and sleep conditions such as insomnia (TGA, 2025). Further, the active ingredient in most medicinal cannabis products is Delta-9-tetrahydrocannabinol (THC). THC is a banned substance under Victorian presence-based drug driving laws and any detectable amount constitutes an offence, regardless of whether it has been legally prescribed (Road Safety Act 1986 (Vic)).

A 2022 review of prescriber advice of risks associated with medicinal cannabis use for patients indicated inconsistent advice and low awareness of driving risks. This supported the delivery of a report from the Medicinal Cannabis and Safe Driving Working Group (the Working Group) to the Victorian Government with recommendations around managing safe driving for people prescribed medicinal cannabis (DJCS, 2021). The Working Group report noted that while medicinal cannabis is prescribed for a range of complex conditions, there is limited information available to support health practitioners to make decisions and recommendations about driving when prescribing to patients with a driving need. The Working Group concluded that point of prescription processes that consider driving needs alongside medicinal cannabis prescribing could be improved. The report included two options for intervention – a low-level intervention based on awareness raising through, for example, generic factsheets outlining the considerations for safe driving, and a higher-level intervention featuring a prescribing tool that enabled systematic and tailored management based on a detailed assessment framework. The Working Group provided a report with a preliminary draft of a Medicinal Cannabis and Safe Driving Clinical Decision Support Tool.

In 2023, the Victorian Department of Transport and Planning (DTP) commenced a project building on the work of the Working Group to deliver an effective tool or resource to support health practitioners in making informed decisions when considering medicinal cannabis as a treatment option for a patient with driving needs.

Conference theme
The project closely aligns with the 2025 conference theme of evolution. The safe system should continue to evolve in response to past and future learnings and challenges. The rise of medicinal cannabis treatment in Australia supports the need for careful consideration of the intersections between such usage and the resultant effects on driving. Through the development of an accessible suite of resources to assist health practitioners and patients consider driving needs when

contemplating medicinal cannabis treatment, the safe system remains responsive to evolving community needs while fostering improved road safety into the future.

It is important for all medicinal cannabis patients to be adequately informed on driving considerations. The project resources facilitate an equitable road user environment, through enabling all patients to have access to informative resources such as the Patient Factsheet when making decisions about taking medicinal cannabis where there is a driving need. The Decision Support Resource equips health practitioners and their patients with the materials needed to make informed choices about medicinal cannabis and driving throughout the treatment process.

Project description

The objective of the project was to ensure that patient driving needs are taken into account and actively managed when medicinal cannabis is being considered and prescribed as a treatment for medical conditions. As such, DTP developed a Medicinal Cannabis and Safe Driving Decision Support Resource, with supportive information and resources for health professionals and patients (Transport Victoria, 2025).

Initially, an environmental scan was undertaken to review the evidence relating to the communication and education of medicinal cannabis and driving, and identify the gaps and opportunities in this space. Given the variable and limited information available on medicinal cannabis and driving for both health professionals and patients (MUARC, 2022), an early priority was to develop consumer and health professional information that would support awareness of the impairing effects of medicinal cannabis, Victorian drug-driving laws and steps for ensuring safety while driving. A Patient Factsheet on Medicinal Cannabis and Driving was developed for this purpose.

Following completion of the environmental scan, an expert Technical Advisory Group was engaged, comprising general practitioners, medical specialists, forensic experts and pharmacists. This Group informed the technical development of the content of the resource and provided crucial insights into the potential application of such a tool or resource in clinical practice. The Technical Advisory Group worked through a range of complex considerations to develop relevant and accurate content relating to managing impairment risk within the context of existing legislation, while also acknowledging the complexities of individual patients that limit a standardised approach to decision making around prescription of medical cannabis. While management of impairment risk was the primary aim of the content, a secondary consideration was to ensure that practitioners make patients aware of the local law for driving while impaired, and the presence/detection law for those prescribed products containing THC.

Findings

The consultation with the Technical Advisory Group revealed a comprehensive guidance resource was more appropriate than a technology-based tool to ensure the resource met the needs of health practitioners and could be broadly implemented across clinical practice. While the initial intention of the project was to develop a technology-based tool that would integrate with the prescribing process and guide decisions relating to driving, a complex range of individual effects in response to medicinal cannabis meant that the definitive guidance required to support such a tool was not currently available.

Given the inaccurate and often conflicting information available from a variety of sources regarding medicinal cannabis and driving, we identified the need for an accessible and reliable ‘source of truth’ to support clinical practice – one that would form the basis of education and consistent messaging for clinicians as well as for the public. As a result, a Decision Support Resource was developed to act as an informative ‘source of truth’ for practitioners, outlining guiding principles, core evidence-based information and general guidance regarding impairment risk and mitigating actions. It also describes the current Victorian legislation and the implications for drivers. The resource does not address the clinical basis for medicinal cannabis treatment, instead focusing on road safety considerations as one aspect of the clinical management process.

Benefits to Road Safety

Equipping health professionals and patients with high quality educative resources on medical cannabis and driving aims to mitigate the risk of patients driving while impaired from THC, presenting a direct benefit to road safety by reducing the number of impaired drivers on our roads.

The project seeks to support road safety by ensuring that patient driving needs are actively managed at the point of the prescription and dispensing of medicinal cannabis. The resource places particular emphasis on establishing the patient’s driving need as an early consideration in the decision to prescribe medicinal cannabis, and more directly positions

driving need as an important determinant for the health practitioner when considering the appropriateness of THC-containing medicinal cannabis as a treatment option. The resources seek to equip prescribers of medicinal cannabis in Victoria with the knowledge and relevant considerations to make an informed decision about whether medicinal cannabis is an appropriate treatment option for patients, and that they communicate risks to their patients, when considering potentially complex medical histories and unique driving needs.

While the environmental scan did not reveal any similar decision support resources used on an international scale, the research identified a range of factors that affect the degree and duration of impairment (Eadie et al., 2021). This framework provides a valuable basis for determining and mitigating impairment risk for individual patients and is integrated within the Decision Support Resource. Importantly, the extent to which medicinal cannabis containing THC impairs driving in different individuals is still unclear. A Medicinal Cannabis Track Trial project is underway in Victoria to explore this relationship. Therefore, the resource has intentionally addressed the risk factors for health professionals to consider when prescribing medicinal cannabis containing THC, without providing a universal prescription formula related to driving impairment and risk.

Implications for Policy and/or Practice

This work has important implications for drivers who have been prescribed medicinal cannabis containing THC to enable them to be informed about the risks associated with driving so that they can have increased compliance with Victoria's fitness to drive policy and drug driving laws. Given this, it has many practical implications for health practitioners and patients. The resources prompt considerations for driving in their clinical decision process when considering whether to prescribe medicinal cannabis (particularly products containing THC). This enables health practitioners to be sufficiently informed of crucial road safety considerations when medicinal cannabis is being considered as a treatment option for patients with a driving need. The development of the Patient Factsheet has practical implications for consumers, providing consumers with the necessary information when making decisions about taking medicinal cannabis treatment and driving.

This work has been carefully designed to be easily used in clinical practice, at the optimal time when prescribing decisions are made. Particularly the 'driving needs checklist', contained within the resource, can be integrated into existing and new clinical guidelines on prescribing medicinal cannabis. The resource also supports the inclusion of specific education around medicinal cannabis and driving into accredited training on medicinal cannabis for health professionals more generally.

Further, the Decision Support Resource may be adapted for applicability to other prescription, and potentially impairing, commonly used over-the-counter medications to ensure driving considerations continue to be elevated in discussions between health professionals and patients.

This project falls under broader initiatives to improve road safety outcomes in relation to THC. Targeted communication on cannabis and driving safety is required to promote community awareness and influence positive behaviour change in relation to drug-driving.

Conclusions

This resource is the first in Australia to provide a comprehensive 'source of truth' for medical practitioners in Victoria to adequately consider the suitability of medicinal cannabis as a treatment option for their patients, when taking into account their specific driving needs. This resource has potential utility to be adapted for use in other jurisdictions and to other specific potentially impairing prescription medications. The resources are available on the Transport Victoria website.

References

Australian Health Practitioner Regulation Agency (AHPRA) (2024). Regulators come together as one million Australians turn to medicinal cannabis treatments. AHPRA Communique. https://www.ahpra.gov.au/News/2024-02-20-medical-cannabis-treatment.aspx#:~:text=The%20use%20of%20unregistered%20medicinal,cannabis%20up%20to%20January%202024

Eadie, L., Lo, L. A., Christiansen, A., Brubacher, J. R., Barr, A. M., Panenka, W. J. and MacCallum, C. A. (2021) 'Duration of Neurocognitive Impairment With Medical Cannabis Use: A Scoping Review', *Front Psychiatry,* 12, pp. 638962.

Monash University Accident Research Centre (2022). Medicinal Cannabis and Driving in Australia. Baseline Research Program Report.

Road Safety Act 1986 (Vic), section 49. https://www5.austlii.edu.au/au/legis/vic/consol_act/rsa1986125/s49.html

Therapeutic Goods Administration. (TGA). (2025). Medicinal cannabis hub. https://www.tga.gov.au/products/unapproved-therapeutic-goods/medicinal-cannabis-hub#:~:text=The%20medicinal%20cannabis%20hub%20provides,cannabis%20goods%20are%20unapproved%20goods

Transport Victoria (2025). Medicinal cannabis and driving resources for health professionals. https://transport.vic.gov.au/registration-and-licensing/licences/medical-conditions-and-reviews/medicinal-cannabis-and-driving-resources-for-health-professionals

Victorian Department of Justice and Community Safety (DJCS) (2021). Assisting medicinal cannabis patients to drive safely. Report of the Medicinal Cannabis and Safe Driving Working Group. https://www.justice.vic.gov.au/medicinal-cannabis

Main Roads Application of Road Safety Management Process

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Abstract
This presentation demonstrates what Main Roads RoSMA process is, where it has come from and the recent changes in the process with regards to projects and the addition and inclusion of AusRAP Star rating system. The inclusion of the Star rating allows for proposed designs to be assessed without the need to have existing recorded crashes and is a formal method of demonstrating deficiencies or beneficial design. Projects at greenfield sites with no recorded history of crashes have significant benefit. The RoSMA process is different to a Road Safety Audit in that it is a wider process and can recommend changes or improvements that a Road Safety Audit may not be able. The RoSMA process has been formally documented since 2016 and has been improved in subsequent years. The inclusion of Star rating is a significant change and improvement to demonstrate a better consistency for projects where a Road Trauma Reduction target was harder to demonstrate.

Social media post
How Main Roads applies the RoSMA process to improve road safety outcomes for activities.

Background
Main Roads WA is the State road authority in Western Australia with direct control of approximately 19,000 kms of roads. Main Roads WA also has an impact on additional approximately 129,000 kms of roads in Western Australia as the organisation that approves speed zoning and in various degrees signing and lining. Main Roads WA also looks after structures such as bridges across the road network.

Western Australia has signed up to the Australian National Road Safety strategy 2021-2030 and has a State Road Safety Strategy, Driving Change. These strategies all have stretching fatal and serious injury reductions of 50 to 70% by 2030 compared to the 3 year average 2018-2020. By 2050 the target is for zero fatal and serious injuries.

This presentation explains how Main Roads has adopted a Road Safety Management process (RoSMA) to help and contribute to these road safety targets. The RoSMA process is applied to any activity within Main Roads that can have an impact on fatal or serious injury. Due to the magnitude of activities that potentially fall within this description the largest road projects were initially looked through the Road Trauma Reduction process and reported back to senior executives through the monthly Corporate Executive meetings. Although the term RoSMA refers to the whole overall approach, it has also become the name of the Road Trauma Reduction process which is applied to road projects. Policy and guidelines are also subject to RoSMA, as an activity that can have an impact on Fatal and Serious injuries.

Conference theme
This work aligns with the conference theme of Equity. The RoSMA process ensures that all road users are included when analysing projects or activities and ensures vulnerability and safe system principles are followed. This is important as some projects may have efficiency for freight or movement of cars as their main focus and the RoSMA process ensures that all road users are included and their safety is assessed.
The theme of Evolution is also touched on as the Safe System Approach is used when assessing projects and especially speed zones. For example counter measures that address safe system deficiencies, such as changing a roundabout to traffic signals, are raised through the process.

Description of Approach
Main Roads adopted the ISO 39001 Road Safety Management process with the launch of the RoSMA process in 2016. The process documented how activities and decision making at Main Roads WA that could influence fatal and serious injuries on the road network would be assessed to ensure they focussed on improving road safety outcomes.

The process initially used a spreadsheet based algorithm that created a crash reduction target based on achieving the 2030 target of 50% reduction in fatal injuries and 50% reduction in serious injuries,, to meet the 50 to 70% reductions as stated in the State Road Safety Strategy.

A suite of documents and procedures was created, based on the ISO 39001 standard, to demonstrate and allow Main Roads to both have a process for improving road safety in the organisations activities and also demonstrate this approach.

Initially this approach was targeting the bigger larger infrastructure projects although the process allowed all activities to go through the process. As we get closer to 2030 with the targets of reducing fatal and serious injuries, the crash reduction target for projects was becoming difficult to implement for some projects, as the algorithm needed to make more significant savings on each project to meet the 2030 targets. Further refinement of the road trauma reduction analysis and outputs has resulted in more methods to assess projects. This includes AUSRap star ratings, safe system matrix and a road safety assessment of designs.

Outcome of refinements to process

These additional methods of assessing projects allow for improved analysis when there are differing variables. For example the spreadsheet bases algorithm works best when there are existing crashes. It does attempt to account for risk on roads that may have few if any crashes over the last 5 years but it is harder for others, project managers and directors for example, to understand and be able to explain the outcome and project to others.

For this reason the AUSRap star rating approach has been introduced and has initially been used predominantly on green field sites where there are no previous crashes and the road safety analysis needs to be on potential risk. The Star rating approach is great for this purpose as it also allows for project managers and directors and others to better understand the approach and outcomes. The greater use of AUSRap star ratings across all projects is likely especially with the combination of cross-section stereotypes and the completion of mapping the existing road network to obtain existing AUSRap star ratings. This allows for an understanding of how well aligned the location might be for good road safety outcomes before any design changes are proposed.

The Safe System matrix has been used as a tool to compare different options on the same project, and allows for an understandable outcome even if there are no or very few previous crashes recorded in the last 5 years.

Road Safety Assessment is another tool that uses the knowledge and understanding of road safety practitioners in the Road Safety Branch to assess a project and give a quicker response to a project that may have few existing crashes or maybe more unique. It can be similar to a road safety audit or inspection but focuses on providing input that may not necessarily be easily included in a Road Safety Audit.

This presentation will also demonstrate the change in methodology for undertaking RoSMA. At the commencement of the process in 2016 it was envisaged that Project Managers would undertake the RoSMA process themselves and use the spreadsheet. However ensuring project managers undertook the assessment in the appropriate manner and if at all become an issue.

To reduce workload on project managers and to ensure the best road safety analysis of projects Road Safety branch took back the role of undertaking the crash reduction target role and the subsequent counter measure analysis. This has allowed for a consistent approach and improved analysis.

Main Roads has a treatment resource guide that demonstrates potential crash savings for various measures that can be implemented with road projects. This allows for projects that have not met a crash reduction target to see if other or additional measures would contribute to an improved outcome and either meet or get much closer to the crash reduction target. More recent updates to the RoSMA process have included focusing on activities that are / were consider day to day business as usual rather than major projects.

This includes speed zoning, with speed being such a major factor in crashes and the potential severity of crash outcomes. As previously mentioned the initial focus of RoSMA was on larger multi-million dollar projects and not the much smaller day to day activities. Speed zoning for example is approved by Main Roads across all roads in Western Australia regardless of the road authority so there is a significant benefit for road safety to have expert analysis on the potential outcomes for speed zoning requests and whether Main Roads agrees with the request or not.

The Road Trauma Reduction part of RoSMA results in an outcome that is either Not Supported, Supported, or Endorsed. Endorsed means that the project is good from a road safety perspective and no other changes need to be made.
Supported means that the project is accepted but could be improved, and a list of improvements are given.

Not Supported means the project is not acceptable from a road safety perspective. The reasons for this are given with suitable mitigation measures or changes listed, to allow the project to move into a Supported or Endorsed outcome.

Effectiveness

The number of projects each year that have been subjected to RoSMA has risen substantially since 2016. The first full year of applying RoSMA, late 2016 to late 2017 had 67 projects reviewed. In the last 12 months Main Roads has reviewed 327 projects through ROSMA with 212 projects reviewed through the previous 12 months (2023/24). Monthly reporting through the Corporate Executive allows high level view of projects that are going through the RoSMA process with numbers broken down to geographical regions and more recently (within the last 6 months) numbers of speed zoning change requests that have undergone the RoSMA process.

The number of projects has risen due to the reporting on type D (over $100 million), C ($10 million to $100 million) and since 2024 type B ($50,000 to $10 million) projects along with an increased awareness within the organisation of RoSMA and how the process can improve project outcomes.

Road Safety branch staff have become more pro-active in ensuring that projects are submitted for RoSMA review and projects that have been submitted for geometry, drainage and signs and lines review through the Road and Traffic Engineering section of Main Roads automatically go through the RoSMA process with this being recorded on the RTE review documentation.

Significant benefits have been shown when projects apply the process with best outcomes with the AUSRap Star ratings approach. The use of the star ratings ensures that all road users are included when making design decisions that will ultimately translate into a finished road. This approach has now extended to the Tonkin Highway southern extension resulting in a 5 star rating for pedestrians and bicycle riders, 4 star rating for vehicle occupants and a 3 star rating for motorcycle riders. The benefit of having the AusRAP star rating at design stage, before work commences on site, is that it is harder for changes to be made on site without ensuring that they don't impact the AusRAP star rating. This is especially relevant for people walking and cycling. The 5 star rating is due to the complete separation of these modes from the faster traffic lanes using an adjacent path network with grade separation at interchanges and side roads. It may be tempting for a project to change designs once on site to either reduce cost or meet time frames. However with publicly available AUSRap star ratings, any changes to the design will still need to maintain the same star rating outcome. The process ensures that road safety is a central part of decision making.

The RoSMA process and road trauma reduction activity are all about improving road safety and ensuring that activities that Main Roads undertakes are improving, and not impacting road safety outcomes. The introduction of more methods to undertake a RoSMA assessment allows for smaller projects to be assessed in a timely manner. RoSMA process also allows for projects to demonstrate short comings in a design and be able to demonstrate why a change to the design is appropriate, and justify this to more senior staff including funders.

One example was a project involving a change a roundabout to a four way cross road, the ROSMA road trauma reduction process demonstrated the negative outcomes of changing a roundabout into a four way signalised intersection in this location and context. Mitigation measures were recommended as part of the feedback to the project manager and included speed limit reductions and a raised safety platforms at the intersection to ensure appropriate safe system speeds for right turn or vulnerable road user collisions were met. The ROSMA process allowed the project manager to have an improved and more robust argument for design changes when discussing with more senior staff.

The ROSMA approach has helped embed a road safety approach throughout the organisation, with oversight and discussion from the highest level, with reporting each month at Corporate Executive meetings.

References

ISO Standard 39001 "Road Traffic Safety (RTS) Management System – Requirements with Guidance for Use" (first published in 2012 and updated in 2024)

Driving Change – Road Safety Strategy, Government of Western Australia, 2020 https://www.wa.gov.au/government/publications/driving-change-road-safety-strategy-2020-2030

ROSMA webpage on Main Roads WA website https://www.mainroads.wa.gov.au/technical-commercial/road-safety/management-system-rosma/

Improving Safe System performance of intersections on rural divided roads

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Abstract

Road Safety Victoria (RSV) reviewed at-grade intersections on rural high-speed divided roads and found they have the second highest rate of road trauma and highest severity outcome per intersection type in Victoria. RSV then created a policy that stated that no new at-grade intersections would be built on the rural high-speed divided road network and instead Safe System aligned intersection forms would be used. This project analysed 101 existing Rural Wide Median Treatments (RWMTs) and crashes from 2011 to 2021 to determine factors that increased the risk of crashes. The output of this project produced two documents: 1) An options toolbox including an FSI estimation tool that assess the risk of existing RWMTs based on side road volume and an options suite for upgrading or planning a new intersection. 2) An analysis of the risk of 101 existing RWMTs that could be used to develop an upgrade prioritisation program.

Social media post

Significant road trauma has occurred at Rural Wide Median Treatment (RWMT) intersections in Victoria. This project investigates ways to improve the Safe System performance of at-grade intersections on rural high-speed divided roads.

Background

Rural Wide Median Treatments (RWMTs) are a common intersection form on rural high-speed (above 80km/h) divided roads in Victoria. Historically they have been seen as an acceptable way to provide full access for the range of vehicle types and sizes that require access to the rural divided arterial road network, at a relatively low cost, when compared to a grade separated interchange (intersection where the minor road goes either over or under the major road or highway and accesses are controlled by intersections at the ramp terminals).



Figure 1. An example of a RWMT (left) and a grade separated interchange (right) (Google Maps)

However, Road Safety Victoria (RSV) undertook a review in 2022 of RWMTs and other full access at-grade intersections on the rural high-speed divided road network and found that they have the second highest rate of road trauma per intersection and the highest road trauma severity of any intersection type in Victoria. From an analysis period of 2014 to 2018, these 220 intersections resulted in 92 Fatal and Serious Injuries (FSI). RSV concluded that RWMTs did not align with Victoria's vision of zero deaths by 2050 or the Victorian Road Safety Strategy 2021-2030. As a result, RSV published a policy stating that new RWMTs were disallowed on the rural high-speed divided arterial road network and in their place better Safe System (Jurewicz et al., 2015) aligned intersection alternatives should be prioritised.

While guidance contained in the national publication Austroads Guide to Road Design allows and enables road designers and planners to develop alternative solutions, a more integrated options toolbox that combines road design, traffic engineering and road safety information is required to assist with implementing site specific solutions that address the immediate context and the requirements for the route. Current guidance is spread over multiple guideline documents and is, at times, not readily apparent to designers and planners when developing solutions for a particular

site in the context of the route. Existing guidance may also not align with RSV's policy and the *Victorian Road Safety Strategy 2021-2030*.

Conference theme, Evolution

This project investigated the appropriateness of past traffic engineering warrants (Barnhill, 1993) for the Rural Wide Median Treatment form found in the Austroads Guide to Road Design Part 4A and the Austroads Guide to Traffic Management Part 6. As a result of analysis conducted on 101 existing Rural Wide Median Treatments a new traffic engineering tool was developed that predicts the number of FSI crashes based on side road traffic volumes. This information was integral for developing an options toolbox that allows road designers, planners and traffic engineers select more Safe System aligned intersection forms for high-speed rural intersections in the place of RWMTs and other at-grade intersection forms.

Project Description

The project comprised of several stages:

1. The review of existing RWMT traffic engineering warrants (the Barnhill equation in AGTM Part 6)
2. The development of a new FSI prediction tool for existing RWMTs to assist with ranking and prioritising the upgrade of RWMTs
3. The development of an 'Options Toolbox' to assist road designers, traffic engineers and planners consider and develop more Safe System aligned intersections on rural high-speed divided roads
4. A feasibility case study for upgrading a RWMT to a new intersection form

Results

An analysis was undertaken of 101 RWMTs for a period from 2011 to 2021 by retrieving crash records from the Department of Transport and Planning's Road Crash Information System (RCIS) database. The RCIS database uses the VicRoads DCA codes to classify a crash type. However, due to the RWMT form which has vehicles entering the conflict zone from the median as well as from the side road, it can be difficult to determine the origin of a cross traffic DCA 110 crash type. The crash data from RCIS DCA codes were recorded from reading the crash reports based on the crash types in Figure 2.

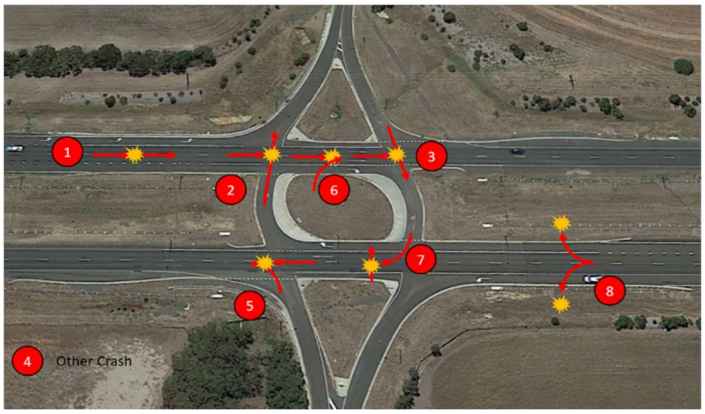


Figure 2. Recoded DCA crash types for RWMTs

The two dominant crash types are crash type 2 (vehicle from the median to the minor road) and crash type 3 (vehicles from the minor road to the median). Crash type 3 accounts for 46% of the crashes but results in 75% of the FSIs. Crash type 2 accounts for 22% of the crashes and results in 14% of the FSIs.

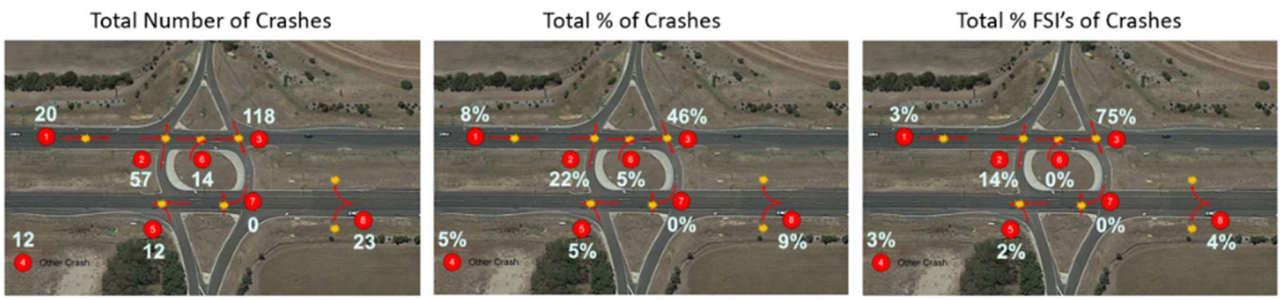


Figure 3. Summary of Crashes at existing RWMTs

A combination of crash types 2 and 3 account for 68% of the crashes but 89% of the FSIs. If the risks associated with these two crash types were understood, then addressing these crashes would significantly reduce the FSI crash risks of RWMTs.

This work resulted in the development of a new traffic engineering and road safety tool (Troutbeck, 2023) which focuses on the major crash types (Type 2, 3, 5 and 6) and predicts the number of FSI's over a 10 year period. From Figure 4, the traffic volume on the major road does not significantly influence the predicted number of FSI's over a 10 year period. This means that a major contributor to increasing crash risk at a RWMT is the increase minor road traffic volume.

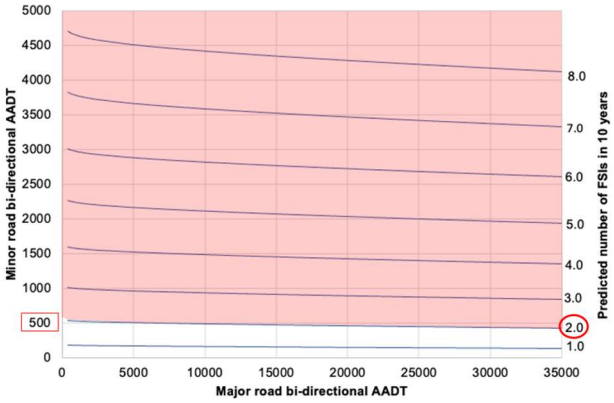


Figure 4. Predicted FSI's over a 10 year period for existing RWMTs

As side road volumes was the significant contributor to increased crash risk, an options toolbox was developed based on side road volumes (See Table 1).

Table 1. Preferred layout based on traffic volumes of the minor road

Volume of minor road (AADT)	Preferred Layout
>3000	Conventional Interchanges (DTP Supplement to AGRD Part 4C)
1000 to 3000	Lower-Cost Interchange or roundabout on the edge of town/built up area
300 to 1000	Divided Road Displaced Intersection (DRDI) or LI/LO with midblock U-turn
50-300	Left In/Left Out with access to a safe U-turn or interchange within 1500m
<50	Close access, consolidate with another access, provide access with a service road, not be within 800m of a significant side road

Benefits to Road Safety and implications for practice

This project allows practitioners to assess the risk of existing RWMTs based on the side road volume by estimating the number of FSI's. This estimate of FSI's can then be used with the willingness-to-pay value of $1.2M per FSI to plan the investment in more Safe System aligned intersection forms. The toolbox was developed through research, workshops and analysis of existing intersections on the rural Victorian network.

Conclusions

This project provides road designers, traffic engineers and planners with tools that allow them to develop and select options for intersections on rural high-speed divided roads that better align with the Safe System. The project also provides DTP staff with information about the safety performance of existing RWMTs to assist with planning and prioritising upgrades of existing RWMTs through records of significant historical crashes.

References

Barnhill, K 1993, Volume Warrants for Wide Median Treatments, VicRoads, Kew, Victoria.

Jurewicz, C, Sobhani, A, Woolley, J, Dutschke, J & Corben B 2015, Proposed vehicle impact speed - severe injury probability relationships for selected crash types, Australasian College of Road Safety, Pearce, ACT.

Troutbeck, R 2023, Evaluation of the safety performance of wide median intersection treatments, Troutbeck and Associates, Rye, VIC.

Impact of Advanced Driver Assistance Systems on insurance claim severity

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Abstract

This study examines the impact of Advanced Driver Assistance Systems (ADAS) on insurance claim severity, addressing a critical gap in understanding their real-world safety benefits and financial compensation outcomes. Using insurance claim records from Queensland (2016/17–2021/22), a joint econometric model evaluates the influence of ADAS features in both claimant and at-fault vehicles on insurance claim severity. The results show that AEB, FCW, LKA and LDW significantly reduce the likelihood of high-claim severity, highlighting their effectiveness in improving safety outcomes. Additionally, ACC-equipped vehicles are associated with higher claim costs, raising concerns about unintended safety trade-offs. These findings inform road safety policies by guiding ADAS deployment strategies, supporting insurance premium adjustments, and shaping enforcement measures to mitigate misuse. The study underscores the evolving role of ADAS in road safety and highlights the need for balanced regulatory and industry responses to maximise their benefits while addressing potential risks.

Social media post

How do ADAS features impact road safety and insurance claims? Our study analyses real-world crash data and third-party insurance claims data to uncover the safety benefits of ADAS. We found that some major ADAS features are likely to have potential benefits in reducing the severity of crash-related third-party insurance claims.

Introduction

The integration of Advanced Driver Assistance Systems (ADAS) in passenger vehicles presents a transformative opportunity for road safety by reducing crash severity. These technologies, including Autonomous Emergency Braking (AEB), Forward Collision Warning (FCW), Lane Keeping Assist (LKA), Lane Departure Warning (LDW), and Adaptive Cruise Control (ACC), aim to mitigate human errors which is one of the primary contributors to road crashes (Amin et al., 2025; Cicchino, 2018; Cicchino, 2022; Cicchino, 2023; Sternlund et al., 2017). While ADAS has been progressively penetrating the vehicle market, studies on the real-world impact of ADAS on crash-related third-party insurance claims are scarce. In addressing this gap, this study investigates the evolving role of ADAS in shaping insurance claim severity outcomes. Specifically, the study examines the impacts of the availability of ADAS in the claimants' and at-fault parties' vehicles on the severity of the crash-related claim outcomes. By bridging the gap between technological advancements and real-world crash outcomes, this research provides insights into insurance regulations for vehicles with and without ADAS features. It also advances the understanding of the relationship between insurance claim severity and ADAS effectiveness by modelling the complex dependencies between vehicle safety technologies and financial compensation outcomes. By leveraging a joint econometric framework, the research captures both direct and systemic interactions, shedding light on how ADAS-equipped vehicles influence crash outcomes and subsequent insurance liabilities.

Conference Theme

This study aligns with the **Evolution** theme of the conference by examining the effectiveness of ADAS technologies to contribute towards the "Safer Vehicles" pillar of the Safe System approach at improving passenger vehicle safety. The findings of the study contribute towards the understanding of the safety implications of ADAS on insurance regulations. By leveraging real-world third-party insurance claim data, this study empirically evaluates the impact of vehicle technologies on injury outcomes, supporting evidence-based policymaking for enhancing system resilience and refining insurance pricing models. The findings offer a nuanced perspective on the role of ADAS in shaping safe mobility strategies, addressing both technological advancements and emerging challenges associated with their real-world deployment.

Method

A joint multinomial logit-grouped ordered logit econometric model is proposed to examine the impact of ADAS features on crash-related third-party insurance claim (referred to as insurance claim hereafter) severity outcomes for

passenger vehicles. In the modelling approach, claim severity is hypothesised to be influenced by the availability of ADAS features in the claimant's vehicle (ADAS-C) as well as in the at-fault party's vehicle (ADAS-A). Specifically, it is hypothesised that the availability of ADAS-C is likely to have both direct and indirect impacts on the claimant insurance claim severity, whereas the availability of ADAS-A is likely to have an indirect impact on the claimant's insurance claim severity. As such, in developing the joint model, the direct effect of ADAS-C is controlled by considering it as an exogenous variable in the claim severity equation and the indirect effects of ADAS-C and ADAS-A are considered as recursive structures in the claim severity equation. In addition, this study recognises that vehicles may have different combinations of ADAS features—resulting in multiple discreteness. As such, unlike standard discrete choice models, which assume a single selected alternative, the proposed modelling approach accommodates multiple discreteness by formulating ADAS presence as a bundled choice set. A simultaneous equations model system is applied to represent these interrelated dimensions effectively. Specifically, the ADAS-C and ADAS-A dimensions of the joint model system are modelled by Generalised Extreme Value formulation. The ADAS features considered are Autonomous emergency braking (AEB), Forward Collision Warning (FCW), Lane Keep Assist (LKA), Lane Departure Warning (LDW) and Adaptive Cruise Control (ACC). In the proposed joint model system, the severity of the insurance claim is modelled using the Grouped Ordered Logit formulation.

Data

The study utilises third-party bodily injury insurance claim data and official crash data from Queensland, Australia for the financial years 2016/17–2021/22. The linked data includes 10,308 claim records, of which 7,723 (2,585) records were randomly selected for model estimation (validation). The study identified the available ADAS features in the linked data from the Australian Vehicle Consumer databases using vehicle make, model and manufacturing year information. In the estimation sample, the proportion of ADAS-C and ADAS-A is presented in Table 2.

Table 2. Proportion of ADAS-C and ADAS-A

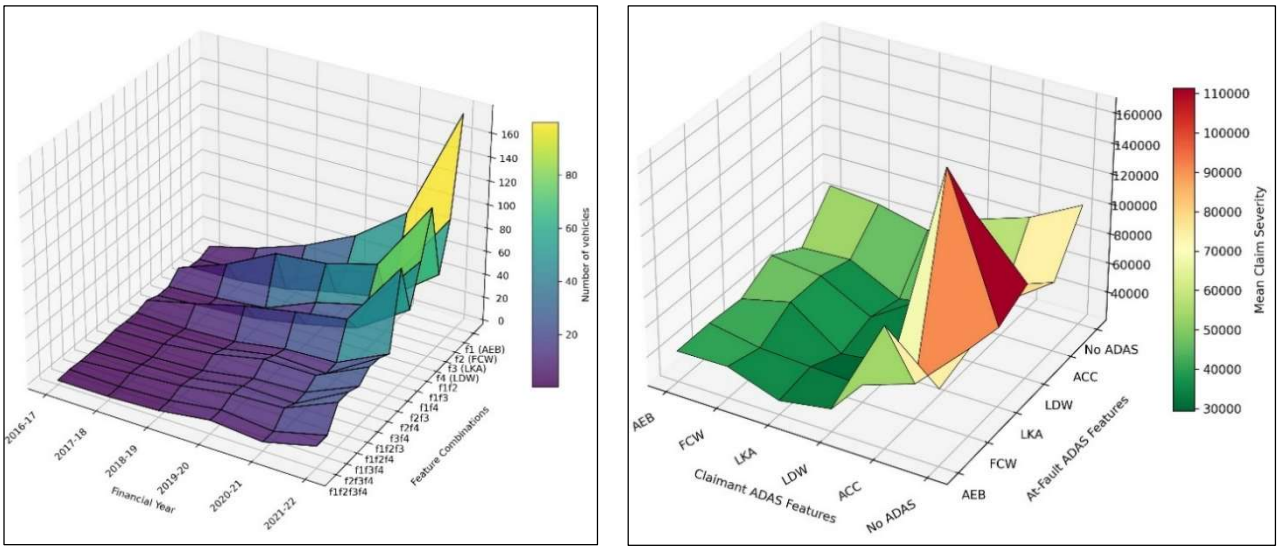
ADAS-C	ADAS-C Percentage*	ADAS-A	ADAS-A Percentage
No features	94.8	No features	96.2
AEB	3.7	AEB	2.7
FCW	2.0	FCW	1.5
LKA	1.2	LKA	0.8
LDW	3.3	LDW	2.1
ACC	1.8	ACC	1.0
*Column percentages are shown. Percentages will not add up to 100% as one vehicle can have multiple ADAS features.			

Figure 3 (a) illustrates the availability of different ADAS features in the vehicle records of linked crash-claim data over different years. From Figure 1(a), it can be seen that there is an increasing trend of vehicles with ADAS features in the linked crash-claim data, perhaps indicating a higher penetration rate of the features in the Australian passenger vehicle fleet. The presence of various ADAS feature combinations in claims suggests that vehicles with different ADAS combinations could be a part of insurance cases due to the likelihood of severity reduction, as observed in Figure 3 (b). Vehicles without ADAS show the highest mean claim severity, suggesting that ADAS-equipped vehicles are associated with reduced severity of bodily injury claims. The presence of ADAS features such as AEB and FCW are associated with lower claim severity, supporting the idea that these systems are likely to prevent or mitigate serious crashes. Overall interaction between the claimant and at-fault vehicle ADAS availability suggests that severity is generally lower when both vehicles are equipped with ADAS features, whereas one-sided ADAS presence may not always reduce severity significantly.

Results

The joint econometrics models are developed based on the exogenous variables which are statistically significant at a 90% confidence interval. With regards to the findings from the joint econometric model for the ADAS-A component, it is found that higher kerb weight vehicles equipped with FCW and LDW, commercial vehicles with AEB, at-fault drivers aged 60 to 74 years old driving vehicles with AEB, and vehicles with ACC at locations with give way sign are more likely to be involved in crashes. With regards to model component for ADAS-C, the results suggest that claimant vehicles equipped with LDW and ACC at evening peak hours (3 PM to 6 PM), LKA, LDW and ACC-equipped vehicles in major cities, LDW-equipped vehicles operated by 50 to 59 years old drivers, LKA and LDW equipped vehicles in rain, wet and slippery road conditions are more likely to be involved in a crash. However, findings from the developed claim severity model indicate that vehicles equipped with ADAS, both in claimant and at-fault vehicles, are associated with reduced claim severity outcomes, reinforcing their effectiveness in crash severity prevention and mitigation. Specifically, claimant vehicles equipped with FCW, LKA and LDW are more likely to decrease the body injury claim severity whereas at fault party's vehicle equipped with AEB is more likely to decrease the body injury claim severity.

Notably, ACC in claimant vehicles is found to be correlated with higher claim payments, suggesting potential unintended safety trade-offs. In addition, the claim severity model suggests that claimants in the age category 21 to 59 years old, male, crashes from 5 AM to 7 PM, road user group as driver, speeding, disobeying road rules, non-Australian licence type and grade vertical road alignment are more likely to increase the claim severity while supervised traffic control at school crossings, speed limits 50 km/h and 60km/h are less likely to increase body injury claim severity.



(a) (b)

Figure 3. (a) Number of vehicles with different ADAS feature combinations over the years and (b) Mean claim severity variation across claimant and at-fault vehicle ADAS features availability (F1: Autonomous Emergency Braking (AEB), F2: Forward Collision Warning (FCW), F3: Lane Keep Assist (LKA), F4: Lane Departure Warning (LDW), Adaptive Cruise Control (ACC))

Benefits to Road Safety

This research highlights the critical role of ADAS in enhancing road safety by reducing injury severity outcomes. The empirical findings provide robust evidence that AEB and FCW significantly lower claim severity, underscoring their effectiveness in reducing crash severity. However, the study also identifies unintended consequences, such as driver over-reliance on LKA and LDW in at-fault vehicles, which may inadvertently increase claim severity. By quantifying these effects, this research contributes to a nuanced understanding of ADAS effectiveness, enabling safer technology deployment and integration into vehicle fleets while also informing the implications of these emerging technologies for Safer Vehicles interventions and insurance regulations.

Implications for policy and Practice

The findings from the research underscores the need for strategic ADAS deployment and regulatory frameworks to maximise road safety benefits through ADAS while managing the risks associated with them. Key takeaways include:

- **Insurance Industry Applications:** Encourage insurers to adopt differentiated premium models that reward demonstrably safer ADAS configurations, ensuring equitable risk assessment and pricing.
- **Road Safety Policing:** Require all new vehicles sold in Australia to meet minimum ADAS performance thresholds and incorporate verified ADAS effectiveness metrics into ANCAP star ratings, incentivising manufacturers to improve system reliability.
- **Workplace Road Safety:** Offer tax credits or grants for commercial fleets retrofitting older vehicles with approved ADAS packages, coupled with periodic compliance audits.
- **Enforcement and Education:** Require ADAS-focused questions in written licensing and refresher exams to test drivers' understanding of each system's functions, limitations, and appropriate use, thereby reinforcing engagement and mitigating overreliance and misuse.

Conclusions

By offering a robust methodological framework and real-world empirical evidence, this study provides actionable insights for policymakers, insurers, and enforcement agencies, ensuring ADAS technologies contribute to tangible road safety improvements. The research underscores the importance of balancing technological advancements with

behavioural considerations to maximise safety benefits while minimising unintended risks. Future work should explore long-term ADAS adoption trends and their evolving impact on insurance and road safety outcomes.

References

Amin, K., Kullgren, A., & Tingvall, C. (2025). Effects of automatic emergency braking systems to reduce risk of crash and serious injuries among pedestrians and bicyclists. *Traffic Safety Research*, *9*, e000085-e000085.

Cicchino, J. B. (2018). Effects of lane departure warning on police-reported crash rates. *Journal of safety research*, *66*, 61-70.

Cicchino, J. B. (2022). Effects of automatic emergency braking systems on pedestrian crash risk. *Accid Anal Prev*, *172*, 106686. https://doi.org/10.1016/j.aap.2022.106686

Cicchino, J. B. (2023). Effects of forward collision warning and automatic emergency braking on rear-end crashes involving pickup trucks. *Traffic Inj Prev*, 1-6. https://doi.org/10.1080/15389588.2023.2176191

Sternlund, S., Strandroth, J., Rizzi, M., Lie, A., & Tingvall, C. (2017). The effectiveness of lane departure warning systems—A reduction in real-world passenger car injury crashes. *Traffic injury prevention*, *18*(2), 225-229.

Road transport injury compensation access for Aboriginal communities

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Abstract

Aboriginal communities face a greater burden of road transport injuries, yet there has been scant focus on access to compensation for their injuries. Across two studies in separate jurisdictions we examined this. Our first study used linked data across police-reported crash and Compulsory Third Party (CTP) claims in New South Wales (NSW) to describe claimant characteristics and identify factors influencing claims. Results indicated Aboriginal people, particularly in rural areas, face barriers accessing compensation. Our second study employed yarning and deep listening methods to explore compensation experiences for Aboriginal people in South Australia, revealing a profound lack of knowledge and support from schemes. Key findings highlight individual physical, psychological, and financial burden, emphasising the need for culturally relational compensation schemes co-designed with community. These findings have significant implications for policy and practice in road safety and compensation frameworks.

Social media post

Our research highlights barriers Aboriginal and Torres Strait Islander people face in accessing road injury compensation. Findings stress the need for culturally specific, strength-based schemes co-designed with communities to improve recovery and reduce disparities. #RoadSafety #Inclusion

Introduction

Third party vehicle insurances are a mandatory component of vehicle registration in all Australian states and territories. In New South Wales (NSW), Compulsory Third Party (CTP) insurance, provides coverage for medical expenses and income loss for individuals involved in motor vehicle crashes regardless of fault attribution. Based on the underlying assumption of the CTP scheme that it has a positive effect on health outcomes, recovery and return to work it is desirable that all those who are eligible can access it, especially the most vulnerable population groups. Aboriginal and Torres Strait Islander people have some of the highest road transport injury rates in Australia (AIHW, 2023; Henley & Harrison, 2019), but to our knowledge to date no studies have looked at access to compensation for Aboriginal and Torres Strait Islander people after road transport injury in Australia. This research addresses access to compensation for road transport injuries among Aboriginal and Torres Strait Islander people, aiming to understand the barriers and enablers to accessing compensation schemes.

Conference theme

The studies presented in this research align closely with the conference theme of equity by highlighting the barries in accessing compensation for road transport injuries faced by Aboriginal and Torres Strait Islander people. The first study highlights barriers in the claims process, revealing that Aboriginal and Torres Strait Islander people, particularly those in rural areas, are less likely to lodge compensation claims despite having higher rates of road transport injuries. The second study further emphasises the lack of knowledge and support for accessing compensation schemes. By focusing on the unique challenges and needs of Aboriginal communities, these studies advocate for equitable access to compensation and support mechanisms.

Methods

Indigenous Governance of Data in these studies was overseen by the Aboriginal and Torres Strait Islander Transport Governance Group, which consisted of Aboriginal or Torres Strait Islander researchers, community and healthcare workers with experience in injury. This group had an essential role in assisting with decolonising research processes and ensuring focus on Indigenous knowledges, and experiences of road transport injuries, throughout all aspects of the research journey.

The first study utilised linked NSW police-reported crash and Compulsory Third Party (CTP) claims data from 2018 to 2023 to describe claimant characteristics and identify factors influencing claim submission. A total of 1954 Aboriginal and Torres Strait Islander claimants were included in the analysis. Descriptive statistics were used to summarise claimant characteristics and multivariable logistic regression models to identify factors associated with lodging a claim.

The second study used qualitative methodologies, it was underpinned by Knowledge Interface Methodology. The Indigenous research method of yarning was used to explore the patient journey for Aboriginal and Torres Strait Islander patients who were involved in a road transport crash that resulted in an injury, with a particular focus on identifying enablers and barriers to compensation and support for their injuries. Participants were Aboriginal people from metropolitan and rural South Australia. Eight yarning sessions were conducted on Country. Thematic coding was performed to analyse the data, ensuring that the voices and experiences of Aboriginal people were accurately represented.

Initial findings from both studies were presented and discussed with the Aboriginal and Torres Strait Islander Traffic Governance Group for further contextualisation and final approval.

Results

In the first study from NSW, higher odds of claiming compensation were associated with being female compared with male (OR 1.16, 95% CI 1.01-1.33), older age (per 1 year increase in age) (OR 1.01, 95% CI 1.01-1.02) and holding a standard licence compared to driving unlicenced (OR 3.83, 95% CI 2.83-5.19). Sustaining no or minor injuries (OR 0.73, 95% CI 0.59-0.90) was associated with lower odds of submitting a claim compared with serious injuries. Claimants in metropolitan areas had higher odds of claiming compared to those living in country areas (OR 1.65, 95% CI 1.34-2.01) and drivers of registered vehicles had higher odds of claiming (OR 2.25, 95% CI 1.59-3.18) compared to those in unregistered vehicles. These findings suggest that demographic and situational factors influence the likelihood of lodging a claim, highlighting areas where support could be improved.

The second study from South Australia revealed significant physical, psychological, and financial impacts from road transport injuries among participants. There was a lack of knowledge and support for accessing compensation schemes. Family and community support and connection to country were important parts of the healing process. Only two out of eight participants received compensation for their road transport injuries.

Benefits to Road Safety

Highlighting the barriers faced by Aboriginal and Torres Strait Islander people in accessing compensation can inform targeted interventions to improve support and simplify the claims process. Enhancing access to compensation can aid recovery, reduce disparities, and improve overall road safety outcomes for Aboriginal and Torres Strait Islander people. By addressing these barriers, policymakers and practitioners can develop more effective strategies to support injured individuals and promote equitable access to compensation.

Implications for Policy and/or Practice

Reforms are needed in compensation schemes to ensure they are culturally specific and strength-based. Co-designing compensation schemes with Aboriginal communities can enhance accessibility and effectiveness. Policymakers should consider the unique needs of Aboriginal people in rural and remote areas to reduce inequalities in compensation access. Health services can play a crucial role in supporting and advocating for road transport injury patients eligible for compensation. These reforms have the potential to create more inclusive and supportive systems that better meet the needs of Aboriginal people.

Conclusions

This research underscores the need for changes in road transport injury compensation schemes to better support Aboriginal and Torres Strait Islander people. By addressing the identified barriers in accessibility and considering

protective factors for the cultural determinants of health for Aboriginal communities compensation schemes can be more inclusive and effective. This can ultimately help to reduce the injury burden and improve recovery Aboriginal communities. The findings highlight the importance of involving Aboriginal communities in the design and implementation of compensation schemes to ensure they are responsive to their needs and circumstances.

References

Australian Institute of Health and Welfare (AIHW). (2023, 06 Jul 2023). Injury in Australia: Transport accidents. Retrieved from https://www.aihw.gov.au/reports/injury/transport-accidents

Henley, G., & Harrison, J. E. (2019). Injury of Aboriginal and Torres Strait Islander People Due to Transport; 2010–2011 to 2014-15. Canberra, Australia,: AIHW

Pedestrian crash risk from evasive actions using AI-based video analytics

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Abstract

Pedestrians are a vulnerable road user group, and assessing pedestrian crash risks is crucial to developing targeted countermeasures to improve pedestrian safety. While traffic conflict techniques are becoming popular for estimating crash risks, current pedestrian conflict measures, such as post encroachment time and gap time, do not consider road user behaviour and associated heterogeneity. This study proposes to utilise evasive action-based interactions to estimate pedestrian crashes using risk force theory and artificial intelligence-based video analytics. Generalised Pareto distribution is used to model the risk force estimated for the evasive action-based events, obtained from 72 hours of video data from three signalised intersections in Queensland, Australia. Results indicate that the evasive action-based events provide a reasonable estimate of pedestrian crashes compared to historical crash records. The proposed framework has a strong potential for proactive road safety analysis by studying road user behaviour and interactions.

Social media post

A new technique to estimate pedestrian crash risk proactively by applying AI-based video analytics. #RoadSafety #PedestrianSafety #AIforRoadSafety #QUT

Introduction

Pedestrian fatalities at intersections account for about 27 % of total pedestrian fatalities in Australia (National Road Safety Strategy 2021-30, 2021). To combat this road safety challenge, it is vital to understand pedestrian safety at intersections. Conventional safety assessment techniques relying on crash data do not provide in-depth insights into pedestrian safety problems. In contrast, proactive safety assessment of pedestrian crash risks by applying traffic conflict techniques has been promising. However, segregating unsafe vehicle-pedestrian interactions from regular interactions at intersections is challenging.

A commonly agreed definition of traffic conflict is " an observational situation in which two or more road users approach each other in space and time to such an extent that a collision is imminent if their movements remain unchanged" (Chang et al., 2017). While traditional conflict measures, such as post encroachment time and gap time, provide valuable insights into near-miss situations, they have several limitations related to identifying conflict events at a stage where conflicting road user trajectories have already crossed. Therefore, these measures do not capture the safety-critical information of vehicle-pedestrian interactions and do not consider road user heterogeneities. Moreover, various studies that used these nearness-to-collision measures applied different threshold values (e.g., 4 seconds or 6 seconds) to classify vehicle-pedestrian interactions as conflicts (Arun et al., 2021), leading to additional uncertainties in identifying pedestrian conflicts for a specific context.

In contrast, the risk force theory, proposed by Sahu et al. (2025), incorporates critical road user-specific factors (e.g., reaction time), vehicle-specific attributes (e.g., braking capability), and environmental parameters to quantify the heterogeneity inherent in road user interactions and surrounding environments. Risk force theory proposes that road users naturally maintain a dynamic safety buffer to keep potential hazards at a safe distance. The risk force derived from this theory includes two quantitative measures: road users' psychological charge, which captures their reaction time and maximum braking capacity, and the risk field, which is a spatial buffer zone influenced by user speed and field of view. This risk force dynamically measure perceived crash risk throughout the duration of a conflicting interaction, providing a continuous assessment of collision nearness. However, to effectively implement the risk force measures, it is imperative to identify critical vehicle-pedestrian conflict interactions and separate them from normal road traffic interactions. To address this critical gap, this study proposes to identify pedestrian-vehicle conflicts through evasive action-based events and risk force measures. These conflicts are fitted with extreme value models to estimate the pedestrian crash frequency from observable rare conflict events. The objective of this study is to develop a framework to estimate pedestrian crash risk by integrating evasive action-based vehicle-pedestrian interactions with risk force

theory and extreme value theory. This study contributes to the evolution of a safe system approach that evaluates pre-crash events to estimate crash risks and provides insights into traffic characteristics affecting pedestrian crash risks.

Methodology

In the modelling framework, video analytics is first performed over the recorded video data to extract road user trajectories. A total of 72 hours of video data is used for the analysis, recorded from the three intersections with high pedestrian activity in Queensland, Australia. These videos are processed using an artificial intelligence-based video analytics algorithm (see Figure 1). From the extracted trajectories of vehicle-pedestrian interactions, evasive action-based safety-critical events are identified when an evasive action is taken by either pedestrians or vehicles. Evasive action is defined as either the pedestrian running (speed > 6km/h) or the vehicle braking (deceleration > 4m/s^2)during the interaction. Using the risk force theory, the risk forces are estimated from the identified safety-critical events. Thereafter, an Extreme Value Theory (EVT) model, as detailed in Ali et al. (2023), is applied to estimate pedestrian crash risk from observable safety-critical events identified through evasive actions. In particular, Generalised Pareto distribution is fitted to the risk force values to estimate pedestrian crash risk.

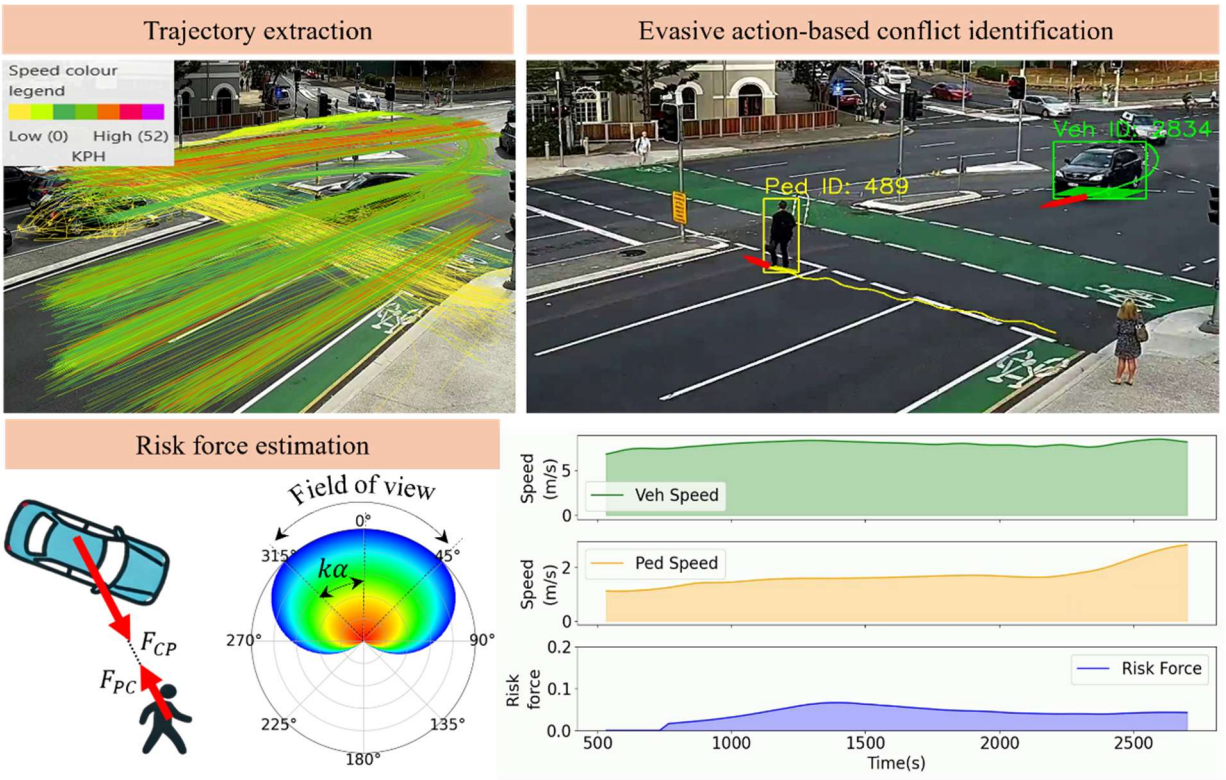


Figure 4. AI-based video analytics for pedestrian crash risk estimation from evasive actions

Result

Stationary and non-stationary (with parameterised scale parameter) generalised Pareto distributions were fitted to the derived risk force values to estimate pedestrian crash risk over a five-year period (2014-18). These estimates were validated against historical crash data from 2014–18, obtained from the Department of Transport and Main Roads, Queensland Government. To quantify the uncertainty associated with crash estimates, 50,000 simulations were conducted and compared against a 95% Poisson confidence interval (CI) for observed crashes. (Songchitruksa et al., 2006). Model estimates are presented in Table 1. Figure 2 illustrates the resulting pedestrian crash frequency estimates. The observed historical crash frequency is 4.00 with a 95% CI of 1.09–10.24, whereas the mean crash frequency estimate for the stationary model is 6.97 (95% CI: 0.00–39.21) and 5.02 (95% CI: 0.00–29.07) for the non-stationary model or the EVT model with parameterised scale parameter.

Results indicate that incorporating the pedestrian-to-turning vehicle frequency ratio per signal cycle as a key covariate affecting pedestrian crash risk in the non-stationary model, markedly improved the model's accuracy (closer mean) and precision (narrower CI) relative to the stationary model. Moreover, the non-stationary model's mean estimate (5.02) closely aligns with the observed crash frequency (4.00), reflecting high predictive accuracy. However, the 95% confidence interval for the non-stationary model (0.00–29.07) is broader than that of the observed frequency (1.09–10.24), underscoring higher uncertainty due to limited observed data.

Table 3. Extreme value model estimates of pedestrian crash frequencies at signalised intersections

Model	Crash Frequency	Scale		Shape	LL	AIC
	Estimate [95%CI]	σ_0 (SE)	σ_{ptvf}(SE)	ε		
Stationary Model	6.97 [0.00,39.21]	0.016(0.002)	-	0.325(0.115)	-278.263	-552.526
Non-Stationary Model	5.02 [0.00,29.07]	-3.762(0.212)	-0.163(0.072)	0.288(0.108)	-280.624	-555.248
Observed	4.00 [1.09,10.24]	-	-	-	-	-

Abbreviation: SE: Standard Error, CI: Confidence Interval, LL: Log-likelihood, AIC: Akaike Information Criterion. Scale parameter: σ_0: intercept, σ_{ptvf}:coefficient for pedestrian-to-turning vehicle frequency ratio per signal cycle, ε: shape parameter

Additionally, the EVT model yields a negative coefficient (-0.16) for the covariate pedestrian-to-turning vehicle frequency ratio per signal cycle, indicating an inverse association between this covariate and pedestrian crash frequency. This result suggests that higher pedestrian volumes tend to encourage more cautious driver behaviour, resulting in reduced crash risk. Overall, the findings highlight the EVT model's effectiveness in accurately predicting crash risk while accounting for the pedestrian-vehicle interaction dynamics that influence pedestrian safety.

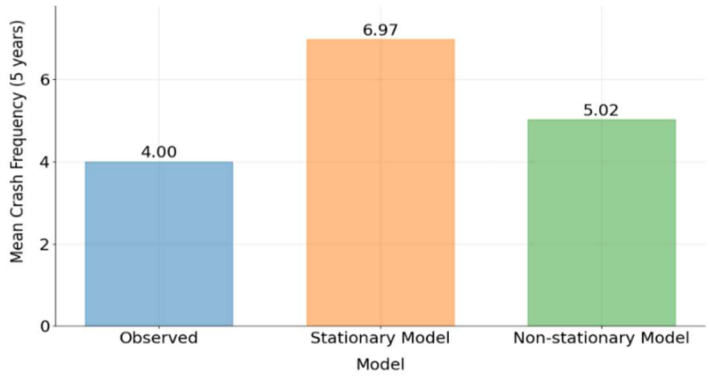


Figure 5. Crash frequency estimates for 5 years (2014-18)

Conclusions

This study proposed a proactive pedestrian crash risk assessment framework using evasive action-based events and risk force theory to measure nearness to collision. Artificial intelligence-based video analytics and extreme value models are applied to estimate pedestrian crashes from the traffic movements of intersections. Results showed that the crash frequency estimates by the proposed extreme value model with a parameterised scale parameter are considerably accurate compared to historical crash records, suggesting that action-based events are good predictors of pedestrian crash risks at intersections. This study advances the scientific literature on traffic safety by linking pedestrian crash frequency to traffic conflicts, paving the way for the development of technological solutions to improve pedestrian safety at signalised intersections.

References

Ali, Y., Haque, M. M., & Mannering, F. (2023). Assessing traffic conflict/crash relationships with extreme value theory: Recent developments and future directions for connected and autonomous vehicle and highway safety research. *Analytic Methods in Accident Research*, *39*, 100276. https://doi.org/10.1016/j.amar.2023.100276

Arun, A., Haque, M. M., Washington, S., Sayed, T., & Mannering, F. (2021). A systematic review of traffic conflict-based safety measures with a focus on application context. *Analytic Methods in Accident Research*, *32*, 100185. https://doi.org/10.1016/j.amar.2021.100185

Chang, A., Saunier, N., & Laureshyn, A. (2017). *Proactive methods for road safety analysis* (WP-0005). https://doi.org/10.4271/WP-0005

National Road Safety Strategy 2021–30. (2021). https://www.roadsafety.gov.au/nrss/developing-national-road-safety-strategy-2021-30

Sahu, S., Ali, Y., Glaser, S., & Haque, M. M. (2025). A physics-informed risk force theory for estimating pedestrian crash risk by severity using artificial intelligence-based video analytics. *Analytic Methods in Accident Research*, *46*, 100382. https:/doi.org/10.1016/j.amar.2025.100382

Songchitruksa, P., & Tarko, A. P. (2006). The extreme value theory approach to safety estimation. *Accident Analysis and Prevention*, *38*(4), 811-822. https://doi.org/10.1016/j.aap.2006.02.003

Do exclusive motorcycle lanes enhance safety? Insights from Bayesian Analysis

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Abstract

Developing countries like India witness a significant presence of motorized two-wheelers in traffic, leading to raised MTW-related crashes. Previous studies suggest that dedicated motorcycle lanes can mitigate such crashes; however, a detailed safety assessment of Exclusive Motorcycle Lanes (EMCLs) remains limited. This study introduces a crash risk evaluation framework for mid-block sections using Bayesian Hierarchical Modeling, employing time-to-collision (TTC) data derived from traffic conflict analysis before and after a temporary EMCL implementation. The analysis integrates a Block Maxima approach with the generalized extreme value distribution and incorporates seven covariates to elucidate the time-varying dynamics of crash risk. Though EMCLs aren't operational in India, temporary implementation on non-urban highways yielded field data. Vehicular trajectory data were extracted and analyzed using traffic conflict techniques, revealing a significant decrease in crash risk post-EMCL implementation. The study's outcomes offer valuable insights for transportation professionals, policymakers, government agencies, and researchers.

Social media post

Exclusive Motorcycle Lanes (EMCLs) can reduce crash risk and enhance safety of road users!

Introduction

In South Asian countries like India, heterogeneous traffic involving vehicles of varied sizes and maneuverability is prevalent. Motorized two-wheelers (MTWs) account for 74.81% of India's 326 million registered vehicles (MoRTH, 2022), and contributed to 44.6% of road crashes in 2021. This critical statistic highlights the urgent need for MTW-focused road safety interventions. The provision of an Exclusive Motorcycle Lane (EMCL), i.e., separating MTW traffic from the main traffic stream by providing a physical barrier, proves to be a commendable tactic to increase the safety of motorcyclists and lessen conflicts with other vehicles (Saini et al., 2022). EMCLs are intended to provide motorcyclists with safety, security, and mobility (Saini et al., 2022). EMCLs built in Malaysia in accordance with ATJ 35:2018 have effectively decreased motorcycle crashes (ATJ, 2018). EMCL gained popularity in Malaysia, Indonesia, Taiwan, and other developing nations over time. However, such lanes are not very popular in India (Saini et al., 2022). In addition, EMCLs are operational in other Asian nations, such as Taiwan and Indonesia, and have been recognized as an effective crash prevention approach (Saini et al., 2022).

Radin Sohadi et al (2000) reported that EMCL significantly abridged motorcycle crashes by 39% with other vehicles in mixed traffic, although an increase in single and multiple motorcycle crashes was observed in the EMCL. A few researchers observed that with the implementation of EMCL in Indonesia, total traffic volume (approx. 25%) and travel speeds (approx. 10km/h) increased for roads with EMCL (Mulyadi, 2018; Saini et al., 2022). Using a microscopic simulation model, Paul et al. further observed that the capacity of the heterogeneous traffic stream increased by 17% with the implementation of EMCL. Despite the above studies, an ample safety analysis of EMCL is missing in the literature. Therefore, this study addresses the research gap on EMCL safety by using traffic conflict techniques and extreme value theory to analyze rear-end crash risk before and after EMCL implementation on non-urban highways.

Methodology

Data collection and Extraction

Given the absence of permanent EMCLs in India, temporary exclusive motorcycle lanes were established using traffic cones along 1-km stretches at three sites in Jammu and Nagpur. Site selection followed IRC 70: 2017,guidelines, requiring a combined MTW and three-wheeler share exceeding 30% and an operational speed above 50 km/h. This approach offered a flexible, low-cost means to simulate EMCL conditions in real-world envioronment. Data were collected via videography for 12 hours at each site before (without EMCL) and after (with EMCL) EMCL implementation. Vehicle trajectory data were extracted using an automated image processing tool. In the “with EMCL” condition, the road was divided into a Mixed Vehicle (MV) lane and a physically delineated EMCL. To reduce

behavioral bias, standard signboards were used and riders were not informed about the temporary nature of the setup. Additionally, the data for analysis were extracted from a point located 500 meters downstream of the EMCL entry, allowing riders sufficient distance to settle into their typical behavior and speed. Figure 1 presentss study corridors and temporary lane configuration

Crash Risk Estimation

Since the present study was carried out on the mid-block section, the rear-end collisions were analyzed using a popularly used surrogate safety indicator, i.e., time to collision (TTC). The TTC indicator is a measurement that estimates the time it would take for a succeeding vehicle to collide with the preceding one if both vehicles maintain their current driving maneuver without any changes. The present study extracted the TTC values for the vehicle categories from the fully automated software. The minimum TTC value observed on the field was 0.08 seconds. The present study considered TTC values of up to 4 seconds to ensure a focused analysis.



a. Nagpur **b. Jammu** **c. Kamptee**

Figure 1. Study corridor locations

In the current study, the block maxima (BM) approach of Extreme Value Theory (EVT) was employed to estimate the crash risk based on a conflict-crash relationship along with the Bayesian Hierarchical approach. Three distinct Bayesian models were developed: Model-1, a non-stationary model incorporating covariates into only the location parameter; Model-2, a non-stationary model incorporating covariates into both the location and scale parameters; and Model-3, a non-stationary model incorporating covariates into only the scale parameter. The different covariates utilized in model development include speed, proportion of MTW, TTC, traffic volume, and the type of interactions (severe, mild, safe).

Results

Figure 2 illustrates the various vehicular interactions observed in the field before and after EMCL implementation. It was observed that after implementing EMCL, interactions involving MTW-Car and MTW-HV were observed. These interactions occur because some MTW riders violate the EMCL regulations by not adhering to the designated lane. Notably, only 81% of motorcyclists adhered to the EMCL rules, while the remaining 19% were violators, which is also a significant limitation of the present study.

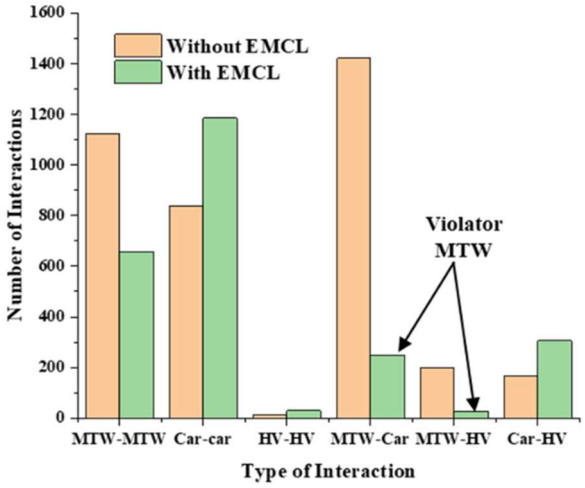


Figure 2. Different Vehicular Interactions

Adhering to the methodology outlined in (Zheng & Sayed, 2019), distinct univariate models were computed for periods before and after Exclusive Motorcycle Lane (EMCL) implementation, and the most fitting models were chosen. The selection for the best model was done based on the lowest WAIC. Table 1 presents the estimation results of the best univariate Bayesian hierarchical model 'for without' and 'with EMCL' cases. Model (1, 1, 0) reported the lowest WAIC value and was chosen for further analysis for both cases, i.e., with and without EMCL. In the case of the 'without

EMCL' best-fitted model, TTC_med was the only significant variable associated with the location parameter of GEV distribution, while the number of severe interactions was associated with the scale parameter. In the case of 'with EMCL' results, three covariates, namely, TTC_med, number of severe and safe interactions, demonstrated a significant association with the location parameter of the GEV distribution. Furthermore, the number of severe interactions was associated with the scale parameter for the best-fitted model. The best-fitted model was employed to anticipate crash risk in both scenarios, i.e., with and without EMCL. The crash risk for each road section was computed.

Figure 3 illustrates the crash risk for individual sections for the whole observation period, along with the average crash risk before and after EMCL implementation. The crash risk presented in Figure 3 is the average of all block intervals for the periods before and after the implementation of the EMCL. Also, the crash risk displayed in Figure 3 indicates the probability of a crash over the total time duration during which data was collected for the scenario. Notably, Figure 3 reveals a discernible reduction in crash risk after implementing EMCL. The decrease can be ascribed to a reduction in interactions between MTW and the remaining vehicular traffic.

Table 1 Estimation results of the best univariate Bayesian hierarchical model for without and with EMCL

Model Parameter		**Without EMCL (1,1,0)**		**With EMCL (1,1,0)**	
		Estimate	**Estimate**	**Estimate**	**Est. Error**
Location (μ)	$\alpha_{\mu 0}[1]$	-0.63649	-0.95313*	-0.95313*	0.06780
	$\alpha_{\mu 0}[2]$	-0.60177	-0.87813*	-0.87813*	0.05335
	$\alpha_{\mu 0}[3]$	-0.45230	-0.97096*	-0.97096*	0.12856
	$\alpha_{\mu}(V_{5\text{-min}})$	-0.00007	0.00004	0.00004	-
	α_{μ}(2w%)	-0.00027	0.00104	0.00104	-
	α_{μ}(Severe)	0.00272	0.02028*	0.02028*	-
	α_{μ}(Mild)	-0.00118	0.00824	0.00824	-
	α_{μ}(Safe)	0.00001	-0.00948*	-0.00948*	-
	α_{μ}(TTC_med)	-0.87750*	-0.68035*	-0.68035*	-
	α_{μ}(Max_speed)	0.00596	-0.00731	-0.00731	-
Modified Scale, $\phi = \log(\sigma)$	$\alpha_{\phi 0}[1]$	-0.30398	-0.47490	-0.47490	0.51485
	$\alpha_{\phi 0}[2]$	-0.30296	-0.50569	-0.50569	0.50248
	$\alpha_{\phi 0}[3]$	-0.47539	-0.41441	-0.41441	0.53492
	$\alpha_{\phi}(V_{5\text{-min}})$	0.00004	0.00008	0.00008	0.00013
	α_{ϕ}(2w%)	0.00019	0.00108	0.00108	0.00240
	α_{ϕ}(Severe)	0.03059*	0.00435	0.00435	0.00843
	α_{ϕ}(Mild)	0.01198	-0.02784*	-0.02784*	0.01021
	α_{ϕ}(Safe)	-0.00783	0.01157*	0.01157*	0.00254
	α_{ϕ}(TTC_med)	0.07170	0.10570	0.10570	0.19785
	α_{ϕ}(Max_speed)	-0.00759	-0.00228	-0.00228	0.00688
Shape (ξ)	$\alpha_{\xi 0}[1]$	-0.12637	-0.32154*	-0.32154*	0.04015
	$\alpha_{\xi 0}[2]$	-0.15626	-0.30216*	-0.30216*	0.03176
	$\alpha_{\xi 0}[3]$	-0.15002	-0.33535*	-0.33535*	0.07420
WAIC		-140.000		-128.100	

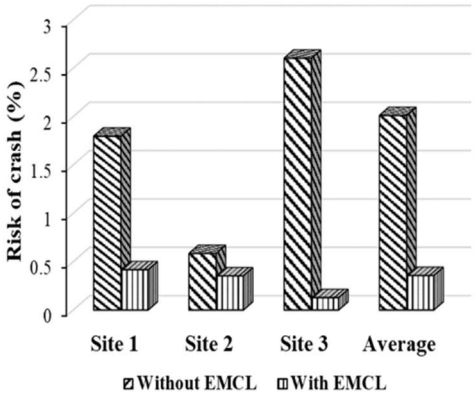


Figure 3 Crash Risk before-after EMCL implementation

Conclusions

A before-after safety analysis was conducted to assess the impact of Exclusive Motorcycle Lanes (EMCL) in Indian heterogeneous traffic conditions, with data collected from a temporary field implementation on three non-urban highways before and after EMCL implementation. Vehicle trajectory data were extracted using automated tools and manually validated. Time-to-collision (TTC) served as the surrogate safety indicator. Crash risk at mid-block sections was estimated using the Generalized Extreme Value (GEV) distribution, based on Extreme Value Theory (EVT). Data were grouped into 5-minute blocks, with the maximum negated TTC per block treated as an extreme event. These were used as inputs in a three-level Bayesian hierarchical model incorporating multiple covariates. Results showed that EMCL implementation significantly reduced crash risk. The study highlights the effectiveness of EVT for micro-level crash estimation and its proactive role in traffic safety management.

References

ATJ, 35/2018. (2018). *Geometric Guideline for Exclusive Motorcycle Lane*. Cawangan Jalan Ibu Pebjat Jabatan Kerja Raya Malaysia.

MoRTH. (2022). Road accidents in India. Transportation Research Wing, Ministry of Road Transport and Highways, Government of India.

Mulyadi, A. M. (2018). Influence of motorcycles lane to the traffic volume and travel speed in Denpasar, Indonesia. *IOP Conference Series: Earth and Environmental Science*, *106*(1).

Radin Sohadi, R. U., Mackay, M., & Hills, B. (2000). Multivariate analysis of motorcycle accidents and the effects of exclusive motorcycle lanes in Malaysia. *Journal of Crash Prevention and Injury Control*, *2*(1), 11–17.

Radin Umar, R. S. (1997). Preliminary cost-benefit analysis of the exclusive motorcycle lane in Malaysia. *REAAA Journal*, *9*.

Saini, H. K., Chouhan, S. S., & Kathuria, A. (2022). Exclusive motorcycle lanes: A systematic review. *IATSS Research*, *46*(3), 411–426.

Zheng, L., & Sayed, T. (2019). A full Bayes approach for traffic conflict-based before–after safety evaluation using extreme value theory. *Accident Analysis & Prevention*, *131*, 308–315.

Safe Active Streets Shifting Road User Behaviours: Collaborative Design Workshop

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Abstract

The WA Department of Transport worked with Western Australian local governments between 2015 and 2023, to develop, trial and evaluate Safe Active Streets (SAS), which use local area traffic management treatments to encourage more people to walk, wheel and ride in their communities. The SAS program trialled and adapted common local area traffic management treatments to create 30 km/hr environments and evaluated their performance against user behaviour and community sentiment. Specific design parameters were determined necessary to shifting road user behaviours towards safer 85th percentile vehicle speeds, lower vehicle numbers and increased active travel on the route. Posted speed reductions with minimal design changes were insufficient to influence consistent and compliant behaviour change. In this workshop, participants will work in small groups to apply a combination of traffic management treatments on differing local streetscapes and discuss the merit of each design on impacting both vehicle and vulnerable road user behaviour.

Social media post

In the Safe Active Streets Shifting Road User Behaviours Collaborative Design Workshop participants will apply and discuss specific design parameters determined necessary to shifting road user behaviours towards safer 85th percentile vehicle speeds, lower vehicle numbers and increased active travel on local streets.

Introduction

Safe Active Streets (SASs) incorporate changes in the posted speed from 50km/hr to 30km/hr, in addition to the application of road safety treatments at regular intervals along a series of connected local streets that form a longer transport route. The use of low cost road safety treatments on local roads is a commonly applied mechanism to reduce crash risk for drivers and vulnerable road users (MRWA, 2022), and the reduction of speed limits to 30km/hr has demonstrated significant reductions in road casualties and crash risk in international studies (Ingamells & Raffle, 2012). The evaluation of Safe Active Streets (SASs) delivered in Western Australia provides evidence of greater Equity and Elasticity due to improved road user behaviours, impacted by the placement of traffic management treatments that enhance compliance with the 30km/hr posted speed; an area of research identified as a gap in current literature (Goel, et al., 2024).

An interactive workshop is the most effective way of demonstrating the design principles applied, reviewing the evaluation outcomes, and discussing how these principles can be applied on other projects in more places. This session will be engaging for all participants, with opportunities for practical reflection on application of strategies for participants' local contexts.

Conference Theme

The issue of road safety for vulnerable road users, such as walkers and bike riders of all ages and abilities, is closely linked with the conference theme of Equity (Dinh & Kubota, 2013; Ingamells & Raffle, 2012). Making local road environments a more attractive, safe and amenable place to walk or ride, links with the theme of Elasticity, especially if it can be shown that efforts to create this enhanced environment lead to a shift in modal choice from car to active travel for short local trips and trips for longer commute purposes (Egli & Field, 2020; Van den Dool, et al., 2017).

This workshop will involve the collaborative re-design of a local street by incorporating parameters that were identified in the evaluation as critical for to shifting road user behaviours towards safer speeds, lower vehicle volumes and increased active travel enroute and to adjacent connected destinations. These can in turn, lead to reduced crash risk and risk of injury severity (Clifton et al., 2009), and return positive social and economic benefits to the community (Aldred & Croft, 2019).

Facilitator

Zarin is an evaluator and strategic planner, who currently leads active transport strategic business case development for Western Australia. Zarin has a PhD in Sustainability Education from UWA and 20 years' experience designing and undertaking evaluations, data collection, analytics, and reporting, and communicating insights with stakeholders. Zarin has a breadth of experience presenting at conferences and facilitating workshops with community, professional and executive groups. She is a confident public speaker, and enjoys designing evaluations and mining data to derive practical insights that can be shared with a wide range of audiences or used to support business cases and strategic goals.

Background and experience of other workshop leaders

Caroline is a civil engineer with 35 years' experience in local and state governments across the United Kingdom and Western Australia. She blends principles of planning, design, cost estimation, delivery, and project management to design and deliver programs and projects that support walking, wheeling, and riding as a transport choice for all. Caroline led the Safe Active Street Program from 2019 to 2023 and found it rewarding to shape a program that changes perceptions of local streets. Caroline enjoys all modes of active travel and chooses the best option for how she is feeling or for the trip.

References

Aldred, R., & Croft, J. (2019). Evaluating active travel and health economic impacts of small streetscape schemes: An exploratory study in London. *Journal of Transport & Health*, *12*, 86–96. https://doi.org/10.1016/j.jth.2018.11.009

Clifton, K. J., Burnier, C. V., & Akar, G. (2009). Severity of injury resulting from pedestrian–vehicle crashes: What can we learn from examining the built environment? *Transportation Research Part D: Transport and Environment*, *14*(6), 425–436. https://doi.org/10.1016/j.trd.2009.01.001

De Vos, J., Schwanen, T., Van Acker, V., & Witlox, F. (2019). Do satisfying walking and cycling trips result in more future trips with active travel modes? An exploratory study. *International Journal of Sustainable Transportation*, *13*(3), 180–196. https://doi.org/10.1080/15568318.2018.1456580

Dinh, DD., & Kubota, H. (2013). Drivers' perceptions regarding speeding and driving on urban residential streets with a 30km/h speed limit. *International Association of Traffic and Safety Sciences Research, 37(1),* 30-38. https://doi.org/10.1016/j.iatssr.2012.12.001

Egli, V., & Field, A. (2020). Safe Active Streets: Rapid literature scan on impacts and learning from 'multiple interconnected sites' interventions. *Prepared for the Department of Transport, WA, by Dovetail Consulting Ltd., Aukland, NZ.*

MRWA. (2022). Strategy and Implementation Framework: Low Cost Urban Road Safety Program. *Main Roads Western Australia, Perth, WA.* low-cost-urban-road-safety-program-strategy-and-implementation-framework.pdf

Goel, R., Tiwari, G., Varghese, M., Bhalla, K., Agrawal, G., Saini, G., Jha, A., John, D., Saran, A., White, H., Mohan, D. (2024). Effectiveness of road safety interventions: An evidence and gap map. *Campbell Systematic Reviews: Better Evidence for a Better World, 20 (1).* https://doi.org/10.1002/cl2.1367

Ingamells, S., & Raffle, A. (2012). 20 mph speed limits are the right policy for sociability, safety, and a healthy population. *BMJ: British Medical Journal.* Page 345. https://doi.org/10.1136/bmj.e6165

SWOV. 2018. 30 km/h zones. SWOV Fact sheet, May 2018. *SWOV, The Hague*. https://www.swov.nl/en/facts-figures/factsheet/30-kmh-zones

Van den Dool, D., Tranter, P., and Boss, A. (2017). Road safety policy and practice safe-street neighbourhoods: The role of lower speed limits. *Journal of the Australasian College of Road Safety, 28(3):* p. 55. Safe-Street Neighbourhoods: the role of lower speed limits - Australasian College of Road Safety (this article was updated in 2019 to include specific insights from WA and NSW 30km/hr street trials)

Intervention preferences and motivation in road user behaviour change

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Presenter: Martin Small

Abstract
This study examines the influence of intervention preferences on road users' behavioural change using 'the COM-B model' in high-risk areas of Bangladesh. Data were collected through on-site interviews (n=102) with pedestrians and drivers who exhibited violation behaviours. Chi-Square and Mann-Whitney U tests revealed significant differences in intervention preferences and motivational factors between the groups. PLS-SEM analysis demonstrated that intervention choices significantly influenced motivation ($\beta = 0.490$, $p < 0.001$), which in turn strongly predicted behaviour change ($\beta = 0.666$, $p < 0.001$). Regression analysis explained 57.1% of the variance in expected behaviour, confirming the role of automatic motivation, reflective motivation, and social opportunity in behavioural change. The model exhibited good fit (SRMR = 0.056) and predictive validity ($Q^2 = 0.171$). Despite the small sample size, the findings highlight the importance of tailored interventions to improve road safety. Future research should explore larger samples for greater generalisability.

Social media post
Working to improve road safety in Bangladesh by integrating behavioural insights, infrastructure design, and policy reforms—focusing on pedestrian safety, driver behaviour, and system-wide interventions for safer, more inclusive roads. #RoadSafety #Bangladesh

Introduction
Road traffic injuries remain a significant public health and safety concern in Bangladesh, with pedestrians among the most vulnerable road users. High-exposure areas such as school zones and marketplaces along national highways create the highest crossing flow (iRAP, 2024). Bangladesh has one of the highest road traffic fatality rates globally, with 102.1 deaths per 10,000 vehicles (The World Bank, 2020). Despite implementing pedestrian safety interventions, such as at-grade crossings and grade-separated facilities, pedestrian compliance remains low, suggesting that existing measures may not fully account for behavioural constraints or environmental influences.

In Bangladesh, there is a significant risk to pedestrian safety due to drivers unyielding to pedestrians and pedestrian violations behaviour (Bhattacharjee et al., 2022; McIlroy et al., 2019). Human factors contribute to approximately 95% of road crashes (Sabey & Taylor, 1980), with a significant proportion influenced by environmental prompts and behavioural violations, such as pedestrian jaywalking and driver speeding. Addressing these violations requires a deeper understanding of the motivations and constraints that shape road user behaviour, where the impact of intervention choices can have a deterministic role.

Co-design methodologies, which emphasise participatory collaboration between system designers and end users, have gained recognition for their potential to develop contextually relevant safety interventions (Colapinto et al., 2022). To manage users' expectations, it is crucial to agree on the intervention type(s) and the degree of behaviour change that can be expected from the design (Nag et al., 2020). To reveal the behavioural factors in the contextual surroundings where they need to interact, the use of behaviour change theories, such as COM-B (Capability, Opportunity, Motivation – Behaviour), can provide a structured framework to assess behavioural determinants and tailor interventions to real-world conditions (Michie et al., 2011).

The Safe System approach underscores shared responsibility in road safety, suggesting that intervention development strategies in Bangladesh need a more inclusive, evidence-based approach to ensure that interventions effectively address the behavioural dimensions of road user violations. This study uses the COM-B model to explore how road users' past unsafe behaviours—such as speeding, jaywalking, or failing to yield—may change if proposed road safety interventions are implemented. In the questionnaire, participants evaluate current site conditions and their own past behaviour, assess selected safety improvements, and express their expected behaviour based on how these interventions influence their capability, opportunity, and motivation.

Capability refers to their physical ease and psychological understanding of using the improved settings. Opportunity reflects external factors (physical) such as space, accessibility, and cooperation from others (Social) that support safe behaviour. Motivation includes both reflective (intentional) and automatic (habitual or emotional) responses. Together, these components help predict whether users are likely to avoid unsafe behaviours in response to the proposed interventions.

This study examines the impact of intervention choices on road users' behavioural dynamics in high-risk areas along national highways in Bangladesh.

Conference theme

This study aligns with the conference theme 'Equity, Elasticity, and Evolution' by approaching road safety through an inclusive, adaptive, and forward-thinking lens. This research supports the development of policies that prioritise equity in road safety, particularly in high-risk environments, by emphasising the perspectives of vulnerable road users. Elasticity is demonstrated by applying the COM-B framework to understand how road user violations, such as pedestrian jaywalking and driver speeding, are influenced by behavioural factors. This allows for adaptable interventions tailored to diverse road safety challenges. Evolution is highlighted by shifting from static, infrastructure-based measures to dynamic, behaviour-driven strategies, integrating participatory design to engage road users in shaping solutions. This study contributes to the evolving people-centred road safety intervention development, fostering safer and more sustainable mobility systems.

Approach

This study employed a mixed-method approach, combining on-site interviews and quantitative analysis to examine factors influencing pedestrian and driver violation behaviours in high-risk areas along two national highways in Bangladesh. A semi-structured questionnaire was used to collect data from 102 participants (pedestrians and drivers) between January and February 2025. Pedestrians who engaged in jaywalking or failed to use designated crossings and drivers who violated speed limits or failed to yield at crossings were surveyed in hazardous locations such as school zones and marketplaces.

To ensure safety during data collection, field staff were trained to identify low-conflict moments—such as traffic slowdowns or pedestrian waiting periods—to approach potential respondents. Pedestrians were interviewed after they had crossed or paused safely near the roadside, while drivers were approached only when parked at rest stops or during fuel breaks, avoiding any active traffic situations. All surveyors wore visible ID vests and followed strict safety protocols to minimise risks. The semi-structured questionnaire explored participants' recent crossing or yielding behaviour, their preferences for specific road safety interventions (e.g., pedestrian fencing, traffic signals, raised crossings), perceptions of effectiveness, and personal motivations. The interviews also considered relevant infrastructure elements such as pedestrian fences, green zones, raised humps, zebra crossings, traffic signals, road diets, and visibility improvements at crossing points.

The study applied the COM-B model to explore how intervention preferences (e.g., fencing vs. greenery, raised crossings vs. traffic signals) influenced road users' capability, opportunity, and motivation to change their violation behaviours. Statistical tests included the Chi-Square test for categorical comparisons, the Mann-Whitney U test for group differences, and PLS-SEM to assess behavioural pathways. Regression and ANOVA validated model fit and predictor significance.

Results

The analysis revealed a significant divergence in intervention preferences between pedestrians and drivers. Pedestrians, including students, showed a clear preference for fencing over greenery for footpath separation and favoured raised humps and enhanced conspicuity at crossings. In contrast, drivers, particularly those operating large vehicles, preferred fencing and raised humps but also placed greater importance on traffic police or signal control for safety. Chi-Square tests confirmed that the difference in preference for fencing over green zones was statistically significant ($\chi^2 = 11.78$, $p < 0.05$), whereas preferences for raised pedestrian crossings versus traffic signals and road humps versus road diets were not significantly different between groups ($p > 0.05$).

Mann-Whitney U tests revealed notable differences in motivation and opportunity between pedestrians and drivers. Pedestrians exhibited significantly higher perceived social opportunity ($U = 1072$, $p < 0.05$, $r = -2.196$) and stronger reflective motivation ($U = 1118$, $p < 0.05$, $r = -2.160$) compared to drivers. Regression analysis further confirmed that intervention preferences significantly influenced motivation and opportunity, leading to behaviour change. Diagnostic

tests, including the Breusch-Pagan Test ($p = 0.154$), VIF (< 3.3), and Durbin-Watson Test (1.845), indicated no issues with heteroskedasticity, multicollinearity, or autocorrelation.

The PLS regression model [Figure 1(a)] explained 57.1% of the variance in expected behaviour change, with ANOVA results [$F(6, 102) = 17.522$, $p < 0.001$] indicating a strong model fit (Adjusted $R^2 = 0.546$). Automatic motivation ($\beta = 0.508$, $p < 0.001$), reflective motivation ($\beta = 0.205$, $p < 0.05$), and social opportunity ($\beta = 0.155$, $p < 0.05$) emerged as significant predictors of behaviour change. The structural model [Figure 1(b)] further highlighted the influence of preferred interventions on motivation ($R^2 = 24\%$), which in turn predicted behaviour change ($R^2 = 53.4\%$). Opportunity ($\beta = 0.490$, $p < 0.001$) played a crucial role in shaping motivation, while motivation ($\beta = 0.666$, $p < 0.001$) emerged as the strongest predictor of behaviour change. Opportunity also had a significant impact on behaviour change ($\beta = 0.117$, $p < 0.05$). Total effect (TE) analysis confirmed that motivation had the highest total effect on behaviour change (TE = 0.666), followed by opportunity's effect on motivation (TE = 0.490) and behaviour change (TE = 0.443). The model fit indicators, including SRMR = 0.056 and predictive Q^2 values (0.171 for behaviour change, 0.205 for motivation), further validated the model's robustness.

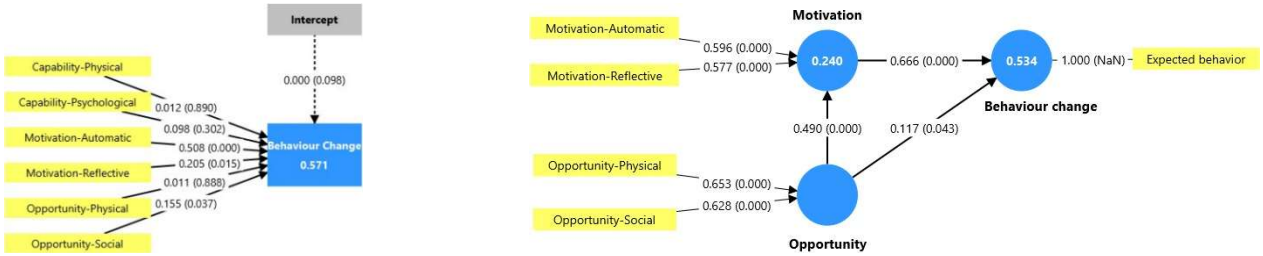


Figure 1. (a) The Regression model (left) and (b) prediction model (right) of road user behaviour change

Benefits to road safety

The findings of this study offer valuable insights into road safety by identifying effective interventions that align with the behavioural motivations and preferences of pedestrians and drivers. By understanding how social opportunity and motivation influence road user behaviour, policymakers can design targeted interventions, such as fencing, raised humps, and improved conspicuity at crossings, to reduce violations and enhance compliance. The study's regression model underscores the pivotal role of motivation in behaviour change, suggesting that effective interventions should go beyond physical infrastructure to actively promote behavioural shifts through targeted enforcement measures and awareness programs. Additionally, recognising the differing safety priorities of road users enables a more inclusive approach to infrastructure planning, ultimately leading to safer pedestrian crossings, reduced speeding, and improved yielding behaviour. By integrating these insights into road safety policies and infrastructure development, authorities can enhance compliance, mitigate risks in high-risk zones, and contribute to a safer transportation environment for all road users.

These findings bridge the behavioural gap between what interventions people prefer and how those preferences translate into meaningful behaviour change. The strong predictive role of motivation in the model supports the notion that even well-designed infrastructure will have limited impact without complementary behavioural interventions. In this context, motivation emerges as the engine behind yielding or compliance, while opportunity—like the presence of group crossings or clear signage—acts as a facilitator. The statistical outcomes, such as the high variance explained in expected behaviour (57.1%) and significant contributions of motivation and opportunity, reinforce that behavioural design must accompany engineering solutions. The interpretation of these results informs an integrated policy direction: combining emotional appeal, social reinforcement, and functional infrastructure.

Implications for policy and/or practice

The findings of this study have significant implications for both policy and practice in the human behaviour domain in road safety management. By identifying behavioural determinants of road user violations through the COM-B framework, policymakers can focus on creating space for road users to express their intervention choices to contribute to producing people-centric solutions beyond traditional infrastructure solutions. Integrating behavioural insights into road safety programs can lead to more adaptive and context-specific measures, ensuring that interventions address the root causes of risky behaviours rather than imposing generic solutions.

Conclusions

In high-risk traffic conditions for vulnerable road users, this study reveals significant disparities in the intervention preferences of drivers and pedestrians. While both groups favour physical separation (e.g., fencing) and raised crossings, their reliance on enforcement measures such as traffic signals and police control differ. The findings underscore the role of motivation as the strongest determinant of behaviour change, with social opportunity and intervention satisfaction also playing significant roles.

The results suggest that policymakers should focus on interventions that enhance automatic and reflective motivation while leveraging social opportunity to foster sustainable behaviour change. Future road safety strategies should integrate infrastructure modifications (e.g., raised crossings, fencing) with behavioural interventions (e.g., awareness programs, community engagement) to ensure compliance and long-term effectiveness. Although the sample size is limited, the findings emphasise the need for tailored interventions to enhance road safety. Future studies with larger samples are necessary to improve generalisability and strengthen the robustness of these insights.

References

Bhattacharjee, A., Mahmud, S. S., Raihan, M. A., Hazra, P., & Hasan, M. F. (2022). Pedestrian Safety in Dhaka Mega City of Bangladesh: Behaviour, Attitude and Risk Perception. *Journal of Engineering Science*, *13*(2), 117-125. https://doi.org/10.3329/jes.v13i2.63732.

Colapinto, C., Finotto, V., Pavan, D., & Pranovi, F. (2022). Redefining and Reframing a City: Co-Designing a New City Model in Venice–Universities and Society to Envision a Resident-Friendly Future. In *Handbook of Research on Urban Tourism, Viral Society, and the Impact of the COVID-19 Pandemic* (pp. 265-282). IGI Global.

iRAP. (2024). Developing Safe Road Improvement Plan for selected highways in Bangladesh iRAP Insights – pilot sections of N4 & N6, Interim Report, 24 November 2024, PricewaterhouseCoopers. Bangladesh Road Safety project.

McIlroy, R. C., Plant, K. L., Jikyong, U., Nam, V. H., Bunyasi, B., Kokwaro, G. O., ... & Stanton, N. A. (2019). Vulnerable road users in low-, middle-, and high-income countries: validation of a pedestrian behaviour questionnaire. *Accident Analysis & Prevention*, *131*, 80-94. https://doi.org/10.1016/j.aap.2019.05.027.

Michie, S., Van Stralen, M. M., & West, R. (2011). The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implementation science*, *6*, 1-12. https://doi:10.1186/1748-5908-6-42

Nag, D., Bhaduri, E., Kumar, G. P., & Goswami, A. K. (2020). Assessment of relationships between user satisfaction, physical environment, and user behaviour in pedestrian infrastructure. *Transportation research procedia*, *48*, 2343-2363. https://doi.org/10.1016/j.trpro.2020.08.284.

Sabey, B. E., & Taylor, H. (1980). *The known risks we run: the highway* (pp. 43-70). Springer US.

The World Bank. (2020). Delivering Road Safety in Bangladesh: Leadership Priorities and Initiatives to 2030.

Promoting pedestrian safety through improved driver yielding: a behavioural intervention

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Abstract
Pedestrian safety remains a critical challenge in low- and middle-income countries (LMICs), where road safety interventions often overlook the behavioural dynamics between drivers and pedestrians at crossings. This study applies the COM-B (Capability, Opportunity, Motivation, and Behaviour) framework to examine how pedestrian characteristics and crossing infrastructure influence driver yielding behaviour at highway crossings in Bangladesh. Using survey data from 202 drivers, 25 factors affecting yielding behaviour were assessed. A model with 14 key factors explained 39.2% of the variance, with motivation as the strongest predictor, followed by opportunity. A refined model, which focused exclusively on pedestrian influences on drivers' decisions by excluding drivers' self-motivation and capability factors, increased the explanatory power to 39.6%. Findings emphasise the importance of pedestrian assertiveness and rule adherence in shaping driver decisions. Integrating behavioural insights with infrastructure improvements, such as clear signage and pedestrian-safe zones, can foster safer crossings, supporting adaptive, behaviour-informed interventions in LMICs.

Social media post
Working to improve road safety in Bangladesh by integrating behavioural insights, infrastructure design, and policy reforms—focusing on pedestrian safety, driver behaviour, and system-wide interventions for safer, more inclusive roads. #RoadSafety #Bangladesh

Introduction
Road traffic crashes cause 1.3 million deaths annually, with 20 to 50 million more injured (WHO, 2023). Vulnerable road users (VRUs), particularly pedestrians aged 5–29, face significant risks, especially in LMICs where rapid urbanisation and increased vehicle numbers have intensified pedestrian-vehicle conflicts. In Bangladesh, high pedestrian crossing flows near industrial, commercial, and educational zones expose large populations to unsafe conditions. Poor infrastructure and low driver compliance exacerbate pedestrian safety issues, as zebra crossings, widely used due to cost constraints, often fail to ensure protection (Tulu et al., 2013; Pawar & Patil, 2015).

While studies have explored pedestrian behaviour, research on drivers' perceptions of pedestrian characteristics and contextual cues at crossings remains limited (Akgün-Tanbay et al., 2022). Road safety interventions in LMICs often replicate models from high-income countries, overlooking behavioural dynamics (Salmon et al., 2016). Pedestrian-vehicle collisions result from a combination of pedestrian characteristics, crossing infrastructure, and contextual cues influencing decision-making (Ezzati et al., 2019). While previous studies identified pedestrian behaviour factors, they inadequately addressed how drivers respond to these cues (Rasouli & Tsotsos, 2019; Anciaes et al., 2020).

Sarker et al. (2023) applied the COM-B model to assess pedestrian attitudes in Bangladesh, finding that opportunity strongly influenced safe crossings, with motivation as a key mediator. However, pedestrian attributes' effects on driver yielding remain underexplored. Given the marginalisation of VRU safety in research and resource allocation, this study addresses the gap by examining how pedestrian characteristics and contextual factors shape driver yielding behaviour at highway crossings. Findings aim to inform targeted interventions that enhance pedestrian safety in LMICs.

Conference theme
This work aligns with the conference theme "Equity, Elasticity, Evolution" by addressing equity through its focus on improving pedestrian safety, particularly for vulnerable road users (VRUs) in Bangladesh. The study explores how contextual factors and pedestrian characteristics influence driver yielding behaviour, promoting safer crossings in low- and middle-income countries where infrastructure and resources are often limited. The elasticity of road safety measures

is examined through the application of behavioural interventions that adapt to the local context, enhancing safety even in challenging environments. Lastly, the evolutionary aspect is reflected in the research's aim to evolve road safety systems by incorporating behavioural insights and adjusting strategies to meet the unique needs of developing countries, ultimately fostering a more inclusive and adaptive approach to road safety.

Method

The research team conducted driver interviews using a survey questionnaire to assess 25 factors affecting yielding behaviour along two high-risk national highways in Bangladesh. Data collection took place between December 2021 and March 2022. This study employed the COM-B model (Michie et al., 2011) to investigate the factors influencing drivers' yielding behaviour at pedestrian crossings. The model integrates three core components: Capability, Opportunity, and Motivation, to predict drivers' actions. The study hypothesises that pedestrian attributes and environmental factors, such as crossing facilities and pedestrian behaviour, directly impact drivers' yielding decisions. Four hypotheses were framed to explore these relationships: (H1) Drivers' capabilities (physical and psychological) significantly influence yielding behaviour; (H2) Opportunities at crossings (both physical and social) shape drivers' motivation and behaviour; (H3) Motivation, driven by pedestrian behaviour and environmental cues, influences yielding decisions; and (H4) Pedestrians' actions and attributes are the strongest predictors of drivers' motivation and yielding behaviour. These hypotheses reflect how individual and environmental factors interact to shape safe pedestrian-driver interactions, providing a basis for intervention development aimed at improving road safety.

Results

The results from the structural model analysis demonstrated that the 14-factor model (see Figure 1) effectively explained drivers' motivation with six factors, and opportunity and capability each with four factors.

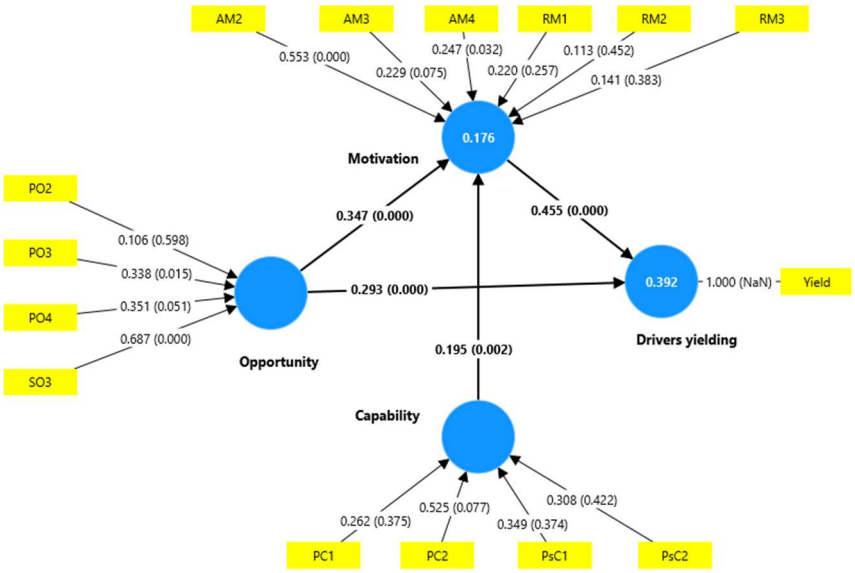


Figure 1. The prediction model of drivers yielding (14-factor model)

The model accounted for 39.2% of the variance in drivers' yielding behaviour and 17.6% in motivation, with a standardised root mean square residual (SRMR) of 0.043, indicating a good model fit. Additionally, the Q^2 values of 0.186 for yielding behaviour and 0.091 for motivation suggested predictive validity beyond the sample. In terms of motivation, six key factors were identified, all of which aligned with the relevant Theoretical Domains Framework (TDF) domains, including beliefs about consequences, social/professional role, reinforcement, and emotional responses to pedestrian behaviour. Within the opportunity construct, significant contributors were enforcement measures (λ = 0.338, PO3) and pedestrian group crossing (λ = 0.687, SO3). Notable automatic motivators within the motivation construct included the presence of vulnerable pedestrians (λ = 0.553, AM2) and visible expressions of fear (λ = 0.247, AM4). Both opportunity and capability were significant predictors of motivation, with opportunity (β = 0.347, $p < 0.001$) and capability (β = 0.195, $p < 0.01$) significantly influencing motivation. Furthermore, both motivation (β = 0.455, $p < 0.001$) and opportunity (β = 0.293, $p < 0.001$) significantly predicted drivers' yielding behaviour. The total effect analysis showed that motivation (TE = 0.455) had the highest total effect on drivers' yielding behaviour, followed by opportunity (TE = 0.451) and capability (TE = 0.195). In the refined 12-factor model, RM3 and PsC2 were excluded to focus on pedestrian influences, as they reflected drivers' self-driven decisions rather than pedestrian impact.

Motivation remained the strongest predictor (TE = 0.458), followed by opportunity (TE = 0.453) and capability (TE = 0.181). This final model also exhibited improved fit (SRMR = 0.042) and substantial explanatory power (39.6%). Hence, the hypothesis testing results confirmed that all hypotheses (H 1-4) were supported.

Benefits to road safety

The findings of this study offer significant benefits to road safety, particularly by highlighting the key factors that influence drivers' yielding behaviour at pedestrian crossings. By understanding the roles of motivation, opportunity, and capability in drivers' decisions, targeted interventions can be designed to enhance pedestrian safety. For instance, reinforcing drivers' motivation through emotional responses to vulnerable pedestrians, such as children or women, and improving opportunities like visible traffic signs and effective enforcement can lead to safer crossing behaviours. Additionally, enhancing drivers' capability by improving their judgment and response times at crossings can further reduce accidents.

These insights can inform policy recommendations, road safety campaigns, and infrastructure improvements, contributing to the overall reduction of pedestrian-related injuries and fatalities. Ultimately, this research supports the development of more effective, evidence-based strategies for creating safer road environments, benefiting both pedestrians and drivers.

Implications for policy and/or practice

The findings of this study have several important implications for both policy and practice in road safety. Policymakers can use the insights to prioritise the implementation of measures that target the key factors influencing drivers' yielding behaviour, such as enhancing the visibility of vulnerable pedestrians (e.g., children, women), strengthening enforcement of traffic laws, and improving road infrastructure, such as traffic signs and pedestrian fences. The study emphasises the need for policies that address not only the physical environment (e.g., road markings, pedestrian crossings) but also social influences, such as promoting responsible driving behaviour through campaigns focused on empathy and emotional responses to vulnerable pedestrians. In practice, road safety programs can be tailored to focus on training drivers to improve their judgment and response times, as well as raising awareness of the importance of yielding to pedestrians in specific contexts, like busy pedestrian group crossings. Additionally, the study's findings suggest that combining motivation-based interventions with environmental and social strategies can enhance the effectiveness of road safety efforts. Overall, these implications call for a more holistic approach to road safety management that integrates behaviour change strategies with infrastructure and enforcement measures, ultimately aiming for safer roads and reduced pedestrian fatalities and injuries.

Conclusions

This study underscores the critical role of motivation, capability, and opportunity in influencing drivers' yielding behaviour at pedestrian crossings, using the COM-B behaviour change framework to develop a model tailored to the local context. The findings suggest that addressing both the capabilities and motivations of drivers, with a particular focus on pedestrian-related elements, is vital for improving pedestrian safety. Specifically, interventions should target drivers' attitudes towards pedestrians, increasing their empathy and awareness of pedestrian vulnerabilities, particularly for high-risk groups like children and the elderly. This approach, which combines emotional responses with reflective motivation, has the potential to create more consistent yielding behaviour. Additionally, enhancing drivers' ability to recognise and respond to pedestrian cues, such as hand gestures and eye contact, can significantly improve their decision-making at crossings, especially at unsignalised crossings. Training programs that focus on improving drivers' judgment of pedestrian actions, speed, and distance can be more impactful than merely modifying crossing contexts. Furthermore, restructuring the environment through clear signage, road markings, pedestrian fences, and community-based group crossing initiatives can increase both the physical and social opportunities for safer pedestrian interactions. In sum, this study provides evidence that interventions focused on fostering empathy and improving drivers' capabilities, in combination with environmental restructuring, can significantly enhance pedestrian safety. Addressing these areas is likely to result in a more significant and lasting impact on drivers' yielding behaviour than merely changing crossing conditions, particularly in regions with prevalent non-yielding behaviour. These strategies are essential for creating safer roads and reducing pedestrian accidents, benefiting both drivers and pedestrians by fostering a shared commitment to road safety.

References

Akgün-Tanbay, N., Campisi, T., Tanbay, T., Tesoriere, G., & Dissanayake, D. (2022). Modelling road user perceptions towards safety, comfort, and chaos at shared space: the via maqueda case study, Italy. *Journal of advanced transportation*, *2022*(1), 4979496. https://doi.org/10.1155/2022/4979496.

Ezzati Amini, R., Katrakazas, C., & Antoniou, C. (2019). Negotiation and decision-making for a pedestrian roadway crossing: A literature review. *Sustainability*, *11*(23), 6713. https://doi.org/10.3390/su11236713.

Anciaes, P., Di Guardo, G., & Jones, P. (2020). Factors explaining driver yielding behaviour towards pedestrians at courtesy crossings. *Transportation research part F: traffic psychology and behaviour*, *73*, 453-469. https://doi:10.1016/j.trf.2020.07.006.

Michie, S., Van Stralen, M. M., & West, R. (2011). The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implementation science*, *6*, 1-12.

Pawar, D. S., & Patil, G. R. (2015). Pedestrian temporal and spatial gap acceptance at mid-block street crossing in developing world. *Journal of safety research*, *52*, 39-46. https://doi.org/10.1016/j.jsr.2014.12.006.

Rasouli, A., & Tsotsos, J. K. (2019). Autonomous vehicles that interact with pedestrians: A survey of theory and practice. *IEEE transactions on intelligent transportation systems*, *21*(3), 900-918. https://doi.org/10.1109/TITS.2019.2901817.

Sarker, M. S., Carsten, O., Huang, Y., & Hajiseyedjavadi, F. (2023). Motivations of pedestrians for safe use of highway crossing: an application of the behaviour change model COM-B in Bangladesh. *Traffic Safety Research*, *4*.https://doi.org/10.55329/apul4688.

Tulu, G. S., Washington, S., King, M., & Haque, M. D. (2013). Why are pedestrian crashes so different in developing countries? A review of relevant factors in relation to their impact in Ethiopia. In *Australasian Transport Research Forum 2013 Proceedings* (pp. 1-18). Australasian Transport Research Forum.

WHO. (2023). Road traffic injuries. https://www.who.int/news-room/fact-sheets/detail/road-traffic-injuries

Applying theory to explore low-level speeding perceptions in Western Australia

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Abstract

Low-level speeding (≤5 km/h over posted limits) is seemingly an intractable risk behaviour. Central tenets of psychological health behaviour change theories are that we behave according to perceived risks and benefits. This study explored whether providing information to heighten the perceived risk (to outweigh perceived benefits) of low-level speeding might improve intentions to drive/ride within the speed limit. Items to test this were embedded in an online survey of a representative sample of 2,281 Western Australian drivers/riders. We asked participants about their low-level speeding in 60 km/h zones over the past year, provided the risk information, and then asked about intentions for the coming year. Findings suggest those reporting *Never* intending to low-level speed doubled (from 10 to 20%); however, 30% reporting *Often* or *Always* did not change. Applying theory offers promise with this single element indicating success for sometimes speeders. Other elements may prove useful to target everyday speeders.

Social media post

WA drivers and riders reported their speeding patterns, then read evidence that 5 km/h over the speed limit is as risky as driving with a 0.05 BAC. For some, the information increased intention not to low-level speed, representing possible new ways to communicate speeding risks.

Introduction

Driving too fast is one of the most pervasive contributing factors to road crashes and their severity (Job & Brodie, 2022), yet also commonly socially acceptable among driver populations, at least when not at extreme levels (Johnston & Howard, 2017). This research project sought to explore representative views of speed and speeding among licensed drivers and motorcycle riders in Western Australia. Scoping recent literature on speed-related surveys (e.g., Kaye et al., 2024), we found several examples that aimed to measure attitudes and engagement in such behaviour, although few explored associated psychological constructs, including risk perceptions, that might further explain responses.

While psychological determinants of health behaviours are many and complex, theories such as the Health Belief Model include a social cognition focus, proposing individuals' thoughts regarding risks and benefits underlie their actions (Hagger, 2025). Based on the conceptualisation of safe driving/riding as a social health behaviour, the objective of the current research was to explore whether providing particular information about the risk (to outweigh perceived benefits) of low-level speeding might improve intentions to drive/ride within the speed limit.

Conference theme

Much effort has focused on reducing high-risk driver/rider behaviours on-road. Success has been achieved in reducing many risky behaviours over the previous decades, yet speeding, especially at low-levels, remains largely socially acceptable. The central pillar of Safe Speeds in the Safe System has supported reductions in posted speed limits as a key focus, yet road users do not all comply with limits. Evolution of the system is needed to support efforts to also change the speeding culture in Australia as part of enhancing Safe Road Users.

Method

Measure

A survey was developed to include standard speed and speeding related items drawn from recent surveys, and to then prompt respondents with fact-based information to determine if this might shift their intentions regarding low-level speeding. To align with six-monthly monitoring surveys conducted in WA, we asked participants to rate their typical speeding behaviour over the past 12 months on roads with posted speeds of 60 km/h and 110 km/h, and on unsealed roads (for which the default maximum speed limit in WA is 110 km/h), as Never, Rarely, Sometimes, Often or Always. Then, knowing that the blood alcohol concentration (BAC) limit of 0.05% is well accepted and generally well adhered to in WA, we included the following statements: Travelling at 5 km/h above the speed limit in built-up areas doubles your risk of a serious crash. This is the same risk as driving with an illegal blood alcohol level of 0.05% (see for

example, Haworth et al., 2001). This was followed by two items with the same Never to Always scale: Over the next 12 months, how often are you likely to drive [ride] over the legal blood alcohol limit? and Over the next 12 months, how often are you likely to drive [ride] at 5 km/h or more over the legal speed limit?

Participants and Procedure

In September 2024, a sample of 2,281 participants was recruited by Verian, a social marketing company that conducts six-monthly road safety surveys in WA, applying consistent procedures as those surveys. Respondents were invited to complete an online survey of approximately 20 minutes duration and received incentive points that could later be redeemed for a range of products. Screening questions excluded participation if they or any family members worked in the following roles: advertising or media, market research, police service or organisation involved in road safety. Other exclusionary criteria used were: aged 17 or below, did not live in WA, held learner or moped licences only, or not licensed. The sampling strategy included pre-weighting to be representative of the WA population as much as possible, including by age, gender, Aboriginal status and location. If respondents held multiple licence types, the following hierarchy was prioritised such that respondents were asked to respond relative to driving/riding on that licence: heavy vehicle, motorcycle then car only. Post-weighting of all data was also then applied to be representative of the WA population by age, gender and region (consistent with the process used in the WA six-monthly surveys). This increases confidence in concluding that the views provided are representative across key demographic groups in WA (while space is not permitting within the Extended Abstract, results relative to these demographic groups will be presented at the conference).

Results

A total of 2,281 responses were received. Two invalid incomplete responses were subsequently removed, resulting in a final sample size of 2,279. Table 1 summarises the respondents by demographics, unweighted and weighted. The majority at 79.4% (n=1,810) held only a car licence, with 12.1% (n=276) responding as a heavy vehicle driver and 8.5% (n=193) as a motorcycle rider.

Table 4. Overall sample demographics with weighted/unweighted data

Background characteristic		Unweighted	Weighted
Gender	Male	1062 (46.6%)	1117 (49.0%)
	Female	1207 (53.0%)	1152 (50.6%)
	Non-binary/Prefer not to say	10 (0.4%)	10 (0.4%)
Age	17-29 years	371 (16.3%)	450 (19.8%)
	30-39 years	569 (25.0%)	446 (19.6%)
	40-49 years	408 (17.9%)	385 (16.9%)
	50-59 years	318 (14.0%)	366 (16.1%)
	60-69 years	340 (14.9%)	309 (13.6%)
	70 years and over	273 (12.0%)	322 (14.1%)
Area of residence	Metro	1805 (79.2%)	1823 (80.0%)
	Regional	474 (20.8%)	456 (20.0%)
Total		2279 (100%)	2279 (100%)

Table 2 summarises responses regarding self-reported speeding behaviour over the past 12 months, showing that speeding was somewhat commonly reported on 60 km/h roads at the lowest level, but less so at higher levels and in the other two conditions. For example, on 60 km/h roads, 30.3% reported driving/riding 1–5 km/h over *Often* or *Always*, compared to 8.4% for 6–10 km/h over, and 2.6 % for 11+ km/h over. On a 110 km/h road, 22.5% of participants reported driving/riding 1–5 km/h over *Often* or *Always*, compared to 9.1% for 6–10 km/h over, and 2.9% for 11+ km/h over.

Figure 1 summarises illegal BAC and speeding intentions over the next 12 months following receipt of information equating 5 km/h over the speed limit in a 60 km/h zone to a BAC of 0.05. The findings clearly contrast a much greater self-reported likelihood of speeding than drink-driving/riding; with only 22% reporting *Never* for low-level speeding compared to 84% for driving/riding with an illegal BAC. However, this figure was approximately double the proportion (10.7%) reporting that they never drove/rode 1-5 km/h over in a 60 km/h zone over the previous 12 months. Further, the original proportion of the sample that reported *Often* or *Always* drive/ride 1-5 km/h over the speed limit over the previous 12 months was ~30%, whereas the equivalent responses for intentions was more than halved at only 14%.

Table 2. Participants' self-reported speeding behaviour on 60 km/hr, 110 km/hr and unsealed roads

Speed limit	n (%)					
	N.A	Never	Rarely	Sometimes	Often	Always
Had driven/ridden over the posted speed limit on a 60 km/h road						
1-5 km/h over	8 (.3%)	244 (10.7%)	574 (25.2%)	761 (33.4%)	530 (23.2%)	162 (7.1%)
6-10 km/h over	13 (.6%)	807 (35.4%)	819 (35.9%)	446 (19.6%)	156 (6.8%)	37 (1.6%)
11+ km/h over	12 (.5%)	1542 (67.6%)	514 (22.5%)	153 (6.7%)	38 (1.7%)	21 (.9%)
Had driven/ridden over the posted speed limit on a 110 km/h road						
1-5 km/h over	38 (1.7%)	609 (26.7%)	520 (22.8%)	599 (26.3%)	380 (16.7%)	133 (5.8%)
6-10 km/h over	42 (1.8%)	1053 (46.2%)	592 (26.0%)	384 (16.9%)	167 (7.3%)	40 (1.8%)
11+ km/h over	43 (1.9%)	1564 (68.6%)	455 (20.0%)	151 (6.6%)	52 (2.3%)	14 (.6%)
Had driven/ridden on an unsealed road at a speed of						
91-100 km/h	159 (7.0%)	1298 (57.0%)	472 (20.7%)	212 (9.3%)	99 (4.3%)	39 (1.7%)
101-110 km/h	168 (7.4%)	1618 (71.0%)	300 (13.2%)	121 (5.3%)	45 (2.0%)	27 (1.2%)
>110 km/h	166 (7.3%)	1850 (81.2%)	189 (8.3%)	45 (2.0%)	13 (.6%)	17 (.7%)

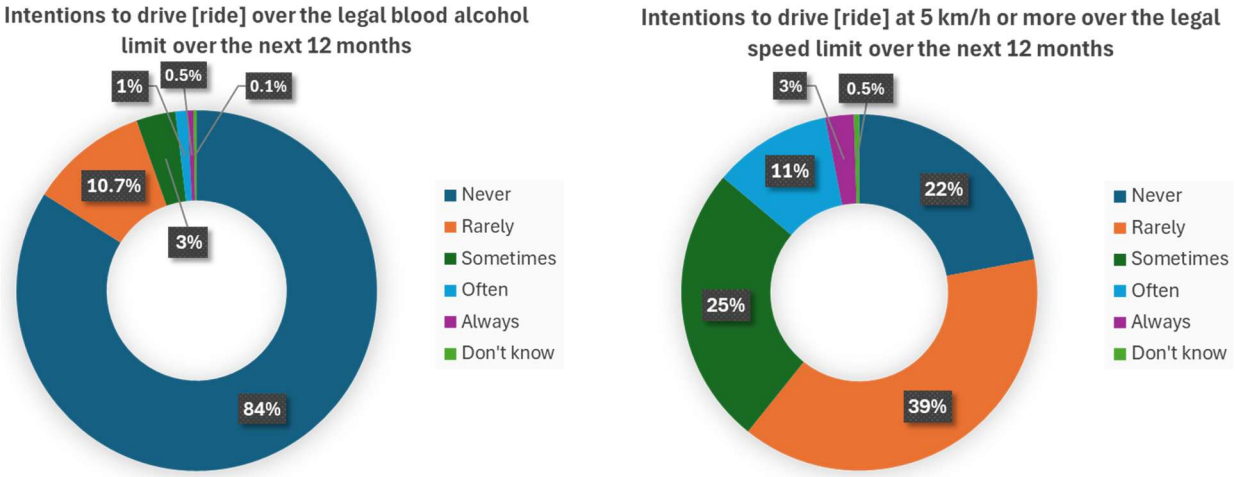


Figure 1. Particpants' intentions to drive/ride over the legal blood alcohol level and to drive/ride at 5km/h or more over the legal speed limit in the next 12 months

Conclusions

This project investigated current views and self-reported behaviour relating to speeding among a representative sample of WA drivers and riders. Applying core elements of psychological social-cognition theory, we explored whether informing participants of the heightened risk of low-level speeding and equating this to a widely understood risky road use behaviour (drink driving) might influence their future speeding intentions. The results suggest a doubling of participants intending not to speed at up to 5 km/h in 60 km/h zones and halving of the proportion reporting this as intended often or always. Additional analysis is needed to determine true within-subjects changes and potential differences by driver/rider demographics, whether responding as a car, motorcycle or heavy vehicle driver/rider, and by WA region. While weighting data for driver/rider demographics by region was not available, weights were applied to increase representativeness of views by age and gender distribution by regions. As a first exploratory study, the survey did not measure other potential psychological theory determinants, such as self-efficacy not to speed (Hagger, 2025), which is a limitation to address in future research. However, overall, the findings indicate there is value in applying theory, such as Health Belief Model constructs, to inform and potentially shift speeding intentions. For example, the current approach could be synthesised with WA's routine surveys in relation to speeding and other behavioural risk factors to identify key messaging needed for public education campaigns. Further elements of psychological health behaviour change theories are worthy of exploration as we work to evolve our efforts towards reaching Australian targets of reducing and eliminating crash fatalities and serious injuries in the coming decades.

References

Hagger, M. S. (2025). Psychological determinants of health behaviour. *Annual Review of Psychology, 76*, 821–850. https://doi.org/10.1146/annurev-psych-020124-114222

Haworth, N., Ungers, B., Vulcan, P., & Corben, B. (2001). *Evaluation of a 50 km/h Default Urban Speed Limit for Australia*. Monash University Accident Research Centre (MUARC). National Road Transport Commission. ISBN 0 642 54494 8. https://www.monash.edu/__data/assets/pdf_file/0010/217837/nrtcsped.pdf

Job, S. & Brodie, C. (2022). Understanding the role of speeding and speed in serious crash trauma: a case study of New Zealand. *Journal of Road Safety, 33*(1), 5–25. https://doi.org/10.33492/JRS-D-21-00069

Johnston, I. & Howard, E. (2017). Promoting "Safe Speeds" behaviour by changing the conversation around speed and speeding. *Journal of the Australian College of Road Safety, 28*(3), 69–72. https://journalofroadsafety.org/article/32183

Kaye, S.-A., Watson-Brown, N., Lewis, I., Oviedo-Trespalacios, O., & Senserrick, T. (2024). Drivers' perceptions of the effectiveness of traditional and technology-based speeding-related countermeasures. *Transportation Research Part F: Traffic Psychology and Behaviour*, *104*, 348–358. https://doi.org/10.1016/j.trf.2024.06.010

How partnership-based general deterrence changed perceptions of drink-driving

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Abstract
A partnership between Auckland Transport and New Zealand Police, through two coordinated campaigns, demonstrated a positive shift in public perception and behaviour regarding drink-driving. The coordinated efforts, including compulsory breath testing and targeted media campaigns resulted in a 10% increase in the percentage of Aucklanders who agreed "if someone drinks and drives, they are likely to get caught", from December 2023 to November 2024. The percentage of Auckland drivers caught over the 250-mcg breath alcohol limit during the main weekend drinking hours decreased from 3.8% in FY 20/21 to 1.8% in FY 23/24. These promising results support that high numbers of compulsory breath tests in Auckland, combined with general deterrence marketing, were accompanied by a decrease in drivers caught with breath alcohol levels over the limit during the main weekend drinking hours. Future efforts should continue to explore new partnerships and leverage diverse channels to sustain and enhance these positive outcomes.

Social media post
Auckland Transport and New Zealand Police coordinated campaigns combined compulsory breath testing and targeted media campaigns. Results showed a 10% increase in Aucklanders agreeing someone who drinks and drives is likely to get caught and a decrease in the percentage of drivers caught over the breath alcohol limit.

Introduction
From early 1900s until 1960, people in New Zealand had one hour from finishing work to get to the local bar or pub before they closed at six o'clock (New Zealand Parliament, 2017). The lasting impacts of this societal attitude of needing to drink quickly is reflected in New Zealand's binge drinking culture. Today, New Zealand Police has specific deployment to high alcohol risk times to help reduce alcohol-related road trauma. This is informed by research which shows risk factors for fatal crashes include being affected by alcohol or drugs, males and drivers under 30 years of age (Keall et al., 2004, Harris et al., 2022). While in Auckland, New Zealand's largest metropolitan area, alcohol was recorded as a factor in 17% of deaths and serious injuries between 2019 and 2023.[1]

Previous research shows compulsory breath testing, coupled with marketing campaigns linked in content and timing with enforcement, has been shown to be an effective countermeasure to drink-driving (Turner, 2021, Delaney et al., 2006). A systematic review showed that mass media drink-driving campaigns are most effective when they are carefully planned and executed, attract exposure among the audience and they are implemented with other prevention countermeasures, for example highly visible police enforcement (Elder et al., 2004).
Understanding how people in community perceive drink-driving risks, including the risks of being caught while driving impaired, can only be learn through public attitude research. Could it be possible for Auckland to further shift public perceptions by exploring new strategies and partnerships?

Conference theme
Evolution:
There is an opportunity to approach how we connect with the road users to change behaviours and diversify our approach to drive change. How can levers we use today to impact perception have a long-term impact in road trauma? What opportunities are there to engage with partners not usually considered to be alongside road safety?

Equity: New Zealand research shows fatal crash risk when driving over the limit is much higher for young drivers than drivers over 30 (Keall et al., 2004). Reducing drink-driving can therefore contribute to reducing the overrepresentation of young drivers impacted by road trauma.

[1] A backlog of data is currently being processed in the Crash Analysis System so this figure is subject to change.

Project description

A partnership with Auckland Transport (AT) and New Zealand Police aimed to see if coordinated enforcement activities and targeted media campaigns could reduce drink-driving and the public attitudes to drink-driving.
“Drink Free Summer” ran from November 2023 till February 2024. Communications were shared via existing media channels with no dedicated media budget. While “Operation Multiplier” ran from June 2024 to August 2024. This second campaign developed creative ideas from Drink Free Summer. A key difference was that following on from the Operation Drink Free Summer learnings, a small amount of paid marketing was carried out via social media posts, billboards, bus back advertising, radio, press releases and media interviews.

The enforcement tools used were compulsory breath testing at checkpoints (general deterrence) and officer testing when an officer in a patrol car had cause to suspect a driver of drink-driving (specific deterrence). The number of breath tests conducted had significantly increased over recent years and the campaign was an opportunity to communicate that to the public. Data was collected from the results of two public attitude surveys, the New Zealand Transport Agency (NZTA) Public Attitudes to Road Safety Survey, and the AT Satisfaction Survey. The AT survey was conducted three times in 2024 at March, June, and November. The NZTA public attitudes survey was conducted over three three-month blocks, January-March, April-June and July to September 2024. New Zealand Police data on breath testing rates were to analyse enforcement measures.

Results

Public perception of likelihood of getting caught drink driving

Both the AT survey and the NZTA survey results showed that from the start of first campaign to the end of the second campaign, people’s perception of likelihood of getting caught increased from 45% to 55% for AT survey and 38% to 46% in the Auckland respondents in the NZTA survey.

When respondents were also asked, “In the last 12 months have you been stopped at an alcohol checkpoint while you have been driving?”, the AT survey had a large increase from 23% to 42%, while the NZTA survey had a higher starting point and increased from 30% to 36%.

The November 2024 Auckland Transport survey also asked, “How many times have you been stopped at an alcohol checkpoint while driving?”, with 19% of drivers remember being stopped 2 or more times in the past year.
This illustrated that the two independent surveys demonstrated a shift in public perception to drink driving during this year of coordinated operations.

Alcohol enforcement activity

High alcohol risk times are defined as the hours between 2200 to 0200 on Friday and Saturday night respectively. Drivers caught with a breath alcohol over 250 mcg were counted as being impaired. It was noted that there was no change in the amount of enforcement during these four hours.

When data for four years (1 July-30 June) from 2020/2021 to 2023/2024 was analysed, there was an overall decrease in impairment from 3.8% to 1.8%. Within these hours, the greatest reduction was seen in drivers caught in the 0100-0200 time period (11.3% to 3.4%). This is illustrated in Figure 1.

When the location of drivers caught was assessed, there was higher percentage of drivers over the limit on lower traffic volume roads than those on higher traffic volume roads. This may indicate an element of drivers trying to avoid police.

Benefits to road safety

The partnership between Auckland Transport and New Zealand Police, through the "Drink Free Summer" and "Operation Multiplier" campaigns, demonstrated a positive shift in public perception and behaviour regarding drink-driving. The coordinated efforts, including compulsory breath testing and targeted media campaigns, effectively increased the public's awareness of the likelihood of being caught if they drink and drive. The shift in enforcement locations to lower traffic volume roads may indicate an adaptive response by drivers attempting to avoid detection, highlighting the need for continuous adaptation in enforcement strategies.

Implication for policy and practice

This work supports that high numbers of compulsory breath tests in Auckland combined with general deterrence marketing targeted to support the testing were accompanied by a decrease in the breath alcohol levels in the driving population in the main weekend drinking hours.

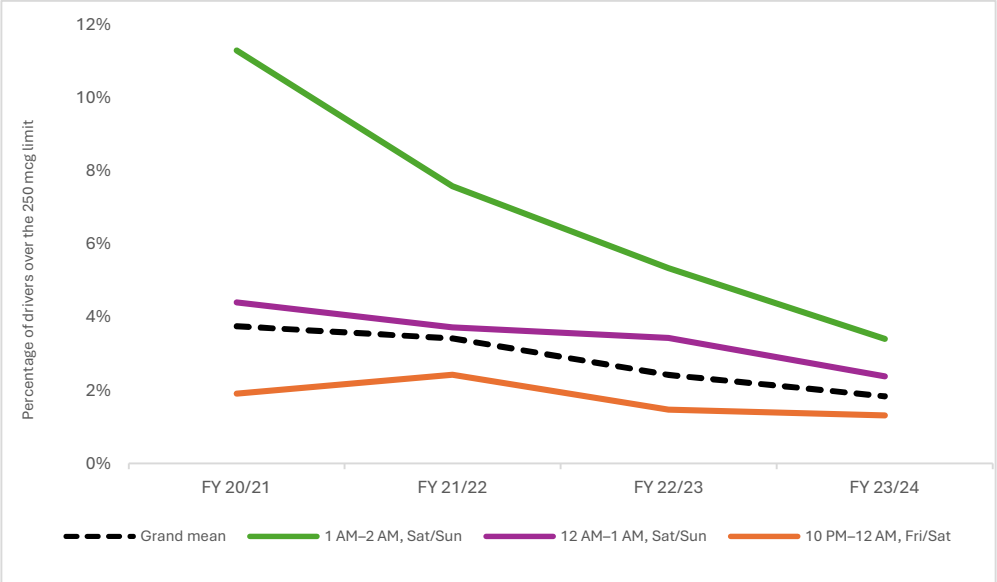


Figure 1. Percentage of drivers caught over 250mcg breath alcohol limit
Source: WSP Research and Evaluation (reproduced with permission)

Future opportunities

Future efforts should continue to explore new partnerships and leverage diverse channels to sustain and enhance these positive outcomes. As the results indicate there may be an adaptive response by drivers attempting to avoid detection, future campaigns could highlight the unpredictability and network coverage of enforcement. Crash analysis may strengthen understanding of the connection between drink driving crashes and the intervention There are also wider opportunities to evolve how drink-driving is addressed through exploring partnerships such as with organisations who may be able to influence access to alcohol, funding for injury prevention, effective responses for recidivist drink-drivers and levers for intergenerational change.

References

Elder RW, Shults RA, Sleet DA, Nichols JL, Thompson RS, Rajab W. (2004). Effectiveness of mass media campaigns for reducing drink driving and alcohol-involved crashes: A systematic review, *American Journal of Preventive Medicine, 27*(1), pp. 57-65. https://doi.org/10.1016/j.amepre.2004.03.002

Frith, B. (2025). Evaluation of Auckland general deterrence of drink-driving partnership operations. WSP Opus research and evaluation

Guria J., Leung J. (2004). An evaluation of a supplementary road safety package. *Accident Analysis and Prevention*, *36*(5), 893-904. https://doi.org/10.1016/j.aap.2003.09.005

Harris, D., Stranks, E., Turner, S., & Smith, D. (2022). Alcohol-related crash trends (Waka Kotahi NZ

Howard, E., Harris, A., & McIntyre., A. (2020). Effectiveness of drink driving countermeasures: national policy framework. Austroads Research Report AP-R613-20

Keall, M. D., Frith, W. J & Patterson, T. L. (2004). The influence of alcohol, age and the number of passengers on the night-time risk of driver injury in New Zealand. *Accident Analysis and Prevention, 36*(1), 49–61 https://doi.org/10.1016/S0001-4575(02)00114-8

New Zealand Parliament. (2017). The six o'clock swill: How drinking law reforms shaped New Zealand society. New Zealand Parliament website, New Zealand.

Roche, A., Kostadinov, V., Fischer, J., & Nicholas, R. (2015). Evidence review: The social determinants of inequities in alcohol consumption and alcohol-related health outcomes. Vichealth.

Transport Agency research report 694)

Turner, B., Job, S., & Mitra, S. (2021). Guide for road safety interventions: Evidence of what works and what does not work. Washington, DC., USA: World Bank

Communicating AusRAP 2025 Results

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Abstract

The Australian Road Assessment Program, or AusRAP, assists jurisdictions and local governments in maximising road safety and reducing road trauma through effective management and investment in Australian roads. Australian state and territory road transport authorities assess and report AusRAP results for their respective jurisdictions, with the current commitment to report on all National Highway and those state or territory-controlled roads that make up 80% of travel in the jurisdiction. Austroads, as the national manager and coordinator of AusRAP, will publish consolidated national AusRAP results early in the second half of 2025.Austroads developed a suite of tools and materials to support release of AusRAP results and for communications and engagement with stakeholders and the public. This presentation will detail and discuss the various aspects of communications associated with the public release of AusRAP results. The presentation will include reflections on what worked well and what could have been done better.

Social Media Post

Austroads communications and engagement materials used to promote and discuss the 2025 AusRAP results are discussed. Reflections on what worked well and what could be done better provide useful guidance to road safety practitioners planning similar communications. For more information about AusRAP see Australian Road Assessment Program (AusRAP) | Austroads

Background

The Australian Road Assessment Program, or AusRAP, assists jurisdictions and local governments to maximise road safety and reduce road trauma through effective management and investment in Australian roads. AusRAP is the Australian version of the International Road Assessment Program (iRAP) and was introduced into Australia by the Australian Automobile Association in the early 2000s, with assessment results published for the Australian national highways at various times between 2004 and 2016. Responsibility for management and coordination of AusRAP was transferred to Austroads in 2021.

The publication of AusRAP results allows the evolution of safer road infrastructure to be tracked over time. AusRAP provides governments a tool to identify and prioritise road safety treatments in a way that saves the most lives soonest. The results allow the public to see the road safety effects of those treatments and can provide support where improvements are still needed to address residual safety risks. At the same time, the results also allow road users to see where those higher risks are on the network and hence where increased attention and some caution should be exercised when driving those routes.

About AusRAP

Australian state and territory road transport authorities assess and report AusRAP results for their respective jurisdictions. The current minimum commitment, agreed by the Austroads Road Safety Task Force, is to assess and report on all National Highways (National Land Transport Network roads) and those state / territory roads that make up 80% of travel in the respective jurisdictions, although some jurisdictions have assessed all roads under their control.

Austroads, as the national coordinator of AusRAP, will publish consolidated national AusRAP results early in the second half of 2025. This will be the first national AusRAP results release since the Australian Automobile Association's last publication in 2016. This lack of AusRAP results data has led to a paucity of public knowledge and understanding about AusRAP and of the safety of our road networks.

Austroads has developed a suite of tools and materials necessary to support and promote public release of AusRAP results and for communications and engagement about AusRAP. The target audiences for AusRAP results include decision makers, road user groups, road safety advocates and researchers, as well as the general public (both as road users and as taxpayers and/or voters).

AusRAP Communications

Austroads developed an AusRAP Communications and Engagement Strategy, which is supported by an AusRAP Communications Information Kit, designed to assist our members to provide nationally consistent messaging when preparing media releases, public statements and other AusRAP related messaging or engagements. Each jurisdiction needs to localise their AusRAP messaging to suit their respective priorities, achievements and sensitivities, while ensuring we maintain nationally consistent messaging. Austroads supports our members through promoting the national results release, promoting our members own releases, as well as development and maintenance of the AusRAP website.

The Information Kit is supported by the AusRAP website, which contains a large amount of detailed information about Road Assessment Programs and about AusRAP in particular and of course, the interactive AusRAP results maps and case studies of achievements in each jurisdiction. Explanatory videos have been produced, explaining all about AusRAP and star ratings, Crash Risk results and how to use them, using star ratings and crash risk results together to drive road safety outcomes and setting policy targets for road safety using star ratings. The video clips supplement the website information and are able to be used as freestanding tools at AusRAP communications and engagement activities and events.

Austroads commissioned a community awareness survey prior to release of AusRAP results and will repeat this survey 12 months after results are released (which will align with a subsequent launch of updated AusRAP and Crash Risk Map results). Traffic to the AusRAP website will also be monitored prior to and after the results launch, to monitor community interest levels.

Demand for publicly accessible road safety information has grown following the AAA's "Road Safety Data Saves Lives" campaign. The data is critical to inform the public, stimulate discourse on major road safety issues and to ensure that government infrastructure investment includes prioritised road safety outcomes.

Part of the communications challenge for AusRAP is to guide the public discussion away from wanting all roads to be 5 star rated, to focussing on bringing high traffic volume roads up to a minimum of 3 Star Rating, in line with both the objectives of the National Road Safety Strategy and Action Plan and Austroads goal for AusRAP, that by 2030, at least 80% of all travel will be on roads rated 3 star (or an equivalent rating scheme) or better. This ensures there is equity in road safety, as the majority of all travel will be on roads that provide an adequate level of safety.

Content of Presentation

This presentation will detail and discuss the various aspects of communications associated with the public release of AusRAP results and the communication of AusRAP key messaging to the Australian public as discussed above. In addition to an overview of the results themselves, the presentation will include reflections on what worked well and what could have been done better in communicating with our various stakeholder groups and the public.

The key objective of the presentation will be to provide road safety practitioners valuable insights into recent and relevant experience in communicating what is a somewhat complex piece of road safety information to the public, to assist them when planning for, or undertaking any similar road safety communication challenge.

AusRAP communications are designed to ensure equity in access to road safety information via an interactive map which includes access for colour blind users, as well as by other means and the presentation will include this and also highlight the evolution of how the AusRAP results are now communicated to the public, focussed on achieving at least 3 Stars and covering 80% of travel in each jurisdiction.

Modelling the impact of injury mechanism on insurance claim severity

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Abstract

This study examines the impact of injury mechanisms on Compulsory Third-Party (CTP) insurance claim severity, filling a critical gap in understanding how co-occurrence of bodily injuries affects financial compensation outcomes in road traffic crashes. Using linked police-reported crash data and CTP insurance claim data from Queensland for the financial years 2015/16-2021/22, a joint econometric framework is proposed and estimated to model the simultaneous nature of injury outcome and claim severity. Specifically, multinomial logit formulation is used to examine the injury outcomes and lognormal linear regression formulation is used to examine the claim severity component in the joint model system. The model results identify key determinants influencing body injury mechanisms and claim severity outcomes. Thus, this study demonstrates the development of data-driven approaches in insurance claim processing and road safety policy planning in reducing the road trauma burden.

Social media post

How do crash-related injury mechanisms impact claim severity? Our study uses linked police-reported crash-CTP insurance data to discover how multiple injuries affect insurance claim costs. A novel econometric model reveals key insights for fairer claims and safer roads.

Introduction

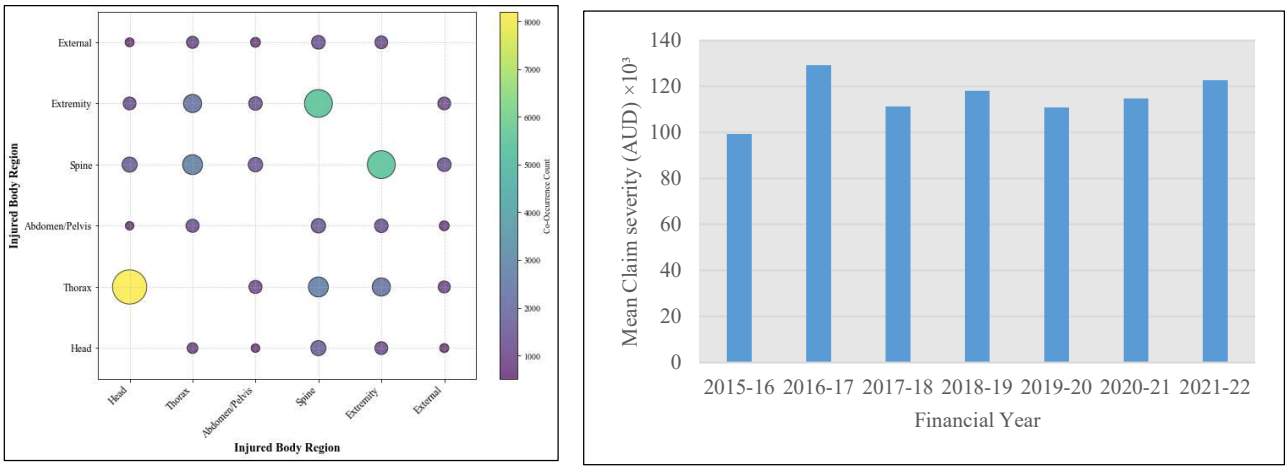
In motor vehicle crashes, occupants often suffer from multiple injuries across different body regions, which is likely to incur higher Compulsory Third Party (CTP) insurance claims. However, limited research examined the impact of crash related body injury mechanisms on CTP claim severity (Bambach & Mitchell, 2015; McColl, 2003). Moreover, in examining the critical factors contributing to road crash-related injury mechanism, earlier studies predominantly considered the principal diagnosis (Kabli et al., 2020). The principal diagnosis is usually relevant to the dominant injury suffered by a crash victim. Such approach does not recognise that there might be multiple body injury resulting from a road crash. On the other hand, safety literature examining data from official crash records use a single scale injury severity outcome variable. Studies examining hospital crash records also generally rely on single injury severity scales such as the Abbreviated Injury Scale (AIS) and Injury Severity Score (ISS) to classify injuries and estimate medical costs. Thus, these studies failed to account for co-occurring nature of injuries in analysing crash-related injury severity mechanism (Li & Baker, 2012). Moreover, multiple body injuries can be associated with higher recovery costs resulting in higher CTP claim severity. Therefore, it can be argued that crash-related CTP claim severity and the injury outcomes are simultaneous in nature. Examining such composite nature of injury mechanisms on claim severity can inform better insurance pricing strategies while also can help to devise effective injury prevention strategies from road crashes. However, the traditional CTP data often lacks detailed information on crash characteristics. On the other hand, police-reported crash data generally lacks information on bodily injury and CTP claims. Towards that end, this study links crash related CTP data with official crash database by using a mixed deterministic-probabilistic assignment approach. The linked data is used to examine the simultaneous nature of injury outcomes and claim severity outcomes as a two dimensions of crash-related injury severity mechanisms. Thus, this study supports the development of data-driven approaches in insurance claim processing and road safety policy planning in reducing the road trauma burden.

Conference theme

This study aligns with the **Evolution** theme of the conference by examining how the understanding of multiple bodily injury mechanisms in road crashes has evolved and how it can further progress to improve understanding on crash-related Compulsory Third Party insurance claims. Traditional approaches to assessing claim severity have predominantly focused on single-injury evaluations, often neglecting the evolving complexity of injury patterns caused by changes in vehicle safety features, road conditions, and driving behaviours. This study applies a joint econometric model for a more comprehensive understanding of how different injury mechanisms contribute to claim severity. This evolution in modelling framework can lead to improved insurance frameworks, better injury prevention measures, and more effective policy decisions that adapt to future road safety challenges.

Data

The study utilises third-party bodily injury insurance claim data and official crash data from Queensland, Australia for the financial years 2015/16–2021/22. These datasets are linked by using a mixed deterministic–probabilistic algorithm. Specifically, the common attributes available from two data sets are used to link the unidentified data records from two databases. The common attributes used for data linking are crash date, crash postcode, claimant gender, claimant age, and claimant role. The police-reported crash data and insurance data include 118,061 and 56,310 records, respectively. For this study, insurance data is considered as the base file, and based on the linkage algorithm, 22,940 records are successfully matched across both databases. Thus, the overall linkage rate is approximately 46%. From the overall linked records, claims relevant to passenger vehicles are considered for this study with claimant as the unit of analysis. Thus, each record in the data represents a claimant who was involved in crashes and had a finalised claim reported within the financial years considered. The data linkage effort complements the insurance data with detailed crash characteristics as available in the police-reported crash database. The final dataset includes 12,453 claim records for light passenger claimant vehicles, among which 9,340 records are randomly selected for model estimation. The descriptive stats relevant to the dependent variables of interests are presented in **Error! Reference source not found.**. **Error! Reference source not found.** (a) shows the frequency distribution of injury co-occurrence for injuries related to Head, Thorax, Abdomen/Pelvis, Spine, Extremity and External injuries. **Error! Reference source not found.** (b) shows the average claim severity values associated with injured body region. In the estimation sample, average value of claim severity is $ 115,714.78.



(a) (b)

Figure 6: (a) Co-occurrence of injured body regions and their frequency (b) The average claim severity values associated with injured body region.

Method

This study examines the impact of injury mechanisms on insurance claim severity using a joint econometric framework. Specifically, in the joint modelling system, multinomial logit framework is used to examine the injury outcome component, and a lognormal linear regression framework is used to examine the claim severity component. For the injury outcome dimension, it is important to realise that crash victims may sustain injuries across several body regions. Hence, the choice set is generated as a bundle of injury co-occurrence across 6 body regions of Head, Thorax, Abdomen/Pelvis, Spine, Extremity and External injuries. Thus, the choice set includes $2^6 = 64$ possible alternatives in the multinomial logit formulation. The joint model is estimated by using simulated maximum likelihood approach and the final model is specified by considering the variables which are significant at 90% confidence level.

Results and Discussion

Tables 1 and 2 present a summary of the estimated joint model (due to space limitation, the full model results are not presented here). Several observations can be made from Table 1. Younger claimants (< 15 years) and older claimants (> 50 years) are less likely to experience lower claim amounts perhaps is indicating more cautious driving among these road user groups. Passengers are likely to be associated with less claim severity relative to driver. Utility panel vans are associated with significantly lower claim severity, potentially reflecting their structural design, whereas at-fault vehicles older than five years show a significant increase in costs, indicating that outdated safety features are likely to elevate injury related expenses. Among crash characteristics, rear-end collisions are found to increase claim severity, perhaps

indicating that rear-end related injuries (such as whiplash-dominant injury) require prolonged treatments incurring more recovery costs.

From the injury outcome component results (Table 5), it can be observed that passengers are more likely to sustain head, thorax, abdomen and pelvis injuries in a crash. Rear-end collisions is found to be associated with reduce head-injury but is associated with higher spinal-injury. Male claimants are associated with lower likelihood of thorax and external injuries but higher spinal-injury probabilities. Claimant's vehicle age > 11 years increases thoracic and external injuries while contributing towards lower spinal injuries, reinforcing the protective role of modern safety features such as side-impact airbags and reinforced cabin structures.

Table 1: Estimation results of the claim severity component

Explanatory variables	Estimates	Std. Error	p-value
Claimant age <15 years old	-1.965	0.144	0.000
Claimant age >50 years old	-0.232	0.035	0.000
Passenger	-0.189	0.039	0.000
Utility/panel van	-0.105	0.047	0.024
Claimant vehicle age <5 years	-0.058	0.034	0.081
At-fault vehicle age <5 years	-0.171	0.035	0.000
Rear-end crash	0.076	0.032	0.018
100 - 110 km/h posted speed limit road	-0.120	0.050	0.017
Early morning period (3 AM-8 AM)	0.080	0.043	0.060
Afternoon period (12 AM-2 PM)	0.067	0.040	0.093

Table 5: Estimation results of the injury outcome component

Body regions	Explanatory variables	Likelihood	p-value
Head	Passenger	Increases	0.002
	Rear-end crash	Decreases	0.000
Thorax	Male	Decreases	0.000
	Passenger	Increase	0.000
	Claimant vehicle age >11 years	Increases	0.007
Abdomen	Passenger	Increase	0.000
	Rear-end crash	Decreases	0.000
Spine	Male, Rear-end crash	Increases	0.000
	Claimant vehicle age >11 years	Decreases	0.041
External	Male	Decreases	0.010
	Claimant vehicle age >11 years	Increases	0.033

Benefits to road safety

By capturing the cumulative impact of multiple injuries, this study aims to provide a robust formulation for insurance claim evaluations and support fairer compensation for crash victims. The findings support data-driven road safety policies that target high-risk injury mechanisms and provide valuable insights for vehicle safety engineers in designing injury-mitigating features such as improved crumple zones, seatbelt restraint systems, and airbag deployment strategies tailored to different crash scenarios. The study also supports more effective road infrastructure planning by identifying crash characteristics and environmental factors that contribute to severe injury outcomes. Policymakers can use these findings to implement targeted interventions, such as safer intersections, improved roadside barriers, and enhanced speed management strategies, reducing the likelihood and severity of crashes.

Conclusions

This study examined the impact of injury mechanisms on insurance claim severity by leveraging linked police-reported crash data and insurance claim records. Through advanced econometric modelling, the research identified key determinants of claim severity and highlighted the importance of accounting for multiple injuries rather than focusing solely on the most severe injury related to road traffic crashes. The findings reinforce the significance of crash data linkage in devising more accurate assessment of injury severity and financial costs, ultimately contributing to fairer compensation models and improved road safety policies. By integrating injury mechanism into claim severity models, this study offers a more comprehensive framework for understanding crash injury outcomes and their economic implications. Future research should explore the role of additional crash variables and emerging vehicle technologies in influencing claim severity, ensuring that risk assessment strategies continue to evolve alongside advancements in road safety and insurance analytics. This analysis is restricted to approved insurance claims. The proposed model can further be extended in future with the availability of more comprehensive insurance datasets.

References

Bambach, M. R., & Mitchell, R. J. (2015). Estimating the human recovery costs of seriously injured road crash casualties. *Accident Analysis & Prevention*, *85*, 177-185. https://doi.org/https://doi.org/10.1016/j.aap.2015.09.013

Kabli, A., Bhowmik, T., & Eluru, N. (2020). A multivariate approach for modeling driver injury severity by body region. *Analytic Methods in Accident Research*, *28*. https://doi.org/10.1016/j.amar.2020.100129

Li, G., & Baker, S. P. (2012). *Injury research*. Springer.

McColl, R. (2003). Differences between CTP insurance statistics and crash statistics. Proceedings of the 2003 Road Safety Research, Policing and Education Conference

Driver merging preferences, behaviour, and strategies at roadworks

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Abstract

Navigating work zones is challenging, especially through lane closures that require drivers to merge. Merging behaviour is influenced by driver characteristics, traffic conditions, and the road environment, making safety improvements complex. In the U.S., Early Merge (EM) and Late Merge (LM) strategies are widely used to improve safety at work zones. Australia could benefit from adapting these strategies; however, the strategies should be tested for Australian conditions before implementation. This research examined the effectiveness of EM and LM for Australian work zones using a comprehensive methodology involving driver surveys, field observations, and microsimulations. Results showed that while drivers prefer EM, actual merging location depends on vehicle type, traffic volume, and lane closure type. Simulations found EM to be more effective for left lane closures (LLC) and LM for right lane closures (RLC). The findings provide valuable insights for optimising work zone traffic management in Australia.

Social media post

Navigating work zones can be tricky, especially with lane closures. A study on Early Merge (EM) and Late Merge (LM) strategies suggests EM works best for left lane closures and LM for right. Testing these strategies in Australia could boost work zone safety.

Introduction

Changing lanes at work zones can be challenging for drivers. Without adequate control measures in place, merging behaviour varies based on individual driver characteristics and attitudes, posing a higher risk of crash. To reduce the crash risk and to streamline the mandatory lane merging process at work zones, merging strategies are developed and are implemented in some parts of the world (Harb et al., 2012). Despite the high number of crashes at work zones (Debnath et al., 2012), Australia is yet to adopt any such merging strategy.

While many merging strategies have been developed from across the world, EM and LM have been studied for a long period of time in the US and are found to be effective (e.g., Beacher et al., 2004; Kurker et al., 2014). EM encourages drivers to merge into the open lane early to reduce the last moment risky manoeuvres and to improve mobility through work zones (Tarko & Shamo, 1999) while, LM utilise the full capacity of a work zone and encourage drivers to use the closed lane/s until the merging point and take turns to merge (Beacher et al., 2005).

Adopting a merging strategy might assist in reducing work zone related crashes in Australia. Even though these two strategies (EM and LM) were proven to be successful in the US (Harb et al., 2012), as driving behaviour can be significantly influenced by culture and location (Sheykhfard et al., 2023), it is important to assess the suitability of these strategies in Australian conditions before direct implementation.

This research aims to address these issues by evaluating EM and LM, which are the two most widely used merging strategies in the US, under Australian conditions, to assess their suitability for Australia. The recommendations made through this research can be utilised by road authorities in the future when implementing merging strategies for Australian work zones to improve safety.

Conference theme: Evolution

This study provides a significant advancement to the safe system approach by identifying safer merging strategies that can be implemented in Australian roadworks to reduce crash risk. The study further provides a holistic view of driver preference and behaviour along with the suggested merging strategies. This involves utilising established methods, as well as incorporating human factors to provide valuable and thorough insights. Adopting the recommended merging strategies at Australian work zones can significantly improve the safety of both motorists and roadworkers contributing to making Vision Zero a reality.

Methodology

This research was conducted under three important phases. First, an online survey was conducted among Australian drivers to examine their views on switching from the conventional merging (CM) setup to a well-established merging strategy. Second, an observational study was conducted using video cameras at two Australian work zones with LLC and RLC configurations. Finally, the merging strategies were tested on a microsimulation platform to examine their performance with regards to improvements in safety and efficiency. Even though data from Australian sites were collected for this study, the methodology and the concepts can be applied globally to assess the suitability of merging strategies in any geographical location before widespread implementation.

The online survey (phase 1) collected data from 455 drivers on their preferences of merging location and strategies. Since driver preferences strongly correlate with compliance rates, and the success of merging strategies depends on compliance, it's crucial to understand whether drivers would: 1) recognise when to merge in work zones with an implemented merging strategy, and 2) prefer a merging strategy over the CM setup. The collected data were analysed using an ordered probit model (Siriwardene et al., 2024) to derive insights on preference based on driver demographics.

In the second phase, video data were collected from two work zones located on high-speed roads in New South Wales (phase 2). The collected video data were processed using validated traffic video processing software (Data From Sky). Data on driver merging behaviour in terms of merging location, merging speed and acceleration/deceleration rates were extracted in this process. The location data were further analysed using an ordered probit model. Since the speed and acceleration/deceleration values were obtained from the same set of merging vehicles, these values are likely to be correlated for each vehicle. Therefore, a simultaneous equation modelling approach was utilised (Siriwardene et al., 2025), where one endogenous variable serves as a predictor of another.

Data collected from the LLC site and the RLC site were used to develop a series of microsimulation models in VISSIM (phase 3). The EM and LM strategies were tested in this simulation environment to assess their suitability at Australian work zones under different traffic volume levels and proportions of heavy vehicles (HVs). These simulation models were calibrated and validated using speed data collected from videos. EM and LM strategies were coded primarily using the lane-changing decision distance parameter.

Results

While the detailed results of each phase are difficult to present, a comparison of the results from each phase is presented in this extended abstract.

Driver preference of merging location (phase 1) and actual merging location (phase 2)

The stated preference survey results showed that drivers prefer merging to the through lane around 500m to 1km ahead of the lane closure. With the increase of age, and driving experience, drivers were around 10% less likely to merge close to the taper end. This preference was similar for both high and low traffic volume scenarios. For the high traffic volume scenario, some drivers preferred merging even further upstream on the lane closure. These responses indicate the desired location for merging. However, while driving, these drivers might not select their desired location to merge.

The video data analysis shows that drivers merge early (approximately 300m before the lane closure) under the RLC condition, which is similar to their stated preference location. However, under LLC conditions, most vehicles would drive closer to the lane closure before merging into the open lane. This behaviour could be explained by driver experience. Australian drivers are familiar with driving on the left lane on high-speed roads, as the right lane is often used for overtaking. Therefore, it can be considered that drivers are more comfortable driving on the left lane until the lane ends to merge in LLC conditions.

Performance of merging strategies (phase 3) and driver preferences (phase 1)

In the driver survey, drivers ranked the merging strategies based on their preferences. The selection of EM as the second preference after CM reflected drivers' preference to merge around 500m before the lane closure at work zones. The drivers did not have a high preference rate for LM.

The simulation study found that both CM and EM performed well under low traffic conditions on regional roads, particularly for the LLC configuration. Implementing EM at LLC resulted in queue lengths of less than 1m when traffic volume ranged from 500-1250 vph, compared to over 3m queues with other strategies. EM showed significant advantages over other strategies in terms of both efficiency and safety for LLC. Although drivers didn't strongly prefer LM, it proved more effective under high traffic volume conditions, especially in RLC situations. While CM resulted in

queues of nearly 30m at 1500 vph, implementing LM reduced the queue length to around 16m at RLC site. The study also showed that travel time was reduced under the LM strategy, leading to higher efficiency for RLC conditions.

Driver merging behaviour (phase 2) and merging strategies (phase 3)

For LLC site, the video analysis showed that drivers prefer merging late. Whereas the simulation analysis suggests that EM is more effective for LLC conditions under lower traffic volumes, while none of the merging strategies were significantly effective under higher traffic volume levels. In the context of RLC, the video analysis showed that drivers merge early, interestingly, the simulation models showed that the efficiency of merging can be improved if LM was adapted for RLC.

When HVs are considered, their merging behaviour differs from that of light vehicles. Phase 2 model results showed that HVs were 22% less likely to merge close to the taper end at the LLC site compared to light vehicles. At the RLC site, HVs were 15% less likely to merge in the advance warning area than light vehicles. Additionally, the gap selection of light vehicles was influenced by the presence of surrounding HVs. Merging speed also increased when an HV was traveling ahead of the merging vehicle. As the proportion of HVs increases, both travel time and queue length are significantly affected. The simulation results showed that queue lengths of around 4m could increase to 14m with a 20% rise in the proportion of HVs.

Conclusions

This research has made significant contributions to the evolution of managing traffic flow at work zones by advancing the understanding of driver merging preferences, behaviour, and strategies. Unlike existing studies in the literature which focused on studying lane merging strategies from driver views or field observations or in microsimulation environments only, this study developed a comprehensive methodology involving all these methodologies which involves human factors as well as traffic modelling. The results showed that implementing EM for LLC sites under low traffic volumes and LM for RLC sites for high traffic volumes can provide an added benefit for Australian work zones over using CM. Therefore, a dynamic version of these merging strategies, where the strategy is only activated when the traffic volume exceeds a certain threshold, can be adopted. Further, according to the driver survey, drivers do not have a high preference for LM, and therefore, driver awareness and educational campaigns might be needed if implementing LM in Australian work zones. The results also highlighted that lane closure configuration, traffic volume, and the proportion of HVs are significant factors affecting merging behaviour.

This research study serves as a crucial revelation for improving efficiency and safety at work zones through effective merging. Moving forward, it is important to build upon the insights gained from this research to continue enhancing work zone safety and efficiency.

Reference

Beacher, A. G., Fontaine, M. D., & Garber, N. J. (2004). Evaluation of the late merge work zone traffic control strategy (No. FHWA/VTRC 05-R6). Virginia Transportation Research Council (VTRC).

Beacher, A. G., Fontaine, M. D., & Garber, N. J. (2005). Guidelines for using late merge traffic control in work zones: results of a simulation-based study. Transportation Research Record, 1911(1), 42-50.

Debnath, A., Blackman, R., & Haworth, N. (2012). A review of the effectiveness of speed control measures in roadwork zones. In Proceedings of the 2012 Occupational Safety in Transport (OSIT) Conference (pp. 1-10). CARRS-Q, Queensland University of Technology.

Harb, R., Radwan, E., & Dixit, V. V. (2012). Comparing Three Lane Merging Schemes for Short-Term Work Zones: A Simulation Study. ISRN Civil Engineering, 2012, 1-18. https://doi.org/10.5402/2012/507269

Kurker, M., Fournier, C., Zhao, Q., Hakimi, S., Qi, Y., Tang, S., Liu, R., Juri, N. R., Duthie, J., & Machemehl, R. (2014). Minimizing user delay and crash potential through highway work zone planning (No. FHWA/TX-13/0-6704-1). Texas. Dept. of Transportation. Research and Technology Implementation Office.

Sheykhfard, A., Haghighi, F., Fountas, G., Das, S., & Khanpour, A. (2023). How do driving behaviour and attitudes toward road safety vary between developed and developing countries? Evidence from Iran and the Netherlands. Journal of Safety Research, 85, 210-221. https://doi.org/10.1016/j.jsr.2023.02.005

Siriwardene, S., Ashraf, M., & Debnath, A. K. (2024). Driver preference regarding merging strategies at work zones. Transportation Research Part F: Traffic Psychology and Behaviour, 104, 217-233.

Siriwardene, S., Ashraf, M., & Debnath, A. K. (2025). An observational study of understanding the factors influencing merging behaviour in work zones. Transportation Research Part F: Traffic Psychology and Behaviour, 109, 556-570. https://doi.org/10.1016/j.trf.2024.12.028

Tarko, A. P., & Shamo, D. (1999). Indiana Lane Merge System for Work Zones on Rural Freeways. Journal of Transportation Engineering, 125(5), 415. https://doi.org/10.1061/(ASCE)0733-947X(1999)125:5(415)

Does training work: 10 years of the New Zealand experience

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Abstract

This paper outlines two New Zealand training initiatives "Ride Forever" and "Drive," that since 2013, have involved over 40,000 motorcycle riders and 270,000 young drivers aged 16-24, respectively. These initiatives demonstrate that participants are up to 24% less likely to make an Accident Compensation Corporation (ACC) motor vehicle claim, a no-fault system. In New Zealand, these claims account for $223million in costs, representing 38% of all motor vehicle claim expenses. ACC's training methodology tracks participants that adjust risk based on non-road claims history, which offers a unique approach to addressing selection and detection biases identified in previous studies. This paper contributes to the evolution of the safe system approach by challenging the belief that training is an ineffective countermeasure. This paper will provide insights for policy makers, practitioners and researchers into the design, delivery, and evaluation of training-based programmes.

Social media post

Two New Zealand training programmes have targeted young drivers and motorcyclists over the last 10-years and have prevented approximately 5,000 injury claims. Learn more about these programmes that are changing the training landscape in Aotearoa #TrainingSuccess.

Introduction

In New Zealand and internationally young drivers (16-24years old) and motorcyclists continue to be over-represented in harm on our roads. For the past 5 calendar years (excluding COVID) on average per year, there were approximately 35,000 motor vehicle Accident Compensation Corporation (ACC) claims; an average of 7,660 for young drivers (22%) and 4,350 for motorcyclists (12.5%). Young drivers are almost one in four motor vehicle accident claims and motorcyclists' claims have a high cost and severity compared to other road injuries.

To address this, most jurisdictions have attempted to employ training as a countermeasure. The literature however is inconclusive, with conflicting evidence on the effectiveness of training, with the Global World Bank outlining that "we can exclude, with reasonable precision, the possibility of even modest benefit" (GRSF, 2023, p. 37). Hazard perception testing and training on the other hand appears to reduce crash risk (GRSF, 2023).

The literature outlines a number of barriers to determining effectiveness of driving training and education such as detection bias, selection bias, sample sizes and often only measured benefits in a short time period (Kardamnidis et al., 2010). The ACC system is unique that it can address some of these.

From 2014 and 2016 the ACC has invested into two training programmes (Ride Forever and Drive respectively) with the objective of preventing motor vehicle injuries to motorcyclists and young drivers. Every three years the programmes seek re-investment. Over $NZD115 million has been invested in these programmes.

The Ride Forever programme is a comprehensive initiative aimed at enhancing the safety and skills of motorcyclists. Ride Forever is one of the only nationally available motorcycle training programmes providing motorcyclists access to on-road coaching and encouraging safe rider practices. Ride Forever includes four courses, Urban, Bronze, Silver, and Gold, which target riders in different parts of their licensing and motorcycle journey. Each course has a series of distinct practical learning outcomes, with Bronze and Silver aligned to the NZ Class 6 motorcycle licence requirements respectively while adding safe riding skills throughout. Ride Forever Gold targets more advanced riders and is tailored to specific technical aspects of safe riding and riding styles. Ride Forever is delivered by a national network of providers, backed up by a training syllabus with assurance of delivery being maintained through regular auditing.

Drive is an interactive mobile online learning tool developed in partnership between the NZ Transport Agency (NZTA) and the ACC. Drive consists of digital and practical resources to support drivers to be safe, skilled and licensed. "Drive Road Code" is an interactive road code consisting of ten modules with chapter and practice tests to reinforce learning. These modules cover all aspects of the Learners Licence stage, including key safety elements such as fatigue,

distractions, car maintenance and conditions. “Drive Go” is a mobile application which supports learners through to their restricted stage, providing a progressive skills-based approach to on-road driving. Drive-Go records distance and time travelled, and reinforces self-reflection post driving, “Drive Community” supports Community Providers who are supporting their community to learn to drive with a number or practical resources to integrate within their driving programme.

Conference Theme

Although inconclusive in the literature, training continues to be implemented internationally within a safe systems approach. This paper contributes to the evolution of the design, implementation, and measurement of training as a countermeasure for young drivers and motorcyclists using 10 years’ experience in the New Zealand context. These initiatives implemented user design and best practice learner outcome principles alongside a design methodology that overcomes selection and detection bias to measure safety outcomes.

Methodology

Drive and Ride Forever were designed around learner outcomes that are based on an understanding of the key areas of risk for the target road users. User-centric design principles were applied in the design and set-up of each initiative, which involved both motorcyclists and young drivers early in the design, ensuring output met both the needs of the target audience and agreed learner outcomes. audiences.

The ACC uses a quasi-experimental design approach as it was a real-world approach. Ideally a Randomised Control Trial (RCT) would have been ideal, but this would have been cost prohibitive. Participants of each programme are identified and placed into cohorts based on when they received the training, allowing the ACC to compare results and demographics. Participants agree to share their information with the ACC through relevant privacy policies and are matched in the ACC claims database.

When building the methodology there were some advantages that the ACC had, that addresses elements of detection bias. The ACC claims system captures 2 million claims from 5.3 million New Zealanders annually, with on average, per year, over 35,000 claims from the ACC Motor Vehicle Account. This system provides a complete history of claims since 1974, helping to identify individuals who claim.

To address selection bias, participants via the claim database are risk adjusted when the ACC are comparing who has completed either programme against who has not. This is similar to age-standardisation principles when comparing two groups who might not be similar. The risk adjustment process looks at all claims not just road claims, as road crashes are rare. The matching process takes the person and retrieves their claims history, with greater weighting on the most recent years. This means that if a person has only made an ACC claim a long time ago, their claim history and risk profile will be different compared to someone who has made multiple claims in recent years, for example.

Outcomes of the work

To date the ACC are unaware of any large studies that had a large sample size, were being monitored for long time periods with similar investment levels to both Ride Forever and Drive. As well as the measure on claims, each programme has a series of qualitative measures that are tracked to ensure consistency of training as well as provide insight into what is working inside the programme.

In over 10 years of delivery of Ride Forever, over 40,000 motorcyclists have completed more than 60,000 courses. To date, it appears the trained motorcyclists are up to 24% less likely to make an ACC motorcycle claim, which prevented an estimated 2,500 claims. The ACC Return on Investment is $2.87 for every $1 invested. Figure 1 demonstrates that motorcycle riders that are not trained in Ride Forever and risk adjusted to address selection bias have a claim rate of 12.5/1000. Motorcycle riders who participate in Ride Forever have a claim rate of 3.8/1000.

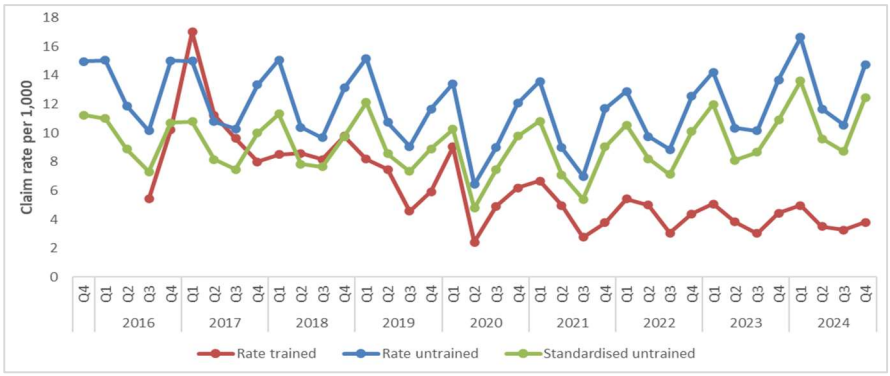


Figure 1: Ride Forever Cohort analysis 2013-2025, Riderforever trained riders vs untrained motorcyclists
Source: The Accident Compensation Corporation

In over 8 years of Delivery, over 270,000 young people have registered with Drive. To date, it appears young people who use or register with Drive are up to 24% less likely to make a motor vehicle claim, preventing an estimated 2,460 claims. The ACC Return on Investment is $4.22 for every $1 invested**.** Figure 2 demonstrates that young drivers not trained in Drive and risk adjusted to address selection bias have a claim rate of 4.8/1000. Young drivers who participate in Drive have a claim rate of 3/1000.

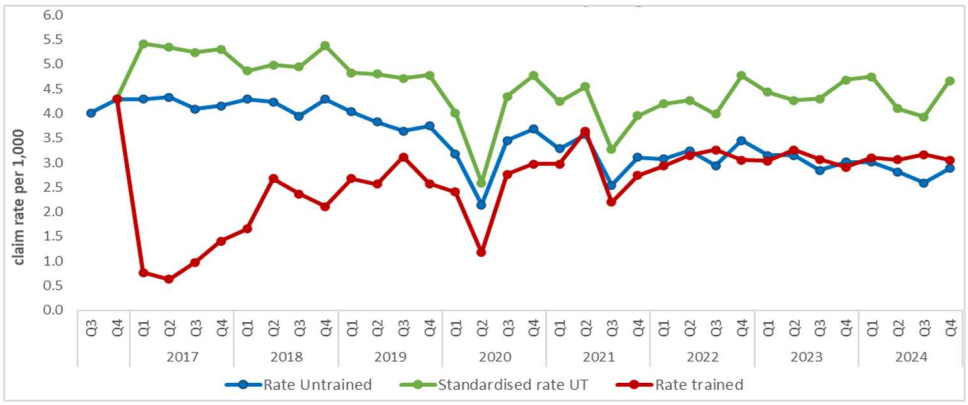


Figure 2: Drive cohort analysis 2016-2025, DRIVE trained users vs untrained young drivers
Source: The Accident Compensation Corporation

Implications for Road Safety Policy and Practice

Training is often seen as an ineffective countermeasure due to the time and investment required to see benefits. However, the New Zealand experience presents information at a volume and time period that adds to the body of knowledge. Based on the New Zealand experience, it is possible Road Safety Practitioners and Researchers need to consider both time and investment to see a similar results. Overcoming the methodology barriers that are known in the literature can be achieved affordably and sustainably based on the New Zealand experience to date.

Conclusion

In conclusion, the New Zealand experience on young drivers and motorcyclists adds to the body of knowledge of training. Despite the limitations in the literature, the New Zealand setting argues that with the right context, environment, investment, and benefits timeline, training could achieve safety outcomes.

References

Global Road Safety Facility. (GRSF). (2023). *Guide for road safety interventions: Evidence of what works and what does not work*. World Bank. https://www.globalroadsafetyfacility.org/sites/default/files/2023-10/Guide%20for%20Road%20Safety%20Interventions%20Evidence%20of%20What%20Works%20and%20What%20Does%20Not%20Work.pdf

Kardamanidis, K., Martiniuk, A., Ivers, R. Q., Stevenson, M. R., & Thistlethwaite, K. (2010). Motorcycle rider training for the prevention of road traffic crashes. *Cochrane Database of Systematic Reviews, 2010*(10), CD005240. https://doi.org/10.1002/14651858.CD005240.pub2

Poster presentation

Training works: Ten years of the New Zealand experience

Our primary goal is to prevent injuries, provide care and recovery support to those who are injured, and help them return to work and everyday life as quickly as possible — with over 50 years of data covering every injury claim in NZ, we are uniquely placed to prove the effectiveness of injury prevention interventions.

ACC pays over **2 million new injury claims per year.**

Young drivers and motorcyclists continue to be **over-represented in harm** on New Zealand roads.

Riders make up **3% of the NZ Fleet** and are **21 times more likely** to be injured or car driver travelling the same distance.

Young Drivers make up **14% of licence holders** but represent **38% of serious injuries** and **27% of fatalities** on NZ roads.

The **average active cost per road claim is $14,500**, nearly ten times higher than the average sports injury claim, and three times that of a work injury.

In 2024 road injuries accounted for **less than 2%** of claims to ACC but represented **11% of costs - $774 million.**

Motorcyclists accounted for

13% of ACC road injuries but

20% of ACC costs - $154 million,

with an **average lifetime cost** estimated at **$41,000 per claim** as of June 2025.

Young Drivers accounted for

11% of ACC road injuries but

17% of ACC costs - $130 million,

with an **average lifetime cost** estimated at **$21,000 per claim** as of June 2025.

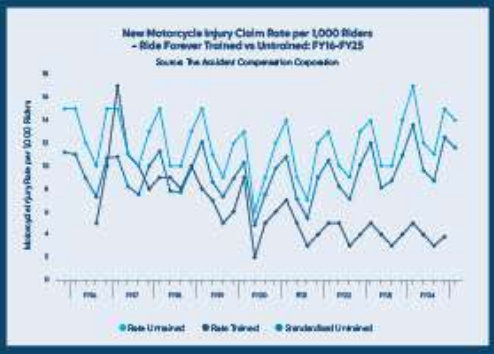
Success State

We have prevented more than 5,000 young drivers and motorcyclists having an ACC road injury claim, amassing claim savings to date in excess of $300 million (NZD) from $115 million investment over 10 years.

Ride Forever

All riders in NZ have skills, knowledge, experience and environment to Ride Forever.

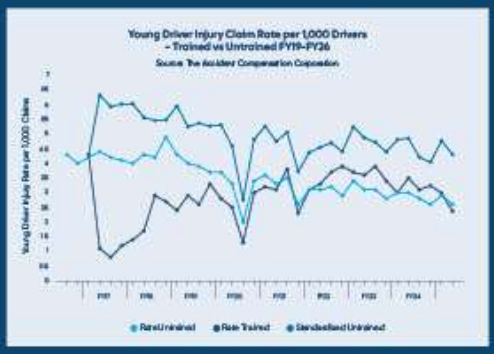
- Is a consistently high-quality, nationally available, graduated rider training programme.
- Ride Forever on-road coaching was launched nationally in 2014.
- To date over 48,000 unique individual riders have participated in Ride Forever courses.
- Courses take a coaching approach to adult learning and follow a recently reviewed Ride Forever syllabus.
- Comparing a statistically robust sample of roughly 3,000 riders, against an equal-size, demographically matched control sample, taking at least one Ride Forever course reduced the incidence of having a crash by 27% and the associated claims cost by 45%.
- In other words, Ride Forever-trained riders crash less often, and the crashes they do have are on average less severe.
- Current Return on Investment to ACC is $3.47: $1.00.
- More than 2,500 motorcycle ACC claims prevented.
- Programme Net Promoter Score of 90%, consistent for last 2 years.



DRIVE

Vision: Drive is the official and credible programme of choice to create safe skilled and licensed drivers.

- Drive is a joint programme between ACC and the New Zealand Transport Agency.
- Includes "Drive Road Code", "Drive Go" and "Drive Community" made up of digital and practical resources to support drivers to be safe, skilled and licensed.
- Codesigned approach with young people for young people.
- Built on best practice Adult Education and gamification principles to engage learners.
- Incentivises access to free practice tests through learning.
- To date over 270,000 young drivers aged 16-24 have engaged with Drive.
- Young people who use or register with Drive are up to 24% less likely to make a ACC motor vehicle claim.
- ACC Return on Investment is $4.22 for every $1 invested.
- More than 2,400 young driver ACC claims prevented.



Conclusion

In conclusion, the New Zealand experience on young drivers and motorcyclists adds to the body of knowledge of training. Despite the limitations in the literature, the New Zealand setting argues that with the right context, environment, investment, and benefits timeline, training does achieve safety outcomes.

RIDE FOREVER
AN ACC INITIATIVE

DRIVE

For more information, scan the QR codes.

Ride Forever DRIVE



A structured framework for implementing and evaluating Mobile Point-to-Point (MP2P) enforcement

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Abstract

Speed-related crashes remain a leading cause of road trauma across Australia and New Zealand. Mobile Point-to-Point (MP2P) camera enforcement combines the benefits of fixed point-to-point with mobile spot-speed camera deployments to allow for a flexible and wider coverage of the road network. MP2P utilises Automated Number Plate Recognition (ANPR) technology and allows for short-term deployment to capture the average speed of vehicles passing through the enforcement corridor. Research and adoption of this relatively new technology has been limited. In this work, as part of a project sponsored by Austroads, a structured trial and evaluation framework are developed to assess the feasibility, operational effectiveness, and long-term impact of MP2P enforcement. This study develops a robust implementation and evaluation framework designed to address jurisdictional requirements and systematically measure the effectiveness of MP2P enforcement. The frameworks are developed through extensive stakeholder engagement, a jurisdictional capability assessment, and a review of best-practice enforcement evaluation methodologies.

Social media post

🚦 Advancing Road Safety with MP2P Enforcement 🚦 We've developed a comprehensive implementation and evaluation framework for Mobile Point-to-Point (MP2P) enforcement, leveraging ANPR technology to enhance speed compliance and reduce road trauma. A data-driven, evidence-based approach for safer roads! #RoadSafety #SpeedEnforcement #MP2P #ANPR #ARSC2025

Introduction

Speeding remains a leading contributor to road trauma, accounting for a significant proportion of fatal and serious injury crashes globally (WHO, 2019). Traditional speed enforcement methods, such as fixed cameras, mobile patrols, and random speed checks, have proven effective but are limited in their ability to enforce compliance over long road segments (Newstead et al., 2011; Alobaidallah et al., 2025). These traditional speed enforcement technologies capture a vehicle's speed at a single location, while point-to-point enforcement measures the average speed of a vehicle travelling between two points using Automated Number Plate Recognition (ANPR). If the average speed exceeds the posted speed limit, a violation is recorded, and a fine may be issued which eliminates penalties for vehicles momentarily speeding to overtake. Fixed point-to-point systems have a permanent setup of entry and exit point cameras, while the mobile system can be temporarily setup along a road, and moved to another location, to achieve speed reductions covering a wider area of the road network. International studies show that MP2P enforcement leads to sustained speed reductions and lower crash severity, particularly on high-speed and rural roads (Soole et al., 2013). A meta-analysis on the effectiveness of speed cameras found that point-to-point cameras achieved a greater reduction in crashes compared to traditional speed cameras, with a 56% decrease in KSI (killed or seriously injured) crashes. (Høye, 2014). Despite its advantages, MP2P enforcement has not been fully implemented in Australia and New Zealand due to limited insights into its effectiveness. A structured evaluation is necessary to assess its impact and ensure its suitability for the Australian and New Zealand contexts. This project proposes a MP2P implementation plan and evaluation framework to assist jurisdictions in deploying and assessing the feasibility, effectiveness, and long-term impact of MP2P enforcement. By incorporating stakeholder engagement, capability assessments, and best-practice methodologies, the framework ensures MP2P enforcement is implemented in alignment with national and international road safety objectives.

Conference Theme

This study supports the conference theme by advancing innovative, data-driven approaches to speed enforcement. It promotes the evolution of safety practices through a robust framework for evaluating MP2P camera effectiveness.

Jurisdictional Requirements

All Australian and New Zealand jurisdictions, including state and local government representatives, participated in a workshop to identify key requirements for MP2P enforcement. Table 1 summarises these requirements and indicates how they are addressed through the implementation plan, evaluation framework, or both.

MP2P Implementation Design

The implementation plan is designed to ensure an easy-to-follow best-practice deployment of MP2P enforcement through a structured and phased approach. Table 2 details the phases, key activities, and steps required for successful execution.

Table 1. Jurisdictional requirements

Requirement	Description	Addressed in Implementation Plan	Addressed in Evaluation Framework
Legislative Amendments	Ensuring compliance with local legislation governing automated enforcement.	✓	✓
Infrastructure Investment	Assessing the readiness of ANPR technology and data systems for enforcement.	✓	
Data Governance	Ensuring adherence to privacy regulations and secure data handling.		✓
Operational Policies	Establishing enforcement parameters, such as speed thresholds and fine structures.	✓	✓
Public Engagement	Enhancing public understanding and acceptance of MP2P enforcement.	✓	✓
Deployment Strategies	Determining site selection, overt vs. covert enforcement, and operational logistics.	✓	
Performance Monitoring	Measuring enforcement effectiveness through speed compliance, infringement data, and behavioural adaptation.		✓

Table 2. Required phases, key activities and steps for a successful implementation

Phase	Key Activities	Steps for Execution
Phase 1: Preparation	Legislative review, stakeholder engagement, and technology assessment.	1. Confirm legislative requirements and necessary amendments. 2. Engage stakeholders to define objectives and constraints. 3. Conduct a technology feasibility study.
Phase 2: Pilot deployment	Selection of test sites, deployment of MP2P systems, and data collection.	1. Identify high-risk corridors for MP2P deployment. 2. Set up ANPR cameras and data logging systems. 3. Collect baseline speed and traffic flow data before activation.
Phase 3: Operational Assessment	Analysis of enforcement strategies (e.g., overt vs. covert), enforcement areas (urban, rural), public feedback, and early performance indicators.	1. Implement MP2P monitoring with phased enforcement strategies. 2. Assess compliance rates and issue warnings before full enforcement. 3. Conduct public engagement sessions and stakeholder review.
Phase 4: Full Implementation Readiness	Refinement of operational policies based on outcomes, recommendations for broader rollout.	1. Analyse data to refine enforcement policies. 2. Develop best-practice guidelines for national adoption. 3. Submit recommendations for legislative and operational improvements.

Evaluation Framework

To assess whether MP2P enforcement meets jurisdictional objectives, a multi-dimensional evaluation framework is developed, incorporating process, short-term, and long-term impact assessments. Statistical analyses will be conducted with at least 80% statistical power to ensure robust evaluation outcomes. Table 3 presents the evaluation measures, key performance indicators (KPIs), required data, and methodologies.

Implementation and Application

The framework supports a phased approach to evaluation, enabling jurisdictions to systematically assess MP2P enforcement while refining operational policies. Key applications include:

- Providing evidence-based recommendations for legislative amendments.
- Ensuring technical readiness by validating ANPR performance and data integrity.

- Informing best-practice deployment strategies based on real-world enforcement data.
- Strengthening public engagement efforts through transparent reporting on the outcomes.

Benefits to Road Safety

This evaluation framework ensures that MP2P enforcement is rigorously assessed, continuously refined, and effectively implemented to maximise its road safety benefits. Expected outcomes include:

- Improved speed compliance, reduced high-risk speeding behaviour and the incidence of death and serious injuries (DSi) crashes.
- Enhanced efficiency in enforcement resource allocation.
- Stronger public confidence in data-driven enforcement solutions.

Table 3. Evaluation categories, corresponding metrics, and associated requirements

Evaluation Category	KPIs and Measures	Data Required	Analysis Method	Technical Requirements
Process Evaluation	- Compliance with legal frameworks - Stakeholder engagement - ANPR system reliability - Enforcement efficiency	- Legislative records - Stakeholder feedback - System logs and uptime - Deployment logs	- Policy analysis - Survey and interview assessments - System performance tracking	- Secure data access to enforcement logs - Cross-agency coordination for policy review
Short-Term Impact	- Change in average vehicle speeds - Speed compliance rates - Public awareness and perception	- Pre/post-speed measurements - Infringement rates - Survey data	- Comparative speed analysis - Public opinion surveys - Trend analysis	- Reliable baseline speed data - Integration with historical enforcement records
Long-Term Outcomes	- Reduction in speed -related crashes - Behavioural adaptation over time - Cost-benefit analysis	- Crash statistics - Driver behavioural studies - Financial reports	- Statistical modelling - Time series analysis - Economic impact assessment	- Standardised reporting structures - Statistical validation tools
Monitoring and Compliance	- Ongoing speed monitoring - Compliance trends - Enforcement effectiveness	- Real-time speed monitoring data - Longitudinal compliance reports	- Continuous data extraction and trend modelling	- Automated speed monitoring systems - Data-sharing protocols across jurisdictions

Implications for Policy and Practice

For jurisdictions to successfully implement and scale MP2P enforcement, policymakers should:

- Utilise the evaluation framework to guide implementation design and legislative adjustments.
- Invest in technology infrastructure and data management systems.
- Incorporate public feedback mechanisms to enhance transparency and acceptance.
- Establish a standardised approach to enforcement evaluation, fostering national consistency.

Conclusions

The implementation plan and evaluation framework developed in this study provides jurisdictions with a structured, scalable, and evidence-driven methodology to deploy and assess the impact of MP2P enforcement. By systematically addressing legislative, technological, operational, and public engagement factors, the framework ensures that MP2P enforcement deployments generate meaningful insights for long-term road safety planning. Future research should explore the integration of connected vehicle data and machine-learning analytics to enhance enforcement adaptability and effectiveness.

References

Alobaidallah, A. M., Alqahtany, A., & Maniruzzaman, K. M. (2025). Safety Effectiveness of Automated Traffic Enforcement Systems: A Critical Analysis of Existing Challenges and Solutions. Future Transportation, 5(1), 25.

Høye, A. (2014). Speed cameras, section control, and kangaroo jumps–a meta-analysis. Accident Analysis & Prevention, 73, 200-208.

Newstead, S., Diamantopoulou, K., Lawrence, B., Clark, B., & Palamara, P. (2011). An evaluation of automated traffic enforcement operations in Western Australia. Malaga, 224(110), 132.

Soole, D. W., Watson, B. C., & Fleiter, J. J. (2013). Effects of average speed enforcement on speed compliance and crashes: A review of the literature. *Accident Analysis & Prevention*, *54*, 46-56.

World Health Organization, (2019). Global status report on road safety 2018. World Health Organization.

An evaluation of Speed Awareness Monitor (SAM) Signs in regional Queensland

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Abstract

Approximately half of all serious crashes in Queensland occur in regional and remote areas, with speeding a common contributing factor. Local road authorities in south-east Queensland have used Speed Awareness Monitor (SAM) signs to provide real-time safety messages to motorists to influence their speeding behaviour for over a decade. Conversely, there has been limited use of these signs in regional areas. A trial and evaluation of SAM signs in regional Queensland demonstrated immediate reductions in average speeds of up to 23 per cent and reductions in the proportion of motorists exceeding the speed limit of up to 61 percentage points, sustained for the entire six months the signs were installed and for a distance up to 150 metres after the sign. Recommendations include more widespread installation of SAM signs on major regional roads at township entry locations, as they represent a cost-effective strategy with typically high levels of public support.

Social media post

A new study of Speed Awareness Monitor (SAM) signs conducted in regional Queensland has shown they lead to immediate and sustained reductions in average speeds and the proportion of speeding vehicles at township entry locations of regional townships, improving community safety.

Conference theme

This project aligns with the ‘Evolution’ conference theme, by exploring the development and implementation of safe systems, including safer speeds and safer people. SAM signs, when implemented effectively, reduce vehicle speeds, and improve compliant behaviour through psychological nudges, which have the potential to reduce road trauma and improvement community advocacy for safer speeds.

Introduction

Speeding remains a serious issue on Queensland roads, with 32 per cent of all fatalities involving speeding motorists in 2023, representing a 37.1% increase compared to the previous five-year average (Department of Transport and Main Roads, 2024). From 2017 to 2022, almost half of serious crashes in Queensland occurred in regional, remote or very remote areas (Department of Transport and Main Roads, 2023), with crashes in these areas more likely to be attributed to speed and have potentially severe consequences due to factors such as higher speed limit roads, less protective roadside infrastructure and greater distances from hospitals.

Speed Awareness Monitor (SAM) signs represent an innovative and proactive approach to speed monitoring and management. These electronic vehicle-activated signs use an embedded radar to measure vehicle speeds and provide relevant real-time safety messages to motorists to influence their behaviour, such as a smiley face to compliant motorists or a message to "Slow Down" to speeding motorists. Local road authorities in Queensland have been using SAM signs to encourage compliance with posted speed limits for over a decade.

While evaluations are scarce, an evaluation of SAM signs installed on local Brisbane City Council streets demonstrated an overall reduction in average speeds of 5.2 km/h and a reduction in the proportion of vehicles exceeding the speed limit of 13 percentage points (Burke, 2015). Similarly, an evaluation of SAM signs in the Redlands district (east of Brisbane) demonstrated a reduction in average speeds of up to 5.8 km/h and a 17 per cent reduction in the proportion of motorists exceeding the speed limit (Blacker et al., 2019). Research has also revealed considerable community support for SAM signs in Queensland, with a study conducted by RACQ showing 63 per cent agreement that the signs have a positive impact on speed awareness and 71 per cent supportive of a greater rollout of SAM signs in their community (as noted in Brisbane City Council, 2023).

Project description

To date, the installation or trial of SAM signs in Queensland has predominantly occurred in residential environments in urban and suburban locations, on local roads with speed limits of 50 km/h or 60 km/h. There has been limited use of the signs in more regional areas, on state-controlled roads, or on roads with higher speed limits. Based on the documented effectiveness and public acceptance of SAM signs in urban areas of south-east Queensland, the Department of Transport and Main Roads initiated a trial of relocatable SAM signs on state-controlled roads at entry points at ten township locations across regional areas of Queensland. In this trial, the SAM signs were deployed in pairs at either end of townships along well-trafficked regional highways, with speed limit reductions from 80 or 100 km/h to 60 or 70 km/h.

This paper provides the findings from an evaluation of this trial. The evaluation involved data collected from the five locations associated with Wave 1 of the trial, located in Finch Hatton, Sarina, and Koumala (in the Mackay/Whitsunday district), and Toowoomba and Millmerran (located in the Darling Downs district). While these five locations included a total of 10 SAM sign sites (deployed in pairs at either side of the township), line-of-sight issues precluded the accurate collection of speed data at two sites, resulting in a total of eight sites being included in the evaluation. All sites were undivided single carriageways with two lanes, with the exception of one site which had three lanes (two lanes heading north into the township).

The study involved a pre-post implementation design, with speed data collected one month prior to the SAM signs being installed, for the six months while they were installed, and for one month after their removal. Data was collected at a range of distances before and after the SAM sign (16m, 50m and 150m before and after), allowing for a comprehensive speed profile to be captured at each site. Bi-directional Doppler radar units were utilised for the measurement and collection of speed and vehicle data. The radars were unobtrusive and unmarked, with the capability of simultaneously measuring speeds across multiple lanes in both directions (approaching and receding) between 12 and 500 metres from the radar (at multiple distances).

Data analysed included overall average speeds, average speeds of motorists exceeding the speed limit, and the proportion of motorists exceeding the speed limit. Given that each site had unique characteristics, analyses were performed at a site-level.

Findings

Impact on average speeds

Pre-during-post-implementation

Analyses showed statistically significant reductions in overall average speeds (with strong effect sizes) while SAM signs were installed, compared to pre- and post-implementation periods, both at 16 metres and 50 metres after the signs, at five out of eight evaluation sites:

- Up to 19.3% at Finch Hatton (East)
- Up to 23.2% at Finch Hatton (West)
- Up to 9.2% at Millmerran (West)
- Up to 17.7% at Sarina (North)
- Up to 17.8% at Koumala (South).

Encouragingly, these average speed reductions were maintained for the entirety of the duration in which the SAM signs were installed (six months). However, post-implementation average speeds immediately returned to pre-installation levels upon the removal of the SAM signs. It is also worth noting that across all sites, average speeds while the SAM signs were installed were below the posted speed limit, at both the 16 metre and 50 metre measurement points, ranging from a low of 2.14 km/h below the limit to a high of 13.86 km/h below the limit.

At the remaining three evaluation sites, non-significant reductions in average speeds of up to 5.6% were observed at Millmerran (East), up to 8.1% at Toowoomba (East), and up to 1.5% at Toowoomba (West).

Before and after the sign
Analyses also showed statistically significant reductions in overall average speeds after motorists passed the SAM sign (with strong effect sizes), at seven of the eight sites, at both 16 metres, 50 metres and 150 metres after the sign:

- Up to 10.5% at Finch Hatton (East)
- Up to 21.7% at Finch Hatton (West)
- Up to 12.0% at Sarina (North)
- Up to 13.8% at Koumala (South)
- Up to 9.2% at Millmerran (West) – 50 and 150 metres after the sign only
- 7.4% at Millmerran (East) – 150 metres after the sign only
- 5.2% at Toowoomba (West) – 150 metres after the sign only.

At the remaining evaluation site, a non-significant reduction in average speeds of up to 2.1% was observed Toowoomba (West) – 50 and 150 metres after the sign only.

Impact on proportion of motorists exceeding the limit

Pre-during-post-implementation
Analyses also showed statistically significant reductions in the proportion of motorists exceeding the speed limit (with strong effect sizes), at seven of the eight sites, at both 16 metres, 50 metres and 150 metres after the sign:

- From up to 63.2% to as low as 6.7% at Finch Hatton (East)
- From up to 57.9% to as low as 3.1% at Finch Hatton (West)
- From up to 50.7% to as low as 12.6% at Millmerran (West)
- From up to 55.7% to as low as 4.3% at Sarina (North)
- From up to 85.7% to as low as 24.6% at Koumala (South)
- From up to 15.7% to as low as 5.1% at Millmerran (East)
- From up to 53.6% to as low as 20.1% at Toowoomba (East).

Encouragingly, at sites where positive impacts were observed, the increased compliance was maintained for the entirety of the duration in which the SAM signs were installed. That said, the proportion of motorists exceeding the speed limit immediately returned to pre-installation levels upon the removal of the SAM signs.

At the remaining evaluation site (Toowoomba - West), non-significant reductions in the proportion of motorists exceeding the speed limit, from up to 33.2% to as low as 23.2%, were observed.

Before and after the sign
Results showed that all observed effects, at all distances, were associated with small or very small effect sizes and were likely to reflect an artefact of the large sample of data, rather than meaningful differences with any practical significance. That is, the findings suggests that while there were substantial reductions in the proportion of motorists exceeding the speed limit at the majority of sites, these reductions were not reflected in changes in the average speeds of those exceeding the speed limit. This likely reflects the fact the SAM signs had the strongest impact on motorists engaged in low-level speeding, with lesser impact on those engaged in moderate and excessive speeding.

Benefits to road safety

The evaluation shows that SAM signs installed at township entry locations along regional highways are likely to represent a cost-effective and proactive approach to speed management. The signs appear to be a timely reminder for motorists, many of whom may not be familiar with the area, to slow down and adhere to the temporary reduction in the posted speed limit while passing through the regional township. The reduction in overall average speeds and proportion of motorists exceeding the speed limits are likely to be associated with discernible benefits to the community, as well as having positive impacts on roads safety and reducing road trauma. While the signs appear to be most effective at reducing low-level speeding, the cumulative impact of this prevalent behaviour on road trauma means the signs are still likely to be associated with meaningful road safety benefits.

Implications for policy and practice

Given that SAM signs represent a low-cost, proactive approach to speed management, with typically high rates of community support, road authorities should consider widespread implementation of SAM signs at township entry locations along major regional highways. The evaluation suggests that road authorities should consider permanent installations of SAM signs, as opposed to the typical approach of rotating signs through multiple sites, as evidenced by the immediate increase in average speeds upon the removal of the signs. This is likely due to the transient nature of motorists along regional highways, with a substantial proportion not being local motorists who build an awareness of

the presence of the signs. Indeed, it is hypothesised that the locations associated with less positive findings represent those with a higher proportion of local residents among the traffic flow, who become more accustomed to the signs and aware of the lack of enforcement associated with them. Finally, the evaluation results suggest that site selection should focus on where the majority of speeding is low-level in nature, with SAM signs likely to be less effective in reducing problematic and habitual speeding compared to more traditional camera-based enforcement operations.

Conclusions

The evaluation of SAM signs installed at township entry locations along major regional highways in Queensland, provides strong evidence of the potential the signs have to reduce average speeds and the proportion of motorists exceeding the speed limit at these locations, particularly those engaged in low-level speeding. When used at appropriate locations, the signs represent a cost-effective and proactive strategy, with high levels of public support, providing a timely psychological nudge to motorists to check their speed, and producing positive outcomes associated with community liveability and road safety. That is, SAM signs represent a potential effective speed management strategy to complement existing speed enforcement approaches.

References

Blacker, A., Aburrow, K., Scott, J. & Jones, D. (2019). *Redland Smart Signs and Smart Messages: A Driver Change Behaviour Project – Year 1 Report, 2018-2019.* Environmental Futures Research Institute, Griffith University: Brisbane.

Brisbane City Council (8 February 2023). *Slow for SAM success*. Accessed 18 September 2024 from https://www.brisbane.qld.gov.au/about-council/governance-and-strategy/vision-and-strategy/smart-connected-brisbane/smart-connected-brisbane-blog/slow-for-sam-success

Burke, A. (2015). Effectiveness of portable speed warning signs. Paper presented at the *Australasian Road Safety Conference*, 14-16 October, Gold Coast, Australia.

Department of Transport and Main Roads (2023) *Road Crash Data* (provided by the Road User Intelligence team).

Department of Transport and Main Roads (2024). *Queensland Road Crash Weekly Report (No. 1389)*. Queensland Government: Brisbane.

Mood, task load and driver distraction: what is the relationship?

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Abstract

Mobile phones and in-vehicle devices distract drivers. Distraction is associated with poor safety outcomes. It is important to understand if there are times when distraction is more likely. This study investigated whether poorer mood, reason for driving and task load were associated with interactions with in-vehicle devices and mobile phones while driving. Driving diaries gathered longitudinal data over 4-weeks. Participants (N = 25; 72% woman; Mean age = 35; SD = 12) completed online diaries after each trip, reporting interactions with in-vehicle devices or mobile phones, details about the trip, their workload and mood. A total of 710 diaries were received. Generalised Estimating Equations using binary regression showed that, after adjusting for duration of driving, worse mood and having more tasks were significantly associated with higher odds of device interaction, particularly navigation and entertainment systems. These findings suggest times when drivers should be conscious of the possibility of distraction.

Social media post

Diary style study of Australian drivers show that drivers are more likely to interact with in-vehicle devices when juggling multiple tasks and in a worse mood.

Introduction

Stress, anger and fatigue have been associated with poor safety outcomes for drivers (Dingus et al., 2016; Filtness et al., 2017; Fitzharris et al., 2022). This may be because mood states can influence how drivers process and respond to their driving environment, leading to slower reaction times to hazards and changed driving behaviours (Stephens et al., 2013).

Mood has also been linked to engagement in distracting activities while driving; primarily cognitive distractions such as rumination (Albert et al., 2022). It may also be that mood is associated with engagement in other potentially distracting activities undertaken to improve mood. For example, interactions with devices in the vehicle, such as phones, entertainment systems or climate controls.

The association between mood, task load (including the need to juggle multiple tasks) and interactions with in-vehicle devices while driving has received limited attention in road safety research. The current study therefore sought to examine the role that a driver's mood and the number of other tasks they had were aware they needed to complete in the day had on the odds of them interacting with an in-vehicle device or a mobile phone. The aim was to identify whether there are times when drivers are at a higher risk of distraction in the vehicle, and therefore time periods when it is most important they are aware of being at greater risk of distraction. This research has the potential to inform strategies that can be used to educate drivers of the risks of distraction, depending on how they are feeling when they are driving.

Conference theme

This study aligns with the ARSC2025 theme of **Equity**. The safety of all drivers when they are travelling in a motor vehicle is important. Research that seeks to identify times when, by reason of mood or task load, that a driver may be at greatest risk of distraction is important in helping them make informed choices about their capacity to drive safely.

Method

Twenty-five drivers (28% males, 72% females; average age 35 years (SD = 12 years) completed one or more brief online diaries after each driving trip for a 4-week period. Participants provided information regarding the reason for the trip (work or leisure), trip characteristics (time, duration, passenger presence, road type and traffic) and whether they had interacted with any type of portable device (e.g., mobile phone) or onboard technology (e.g., car radio) when driving, including when being stopped at traffic lights (Yes/No). Participants also reported their mood and stress levels during the drive. This included how well they felt, levels of tension, agitation and fatigue. Ratings were on a 5-point scale with positive and negative anchors (e.g., tense to relaxed; agitated to calm etc). Participants also rated their current level of stress (0-100; no stress to stress) and how many tasks they had to achieve on that day (0 to 100).

Results

A total of 710 diaries were received, averaging 28 diaries (SD =33) per participant. Generalized Estimating Equations (GEE) with binary logistic regression and unstructured correlation matrix assessed the associations between mood states, purpose of driving and number of tasks for that day, with interaction with any devices during the drive. Participants were nested by diary day and trip number. The log of driving duration was included as an offset variable to adjust for exposure. Univariate analyses showed that worse mood across all mood states was significantly associated with higher odds of interaction with devices. Due to strong correlations between mood variables, a latent variable (Cronbach alpha = .95) was created, indicating poor or good mood, and used in the multivariate analysis.

When adjusting for duration of driving, worse mood and having more tasks to do were significantly associated with higher odds of interacting with devices, particularly navigation and entertainment systems. Interactions were also influenced by the purpose of the trip, with the odds of interaction with devices higher when juggling multiple tasks and driving for work. Interesting relationships emerged with hand-held and hands-free devices. Here, the odds of interacting with hand-held or hands-free devices were lower when driving for work and having less tasks, compared to when driving for leisure and having more tasks. This may be due to work place policies related to driving.

Table 1. Associations between mood, number of tasks, purpose of driving and interaction with devices, adjusting for minutes driven

	B	SE	Significance	OR	95%CI
Any device (72% yes)					
Mood (poorer to better)	-.43	.14	.002	.65	.50-.85
Driving for work (vs driving for leisure)	-1.75	.53	.001	.17	.06-.49
Number of tasks	.009	.004	.019	1.01	1.00-1.02
Interaction between driving for work and number of tasks	.03	.01	<.001	1.03	1.02-1.05
Sat Nav (11% yes)					
Mood (poorer to better)	-.64	.16	<.001	.54	.39-.72
Driving for work (vs driving for leisure)	.36	.37	.33	1.43	.69-2.97
Number of tasks	.03	.01	<.001	1.03	1.01-1.04
Entertainment system (yes 28%)					
Mood (poorer to better)	-.26	.12	.028	.77	.61-.97
Driving for work (vs driving for leisure)	-.16	.28	.57	.85	.50-1.48
Number of tasks	.01	.01	.002	1.01	1.01-1.02
Climate controls (yes = 12%)					
Mood (poorer to better)	-.30	.16	.47	.99	.98-1.01
Driving for work (vs driving for leisure)	.35	.65	.57	1.42	.40-5.09
Number of tasks	.01	.01	.29	1.01	.99-1.02
Hand held phone (yes = 9%)					
Mood (poorer to better)	-.25	.16	.11	.78	.57-1.06
Driving for work (vs driving for leisure)	.13	.70	.85	1.14	.29-4.44
Number of tasks	-.03	.006	.61	1.00	.99-1.01
Interaction between driving for work and number of tasks	-.03	.02	.04	.98	.96-1.00
Hands free phone (yes = 11%)					
Mood (poorer to better)	.38	.16	.02	1.47	1.08-2.00
Driving for work (vs driving for leisure)	.14	.77	.86	1.15	.25-5.22
Number of tasks	.02	.01	.002	1.02	1.01-1.03
Interaction between driving for work and number of tasks	-.32	.01	.004	.97	.95-.99

Benefits to road safety

The findings demonstrate relationships between poorer mood and number of daily tasks with device interaction while driving. The motivations for these interactions are not clear, but they may be strategies to improve mood. Of note is that people driving for work generally reported fewer overall interactions, unless they were juggling multiple tasks. These findings support initiatives to raise awareness of how mood state can influence interactions within the vehicle. These may not necessarily pose a danger, particularly if the interactions are low risk and support improved mood and attention. Further research is warranted to investigate the influence of device interaction on driver safety when in different mood states and under different work load conditions.

Conclusions

The results of this study highlight the relationship that exists between mood, task load and interaction with in-vehicle devices and mobile phone use, whilst driving. This study offers insights into time periods where drivers may be at greatest risk of distraction, and therefore potentially poor safety outcomes, as a result of this distraction. By identifying these time periods of risk, there is an opportunity to develop strategies that can aid drivers in making assessments of how they feel before commencing driving and putting strategies in place to ensure they are able to stay safe.

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References

Ashish, & Mhaske, S. Y. (2023). Road Safety Audit (RSA) guidelines of selected nations – a comparative review. *Journal of Road Safety*, *34*(4), 42–50. https://doi.org/10.33492/JRS-D-23-209291

Hidayat, E., Lange, D., Karlovsek, J., & Kim, J. (2023). Variables Affecting the Risk of Vehicle Collisions in Australian Road Tunnels. *Journal of Road Safety*, *34*(4), 20–30. https://doi.org/10.33492/JACRS-D-22-00032

Albert, D. A., Ouimet, M. C., & Brown, T. G. (2022). Negative mood mind wandering and unsafe driving in young male drivers. Accident Analysis & Prevention, 178, 106867.

Dingus, T. A., Guo, F., Lee, S., Antin, J. F., Perez, M., Buchanan-King, M., & Hankey, J. (2016). Driver crash risk factors and prevalence evaluation using naturalistic driving data. Proceedings of the National Academy of Sciences, 113(10), 2636-2641.

Filtness, Ashleigh J., Kerry A. Armstrong, Angela Watson, and Simon S. Smith. "Sleep-related crash characteristics: Implications for applying a fatigue definition to crash reports." Accident Analysis & Prevention 99 (2017): 440-444.

Fitzharris, Michael, Michael Lenne, Bruce Corben, Tandy Pok Arundell, Sujanie Peiris, Sara Liu, Amanda Stephens et al., "Enhanced crash investigation study-Report 1; overview and analysis of serious injury crashes-crash types, injury outcomes and contributing factors."

Stephens, A. N., Newnam, S., & Young, K. L. (2022). Preliminary evidence of the efficacy of the Reducing Aggressive Driving (RAD) program. Journal of safety research, 82, 438-449.

Stephens, A. N., Trawley, S. L., Madigan, R., & Groeger, J. A. (2013). Drivers display anger-congruent attention to potential traffic hazards. Applied cognitive psychology, 27(2), 178-189.

Developing South Australia's metro network safety plan

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Abstract
The South Australian Department for Infrastructure and Transport and the Centre for Automotive Safety Research are working together to develop South Australia's network safety plans (NSPs), which are being developed for both regional and metropolitan areas to support systematic improvement in road safety. The NSPs consist of two key concepts; the prioritisation of roads slated for improvement through the identification of both safety risk and benefit-cost ratio assessment, and the development of stereotypes to drive network design towards safe outcomes for all road users. They will help identify road safety issues, set road safety targets, and formulate a plan of actions to improve road safety towards the targets set in the *South Australia's Road Safety Strategy to 2031*. The approach outlined here focuses on the metro NSP, including the key steps that are proposed to be undertaken to assess risk, identify improvements, and prioritise investment, subject to Government decision making.

Social media post
The Department for Infrastructure and Transport and the University of Adelaide's Centre for Automotive Safety Research are working together to develop a transformative, equitable network safety plan for all South Australians.

Background
Over recent years, South Australia has achieved improvements in road safety outcomes, with 22% fewer fatalities in 2024, compared to that of in 2023. An 8% reduction over the previous five-year average has also been achieved (2019-2023) (Government of South Australia, 2024). However, the number of lives lost on South Australia's roads each year continues to be volatile and needs to continue to be reduced.

To further these improvements and drive a targeted reduction in harm, the Department for Infrastructure and Transport (DIT), with assistance from the University of Adelaide's Centre for Automotive Safety Research, is developing comprehensive network safety plans (NSPs), for both regional and metropolitan areas, to allow for a systematic improvement in road safety across South Australia. NSPs are an integral part of the Australian Government's plan for improving road safety on Australian roads (Commonwealth of Australia, 2021) and increasingly becoming a fundamental requirement for managing road safety to a consistently high standard. As such, the development of NSPs for South Australia is identified as a key focus within *South Australia's Road Safety Strategy to 2031* (Government of South Australia 2022), with an aim to achieve at least a 50% reduction in lives lost and at least a 30% reduction in serious injuries on South Australian roads by 2030, and with the long-term vision of zero lives lost by 2050.

As defined within the *National Road Safety Action Plan 2023-25* (Commonwealth of Australia 2023), NSPs are an assessment of the road safety risk across a road network supplemented by the assessment of benefits against the costs of specific road safety interventions to reduce that risk. NSPs are aimed at identifying key safety needs and guiding investment decisions to achieve reductions in fatalities and serious injuries.

The paper presented here focuses on the metro network safety plan (metro NSP), specifically developed for metropolitan road network of South Australia. The metro NSP provides a method for investment prioritisation and gap analysis based on collective risk and develops road design stereotypes that guide road design towards safer outcomes. While Aumann et al (2020a; 2020b) established a good foundation for the design of road stereotypes, they are largely unsuitable for direct implementation onto the South Australian metropolitan road network. Hence, stereotypes have been developed that consider the context and needs for application on South Australian roads, while continuing to use the concepts developed by Aumann et al (2020a; 2020b) as a foundation for their presentation. The function of a road has been identified as a key factor in developing road design that aligns with the principles of movement and place. Hence, the NSPs are aligned to the principles of movement and place through the integral consideration of functional hierarchy for multiple road user types, including those of general traffic (movement), place (pedestrians) and cycling.

Conference theme

This work aligns with the conference themes of equity – by promoting design that addresses the needs of all road users – and evolution – by evolving road safety planning and design to that well-aligned to the Safe System.

Approach

The network safety plan (NSP) for South Australia is divided into two regions of the road network: metropolitan Adelaide (metro NSP) and areas outside of metropolitan Adelaide (regional NSP). The approach outlined here focuses on the metro NSP currently under development. The metro NSP provides a method for assessing, prioritising and developing safety improvements for metropolitan roads (see Figure 1). The key steps are:

- The development of road design stereotypes to guide safe design of midblock and intersections
- The initial prioritisation of road sections based on risk analysis, of which highest priority sections are shortlisted for further assessment
- High-level design and gap analysis for the shortlisted sections
- High-level benefit-cost ratio (BCR) assessment for each shortlisted section, following by prioritisation based on calculated BCR
- Creation of investment plan based on development of high-level designs for shortlisted sections, after which projects and progression to the detailed design phase can be undertaken for individual sections as funding becomes available.

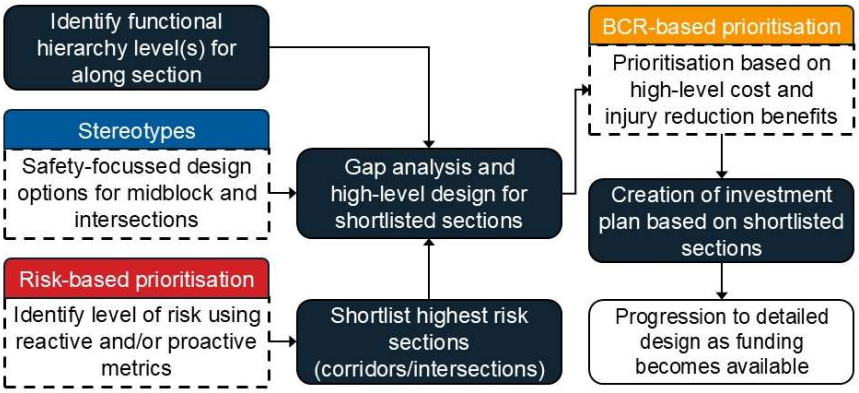


Figure 1. Proposed method of selection of road section and preferred safety upgrades

Road design stereotypes were modelled after those developed by Aumann et al (2020a, 2020b) and provide road design guidance during the conceptual design phase of a project, such that the safest feasible design can be selected before funding is acquired and detailed design is started. Consideration at this early stage allows fundamental aspects of the design to be viewed from a safety perspective, before major design considerations are solidified. Each stereotype, represented as a table of design attributes and risk metrics, provides multiple design options for a specific type of location across the road network. Stereotype tables are provided for both midblock (between intersections) and intersections. Midblock stereotype tables are split by single/multi-lane roads, while intersection stereotype tables are split by side road volume.

DIT are also developing a new functional hierarchy that builds on the concept of movement and place. The stereotype tables incorporate this hierarchy through the provision of separate stereotype tables for general traffic, place (pedestrians) and cycling functions. While spatial constraints may necessitate trade-offs between the spatial needs of each function, separate consideration of their needs can enable a greater range of potential outcomes to be explored before consolidating the design. Design options within the stereotype tables represent designs with different levels of safety. The level of safety offered by each design option is measured using AusRAP star ratings and fatal and serious injury (FSI) reduction ratios. Design targets were developed to categorise the desired level of safety and guide the user in the selection of the appropriate design option. Design targets are set as minimal (3.0-3.9 stars), desirable (4.0-4.9 stars) and aspirational (5.0-5.9 stars). Design options with a star rating below 3.0 are considered inadequate for upgrade, but are provided for undertaking the gap analysis through the comparison of current versus required level of design.

To assign funding to sections of the road network with the greatest safety improvement needs, a two-stage method for prioritisation has been developed; the first stage is based on risk, while the second stage is based on a high-level benefit-cost ratio (BCR) assessment. The first stage of prioritisation is based solely on historical crash data. As proactive safety metrics (e.g., AusRAP star ratings) are not available for the metropolitan road network, these could not be included –

where available, these will be included into future prioritisation of the wider network. A key principle of network safety plans is the consistent application of safe design at a corridor level (Aumann et al., 2020b). As such, prioritisation was conducted on road sections at a corridor level, with corridors (n = 194) consisting of continuous sections of road with a reasonably homogeneous environment (e.g., speed limit, traffic volumes, road reserve width and cross-section design). The prioritisation of major intersections (n = 243) is undertaken separately, as these often represent substantially different environments compared to their connecting road links. Prioritisation is initially undertaken separately for general traffic, place (pedestrian) and cyclist functions, such that each section is ranked separately for injuries that occur to these road user groups. Hence, three initial prioritisation lists are generated. The rank of each section is based on a scoring system in which all injury crashes are considered, and fatal and serious injury crashes are weighted more heavily than those that result in less severe injuries. Following this, the scores for each section across the three road user groups are normalised against their respective maximum score and summed to form a combined prioritisation list. This procedure is undertaken to ensure that injuries to motor vehicle occupants, which are far more numerous than those for pedestrians and cyclists, do not bias the combined prioritisation list solely towards this road user group.

Once the first stage of prioritisation is completed, a shortlisted group comprising the highest risk sections is selected for further consideration. A high-level concept design and gap analysis is completed for each section. Here, both the functional hierarchy levels and stereotypes are considered to produce a concept design that provides for the safety needs of each road user type commensurate to their functional hierarchy level and the design target being pursued. The high-level BCR assessment of each shortlisted section is then undertaken, with both safety benefits (estimated reduction in FSIs) rough order of magnitude costs being considered. This forms the basis of the second state of prioritisation, with the highest BCR sections forming the basis for an investment plan, with consequent priority for funding and further development.

Implications for policy and practice

To date, the focus of South Australia's network safety plans has been on developing responses to the key contributors to harm across the South Australian road network, with the aim of attaining the road safety targets outlined in *South Australia's Road Safety Strategy to 2031* (Government of South Australia, 2022). Hence, the initial focus has been on applying this work to leading contributors to harm across South Australia's road network; low-speed roads in metropolitan Adelaide and moving forward, high-speed regional roads. Beyond this, the NSPs will be extended to include high-speed peri-urban and limited access roads, regional townships and roads within the Adelaide Hills and surrounding area, which represent a uniquely mountainous road environment for South Australia.

The NSPs will provide a range of benefits for future network investment in South Australia. Specifically, the NSPs will:

- Serve as a tool for prioritising road sections to assist in the investment decision making process and will provide road design stereotypes to guide safety interventions aligned with South Australia's road safety commitments.
- Work towards achieving homogeneous road infrastructure section within a corridor for better safety outcomes, progressing the road safety mindset beyond blackspot programs that are, by their nature, limited in effectiveness due to their localised scope (Aumann et al., 2020b).
- Help set objectives for each road section based on its function, allowing for the implementation of appropriate design criteria that will lead to an environment more accommodating of all road users, enabling both a safe and efficient transport system for all road users. Moreover, they are adaptive to both shorter- and longer-term safety agendas, with the use of multiple design targets that will enable the adaptation of design aspects to achieve current and future road safety targets while addressing practical constraints that may arise within projects.

Conclusions

The practical implementation of road safety is moving on from the days of blackspot-based treatment, while these still have their place, it has been recognised that a greater emphasis at the network-scale is required for consistent and meaningful improvements to be made. The Federal Government has made it clear that network safety plans will increasingly become a fundamental aspect of each road authority's road safety toolkit. To this end, DIT are developing and implementing robust NSPs that will lead South Australia towards the targets set out in its road safety strategy and beyond.

Overall, the NSPs will support adoption of a system-based approach to ensure all components of transport system, including infrastructure, vehicles and road users, function cohesively to enhance road safety. They will help identify road safety issues, set road safety targets, and formulate a plan of actions to improve road safety towards the targets set in the *South Australia's Road Safety Strategy to 2031* (Government of South Australia, 2022).

References

Aumann, P., Bekavac, M., Steinmetz, L., Tziotis, M., Ahmed, F., Fanning, R., Bobbermen, D. (2020a). *Road cross-section design for road stereotypes (including network safety plans) and a Safe System* (AP-R618-20). Sydney: Austroads.

Aumann, P., Bekavac, M., Steinmetz, L., Tziotis, M., Ahmed, F., Fanning, R., Bobbermen, D. (2020b). *Network design for road safety (stereotypes for cross-sections and intersections) user guide* (AP-R619-20). Sydney: Austroads.

Commonwealth of Australia. (2021). *National Road Safety Strategy 2021-30*. Canberra: Department of Infrastructure, Transport, Regional Development and Communications.

Commonwealth of Australia. (2023). *National Road Safety Action Plan 2023-25*. Canberra: Department of Infrastructure, Transport, Regional Development and Communications.

Government of South Australia (2022). *South Australia's road safety strategy to 2031*. Adelaide: Department for Infrastructure and Transport.

Government of South Australia (2024). *Road crash report (preliminary): Lives lost in South Australia 2024, Think Road Safety*. Adelaide: Department for Infrastructure and Transport.

Beyond the crash: addressing the psychological impact of road incidents

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Abstract

Road traffic incidents have far reaching consequences, extending beyond physical injuries to affect the lives of those directly and indirectly involved. While post-crash care is a crucial element of a safe road system, it is often overlooked in strategic network planning. Fortunately, there are some services providing specialist trauma support to individuals impacted by road traffic incidents, including Road Trauma Support WA (RTS WA). Since 2013, RTS WA has been providing specialised information, support, training and counselling to the WA community regardless of when the incident occurred or the person's level of involvement. Continuous evaluation of the service has demonstrated the positive impact of the service in reducing the psychological impact of road traffic incidents and ultimately contributing to improved road safety and enhanced community well-being.

Social media post

Post-crash care is a vital component of a safe road system so why are we neglecting its value? Road Trauma Support WA and other specialist road trauma support services are integral to keeping our community safe on our roads.

Introduction

In 2024, 1,306 people died on Australian roads and even more people were injured and/or traumatised by the hundreds of thousands of crashes on the roads a year (BITRE, 2024). The impact of a road traffic incident on those involved and the wider community is profound. Road trauma can ripple through our lives and communities in different ways and can leave individuals feeling stressed, overwhelmed, helpless and vulnerable. It has been estimated that globally over 15% of road traffic crash survivors suffer from an acute stress disorder (Dai et al., 2018) and a meta-analysis has reported that post-traumatic stress disorder was prevalent in 22% of road traffic crash survivors (Lin et al., 2018). The prevalence and impact of psychological symptoms can vary over time, however research findings have indicated that psychological symptoms are still common three years after a motor vehicle crash (Mayou & Bryant, 2002).

The World Health Organization identifies mental health care and psychological support as key components of the post-crash response due to its role in mitigating grief, anxiety and other bereavement reactions, and in preventing psychological distress from becoming a disability that interferes with re-integration into work and social life (WHO, 2016). However despite this recognition and the potential for long-term implications of road trauma, mental health consequences are often be overlooked in comparison to physical health rehabilitation (Heron-Delaney et al., 2013).

The Safe Systems approach to road safety highlights that the whole road system must work together to prevent crashes and reduce their severity by having Safe Speeds, Safe Roads, Safe Vehicles, Safe People and Post-Crash Care. The Post-Crash Care element of the approach can be complex; however, it acknowledges that our ability to reduce the impact of a road crash does not end when the crash occurs. Post-crash care involves emergency response, mental health, legal support, legislation and data.

Despite the importance of post-crash care it is often neglected within influential documents. For example, the National Road Safety Strategy 2021-30 outlines Australia's road safety objectives and focuses on three main themes, safe roads, safe vehicles and safe road use (Infrastructure and Transport Ministers, 2021). Despite not being a specific theme within the Strategy, there are numerous mentions of the value of speed management throughout the Strategy. However, there is only one mention of the fifth pillar, Post-Crash Care (Infrastructure and Transport Ministers, 2021). It could be argued that post-crash care is a health issue and, therefore, is the responsibility of health and emergency services departments, but this significantly neglects the intersectionality of the objectives the Strategy aims to meet.

Fortunately, despite the lack of acknowledgement within the National Strategy, there are a number of highly valued services working in the psychological trauma space of post-crash care including Road Trauma Support WA, Road

Trauma Support Group NSW, Road Trauma Support Team of South Australia, Road Trauma Support Tasmania and Amber Community in Victoria.

Conference theme

By providing post-crash care to the whole community, regardless of their involvement in the road traffic crash or the severity of their injuries RTS WA treats everyone fairly and enables individuals to make informed choices about the support they would like to access. Some members of the community may be at increased risk of vicarious road trauma (i.e., first responders) and therefore it is vital that they are provided with tailored support.

Over its 12 years of service delivery, RTS WA has continued to evolve to ensure the service continuously adapts to meet the current and future needs of the community. By utilising qualitative and quantitative data, the service is continuously adapted to ensure equitable access and the provision of multi-layered support to minimise the impact of road trauma.

Project description

Injury Matters delivers Road Trauma Support WA to reduce the ongoing psychological and social distress experienced by people impacted by road trauma. The service offers specialised information, support, training and person-centred counselling, regardless of when the incident occurred or the person's level of involvement. All services are developed with and for the community, with the goal of supporting each individual's unique recovery journey.

Injury Matters is able to provide tailored support to the WA community thanks to funding from the Road Trauma Trust Account (RTTA) with contract management provisioned by the WA Road Safety Commission. Following a road traffic incident, numerous health professionals provide care to those involved and witness firsthand the impact this unexpected event has on an individual's life and that of their family. Injury Matters are fortunate to collaborate with various professionals to ensure their clients or themselves are supported.

Results

In maintaining an evidence-based approach to the service and demonstrating the significant impact of the service, Injury Matters follows a comprehensive evaluation framework. Ongoing process data collection metrics include the number of counselling sessions and contacts, client outcome measurements, workshop attendance, enquiries, referral points and resource access. Since its establishment in 2013, RTS WA has provided specialised counselling to over 2,000 individuals, responded to over 2,500 requests for information and resources and delivered workshops to over 2,000 first responders, allied health professionals and community leaders.

An annual survey is administered to people who engage in the service via enquiries, workshops and presentations, counselling sessions and resources. The 2024 survey tool included questions relating to the following domains: engagement, knowledge, satisfaction, and behaviour change. Results were analysed and reported as frequencies using Jamovi (Version 0.9) data analysis software. Open-ended responses were analysed and reported through themes.

The 2024 Road Trauma Support WA annual survey received 65 responses. The majority of survey respondents indicated that they were satisfied with their experience with RTS WA (91%, n=53). Respondents were also in agreeance that the various service elements were valuable, with 88% of counselling respondents agreeing that the sessions helped them manage their issues and/or concerns (n=35), 88% of respondents who accessed the enquiry service agreed that the Service provided them with the information that they required (n=35), 94% of respondents who accessed a resource agreed that the resources increased their knowledge of how road trauma affects people (n=30) and 100% of workshop/presentation respondents agreed that the workshop/presentation increased their awareness of where to refer people impacted by road trauma (n=14).

The annual survey has evolved over the years to capture data regarding the programs impact. However since its implementation in 2021 the results have consistently indicated that the Service is successfully raising awareness of the impact of road trauma in WA, providing timely specialist support to people impacted by road trauma and building the capacity of people who may be exposed to road trauma as part of their work.

Benefits to road safety

Research supports that mental health disorders can increase an individual's risk of having a crash due to the detrimental impact on cognitive functioning, including the brain functions that are required to drive safely. A study of road users injured and admitted to the Royal Adelaide Hospital found that mental health issues were a contributing factor in 22% of crashes attributed to a medical condition or event (Baldock & Raftery, 2025).

RTSWA provides support strategies to reduce the ongoing psychological and social distress experienced by people affected by road trauma. This contributes to improved well-being and quality of life and reduces the negative impacts of adverse psychosocial outcomes. Injury Matters' advocacy and stakeholder engagement have led to legislative changes in road safety, increased access to support services, and the implementation of additional safety initiatives.

Implications for policy and/or practice

The positive impact of RTS WA on the WA community over the last 12 years reinforces the importance of providing evidence-based post-crash care and the value of the fifth pillar in creating a safer road system. Despite existing trauma support services in some locations, it is vital that action is taken to increase access to timely specialised road trauma support across Australia.

The robust evaluation framework underpinning RTS WA supports the value of all road safety initiatives investing in rigorous evaluation activities to ensure the initiative is measured and adapted to maximise the benefits for the target audience. Injury Matters' focus on partnerships and collaboration also further reinforces the value of working with first responders, health professionals, government officials and community members to raise awareness of the impact of road traffic incidents and advocate for the need to deliver solution-focused initiatives that improve road safety in Australia.

Conclusions

Given the significant impact of mental health conditions on an individual's driving ability and the positive outcomes associated with RTS WA for the WA community, it is evident that post-crash care should be considered an essential pillar of any safe road system. Reducing road fatalities and serious injuries is an important goal. However, road crashes will still occur, and therefore, it is critical that individuals impacted by road trauma are provided with specialist support.

References

Baldock, M. R. J., & Raftery, S. J. (2025). A cross-sectional study of the prevalence of medical conditions as contributors to road crashes in South Australia. *Traffic Injury Prevention*, *26*(1), 24–32. https://doi.org/10.1080/15389588.2024.2389205

Bureau of Infrastructure and Transport Research Economics. (BITRE). (2024). *Road deaths: Calendar year Australia*. https://app.powerbi.com/view?r=eyJrIjoiN2M1NjI0ZDQtZDhhYS00MDM5LTk5YzUtZmUwZjQ1M2JhYTgxIiwidCI6ImFhMjFiNjQwLWJhYzItNDU2ZC04NTA1LWYyY2MwN2Y1MTc4NCJ9

Dai, W., Liu, A., Kaminga, A. C., Deng, J., Lai, Z., Yang, J., & Wen, S. W. (2018). Prevalence of acute stress disorder among road traffic accident survivors: A meta-analysis. *BMC Psychiatry*, *18*, 188. https://doi.org/10.1186/s12888-018-1769-9

Heron-Delaney, M., Kenardy, J., Charlton, E., & Matsuoka, Y. (2013). A systematic review of predictors of posttraumatic stress disorder (PTSD) for adult road traffic crash survivors. *Injury*, *44*(11), 1413–1422. https://doi.org/10.1016/j.injury.2013.07.011

Infrastructure and Transport Ministers. (2021). *National Road Safety Strategy 2021—2030*. Commonwealth of Australia. https://www.roadsafety.gov.au/sites/default/files/documents/National-Road-Safety-Strategy-2021-30.pdf

Mayou, R., & Bryant, B. (2002). Outcome 3 years after a road traffic accident. *Psychol. Med.*, *32*(4), 671–675. https://doi.org/10.1017/S0033291702005470

World Health Organization. (WHO). (2016). *Post-crash response: Supporting those affected by road traffic crashes*. WHO. https://www.who.int/publications/i/item/post-crash-response-supporting-those-affected-by-road-traffic-crashes

Evaluating road markings as a safety measure in Indonesia

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Abstract
This extended abstract evaluates the effectiveness of edge and centerline road markings at nine blackspot sites on Indonesia's 2/2-UD national rural roads in North Sumatra Province. The evaluation uses a before-and-after crash rate analysis. Crash rates were calculated per million vehicle kilometres travelled for fatalities, injuries (serious and minor), and total crashes. Although some variations were observed, the Wilcoxon signed-rank tests showed no statistically significant differences ($p > 0.05$). These findings highlight the need for improved implementation quality, maintenance, and additional measures beyond markings alone. This before-and-after analysis serves as an initial exploratory effort to establish baseline data for future, more comprehensive studies. Future research should utilise Empirical Bayes methods and include matched control sites to enhance the robustness of evaluations.

Social media post
The installation of road markings is not merely a component of road maintenance but a crucial element of road safety.

Introduction
Indonesian national roads play a crucial role in transportation, linking various activity centres nationwide. However, the high rate of traffic crashes on these roads presents a significant challenge. The Ministry of Public Works of the Republic of Indonesia, which manages national roads, has identified 929 black spot sites based on police data from 2020 to 2024. While various treatments have been applied to these black spots, an evaluation of their effectiveness has not yet been conducted. Assessing the impact of interventions at these locations is essential for determining whether these treatments reduce the number and severity of traffic crashes (Hauer, 1997; AASHTO, 2010; PIARC, 2003).

One low-cost intervention that has been implemented is the installation of edge and centerline markings. Carlson et al. (2009) reported that these markings can provide crash reduction factors (CRF) of up to 24%. Previous studies in developed countries have shown that edge and centerline markings contribute to crash reductions ranging from 3% to 24%, with Crash Modification Factors (CMFs) typically reported between 0.76 and 0.97 (FHWA, 2024). However, compared to Indonesia, these CMFs are derived from contexts with better enforcement, infrastructure quality, and driver compliance. Therefore, localised evaluations are necessary to develop context-specific CMF values reflecting Indonesia's unique traffic and road conditions. This paper aims to evaluate the effectiveness of edge and centerline markings at nine black spot sites on 2/2-UD national rural roads in North Sumatra Province.

Conference Theme (Evolution)
This research is expected to serve as initial momentum for developing CMF values based on various treatments implemented at 929 sites on Indonesian national roads, using a more rigorous method. Thus, the Indonesian government, which is responsible for managing national roads, can achieve safer national roads by the Safe System Approach, where treatments should be more proactive and systematic, focusing on prevention and implementing strategies that consider the tolerance limits of road user errors.

Method
The study examined edge and centerline markings installed in 2021 at nine blackspot locations on 2/2-UD national rural roads in North Sumatra Province. A before-and-after study design was adopted using three years of crash data before (2017-2019) and after treatment (2022-2024). Crash data before and after the treatment were obtained from the Police IRSMS database. Crash rates were calculated per million vehicle-kilometres-travelled (VKT), using traffic volume and segment length as exposure data. AADT data was sourced from the annual survey conducted by the Ministry of Public Works. Wilcoxon signed-rank tests were used for significance testing after normality assessment using Minitab Version 21.1.0. Note that in this study, the effectiveness of edge marking and centerline marking was not evaluated separately, but was evaluated together. It should also be noted that this study did not incorporate control sites for comparison, limiting the ability to isolate the treatment effect from other influencing factors. Nevertheless, this before-and-after analysis serves as an initial exploratory effort to establish baseline data for future, more robust studies

Results

Crash rates per million VKT before and after treatment are shown in Table 1. The results of the evaluation of the effectiveness of edge and centre markings are summarised in Table 2.

Table 2. The effectiveness of the edge and centre markings

Crash rate type	p-value	Significance
Fatality Rate	0.529	Not Significant
Injury Rate	0.722	Not Significant
Total Crash Rate	0.554	Not Significant

The significance tests revealed no statistically significant results, indicating that the installation of edge and centre markings did not have a substantial effect on improving road safety for addressing the black spots at nine sites on 2/2-UD national rural roads in North Sumatra Province.

The yearly analysis of crash data indicates that the majority of crashes occurred in the second and third years following the installation of new road markings. This trend suggests that in the first year, the road markings significantly enhanced visibility and improved guidance for drivers. Clear road markings assist drivers in maintaining their lanes and reducing uncertainty, especially on roads with poor lighting or adverse weather conditions. However, the advantages of these markings were not sustained over time, partly due to common challenges encountered in low- and middle-income countries, such as:

1. The quality of work often fails to meet established standards. Implementing markings that comply with retro-reflectivity standards can greatly improve road safety. This aligns with the findings of Bektas et al. (2016), which indicate a significant statistical correlation between the retro-reflectivity of road markings and the number of crashes.
2. The Maintenance of road markings is not optimal, leading to quick fading and reduced effectiveness.
3. Driver behaviour often fails to recognise the importance of road markings. Therefore, it is essential to continue consistent education and public awareness efforts. Moreover, incorporating psychological approaches can enhance effectiveness; for instance, using road markings with optical effects that create the illusion of lane narrowing can prompt drivers to reduce their speed.

This study presents several limitations. The absence of control sites hampers causal inference regarding the effectiveness of road markings. Additionally, the use of simple before-and-after methods does not adjust for regression to the mean or account for confounding factors. Furthermore, edge and centerline markings were evaluated collectively without disaggregating their impacts. Future research should adopt more robust analytical approaches, such as utilising Empirical Bayes methods to adjust for regression to the mean and mitigate other potential biases. Such enhancements will support the development of reliable Crash Modification Factors (CMFs) for Indonesian road conditions.

Benefits to Road Safety

This paper provides input to the Indonesian government, particularly national road administrators, emphasising that road safety must consider human, vehicular, infrastructure, and speed factors to reduce the risk of crashes and their impacts, thereby minimising the fatal consequences of road user error

Implications for Policy and/or Practice

It is crucial to evaluate the effectiveness of the Ministry of Public Works' interventions at black spots to establish a foundation for future safety measures. Additionally, this evaluation presents an opportunity to develop Crash Modification Factor (CMF) values tailored to Indonesian conditions, enabling a more accurate assessment of different safety interventions.

Table 1. Crash rate before and after treatment

Black spot identity	Length of segment (km)	Before (2017-2019)							After (2022-2024)						
		avg. AADT	Crash frequency			Crash rate			avg. AADT	Crash frequency			Crash rate		
			Fatal	Injury*	Total	Fatal	Injury*	Total		Fatal	Injury*	Total	Fatal	Injury*	Total
01 Pelawi Selatan Babela	0.26	27,728	1	1	2	0.380	0.380	0.760	21,759	0	2	2	0.00	0.969	0.969
03 Langkat Tamiang Halaban	0.54	21,415	2	3	5	0.474	0.711	1.185	10,988	0	1	1	0.00	0.462	0.462
05 Pekan Besitang	0.35	21,415	1	2	3	0.366	0.731	1.097	10,988	1	2	3	0.71	1.425	2.137
06 Tikungan Simpang Bluma Hilir	0.76	26,824	1	2	3	0.134	0.269	0.403	48,915	3	2	5	0.22	0.147	0.368
07 Tikungan KM 21	0.60	26,824	2	7	9	0.340	1.192	1.532	48,915	5	6	11	0.47	0.560	1.027
15 Jl. Ir H. Djuanda, Sei Bamban Estate	0.61	65,308	2	4	6	0.138	0.275	0.413	32,904	3	3	6	0.41	0.409	0.819
19 Jln Tanjung Pura	0.69	27,728	3	2	5	0.430	0.286	0.716	21,759	0	0	0	0.00	0.000	0.000
20 SPBE Pertamina	0.64	37,734	0	4	4	0.000	0.454	0.454	23,283	0	2	2	0.00	0.368	0.368
31 Jl. Jend. Sudirman Perdmaian	0.72	33,030	2	7	9	0.230	0.806	1.037	26,888	1	4	5	0.14	0.566	0.708

* includes Serious and Slight injuries

Conclusions

The evaluation of edge and centerline road markings at nine blackspot locations showed no statistically significant reduction in crash rates per million vehicle kilometres travelled (VKT). The effectiveness of these road markings tends to decline after the first year due to several factors, such as poor implementation quality, inadequate maintenance, and driver behaviour that ignores the markings. To achieve meaningful improvements, comprehensive strategies are essential. These strategies should combine high-quality implementation, regular maintenance, behavioural interventions through awareness campaigns, and advanced evaluation methods. Additionally, this study highlights the importance of data-driven evaluations in developing more accurate Crash Modification Factor (CMF) values to support national road safety policies.

References

AASHTO. (2010). Highway Safety Manual. Highway Safety Manual. https://doi.org/10.1126/science.88.2293.8.s.

B. Aldemir-Bektas, K. Gkritza, and O. Smadi. (2016), Pavement Marking Retroreflectivity and Crash Frequency: Segmentation, Line Type, and Imputation Effects. Journal of Transportation Engineering, vol. 142, no.8, Article ID 04016030. https://doi.org/10.1061/(ASCE)TE.1943-5436.0000863

Carlson, Paul & Park, Eun Sug & Andersen, Carl. (2009). The Benefits of Pavement Markings: A Renewed Perspective Based on Recent and Ongoing Research. Transportation Research Record Journal of the Transportation Research Board.

FHWA (2024). Crash Modification Factors Clearinghouse. Federal Highway Administration. Retrieved from https://cmfclearinghouse.fhwa.dot.gov/

Hauer, Ezra (1997). Observational Before/After Studies in Road Safety: Estimating the Effect of Highway and Traffic Engineering Measures on Road Safety. Emerald Group Publishing Limited, 1997.

Minitab LLC "Minitab Statistical Software, (version 21.1.0)", [computer program] Available at: https://www.minitab.com/en-us/support/downloads/

World Road Association (PIARC). (2003): Road Safety Manual. World Road Association, PIARC, Paris

Case studies from fatal crash investigations by Court-appointed Expert Witness

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Abstract

Could a speed limit reduction from 100 to 80km/h on a quiet rural road have contributed to a fatal crash occurring on a fateful winter evening? The author is an Expert Witnesses to the Victorian County Court, assisting on cases where drivers are charged with dangerous driving causing death. In one of these cases, the implementation of a speed limit reduction was identified as a causal factor. These Court appointments provide a unique opportunity to glean insights from actual high severity crashes, allowing the available evidence to highlight the unique factors in each crash and show how seemingly minor details can have serious implications. Patterns can be identified to provide practitioners and researchers insight into non-obvious factors that can have disproportionate influence on road trauma outcomes. Actual Court findings show how the Courts (and by implication, broader society) accept that these factors mitigate the culpability of drivers' actions.

Social media post

Could a speed limit reduction from 100 to 80km/h on a quiet rural road have contributed to a fatal crash occurring? A Court Expert Witness identifies non-obvious factors that have disproportionate influence on road trauma outcomes and discusses society's acceptance of them as mitigating driver culpability.

Introduction

The author is an established road traffic Expert Witness to Australian Civil and Criminal Courts. This presentation is derived from cases run within the Victorian criminal justice system, where drivers and other road users are prosecuted for their role in serious injury and fatal crashes.

A core principle of the Safe System Approach is that humans will inevitably make errors, and that there are known biological limits to the amount of force that can be tolerated before injury occurs. The Safe System Approach aims to provide a more forgiving road system so that mistakes do not result in traumatic consequences.

Less often discussed is whether the Safe System Approach should extend the forgiveness principle to the extent that "at fault" road users could be forgiven from the outcomes of criminal prosecution. While this question moves away from the prevention of physical harm, the core principle of being able to "forgive a mistake" remains the same. After all, the **Equity** theme of this conference means that the driver who has made a mistake is just as valuable as the victims of their crash, as grating as that may be perceived to some.

Expanding the Safe System Approach

In her paper arguing to broaden the Safe System Approach to recognise opportunities to prevent or reduce road user error through improved design, Williamson (2021) challenges the preconceived notion that all road user error is inevitable. Her paper argues that society would do well to tackle crash likelihood in addition to the existing effort to reduce crash severities.

The work undertaken by the presenter in examining actual severe crashes (backed by the police brief of evidence and capable efforts of crash reconstructionists) can form the basis of a body of knowledge that addresses the root causes of road user error. Like Williamson, we seek evidence that answers the question "Why did the road user behave in that way at that time?" and in most cases, we have managed to find some answers that have been used to inform the Court.

These answers can then be used to inform road managers on the shortcomings and contribute to a more resilient system than current practice allows, also addressing the conference theme of **Elasticity**.

Crash investigation and reconstruction – current industry practice

Our work differs from established crash investigation efforts. Within Victoria, crash investigaions are undertaken by Police in assembling a brief of evidence that may form part of the state's case against the driver who made the mistake.

We note that just because the investigation and reconstruction is conducted by Police, that does not mean that it is inherently biased towards proving the errant road user to be guilty. While the Prosecutor's office may be motivated towards Court findings of guilt, we have found that the collection of valuable evidence and data shortly after the crash occurs has the potential to contribute so much insight to an impartial investigator that it can be used to identify factors that contribute to the road user's error beyond "they made a mistake, they are at fault."

The other common form of crash investigation is undertaken by road authorities after a fatal crash as a matter of routine. Similar to the author/presenter's aims, it considers the contribution of the road infrastructure to the crash outcome. Unfortunately, in the presenter's experience, the motivation for these investigations is largely aimed at minimising liability claims against the relevant road authority. The steps to achieve this is typically to check the infrastructure for compliance with standards that may have existed at some point in the past. The question "why did the road user behave in that way at that time?" is almost never asked.

This is not to fault the road authorities. The level of investigation performed by road authorities is appropriate to the narrow objectives of their organisation, so they work with far less information than their police counterparts. The police crash investigators and reconstructionists are well trained, on scene immediately after the crash, and are equipped with state-of-the-art equipment like 3D point cloud scanners and high resolution cameras. They also perform skid/friction testing and capture vast amounts of data from the scene.

A better way (or, Evolution of current practice)

The presenter pursues an improved standard of crash investigation, and by this improved practice, develop an evidence base that addresses the problem of safe behaviour being difficult for drivers. Each crash is unique and has distinctive factors that contributed to the unfortunate outcome. However, these can be distilled into common principles and failure modes that can contribute to a better understanding of crash causality from a human factors perspective. As a bonus, the cases provide ready-made examples of the factors in action.

Another improvement to crash investigation practice is the ability to integrate vehicle factors beyond the obvious scope of roadworthiness regulation, which is the usual standard on which police crash investigation is based. Vehicle safety factors extend far beyond basic roadworthiness, especially in a time of increasing automation and interventions such as Lane Keep Assist and Automatic Emergency Braking. The convenience factor of Lane Centering and Adaptive Cruise Control has the propensity to degrade driver response times as complacency sets in. As these features proliferate across the fleet, we expect to see more cases where these features are a factor in crashes.

The presentation

The presentation will present case studies of actual criminal prosecutions and cover the details of our investigation findings including the police brief of evidence. There will be surprise factors that are not obvious to the majority of road managers and road safety practitioners. Our presentation will be done in collaboration with the relevant road authority responsible for the roads where the fatal crash occurred. Our aim in conducting this presentation is that the audience understands that there is greater potential to reduce driver error and address the human factors that contribute to crash likelihood, and to illustrate this by means of real case examples.

Note: out of sensitivity to our audience, we will not be showing crash CCTV or triggering graphic photos/footage of the crash scene or vehicles. Neither will we be disclosing any subpoena documents due to privacy considerations. Media during the presentation will be limited to drive throughs of the relevant roads to show contemporary road conditions.

References

Williamson, A. (2021). Why do we make safe behaviour so hard for drivers? *Journal of Road Safety - Volume 32, Issue 1*, 24-36.

Streets Alive: A community-led approach to road safety

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Abstract

Road safety is a shared responsibility that requires more than government-led infrastructure and enforcement. Lasting change depends on shifting community attitudes and behaviours towards speed through citizen-led street calming projects and activities. Speeding is a major factor in road trauma, yet government-mandated speed reductions often face resistance. The key is empowering communities to recognise the benefits of lower speeds and Streets Alive demonstrates that when locals lead the conversation and co-design street safety solutions, they take ownership of their environment and embrace safer speeds. Through placemaking and community-led interventions, this initiative fosters a culture where slower speeds are not imposed but desired, making streets safer and more inclusive. Streets Alive also influences policy by embedding community-led street calming and collaboration into local and state government strategies. This cost-effective, scalable model exemplifies the Safe System approach, proving that equitable, citizen-driven road safety improvements can create lasting, widespread impact.

Social media post

Safer streets start with community action! Streets Alive empowers locals to lead change, making slower speeds a choice, not an imposition = safer, more inclusive streets for all. #StreetsAlive #ARSC2025 @townteammovement @mainroadswesternaustralia

Conference theme

Streets Alive aligns with the ARSC2025 theme:

- Equity: Ensuring all road users, including children, seniors, and people with disabilities, have safe access to transport.
- Elasticity: Building community resilience by adapting public spaces for safer pedestrian and cyclist movement.
- Evolution: Showcasing a scalable model for embedding safe system principles and collaboration in local road safety projects.



Introduction

Pedestrian safety remains a pressing road safety issue, with pedestrians accounting for a significant proportion of road trauma. Walkable environments contribute to public health, social inclusion, and sustainability but require targeted interventions to address safety risks. Streets Alive is a community-driven initiative improving walkability through co-designed road safety interventions, focusing on equitable access to safe active transport options.

Project description

The initiative is being implemented across urban and suburban areas in Western Australia, focusing on local roads and integrating movement and place thinking into road design and use. Through a community co-design process, it engages residents, local governments, and transport agencies in placemaking interventions, temporary street modifications, and road user education. Impact is assessed through surveys, observational studies, and community feedback. An in-depth summative analysis will be available in 2028 with case studies showcased having already attracted both national and international interest.

Since 2024, 68 community-led projects have been supported across Western Australia, leading to shifts in local government approvals, processes, and changes to Main Roads policies and guidelines.

Results

- Increased pedestrian activity in project areas
- Reduced vehicle-pedestrian conflict points
- Improved community perception of safety
- Improved community attitudes and behaviours towards vehicle speeds
- Increased stakeholder collaboration on road safety initiatives
- Improvements to local and state government process and policies

Benefits to road safety

By prioritising pedestrian-friendly design and community-led safety interventions, Streets Alive contributes to reduced road trauma, greater compliance with speed limits, and heightened public awareness of pedestrian safety.

Implications for policy and/or practice

Findings support the integration of walkability-focused policies in urban planning and transport strategies. The initiative serves as a replicable model for governments and community organisations aiming to improve road safety through place-based interventions.

Strategic alignment

The Streets Alive program has a strategic alignment with the Australian Government's National Urban Policy to deliver targeted and place-based investment that promotes sustainable growth and enables communities to thrive.
Furthermore, the Australian Government, with WA as a signatory, has two road safety targets:

- at least a 30% reduction in serious injuries by 2030; and
- a reduction in fatalities of 50% by 2030.

The Western Australian (WA) State Government has a target of reducing the numbers of people killed, severely or seriously injured by 50-70% by 2030.

The Driving Change Strategy notes that '…a majority of Western Australians are supportive of local changes to speed in high pedestrian and cycling areas' and that supporting and implementing speed reforms is a priority.

The National Road Safety Strategy identifies a movement and place approach for speed management as an area of focus for results and that speed management is critical. This program tests and demonstrates the benefits of the movement and place approach.

Conclusions

Streets Alive demonstrates that community-driven road safety improvements can lead to safer, more liveable streets. The initiative provides a framework for equitable, adaptable, and sustainable road safety enhancements that can be scaled and applied across diverse communities.

This program is leading the way, not only nationally but internationally in terms of its community-led and collaborative street calming approach focused on changing local attitudes and behaviours towards speeding.

References

The Streets Alive Program is delivered by Town Team Movement, and designed in partnership with Main Roads Western Australia and WALGA. www.streetsalive.org.au

Driver behaviour preceding crashes at stop/give way sign-controlled intersections

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Abstract

This study investigated driver behaviour and circumstances that led to right-angle crashes at stop and give way sign-controlled intersections. In-depth casualty crashes investigations in South Australia from 2014 to 2023 were analysed. At-fault drivers in 57 right-angle crashes did not statistically significantly differ from at-fault drivers in 375 crashes of other types in testing positive for alcohol or drugs or having passengers. Their vision of the other road user was restricted in 26 crashes. In 33, they slowed or stopped at the intersection before moving into the path of the other road user (16 were looked-but-failed-to-see crashes). In 19, they proceeded straight into the intersection without slowing or stopping, and the most common preceding circumstance for these drivers was that they were unfamiliar with the road (11 crashes). Safety can be improved through superior intersection design and treatments that increase driver awareness of the intersection or reduce crash forces.

Social media post

Why do drivers go through stop and give way signs into the path of another road user, often despite clear signage and advanced warnings? Are they distracted or unfamiliar with the road? Is their vision blocked, or have they stopped and looked but failed to see?

Conference theme alignment – Evolution

This abstract examines one of the most common types of crashes on the road network – right angle crashes at stop and give way sign-controlled intersections. It examines the driver behaviour and circumstances that lead to the failure to obey these signs and aims to identify effective interventions and treatments. It shows that these crashes result from human error but that they continue to occur despite common interventions (e.g., advanced warning signs, additional delineation). Therefore, this aligns with the third conference theme by demonstrating that traditional safe system approaches to prevent these crashes have not worked and that the system and related thinking and implementation need to **evolve** to effectively address them – through grade separation to remove potential conflict, rumble strips on the approach to increase driver awareness, and energy management by reducing vehicle speeds to survivable levels.

Introduction

Intersections are a fundamental and necessary component of the road system. However, they create conflict points between vehicles travelling in the same and from opposite directions and on adjacent roads. Many intersections are controlled by stop or give way signs, which require decision-making and judgement by the driver and, therefore, have a high potential for human error. Right-angle crashes, in which two vehicles approaching the intersection from adjacent roads collide when one driver fails to give way, are the most common type of crashes at non-signalised intersections (Mongiardini et al., 2021; Stokes & Woolley, 2022). Souleyrette et al (2005) found that 82% of crashes at rural stop sign controlled intersections in Iowa, USA were right-angle crashes. The present study investigated the driver behaviour and circumstances that precede right-angle crashes at stop and give way sign-controlled intersections to gain an understanding of why they occur and highlight the most effective treatments and interventions to prevent them.

Method

In-depth at-the-scene investigations of casualty crashes conducted by the Centre for Automotive Safety Research (CASR) in South Australia (SA) from 2014 to 2023 were analysed. The narratives (e.g., statements/interviews/reports from participants/witnesses/police), details (e.g., time, location), circumstances (crash configurations, vehicle damage), and other information (e.g., dashcam/CCTV footage, downloads from vehicle event data recorders) of right-angle crashes at stop or give way sign-controlled intersections were examined to build a holistic understanding of what occurred. The design and police-reported crash history of the specific intersections where crashes were investigated by CASR were also examined to determine whether there were any characteristics of these locations that could have contributed to the crashes (e.g., visibility issues). Frequency counts and chi-square tests (with an alpha level of 0.05 for statistical significance) were used for analyses.

Results

Fifty-seven right-angle crashes were examined. Thirty-seven occurred at give way sign-controlled intersections and 20 occurred at stop sign-controlled intersections. Fourteen occurred at T-intersections and 43 occurred at crossroad intersections. At-fault drivers in the 57 right-angle crashes did not statistically significantly differ from at-fault drivers in a comparison sample of 375 crashes of other types in their likelihood of testing positive for alcohol ($c^2(1) = 0.8$, $p = .366$) or drugs ($c^2(1) = 0.1$, $p = .762$), or of having passengers in their vehicles ($c^2(1) = 2.5$, $p = .112$). This suggests that the right-angle crashes were not more likely than other crashes to result from risky driver behaviour such as driving while under the influence or distracted but, rather, that they mostly resulted from driver error and external factors. This is based on the following results:

- In 33 right-angle crashes, the driver slowed or stopped at the intersection before moving into the path of the other road user, suggesting that they were aware of the intersection and their requirement to give way, but another factor contributed to the crash (e.g., they looked but built-up traffic blocked their vision of the other vehicle). Looked-but-failed-to-see errors (in which drivers look in the direction where the other road users are but do not perceive them (Koustanaï et al., 2008)) contributed to 16. A list of factors that contributed to the right-angle crashes is provided in Table 1.
- In 19 right-angle crashes, the driver proceeded straight into the intersection without slowing or stopping, which suggests that they were completely unaware of their requirement to give way, or unaware that they were approaching an intersection. The most common preceding circumstance for these drivers was that they were unfamiliar with the road (11 crashes), which was determined through self-report information from participant and witness statements. A complete list of the preceding circumstances is provided in Table 2. In 12 of the 19 run-through crashes, there were advanced warning signs on the approach.
- The at-fault driver's vision of the other road user was restricted in 26 right-angle crashes.

The key results are summarised in the infographic in Figure 1.

Table 1. Factors that contributed to crashes: at-fault driver slowed or stopped for the stop or give way sign and looked for traffic but moved into the path of an oncoming road user on the priority road (n = 29 for which details were known). Many were determined through self-report information from participant and witness statements

Contributing factors	Frequency
Driver looked-but-failed-to-see	16
Dynamic visual obstruction (other vehicles on the priority road)	6
Static visual obstruction (e.g., road signs, parked vehicles, side mirrors)	4
Driver misjudged speed, distance, or available gap of traffic	3
Sun glare affected vision	3
Conspicuity of approaching road user	3
Driver illegal BAC	2
Driver drug positive	2
Intersection visibility issues due to trees, embankments, corners, etc.	2
Driver distracted by dropping something in the vehicle	1
Driver distracted by life events	1
Driver unfamiliar with vehicle/did not accelerate as fast as expected	1
Driver fatigue	1
Reckless driving (slowed for stop sign but did not stop and adequately check for traffic)	1

Table 2. Preceding behaviour and circumstances of drivers who travelled straight through the intersection without slowing or stopping for the stop or give way sign (n = 12 for which details were known), these were often determined through self-report information from participant and witness statements

Preceding behaviour and circumstances	Frequency
Unfamiliar with road	11
Dark lighting conditions	5
Stop/give way line marking faded or not present	4
Inclement weather (rainy/wet conditions)	3
General route confusion/driver lost	2
Distraction (e.g., mobile phone use, talking to passenger)	2
Driver drug positive, and it likely contributed to the crash	1
Speed too high for conditions (e.g., on a dirt road)	1
Mental health condition	1
Sun glare	1
Following another vehicle that also went straight through intersection	1

The 57 right-angle crashes that were investigated by CASR occurred at 50 individual intersections across SA (multiple crashes were investigated at five intersections – three intersections had two crashes investigated at them and two intersections had three). The prior ten-year police-reported crash histories of these 50 intersections were examined and more than 20 right-angle crashes had occurred at each of ten intersections (three had 30 or more). This suggests that these crashes continue to occur at many intersections, often despite considerable intersection upgrades and crash prevention treatments being applied.

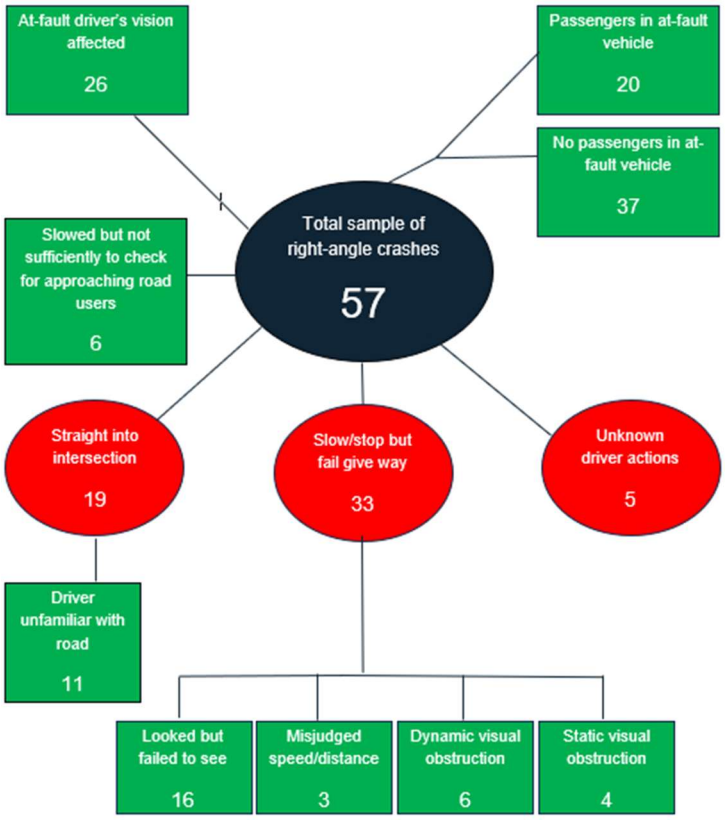


Figure 2. Key results from this study

Conclusions

This study demonstrated that one of the most common types of crashes that occur on the road network – right-angle crashes at stop and give way sign-controlled T-junctions and crossroad intersections – largely results from driver error (e.g., looked-but-failed-to-see errors) and external factors (i.e.,, factors that restrict driver vision). The acknowledgement that drivers are fallible and make mistakes, and that the road system should accommodate for these mistakes without the road users being seriously or fatally injured, is the central tenet of the concept of the Safe System (Woolley et al., 2018). Safety improvements to both planned and existing intersections can be achieved through superior design that aligns with safe system principles (e.g., grade separation to remove potential conflict) and treatments that increase driver awareness of the intersection (e.g., rumble strips on the approach) or reduce crash forces so that they do not exceed the human biomechanical tolerance to harm (e.g., reducing the speed of vehicles to survivable levels through raised platforms and plateaus, and lower speed limits in the vicinity of the intersection). However, practical considerations, such as the cost of potential treatments, predicted effectiveness, and optimising traffic flow, are also important. It should be noted that the sample of 57 crashes was small and that this could reduce the generalisability of the results to right-angle crashes at stop and give way sign-controlled intersections in general.

References

Koustanaï, A., Boloix, E., Van Elslande, P., & Bastien, C. (2008). Statistical analysis of "looked-but-failed-to-see" accidents: Highlighting the involvement of two distinct mechanisms. *Accident Analysis & Prevention*, *40*(2), 461-469. https://doi.org/10.1016/j.aap.2007.08.001

Mongiardini, M., Elsegood, M. E., & Stokes, C. S. (2021). *Profile of crashes at intersections in South Australia* (CASR179). Adelaide: Centre for Automotive Safety Research.

Souleyrette, R. R., Tenges, R., McDonald, T., & Maze, T. (2005). *Guidelines for removal of traffic control devices in rural areas* (No. IHRB Project TR-527).

Stokes, C. S., & Woolley, J. E. (2022). *A comparison of uncontrolled, give way sign controlled and stop sign controlled intersections in South Australia* (CASR151). Adelaide: Centre for Automotive Safety Research.

Woolley, J., Stokes, C., Turner, B., & Jurewicz, C. (2018). *Towards Safe System infrastructure: A compendium of current knowledge* (AP-R560-18). Sydney: Austroads.

Predictors of aggression towards cyclists

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Abstract

This study examines the characteristics of cyclists that predict aggression from other road users. A survey was completed by 321 cyclists from the Australian Capital Territory. Between 20% and 58% of participants reported that they sometimes, often or always experienced verbal abuse, horn sounding, hand gestures, tailgating, deliberately driving close, cutting in front, thrown objects, and general poor behaviour. Physical assault was sometimes, often or always experienced by 6%. Regression analyses demonstrated that increased distance ridden predicted verbal abuse, horn sounding, hand gestures, physical assault, and thrown objects. Cyclists who ride road bikes were more likely to be verbally abused and male cyclists were more likely to have an object thrown at them. Younger cyclists, male cyclists, less confident cyclists, and those who have received a prior police caution or infringement are more likely to be physically assaulted. Negative perceptions of cyclists must be reversed to reduce such aggression.

Social media post

Is aggression towards cyclists common? What predicts it? 20-50% of cyclists sometimes, often or always experienced it. Increased riding distance and other factors (younger cyclists, males, road bike) increased abuse frequency.

Conference theme alignment – Equity

This study demonstrates that cyclists commonly experience aggression from other road users. This is potentially violent, harmful and a significant barrier to cycling participation. They must come to be seen as acceptable and beneficial users of the road system. Therefore, this abstract aligns with the first conference theme of **equity**.

Introduction

Cycling is a convenient form of transport that provides health and fitness benefits to the individual, as well as societal benefits such as reduced environmental, traffic and economic impacts. However, aggression from other road users may be common. This is likely to be a barrier to cycling participation (McKenna & Whatling, 2007). Basford et al (2002) suggested that motorists hold negative views of cyclists and view them as an out group. Basford et al. showed that car drivers are annoyed by the presence of cyclists on the road, particularly when they perceive them to be weaving in and out of traffic, not using proper signalling, and getting in the way. Cyclists filtering through traffic in front of traffic lights, slowing down traffic and behaving in an unpredictable manner were also annoying. This frustration with cyclists influences driver behaviour towards them, often through aggression (Fruhen & Flin, 2015). Heesch, Sahlqvist and Garrard (2011) surveyed cyclists in Queensland, Australia and found that 76% of males and 72% of females reported harassment in the previous 12 months. The most reported forms were driving too close (66%), shouting abuse (63%), and making obscene gestures/sexual harassment (45%). Older age, overweight, less cycling experience and less frequent cycling were associated with a lower likelihood of harassment, while living in highly advantaged areas, cycling for recreation and cycling for competition were associated with a higher likelihood.

The present research examined the physical (e.g., male versus female) and behavioural characteristics (e.g., distance ridden per week, compliance with road rules) of cyclists that predict aggression from other road users. Cyclists in the Australian Capital Territory (ACT) completed a survey on their demographics, how much they ride (exposure), their cycling confidence, their safety habits (e.g., hand signals to indicate to turn), their compliance with road rules (e.g., red light compliance), and any aggression that they have experienced from other road users.

Method

Participants

Participants were recruited through emails, fliers and social media posts to ACT Government staff, Pedal Power ACT members and other stakeholder organisations in the ACT (Canberra Cycling Club, Vikings Cycling, Conservation Council, Greens ACT, Micromobility Report, Amy Gillett Foundation, and Australian National University Cycling Club). They had to be 18 years or older and regularly cycle (at least once a month) on roads and public paths.

Materials

Sections and specific questions from the survey of ACT cyclists relevant to the present paper are as follows:

- Demographics: gender (male, female, non-binary, or gender not listed), age group (18-24, 25-34, 35-44, 45-54, 55-64, and 65 years or over), and type of bike most ridden (e.g., road, mountain, etc.).
- Cycling exposure: estimate of kilometres ridden per week.
- Riding confidence: riding style (confident, cautious, interested, or not interested).
- Safety habits and road rule compliance: how often they cross through intersections against red traffic signals, turn left through red signals, and use hand signals to indicate to turn left or right (never, rarely, sometimes, often, or always). Also, whether they have been given an infringement or caution by police while riding.
- Aggression from other road users: how often (never, rarely, sometimes, often, or always) they experience verbal road rage, aggressive horn sounding, hand gestures, tailgating, deliberately driving close, physical assault, cutting in front, thrown objects and general poor behaviour.

Procedure and statistical analyses

The survey was online between August and October 2023 and took 30 to 40 minutes to complete. Ethics approval was granted by the Human Research Ethics Committee at the University of Adelaide (approval number H-2023-127). Responses were explored using frequency counts, percentages, and measures of central tendency. Multiple regression was used to examine variables that predict aggression. There were nine regression models with the dependent variable in each being one type of aggression. The following independent variables were entered into each model: cyclist age group, gender (male or female), bicycle type (road or other type), riding confidence (confident or cautious), how often they cross through intersections against red signals, how often they turn left through red signals, how often they use hand signals to indicate to turn left or right, and whether they had ever been given an infringement or caution by police. Self-reported kilometres that they ride per week (cycling exposure) was included in each model as a mediating variable.

Results

The survey was completed by 321 participants. Thirty-seven percent identified as female and 61% as male. Weekly distance was provided by 278 respondents (86%). Mean distance was 81.7 kilometres per week (SD = 80.5) with individual distances ranging from 1 to 500 kilometres per week. Most cyclists were confident (191, 60%), while 107 cautious riders accounted for 33% of the sample and 20 interested riders accounted for 6%. Ninety percent never, rarely or sometimes cross through intersections against red traffic signals and 90% never, rarely or sometimes turn left through red signals. Around 75% often or always use hand signals to turn left or right. A police infringement or caution had been given to 55 (18.4%). Table 1 presents responses to how often participants have experienced aggression from other road users. Verbal, horn sounding, hand gesture, deliberately driving close, cutting in front and general poor behaviour were most common, with 46.6% to 57.4% of participants sometimes or often experiencing them. The regularity of tailgating, physical assault and throwing an object was low, with 66.5% to 93.6% indicating never or rarely experiencing these types of aggression. Regression models for verbal road rage, horn sounding, hand gestures, physical assault and object throwing were statistically significant (Table 2). Explanatory and criterion variable associations were moderately strong (Multiple R 0.41 to 0.50). Explanatory variables accounted for 11% to 21% of variance (adjusted R^2) in criterion variables. Exposure (weekly kilometres) was a statistically significant predictor in each significant overall regression model (models 1, 2, 3, 6, and 8) and was the only significant predictor of horn sounding and hand gestures (Table 3). Verbal road rage was also predicted by the type of bike that the cyclists most commonly ride. Object throwing was also predicted by the cyclist's gender. Physical assault was predicted by exposure, as well as cyclist age, gender, riding confidence and whether they had ever received a caution or infringement from police.

Discussion

Aggression is commonly experienced by cyclists, with 20% to 58% of participants sometimes, often or always experiencing verbal road rage, horn sounding, hand gestures, tailgating, deliberately driving close, cutting in front, object throwing, and general poor behaviour. Six percent had sometimes, often or always been physically assaulted, which is alarmingly high given the extreme nature and possible consequences. Cyclists who ride road bikes are more likely to be verbally abused. Men are more likely to have an object thrown at them. Younger, male, and less confident cyclists, and those who have received a prior police caution or infringement, are more likely to be physically assaulted. It may be perceived that it is somehow acceptable to treat certain cyclists this way or that they deserve it. Cyclists with the identified characteristics may represent a certain type of cyclist that particularly frustrates or annoys motorists. Specifically, male cyclists who ride racing-style road bikes may be viewed more negatively by drivers because they travel faster and are more assertive in their riding style, while younger, less confident and less experienced cyclists may be perceived as making mistakes in the road environment or riding too slowly and, therefore, as being frustrating and in the way. Future research could examine these issues from the perspective of motorists to determine what frustrates them

or motivates their aggression; it may also be useful to explore which motorists (characteristics, attitudes and personal circumstances) are aggressive. To reduce aggression, and potentially increase cycling participation, positive representations of cyclists need to be proliferated. Public depictions of cyclists are often negative and can be viewed as trivialising violence against them (Johnson, 2014). Cyclists must instead be seen as acceptable and beneficial users of the road system. Increased enforcement of behaviours that could potentially harm cyclists is also important.

Benefits to road safety and implications for policy and practice

Aggression towards cyclists is abusive, violent and both physically and mentally harmful. Therefore, this study highlights an under-addressed road safety issue and provides a starting point from which it can be improved. Efforts to reduce aggression must be supported by appropriate policy decisions and practice. Visible support by governments, police and road safety advocates for positive cyclist representations should be required practice. Additionally, increased penalties and enforcement of intimidating and dangerous behaviour are an example of necessary policy changes.

Table 1. Cyclist responses (%) to how often they have experienced aggression from other road users

	Never	Rarely	Sometimes	Often	Always
Verbal road rage	11.0	30.6	46.8	11.6	0.0
Aggressive horn sounding road rage	17.8	28.7	39.1	14.4	0.0
Hand gesture road rage	14.9	30.5	40.2	13.2	1.1
Tailgating by a vehicle	34.7	31.8	20.2	12.1	1.2
Vehicle deliberately driving close	17.5	32.7	38.0	11.1	0.6
Physical assault road rage	78.7	14.9	2.9	2.9	0.6
Road user cutting in front	12.7	28.9	39.3	16.2	2.9
Road user throwing an object	42.2	37.6	16.8	3.5	0.0
General poor behaviour towards cyclist	20.3	32.6	32.6	14.0	0.6

Table 2. Overall results for individual regression models

Model number/type of aggression	R	Adjust. R^2	df	F	Sig. (*p < .05)
Model 1: Verbal road rage	.503	.205	9, 138	5.204	<.001*
Model 2: Aggressive horn sounding road rage	.414	.118	9, 139	3.202	<.001*
Model 3: Hand gesture road rage	.407	.112	9, 139	3.068	.002*
Model 4: Tailgating by a vehicle	.310	.038	9, 139	1.643	.109
Model 5: Vehicle deliberately driving close	.262	.008	9, 137	1.123	.351
Model 6: Physical assault road rage	.500	.201	9, 139	5.141	<.001*
Model 7: Road user cutting in front	.265	.010	9, 138	1.158	.327
Model 8: Road user throwing an object	.491	.191	9, 138	4.867	<.001*
Model 9: General poor behaviour to cyclist	.325	.047	9, 138	1.812	.071

Table 3. Statistically significant explanatory variables that predict aggression from other road users

Type of aggression/significant explanatory variables	Unstandardised coefficients	Standardised coefficients	t	Sig. (*p < .05)
Verbal road rage				
Bicycle type	-.368	-.229	-2.788	.006*
Kilometres per week	.003	.318	3.606	<.001*
Aggressive horn sounding road rage				
Kilometres per week	.004	.404	4.360	<.001*
Hand gesture road rage				
Kilometres per week	.004	.394	4.234	<.001*
Physical assault road rage				
Age group	-.124	-.201	-2.595	.010*
Gender group	-.362	-.245	-3.081	.002*
Riding confidence	-.332	-.265	-3.392	<.001*
Police caution/infringement	-.328	-.157	-2.080	.039*
Kilometres per week	.001	.184	2.081	.039*
Road user throwing an object				
Gender group	-.333	-.196	-2.408	.017*
Kilometres per week	.003	.348	3.905	<.001*

References

Basford, L., Reid, S., Lester, T., Thomson, J., & Tolmie, A. (2002). Drivers' perceptions of cyclists. Department for Transport, 42, 38.

Fruhen, L. S., & Flin, R. (2015). Car driver attitudes, perceptions of social norms and aggressive driving behaviour towards cyclists. Accident Analysis & Prevention, 83, 162-170. https://doi.org/10.1016/j.aap.2015.07.003

Heesch, K. C., Sahlqvist, S., & Garrard, J. (2011). Cyclists' experiences of harassment from motorists: Findings from a survey of cyclists in Queensland, Australia. Preventive medicine, 53(6), 417-420. https://doi.org/10.1016/j.ypmed.2011.09.015

Johnson, M. (2014). Why do we still hear people joke about hitting cyclists? The Conversation, accessed at https://theconversation.com/why-do-we-still-hear-people-joke-about-hitting-cyclists-31214.

McKenna, J., & Whatling, M. (2007). Qualitative accounts of urban commuter cycling. Health Education, 107(5), 448-462. https://doi.org/10.1108/09654280710778583

Finding the right path: an evaluation of Queensland's e-scooter regulations

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Abstract

E-scooter use has increased significantly across Queensland and they continue to be a popular transport mode. This has seen Queensland become a national leader with its approach to regulating e-scooters and other Personal Mobility Devices (PMDs). As the first jurisdiction to introduce a comprehensive regulatory framework to support safe use of PMDs on the transport network, it was timely to review the reforms implemented in 2018, 2022 and 2024 to ensure they are meeting their intended road safety outcomes and inform future rule changes in an evidence-based manner. As such, an early evaluation of the PMD regulations, usage trends, road rule compliance, enforcement, and injury data was completed in mid-2025. The evaluation produced a suite of practical recommendations to further support PMD safety in Queensland. Importantly, lessons learned from Queensland's experience are valuable in advancing the national conversation on PMD safety, particularly for other jurisdictions grappling with similar issues.

Social media post

Queensland undertakes an evaluation of their nation leading e-scooter safety reforms to understand what's working, what's not and where to next.

Background

As of the submission date of this abstract, the results are not yet available. The evaluation is expected to be completed by mid-2025. Findings will be ready at the time of presentation in October 2025.

In 2024, there were tragically 8 recorded PMD user fatalities in Queensland, representing a 166% increase from 2023. Data from the Queensland Injury Surveillance Unit also showed that the number of PMD-related injuries increased from 691 in 2022 to 1,273 in 2023. While these figures are concerning, it is essential to consider them within the broader context of the level of PMD usage. From 1 November 2018 to 31 January 2025, there have been more than 16 million PMD trips taken in Brisbane City, with an average of 7,000 trips taken per day (Brisbane City Council, 2025). The boom in PMD use across Queensland underscores the need for a reliable measure to accurately understand emerging trends. An evaluation is therefore currently being undertaken to analyse usage and injury data, enforcement, regulations and community understanding and acceptance of the PMD rules.

Importantly, the evaluation aims to assess the effectiveness of PMD reforms undertaken in 2018, 2022 and 2024 and inform any future changes in an evidence-based manner. As with any new technology, there is a need to continually review and adapt the approach to managing PMD use. Community support for PMDs remains a challenge as market research conducted in 2023 found that e-scooters usage has 69% support from those who ride the devices and 30% support from non-riders (Figure 1). To improve public confidence and further promote safe use of PMDs, it is important to understand what aspects of the current regulatory framework are working and where improvements can be made.

E-scooters were first legalised in Queensland in 2018 with comprehensive reforms subsequently implemented on 1 November 2022. The changes aimed to clarify how and where PMDs can be used in public spaces in Queensland, to enhance the safety of PMD riders and the broader community. This included:

- A 12 km/h speed limit on footpaths;
- Tougher penalties for speeding offences;
- Allowing PMDs to be ridden in some on-road bike lanes;
- Ensuring PMD riders obey general road rules, such as traffic lights and signs as well as turning and give way rules, in the same way as other drivers/riders;
- Broadening the type of helmet PMD riders can wear to include an approved motorcycle helmet;
- Mandating PMDs with handlebars to be fitted with a bell; and
- Introducing higher penalties for some high-risk offences committed by PMD riders.

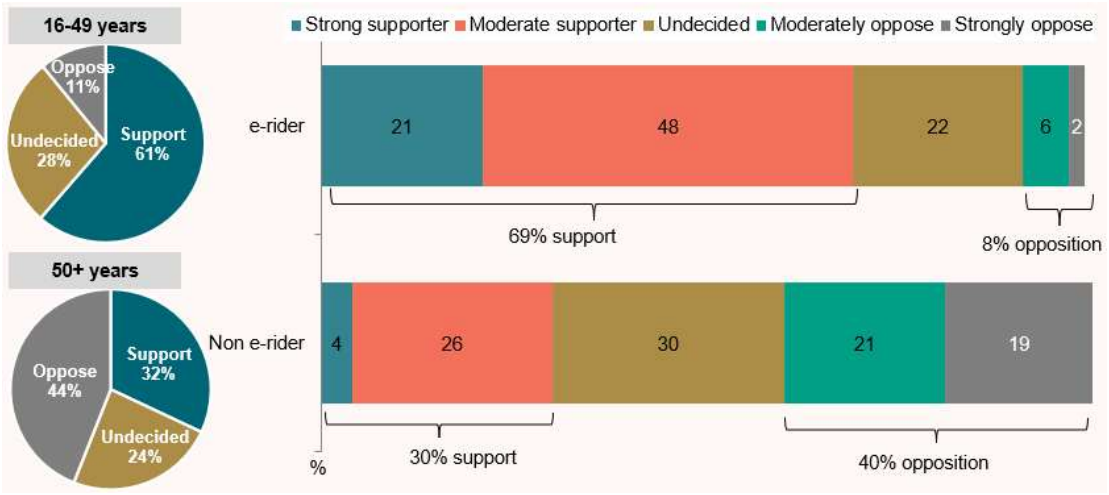


Figure 1. Community survey results regarding e-scooter support (November 2023)

Additional PMD safety laws were introduced in February 2024 to build on previous reforms and further improve safe interactions between path users and riders. This included an offence for the rider of a PMD to ride without due care and attention on a road-related area, such as a footpath or shared path. The laws also aligned post-crash obligations on road-related areas, with all drivers and riders being required to stop and render assistance and exchange details in the event of a crash, regardless of location.

In light of these reforms, Queensland has been at the forefront of PMD regulation offering valuable insights to other jurisdictions. Queensland's experience has been a useful tool in driving the national conversation on PMD safety and will continue to do so with the findings of this evaluation.

Conference theme

Elasticity: PMDs offer a flexible, low cost, space efficient, low emission form of transport and are particularly useful for shorter trips in place of a car. The evaluation assesses the impacts of the reforms and examines whether the regulatory framework in Queensland adequately supports the use of PMDs.

Evolution: The PMD reforms were implemented to facilitate a safer transport network for PMD riders and path and road users. The evaluation will provide insights into the effectiveness of the current rules and offer insights on how to further improve PMD safety so that the regulatory framework can be responsive to future challenges.

Approach

The Department of Transport and Main Roads (TMR) engaged the Centre for Accident Research and Road Safety – Queensland (CARRS-Q) to undertake the evaluation. The primary objective of the evaluation is to determine whether the PMD reforms were effective in improving safety, based on the below metrics. The results are expected to address the corresponding research questions for each metric:

- Awareness of the rules – How aware are Queenslanders of the PMD rules?
- Acceptance and compliance of the rules – What is the extent of acceptance and compliance with the rules by Queenslanders?
- Infringements related to PMD use over time – Have the number of infringements related to PMD use changed over time?
- Accidents and injuries related to PMD use over time – How have the number of accidents and injuries related to PMD use changed over time?

To achieve the objective, the evaluation is being conducted in three key phases:

1. Establishment of an evaluation framework (Completed): Data source mapping exercise to systematically identify available data relevant to the evaluation questions, and a gap analysis to highlight any critical aspects of the evaluation needing further data collection.
2. Implementation of evaluation (In progress): Targeted data collection and analysis to answer the research questions. This also involves a literature review of academic and scholarly sources, alongside a comparative analysis of PMD use and safety in different jurisdictions and countries, to identify emerging practices that demonstrate effectiveness in PMD safety.

3. Results (To be completed by mid-2025): Results from the data analysis, literature review and jurisdictional analysis will be used to answer the research questions, and practical recommendations for future enhancements relating to PMD safety in Queensland (including but not limited to regulation, education, communication, infrastructure, and enforcement) will be addressed.

The evaluation approach sits within Tier 4 of the Goals, Objectives, Strategies, Programs/Plans and Actions (GOSPA) Framework. The GOSPA framework was developed by the Monash University Accident Research Centre (MUARC) (MUARC, 2009) under tender to TMR and is based on previous work undertaken by Cameron (1999). This framework is linked to the elements under which strategies and plans are commonly organised, particularly the Queensland Road Safety Strategies (MUARC, 2009; Watson et al., 2016).
The evaluation approach to date has demonstrated the importance of leveraging stakeholder relationships. This is one of the key lessons learned so far and will be of interest to other jurisdictions. Collaboration has always been part of Queensland's approach to PMD regulation, particularly in the development of the reforms, and continues to play a valuable role in the current evaluation. The PMD Safety Reference Group (SRG) was established in early 2022, comprising a range of external government and non-government representatives. This includes Queensland Police Service, local councils, PMD user groups, disability advocates, and pedestrian and cycling groups. TMR has been able to leverage the SRG to build relationships and identify data sources for the evaluation, including obtaining the following:

- Shared e-scooter usage data from local councils and a long-standing shared provider.
- PMD-related injury data from the Queensland Injury Surveillance Unit, facilitated through representatives from the Jamieson Trauma Institute.
- Observational survey data conducted by other TMR divisions.

At this stage, it is not appropriate to disclose all data sources as the evaluation is still in progress.

Given the growing interest in PMD regulation and safety, presenting the findings following completion of the evaluation in mid-2025 will be highly relevant and timely to inform future decisions and improvements for PMD safety state-wide and nationally.

Benefits to road safety

People who ride e-scooters and other PMDs are part of the vulnerable road user cohort, representing a significant number of the lives lost and serious injuries on Queensland roads and paths. No level of trauma on Queensland roads is acceptable and TMR is committed to reversing this trend. As such, it is critical to ensure that the regulatory framework effectively supports the safe use of PMDs, both for the PMD user and others in the transport network, especially other vulnerable road users. This evaluation will provide valuable insights into how PMD safety can be improved, supporting Queensland in reducing road trauma and developing a more efficient, reliable and safe transport network.

References

Brisbane City Council. (2025). *E-mobility trip numbers.* https://data.brisbane.qld.gov.au/explore/dataset/e-mobility-trip-numbers/table

Cameron, M. (1999). *A method of evaluation based on a strategic planning framework.* Australasian Road Safety Research and Policing and Education Conference, Canberra.

Department of Transport and Main Roads. (2022). *Personal Mobility Device Safety Action Plan*. https://www.tmr.qld.gov.au/safety/road-safety/road-safety-strategy-and-action-plans/personal-mobility-device-plans

Monash University Accident Research Centre. (2009). *The development of a framework for road safety strategy evaluation*. https://www.tmr.qld.gov.au/_/media/safety/roadsafety/road-safety-research-reports/development-framework-qld-road-safety-strategy-evaluation-2009.pdf?sc_lang=en&hash=FF21B737020F02D29CD34226AD6B7824

Watson, A., King, M., Williamson, A., Blackman, R., & Edwards, J. (2016). *Evaluation framework for the Queensland Road Safety Strategy 2015-2021*. https://www.tmr.qld.gov.au/_/media/safety/roadsafety/road-safety-research-reports/evaluation-framework-qld-road-safety-strategy-2015_21.pdf?sc_lang=en&hash=1EDD6EC77496EE0AA839351B5AAA81D4

Increasing nighttime safety at passive railway crossings with photoluminescent elements

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Abstract
This study addresses nighttime safety issues at passive railway level crossings (RLXs) by integrating photoluminescent (glow-in-the-dark) elements. Four new designs using photoluminescent road markings and signs were evaluated in a virtual reality (VR) driving simulator experiment. Results showed that extended photoluminescent line markings combined with pavement markings and signs could reduce vehicle speeds and significantly improve train detection compared to standard passive RLXs with rumble strips. Participants also perceived these enhancements as safer. The findings support photoluminescent designs as an effective solution for enhancing nighttime safety at passive RLXs in rural and regional areas, contributing to the evolution of safe systems.

Social media post
A VR driving simulation study shows that glow-in-the-dark road markings and signs boost train detection and slow drivers at passive railway crossings at night.

Introduction
Railway level crossings (RLXs) equipped with passive safety measures are high-risk locations, particularly in rural and regional areas where electrical infrastructure is often lacking. Poor nighttime visibility at these crossings has been identified as a significant factor contributing to train-vehicle collisions, as drivers rely solely on static signage, road markings, and the limited range of car headlights for navigation and hazard awareness. While many previous studies have explored various interventions to enhance safety at RLXs in general (Beanland et al., 2018; Larue et al., 2019), very few studies have addressed nighttime issues at passive RLXs (Silla et al., 2022; Thompson et al., 2021).

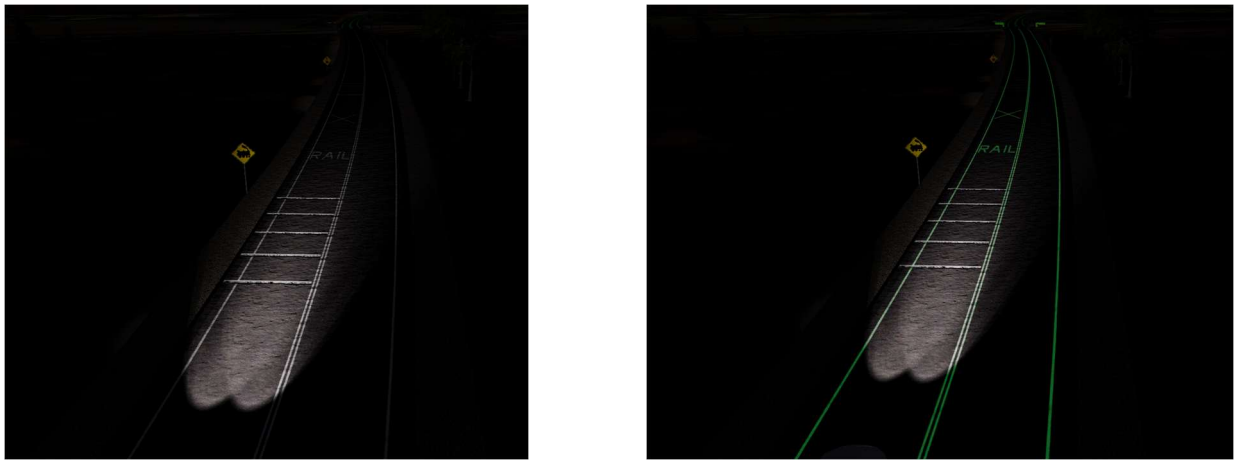
A promising approach to improving nighttime safety at passive RLXs involves the integration of photoluminescent (glow-in-the-dark) materials into road markings and signage. Photoluminescent technology, which absorbs ambient light during the day and emits illumination at night, offers a cost-effective, self-sustaining solution that enhances visibility without the need for external power sources. The potential benefits of such materials have been suggested in road marking applications, but their impact on traffic safety remains largely unexplored. Recent research has reported that combining 500 metres of glow-in-the-dark road marking and railway signage could enhance nighttime safety by increasing driver awareness and reducing their approach speeds (Nguyen et al., 2025). However, the impacts of shorter segments of glow-in-the-dark road marking and glow-in-the-dark features on the detection of approaching trains are unclear.

This study investigates the impacts of new passive level crossing designs incorporating photoluminescent elements on approach speeds and train detection, using a virtual reality (VR) driving simulator experiment.

Method
This study employed a fixed-based driving simulator with a Logitech G923 force-feedback steering wheel, pedals, and an adjustable seat. The immersive visualisation was delivered through an HTC VIVE Pro Eye VR headset that had a refresh rate of 90 Hz. The virtual environment, driving simulation, and data collection were implemented using Unity 3D.

Forty participants, who had an Australian driving license and were at least 18 years old, were recruited through social media advertising and notices on the surrounding campus. After completing the experiment, participants received an AUD$60 gift card. The study's ethical approval was obtained from La Trobe University (HEC24217). Approximately 60% of the participants were male, indicating a relatively balanced sample. Participants were aged between 20 and 68, with an average of 14.8 years of driving experience. Approximately 85% had a full driving licence, and 75% drove at least 5,000 kilometres annually. Around 35% and 25% encountered RLXs weekly and daily, respectively. Prior experience with VR was relatively high (72.5%).

In the experiment, each participant completed four scenarios under nighttime conditions. These scenarios were developed using typical conditions of two-lane, two-way rural roads in Victoria, Australia. The distance travelled in each scenario was approximately 10 to 11 km. The speed limit was 80 km/h on the approaches to the RLXs and 100 km/h otherwise. In each scenario, participants encountered four to five RLXs, with and without an approaching train. In addition to a standard passive crossing equipped with rumble strips (Base design), four new passive designs were considered, including photoluminescent 200-metre line marking and Rail X pavement marking (200 design), photoluminescent 350-metre line marking and Rail X pavement marking (350 design), photoluminescent 200-metre line marking and Rail X pavement marking coupled with Railway Crossing signs (200S design), and photoluminescent 350-metre line marking and Rail X pavement marking coupled with Railway Crossing signs (350S design). The order of appearance of these RLX designs and the presence of an approaching train varied across the scenarios. Examples of RLX designs with and without photoluminescent elements are illustrated in Figure 1, while the photoluminescent Rail X pavement marking and Railway Crossing signs are depicted in Figure 8.



a) Without photoluminescent elements b) With photoluminescent elements

Figure 7 RLX designs with and without photoluminescent elements



a) Photoluminescent Rail X pavement marking b) Photoluminescent Railway Crossing signs

Figure 8 Photoluminescent Rail X pavement marking and Railway Crossing signs

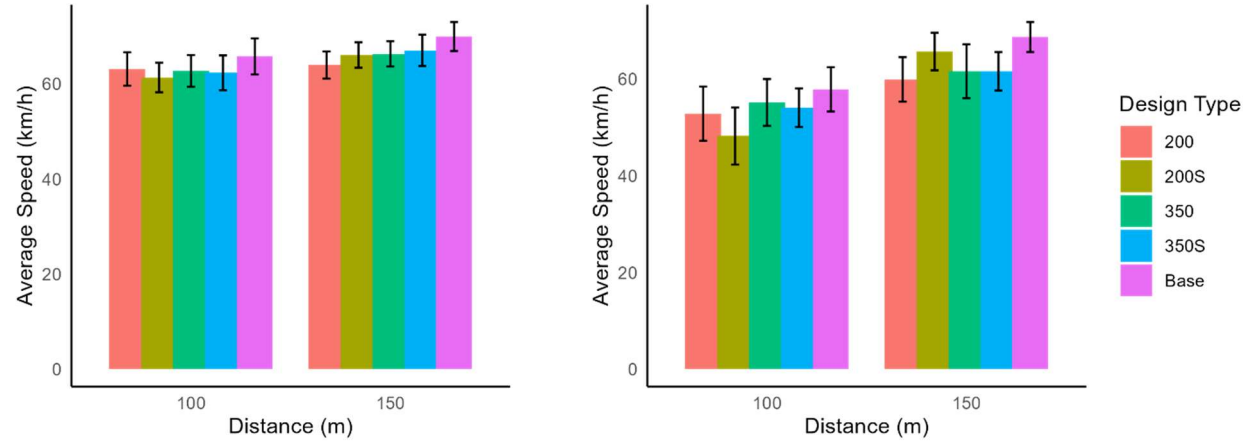
Regarding the experimental procedure, participants completed an informed consent form, followed by a demographic questionnaire and a virtual reality sickness questionnaire (VRSQ). Next, after eye-tracking calibration, participants had a 10-minute training session to familiarise themselves with the VR simulator. After the training, participants completed four scenarios and the VRSQ after each scenario. Finally, participants completed a questionnaire about simulation realism and the perceived effectiveness of the new designs using a 7-point scale.

Results

Figure 9a shows average approach speeds measured at 100m and 200m from the crossing when there is no approaching train. Compared to the Base design, approach speeds at 100m and 200m from the new designs were lower but not statistically significant. Figure 9b shows average approach speeds measured at 100m and 200m from the crossing when there is an approaching train. Similarly, approach speeds at 100m from the new designs were lower but not statistically significant compared to the Base design. Although approach speeds at 150m from the 200S and 350 designs were also lower but insignificant, those from the 200 and 350S designs were significantly lower (p-value < 0.05) than that from the Base design. Overall, the results suggest that photoluminescent markings and signs could encourage drivers to reduce their approach speeds, though the magnitude of the reduction is often insignificant.

Figure 10 presents the average distance from the crossing at the first fixation on an approaching train. The average distance from the crossing where participants first detected the train was higher in the 200 design than in the Base design, but this difference was insignificant. On the other hand, in other new designs (200S, 350 and 350S), approaching trains were detected much further away from the crossing than in the Base design (statistically significant at p-value <0.05). Approaching trains were detected by participants slightly earlier in the 350S design than in the 200S and 350 designs.

Participants reported high levels of perceived effectiveness in increasing awareness and safety, with an average rating of 6.5/7 for photoluminescent line marking, 6.3/7 for photoluminescent Rail X pavement marking, and 6.3/7 for photoluminescent Railway Crossing signs. About 67.5% of the participants strongly agreed that they felt more confident and safer with the photoluminescent markings and signs than with the standard passive design.



a) Without an approaching train b) With an approaching train

Figure 9 Average approach speeds

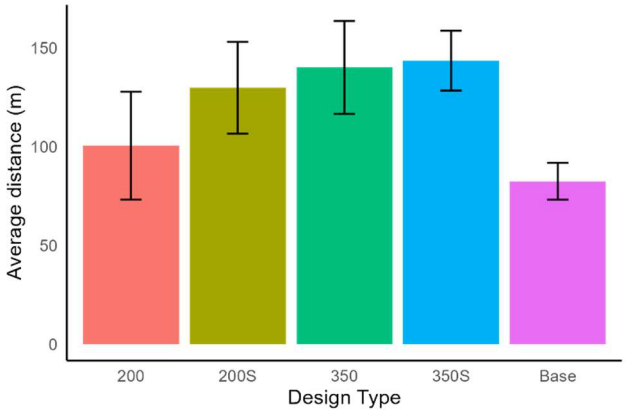


Figure 10 Distance from RLX at the first fixation on an approaching train

Conclusions

The findings of this study indicate the impact of incorporating photoluminescent line markings, pavement markings, and signs on reducing approach speeds and significantly improving train detection at passive RLXs during nighttime. More significant benefits in train detection at passive RLXs during nighttime were found when combining photoluminescent pavement markings, photoluminescent signs, and extended photoluminescent line markings. Future research should further explore the impact on drivers' mental workload using eye-tracking data, such as pupil diameter.

References

Beanland, V., Grant, E., Read, G. J. M., Stevens, N., Thomas, M., Lenné, M. G., Stanton, N. A., & Salmon, P. M. (2018). Challenging conventional rural rail level crossing design: Evaluating three new systems thinking-based designs in a driving simulator. *Safety Science*, *110*, 100-114. https://doi.org/10.1016/j.ssci.2018.03.002

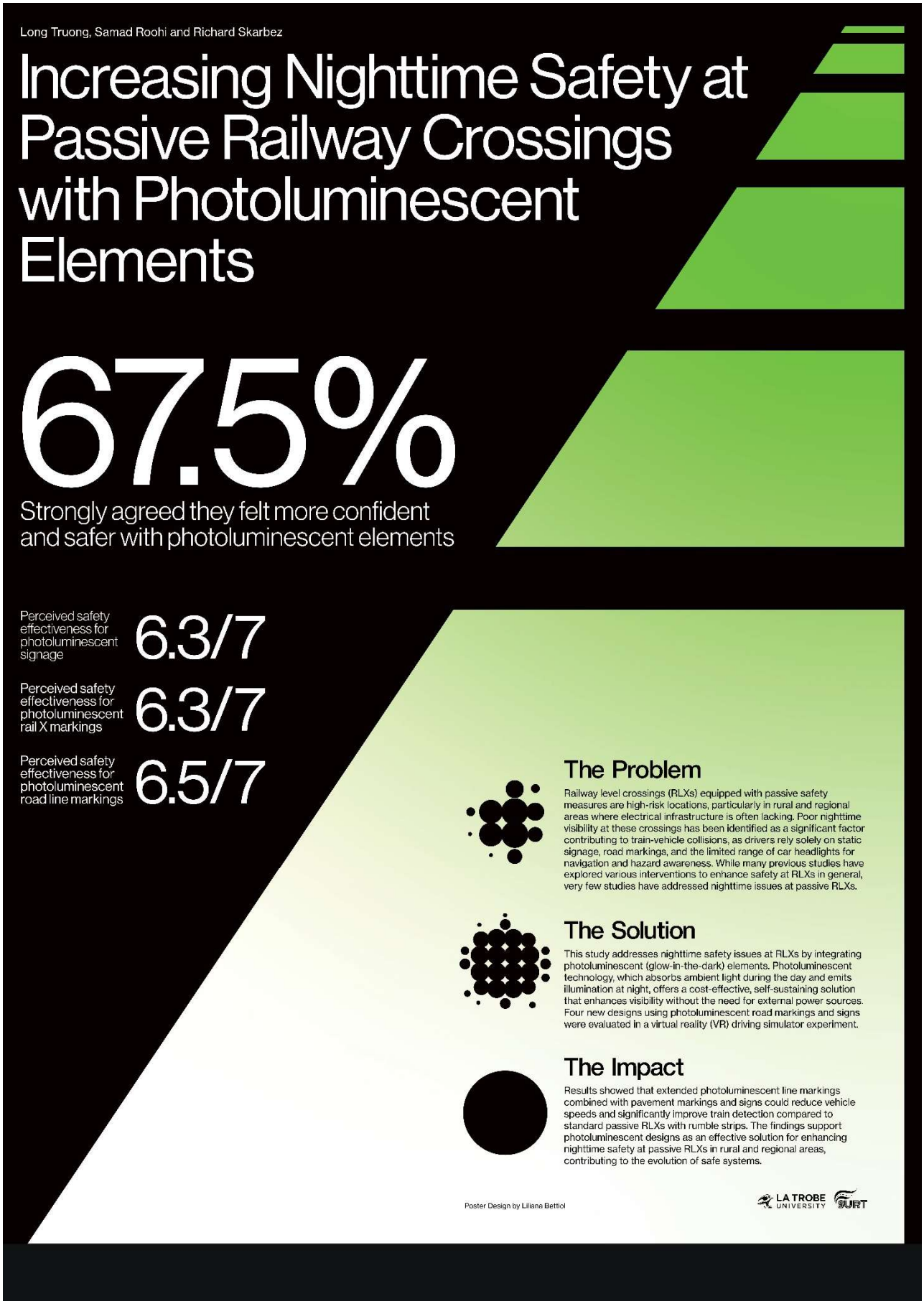
Larue, G. S., Watling, C. N., Black, A. A., & Wood, J. M. (2019). Getting the Attention of Drivers Back on Passive Railway Level Crossings: Evaluation of Advanced Flashing Lights. *Transportation Research Record*, *2673*(2), 789-798. https://doi.org/10.1177/0361198119828679

Nguyen, N. A. T., Truong, L. T., & Skarbez, R. (2025). Improving nighttime visibility and safety at passive railway level crossings: New designs incorporating photoluminescent markings and signs. *Traffic Injury Prevention*. https://doi.org/10.1080/15389588.2025.2479187

Silla, A., Dressler, A., Lehtonen, E., Virtanen, A., Mesimäki, J., & Grippenkoven, J. (2022). Potential of auxiliary strobe lights on train locomotives to improve level crossing safety. *Applied Ergonomics*, *103*, 103767. https://doi.org/10.1016/j.apergo.2022.103767

Thompson, J., Baldock, M., & Stokes, C. (2021). An evaluation of retro-reflective screens to aid conspicuity of freight trains at passive-control level crossings. *Journal of Road Safety*, *32*(2), 22-29. https://doi.org/10.3316/informit.833527354425110

Poster presentation



Debunking the myth: raised crossings don't create significant congestion

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Abstract
Over the past six years, Auckland Transport has installed raised crossings to reduce pedestrian road trauma. This study analyses travel time delays at fifteen raised crossings on arterials in Auckland using three methods. The first method examines TomTom data along 1 km corridor segments, the second method looks at TomTom data in the immediate approaches, 100 metres, and the third method uses drone-collected free flow speeds of vehicles traveling over some of these raised crossings. The preliminary findings show the increased average travel time delays range from 2.3 to 9.1 seconds. These results indicate that the increase in travel time is not significant enough to outweigh the safety potential to save lives or prevent serious injuries. Understanding these travel time impacts can help when communicating the benefits of raised crossings to the public, fostering greater acceptance and support for such measures by emphasising their safety benefits.

Social media post
This study investigates travel time impacts at 15 raised arterial crossings in Auckland. Preliminary results show an increased travel time of just 2.3 to 9.1 seconds, a small price to pay for the significant road safety benefits and debunks the myth: Raised crossings create significant congestion.
#AucklandTransport #Travel time delays #Raised crossing #RoadSafety

Background
Auckland's road safety performance deteriorated significantly with death and serious injury crashes increasing by more than 70% between 2014-2017 compared to the previous five years. During the same period, a fifth of all pedestrian-related crashes in Auckland occurred at existing zebra crossings. In response, the Mass Action Pedestrian Improvement Programme (MAPI) raised 37 zebra crossings over 2018/19 financial year and since this time, Auckland Transport has upgraded more than 100 crossings across the network. While there is clear evidence suggesting the raised zebra crossings have effectively improved the pedestrian safety, the stakeholder feedback on these safety improvements has been mixed. One of the concerns was associated with the delays/congestion experienced at these raised crossings, in particular on arterial roads. This study discusses the data collection and analysis that were undertaken to inform the travel time increase at 15 of these raised crossings built within the MAPI Programme.

Conference theme
Raised crossings can significantly improve the equity and evolution of people using the transport network in the following ways:

Equity: Raised crossings make transport networks safer and more accessible for all users, ensuring that everyone, regardless of physical ability, can safely cross the road. This promotes equal access to transportation infrastructure, reduces the risk of death or serious road trauma, and fosters a more inclusive and equitable community.

Evolution: The use of drone data collection and analysis represents an innovative approach to studying travel time impacts. This methodology can inspire other researchers to adopt similar techniques, enhancing the accuracy and reliability of road safety studies.

It's crucial for people to understand the travel time delays associated with raised safety crossings because this is one of the Safe System devices that ensure the safety and accessibility of transport networks. By managing vehicle speeds at conflict points, raised platforms significantly reduce the risk of death and serious trauma and make it safer for everyone to cross the road. Clear communication about these benefits, along with good design and systematic community engagement, can help address concerns about travel delays, ultimately fostering acceptance and support for these safety measures.

Project description

The first method (Tanielu & Su, 2024) examines TomTom data along 1 km corridor segments, the second method looks at TomTom data in the immediate approaches of 100 metres. The third method (Eliga, 2024) involved drone data collection and analysis of the study on travel time delays at a number of raised crossings. Drones were used to capture the free flow speeds of vehicles traveling over the raised crossings. This allowed for precise and real-time data collection, providing an accurate representation of vehicle speeds in the absence of traffic congestion. The data was then analysed to determine the impact of the raised crossings on vehicle speeds. By comparing the free flow speeds with the speeds recorded at the raised crossings, the study was able to quantify the travel time delays caused by the crossings.

Results

The study analyses travel time delays at fifteen raised crossings on arterials in Auckland using three different methods. The preliminary findings show that the increased average travel time delays range from 2.3 to 9.1 seconds. The preliminary results can be summarised in the following table:

Table 1. Summary of the data analysis

Method	Data Source	Data Collection Period	Traffic condition	Average delay (seconds)
Method 1: Corridor segment	TomTom	2018 2022, 2023	All day	9.1
Method 2: 100 m on the approaches	TomTom	March/April 18 March/April 23	7 – 8 AM A.M. peak 5 – 6 PM P.M. peak 9 - 10 PM – low traffic and pedestrian	7.8 7.8 4.5
Method 3: 50 m on the approaches	Drone	March and April 24	Free Flow – with no impediment from other external traffic condition	2.3

Further work is currently underway to evaluate the safety benefits (5 years after the implementation) of these raised crossings and to identify potential opportunities to refine the corridor segment selections and to examine delays during different time periods in Method 1, with further data collected in Method 3.

Benefits to road safety

By quantifying the travel time delays associated with raised safety platforms, the Road Control Authority can provide clear and evidence-based information to the public. This helps in debunking myths and misconceptions, such as the belief that raised crossings create significant congestion.

Clear communication about the minor delays can foster greater acceptance and support for these safety measures. Understanding the travel time impacts allows us to balance the minor inconvenience of delays with the substantial benefits of improved road safety. This perspective is essential for promoting the adoption of raised crossings as a standard safety measure.

Implication for policy and practice

Policy Implications: The findings support the continued implementation of raised crossings as a policy measure to enhance pedestrian safety. The minor increase in travel time delays (ranging from 2.3 to 9.1 seconds) is a small trade-off for the substantial benefits of reducing pedestrian road trauma. This evidence can be used to justify and advocate for the inclusion of raised crossings in urban planning and road safety policies.

Practice Implications: For practitioners, the document emphasises the importance of clear communication about the benefits of raised crossings to foster greater acceptance and support from the public. Addressing concerns about travel delays and systematic community engagement can help in gaining public support for these safety measures.

The use of drone data collection and analysis represents an innovative approach to studying travel time impacts. This methodology can inspire other researchers to adopt similar techniques, enhancing the accuracy and reliability of road safety studies.

Conclusion

In conclusion, the implementation of raised crossings in Auckland has proven to be an effective measure for enhancing pedestrian safety. The preliminary analysis of travel time at 15 raised crossings using TomTom data and drone-collected free flow speeds indicates that the delays range between 2.3 to 9.1 seconds. This minor increase in travel time is a small trade-off for the substantial benefits of reducing pedestrian road trauma. By clearly communicating these findings to the public, Auckland Transport can foster greater acceptance and support for raised crossings, emphasising their critical role in creating a safer and more inclusive transportation network.

References

Eliga. (2024). Investigation Report - Speed Evaluation of Post Construction Speed Tables . Auckland.

Tanielu, V., & Su, V. (2024). Raised Safety Platforms (RSP) review: impact on average speed; travel time and crashes. Auckland : Auckland Transport .

Tse, I., McDonald, A., Patel, A., Blewden, M., & MacArthur-Beadle, S. (2023). *Auckland Transport's Mass Action Pedestrian Improvement Programme. Journal of Road Safety*, 34(3), 11–21. https://doi.org/10.33492/JRS-D-21-00057

Poster presentation

Winner, Best Poster

Debunking the myth

Raised crossings don't create significant congestion

Over the past six years, Auckland Transport has installed raised crossings to increase pedestrian safety. However, there is a perception amongst drivers that the raised crossings create excessive delays and congestion.

To uncover the actual delays created by raised crossings, we conducted two macro level analysis and one micro level analysis.



Method 1:
Analysed a corridor segment over a length of 900m
Result:
Delay of 9.1 seconds

Method 2:
Analysed the immediate approach of the crossing over 200m
Result:
Delay of 8 seconds in peak hours and 4.5 seconds in off-peak hours

Method 3
Drone-collected free flow speed of vehicles going over the raised crossing
Result:
Average delay of 2.3 seconds.

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Raised crossings do not cause significant delays. They provide significant safety benefits and contribute to a safer, more inclusive road network.

Predicting driver sleep history with machine learning: a simulator-based study

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Abstract
Fatigued driving is a major road safety concern and is a contributing factor to approximately 20% of all road traffic accident worldwide. Identifying a driver's recent sleep duration may help to detect at-risk drivers before they make an error. Participants (n = 84, 23.6 ± 4.5 years) completed a 7-day laboratory study and were randomly allocated to a sleep condition: 9h or 5h sleep opportunity. Each participant completed two 20-min simulated drives (n = 795) at 8:10h and 17:30h each day. A random forest model was implemented using the output of the driving simulator to classify prior sleep duration (9h or 5h). Accuracy was determined using 3-fold cross validation, with the highest accuracy produced by the model of 65% (F-score = 0.64). High importance features identified by the random forest for classification included lane position and speed. Preliminary results suggest that this approach is suitable for classifying prior sleep duration with further model hyperparameter tuning required to increase model performance.

Social media post
Fatigued driving causes 20% of crashes worldwide. A recent machine learning study used driving data to predict if drivers had 5h or 9h of sleep the prior night with 65% accuracy. Lane positioning and speed were key to identifying at-risk drivers. #RoadSafety

Introduction
Driver fatigue is a major road safety concern which is associated with up to 20% of fatal road accidents worldwide (Al–Mekhlafi et al., 2021). Fatigued driving may be particularly prevalent due to the high occurrence of inadequate sleep amongst adult Australians, with up to 45% of the population not obtaining the recommended 7-9 hours of sleep per night (Adams et al., 2017). Fatigued driving can impact areas such as reaction time and psychomotor functioning, which are crucial to safe driving practices and result in performance decrements (Phillips, 2015). Previous research has linked driver behaviours such as inadequate speed and lane control to driver fatigue. Such impacts can be captured in a safe and controlled environment using driving simulators which are sensitive to measuring performance decrements, particularly those associated with driver states such as fatigue. However, previous research has not focused on classifying specific driver and vehicle performance based on prior sleep duration. Knowledge of prior sleep duration from driver inputs (e.g., speed and lane control) may help to identify potentially at-risk drivers and can be utilised to inform drivers when to pull over and have a break, or even when to stop driving. Even if a driver may be in control of the vehicle at that stage and other forms of fatigued are not detected, if a driver is sleep restricted, they are potentially more at-risk than other drivers on the road. One such way to identify previously unknown patterns in high-dimensional data is through the application of machine learning. Machine learning has been applied to a number of road safety issues and has provided a number of risk-reducing breakthroughs (Dong & Cai, 2022). A machine learning approach can help to identify patterns within data which may be otherwise missed or unknown. In particular, random forests which are a form of ensemble supervised machine learning adapt well to high-dimensional data and known for their efficiency and interpretability and have been widely utilised in fatigue detection studies (Dong et al., 2022). For that reason, a random forest classifier was chosen in this study to classify the prior sleep duration of drivers from vehicle inputs into a driving simulator (e.g., steering wheel angle, speed). A preliminary model predicting sleep duration will be presented, with updated results to be presented at a later stage after further hyperparameter tuning.

Conference theme
The research presented aligns with the conference themes of evolution through the aims and outcomes of this work. The work presented here addresses the concept of evolution in road safety research, by extending on existing knowledge on driver-vehicle behaviours and using machine learning to potentially identify new patterns of behaviours. By understanding which driving performance measures could be of more focus (or further solidifying current knowledge), we can help to mitigate the risk of fatigue related accidents on the road.

Method

Participants

Healthy participants (n = 84, age 23.6 ±4.5 years, 49% female) participated in a 7-day live-in-laboratory sleep study (5 experimental days). Participants were randomly allocated to one of two sleep conditions: 9 h of sleep or 5 h of sleep per night.

Ground truth verification

To verify the ground truth of the sleep conditions, the Actical device (Respironics, Bend, Oregon), which is a wrist-worn activity monitor was worn each experimental night to monitor total sleep time. The Actical is a validated measure for sleep time and wakefulness.

Driving scenario

Participants completed two 20-minute simulated monotonous rural commutes per day at 8:10h and 17:00h to simulate an average commute to and from work. Driving performance was measured using the York driving simulator with the simulation presented on a single screen displaying a forward-facing view from the driver's position. The driving simulation scenario comprised of a single carriageway with a two-laned road with minimal traffic moving in either direction and obstructions such as pedestrians, lane changing or road hazards were not included in this simulation.

Feature list

The complete list of features used for model training are provided in Table 1 (aggregated by domain) and are representative of key driver input features captured by the driving simulator. A total of 11 outputs from the driving simulator used as input features for the model.

Data pre-processing

The feature list from the driving simulator drives (n = 795, sampled at 25 hz) was pre-processed to include only the features listed in Table 1, and labelled with a target (9h or 5h prior sleep duration) prior to model input for binary classification.

Table 1. Features in simulator drives

Domain	Features (extracted from simulator)
Steering	Steering position
	Steering angle
Speed	Speed (kph)
Vehicle positioning	Lane positioning
	Distance to lead vehicle (m)
Vehicle metrics	Throttle position
	Velocity (ms)
	Acceleration (mss)
	Crash status
Brake	Brake position
	Brake switch

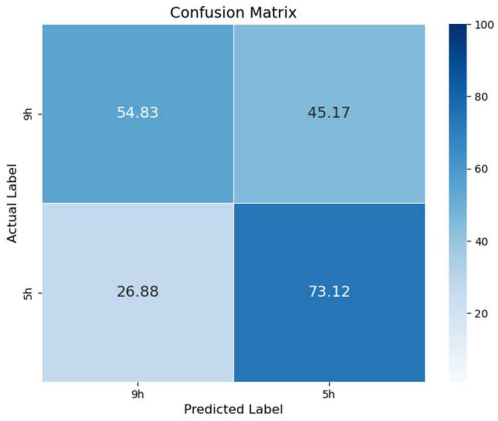
Model development and training

A preliminary random forest model was developed using Python (v3.12.7) with Sklearn (v1.5.1) and implemented on a Windows 11 machine with 4.785 GHz CPU (AMD Ryzen 9 7900x 12-core) and 64 GB of RAM. A randomised search function (using Sklearn model selection) was implemented during training to identify optimal model parameters which included: number of trees, max features, max depth, minimum sample split, minimum leaves, bootstrapping and criterion. Data were randomly shuffled prior to data splitting and a random state of 42 was applied to the model. A splitting procedure was performed using 3-fold cross validation. Accuracy, F-score, precision and recall were used to assess model performance. Feature importance was assessed using Gini importance (mean decrease in impurity-MDI).

Results

Ground truth verification

Total sleep time across each experimental night was statistically different ($p < 0.000$) between the 9h sleep opportunity (08:00 ± 00:40 h) and 5h (04:34 ± 00:18 h) sleep opportunity conditions.



Model performance

The overall accuracy of the model was 65%, with an F1-score of 0.64. Figure 1 shows that the current model is better as classifying 5h prior sleep duration compared to 9h from vehicle inputs, which is illustrated by the high rate of false negatives (actual label is 9h but predicted label was 5h).

Figure 1. Confusion matrix from the random forest model for the classification of prior sleep duration (9h or 5h) presented as a percentage (%)

Additionally, features were ranked as the most important for classification are presented in Figure 2, in order of importance for classification of 9h vs 5h prior sleep duration. Constant speed and road positioning are the top two features useful in classifying prior sleep history from vehicle inputs with the current model and parameters.

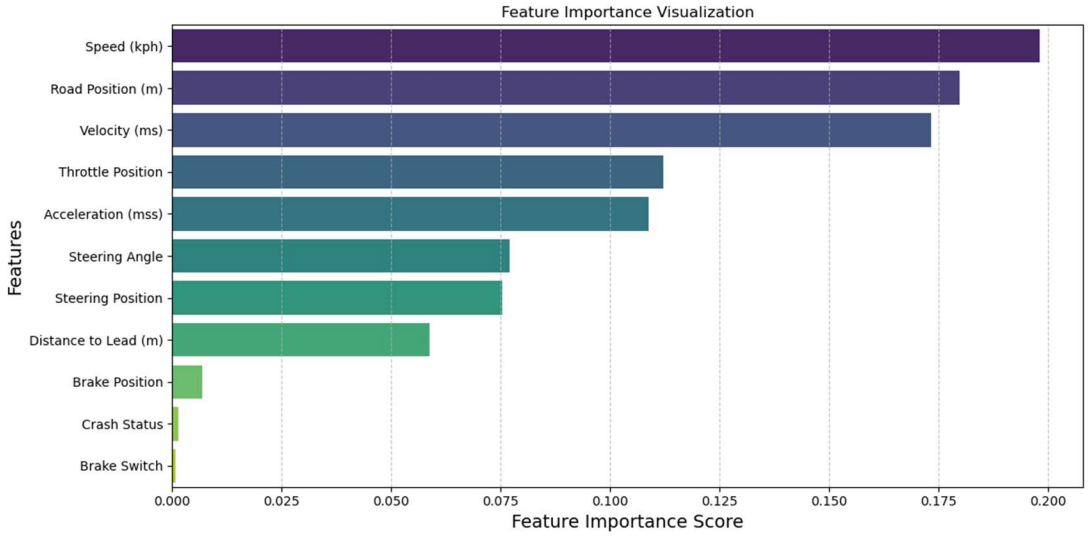


Figure 2. A bar graph presenting the feature importance (Gini importance) of input feature by strength.

Benefits to road safety

Utilising a machine learning approach to analyse multiple driver input features can provide valuable insights into driver sleep history, particularly in identifying behaviours and vehicle dynamics linked to driver fatigue and performance decrements. The approach used in the current study could potentially enhance fatigue detection systems and improve our understanding of key risky behaviours for drivers experiencing sleep restriction or fatigue, improving road safety.

Implications for policy or practice

The findings from this preliminary study have several implications for future practice. Currently, many laboratory studies analyse driving simulator data using variables averaged across an extended period of time, for example lane variability in metres over a 2 to 5 minute window (or bin). Extending the use of driving simulator data by using raw data can help to identify new patterns which may be otherwise potentially disregarded during standard aggregation of driving simulator data. This approach can also potentially be utilised in future research for the classification of other

physiological or health behaviours which may have an impact on driver safety but are yet to be quantified with non-machine learning approaches.

Conclusion

The preliminary findings of this study demonstrate the suitability of this machine learning approach to prior sleep history classification from vehicle inputs, particularly identifying at-risk drivers who are potentially sleep restricted. Applying machine learning to driver inputs can help identify new patterns which may be of benefit when identifying at-risk drivers crash? before they and reducing the risk of injury on the road.

References

Adams, R. J., Appleton, S. L., Taylor, A. W., Gill, T. K., Lang, C., McEvoy, R. D., & Antic, N. A. (2017). Sleep health of Australian adults in 2016: Results of the 2016 Sleep Health Foundation national survey. Sleep Health, 3(1), 35–42.

Al–Mekhlafi, A–B. A., Isha, A. S. N., Chileshe, N., Abdulrab, M., Saeed, A. A. H., & Kineber, A. F. (2021). Modelling the relationship between the nature of work factors and driving performance mediating by role of fatigue. International Journal of Environmental Research and Public Health, 18(13), 6752. https://www.mdpi.com/1660–4601/18/13/6752

Dong, L., & Cai, J. (2022). An overview of machine learning methods used in fatigue driving detection. Paper presented at the 2022 7th International Conference on Intelligent Information Technology, Foshan, China. https://doi.org/10.1145/3524889.3524900

Dong, B. T., Lin, H. Y., & Chang, C. C. (2022). Driver fatigue and distracted driving detection using random forest and convolutional neural network. *Applied Sciences*, *12*(17), 8674.

Phillips, R. O. (2015). A review of definitions of fatigue–And a step towards a whole definition. Transportation Research Part F: Traffic Psychology and Behaviour, 29, 48–56. https://doi.org/10.1016/j.trf.2015.01.003

Enhancing iRAP Star Ratings in Brunei

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Abstract
Road traffic injuries remain a global public health crisis. The International Road Assessment Program (iRAP) addresses the safer roads pillar through a standardised star rating system. In line with UN Road Safety Goals, the Brunei Department of Roads (DOR) conducted iRAP assessments in 2015 and 2024. Performance tracking revealed a significant increase in strategic roads that are rated 3-star or better (from 46% to 76%), primarily due to reductions in operating speeds and improvements in road conditions. While vulnerable road user star ratings remain a concern, with most routes still rated 1 or 2-star, the number of FSI is low, given low levels of these road users. Next steps include implementing the recommended Safer Roads Improvement Plans (SRIPs) for the remaining 22% of the network that is 2-star. To address limitations in the traditional iRAP methodology, including potential coding inconsistencies, Brunei DOR are considering using AiRAP for future assessments.

Social media post
Brunei was one of a small number of countries that achieved a 50% reduction in fatal crashes in the first decade of action (2010-19). IRAP performance tracking between 2015-24 reveals the proportion of 3-star+ roads increasing from 46% to 76%. #iRAP #Brunei #VisionZero

Introduction
Deaths and injuries from road vehicle crashes represent a pressing and escalating public health crisis. The International Road Assessment Programme (iRAP) has leveraged the extensive knowledge base of the developed world's road assessment programs (EuroRAP, AusRAP, and usRAP) to devise a road survey methodology applicable to all nations. IRAP employs a star rating system, which assigns a safety rating to roads from 1-star, indicating the highest risk, to 5-star, representing the lowest risk. This star rating methodology operates independently of detailed crash data, which can be lacking in some countries, and is based solely on road surveys.

Two of the United Nations road safety goals (target 3 and 4 below) encourage countries to focus on the safety of their strategic road network. This is typically the routes that carry 75% of a countries vehicle-kilometres travelled (VKT). The goal is to upgrade these roads to a 3-star or better rating, as significantly benefits, in terms of less deaths and serious injuries, can be achieved by upgrading 1- and 2-star roads. If all countries were to achieve this goal, this would go a long way to achieving the United Nations 50% reduction goal by 2030. Brunei is one of a few countries to have achieved the 50% reduction goal in the first decade-of-action for road safety (2010 to 2019). Their national road safety goal is to get to zero deaths by 2050.

To align with the new road safety targets set by the United Nations through to 2030, the Brunei Department of Roads (DOR) initiated a second iRAP assessment in 2024 to reassess their key arterial road network and track their road safety performance compared to their 2015 assessment (Turner et al., 2016). This 2024 assessment also helps them better understand the remaining crash risk factors on these roads. These roads were assessed using the same traditional iRAP methodology, including the identification of cost-effective approaches to improve star ratings and reduce risk.

Analysis - iRAP Performance Tracking
With two assessments (2015, baseline and 2024) it was possible to do iRAP performance tracking; this compares iRAP data from one period to another to determine what changes have occurred to the underlying crash risk across the assessed network, and what underlying safety attributes affect this change. These types of analysis are essential so that road-controlling jurisdictions can understand the effect their road safety investment has had across their network and what changes should be made in future road safety investment plans.

As shown in Figures 2 and 3 the performance tracking analysis revealed a significant improvement in vehicle star ratings on the main roads (around 600km) between 2015 and 2024, especially from 1 and 2-star to 3-star or better. The assessment showed that for the network assessed in 2015, the vehicle occupants' star rating has improved from 46% 3-

star or better to 76% 3-star or better. Further examination of the data showed that this improvement is mainly due to lower average vehicle operating and 85th percentile speeds. The improved surface condition of the roads also improved the star rating.

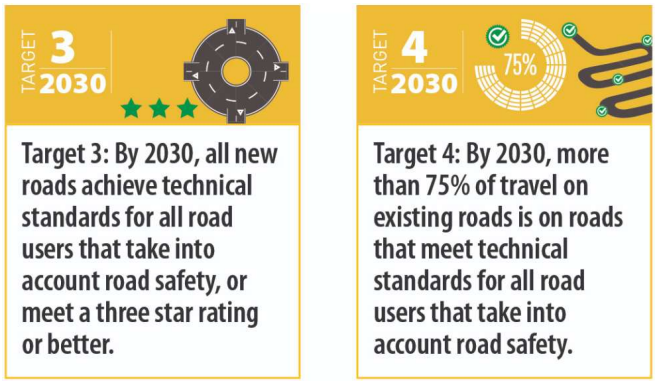
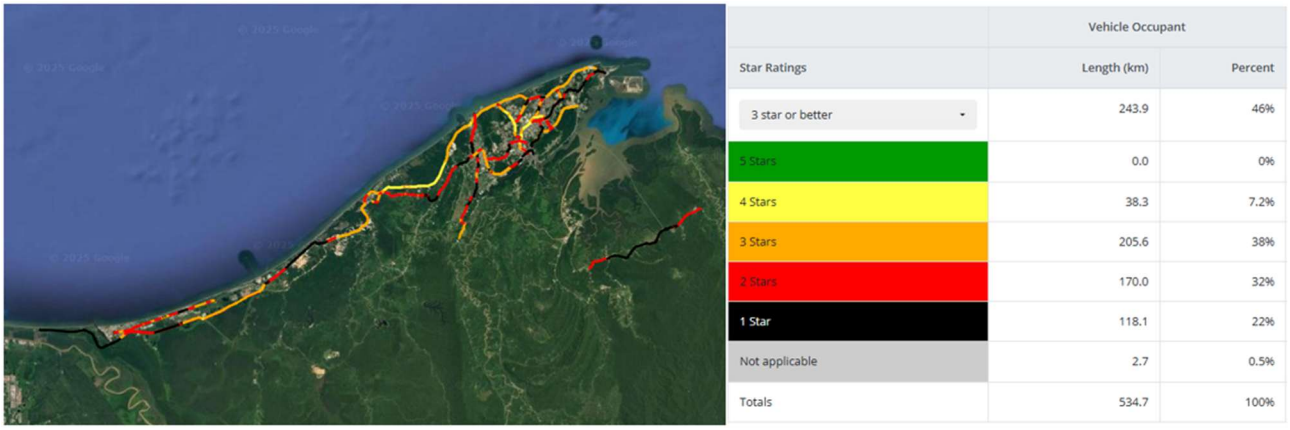
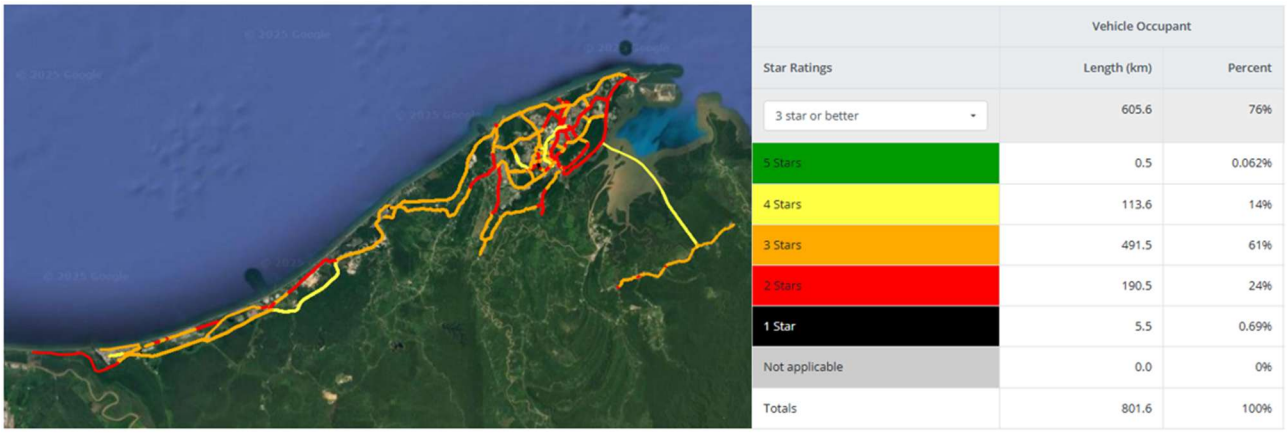


Figure 1. United Nations Targets 3 and 4 (Source: iRAP)



	Vehicle Occupant	
Star Ratings	Length (km)	Percent
3 star or better	243.9	46%
5 Stars	0.0	0%
4 Stars	38.3	7.2%
3 Stars	205.6	38%
2 Stars	170.0	32%
1 Star	118.1	22%
Not applicable	2.7	0.5%
Totals	534.7	100%

Figure 2. 2015 Star Rating Results for Strategic Road Network (Vehicles only)



	Vehicle Occupant	
Star Ratings	Length (km)	Percent
3 star or better	605.6	76%
5 Stars	0.5	0.062%
4 Stars	113.6	14%
3 Stars	491.5	61%
2 Stars	190.5	24%
1 Star	5.5	0.69%
Not applicable	0.0	0%
Totals	801.6	100%

Figure 3. 2024 Star Rating Results for Strategic Road Network (Vehicles only)

While there has been some improvement in 3-star or better for vulnerable road users (VRUs), most of the network is still 1 or 2-stars. This is less of a concern as VRU volumes are very low on these roads. Even motorcycle volume are very low, especially compared to surrounding countries, and more like the levels found in New Zealand and Australia. The national FSI statistics do show some VRU fatalities. But these are not necessarily on the major roads and are spread out over the network. Much of the pedestrian activity is concentrated on local roads, like strip shopping malls. However, this is an issue that Brunei will have to address to get down to zero fatalities.

Overall, the performance tracking results are promising, given the high proportion of the network (76%) that was 3-star or better for vehicle occupants. This success indicates that targeting the remaining 2-star routes will lead to further improvements, fostering a sense of optimism among stakeholders for the future of road safety.

Learnings and Limitations

The analysis underscored the beneficial influence of reduced speeds between 2015 and 2024 on the overall star ratings. Specific sites were surveyed to confirm that the speed reductions were not isolated incidents. This validation verified that speeds had decreased at most surveyed sites, thereby validating the accuracy of the findings.

Another key contributor to the improved star rating was the better road condition rating. A key contributor to this was improve maintenance practices. While there were defects in the road surfacing, a drive around the network showed that most of the damage, like pot-holes, had been patched. Perhaps harder to assess from video/photos was skid resistance. Coding of this variable is tricky and its harder to verify any improvements in skid resistance.

In addition to changes in the risk factors, the improvement in star ratings also coincided with a big reduction in road fatalities in Brunei after 2015 and this has been maintained from 2019 onwards. While this more than 50% drop won't be just due to a safer road network, the improvement in star rating is a likely contributor to the lower annual fatalities.

At a higher level the comparison of the 2015 and 2024 Brunei iRAP assessments and performance tracking revealed key learnings and limitations of the traditional iRAP methodology. The analysis assumes reasonable accuracy of the iRAP coding data. Despite different organisations being responsible for coding (in this case we could not use the same coding organisation), the same coding methodology was assumed for both studies. The data was collected following the iRAP-specified method for star rating. Both organisations were trained/accredited by iRAP. However, the manual nature of data coding and the subjective nature of some variables, especially condition ratings, mean that some of these changes observed may result from coding bias rather than actual changes on the network.

While the use of the same coding organisations and teams may mitigate this issue; performance tracking across multiple years and more often, using traditional methods, is likely to result in some counterintuitive findings when based on the traditional approach. While efforts can be made to ensure consistency, there is a limitation to what can be achieved with human observations and coding. A more accurate coding method, with better quality data, such as AiRAP becomes important in regular performance tracking.

Next Steps – Upgrade all 1- and 2-star Strategic Roads to 3- star or better

There are two key next steps for the Brunei DOR, 1) the upgrading of 1- and 2-star roads, so all strategic roads are 3-star or better and 2) adoption of AiRAP for future assessments, to remove the bias associated with manual coding in traditional assessment and over time reduce costs in iRAP network assessments. The AiRAP approach may also enable more of the road network to be assessed for a given cost.

With regard to 1), during the 2024 iRAP assessment a Safer Road Investment Program (SRIP) was developed for upgrading all the 1- and 2-star roads to 3-star or better. This SRIP also looks at where it makes sense to upgrade 3- and 4-star roads to higher star ratings, to further reduce crash risks. Based on the SRIP the DOR next step, assisted by the study team is to sense check and if needed modify the upgrade plans for all 2-star roads. The initial part of this assessment is looking at the 2-star sections that are on the Trans-Borneo highway. For one of these sections the plan is to do a road diet, reducing the road from four lanes to two lanes. This will enable a painted/flush median and shoulders to be installed to assist with safe turning of vehicles in an out of adjoining properties. At the same time the capacity of the highway will be assessed. While long term 4-lanes may be required, there are options to bypass this section of the highway so that vehicles are traveling on a safer access-controlled motorway.

The Brunei DOR are also keen to adopt the AiRAP approach for future assessment to improve the accuracy of their star rating. AiRAP is an automated, intelligent assessment method that improves data accuracy, reduces costs, and ensures consistent performance tracking over time. AiRAP for iRAP assessments standardises data outputs, making assessments more reliable and validating performance tracking. This is both in terms of the attributes that need to be coded, but also in being able to utilise other databases, like skid resistance maintenance records and probe data for traffic volume and speeds.

References

Turner, S, Smith, M and Robson, M (2016). Brunei iRAP – Speed Management and Infrastructure Improvements (Full Paper), Proceedings of the Australasian Road Safety Conference in Canberra, Australia.

Implementing speed management: lessons from Australasian case studies

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Abstract

Speed is a major contributor to road trauma, influencing both the likelihood of a crash occurring as well as the severity of the outcome. Much is known about the relationship between changes in speed and the benefits of more effective speed management, and many of the technical solutions, including interventions to support speed change, are known. However, there are implementation issues that present a major barrier to change. This paper explores some of these issues through the use of case studies. These are taken from experience in Australia and New Zealand, and provide direction on how to effectively implement speed changes.

Social media post

Alternatively: Effective engagement with decision makers and communities to deliver speed management initiatives: lessons from case studies

Introduction

Speed is recognised as being a major contributor to road trauma, with impacts on likelihood of a crash occurring, as well as the severity outcome (WHO, 2024). Common estimates are that speed plays a role in around 30% of fatal crashes (e.g., ERSO, 2021), but the contribution is likely to be double this (e.g., Job & Brodie, 2022; Fondzenyuy et al., 2024). Guidance exists on the benefits of speed management; good practice methods for setting of speed limits; and the measures that can be used to support speed limits that are safe (GRSP, 2023; World Bank, 2024; Austroads, 2025a). However, uptake of speed limit change has been slow, and speed remains a significant contributor to crash risk. Progress in management of speed has been slow due to the perceived barriers to the use of more effective speed limits, and the measures that can be used to support these. These barriers are likely to limit efforts to make further speed-related change, despite the demonstrated benefits. However, there are also many success stories from around Australia and New Zealand regarding successful management of speed.

A project was undertaken by Austroads to identify case studies to help support speed management activity. The focus was on information and activities related to communications, engagement and partnerships; elements of speed management that have been identified as barriers to effective change. The key purpose was to document lessons regarding success factors, as well as issues that negatively impacted desired outcomes. The case studies are provided in Austroads (2025b). This paper focuses on some of the key lessons from these case studies.

This paper contributes to the conference theme of Evolution, helping identify a key challenge to the effective implementation of Safe System activities, and highlighting a pathway to future development of this approach.

Method

A case study approach was used to identify key issues as well as examples of relevant practice. Initial workshops were held with representatives from each Austroads jurisdiction (including nominated local government representatives) to outline requirements, and identify possible case studies, along with the key learnings from these. A presentation was provided to set the context, and a structured approach used to identify relevant activity. Based on these initial workshops, additional discussions were held with representatives from local government, industry and academia to gather further details on case studies of interest. An initial 190 case studies were identified based on this consultation. An assessment of these was made to combine similar topics and remove less relevant topics. This led to a revised list of around 60 speed-related topics. For each of these topics, a subjective assessment was made on the ‘importance’ of the case study and the ‘difficulty’ in collecting the required data and producing a useful summary. The topics were ranked based on this assessment and presented to the Austroads Speed Technical Reference Group for discussion. Given resource constraints, a total of 28 case study topics were selected for inclusion, with most topics including more than one example of speed-related activity. Information was collected for each of the identified topics and documented using an agreed structure. The initial text was then sent to contacts for checking and further refinement. Common themes were identified, and topics were arranged based on these themes. Key lessons across all themes, including some of the

findings from discussions with stakeholders not included in case studies, were gathered. The case studies are provided in Austroads (2025b), while information on key themes is provided in this paper.

Results

The case studies were allocated to various themes, including the benefits from speed change; collecting and using speed data and surveys; use of data to engage and convince; and supporting activities and measures. Across each of these topics, some common findings and lessons emerged as discussed below.

Benefits of speed limit change

The case studies identified that speed limit reductions can produce a range of benefits. In addition to improved safety outcomes, there may well be other benefits. It is important to ensure that the public and decision makers are aware of these benefits, and especially the reasons why speed change matters. Clearer communication targeted to these audiences is needed. When engaging on this issue, it is important to understand stakeholder interest and context, as on an individual basis, some of these benefits will be of little interest, while others might be far more salient and better able to produce support for change. As highlighted in one interview, there is a need to "deeply understand your audience". There is no point in highlighting the road safety benefits if this is not what drives decision making.

As an example, surveys in one case study identified that individuals not supportive of speed reductions were less likely to believe that the change would have an impact on safety. Better knowledge and engagement with communities and decision makers on the safety benefits from speed reduction is needed to help improve understanding and acceptability of change.

Other examples of benefits from case studies included reduced emissions (including CO2), and lower vehicle operating costs, especially through reduced fuel use. There were examples where benefits were identified for local businesses from reduced speeds, including one case where the increase in economic activity has been quantified. In other examples, the changes in speed limits are being made to help encourage economic activity. Speed limits are being reduced in some locations to reduce the impact on local wildlife, and this is a consideration in at least one state's guidance on setting speed limits.

There are examples where speed limit reductions have led to improved traffic flow, and that there is often a significant over-estimation of the detrimental impact of speed change on travel times. Given this is a major barrier to change, there needs to be clearer guidance on this issue, and local case studies using actual change in journey time should be presented to the public and decision makers to help counter false beliefs. Several freight and commercial operators have mandated lower speed limits for their light and heavy vehicle fleets, recognising the significant benefits that can be achieved. This runs counter to the perception that lower speeds bring negative economic impacts or are bad for business.

Speed Data

Good speed-related data is needed to identify safety-related risk factors and locations, to plan effective strategies and set targets, and to monitor implementation and progress. One case study identified the importance of Safety Performance Indicators (SPIs) to help manage safety outcomes. Several examples of new sources of speed data were identified. This includes 'big data' sources as well as Event Data Recorder information. These can potentially bring significant benefits in managing speed, but in some cases, better guidance is needed on collection and use.

Information on community attitudes to speed is important to monitor public knowledge on speed as an issue, as well as driver speed behaviours. Surveys of community attitudes can also provide useful information on interest and acceptance of speed related policy (e.g., 80 km/h speed limits on poor quality rural roads) and on speed-related interventions.

Using data for engaging and convincing

Case studies were provided on ways that information and data can be used to help convince the public and policy makers about the importance and benefits of speed change. As highlighted above, increases in travel time from speed limit reduction is often vastly over-estimated. Specific, local case studies can be generated to help provide information on actual impacts. In addition, the costs and benefits across different policy objectives such as safety, vehicle operating costs (e.g., fuel use), emissions and journey time can be calculated. Even in situations where there are increases in costs due to increased journey times, these tend to be far outweighed by other benefits. The evidence on this issue needs to be presented more clearly to the public and decision makers.

At the local or project level it is often the case that, when changes are explained properly, there is strong community support for change. This shows the importance of conducting local surveys and providing the outcomes to decision makers to counter a vocal minority who sometimes dominate the conversations on speed change.

Practitioners need to be transparent about speed related activity. This includes presenting both the positive and negative to ensure real consultation and consideration of all views. It is good engagement practice to ensure that all relevant information is available to the public and decision makers. Similarly, it is important to acknowledge and address concerns related to speed change, such as change in journey time.

Most of the potential barriers to speed change have been documented across various publications. Practitioners should anticipate these barriers and prepare evidence-based responses. A case study on Frequently Asked Questions (FAQs) highlights one example of an approach that can be taken to address barriers and concerns.

Other supporting activities and measures

There appears to be growing community support for speed limit change. Various examples identified a ‘bottom up’ approach to this issue, with community members seeing the benefits achieved in neighbouring communities and demanding similar change. In some cases, state speed policy is not keeping pace with this community sentiment for change. Community voices can be very compelling when convincing decision makers on the need for change. There is value in good communications and research to help bridge a gap in understanding and acceptance. There are often easy solutions to address likely negative impacts, and working closely with important stakeholders like emergency service providers can lead to mutually beneficial outcomes.

Public confidence in the use of speed cameras can be increased, and activities to support this are needed to counter any negative public perceptions regarding these safety devices. This includes greater transparency on issues such as the site selection processes, accuracy of equipment, and use of generated revenue.

Speed limit setting tools can increase the level of confidence in speed limit setting processes, especially amongst internal stakeholders. Several tools were identified that help with the speed limit setting process. One of these tools also helped identify the broader benefits from the speed limit change. As well as increasing the credibility of the speed limit setting process, these tools help improve consistency in speed limit setting. Another example suggests that simplifying the speed limit setting process, especially for those in local government, can bring benefits.

Providing information on the reason for a reduced speed limit may be a useful approach, as often road users are unaware of the risks that are present. Providing this information can help increase public understanding and acceptability for speed limit reductions. The use of sub-plates on the speed limit sign, for example, can indicate directly to motorists the reason for change, with flow on benefits for compliance.

There are several trials underway on the use of in-vehicle speed monitoring systems, and these are showing some benefits. These can be used by fleet managers or insurance companies to help manage risks. For companies, drivers who continually exceed the speed limit, or exhibit other risky behaviours, can be retrained or suffer penalties. Emerging results indicate that this technology may bring useful safety benefits.

Conclusions

Speed plays a significant role in crash causation and severity, and substantive reductions in road trauma will not be achieved unless this speed issue is directly addressed. The case studies identified clear evidence on the benefits of speed reduction, with substantial reductions in road trauma possible from even quite limited changes in speed. There are also broader benefits from speed reduction that are often not recognised.

Despite these clear benefits, reductions in speed have been slow, and it is likely that this is due to a variety of reasons including barriers to change. These barriers represent an implementation issue rather than a technical one, as many of the solutions on how to reduce speeds are already well known. Some of these barriers are based on myths and disinformation. For example, it is often believed that journey times will increase substantially when speed limits are reduced, when they typically do not. These barriers are well known, and practitioners must anticipate these when engaging with communities and decision makers, and prepare compelling responses based on evidence. It is recommended that the examples from this study and the broader evidence base be used when engaging on this issue.

References

Austroads (2025a), Guide to Road Safety Part 3: Safe Speed, Austroads, Sydney, Australia.

Austroads (2025b), Speed limit case studies. Austroads, Sydney, Australia.

ERSO (2021), Road safety thematic report – Speeding. European Road Safety Observatory, European Commission, Directorate General for Transport, Brussels.

GRSP (2023), Speed management: a road safety manual for decision-makers and practitioners, second edition. Global Road Safety Partnership, International Federation of Red Cross and Red Crescent Societies, Geneva.

Job, S. and Brodie, C. (2022), Understanding the role of speeding and speed in serious crash trauma: a case study of New Zealand. J Road Saf. 2022;33(1):5-25.

Fondzenyuy, S.K, Turner, B.M., Burlacu, F.A. and Jurewicz, C., 2024. The contribution of excessive or inappropriate speeds to road traffic crashes and fatalities: A review of literature. Transportation Engineering,17.

World Bank (2024), Guide for Safe Speeds: Managing traffic speeds to save lives and improve liveability, World Bank, Washington DC.

Outcomes of an intensive traffic enforcement operation in New Zealand

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Presenter: Peter McKennie

Abstract
In the past decade, New Zealand has faced a high level of traffic mortality, ranging 7 to 8 fatalities per billion vehicle kilometres travelled (B VKT). This brought increasing pressure on Police to increase its intensity of enforcement for breath testing and speeding. A national operation (2023-present) was devised to maximise general deterrence for risky driving offences, combining dosage, unpredictability, and rural deployment. Breath tests increased from 2.1 million in 2022 to 4.1 million in 2024. Officer-issued speed notices increased from 326,000 in 2022 to 461,000 in 2024. Early indications to indicate a negative relationship between the amount of traffic enforcement and the rate of traffic fatalities. In 2024, New Zealand recorded a historic low rate of road deaths of 5.9 per B VKT. Traffic enforcement is an effective road safety measure at high intensity; however, it is no panacea.

Social media post
New Zealand Police has undertaken a large-scale national traffic enforcement operation over the past two years. The intensity of traffic enforcement activity was likely among the highest per head of population worldwide. In 2024 New Zealand had a historic low rate of road deaths. We further explore the relationship between road policing and traffic fatalities, as well as its constraints as a road safety measure.

Background
Since a previous historic low traffic fatality rate of 6.2 deaths per billion vehicle kilometres travelled (VKT) in 2013, New Zealand has faced an increased level of traffic-related mortality, ranging between circa 7 and 8 road deaths per billion VKT. With little progress made in improving road safety performance over the ensuing decade, this has placed New Zealand in the top quintile in terms of road deaths per distance travelled and per head of population (OECD/ITF, 2023).

This ongoing lack of progress in improving New Zealand's road safety performance brought with it scrutiny on the New Zealand Police and wider road safety sector. In particular, the levels of alcohol breath testing and speed enforcement were viewed as insufficient. In response to this and the aforementioned ongoing challenge, New Zealand Police sought to leverage the general deterrence effect and maximise its impact to improve road safety.

Previous research has provided evidence of a dose-response type relationship between enforcement and safety – that is, increases in the intensity of enforcement is associated with a reduction in traffic fatalities (Elvik, 2001: p. 35).

Conference theme: Evolution
The current paper presents the results of a prolonged intensive traffic enforcement operation in New Zealand and proposes further evidence of the relationship between the relative amount of enforcement and the corresponding rate of traffic fatalities. It describes both a contemporary evolution of one functional aspect of a safe system (traffic enforcement) and how traffic fatalities vary as a factor of enforcement intensity over past decades. While increases in traffic enforcement can be shown to be effective in reducing traffic casualties over time, there are constraints to relying on intensifying traffic enforcement activities to improve road safety performance.

Approach
Commencing 19 December 2022 (to present), New Zealand Police introduced "Operation Open Roads". This is a national operation that has aimed to increase proactive traffic enforcement by setting challenging targets. This has included: speed limit exceedance including an increase in the rate of deployment to rural roads and notices issued to low level speeding <11 km/h excess; random breath testing for alcohol (including an increased rate of tests undertaken during 'high alcohol hours' (chiefly Friday 22:00-Saturday 02:00, Saturday 22:00-Sunday 02:00); seat belt non-

compliance; and hand-held mobile phone use. The operation has presently been in place for over two consecutive years with support from Police leadership and operational police officers.

Results

Operation “Open Roads”

Police districts were provided with a bespoke dashboard which contained recent road policing activity and progress toward its annual targets. These targets involve several enforcement goals (officer issued offence notices or charges). Under the operation, breath tests increased from 2.1 million in 2022 to 3.2 million in 2023, and to 4.1 million in 2024. Officer detected speed notices increased from 326k in 2022 to 403k in 2023 and 461k in 2024.

Traffic fatalities

The number of road deaths have declined for two consecutive years over 2023 (342 deaths) and 2024 (292 deaths). After COVID-19 related travel restrictions ended in 2022 (371 deaths), the number of road deaths rose sharply and reverted to a similar level seen in 2018-2019 (372 in 2022 vs 378 in 2018 and 2019). During the COVID-19 related travel restrictions, New Zealand experienced a reduced level of road deaths of 318 in 2020 and 319 in 2021, consistent with international anomalous reductions (OECD/ITF, 2022). Per total distance travelled (B VKT), 2024 also had the lowest number of road deaths in any year in recent history at 5.9 per billion VKT, for reference this rate was 7.7 in 2022 (-23%).

The relationship between traffic enforcement intensity and road safety performance

There is evidence of a previously documented relationship between the amount of traffic enforcement and a corresponding rate of traffic casualties. Elvik described the relationship between enforcement intensity for alcohol testing, manual speed enforcement, seat belt enforcement, and total traffic enforcement in Norway (Elvik, 2012; Elvik, 2024).

New Zealand data was structured in a similar manner to what is described in Elvik (2024) to assess whether the relationship between traffic enforcement intensity and the rate of traffic fatalities could be replicated.

New Zealand data was analysed in the same manner described in Elvik (2024), with data available for 1998 – 2024. Total traffic enforcement was divided by annual total VKT and the proportional change from the indexed year (being the year with the least amount of enforcement per million VKT) against the proportional change in road deaths in the corresponding year.

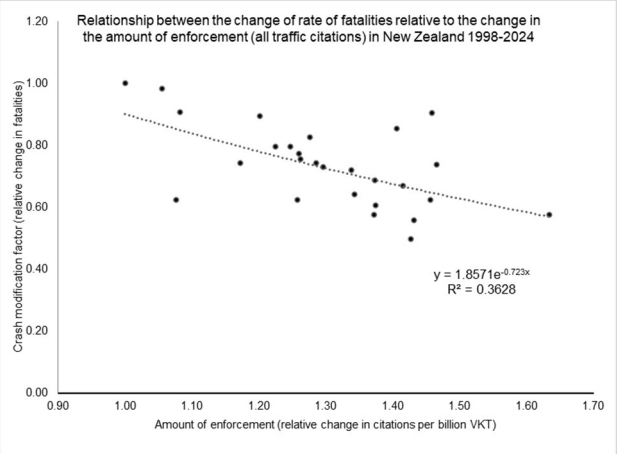


Figure 1. Total traffic offences (notices and charges) per million vehicle kilometres travelled (indexed to lowest year) vs change in road deaths in corresponding year (1998 - 2024).

The results largely replicated the findings presented in Elvik (2024) with some variation. Years with a higher rate of offence detection tended to have a lower rate of traffic fatalities.

The enforcement data considered in Figure 1 does not include the variation in breath alcohol test intensity. This data was separately modelled and produced a similar result (Figure 2). Higher amounts of breath testing tended to be accompanied by a lower rate of traffic fatalities. Overall, the results appear congruent with the studies reviewed in Elvik (2024).

It was considered to include serious injuries in these analyses, however, while a similar relationship was produced, this substantially reduced model fit. It appears that the relationship between increased traffic enforcement intensity, in this case mostly breath alcohol tests and speed enforcement, is more strongly related to reducing the most severe (fatal) traffic injuries. This finding is consistent with previous studies (Elvik et al., 2019; Elvik, 2024). The relationship between increased speed and the incidence of fatal vs non-fatal injuries being much steeper for fatal injuries (Cameron & Elvik, 2010). Elvik (2024) also noted "A given change in the amount of enforcement is associated with a larger change in fatal injuries than in less serious injuries" (p. 8.). Traffic offending appears to be related to the most severe of traffic crashes.

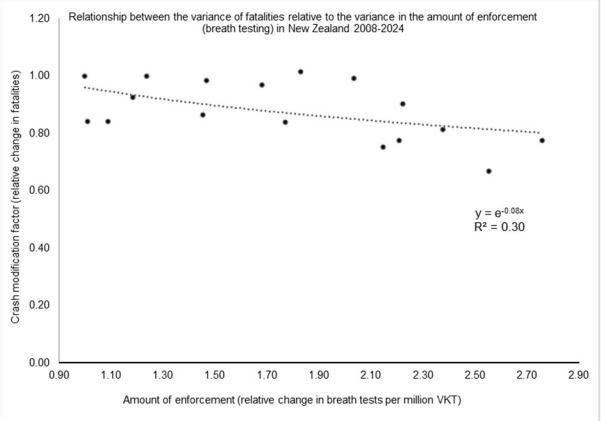


Figure 2. Random breath tests undertaken per million vehicle kilometres travelled (indexed to lowest year) vs change in road deaths in corresponding year (1998 - 2024).

Benefits to road safety

Further developments of the work on the traffic safety effect of traffic enforcement intensity (Elvik, 2001) are described in Elvik and Elvik et al. (2011; 2012). Carson et al. (2022) have additionally provided some key traffic enforcement statistics in European jurisdictions per 1,000 population, including for manual/automated speed enforcement, breath alcohol tests, seat belt offences, and mobile phone offences. Using the estimates described in Elvik et al. (2012) combined with the traffic enforcement statistics provided in Carson (2022), it is possible to calculate the estimated crash modification factor of the level of traffic enforcement intensity and how this compares on a population moderated rate for New Zealand (2024) with Norway (2018) as a reference. Table 2 contains the results of these estimates.

Table 2. Estimated effect of increased level of traffic enforcement in New Zealand.

Type of enforcement	Traffic enforcement		Per 1,000 population		Increase (times)	Fatal crash modification factor (%)
	NZ (2024)	Norway (2018)	NZ (2024)	Norway (2018)		
Speeding	460,858	102,629	86	19	4.5	9.9
Breath tests	4,060,958	937,325	761	177	4.3	7.2
Seat belts	48,996	4,236	9	1	11.5	6.7
mobile phone	59,141	20,123	11	5.0	2.9	n/a

Implications for policy and/or practice

As per the estimates of the crash modification factors of enforcement in intensity described in Elvik et al. (2012), the level of traffic enforcement intensity in New Zealand under 'Operation Open Roads' is near to the level where benefits begin to outweigh costs. The relationship detailed in Elvik et al. between traffic enforcement and effects on the rate of fatalities is not linear, but logarithmic, as was also the case in the data analysed in the present paper.

By cross referencing the work by Elvik et al. (2012) with the data presented in the current paper, it can be inferred that there are likely limits to what improvements in road safety performance can be derived from further increases in traffic enforcement intensity. Comparing the rate of traffic enforcement per 1,000 population (Carson et al., 2022), the intensity of traffic enforcement in New Zealand in 2024 was substantially higher compared to many European jurisdictions, jurisdictions with much higher road safety performance (OECD/ITF, 2023). The points of difference between road safety performance in New Zealand compared to well performing jurisdictions are likely varied and reach across the implementation of many parts of the safe system.

Conclusions

While the results of the current study support the notion that higher intensity traffic enforcement is associated with a lower rate of fatal traffic injuries, and the enforcement operation was accompanied by the lowest rate of traffic fatalities in recent history, the findings are also cautionary. The Traffic enforcement operation was largely successful in lifting traffic enforcement intensity within a relatively short period of time. However, even with four or more times the level of enforcement reported by Norway, New Zealand's record of road safety performance is yet to advance (OECD/ITF, 2023). In 2024, New Zealand experienced 5.5 road deaths per 100,000 population, while an improvement on 7.3 deaths per 100k in 2022, Norway recorded just 1.7 deaths per 100k in 2024. The results obtained from this large-scale traffic enforcement operation demonstrates why it is important to adopt and implement an approach that strengthens all parts of the system to substantially advance traffic injury prevention. NZ Police intends to continue this national road policing operation into 2025 and monitor its effects more locally.

References

Cameron, M. H., & Elvik, R. (2010). Nilsson's Power Model connecting speed and road trauma: Applicability by road type and alternative models for urban roads. *Accident Analysis and Prevention*, *42*(6), 1908–1915. https://doi.org/10.1016/j.aap.2010.05.012

Carson, J., Jost, G., & Meinero, M. (2022). *How traffic law enforcement can contribute to safer roads*. European Transport Safety Council. https://etsc.eu/wp-content/uploads/ETSC_PINFLASH42_v2TH_JC_v2.pdf

Elvik, R. (2001). *Cost-Benefit Analysis of Police Enforcement*. The "Escape" Project (RO-98-RS. 3047). Technical Research Centre of Finland (VTT). http://virtual.vtt.fi/virtual/proj6/escape/escape_wp1.pdf

Elvik, R. (2011). Developing an accident modification function for speed enforcement. *Safety Science*, *49*(6), 920–925. https://doi.org/10.1016/j.ssci.2011.02.016

Elvik, R. (2024). A comparative analysis of accident modification functions for traffic law enforcement. *Accident Analysis & Prevention*, *195*, 107415. https://doi.org/10.1016/j.aap.2023.107415

Elvik, R., Sogge, C. V., Lager, L., Amundsen, F. H., Pasnin, L. T., Karlsen, R., & Fosli, K. (2012). Assessing the efficiency of priorities for traffic law enforcement in Norway. *Accident Analysis and Prevention*, *47*, 146–152. https://doi.org/10.1016/j.aap.2012.01.017

Elvik, R., Vadeby, A., Hels, T., & van Schagen, I. (2019). Updated estimates of the relationship between speed and road safety at the aggregate and individual levels. *Accident Analysis And Prevention*, *123*, 114–122. https://doi.org/10.1016/j.aap.2018.11.014

OECD/ITF. (2022). *Road Safety Annual Report*. OECD Publishing. https://www.itf-oecd.org/road-safety-annual-report-2022

OECD/ITF. (2023). *Road Safety Annual Report*. OECD Publishing. https://www.itf-oecd.org/sites/default/files/docs/irtad-road-safety-annual-report-2023.pdf

Targeting high-risk corridors for evidence-based crash reduction in Kenya

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Abstract
Infrastructure assessments of high-risk corridors effectively reduce fatalities in resource-constrained settings. A combined International Road Assessment Programme (iRAP) and Road Safety Audit (RSA) assessed 640 km across eight Kenyan counties, accounting for 46% of national fatalities (2021-2023). Initial iRAP modelling projected optimistic fatality reductions (~70%, BCR=6.05), but sensitivity analyses highlighted significant uncertainties linked to enforcement effectiveness, driver behaviour, and implementation constraints. RSA field audits provided critical realism, identifying specific hazards such as hazardous road geometry, damaged barriers, insufficient pedestrian facilities, and prevalent speeding (>50% exceeding limits by >15 km/h). Consequently, RSA-adjusted realistic fatality reduction expectations ranged between 40-70%. This integrated approach emphasises the necessity of combining predictive modelling with detailed, context-sensitive local audits for achievable and sustainable road safety outcomes.

Social media post
Kenya’s integrated iRAP-RSA assessments realistically project 40-70% fewer fatalities on high-risk road corridors. Combining predictive modelling and local audits means safer, sustainable roads. #RoadSafety #Kenya

Introduction and Background
Kenya's road safety performance has fluctuated significantly over the past two decades, with fatalities per 100,000 population peaking at 10.1 in 2009, decreasing to 6.0 by 2017, then rising again to 9.1 by 2024. Serious injuries similarly increased sharply from 8.1 (2017) to 19.3 (2024) (KNBS, 2024). These troubling trends underscore an urgent need for evidence-based, sustainable interventions. In response, Kenya’s National Road Safety Action Plan (2024-2028) targets a 50% reduction in fatalities by 2030, consistent with the Safe System framework emphasising safer roads, robust enforcement, and improved post-crash care. Authorities identified eight counties representing 46% of national road deaths from January 2021 to June 2023, using geolocated crash data (Government of Kenya, 2024). Prioritising these high-risk areas aligns with international best practices promoting targeted interventions informed by data-driven network-wide screening (Bonera et al., 2024; García-Ramírez et al., 2021).

Conference Theme
- **Equity:** Protecting vulnerable road users by targeting hazardous corridors.
- **Elasticity:** Adaptable interventions tailored to local infrastructure and behaviours.
- **Evolution:** Integrating predictive analytics (iRAP) with detailed RSA assessments advances road safety towards a proactive Safe System approach.

Project description and Approach
From January 2021 to June 2023, combined iRAP and RSA assessments covered approximately 640 km across eight Kenyan counties, representing nearly half of national road fatalities. The integrated methodology combined quantitative predictive modelling, utilising iRAP’s star ratings (ViDA software), georeferenced video surveys, crash records, traffic volume, and speed analyses, with detailed qualitative RSA field inspections. RSA observations validated model predictions, capturing local behaviours, infrastructure conditions, and practical constraints.

Outcome of the Work

Initial iRAP Results
Initial iRAP modelling projected significant potential fatality and serious injury (FSI) reductions, averaging around 73% across targeted counties, with a high average benefit-cost ratio (BCR) of 6.05 (Table 1). Figure 1 visually demonstrates

expected improvements in iRAP star ratings from baseline to post-intervention under the five-year Safer Road Investment Plan (SRIP).

Realistic Grounding through Road Safety Audits

Despite optimistic projections, RSA field inspections highlighted critical real-world constraints such as enforcement limitations, persistent speeding, inadequate pedestrian compliance, infrastructure maintenance challenges, and limited funding. RSA evaluations provided wide-ranging, realistic BCR estimates (Table 2), reinforcing the importance of integrating ground-level audits with model-based approaches.

Sensitivity Analysis and Uncertainty

A sensitivity analysis underscored significant variability around projected crash reductions, influenced by enforcement effectiveness, user behaviour, and resource availability. The initial 70% reduction from iRAP modelling thus represents an optimistic, upper-bound scenario contingent upon ideal conditions rarely achieved in practice, especially within resource-constrained LMIC contexts (Heydari et al., 2019; Shuey et al., 2020). RSA adjustments yielded a more practical, achievable crash reduction estimate of 40-70%, providing critical realism for decision-making.

Table 1. iRAP Star Rating Investment Plan Results (5 Year)

County	FSIs Saved	Avg. Cost per FSI (USD)	Avg. BCR	Avg. Fatality Reduction
Nairobi	6,335	815,583	7.38	70%
Kiambu	6,138	981,300	8.69	73%
Machakos	3,041	1,905,200	3.22	74%
Nakuru	2,439	1,968,700	3.9	70%
Kisumu	1,705	1,668,100	3.68	81%
Kakamega	1,320	1,778,800	3.89	74%
Kericho	1,082	1,737,980	11.99	69%
Makueni	788	1,266,900	5.44	74%
Total	22,847	1,498,254	6.05	73%

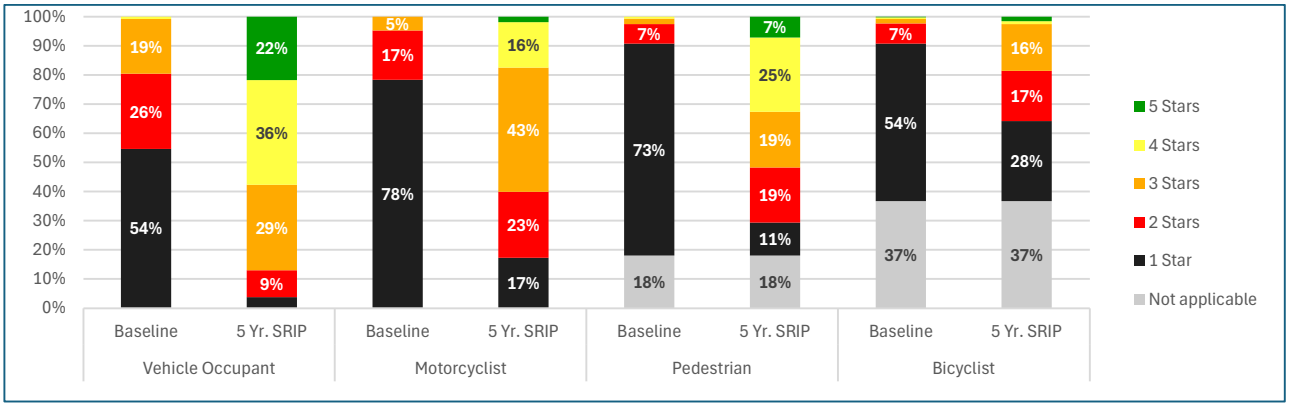


Figure 1. iRAP Star Rating Comparison of Baseline and 5 Year SRIP Results
Source: iRAP VIDA Analysis of Infrastructure Assessments for Hazardous Corridors in Kenya (NTSA)

Table 2. Road Safety Audit Output

County	Total RSA Cost (USD)	Total Crash Savings (USD)	BCR Range
Nairobi	4,205,366	3,242,507	0.11 - 22.83
Kiambu	9,152,635	488,479	0.01 - 9.46
Nakuru	5,889,682	2,870,947	0.02 - 9.46
Machakos	12,575,846	4,429,739	0.04 - 0.98
Kisumu	7,689,835	2,893,413	0.06 - 1.95
Kakamega	6,453,748	2,931,496	0.11 - 9.46
Makueni	1,476,760	889,214	0.05 - 50.00
Kericho	17,934,292	11,226,946	0.02 - 1.07

Findings

The combined RSA and iRAP assessments highlighted critical recurring road safety issues across corridors: hazardous geometry (sharp curves, steep embankments), inadequate road delineation, damaged or absent barriers, insufficient pedestrian facilities, and prevalent speeding, with over half of vehicles exceeding posted limits by 15 km/h or more. These findings emphasised the complexity of addressing combined infrastructure and behavioural risks effectively.

Evaluation and Effectiveness

Integrating iRAP's predictive modelling with RSA's ground-level assessments provided realistic and achievable road safety insights (Table 3). While initial iRAP models optimistically projected ~70% fatality reductions, RSA audits revealed substantial practical constraints, aligning with international findings emphasising the necessity of pairing predictive tools with localised validations (Husnudzon et al., 2023; García-Ramírez et al., 2021). Consequently, realistic fatality reduction expectations were adjusted to 40-70%, contingent upon effective enforcement, adequate funding, and sustained infrastructure maintenance.

Table 3. Comparison of IRAP and RSA

Parameter	iRAP (Model-Based)	RSA (On-Site)
Scope	High-risk segments, predictive	Comprehensive corridors, local observations
Data Sources	Video data, crashes, traffic modelling	Field surveys, direct visual inspection
BCR Range	High (~6.0 avg., up to ~12)	Variable, realistic (0.02-9.46)
Fatality Reduction	Optimistic (~70-80%)	Realistic (40-70%), grounded
Speed Compliance	Assumed improvement post-intervention	Directly observed speeding non-compliance
Costing Method	Standardised unit-cost estimation	Local market-based costing
Implementation Strategy	Priority segments ("black spots")	Phased, corridor-wide strategies
Key Strength	Efficient, globally standardised	Grounded, context-sensitive
Key Limitation	Overly optimistic without local context	Accuracy dependent on frequent updates

Benefits to Road Safety

The integrated iRAP-RSA approach offers practical, realistic safety benefits:

- Targeted Risk Mitigation: Effective hazard prioritisation based on observed infrastructure conditions and behaviours.
- Equitable Protection: Improved safety for vulnerable road users (pedestrians, cyclists, motorcyclists).
- Cost-Effectiveness: Efficient allocation of resources through realistic BCR estimates.
- Sustainable Outcomes: Promotes continuous maintenance, enforcement, and community involvement, aligning with international best practices (Godthelp & Ksentini, 2024; Tavakkoli et al., 2022).

Implications for Policy and Practice

To maximise road safety improvements, the following policy actions are recommended:

Policy Action	Expected Impact
Prioritise RSA-informed interventions	Practical resource use and realistic outcomes (Gupta & Bandyopadhyay, 2020)
Enhance speed enforcement and education	Sustainable behavioural improvements
Regularly update assessments (RSA/iRAP)	Adaptable, effective intervention strategies (Bonera et al., 2024)
Strengthen inter-agency collaboration	Consistent and sustained road safety benefits

Conclusions

This integrated assessment demonstrates that realistically targeted interventions on Kenya's high-risk corridors can substantially reduce road fatalities by 40-70%. Combining predictive analytics (iRAP) with detailed local assessments (RSA) provides practical, sustainable, and context-sensitive recommendations. Achieving and sustaining these improvements requires continuous policy support, robust enforcement, ongoing infrastructure maintenance, and strong community engagement. This combined approach offers Kenya a clear, achievable pathway toward safer and equitable mobility for all road users.

References

Bonera, M., Barabino, B., Yannis, G., & Maternini, G. (2024). Network-wide road crash risk screening: A new framework. Accident; analysis and prevention, 199, 107502. https://doi.org/10.1016/j.aap.2024.107502

García-Ramírez, Y., Camacho, J., & Montoya, J. (2021). Uso del modelo iRAP para evaluar la seguridad vial en carreteras de dos carriles en Ecuador [Use of the iRAP model to evaluate road safety on two-lane highways in Ecuador]. Ciencia, Ingenierías y Aplicaciones [Science, Engineering and Applications], 4(1), 7-23. https://doi.org/10.22206/cyap.2021.v4i1.pp7-23

Godthelp, H., & Ksentini, A. (2024). Specific road safety issues in LMICs: an overview and some illustrative examples. Traffic Safety Research, 8, e000068. https://doi.org/10.55329/sdtu9515

Government of Kenya. (2024). National Road Safety Action Plan 2024-2028. National Transport and Safety Authority (NTSA). http://libraryir.parliament.go.ke/handle/123456789/27722

Gupta, M., & Bandyopadhyay, S. (2020). Regulatory and Road Engineering Interventions for Preventing Road Traffic Injuries and Fatalities Among Vulnerable Road Users in Low- and Middle-Income Countries: A Systematic Review. 2. https://doi.org/10.3389/FRSC.2020.00010

Heydari, S., Hickford, A., McIlroy, R. C., Turner, J., & Bachani, A. M. (2019). Road Safety in Low-Income Countries: State of Knowledge and Future Directions. Sustainability, 11(22), 6249. https://doi.org/10.3390/SU11226249

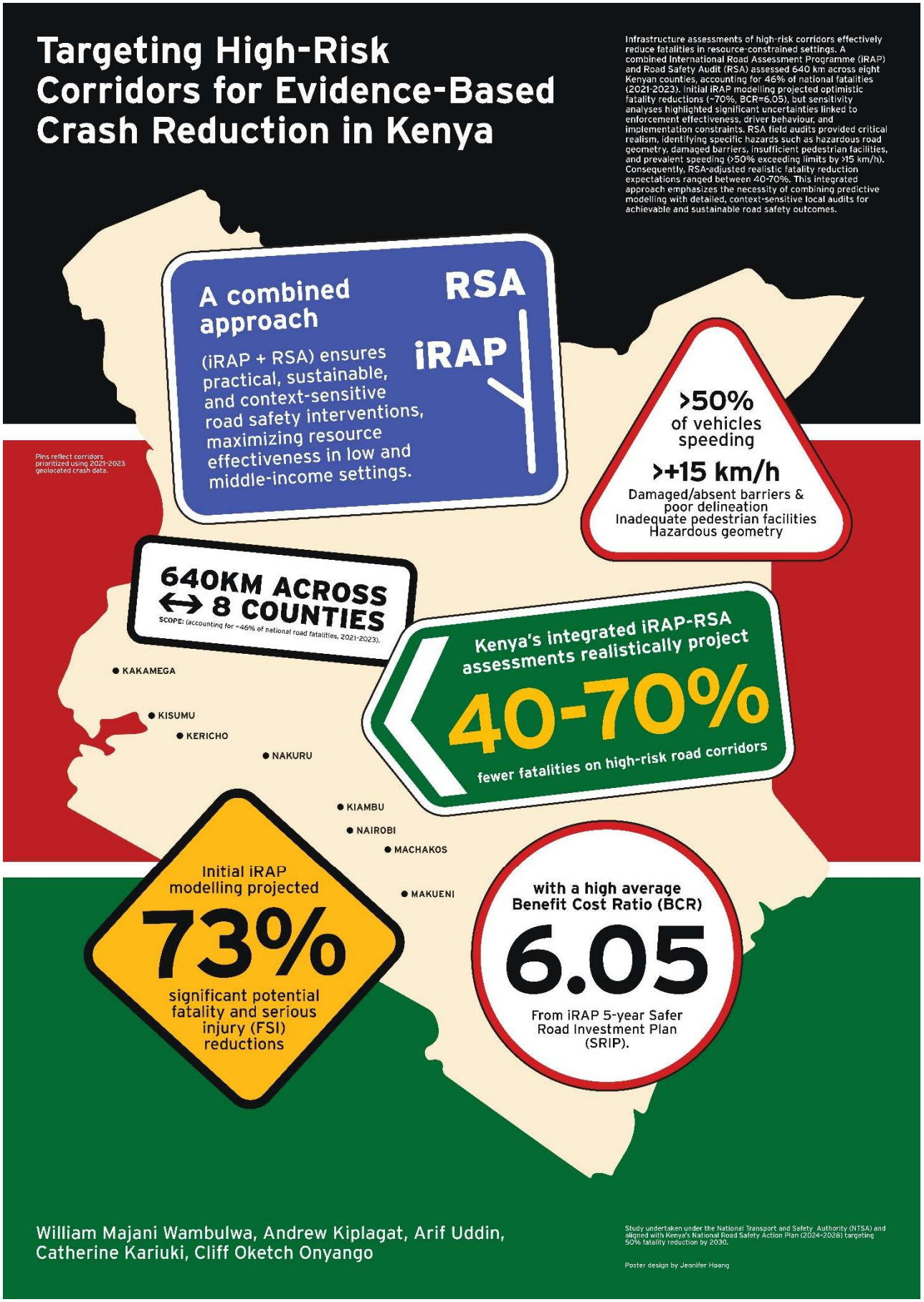
Husnudzon, D. A., Kusumawati, A., & Weningtyas, W. (2023). Improvement Of Road Safety Conditions Based on IRAP Star Rating and Road Safety Inspection (Case Study Kopo - Soreang Provincial Road). Jurnal Teknik Sipil, 30(3). https://doi.org/10.5614/jts.2023.30.3.1

KNBS. (2024). Economic Survey 2024. Kenya National Bureau of Statistics. https://www.knbs.or.ke/reports/2024-economic-survey/

Shuey, R., Mooren, L., & King, M. J. (2020). Road safety lessons to learn from Low and Middle-Income Countries. 31(3), 69-78. https://doi.org/10.33492/JRS-D-20-00257

Tavakkoli, M., Torkashvand-Khah, Z., Fink, G., Takian, A., Kuenzli, N., de Savigny, D., & Cobos Munoz, D. (2022). Evidence From the Decade of Action for Road Safety: A Systematic Review of the Effectiveness of Interventions in Low and Middle-Income Countries. Public Health Reviews, 43. https://doi.org/10.3389/phrs.2022.1604499

Poster presentation



Has the COVID-19 Pandemic influenced current driving behaviours?

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Abstract
Non-compliant driving behaviours contribute to road trauma. The current extent of road trauma in Australia is worthy of an exploration of the potential impact the COVID-19 pandemic may have had on recent engagement in non-compliant driving behaviours such as speeding and phone use while driving. This study explored multiple factors, including health and stress, that were experienced during the pandemic and the possible influence on current driving behaviours. A total of 202 Australian drivers responded to an online survey. The findings confirmed there was reduced engagement in non-compliant behaviours during 2020 compared to 2019 suggesting a positive impact from reduced traffic density, however there was a reported increase in engagement in 2023 compared to both 2019 and 2020.Young drivers, compared to older drivers, reported greater experiences of stress and loneliness during the pandemic along with greater engagement in non-compliant driving behaviours in 2023. These preliminary findings suggest there may be a lasting impact on drivers' behaviours from their experiences during the pandemic.

Social media post
The COVID-19 pandemic was stressful and a lonely experience for some which may have led to ongoing impacts on driving behaviours. Younger, compared to older drivers had a more negative pandemic experience, and it was reported that they are now engaging in more non-compliant driving behaviours.

Introduction
Australian road crash fatalities have increased since 2019, prior to the COVID-19 pandemic. There has been a 10% increase comparing 2019 to 2024 fatalities (BITRE, 2025). Limited research has examined the lasting impact from the pandemic that was declared in early 2020. Beyond the immediate health concerns, the pandemic led to unanticipated economic and lifestyle impacts requiring individuals in Australia to temporarily, and for some permanently, make adaptations to their work, education, and social life (Australian Government, Infrastructure Australia, 2020). Furthermore, mental health for some was negatively impacted due to isolation from lockdowns and travel bans, job losses, and questioning the potential new reality (Saltzman et al., 2021).

At the start of the pandemic, the lockdowns and travel bans meant there were fewer vehicles on the roads. Consequently, the number of crashes decreased for most states in Australia. However, some states such as in Queensland experienced an increase in road crash fatalities (Catchpole & Naznin, 2020). Research conducted early in the pandemic found, for example, that Queensland drivers who had never engaged in drink driving, did so during lockdowns as it was perceived that there was reduced road traffic enforcement. It was also noted that those who reported engaging in extreme driving behaviours during this time were more likely to be young males (Watson-Brown et al., 2021).

This research aims to explore the potential association between COVID-19 pandemic related factors such as health, financial concerns and stress, and the driving behaviours of Australians in 2023 when the status of the pandemic was revised. Other variables explored that were considered could be associated with current driving behaviours included reduced certainty of apprehension by police for non-compliance with road rules, risk perception and optimism bias.

Conference theme
This research highlights that the evolution of a safe system must consider unanticipated impacts from unpredictable events such as the pandemic. The findings provide insights into the impact of future global epidemics on road safety and in particular on driving behaviours that may not be evident as direct outcomes in the short-term following such events. The research highlights how road safety is nested within a broader system including, as is the case with the COVID pandemic, health (encompassing mental health) and economics.

Method

A total of 202 Australian participants (Mage = 37.71 years, SD = 17.18; Range 18-80 years) responded to an online survey and were recruited via paid Facebook advertising and avenues to participate in research within the university. Participants from Queensland comprised 77.7% of the sample, 8.4% were from NSW, 5.9% were from Victoria, 3.0% from Western Australia and the remaining participants were from Tasmania and South Australia. Of these participants 68.8% were female, 30.2% male, and 1.0% identified as binary. Most participants reported living in a suburb (63.4%) or in a city (19.8%). There were 8.4% living in regional areas, 5.4% in rural, and 3.0% in remote. Driving hours per week in 2020 were reported to be on average 4.86 hours (SD = 5.77) and in 2023 were 9.93 hours (SD = 10.27). The survey took approximately 25 minutes to complete.

Measures

In addition to demographic questions, the survey included questions about risky and non-compliant driving behaviours, perceptions of enforcement, risk perception and optimism bias. There were also questions regarding participants' health, wellbeing, and financial concerns during the pandemic. Key variables of stress and loneliness were measured with validated scales; the short form Perceived Stress Scale (Herrero & Meneses, 2006) and the UCLA Loneliness Scale (Russell et al., 1978). The timeframe for some questions was before (2019), during (2020), and after/now (2023) the pandemic to inform what has impacted current driving behaviours.

Results

A composite non-compliant driving scale was created that included drink and drug driving, speeding, phone use while driving, fatigued driving and not using a seatbelt (α = .70 - .71 for the three timepoints of interest). On a 6-point scale (0 = never, 5 = always), the mean score for non-compliant driving in 2019 was 0.64, 0.56 in 2020, and 0.69 in 2023 (Table 1). These scores between 0 and 1 indicated that on average participants engaged in non-compliant driving behaviours between never and less than monthly.

Table 1. Means scores for each of the non-compliant driving behaviours and the composite scale across 2019 (pre-pandemic), 2020 (COVID-19 pandemic), and 2023 (current)

	2019 mean(SD)	**2020 mean(SD)**	**2023 mean(SD)**
Drink driving	0.13(0.58)	0.15(0.70)	0.17(0.61)
Drug driving	0.10(0.57)	0.09(0.48)	0.09(0.51)
Speeding	1.50(1.57)	1.35(1.52)	1.71(1.66)
Phone use while driving	0.82(1.44)	0.70(1.24)	0.82(1.41)
Fatigued driving	1.23(1.27)	1.00(1.22)	1.30(1.42)
No seatbelt use	0.08(0.54)	0.09(0.54)	0.08(0.51)
Composite scale	0.64(0.70)	0.560.65)	0.69(0.72)

Note. Items were scored on a six-point scale where 0 = never, 1 = less than monthly, 2 – monthly, 3 = a few times a month, 4 = weekly and 5 = always/daily or most days regarding engagement in the behaviour.
SD – standard deviation

Comparisons were made regarding changes in the composite non-compliant behaviour variable across 2019, 2020, and 2023. There was an overall statistically significant difference in non-compliant behaviours, $F(1.621, 322.572) = 8.816$, $p < .001$, $\eta^2 = 0.007$. Post-hoc tests identified significant differences between 2019 and 2020 ($p = .001$) with reduced engagement in non-compliant behaviours during 2020 compared to 2019, and between 2020 and 2023 ($p < .001$) with increased engagement during 2023 compared to 2020. There was no significant difference between 2019 and 2023 albeit the mean score was higher in 2023.

In examination of the relationship between non-compliant driving behaviours and the key variables of interest it was identified that there were significant and positive associations between engaging in non-compliant driving behaviours in 2020 and 2023 and the measure of stress during the pandemic ($r = .22$, $r = .25$ respectively). The measure of loneliness during the pandemic was also significantly and positively associated with non-compliant driving behaviours in 2023 ($r = .22$). Age was also significantly but negatively associated with stress ($r = -.33$), loneliness ($r = -.27$), and non-compliant behaviours in 2023 ($r = -.27$). This suggests that younger participants experienced greater stress and loneliness during COVID and engage in more non-compliant driving behaviours now. There were no significant relationships found between driving behaviours and certainty of apprehension, risk perception, optimism bias.

Benefits to Road Safety

It is important to understand the factors associated with the current levels of risky and non-compliant driving behaviours given road crash fatalities and serious injuries are not trending towards the 50% reduction in fatalities and 30% reduction in serious injuries set in The National Road Safety Strategy 2021-30. It is well established that the driving behaviours examined in this study, drink and drug driving, distraction, speeding and fatigue contribute to road trauma. Targeted interventions can be developed informed by insights from this study. That is, from the knowledge and understanding of contributing factors to the increase in risky and non-compliant behaviours on Australian roads we can target relevant groups identified such as young drivers. Furthermore, the findings provide an insight into the types of early interventions that might need to be undertaken in the event of another pandemic or similar.

Implications for Policy and/or Practice

The insights from this study suggest early intervention strategies such as public information and education campaigns could be applied in future pandemics or other large-scale crises. Furthermore, this study has practical implications for domains beyond road safety, such as mental health, and suggest it is critical that road safety is not examined in isolation of the broader system that impacts road users' behaviours. Collaborative efforts among health and road safety stakeholders will be important in future similar events.

Conclusions

The study aimed to understand the associations between factors that were evident and impacted the lives of Australians during the COVID-19 pandemic (2020) and current (2023) engagement in non-compliant driving behaviours. Australian drivers who participated in this study reported reduced engagement in non-compliant behaviours during 2020 compared to 2019 suggesting a positive impact from reduced traffic density, however there was a reported increase in engagement in 2023 compared to both 2019 and 2020. Further examination identified associations between stress and loneliness during the pandemic with current engagement in non-compliant driving behaviours. Research has shown that stressful life events can impact driving behaviours via, for example, the effect of emotions on distraction (Cunningham & Regan, 2016). Younger participants reported experiencing greater stress and loneliness during 2020 compared to older participants and also reported engaging in more non-compliant behaviours in 2023.

Limitations concerning this study included the biases inherent in self-report data and the recollection of behaviours 3-4 years prior. However, self-report data has been shown to provide similar findings in regard to engagement in risky driving behaviours compared to more objective measures (Taubman-Ben-Ari et al., 2016).

A deeper exploration of the data collected, including multivariable modelling, will enable greater insight into additional factors such as perceived certainty of apprehension and the influence of past non-compliant behaviours on current behaviours. Moreover, the association of these factors with the specific driving behaviours of speeding, distraction, drink and drug driving and fatigue could be explored.

References

Australian Government - Infrastructure Australia. (2020). Infrastructure beyond COVID-19: A national study on the impacts of the pandemic on Australia: An interim report for the 2021 Australian Infrastructure Plan. Infrastructure beyond COVID-19 | Infrastructure Australia

BITRE. (2025). Road deaths Australia: January 2025. rda_jan2025.xlsx

Catchpole, J., & Naznin, F. (2020). *Impact of COVID-19 on road crashes in Australia*. https://f.hubspotusercontent20.net/hubfs/3003125/ADVI%20Covid%2019%20Report%20FINAL.pdf

Cunningham, M. L., & Regan, M. A. (2016). The impact of emotion, life stress and mental health issues on driving performance and safety. *Road & Transport Research, 25*(3), 40–50. https://search.informit.org/doi/10.3316/informit.476816178722935

Herrero, J., & Meneses, J. (2006). Short Web-based versions of the perceived stress (PSS) and Center for Epidemiological Studies-Depression (CESD) Scales: A comparison to pencil and paper responses among Internet users. *Computers in human behaviour*, *22*(5), 830-846. https://doi.org/10.1016/j.chb.2004.03.007

Russell, D., Peplau, L. A., & Ferguson, M. L. (1978). Developing a measure of loneliness. *Journal of Personality Assessment*, *42*(3), 290-294. https://doi.org/10.1207/s15327752jpa4203_11

Saltzman, L. Y., Lesen, A. E., Henry, V., Hansel, T. C., & Bordnick, P. S. (2021). COVID-19 mental health disparities. *Health Security, 19*(S1), S-5-S-13. https://doi.org/10.1089/hs.2021.0017

Taubman – Ben-Ari, O., Eherenfreund – Hager, A., & Prato, C. G. (2016). The value of self- report measures as indicators of driving behaviours among young drivers. *Transportation Research Part F: Traffic Psychology and Behaviour, 39*, 33-42. doi:10.1016/j.trf.2016.03.005.

Watson-Brown, N., Truelove, V., Parker, E., & Davey, J. (2021). Drink driving during the COVID-19 pandemic. *Transportation Research Part F: Traffic Psychology and Behaviour, 78*, 369-380. https://doi.org/10.1016/j.trf.2021.02.020

Evolving the Safe System: Safe mobility in strategic transport planning

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Abstract

Transport for NSW is **evolving the Safe System** by expanding its influence. To achieve this, two road safety subject matter experts have been embedded within the strategic transport planning team to work closely with transport planners to address challenges in balancing priorities for medium- and long-term transport plans and strategies. This approach has helped bridge the gap between long-term and short-term operational teams, fostered a better understanding of each team's competing priorities, and served to highlight how to best manage these priorities to ensure safe mobility is the primary function of the future NSW transport network. This presentation will share key learnings, challenges and opportunities from this approach, which has reinforced a culture of collaboration and enabled more effective integration of road safety into the strategic planning function and fostered an informal network of 'road safety champions', supporting the vision of zero road trauma by 2050.

Social media post

At Transport for NSW, road safety and strategic transport planning work 'hand in glove' to integrate the Safe System approach to road safety into transport plans and strategies, delivering mobility as a core element of the long-term visionary transport network in NSW. #Towards Zero

Background

The Future Transport Strategy sets an integrated vision for transport in NSW, with a key strategic direction focused on ensuring the safety of transport networks through a commitment to Vision Zero and the Towards Zero vision for zero road trauma by 2050. The 2026 Road Safety Action Plan sets targets to halve fatalities and reduce serious injuries by 30% by 2030 as stepping stones on the path towards zero road trauma.

Transport for NSW has adopted the Safe System approach and integrated it into supporting frameworks and policies for managing networks. Currently the Safe System approach is integrated into the Movement and Place Framework, Road User Space Allocation Policy and the NSW Speed Zoning Standard.

As NSW continues to grow, we are leveraging opportunities to increase safe mobility by influencing how places and transport networks are designed, planned, and delivered. Ensuring that medium- to long-term transport strategies and plans developed by Transport for NSW adequately address road safety will help achieve the Future Transport vision, meet the trauma reduction targets of the 2026 Road Safety Action Plan, and ultimately realise the Towards Zero vision of zero road trauma by 2050.

Addressing ARSC2025 conference theme of 'Evolution'

The evolution of a Safe System is one of the three themes of the 2025 Australian Road Safety Conference.
The presentation will demonstrate how embedding two matrixed strategic road safety resources into the strategic transport planning team has increased road safety knowledge, improved cross-organisational collaboration, and created a significant opportunity to evolve the Safe System and its implementation at Transport for NSW.
The presentation will also highlight the challenges faced by the matrixed team when working with varying levels of road safety knowledge and differing personal and professional perspectives within strategic transport planning at Transport for NSW. It will provide a critical assessment of the various approaches employed by the matrixed team, including what has – and has not – been effective with the approaches used so far when trying to make sure road safety, and safe mobility, is prioritised as part of the long-term future visionary network in NSW.

A matrixed approach to enhance collaboration and extend influence

Since 2021 two road safety subject matter experts (SMEs) have been part of a matrixed team working with strategic transport planners to elevate road safety at Transport for NSW. The current focus is working with teams responsible for the long-term planning for roads and public transport with planning horizons of 20-40 years.

A matrixed approach allows the two road safety SMEs to work 'hand in glove' with the strategic transport planners, facilitating both formal and informal engagement and influence. The intention of the matrixed approach is to:

- Elevate strategic transport planners' understanding of NSW's commitment to the Towards Zero vision, the 2026 Road Safety Action Plan, and the Safe System approach
- Reinforce strategic transport planners' role as 'system designers', responsible for shaping a transport system that enables safe mobility.
- Foster closer collaboration between the road safety and strategic transport planning teams, enhancing mutual understanding of competing priorities.
- Provide a feedback mechanism for strategic transport planners to raise road safety issues and opportunities.
- Use learnings and insights to more effectively plan for road safety.

Early successes: Mutual benefits and creation of a 'secret weapon'

By adopting a matrixed approach, the road safety SMEs have been well-informed and actively engaged in a wide variety of strategic transport planning projects. Over the past three years, there has been noticeable improvement in aligning strategic transport planning with the broader road safety framework. This includes closer alignment with the Towards Zero vision, the 2026 Road Safety Action Plan, and more consistent application of the Safe System approach. This has provided the matrixed road safety SMEs with firsthand understanding of the competing priorities transport planners face when developing medium- and long-term plans, as well as the challenges of balancing road safety objectives with broader transport network goals. This experience has enhanced the road safety SMEs' ability to influence planning decisions, deepened their understanding of the complexities involved in strategic transport planning, and brought the aspirations of long-term planning closer to the practical realities of short-term planning and operational teams, resulting in better alignment for road safety.

Transport for NSW is proactively shaping the future with long-term planning strategies like the Future Transport Strategy and more recently the Strategic Regional Integrated Transport Plans (SRITP). It is an exciting time to be involved in the development of nine SRITPs, with two currently released in draft and on public exhibition. Each SRITP sets a future vision for the region, focusing on creating a safe transport network underpinned by the Towards Zero vision.

Strategic transport planners must engage with a wide range of stakeholders (including those outside of Transport for NSW) and consider varied and sometimes narrow perspectives on future transport priorities. By working closely with strategic transport planners, we have fostered an informal network of 'road safety champions' who advocate for Safe System principles and identify opportunities to embed safety in plans. This emerging internal advocacy has proven to be a secret weapon in successfully integrating road safety into strategic decision-making across all planning horizons, contexts and modes.

The challenges: Navigating multiple transport priorities

Transport planners are a diverse group and unsurprisingly have divergent perspectives on road safety. They work with diverse stakeholders and must manage multiple transport priorities concurrently, and achieving better road safety outcomes is an ongoing challenge to overcome. Ideas and concepts that consistently re-emerge in transport planning include:

- The use of 'hot spot' road safety analysis and addressing 'crash clusters' is still relied on when developing transport plans and strategies. A more systemic analysis of road safety risks presented in the transport network is required as part of longer-term strategic transport planning projects.
- A continuing emphasis on 'trade off' decisions which can serve to undermine safe mobility. This view reinforces the perception that transport planners must somehow 'balance' efficiency with road safety, when a longer-term approach aligned with the Safe System approach requires planning a network that prioritises safe mobility for everyone.
- Rogue and inconsistent road safety language, particularly with reference to placing blame on road users for 'bad behaviour' as the reason improved road safety performance cannot be achieved, even in the long term. It is crucial to reinforce road trauma and crashes as predictable and preventable events and help strategic transport planners reframe their responsibility as 'system designers' who must work towards a visionary future network where the people using it are not killed or seriously injured.
- A tendency to conflate the benefits of modal shift on road safety with the idea that the 'health gains' from active transport can offset the road safety risks faced by people walking, wheeling, and cycling without access to planned infrastructure for active modes.

- Working within a matrixed team across two divisions in Transport for NSW has presented challenges, with ambiguities around workload, accountabilities and responsibilities, as well as logistical challenges including multiple office locations. We must continue to break down silos across Transport to foster a truly collaborative culture.

Next Steps: Planning for Road Safety – A guide for transport planners

As part of ongoing efforts to strengthen road safety integration across Transport for NSW, the 'Planning for Road Safety' guide is currently being developed. Led by core principles, this guide will support transport planners in their role as system designers, ensuring road safety is embedded at every stage of the planning process. It will focus on systemic risk assessment, fostering collaboration, and aligning planning with the Towards Zero vision.

This guide will be an important next step in ensuring that road safety is consistently prioritised in all future transport strategies and plans.

Conclusion: Creating opportunities for success, especially in the long term

The matrixed team approach has proven successful in advancing road safety within strategic transport planning at Transport for NSW. Since 2021, road safety SMEs embedded within planning teams have elevated the importance of road safety, ensuring it is integrated into long-term planning from the outset. As transport strategies and plans continue to evolve, this sustained focus will help make safe mobility a defining element of the future transport network, contributing to meaningful trauma reduction.

While challenges remain, particularly in addressing entrenched views, the progress made underscores the power of collaboration. The emergence of an informal network of 'road safety champions' has been instrumental in integrating Safe System thinking across all planning horizons and modes.

Looking ahead, the 'Planning for Road Safety' guide will further strengthen this integration. Grounded in core Safe System principles, it will help transport planners understand their role as system designers and ensure that road safety is embedded in every stage of planning. A continued focus on risk assessment, collaboration, and alignment with the Towards Zero vision will continue to drive the cultural and systemic changes needed to achieve zero road trauma by 2050.

References

Transport for NSW (2021) Future Transport Strategy – Our vision for transport in NSW. https://www.future.transport.nsw.gov.au/

Transport for NSW (2022) 2026 Road Safety Action Plan – Towards zero trauma on NSW roads. https://towardszero.nsw.gov.au/roadsafetyplan

Transport for NSW (2022) Movement and Place Framework. https://www.movementandplace.nsw.gov.au/

Transport for NSW (2024) Road User Space Allocation Policy. https://www.transport.nsw.gov.au/system/files/media/documents/2024/road-user-space-allocation-policy_july-2024.pdf

Transport for NSW (2024) NSW Speed Zoning Standard. https://standards.transport.nsw.gov.au/

An overview of PCYC Queensland's Road Safety Programs

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Abstract

PCYC delivers a range of road safety programs within Queensland, that interact with diverse road user need, that specifically focus on young people that don't have equitable access to road safety resourcing. PCYC is a strong road safety advocate who supports road users from 10 years and older; navigating from how to safely ride bikes to how to interacting and driving a vehicle. Our principal road safety programs are Braking the Cycle and Changing Gears. These are our Learner Driver Mentor Programs, that partner with volunteers in the community. Through volunteer partnerships, young people that don't have access to a supervisor are supported to get assistance from a volunteer in their community. PCYC also delivers Wheely Wise, which promotes safe bike use in primary schools and throughout our Outside School Hours Care program platform. PCYC facilitates education programs from 3 PCYC clubs, as well as 3 portable services where we teach children to how to ride bikes safely, in their school or outside school environments.

Social media post

PCYC Queensland advocates for road safety across all clubs by providing equitable access to a range of programs that support young people's road safety development starting with learning to ride bikes safely to and from school through to supporting young people to obtain their licenses whilst learning the importance of being a responsible and safe driver.

Introduction OR Background

Road fatalities within Queensland remain high and consistent, with majority of fatalities involving young drivers between 16 and 25 years of age. On average, between 2018 and 2022, 29.5% involved unlicensed riders/drivers (Department of Transport and Main Roads, 2025); the overrepresentation of young people in hospitalisation and fatalities, coupled with the high rates of unlicensed driving and riding, PCYC Queensland is very committed to delivering our Road Safety program. PCYC's Road Safety programs, Braking the Cycle, Changing Gears, and Wheely Wise target a range of distinctive age groups to provide a holistic and ongoing approach to road safety.

Wheely Wise is our bike education program aimed at primary-school aged users from grade 4 to 6. Young people in this program are taught how to ride safely on pathways with other road users, as well as on and near roads. Utilising various best practice approaches, the intention is to increase young people's knowledge and awareness of road safety and increase the rate that 'good decisions' are being made. This program is run through 4 different regions throughout Queensland.

In addition to Wheely Wise, PCYC Queensland's predominate road safety program offering relates to Braking the Cycle. As a Learner Driver Mentoring Program, we provide vehicles and match young people with volunteers, to increase equitable access to support in obtaining a licence. The barriers to obtaining a licence in Australia for low-income households, with a Graduate Licencing system such as ours, is well noted. Hinchcliff, et al (2014), through their survey of people living in rural NSW, identified that one of the biggest barriers for young people of low-income families, is access to a competent driver. It was identified that access to a registered and road worthy vehicle is also a barrier. Furthermore, young people that live in regional and remote communities, have not only higher barriers to overcome, but also higher fatality rates, with one third of Queensland fatalities occurring on regional roads (Centre for Accident Research and Road Safety, 2017).

PCYC Queensland works closely with several remote first nations communities to deliver Changing Gears (CG). CG, which is a similar project to Braking the Cycle, is specifically designed to meet the unique needs of each remote community we partner with. We are proud of the work we do there, consider the significant barriers remote communities face in obtaining a licence. Some of the important, and unique, barriers for service delivery for remote First Nations communities include test content issues, justice issues, lack of information, cost and access issues, among others (Edmonston, 2016).

Conference Theme

The work that PCYC Queensland currently undertakes aligns closely under the theme of equity. PCYC Queensland works with 57 communities throughout Queensland to deliver our road safety program. These programs have limited barrier to entry, though it does have a specific focus on supporting individuals and communities that don't have the same level of access to services, information, formal and informal support available to them.

Volunteering plays a pivotal role in the work that we do in the road safety space, with over 600 volunteers supporting the programs. This volunteer aspect provides a range of additional support to young people by providing mentoring, training and informal support to young people so they can make safe and informed decisions.

Further to this, our community-based collaborative approach, in partnering with local business and services we work, enhances our ability to provide a wide range of information to those interacting with our programs.

Project Description

Braking the Cycle

BTC has been operating for the last 12 years. It initially began in Logan and Ipswich, Queensland, in response to high levels of youth unemployment, despite a high number of entry-level jobs available. From there, the program has spread to 57 communities across Queensland. Currently, our 2 biggest supporters of the program are Department of Transport ad Main Roads and the Motor Accident Insurance Commission. Our program predominately focuses on young people between the ages of 16-25, however, we support other community members above this age group, if their circumstances require this support. Participants have to have 10 hours recoded on their logbook, to ensure they are across the basics, and they also have to undertake a driving lesson to ensure they know the basics and are safe. Volunteers play a big role in this program. We recruit volunteers across all locations to deliver the driving sessions. Currently, we have over 600 volunteers that give their time each week to support these lessons. To volunteer, community members must have had an open licence for at least 12months, be able to obtain a blue card, and complete all required PCYC training.

Changing Gears

Changing Gears is our remote, first nations version of BTC, with some key difference. CG allows for further flexible delivery, to ensure the program meets community needs and expectations of the program. At our 4 locations, we offer additional supports including support in obtaining a learners licence, support in obtaining identification documents and general support to stay engaged with the program. Throughout our CG communities, there are no age restrictions and other strategies are put in place to support new learners, due to the absence of driving schools in most communities.

Wheely Wise

Our Wheely Wise program is an adaptable program that allows us to take our bikes or other 'wheels', such as scooters, and teaching resources to schools directly. At the school, we teach grade 4-6 children how to ride their bike safely. We do this on a cemented area of the school and play a range of games and activities to build core safety skills and teach how to recognise important road signage, as well as a heavy focus on hazard perception.

Outcomes

Braking the Cycle (BTC) and Changing Gears (CG)

There are a few core outcomes achieved through this program. Initially, our goal is to assist as many young people and community members obtain their licence as possible. Our other top priority is road safety. We work with local business, services and volunteers top provide as much additional road safety education as possible. Supplemental education we provide includes how to conduct regular vehicle checks, how to buy a used car, the fatal five and what they can do to prevent these risks, along with our own set curriculum.

Additionally, we look to increase the rate and quality of employment for our program participants. Obtaining a licence opens many new job and training opportunities but, from our feedback, also increases the quality of employment. Lastly, but just as important, is increased access to social and cultural connection. Spending hours driving with positive volunteer role models allows for important mentoring to occur between the volunteers and participants. Once a licence has been obtained, community members and young people are easily able to access increased social connection. Some of our core outcomes can be seen below:

Table 1. Program details

	Braking the Cycle			Changing Gears		
	2023	2024	Since Inception	2023	2024	Since Inception
Young people supported	1,659	1.377	12,603	33	33	211
Volunteer Supported Driving Hours	52,365	48,715	346,059.24	299	395	1262
Licences	920	915	4,437	21	14	50
Extra Road Safety Education Hours	1,534.71	1,811.75	7,301.12	11	14	39.15

Wheely Wise

Our approach to Wheely Wise has changed is to not only provide immediate support to young people as they ride their 'wheels', but to also provide foundational support and understanding of road safety. By engaging young people early, we hope to build positive habits and the ability to recognise safe riding practice, which they may be able to impart on peers and family members. Some of our core outcomes can be seen below:

Table 2. Program details

	Moreton Bay Region		Logan Region		Upper Ros/Townsville Region	
	2024	2025	2024	2025	2024	2025
Participants	191	127	256	45	168	0
Number of Programs Run	9	12	13	3	8	0

Benefits to Road Safety

As previously spotlighted, we have supported thousands of driving and road safety education hours, for thousands of Queenslanders across the state. With high rates of rural and road safety fatalities and injuries caused by young and unlicenced drivers, by providing equitable access to appropriate training, education and access to obtaining a licence, we are confident that we have had an impact on the thousands of Queenslanders that have obtained their licence through our program.

With 50 licences in our First Nations communities, along with many road safety education hours that would otherwise not have existed without this program, we are confident that we have had a positive impact on the road safety system.

Further benefits to the wider road safety industry related to sharing our success and specifically the various challenges, that we have had in obtaining outcomes. One of the regular challenges we face is engaging young people in learning opportunities to understand road safety. As a road safety program, one of our core outcomes is to teach new drivers to be safe as possible. As such, we attempt to engage new drivers with a range of supplemental education opportunities. This includes in person sessions with driving examiners, mechanics, police and other service providers, to enhance safety knowledge. Despite these attempts at engagement, attendance and engagement is lower than we would expect. The focus for young people remains on achieving the physical licence, rather than specifically the safety knowledge. To overcome this challenge, we have provided volunteers with more structured 'lesson plans' to ensure important road safety lessons are occurring during the drive. We are also reviewing potential online education components. We continue to source feedback from young people to inform and adjust our approach.

Implications for policy and/or practice

The work that we undertake at PCYC Queensland can be used to support other similar programs or communities that have identified a lack of road safety education to vulnerable young road users. We strongly believe in the value of sharing successes, challenges and opportunities with the wider industry to support others, but to also solicit feedback so that we can improve our own approach.

PCYC Queensland firmly believes that the work that we are undertaking, with our funding partners, is an example of what financial investment in targeted road safety programs can achieve for many communities across Queensland, especially those community members who are deemed vulnerable road users due to numerous factors

Conclusion

PCYC Queensland plays a significant and purposeful role in the Queensland road safety system. Our approach focuses on early information and intervention through Wheely Wise and developmental through support to remove barriers in

creating safer drivers of all ages and stages. We seek continual improvement of our road safety program offerings in the never-ending changing landscape of education programs. We are committed to sharing our success and challenges in hope that we can better interact with the wider road safety community in a shared learning continuum.

References

Centre for Accident Research & Road Safety. (2017). *Rural and remote road safety* [Fact Sheet]. FINAL-Rural-remote-road-safety-screen.pdf

Department of Transport and Main Roads.(2025). *Queensland Road Crash Weekly Report* [Fact Sheet]. Queensland Road Crash Weekly Report

Edmonston, C. (2016). Profiling Indigenous and Non-Indigenous road trauma in rural and remote North Queensland: it's not all black and white. *Centre for Accident Research and Road Safety* Profiling Indigenous & non-Indigenous road trauma in rural and remote North Queensland : it's not all black and white | QUT ePrints

Hinchcliff, R., Holloway, L., Kurti, L., Fase, D., Grant, J., Thompson, J., Higgins-Whitton, L., Ma, A., Walker, E. (2014). Barriers to obtaining a driver licence in regional and remote areas of Western NSW. *Proceedings of the 2014 Australasian Road Safety Research. Policing and Education Conference,* pp.1-11. https://eprints.qut.edu.au/126814/

NaviStation initiatives preparing the Golden Generation through transportation safety education

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Abstract

Navi_Station project addresses the evolution of safe public transport system by equipping children with essential wayfinding literacy, ethical conduct, and safety awareness. As rail networks expand rapidly, public readiness, particularly among young users, remains a challenge, especially during their first- and last-mile journeys. As legacy of the Australia Awards Short Course of Public Transport in Metropolitan Areas and funded by ITB, and Ministry of Education, it has since 2023 expanded the implementation to more than 600 children coming from 10 schools and several children communities across West Java and Jakarta. This initiative fosters elasticity by enhancing public adaptability to complex transit environments through a play-based educational model aligned with early learning curricula. By instilling safe behaviours and navigation skills, Navi_Station ensures equity by enabling all children to access and engage with public transport confidently. As transit systems evolve, this initiatives are crucial in shaping an informed, responsible, and safety-conscious generation.

Social media post

In Indonesia, transit expansion brings challenges wayfinding confusion, unsafe crossings, and accessibility gaps. Navi_Station equips children with wayfinding, ethics, and safety literacy through play-based learning, ensuring they navigate public transport safely and confidently.

Introduction

Have you ever wondered how people naturally do navigation? Why some people are good navigators, and some are not. Ask any random group of people, and you will get answers ranging from “I am great with directions” to “I get lost all the time (Shelton, 2013). This might be related to how when you were young as a child you were allowed to roam by yourself without adult supervision. The extent of how far you can roam is strongly related to your ability as an adult in navigation. Almost across the world there has been a dramatic decrease in the right to roam for children and believe it or not it also happens here in Indonesia. A study in 2015 in Children’s Geographies, showed how over three generations of children in families had overgone a severe hemming movement in England (Wolly, 2015). The boundaries were set usually because it is done in the name of “safety,” and because we get so used to the restrictions that they begin to seem like common sense (O’Connor, 2019). This restriction, while well-intentioned, may inadvertently reduce children’s exposure to real-life spatial and traffic situations that are essential for developing road safety awareness. *“Children who are allowed to roam by themselves farther away from their homes are likely to become better, more confident navigators as adults than children who are more restricted.”* Wayfinding is an essential part of intelligence as well as a survival skill for any person or animal who must travel to find food, water, shelter, or mates. But how individuals navigate their environment can vary. For example, when some people pay close attention to landmarks such as stop signs or buildings, it is called route information. And when others prefer to use cardinal directions – such as north and south – or reference points like the Sun as a guide. This is called orientation information. Most people combine both information navigation styles (www.neurosciencenews.com). Developing these skills early in life not only enhances spatial cognition, but also supports children’s ability to make safe, independent decisions when navigating urban environments, an important aspect of pedestrian and road safety. *‘If you design a street for kids, it works for everyone’ Janette Sadik-Khan, NACTO and GDCI (GDCI, 2020).* Children’s safety on urban roads is a critical concern with young pedestrians and cyclists being among the most vulnerable groups to traffic-related dangers. (Abdolahi, 2024)

Policy and investment choices made for children today will have an enormous impact on Indonesia’s future. The right choices will keep this country on a path toward a more just, equitable, and prosperous society. Indonesia has 80 million children, the world’s fourth-largest child population (UNCF, 2020). The 2030 Agenda presents an important opportunity to accelerate progress for children, given its key principle: leave no one behind. The well-being of today’s children will be an important marker of Indonesia’s progress towards the Sustainable Development Goals (SDGs) by 2030. When we consider the experience of babies, toddlers, and their caregivers in the planning and design of cities, we can better meet

the needs of all residents and users of public space (GDCI, 2020)," Children experience street infrastructure uniquely. However, how we design streets doesn't always consider children's needs (cities4children) Given the high rate of child pedestrian injuries and fatalities in traffic incidents, especially in rapidly urbanising cities, including child-focused design in urban streets is not only an equity issue but also a life-saving strategy (AAPCIVPP, 2023). In Indonesia, new public transport systems have been expanded at great speed. One can observe that the development starting from the National rail operator, BRT operator include Transjakarta, and other large rail transport operators, who collectively serve more than tens of millions of passengers per day, are amazingly built one by one like we have never imagined before. What we should be aware of is how the next generation will overcome this situation. At the current state, the number of stations and shelters has developed into a significant number. The range of the network has been extensively greater and more complex than before. This should be an alert alarm for us to act. Preparing the next generation for safe pedestrian and ethical public transportation use is crucial as the network expands. Early education on safely navigating pedestrian and public transportation is essential, requiring a tool for clear explanations and wayfinding literacy. Moreover, children often rely on walking as their primary first and last mile access to transit, making their safety on sidewalks, crossings (Oxley, 2012), and station areas a vital concern. Without proper wayfinding understanding and road safety education, this daily movement exposes them to high-risk traffic. The author aims to promote readiness and awareness of children for wayfinding literacy, navigation, and road safety. The readiness of children as the future generation to be able to ride public transportation operating in Indonesia; The creation of ethical behaviour that is polite and follows the rules applied on public transportation mode and stations/ shelters; The establishment of safety behaviour among children and teachers on public transportation, stations/ shelters, and road crossings. In the next 5-10 years, these children would be the prospective customers to this transit system and eventually will increase the ridership.

Conference Theme

This initiative fosters elasticity by enhancing public adaptability to Indonesia's evolving transit system through a play-based educational model, ensuring resilience and equitable access. By instilling wayfinding literacy, ethical awareness, and safety skills, Navi_Station promotes equity, recognising the value of every child as a future transport user and empowering them with informed choices, dignity, and confidence. As transit networks evolve, Navi_Station contributes to the development of a safe system, embedding safety culture early and preparing an informed, responsible, and safety-conscious generation to navigate public transport efficiently.

Method

This initiative follows a structured methodology to develop an engaging and inclusive public transport education toolkit for young children. The process is divided into four key stages: Discover, Define, Develop, and Deliver. Each stage ensures a systematic approach, from identifying target users and assessing competency levels to refining educational materials and distributing the toolkit through collaborations. The framework promotes a play-based learning model, leveraging partnerships with public transport operators and stakeholders to amplify impact and accessibility.

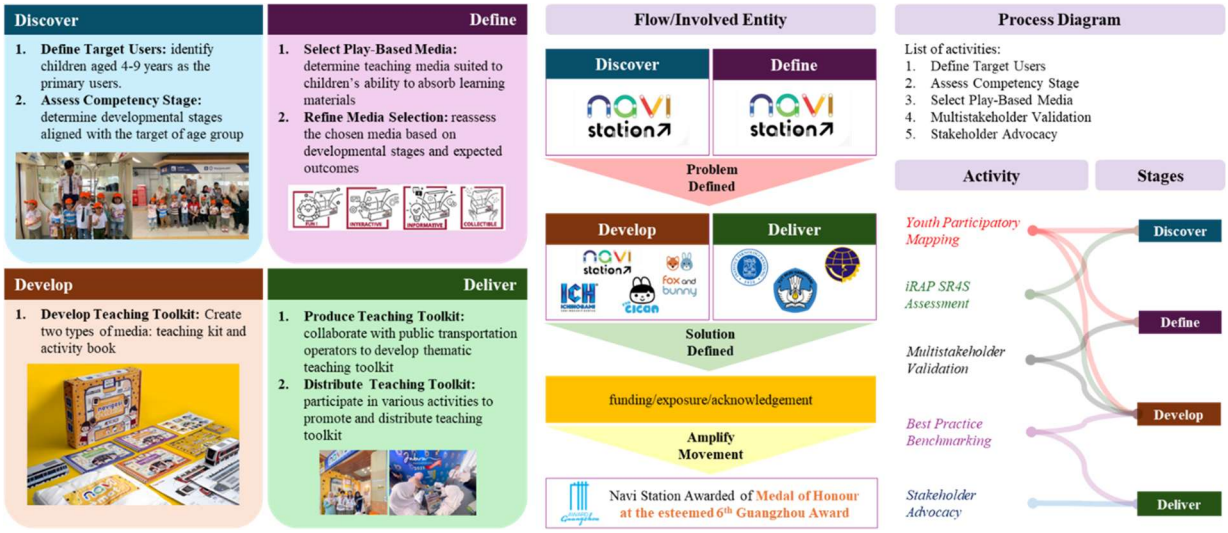


Figure 1. Navi_Station Methodology: From Concept to Implementation
Source: Developed by the author

Results

Navi_Station has advanced transport education for children by partnering with public transport operators in Indonesia to develop thematic teaching toolkits, distributed to schools across West Java and the Jakarta Region. The initiative was recognised at Jakarta Innovation Day and received a Medal of Honour at the 6th Guangzhou Award. To evaluate its early impact, a pilot project focusing on the railway mode was conducted. Children aged 4–6 completed a guided quiz assessing their knowledge of public transport, including operator logos, mascots, station literacy, appropriate behaviour, and safety at stations and level crossings. Administered in two stages pre and post education sessions, 56 children completed the pre-test and 11 the post-test. Results showed an average increase from 84.32 to 89.27, indicating improved understanding and awareness.

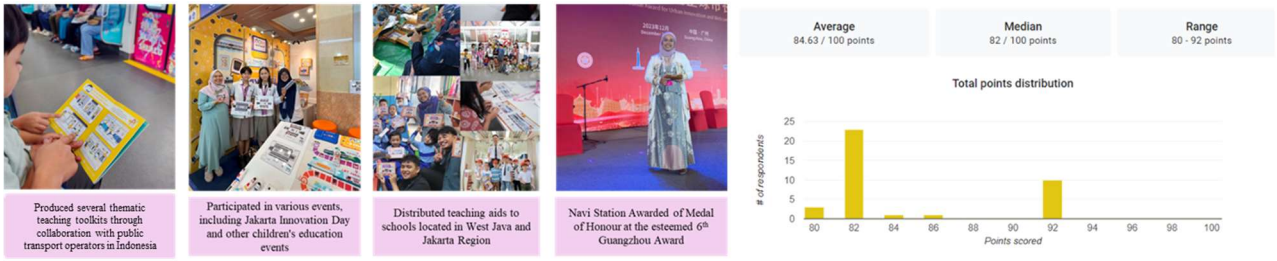


Figure 2. Navi_Station Impact and Recognition
Source: Developed by the author

Benefits to Road Safety

Ultimately, this approach indirectly increases safety awareness after introducing and developing fundamental transportation skills. Eventually, as pedestrians and public transport users these children would become better navigators, navigate naturally and eventually hold the future of public transport. It will be a long process and cannot be done all at once and one time only, but it is not an impossible project to do.

Implications for policy and/or practice

Indonesia itself has not yet focused on public transportation education, especially for young children, specifically those aged 5-9 years. Comparatively, countries like Australia, the UK, and the USA have already implemented transportation education for children, particularly emphasising safety. Thus, Navi_Station's presence in Indonesia serves as benchmarking from these countries. Moreover, Navi_Station has a visionary development innovation where education goes beyond safety, starting with wayfinding literacy to provide early understanding for children, enhancing their basic navigation skills public transportation as pedestrians and passengers.

Conclusions

This initiative supports SDG No. 4 by promoting inclusive and equitable education and fostering lifelong learning. Educating children about public transport from an early age instils a mindset that encourages cleaner cities through reduced vehicle emissions. The educational materials on wayfinding literacy, navigation, and safety align with this goal. Additionally, the program contributes to SDG No. 11, which aims to create inclusive, safe, resilient, and sustainable cities. Implementing a seamless public transport design aligns with this objective, while targeting children aged 5–9 ensures that future generations are prepared for safe and sustainable urban mobility. Navi_Station is the author's ongoing initiatives since 2023 and in 2025 will expand more of the project collaborate with more children communities and embedded in several public transportation edu visit activity.

References

Abdollahi, S., Waygood, O., Tavakoli, Z., Cloutier, M., & Abi-Zeid, I. (2024). Understanding the Factors Affecting Traffic Danger for Children: Insights From Focus Group Discussions. Urban Planning, 9, Article 8481. https://doi.org/10.17645/up.8481

American Academy of Pediatrics Committee on Injury, Violence, and Poison Prevention. (2023). Child pedestrian safety. Pediatrics, 152(1), e2023062506.

Cities4Children. (n.d.). Mobility blog category. Retrieved from https://cities4children.org/blog/category/mobility/

GDCI. (2020). Designing streets for kids: Global Street Design Guide (GSDG).

O'Connor, M. R. (2019). Wayfinding: The science and mystery of how humans navigate the world. St. Martin Press.

Oxley, J., Congiu, M., Whelan, M., D'Elia, A., & Charlton, J. (2012). Teaching young children to crossroads safely. International Journal of Injury Control and Safety Promotion, 19(2), 125–132.

Shelton, A. L., Marchette, S. A., & Furman, A. J. (2013). A mechanistic approach to individual differences in spatial learning, memory, and navigation. In B. H. Ross (Ed.), Psychology of Learning and Motivation (Vol. 59, pp. 223–259). Academic Press.

United Nations Children's Fund. (2020). The state of children in Indonesia – Trends, opportunities and challenges for realizing children's rights. UNICEF Indonesia.

Wolley, Helen E, and Elizabeth Griffin. (2015) "Decreasing Experiences of Home Range, Outdoor Spaces, Activities and Companions: Change Across Three Generations in Sheffield North England." Children Geographies 13 no 6. https://doi.org/10.1080/14733285.2014.952186

https://neurosciencenews.com/child-exploration-adult-navigation-19079/

Poster presentation



Road safety insights for future generations

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Abstract

Despite significant investment in road safety, progress in reducing road trauma has stalled. Recognising the need for a step-change in approach, this research explores how road agencies are adapting to challenges and where real impact is being made. To investigate this, we conducted a multi-stage research study: Policy and Strategy Review; Industry Surveys and Interviews, and Case Study Analysis. Findings highlight that while agencies prioritise community engagement, technology adoption, and law enforcement, barriers such as slow vehicle safety uptake, road design limitations, and funding constraints continue to hinder progress. Success stories emerged where leadership, policy modernisation, and targeted funding were effectively leveraged to drive change. By examining what's working and what's not, this presentation will provide practitioners with actionable insights to help road agencies adapt and accelerate their impact on reducing road trauma.

Social Media Post

Despite major investment, road trauma reductions have stalled. Our research explores how road agencies are adapting, what's working, and what's not, drawing on strategy reviews, industry input, and case studies to uncover insights that can drive real change.

Introduction

Despite sustained investment in road safety, progress in reducing road trauma has plateaued in many jurisdictions. Road agencies continue to implement safety measures, yet the data shows that the rate of serious injuries and fatalities has not seen the expected downward trend. Recognising the need for a step-change in approach, this research investigates how road agencies are adapting to challenges and where measurable impact is being made. The concept of elasticity, the ability of agencies to adapt to changing circumstances, is explored through a combination of industry insights, practitioner perspectives, and case study analysis.

The increasing complexity of road safety requires agencies to be flexible and responsive to emerging risks and challenges. Factors such as new vehicle technologies, evolving road user behaviours, and competing priorities in infrastructure investment demand a dynamic approach to road safety planning and execution. However, agencies often operate within rigid policy frameworks and funding constraints, making it difficult to trial and implement innovative safety solutions. This research seeks to identify the common barriers that hinder progress, as well as highlight successful case studies where agencies have effectively adapted to achieve meaningful safety improvements.

Research Methodology

A multi-stage research approach was undertaken to identify barriers, successes, and opportunities within road agencies' efforts to reduce road trauma. This study began with a comprehensive review of road safety policies and strategies, both locally and globally. By examining existing frameworks, investment commitments, and emerging trends, the research team sought to understand the overarching priorities and constraints shaping road safety decision-making. This phase provided a foundation for identifying key themes that would later be tested through practitioner engagement.

To gain firsthand insights from industry professionals, the research incorporated a series of surveys and interviews. An initial internal survey was conducted with practitioners who regularly engage with road authorities. This allowed the research team to understand common challenges and priorities from the perspective of consultants working closely with government agencies. Following this, an industry-wide survey was launched via LinkedIn, inviting participation from a broad spectrum of road safety professionals. A more targeted survey was then distributed directly to road authority practitioners to delve deeper into specific road safety strategies and their effectiveness.

Building on the survey responses, a series of in-depth interviews were conducted with twenty road agency practitioners. These interviews provided valuable qualitative insights into the real-world experiences of those responsible for implementing road safety initiatives. The discussions explored factors that contribute to successful safety interventions, the barriers that impede progress, and the role of leadership and funding in driving change. The final phase of the research involved analysing case studies from different jurisdictions, identifying examples where agencies had successfully navigated challenges to improve road safety outcomes. These case studies serve as practical examples that

can inform policy development and implementation strategies in other regions.

Key Findings

The research identified several key investment priorities and challenges that road agencies face in their efforts to reduce road trauma. One of the most significant findings was that road agencies prioritise community engagement, technology adoption, and law enforcement as core elements of their safety strategies. However, despite these investments, many agencies continue to struggle with persistent challenges, including the slow uptake of vehicle safety technology, road geometry issues, fatigue and driver distraction, and the increasing presence of micromobility users. Additionally, agencies face constraints related to traffic congestion and the competing demands of maintaining aging infrastructure while implementing safety upgrades.

Leadership and funding emerged as two critical enablers of successful road safety programs. Agencies that demonstrated strong political and organisational leadership were more likely to achieve positive safety outcomes, as decision-makers prioritised road safety initiatives and allocated the necessary resources to implement them effectively. Funding flexibility was also a key factor, with agencies that had the ability to reallocate budgets based on real-time safety data seeing better results in reducing fatalities and serious injuries. The findings suggest that when road safety investment is aligned with proactive risk assessment and Safe System principles, agencies are better positioned to achieve their safety goals.

Another key theme that emerged from the research was the role of data in shaping road safety strategies. Agencies that leveraged connected vehicle data, predictive analytics, and other emerging technologies were able to identify high-risk locations before crashes occurred, allowing for targeted interventions. However, many agencies still rely heavily on historical crash data to justify funding allocations, limiting their ability to implement proactive safety measures. The research highlights the need for agencies to embrace new data sources and analytical tools to enhance their decision-making processes.

Discussion: The Elasticity of Change in Road Safety

The findings indicate that some agencies are successfully adapting to challenges through strategic prioritisation, flexible funding models, and data-driven decision-making. Agencies that integrate Safe System principles into long-term investment frameworks see the greatest impact, as they are able to systematically address risk factors and improve road safety outcomes over time. In contrast, agencies that lack flexibility in their funding models often struggle to respond to emerging safety concerns, leading to delays in implementing critical interventions.

One of the most important aspects of elasticity in road safety is the ability to pivot in response to new challenges and emerging risks. Agencies that proactively reassess their safety strategies and incorporate lessons learned from past projects are better equipped to drive continuous improvement. This is particularly important in the context of evolving vehicle technologies, changing mobility patterns, and increasing demand for sustainable transport solutions. The research highlights several case studies where agencies have successfully navigated these complexities, demonstrating that adaptability and innovation are key to achieving long-term safety improvements.

However, institutional inertia remains a significant barrier for many road agencies. Legacy design standards, slow regulatory approval processes, and fragmented leadership structures can make it difficult for agencies to implement progressive safety measures. The research underscores the need for a cultural shift within road agencies, where flexibility and innovation are encouraged rather than hindered by bureaucratic constraints. By fostering a culture of continuous learning and improvement, agencies can enhance their ability to reduce road trauma and move closer to achieving Vision Sero.

The insights from this research provide valuable guidance for road authorities seeking to enhance their safety programs. By focusing on leadership, data-driven decision-making, and funding flexibility, agencies can create more effective and responsive road safety strategies. This study offers a practical roadmap for improving road safety outcomes and ensuring that road agencies remain adaptable in an ever-changing transportation landscape.

Conclusion

The insights from this research provide valuable guidance for road authorities seeking to enhance their safety programs. The ability of agencies to adapt to new challenges, embrace flexible funding models, and incorporate data-driven decision-making will be crucial in achieving sustained reductions in road trauma. While some agencies have demonstrated strong leadership in these areas, others continue to face constraints that limit their capacity for innovation.

This study offers a practical roadmap for improving road safety outcomes by focusing on strategic investment, emerging technologies, and collaborative leadership. The findings emphasise that a proactive, adaptable approach—one that prioritises continuous learning and responsiveness to new challenges—is essential for making meaningful progress

toward Vision Sero. Road agencies must remain agile in their policies, funding allocations, and implementation strategies to ensure that their efforts translate into lasting safety improvements. The research underscores the importance of cross-jurisdictional learning, where successful case studies can be leveraged to inform and inspire new approaches to road safety on a broader scale. By fostering resilience and adaptability, road agencies can drive a new era of road safety innovation and effectiveness.

Evaluation of motorcycle gear rating programs MotoCAP and CRASH

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Abstract
MotoCAP and CRASH provide safety ratings for motorcycle gear and helmets. These programs aim to educate and encourage consumers to demand high performing gear from manufacturers, and to influence industry to supply high performing products for riders. An independent evaluation was performed using a theory-based approach and mixed-methods data collection to assess if MotoCAP and CRASH were achieving the intended outcomes and to identify opportunities for improvement. This involved developing a Theory of Change, in-depth interviews with riders and industry stakeholders, a quantitative survey and mini focus groups with riders. Results indicated the programs were generally reaching the intended audiences, but engagement was mixed. MotoCAP and CRASH improved the capabilities of riders and aligned with their motivations but were not influencing the capabilities or motivations of industry due to low engagement. The evaluation outcomes have been used to develop a long-term strategy for maximising the impact of MotoCAP and CRASH.

Social media post
Evaluation of MotoCAP and CRASH found the programs are influencing rider behaviour, but more is needed to shift industry motivation to produce safer motorcycle gear for riders in Australia and New Zealand.

Introduction
The Motorcycle Clothing Assessment Program (MotoCAP) is a consumer information star-rating scheme for the safety and breathability of motorcycle jackets, pants and gloves. Established in 2018, it aims to empower motorcycle and scooter riders to choose the best protective clothing for their riding. The ratings are available on a public website (motocap.com.au or motocap.co.nz). The Consumer Rating and Assessment of Safety Helmets (CRASH) program is a similar star-rating scheme for the safety and comfort of motorcycle helmets and was established in 2009. Helmet ratings from CRASH were included on the MotoCAP website in 2022 to provide a single source of information for riders on the performance of motorcycle gear.

Both programs aim to influence consumer behaviour so that riders prioritise purchasing and wearing safer gear. They also aim to encourage manufacturers and suppliers to supply products that provide the best possible safety, breathability and comfort. The overall goal of the programs is to prevent and reduce the severity of injuries to crashed riders because fewer riders then wear poor-quality products that fail prematurely (de Rome et al., 2011) and because the protective benefits of these effective safety interventions are then maximised (Liu et al., 2008; de Rome et al., 2011).

The objective of this project was to evaluate whether the MotoCAP and CRASH are achieving the intended outcomes and to identify opportunities for optimisation of the programs.

Conference theme
This work aimed to evaluate and improve MotoCAP and CRASH, and aligns with the conference theme of equity because these programs recognise the importance and value of each motorcycle rider in making informed choices about the gear they choose to wear for protection, and managing fatigue when riding.

Approach
The evaluation was conducted by an external evaluator to ensure independence of the outcomes and recommendations from the programs and their member organisations. The evaluation used a theory-based design. This involved developing a Theory of Change (ToC) which is a conceptual diagram and logic model that sets out how and why a program is expected to achieve its ultimate goal.

The ToC was co-designed by the external evaluator and the MotoCAP/CRASH program teams using existing evidence and stakeholder expertise in a 3.5 hour workshop with four subsequent iterations. It determined the focus for the

evaluation and underpinned the Key Evaluation Questions (KEQs), with data collection methods selected appropriate to the KEQs and evaluation setting.

The KEQs were as follows:

1. Is MotoCAP / CRASH reaching intended audiences? Where are the gaps and how can they be addressed?
2. Is MotoCAP / CRASH engaging intended audiences? What works well and what could be done better?
3. Is MotoCAP / CRASH improving the capability of target audiences to benefit from the program? Do different audience segments have different needs?
4. Is MotoCAP / CRASH improving the motivation of target audiences to benefit from the program? Do different audience segments have different drivers?
5. What are the barriers to intended audiences following through on their intentions, including environmental/contextual factors? How can MotoCAP / CRASH improve social and physical opportunities for behaviour change?

Data collection methods

A mixed-method approach of qualitative and quantitative research was used. First, in-depth 60-minute interviews with riders (n=24) explored broad attitudes and behaviours to safety when riding, safety gear (protective clothing and helmets), safety ratings and MotoCAP and CRASH. Similar in-depth interviews with industry stakeholders (n=10) explored attitudes to safety in supplying gear, safety ratings and standards as well as willingness to engage with MotoCAP and CRASH.

A 15-minute survey was then administered online to motorcycle and scooter riders (n=1256) and potential influencers (family/friends) of riders (n=210). This provided quantitative data on awareness and usage of MotoCAP and CRASH, and the prevalence of key attitudes and behaviours around safety when riding, safety gear and the use of safety ratings.

Lastly, 8 mini focus groups of motorcycle and scooter riders (n=36) were conducted to activate the insights gathered in the previous rounds of research. These sessions informed the strategy for optimisation of both programs by testing potential interventions, communications, and stimuli.

Results

Riders

When initially asked where they find information about the safety performance of gear, only 11% of riders selected the MotoCAP/CRASH website. However, when prompted with an explanation and provided a link, 61% reported having previously visited the MotoCAP website. This discrepancy in unprompted and prompted awareness implies that riders were not familiar with the name but recognised the website.

Most riders that had previously visited the website agreed that they trusted it to tell them which products are safer (83%), that the product ratings were easy to understand (83%) and that the products on the website are available in store and relevant (66%). Riders reported that the program had impacted their capability as a result of visiting the website (Figure 1) in terms of education (riders learnt something from the website) and selecting gear (some riders had acted due to the website). The impact of website visitation on riders' motivation to subsequently use safety ratings was unclear from the evidence. However, the overall premise of the program aligned with riders' values to protect themselves from injury through gear selection.



Figure 1. Impact of MotoCAP and CRASH website on rider behaviour

The most limiting factors for program effectiveness were the current context and operating environment in terms of rider attitudes towards safety gear, use of safety gear, and awareness and use of ratings. While riders generally recognised that wearing gear was beneficial, they gave several reasons which prevented them from wearing it consistently. These included the perceived level of risk (e.g., going for a short ride), that some pieces of gear are more important than others, social norms (those around me do not wear gear) and personal morals (it is not important to me to wear gear). Safety ratings were also not frequently used or promoted among riders.

Manufacturers, distributors and retailers

Nine of ten industry stakeholders interviewed were aware of MotoCAP and CRASH but knowledge and perceptions of the programs were mixed and engagement was low. Manufacturers had high trust in European Standards CE certification levels. Therefore, when MotoCAP safety ratings conflicted with their expectations (determined by the CE ratings) or were seen as too demanding, they disengaged, and this limited the ability of the programs to improve the capabilities of industry in producing safer gear (Figure 2). For distributors and retailers, safety was not the determining consideration for supply decisions (though it is always a consideration). Moreover, CE ratings were again preferred.

Overall, MotoCAP and CRASH had low influence on motivation among industry stakeholders to benefit from the programs. This was also partly because they felt safety was not the only consumer focus (they believed style, comfort, affordability and breathability were all also considered by consumers).



Figure 2. Low engagement prevented MotoCAP and CRASH from improving manufacturer capabilities

Opportunities for improvement

Several immediate actions were suggested, primarily relating to website optimisation (e.g., clarify the purpose of the program and differentiate it from a commercial website). Long-term recommendations to improve the program efficacy for riders focussed on shifting the context around rider attitudes and behaviours. Specifically, work is required to demonstrate the need for safety ratings, persuade riders of the value of wearing gear all the time (not sometimes), give salience to different types of gear for different contexts (such as for scooter riders) and build and embed new social norms for using safety ratings (by focusing on new riders and embedding habits early, and appealing to riders' self-identity).

For manufacturers, distributors and retailers, recommended actions included education about the similarities between MotoCAP and CE testing procedures as well as engagement to build trust and increase knowledge of the programs.

Implications for MotoCAP and CRASH

The findings of the evaluation were considered and discussed by the MotoCAP and CRASH Steering Committee members to develop a long-term strategy for the programs. Most recommendations were accepted and included in the strategy. The only actions not supported were either impractical or outside the scope of the programs (e.g., changing the website URL, offering incentives to riders to purchase gear). The strategy outlines timelines, assigns responsibility for delivery of the action items, and defines clear, measurable targets for tracking including monthly website users, the proportion of different types of rated gear available to riders and industry requests for advice and ratings. Future follow up evaluation is planned to measure the success of the new actions in growing the impact of MotoCAP and CRASH.

References

de Rome, L., Ivers, R., Fitzharris, M., Du, W., Haworth, N., Heritier, S., & Richardson, D. (2011). Motorcycle protective clothing: protection from injury or just the weather?. *Accident Analysis & Prevention*, *43*(6), 1893-1900.

Liu, B. C., Ivers, R., Norton, R., Boufous, S., Blows, S., & Lo, S. K. (2008). Helmets for preventing injury in motorcycle riders. *Cochrane database of systematic reviews*, (1).

Understanding equity across the Safe System in New Zealand

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Abstract
In New Zealand road harm outcomes are inequitable across the system. The current inequities in New Zealand are a result of a complex range of historical, societal and geographic factors. Problematically, equity and safety are often considered in a disjointed way and often as separate or competing outcomes, making it challenging to achieve equality in safety outcomes. Definitions of equity in road safety are varied, involving different elements and emphasis, and with interactions and nuances that can be missed unless a joined-up view is taken. Examples from parts of the Safe System are presented in this paper to demonstrate the scale and complexity of the topic. The benefits of a holistic view with a move towards outcomes are presented to support practitioners in taking a coordinated approach to improve equity and safety together, with suggestions for further work and implications for policy and practice.

Social media post
Equity and safety are often considered in a disjointed way and as separate outcomes, resulting in stalled progress towards achieving equity in road safety outcomes. A holistic system view is needed to ensure the complexities of road safety and equity are seen and addressed in reducing DSIs among currently underserved groups.

Conference theme
This abstract contributes to Equity by defining and conceptualising it in road safety and the Safe System. It relates to Elasticity by emphasising equitable access and its relationship to safety. It relates to Evolution by encouraging a holistic view of equity and safety with examples across the Safe System and the application of human factors approaches.

Overview
In New Zealand road harm outcomes are inequitable across the system when considering ethnicity, age and gender, transport mode, and sectors of work-related road safety. These outcomes are a result of a complex range of historical, societal and geographical factors. Examples such as car-centric planning in land use, infrastructure design and social inequities have led to poor road safety outcomes for some groups. These factors continue to influence people's experience with the road transport system which have implications as we work to improve road safety outcomes and simultaneously address inequality throughout the system. Making progress requires us to take a more holistic view of equity and safety together, starting with how equity is conceptualised and defined in a road safety context, and then understanding the scale and complexity across the Safe System and in a New Zealand context.

Introduction
In New Zealand we are seeing inequities in how people experience the transport system which is having an impact on road safety and wider social and health outcomes. Understanding the systemic relationship of safety and equity is critical to reducing harm in the transport system and addressing the safety needs of those currently underserved. There are various aspects of the road safety system in which inequity is evident, including unequal access to the transport system, disproportionate representation of certain road users in DSIs, and the consequences of inequitable road safety design or implementation. Problematically, equity and safety are often considered in a disjointed way and as separate outcomes. Part of the challenge is also that different agencies look at it from different angles with different and sometimes competing priorities which can be contentious and stall progress, which undermines outcomes.

The scale and complexity of equity and safety combined require a holistic perspective of how the current transport system both contributes and fails to consider inequities which lead to poor road safety outcomes. This paper aims to look at equity and safety together, highlighting issues relating to how equity is defined in road safety, its relationship to road safety outcomes, and the benefits of a holistic view. This paper brings together subject matter expertise into key equity issues across the Safe System. Examples are presented here to elucidate the scale and complexity of the topic. With this understanding, we as road safety practitioners can continue to understand and design for the most vulnerable road users, while addressing wider inequities in the system and reducing high numbers of DSIs among certain groups.

Defining equity in road safety

There are varying definitions of equity in road safety in the literature. These involve different elements, with some focusing on inputs, and others on outcomes. There is also nuance in how vulnerability is conceptualised. Road users are not necessarily inherently vulnerable; their vulnerability is increased by the way the current road system is designed and their interaction with it (McCullogh et al., 2022). However, there are certain aspects of inherent vulnerability that still need to be considered. For example, if a motorcyclist makes a mistake, the likelihood is that the consequences will be worse compared to a driver of a 5-star car. Likewise, young people are inherently more vulnerable due to inexperience, risk taking behaviour (especially young men) and brain development. The transport system is also inherently spatially inequitable due to our physical and human geography. Without a holistic view of the relationship between inputs and outcomes, these nuances can be overlooked and result in the disjointed and ineffective delivery of outcomes.

Examples of inequities that contribute to harm across the Safe System

Road user choices

In New Zealand, disadvantaged groups, including young people within these groups, face barriers in obtaining a driver's license and progressing through the licensing system. Drivers who do not progress through the system have a higher risk of being in a crash than those who do (Walton, 2022). It is more difficult for people living in remote areas or on low income to access licensing and training services with implications for safety, social and economic outcomes.

New Zealand has relatively low penalties for high-risk offences and limited tools for managing repeat offenders. This undermines the ability to achieve deterrence and safety outcomes. This has implications for equity in safety because high-risk offending is occurring and not only increases risk for offenders but also compliant and vulnerable road users. Penalties can also impact people disproportionately due to income stress, which is another facet of equity in this area.

Infrastructure and speed

New Zealand's road transport system has been primarily designed for motor vehicle travel. This increases vulnerability for people in relation to vehicles, especially for children and other vulnerable road users. In addition, the quality of our roads means the system can be unforgiving if road users make a mistake. Challenging physical geographies makes it more expensive to service those areas, which can contribute to poorer quality roads in some areas affecting certain groups more than others. Infrastructure also has not adequately considered people with disabilities (Doran et al., 2022).

Speed is arguably the most contentious area of equity in the Safe System. Science is clear on risk for each road user group at different impact speeds, but speed limits usually balance this with co-objectives of efficient movement of people and goods. How this is balanced influences equity considerations and outcomes for vulnerable road users and communities, for example children around schools, marae, and pedestrians and cyclists in urban areas.

Work-related road safety

Work-related road fatalities make up around a third of all worker fatalities and a third of the national road trauma in New Zealand. When we widen the scope to include those killed in a work-related journey, the highest percentage of people killed are passengers, pedestrians and other road users rather than those driving for work, regardless of fault.

The transport sector and construction industry bear the highest burden of work-related traffic injuries in New Zealand (Thorne et al., 2022). In these sectors we tend to find an overrepresentation of men, those in an older age bracket, and a higher percentage of Māori and migrants compared to other industries. These groups are over-represented in DSI data and specifically in driving for work crash data. A further layer of inequity among these sectors is the high prevalence of those working on less secure contracts or outside standard forms of work such as contract drivers or gig workers. These groups tend to have little to no access to health and safety and standard employment protections which influence their ability to operate safely on and around the roads (Tedestedt George, 2018; Raja et al., 2022).

Safe Vehicles

In New Zealand, safe vehicles are available in most price ranges (NZTA, 2024). However, there are equity considerations relating to information access about star ratings, and younger people's generally lower disposable income. Research has shown that the youngest and oldest drivers were more likely than middle-aged drivers to drive vehicles that were older, did not have electronic stability control, and were not equipped with side airbags. Additionally, across all age groups drivers of higher socio-economic status were in newer and safer vehicles compared with those of lower socio-economic status. For example, young drivers living in lowest-income census tracts drove vehicles that were on average almost twice as old as young drivers living in highest-income tracts (Metzger et al., 2020).

There are also equity considerations relating to vehicle design and crash testing. People with obesity, for example, are at increased risk of death during a car crash compared to normal weight individuals (Enayatollah et al., 2020). This is relevant to the New Zealand's population which includes a range of builds (e.g., between ethnicities) and a diverse fleet, comprising vehicles designed for overseas markets (e.g., Japanese or European). Significant advancements have been made so that crash dummies account for the physical diversity of vehicle occupants. Seatbelt design and correct use is a specific issue for pregnant women and maternal and foetal safety (Koppel et al., 2025).

Summary

This paper highlights the complexity and nuance in understanding and defining equity in a road safety context. The examples demonstrate the scope of equity across each area of the Safe System and how it contributes to inequality in safety outcomes. Improvements are being made in New Zealand to address many of these issues, including those highlighted as examples in this paper. However, addressing equity and safety remains disjointed and as a result our efforts are not always having the desired impact or implemented at the desired pace.

Benefits to road safety

Understanding the complexities of equity in a road safety context is critical to achieving improved safety outcomes for all road users. Taking a holistic view of the factors that have and continue to lead to inequities across the road transport system is likely to have a positive impact on road safety outcomes and wider inequalities throughout the system. Advancing a definition of equity to focus on the relationship between inequities and outcomes supports a joined-up view of how to achieve safety and equity together. Further work is needed to develop a framework and set of principles to inform this definition of equity in relation to road safety, and how that integrates with the Safe System.

Implications for policy and practice

As practitioners it is our job to ensure that all road users can navigate and use the road system without experiencing disproportionate harm. Taking a more holistic system view of safety and equity supports practitioners and policy makers to understand which groups are least well served by the road system (and why) and consider equity more explicitly when designing the system to achieve equity in safety outcomes, including for young people, Māori and vulnerable road users, without compromising outcomes across the wider population. This could be applied to each area of the Safe System and through cross-agency transport policy to reduce reliance on motor vehicles and increase walking, cycling and public transport. Human factors and systems thinking approaches add value here. This promotes road safety as a more integrated component of other policy agendas, rather than a standalone issue. For example, improving penalties should be evidence-based to achieve deterrence and manage repeat offenders, including where there may be underlying health or other issues to address by taking a joined-up public health view. System-wide barriers and unintended consequences can be considered, with system-wide solutions to then minimise those without compromising on safety goals. This approach will likely require greater collaboration and coordination across agencies and significantly improved data sharing. This approach aligns with the Global Plan for the Decade of Action for Road Safety 2020-2030 and supported by system management in the Safe System. Addressing equity and safety in a coordinated way also has wider policy benefits across public health, liveability, sustainability, inclusivity, and social justice.

Conclusions

This paper contributes to our understanding of how equity is conceptualised in a road safety context and the scope and complexity of equity across the Safe System. It helps to inform a holistic view for how equity can be defined with a focus on outcomes as a way forward to address equity and safety in a more coordinated way and improve safety and wider outcomes.

References

Doran, B., Crossland, K., Brown, P., & Stafford, L. (2022). Transport experiences of disabled people in Aotearoa New Zealand. Waka Kotahi NZ Transport Agency research report 690.

Enayatollah, H.R., Khodadady-Hasankiadeh, N., Kouchakinejad-Eramsadati, L., Javadi, F., Haghdoost, Z., Hosseinpour, M., Tavakoli, M., Davoudi-Kiakalayeh, A., Mohtasham-Amiri, Z., Yousefzadeh-Chabok, S (2020). The relationship between weight indices and injuries and mortalities caused by the motor vehicle accidents: a systematic review and meta-analysis. *Journal of Injury and Violence Research, 12*(1), 85-101.

Koppel, S., Bugeja, L., Zou, X., McDonald, H., Lue, K.A., Forman, J., Zonfrillo, M.R., Baker, G.H., Kidd, D.G., Cripton, P.A., Oyen, M., Viano, D., Brown, J (2025). Assessing seatbelt use among pregnant drivers in Australia: Correct seatbelt positioning, discomfort, knowledge and information sources. *Journal of Safety Research, 93,* 15-23.

McCullogh., E., Giles, A., Macpherson, A., Hagel, B., Buchan, C., Pike, I., Torres, J., Fuselli, P., Pitt, T., Tavakolfar, P., Desrochers, E., & Richmond, S.A. Applying the Consolidated Framework for Implementation Research (CFIR) to examine barriers and facilitators to built environment change in five Canadian municipalities: Lessons from road safety and injury prevention professionals. *Journal of Transport and Health, 27*, 101478.

Metzger, K.B., Sartin, E., Foss, R.D., Joyce, N., Curry, A.E. (2020). Vehicle safety characteristics in vulnerable driver populations. *Traffic Injury Prevention*, 21(1). P. S54-S59.

NZTA (2024). 2024 vehicle safety ratings released on Rightcar.govt.nz. https://www.nzta.govt.nz/media-releases/2024-vehicle-safety-ratings-released-on-rightcar-govt-nz. Accessed 12/3/24.

Raja, A., MacArthur-Beadle, S., Tedestedt George, C., Blewden, M., Mackie, H., & Signal, T. L. (2022). The gig economy and road safety outcomes. Waka Kotahi NZ Transport Agency research report 709.

Tedestedt George, C. (2018). An inquiry into contextual factors impacting the occupational health, safety, and well-being of New Zealand truck drivers: An ecological systems approach. Doctoral thesis, Auckland University of Technology, Auckland, New Zealand.

Thorne, R., Tedestedt George, C., Raja, A., Blewden, J., Mackie. E., Li. E., & Mackie, H. (2022). Contextual Factors in Driving for Work Crashes: A systems analysis. A report prepared for the AA Research Foundation by Mackie Research.

Walton, D. (2022). Crash risk associated with pace of progression through the Graduated Driver Licence Scheme. Wellington: Crow's Nest Research.

Estimating the road safety benefits of seatbelt cameras in Queensland

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Abstract

Ensuring compliance with laws designed to keep road users safe continues to be a challenge for transport agencies globally. Advances in technology may allow for improved enforcement of these road rules. Seatbelts are one area where enforcement was historically difficult, requiring in-person observation of the violation and then interception by a police officer in order to enforce these rules. In response to the still unacceptable numbers of unrestrained vehicle occupants killed and seriously injured, in July 2021 the Queensland Government introduced mobile phone and seatbelt (MPS) detection cameras for the enforcement of seatbelt wearing by front seat vehicle occupants. An early evaluation, which included modelling the effect of the program in terms of trauma reduction benefits, has been completed. This modelling estimated the MPS camera enforcement for seatbelt non-use or misuse in Queensland resulted in a total annual saving in trauma costs to the community ranging between $18.7 million and $48.8 million.

Social media post

An early evaluation of the Queensland mobile phone and seatbelt cameras has been completed, with modelling estimating the cameras resulted in total annual trauma cost savings of between $18.7 million and $48.8 million due to increased seatbelt compliance by front seat vehicle occupants.

Introduction

In the period 2016-2020, 151 people who were not wearing a seatbelt were killed in a crash on Queensland roads. During this same period, seatbelt offending (non-use and incorrect use) contributed to over 1,200 people being hospitalised. In response, in 2020 the Queensland Government undertook a trial of mobile phone and seatbelt detection cameras, which led to the introduction of the cameras for enforcement from July 2021, starting with a 3-month grace period (warning letter but no fine or demerit points). During the first 12-months of enforcement (from 1 November 2021) 52,542 infringement notices were issued for front-seat vehicle occupants for failing to wear or incorrectly wearing a seatbelt.

In addition to the introduction of the cameras, the Queensland Department of Transport and Mains Roads (TMR) was undertaking a review of the appropriateness of penalties for dangerous driving behaviours (speeding, red-light and seatbelt offending). Following this review, on 1 July 2022 the Queensland Government introduced substantially increased penalties (fines and demerit points) targeting these high-risk driving offences, which are some of the toughest penalties in Australia for these offence types. The penalty for failing to wear, or incorrectly wearing, a seatbelt increased from $413 to $1,078 (3 to 7½ penalty units), and the number of demerit points increased from 3 to 4.

Monitoring against the Road Safety Strategy targets

The Road Safety Research and Evaluation team (RSRE) at TMR produces a quarterly monitoring report, which is one component of the ongoing performance management and monitoring of progress towards the Objectives and Targets of the Queensland Road Safety (QRS) Strategy 2022-31. The number of fatally or seriously injured (taken as hospitalised casualties) unrestrained vehicle occupants in road crashes is one of the performance indicators included in the quarterly monitoring report.

Analysis of the trends for these indicators shows there has been a notable reduction in the number of both fatal and hospitalised casualties who were unrestrained since the introduction of the seatbelt enforcement cameras and the increased penalties. Since mid-2023, the numbers of unrestrained hospitalised casualties have been decreasing. Figure 1 shows a similar trend has been observed for unrestrained fatalities, although this reduction has not been as consistent. The delay in reductions in the numbers of unrestrained fatalities and hospitalised casualties after camera program introduction is expected, as it can take time for the deterrent effect of a new road safety initiative to become successful. This is especially the case for specific deterrence, which relies on those who do not wear, or incorrectly wear, a seatbelt experiencing detection and the resultant sanctions.

For comparison, the quarterly change in the total numbers of fatalities or hospitalised casualties is also presented in Figure 1. This provides evidence that the reduction observed in the numbers of unrestrained fatalities and hospitalised casualties is not just the result of reductions in the overall numbers of fatalities or hospitalised casualties.

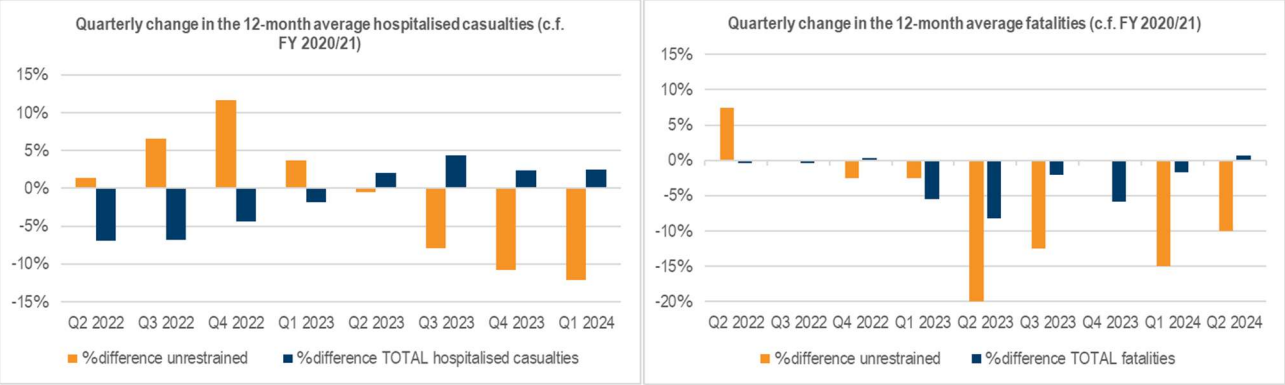


Figure 1. Quarterly change in the 12-month average number of unrestrained fatalities and hospitalised casualties in Queensland

Interim evaluation of the Queensland mobile phone and seatbelt camera program

In February 2024, TMR commissioned the Monash University Accident Research Centre (MUARC) to undertake an interim evaluation of the Mobile Phone and Seatbelt (MPS) camera program. This early evaluation was limited by the amount of data available on which to undertake analyses. with only two years of post-implementation casualty road crash data available. Consequently, a traditional retrospective analysis of the program benefits was not possible, so a prospective modelling of the anticipated road safety benefits of the MPS camera program was conducted. It estimated the effect of the program in terms of trauma reduction based on current siting, deployment and crash coverage of the program, the prevalence and risks of the targeted behaviours, and changes in behaviour prevalence likely to be achieved from program implementation. The remainder of this paper is focussed on the methods, results, and conclusion from the prospective modelling.

Conference theme

Evolution: The findings from this work align with providing “insights into components, measures and human factors”. The effects of improved compliance with seatbelt laws will not only result in improved outcomes for vehicle occupants, but also for those whose work brings them face-to-face with the consequences of road crashes, including first responders and those in after-crash care.

Method

Trauma reductions associated with MPS camera implementation were estimated using the prevalence of seatbelt non-compliance in people injured in crashes. Preventing seatbelt non-compliance reduces injuries in the event of a crash (rather than crash occurrence), and therefore prevalence of seatbelt non-compliance in casualty crashes is of most use for estimating the benefits. The prevalence of seatbelt non-compliance in crashes was obtained from Queensland road crash data for the 3-year (pre-COVID) period 2017-2019.

To estimate the potential road safety benefits of the MPS camera program, the expected deterrence effect of MPS camera enforcement were required. Deterrence estimates were obtained by drawing on various sources, including i) camera operational data, ii) Queensland licensing and infringement data (survival analysis to estimate rate of recidivism), iii) self-report survey data (from a subsample of drivers who indicated they has received a MPS camera infringement, and iv) previous research examining the effectiveness of camera-based enforcement (unlicensed driving).

The relative risk of seatbelt non-compliance was drawn from an analysis undertaken by MUARC for the Victorian Department of Justice and Community Safety, which used Victorian crash data for the period 2015-2019 (Lawrence et al., 2022). A summary of the information, data, and sources used to estimate the benefits for seatbelt non-compliance from the MPS camera program is shown in Table 1.

The proportion of injuries within a population (e.g., front seat occupants injured in Queensland road crashes) that could be prevented or reduced in severity by preventing exposure to a risk factor (e.g., not wearing a seatbelt) can be estimated by calculating the Population Attributable Fraction (PAF). The formula includes two variables: i) an estimate of the prevalence of the risk factor in the crash population (seatbelt non-compliance in front seat passengers injured in a crash), and ii) the relative risk of injury associated with the risk factor:

$$PAF = \frac{P_p \times (RR - 1)}{1 + P_p \times (RR - 1)}$$

- where P_p is the proportion of the population exposed to the risk factor, that is, the proportion of front seat passengers injured in crashes in Queensland who were not wearing a seatbelt, and
- where RR or relative risk is the risk of being injured if involved in a crash whilst not wearing a seatbelt compared to the risk of being injured whilst wearing a seatbelt, if involved in a crash.

The PAF (the proportion of injuries that would be reduced in severity or prevented if seatbelt non-compliance was eliminated) can be directly applied to calculate the number of injuries that would be prevented or reduced if drivers and front seat passengers wore a seatbelt. Adjustments can also be made to account for program reach (the proportion of drivers exposed to MPS cameras) and likely deterrence (proportion of drivers who would be deterred from seatbelt non-compliance by the camera program).

Table 1. Required information, data and sources for calculating the impact on road trauma from MPS cameras for seatbelt non-compliance

Information required	Data	Source	Estimate
Pre-program Prevalence of front seat occupant seatbelt non-compliance*	QLD crash data (2017-2019)	TMR	Fatal crash prevalence = 14.0% Serious injury crash prevalence = 3.1%
Injury severity increases related to seatbelt non-compliance*	Odds of a front seat occupant not wearing a seatbelt in a crash	Lawrence *et al.* *(*2022)	Fatal crash relative to a minor crash OR = 2.22 Serious injury crash relative to a minor crash OR = 1.38
Deterrence effect of the program		Multiple sources (see above)	Range: 13.5% to 85% (Final model: 20% or 50%)
Injury profile of the MPS camera program	QLD casualty data linked to MPS site location data (1km, 5km radius, or whole state)	TMR	Queensland (whole state): Avg. fatalities: 237 Avg. serious injuries: 6,784 Avg. minor injuries: 10,064
Average injury costs	Hybrid human capital crash costs	BITRE (2022)	Fatal injury: $2,900,000 Serious injury: $241,100 Minor injury: $26,000

Note: * = Calculated using 'Casualty_restraint_use' binary variable ('unrestrained') in QLD crash data

Results

The final model, based on a deterrence effect of either 20% or 50% (representing the likely range), and applied to the whole state of Queensland, estimated that MPS camera enforcement for seatbelt non-use or misuse in Queensland resulted in a total annual social cost saving ranging between $18.7 million and $48.8 million, which comprised:

Most conservative estimate (20% deterrence)

- 5.6 fatalities reduced in severity or prevented per year ($15,977,655), and
- 13 serious (hospitalised) injuries reduced in severity or prevented per year ($2,763,096)

Least conservative estimate (50% deterrence)

- 15 fatalities reduced in severity or prevented per year ($41,832,512), and
- 32 serious (hospitalised) injuries reduced in severity or prevented per year ($6,932,292)

Benefits to road safety

This interim evaluation has estimated a significant reduction in serious road trauma and its associated cost to the community associated with introduction of the MPS camera program in Queensland. It is expected that this effect will increase as the MPS camera program is expanded, including additional regional and remote area coverage.

Conclusions

The estimated road safety benefits from the MPS camera program due to enforcing seatbelt compliance are substantial. However, due to the timing of the increase in the associated penalty (fine and demerit points) for non-wearing and incorrect wearing of seatbelts, it is expected that the reduction observed is due to a combination of the MPS camera

enforcement and the increased penalty. Once sufficient data is collected, including the number of fatalities and serious injuries from crashes where vehicle occupants were unrestrained, an outcome evaluation, including a retrospective analysis of the MPS program benefits, will be undertaken.

References

BITRE. (2022). *Social cost of road crashes*¸ Report for the Bureau of Infrastructure and Transport Research Economics. Australian National University, Canberra.

Lawrence, B., Stephan, K. & Newstead, S. (2022). *Mobile phone and seat belt enforcement cameras in Victoria: Initial siting criteria and site selection*, MUARC draft report for the Department of Justice and Community Safety.

Travel to School: new guidance for safe and active travel

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Abstract
We all want better outcomes for our children travelling to school. New Austroads guidance provides a consistent and integrated approach to improving safe and active travel to school. It presents a precinct approach to school travel planning and evidence, case studies and resources to implement best practice improvements. It has three objectives: protect people from harm; informed by community needs; and feasible and sustainable for a local context. It recognises that road safety and active travel improvements are inter-related across three areas: infrastructure and safe speeds; vehicle access and management; and behavioural education and support programs. Implementing changes to school travel is complex and involves many actors: including school communities, local councils, and state agencies. The guidance presents a clear process for both new and existing schools. This presentation will: share consultation outcomes; explain the framework and resources; raise government and industry awareness of its application in their work.

Social media post
New Cross-jurisdictional Travel to School guidance shows that road safety and active travel improvements are inter-related and should focus on a precinct, not just the school gate. It gives guidance across three areas: infrastructure treatments and safe speeds; vehicle access and management; and behavioural education and support programs.

Background
The purpose of this project has been to deliver best practice guidance on how to support safe active travel to and from school.

Travel to school encompasses the journeys that connect people from the school grounds to surrounding communities. These journeys should be safe and accessible, enabling children to travel independently or with others. This requires environments that enable safe trips by all modes while supporting walking and riding for people of all ages and abilities from the surrounding area or a nearby transport stop. Safe school environments combine infrastructure, programs and policies to create spaces where children and families can walk, ride, use public transport or drive to school safely.

Transport managers have a central role in ensuring that children can make healthy travel choices by improving active travel options and improving safety and management of vehicle access and travel in school precincts. Yet there is limited, or at times inconsistent, guidance on how to improve options for safe and active travel to and from schools. The existing Cross-jurisdictional guidance on integrated transport planning for developments does not specifically provide advice on how to plan for, or improve safe active travel options in relation to school travel. It is recognised that improving safe active travel to school and encouraging increased use of these options has a range of benefits, including:

- Safer journeys
- Better network outcomes
- Healthier and more connected communities
- Reduced transport emissions

Conference theme
The presentation addresses the theme of *Evolution*. It recognises that to achieve road safety outcomes for school travel our focus and practice must evolve beyond the proximity of the school gate and address the whole journey to school. This requires a precinct approach to managing road safety. It also requires an evolved understanding of safe system; that road safety outcomes are inter-related with increasing active travel to school; and that infrastructure treatments and safe speeds must be complemented with behavioural interventions and support programs to ensure sustained changes in school travel behaviours.

Project Overview
When considering the most appropriate solutions to enable safe and active travel to school, it is critical to consider the

user and the context. Historically, there has been a focus on individuals to make changes to their own travel behaviours; however, it is now recognised that the environment and transport infrastructure need to be conducive to safe and active travel before caregivers are comfortable letting their children travel independently.

This extends to facilitating safe speeds for cars, safer parking and drop-off zones, and ensuring public transport stops and stations are safely accessible, recognising that some school trips will be made by vehicle. Ensuring safe facilities for all modes of transport will have benefits for everyone.

Austroads will publish new Travel to School guidance in 2025. This guidance provides a consistent and integrated approach to improving safe and active travel to school. It includes best practice approaches for planning new schools and improving safe and active travel at existing schools. It addresses good governance and stakeholder interactions, as well as presenting clear methods to apply for local councils and other stakeholders involved in improving road safety and active travel to school.

The guidance has been developed over 18 months informed by a literature review, good practice approaches already underway and stakeholder engagement, which addressed the following:

- Review and identification of principles guiding travel to school outcomes
- Identification of existing good practice case studies of integrated actions that support road safety and active travel outcomes
- Extensive consultation with a range of stakeholders across transport and education sectors, including:
    - Local councils across Australia and New Zealand
    - Education departments from most jurisdictions from Aus/NZ
    - Cross-sector workshops in WA and Qld, including state agencies, advocacy groups (e.g., disability sector)
    - State transport agency and specialist practitioners (academics and practitioners delivering school travel programs)

Key themes from stakeholder consultation include the following points, which have informed practitioner advice in the Travel to School guidance:

- Need for genuine collaboration and engagement
- Limited funding and resources are often a constraint for delivery. Data helps to build a case.
- Safety concerns are limiting travel to school outcomes
- Improved infrastructure to facilitate safe, convenient and attractive travel to school
- Integrating infrastructure delivery with behaviour change programs

These themes have informed and shaped the Travel to School guidance, which has three inter-related objectives as shown in Figure 1.

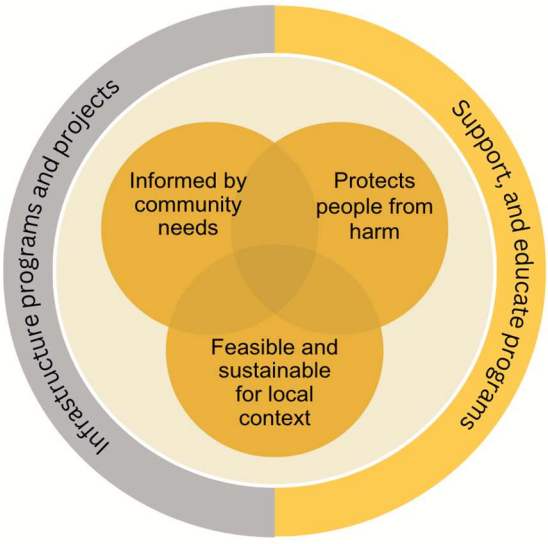


Figure 1: Integrated objectives of Travel to School guidance

The guidance itself covers best practice planning for new schools and managing changes in travel behaviour and improving road safety outcomes for existing schools across varied contexts, from urban and suburban primary schools, regional and remote schools and larger catchment secondary schools and private schools.

The guidance provides the following information and resources. It also references the good practice case studies identified earlier in this project.

- Good practice planning principles for new schools
    - Movement and Place and Safe System Principles
    - School catchment areas
    - School siting
    - School transport assessment and planning
- Cross-sector collaboration – stakeholders to involve in travel to school planning and management
- Good practice travel planning for existing schools
    - Community-informed methodology
    - Assessment of risks, barriers and opportunities
    - Identification of and scoping solutions (treatments, speed management, programs)
- Toolkit of initiatives
    - Active transport infrastructure requirements
        - Good practice intersection design
        - Good practice road crossings
        - Managing public transport access e.g., school buses
    - Supporting behaviour change and education initiatives
    - Monitoring and evaluation

Key recommendations from the guidance is that effective travel to school planning – to support road safety and active travel outcomes – must take an integrated approach. It cannot focus just on the school perimeter; it must focus on a precinct-level, considering a student's whole journey to school. Improvements need to combine road safety infrastructure treatments to reduce vehicle travel speeds and increase safety for students walking and riding to school. Safe speeds of 30km across the whole precinct are also best practice. Due to very high rates of car travel, effective programs must also introduce road safety and behaviour change programs to encourage mode shift towards active travel.

At time of writing the guidance is in final draft form, it is anticipated that the guidance will be published just prior to the conference. Exact date not yet confirmed.

Benefits to Road Safety

The guidance is grounded in Safe System principles and addresses an integrated approach to improving road safety outcomes for travel to school. These include specific guidance and resources for:

- Infrastructure treatments relevant to different contexts
- Safe speeds – referencing current standards across jurisdictions and recommended best-practice transition to safe speeds of 30km/h in school precincts
- Vehicle access and management (parking, drop-off/pick-up) – user-relevant information to guide decision-making for different school contexts, including approaches to reduce vehicle and vulnerable road user conflicts through separation and speed management; including park and walk options and drop-off/pick-up zones
- Behavioural education and support programs to help address social norms relating to driving and encourage safer driver behaviours, active travel interventions and road safety education for students

Resources are provided for different contexts and cover each of the integrated areas to improve safety and boost active travel.

Implications for policy and/or practice

This Cross-jurisdictional guidance fills a gap in implementing consistent best practice approaches for improving road safety outcomes for travel to school. Specific guidance on improving travel to school outcomes is an important resource for road and transport managers and other stakeholders seeking evidence and support to implement best practice changes for their school precincts. This is a significant step forward for Australia and New Zealand jurisdictions.

Understanding Aboriginal road crash fatalities in South Australia

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Abstract

Aboriginal and Torres Strait Islander people are overrepresented in road trauma. To improve road safety for these road users, it is important to understand the factors contributing to these crashes and their severity. This study investigated road fatalities involving Aboriginal road users in South Australia, based on Coroner's files from 2008-2018. Licensing history was also linked for fatally injured drivers/riders. Analysis of 57 fatalities from 46 crashes revealed that most fatalities occurred in rural areas, with the highest proportion in remote regions. The most common crash types were single vehicle and pedestrian. Key risk factors identified included unlicensed driving, non-seat belt use, and alcohol and drug use. While these issues are not unique to Aboriginal road users, they must be viewed within the broader context of systemic cultural and societal challenges. The findings inform initiatives and programs aimed at preventing road trauma and promoting equity for Aboriginal people.

Social media post

New research highlights Aboriginal people face higher rates of road trauma, especially in regional/remote areas. It's time for culturally informed, community-led road safety solutions.

Introduction

Aboriginal and Torres Strait Islanders are over-represented in road crashes. In South Australia (SA), they comprise 2.5% of the population but account for 5.3% of road deaths with a fatality rate that is 2-3 times greater than for non-Aboriginal people (BITRE, 2023a). To improve road safety for Aboriginal road users, it is important to understand the nature of crashes for this population, including the factors that contribute to their incidence and the severity of outcomes. However, a major challenge is the lack of crash data specifically relating to Aboriginal road users. Police-reported crash data in many Australian jurisdictions do not include the identification of Aboriginal people and this information is also lacking from licensing records (Cullen et al., 2020). An alternative source of information are Coroner's files which contain comprehensive, detailed information about the circumstances surrounding a fatal crash.

The aim of this research is to build a body of evidence regarding the factors contributing to fatalities involving Aboriginal road users in SA, considering the contribution of systemic factors including vehicle safety, road infrastructure and behavioural factors with consideration given to the cultural context that encompasses these issues. These insights will assist in improving road safety outcomes for Aboriginal people.

Conference theme

The findings from this research will benefit both Aboriginal people and the wider Australian community by identifying system gaps that future initiatives can address to prevent further road-related deaths and injuries among Aboriginal people. This study promotes equity by highlighting the disproportionate impact of road trauma on Aboriginal people. By identifying key risk factors, this research advocates for fair treatment of Aboriginal road users. Acknowledging the broader systemic and cultural challenges they face ensures that safety measures are both fair and tailored to their unique needs, promoting dignity and equality.

Method

All deaths resulting from road crashes in South Australia are legally required to be reported to the state Coroner for investigation. Road crash fatalities involving Aboriginal road users in SA, as identified in closed Coroner's files for the years 2008 to 2018, were examined. Aboriginal status was determined by information in the Coroner's files including the 'Report of Death' document, the forensic autopsy and interviews with crash participants and family members. In some cases, insufficient information was available to make this determination, so it is likely that the proportion of Aboriginal road users is an underestimate. To examine the context of the fatality, the following circumstances and characteristics were examined: road user type and demographics, seat belt use, substance use, location of crash, crash type, road characteristics, and vehicle characteristics. Licensing status and history, including previous traffic offences and crashes, was also linked for fatally injured drivers and riders. There was active Aboriginal oversight of this project at all stages and ethical approval was obtained from the University of Adelaide Human Research Ethics Committee.

Results

Road user characteristics

A total of 57 Aboriginal road user fatalities were identified resulting from 46 road crashes in SA. Table 1 shows the age, sex, and road user type of fatally injured Aboriginal people. The majority of fatalities (72%) were male road users. Female fatalities tended to be passengers and pedestrians. Around 19% of fatalities were children aged under 16 years who were mainly passengers or pedestrians. Almost 39% of fatalities were passengers and 30% were pedestrians. Most fatalities were rural residents (remote 58.9%, n=33; regional 17.5%, n=10).

Seat belt wearing rates were low, with just over one third of fatalities wearing a seat belt (35.1%, n=13/37), and declined with remoteness. In metropolitan Adelaide, half (n=2) of the fatalities were restrained, 40% (n=2) in regional areas and 32.1% (n=9) in remote areas. Of the driver/rider fatalities, 52.9% (n=9/17) were unlicensed. The majority of unlicensed driver/rider fatalities lived in rural SA (66.7%, n=6)

High levels of intoxication were evident among most road user groups. Of the drivers/riders (excluding pedestrians, passengers) with a known Blood Alcohol Concentration (BAC), 70.6% had a BAC over 0.05 and 58.8% had a BAC over 0.15. Of the drivers/riders (excluding pedestrians, passengers) with a known drug test result, 41.2% were positive, with THC the only drug detected. Eight road users (15%) were positive for alcohol and THC.

Table 1. Age, sex, and road user type for Aboriginal fatalities in South Australia, 2008-2018

Age group (years)	Driver		Passenger		Pedestrian		Rider	Cyclist	Total
	Female	Male	Female	Male	Female	Male	Male	Male	
0-15	-	1	3	3	1	3	-	-	11 (19.3%)
16-25	-	-	-	6	-	1	1	-	8 (14.0%)
26-39	1	3	2	1	3	4	1	-	15 (26.3%)
40-49	1	7	2	-	1	3	-	-	14 (24.6%)
50-59	-	2	1	3	1	-	-	1	8 (14.0%)
60+	-	-	-	1	-	-	-	-	1 (1.8%)
Total	2	13	8	14	6	11	2	1	57
	15 (26.3%)		22 (38.6%)		17 (29.8%)		2 (3.5%)	1 (1.8%)	

Crash and road characteristics

Of the 46 crashes, 75% (n=33) were in rural areas with the majority of crashes (59%, n=24) occurring in remote areas. Crashes in remote areas tended to have more passengers in the vehicle at the time of the crash than those in regional and metropolitan areas. Half of the fatal crashes in remote areas occurred on unsealed roads. Most crashes occurred from 3pm to 10pm (65.2%, n=30) with some regional/remote crashes in the early hours of the morning. Almost 60% of crashes occurred from Friday to Sunday.

Single vehicle crashes were the most common crash type (52.2%, n=24), occurring predominantly in remote areas (n=20) on highways (n=10) or unsealed local roads (n=9). Many of these crashes occurred on roads with unsealed/no shoulder, no edge line delineation or roadside barriers. Pedestrian crashes were the second most common crash type (37%, n=17) which occurred most frequently in the Adelaide metropolitan area (n=9), on arterial roads (n=8) and at night (n=12). In six cases, the pedestrian was lying on the road when they were struck. Alcohol use was an issue for pedestrians, with all adult pedestrian fatalities (n=13) recording a BAC from 0.14 to 0.59.

Vehicle characteristics

The majority (92.3%, n=36) of fatalities occurred in vehicles aged 11 years or more at the time of the crash, older vehicles that have fewer safety features. Eighteen vehicles were reported to be in reasonable mechanical condition and six vehicles were deemed to be in poor condition.

Discussion: Benefits to road safety

Drawing on the detailed evidence available in closed Coroner's files, it was possible to investigate the circumstances surrounding Aboriginal road crash fatalities and examine details that would not be recorded within traditional police-reported crash databases. It is noteworthy that 19% of fatalities were aged under 16 years, which is 3.5 times higher than the average proportion of road fatalities in this age group for SA (5.4%, BITRE, 2023b). Fatalities for younger people aged under 25 years, particularly children, primarily occurred as the passenger in a vehicle and as a pedestrian. Importantly, there were higher rates of Aboriginal pedestrian fatalities (30%) compared to those recorded in SA at that time (13.7%, BITRE, 2023b), consistent with findings from NSW for seriously injured pedestrians (Falster et al., 2013).

Some of the key gaps identified in the road transport system for fatally injured Aboriginal road users included licensing, lack of seat belt use, and alcohol and other drug use, all of which are shaped by and occur, primarily, against a background of remoteness. Around 43% of Aboriginal people in SA live in regional/remote areas, however 75% of Aboriginal road fatalities occurred in these areas (the majority in remote areas 59%). Living in regional/remote areas is associated with additional road safety challenges (e.g., long distance travel, low quality roads and infrastructure, high-speed roads, delays in emergency medical care) and transport disadvantage (Wundersitz et al., 2019). Limited or no access to public transport, services and cultural activities can lead to social exclusion and unsafe driving decisions (i.e., alcohol and drug use, unlicensed driving, failure to wear seat belt) that can increase the risk of crashing and the severity of injuries. These findings are consistent with those from other Australian jurisdictions (e.g., Edmonston et al., 2020; Pammer et al., 2020).

Of concern, more than half of the fatally injured drivers (n=9/17) were unlicensed and they were primarily from rural SA. More than half of the unlicensed drivers (n=5) had never previously held a licence and the remainder had not renewed their licence. There are significant barriers to obtaining and maintaining a licence and many Australian jurisdictions have implemented programs to address this issue. In SA, the On the Right Track (OTRT) service was introduced in 2015 to assist Aboriginal people to obtain and retain their driver's licence. Due to small numbers, no meaningful analysis was possible to determine the impact of OTRT on licensing.

Increasing seat belt use remains an important focus to improve Aboriginal road safety. More than half (62%) of the fatally injured vehicle occupants (drivers and passengers) were not using a seat belt at the time of the crash. There were also cases involving incorrectly installed child restraints and children not using appropriate restraints. The availability of child restraints is limited in remote areas and the cost to purchase can be up to three times more in remote communities (Pammer et al., 2021). The OTRT program also addresses seat belt use. As of July 2021, OTRT had provided over 1,000 child restraints to Aboriginal people in regional/remote areas.

Very high levels of alcohol intoxication were observed for fatally injured road users. All adult pedestrians had a BAC of 0.14 or greater. Of the drivers and riders (excluding pedestrians, passengers) who were tested, 71% had a BAC over 0.05 and 41% were positive for THC. While these levels are higher than what has been observed for all road crash fatalities in SA, they counter other findings reporting drug use is more prevalent than alcohol in crash-involved drivers (Baldock, 2023). A review of the harmful use of alcohol among Aboriginal people found that the use of alcohol can be partly explained by historical and societal factors including "educational attainment, employment status, access to capital resources, social organisation and societal mechanisms of inclusion and exclusion" (Wilson et al., 2010: p.7).

Implications for policy and/or practice

Aboriginal road users, particularly in regional/remote areas, may experience disparities in road infrastructure, vehicle safety, and access to transport. This research highlights the higher rates of road fatalities within this population, revealing systemic inequities in the resources and support available to them. It emphasises the need for policies, education, and initiatives tailored to their specific circumstances, ensuring equitable treatment in road safety efforts. Such initiatives must be culturally appropriate, evidence-based, and involve community participation in both program development and implementation.

Conclusions

The risk factors identified are not unique to Aboriginal people and are widely acknowledged as increasing the risk of crashes for all road users. To properly recognise how these factors contribute to the risk for Aboriginal people, consideration must be given to the historic, cultural, and social background against which these occur. Many of these crashes also transpire within the context of remoteness, which brings many additional challenges. These findings will inform initiatives and programs to prevent future road trauma among Aboriginal road users on Australian roads.

References

Baldock, M. (2023). Characteristics of crash-involved drink and drug car drivers and motorcyclists. Traffic Injury Prevention, 24, 7-13.

Cullen, P., Hunter, K., Clapham, K., Senserrick, T., Rogers, K., Harrison, J.E., & Ivers, R. (2020). Road user behaviour, attitudes and crashes: a survey of Aboriginal and Torres Strait Islander people in Australia. Injury Prevention, 26, 123-128.

Bureau of Infrastructure, Transport, and Regional Economics (BITRE, 2023a). First Nations Peoples Road deaths in Australia 2012-2021 BITRE. https://www.bitre.gov.au/publications/2023/first-nations-peoples-road-deaths

Bureau of Infrastructure, Transport, and Regional Economics (BITRE, 2023b). Road trauma Australia, 2022 statistical summary. BITRE. https://www.bitre.gov.au/publications/ongoing/road_deaths_australia_annual_summaries

Edmonston, C., Siskind, V., & Sheehan, M. (2020). Understanding the roles of remoteness and Indigenous status in rural and remote road trauma in North Queensland: Using a mixed-methods approach. International Journal of Environmental Research and Public Health, 17, 1467.

Falster, M., Randall, D., Ivers, R, & Lujic, S. (2013) Disentangling the impacts of geography and Aboriginality on serious road transport injuries in NSW. Accident Analysis and Prevention, 54: 32-8.

Pammer, K., Freire, M., Gauld, C., & Towney, N. (2021). Keeping safe on Australian roads: Overview of key determinants of risky driving, passenger injury, and fatalities for Indigenous populations. International Journal of Environmental Research and Public Health, 18, 2446.

Wilson, M., Stearne, A., Gray, D., & Sherry, S. (2010). The harmful use of alcohol amongst Indigenous Australians. http://www.healthinfonet.ecu.edu.au/alcoholuse_review

Wundersitz, L. N., Palamara, P., Brameld, K., Raftery, S. J., Govorko, M., & Thompson, J. P. (2019). National View on Regional and Remote Road Safety (AP-R603-19). Sydney: Austroads.

Distractibility of in-vehicle infotainment systems: a methodological protocol measuring distraction

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Abstract
Driver distraction is recognised as a leading cause of road-related injuries and fatalities. Driving is a complex task, with distraction identified as a main contributing factor in 16% of serious crashes. Given the increasing availability of consumer technology within the vehicle, including in-vehicle infotainment systems (IVISs), the potential for distraction and resultant collisions is likely to increase over the next decade. Currently the IVIS is not considered within a vehicle's ANCAP safety rating, despite its increasing involvement in crashes. There are currently no recognised standards to quantify the level of distraction of an IVIS. This paper presents a summary of the methodology used, drawing data from 12 different IVIS systems, to develop a series of tools to calculate the level of distraction of an IVIS. We present for other researchers and practitioners, a methodological protocol, with learnings from this standard to be implemented in future distraction research and practice.

Social media post
Researchers from University of Newcastle present the development of a methodology to calculate #DriverDistraction from #IVIS

Introduction
Driver distraction is a significant challenge for road safety, resulting in a high number of crashes and fatalities (e.g., Young & Regan, 2007), and secondary tasks have been identified as the most common distraction activities by road users (68.7%) (McEvoy et al., 2006). Research has demonstrated that drivers spend between 30%-40% of their driving time engaged in secondary tasks (Metz et al., 2014). Commensurate with the increase in driver distraction crashes and fatalities, is the development of increasingly sophisticated in-car entertainment system (infotainment systems), where the driver can engage in a range of entertainment and operational tasks. The increasing sophistication of infotainment systems means that the driver has access to a range of information, with increasingly complex components, requiring a range of complex multi-modal interactions. While a vast amount of useful information is now – literally - at the driver's fingertips, the increasing amount of information available, coupled with a need to place more information into increasingly smaller devices, has resulted in a driver that is vulnerable to a high degree of in-car distraction (Crundall et al., 2016). Such visual distraction can lead to task-neglect, impaired hazard detection and frequent, and long off-road glances (Liang & Lee 2010), dramatically increasing the driver's risk of a crash.

As drivers, we have limited attentional resources. Most of our attention is devoted to monitoring the driving environment and operating the vehicle. When a driver engages in a secondary task, the attention required to engage in that task, draws attention away from driving the vehicle, resulting in a deterioration in driving performance (Choudhary & Velaga, 2017). The distraction associated with interacting with an infotainment system, is therefore a combination of eyes-off-road visual distraction, an increase in cognitive load as interacting with the infotainment system stretches limited cognitive resources, and manual distraction from physically interacting with the system (Strayer et al., 2011).

The ingenuity of car designers and consumer demand means infotainment distraction will continue to be ubiquitous in new cars. Therefore, the aim of the current project is to develop a distraction rating system for infotainment systems in vehicles. The outcome is to provide guiding metrics for vehicle manufacturers to produce safer vehicles, and to allow consumers to make safer purchases (Imberger et al., 2020).

Methodology Overview

Participants
Twenty participants (15 male) were recruited by social media posts and convenience sampling. All participants had normal or corrected-to-normal vision. All participants held a current Australian driver's license and drove their car more

than once a week. All participants were familiarised with the IVIS system in their test car before testing; most being naïve to the system they were using.

IVIS Task Interactions

Participants completed a series of seven IVIS tasks (initiate a call, receive a call, send a text message, receive a text message, tune the radio, navigation, and play a song from a playlist). The IVIS task interactions were based on previous research studies (Strayer et al., 2017); and confirmed by an online survey of drivers' IVIS interactions.

IVIS/Vehicles

We tested 12 IVISs/vehicles. The vehicles were from a range of car categories (4WD/Ute, European, electric vehicle, SUV etc.). All were able to complete at least four of the seven IVIS tasks. All participants completed all activities in the same 'baseline' car, and then two of the additional 11 vehicles.

Materials and Procedure

Stage 1: Track Drive ('Gold' methodology)

Participants drove a range of cars on-road while engaging with the infotainment system. Distractibility was evaluated using high-fidelity 'Gold' standard measures including cognitive load (Detection Response Task) and eye tracking. This extensive dataset presents an ecologically-valid assessment of driver distraction and can then be modelled using advanced statistical modelling techniques to provide end-users with a reliable tool to quantify the IVIS' distractibility. All vehicles were fitted with cameras to record their IVIS interactions and drivers wore Tobii Pro Glasses to record eye movements. The driving task was completed on a 4.2 kilometre long, 7.6 metre wide, closed oval circuit at the Australian Automotive Research Centre in Wensleydale, Victoria, Australia. Vehicles were fitted with VBox and Oxford testing kits, to record objective driving performance measures (e.g., speed, braking, acceleration, and GPS).

Stage 2: Stationary Testing ('Silver' methodology)

Stage 2 used a once-removed level of fidelity; our 'Silver' level method in which participants completed the same IVIS tasks in the same vehicles, using proxies for driving (visual occlusion and tracking tasks) while sitting in a stationary vehicle. The purpose of this was to provide simulation tasks could be used as a reasonable correlates of on-road driving, but without the operator driving the vehicle.

Visual Occlusion Task (VOT): For the VOT, participants wear visual occlusion goggles, a head mounted unit, similar to ski goggles, with variable-transmittance lenses that alternate between open (transparent lens) and closed (opaque lens). Participants opened the lenses by pressing a small micro-switch, strapped around their right index finger.
Detection Response and Tracking Task: The Tracking task (see Figure 1) is a bespoke cognitive task that induces cognitive workload as a surrogate for the demands of on-road driving. This task demonstrates a similar level of distraction, without end-users needing to drive cars on a test-tack. Participants control a needle using a keyboard which they attempt to line up with a target line that 'tracks' left and right across a computer screen, changing directions at random intervals. The task requires both visuo-spatial awareness and motor control to perform; incorporates a visual detection response task to measure residual workload, and produces both reaction time and error-state outcome measures.

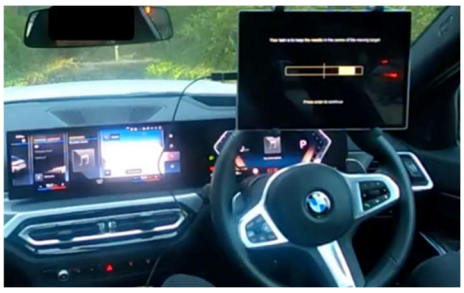


Figure 1. Configuration of tracking task as completed in the stationary testing sessions

Stage 3: ('Bronze' methodology)

Drawing on the data collected in Stages 1 and 2, the third outcome is our 'Bronze' level methodology. It assesses the individual components of different IVIS (e.g., touch-screen, dial, number of steps etc.) to determine their relative contribution to the overall distractibility rating of an IVIS. This method draws on Human Factors methodologies allowing operator load scores to be derived as a measure of driver distractibility for each IVIS and task, across touchscreen, centre stack and voice recognition. This is a twice-removed fidelity phase in which statistical modelling links the features of the IVIS systems to distractibility measures.

Preliminary Outcomes

Full outcomes for this project are in development, and so preliminary findings are presented here. All statistical estimation and inference used multi-level model that includes random effects for drivers crossed with fixed effects for IVIS task type and IVIS.

Using the extensive dataset consisting of cognitive workload, eye-gaze behaviour, and driving performance advance statistical modelling has quantified the distractibility of each IVIS. Higher cognitive workload and more frequent off-road glances are associated with more distractible systems. An example heat map of gaze behaviours while completing a task appears in Figure 2, showing the areas that draw attention relate to the road-ahead, speed and eye-line IVIS view, as well as the centre-console IVIS screen.



Figure 2. Heat map produced of driver's eye movements and gaze behaviours while performing a series of tasks

We have found a clear link between our gold-standard experiment and the silver-standard experiment, demonstrating that a cost-effective non-driving task can be used as a proxy for assessing driver distraction when using IVIS, providing support for the methodology as a valid measure of distraction.

It was consistently observed that the lowest operator loads involved voice recognition systems, hence greater availability of these systems may help to decrease distraction and thereby improve road safety. However, a key component to this decreased operator load is the menu complexity of the system; those with more complex systems increase the operator load and therefore increase the level of potential distraction.

Conference Theme

This paper contributes to the Conference Theme: Evolution; exploring the development and implementation of safe systems, including past approaches, future challenges and insights into components, measures and human factors. We have developed and tested three IVIS assessment methods; allowing end users to scale-up the modelling approach to determine the level of intractability of their system.

Implications for Policy and Practice

This has implications for practitioners and researchers, as well as the further expansion of policy to consider the distractibility of a vehicles IVIS. The overall outcome of this project is a technique where a single non-experienced operator can conduct a simple evaluation on any current or emerging vehicle to determine the potential distractibility of the human-machine interface.

References

Choudhary, P., & Velaga, N. R. (2017). Analysis of vehicle-based lateral performance measures during distracted driving due to phone use. *Transportation Research Part F: Traffic Psychology and Behaviour, 44*, 120-133. https://doi.org/10.1016/j.trf.2016.11.002

Crundall, E., Large, D. R., & Burnett, G. (2016). A driving simulator study to explore the effects of text size on the visual demand of in-vehicle displays. *Displays, 43,* 23-29. https://doi.org/10.1016/j.displa.2016.05.003

Imberger, K., Poulter, C., Regan, M. A., Cunningham, M. L., & Paine, M. (2020). Considerations for the development of a driver distraction safety rating system for new vehicles. *Journal of Road Safety, 31*(2), 23-34. https://doi.org/10.3316/INFORMIT.331201082740957

Liang, Y., & Lee, J. D. (2010). Combining cognitive and visual distraction: Less than the sum of its parts. *Accident Analysis & Prevention, 42*(3), 881-890. https://doi.org/10.1016/j.aap.2009.05.001

McEvoy, S. P., Stevenson, M. R., & Woodward, M. (2006). The impact of driver distraction on road safety: results from a representative survey in two Australian states. *Injury Prevention, 12*(4), 242-247. https://doi.org/10.1136/ip.2006.012336

Metz, B., Landau, A., & Just, M. (2014). Frequency of secondary tasks in driving–Results from naturalistic driving data. *Safety Science, 68*, 195-203. https://doi.org/10.1016/j.ssci.2014.04.002

Strayer, D. L., Watson, J. M., & Drews, F. A. (2011). Cognitive distraction while multitasking in the automobile. *Psychology of Learning and Motivation, 54*, 29-58. https://doi.org/10.1016/B978-0-12-385527-5.00002-4

Strayer, D. L., Cooper, J. M., Goethe, R. M., McCarty, M. M., Getty, D., & Biondi, F. (2017). Visual and cognitive demands of using in-vehicle infotainment systems. Retrieved from https://trid.trb.org/view/1486450

Young, K. & Regan, M. (2007). Driver distraction: A review of the literature. In: I.J. Faulks, M. Regan, M. Stevenson, J. Brown, A. Porter & J.D. Irwin (Eds.). *Distracted driving*. Sydney, NSW: Australasian College of Road Safety. Pages 379-405.

Performance evaluation of safety roller barriers made of recycled rubber

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Abstract

The Safety Roller Barrier (SRB) system, which employs rollers made of Ethylene-Vinyl Acetate (EVA) foam, has been proven to enhance road safety significantly over traditional barriers in crash incidents. Despite its advantages, the high cost of EVA rollers hinders its widespread adoption. This study introduces a cost-effective alternative by using a foam made from recycled rubbers. A sophisticated numerical crash model was constructed in accordance with the Manual for Assessment of Safety Hardware (MASH) to mimic the crash response of vehicles into the modified SRB system. Quasi-statical and dynamic mechanical properties of the constructing materials were experimentally obtained for finite element simulation using ANSYS/LS-DYNA. The results showed that the modified SRB has comparable performance with the existing system, which will promote the wider adoption of SRB system and, therefore, reduce the fatalities and serious injuries in run-off-road vehicle impacts.

Social media post

Introducing a significant advancement in road safety technology: a cost-effective Safety Roller Barrier (SRB) system using recycled rubber foams, which may achieve equivalent safety performance to commercial ones with significantly reduced costs.

Introduction

Australia has set ambitious targets within its National Road Safety Strategy 2021-2030, aiming to reduce fatalities by at least 50% and serious injuries by at least 30% in road accidents by 2030, and zero road deaths and serious injuries by 2050 (Infrastructure and Transport Ministers, 2021). Recent reports indicate significant challenges in meeting these objectives, as the current fatality rate is continuously increasing since 2021, and hospitalised injuries are on rise (BITRE, 2021). This situation calls for an urgent need to reevaluate traditional safety measures such as wire barriers, W-beams, and concrete barriers, which are useful but have limitations. For instance, W-beams can absorb crash energy through rail deformation but may also cause vehicle snagging, rollovers, or crossovers due to excessive deformation, and often require extensive maintenance or replacement after collisions. In contrast, the past decade has seen the rise of innovative safety roller barriers (SRB) systems, which use posts covered with polymer foam rollers to effectively absorb shock energy and direct vehicles gliding along the road, reducing the risk of severe accidents. For example, the Laverton section, equipped with SRB (Figure. 1), has experienced numerous impacts over more than eight years without a single reported death or serious injury (VicRoads Crash Data), and remarkably, has received no maintenance or replacement.



Figure 1. SRB installed at High St. Laverton, Victoria

Original SRB uses Ethylene-Vinyl Acetate (EVA) foam material for the rollers. This material has many advantages such as durability and UV resistance. However, the high cost of the EVA foam roller is the main obstacle for its widespread adoption. Lowering the cost may greatly facilitate its rate of deployment on roads in Australia and overseas, thereby helping Australia to achieve the road safety targets and save lives in road accidents. Recycled ground tyre rubber (GTR) has been applied for road safety applications (Monteiro et al., 2022; Sánchez-Lozano & Abellán-López, 2022), which is a good choice for not only reducing the cost, but also improve sustainability. Australia is currently recovering 77 per cent of used tyres. While this achievement is something to be proud of, recovering the remaining 23 per cent is critical to achieving national waste reduction goals, reducing carbon emissions, and preventing environmental hazards in the future (Ridley, 2024).

In this study, rollers made from a new compound foam blending EVA with GTR were introduced to the SRB design. The EVA/GTR compound foam is shown in Figure 2. To evaluate the effectiveness of the SRB constructed from this innovative material, a comprehensive comparison with the original SRB model was undertaken. Initial steps involved testing the material properties of each component under both quasi-static and dynamic conditions, which were assigned to the numerical models for simulations of SRB systems impacting with passenger cars and pickups in ANSYS/LS-DYNA. The simulation model is illustrated in Figure 3, showing a passenger car collision with a segment of the safety roller barrier.

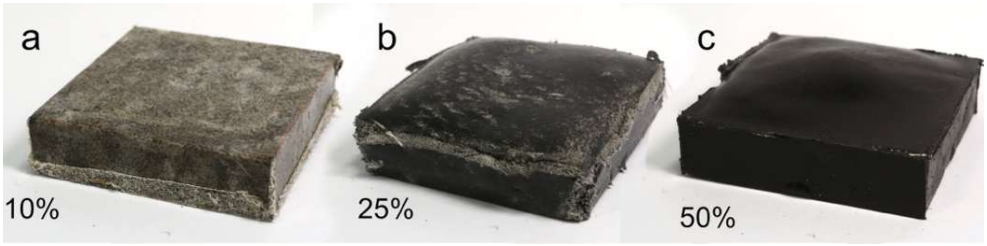
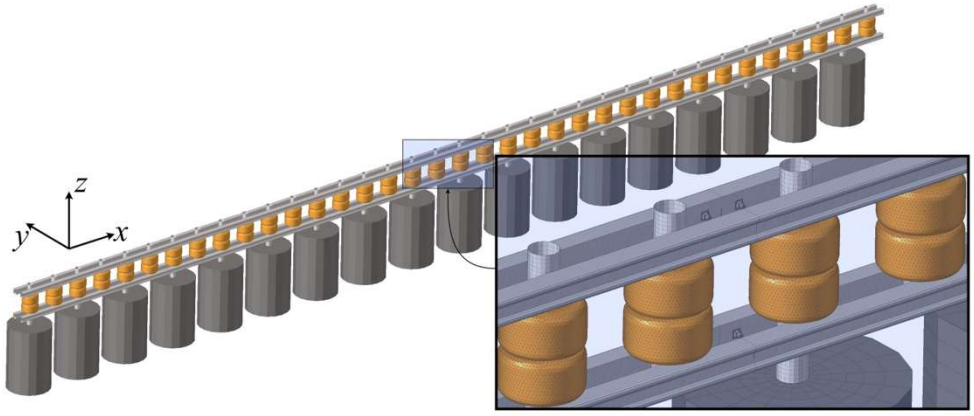
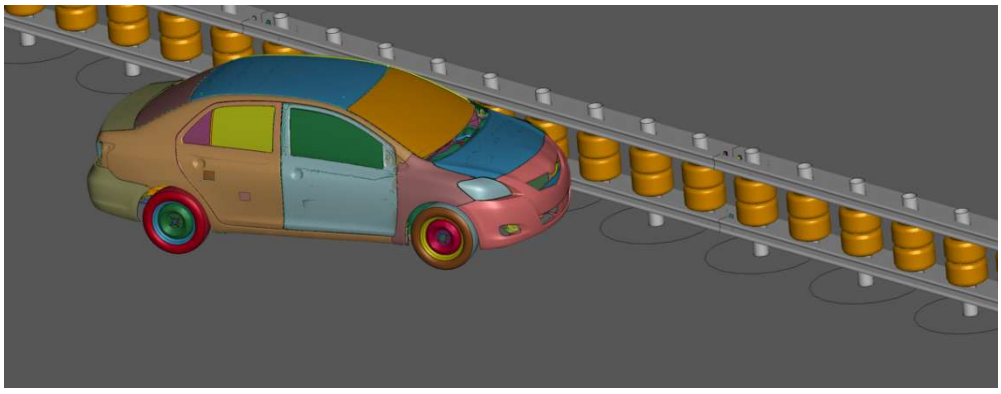


Figure 2. Photos from EVA/GTR compound foams with different GTR contents



(a)



(b)

Figure 3. Simulation model of (a) SRB barrier and (b) Toyota Yaris crashing into a segment of safety roller barrier.

The validity of the numerical model for the existing SRB was confirmed by comparing the impact characteristics with standard MASH tests carried out in Christchurch, New Zealand, in 2012. The validated model is used to identify the key occupant risk indices in the new SRB system, such as ridedown acceleration (RA) and occupant impact velocity (OIV), derived from the simulation results of the two SRB variants. This comparative analysis aimed to assess the performance of the new SRB, utilising the EVA/GTR compound foam, against the existing system.

The results listed in Table 1 indicated that the SRBs employing the EVA/GTR compound foams containing up to 50% recycled ground tyre rubber (rGTR) exhibited performance indices comparable to those of the existing SRBs. Key safety indices, including exit velocity, working width, occupant impact velocity (OIV) and ridedown (RA) acceleration, were well within the safety range defined in the standards AS/NZS 3845. This research highlights the potential of incorporating the EVA/GTR compound foam into SRB systems, promoting wider deployment of safety roller barrier system and significantly reduce fatalities and serious injuries in run-off-road impacts.

Table 1. The evaluation indexes of the crash simulations

Roller material	Original	10% rGTR	25% rGTR	50% rGTR
Exit velocity (km/h)	69.12	70.92	70.5	70.2
Exit angle (degree)	16.14	16.88	15.33	15.44
Working width (m)	0.154	0.154	0.153	0.156
OIV-x (m/s)	7.18	7.31	7.15	7.01
OIV-y (m/s)	8.79	8.38	8.52	8.55
RA-x (g)	6.35	5.72	6.43	5.38
RA-y (g)	8.74	10.31	8.36	9.09

References

Infrastructure and Transport Ministers. (2021). National Road Safety Strategy 2021-2030. *Commonwealth of Australia*, Canberra ACT

Bureau of Infrastructure, Transport and Regional Economics. (2021). Road Trauma Australia 2020 Statistical Summary. *Commonwealth of Australia*, Canberra ACT.

Monteiro, H., Ribeiro, I., Gonçalves, M., Iten, M., & Caetano, N. S. (2022). Life cycle energy and carbon analysis of a road-safety barrier produced using recycled tire rubber. *Energy Reports*, *8*, 270-276.

Sánchez-Lozano, M., & Abellán-López, D. (2022). Optimization of a motorcyclist protection system made of recycled rubber–impact simulation and test uncertainties. *International journal of crashworthiness*, *27*(4), 995-1008.

Ridley, R. (2024). *How to end tyre dumping for good in Australia.* TSA. https://www.tyrestewardship.org.au/news/how-to-end-tyre-dumping-for-good-in-australia/

Investigating the safety of raised platform markings

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Abstract

Pedestrians may confuse piano key markings on raised platforms for zebra crossings, creating the potential for negative interactions between drives and pedestrians. Main Roads Western Australia (MRWA) are exploring replacing piano key markings with shark's teeth markings on raised platforms. The current study aimed to determine if shark's teeth markings are superior to piano key markings for this purpose. Participants completed a computer task and a questionnaire. The computer task comprised of a loop sequence, showing images of relevant road infrastructure (shark's teeth and piano key markings, zebra and wombat crossings; and dummy images e.g., speed signs) and questions regarding road user behaviour. Participants had to answer the questions quickly with true or false. Results from both the computer task and the questionnaire suggest that piano key markings are more confusing than shark's teeth markings.

Social media post

Have you seen some new triangle markings at various intersections and wonder what they are used for? This project explains their purpose, and how they can help make our intersections safer for everyone.

Introduction

Raised platforms in Western Australia (WA) are traditionally used to warn drivers to slow down and are typically highlighted with a piano key marking (Figure 1). Due to their visual resemblance to zebra crossings, these markings may be misinterpreted by pedestrians as designated crossing points, potentially leading to unsafe interactions between vehicles and pedestrians.

One solution that has been suggested is to replace the piano key markings with 'shark's teeth' markings (Figure 2). However, there is concern about the comprehensibility and safety performance of shark's teeth markings for both drivers and pedestrians, as no prior research has investigated these newly introduced markings. As a result, Main Roads Western Australia (MRWA) commissioned the Western Australian Centre for Road Safety Research (WACRSR) to investigate whether there is any safety advantage for shark's teeth road markings on raised platforms relative to piano key markings.

This research aims to determine whether the visual similarity of piano key road markings to traditional zebra crossings leads to confusion among pedestrians and drivers regarding their primary function—which is to prompt drivers to slow down, rather than to serve as pedestrian crossings. The current study created a computer-based task to assess both pedestrians' and drivers' comprehension of piano key markings compared to shark's teeth markings. This computer task has been adapted from previous successful studies looking at comprehensibility of lane closure signages (Boddington et al., 2014), and overtaking legality in wide centre line treatments (Goodsell & Roberts, 2018).



Figure 1. Piano Key marking on raised platform



Figure 2. Shark's Teeth marking at intersection

Conference Theme

Equity – By collecting the perspectives of both pedestrians and drivers, we recognise that both pedestrians and drivers play equally important roles in informing our road design choices to improve safety.

Evolution – The introduction and development of these more comprehensible road markings aim to enhance understanding among all road users. By clearly delineating spaces for vehicles and pedestrians, these markings are expected to reduce potential conflicts and increase overall safety, thus evolving our road spaces for all users.

Method

Experiment

The stimuli selected consisted of 12 raised platforms with shark's teeth road markings, 12 raised platforms with piano key markings, 12 wombat or zebra crossings (6 images of each) and 12 'dummy' images such as zigzag lines or speed limit signs. There were an equal number of questions where the answer was true, and the answer was false across the image categories.

The task comprised of a loop sequence as follows with accuracy and reaction time recorded:

Step 1 Participants are presented with a statement relevant to the subsequent road marking image. E.g., 'Drivers are expected to slow down here'.
Step 2 A red fixation dot is presented for gaze control.
Step 3 Blank screen.
Step 4 Image is presented (one of four stimuli: shark's teeth, piano key marking, wombat or zebra crossing, or dummy image is shown) for 400ms.
Step 5 Blank screen.
Step 6 Participants are asked to key in their response (true/yes or false/no) as quickly as they can. Loop sequence is repeated.

Questionnaire

Participants completed the questionnaire via Qualtrics. It consisted of 75 questions in total, divided into nine blocks of questions. The first block of questions were demographic questions relating to age, gender, occupation and driving experience. In blocks Two to Five, participants had to take the perspective of a pedestrian. In each block, participants were presented with a shark's teeth, piano key, a wombat crossing and zebra crossing image and asked questions about their comprehension of the markings as well as questions relating to expected driver and pedestrian behaviour and safety and the legality of those behaviours. In blocks Six to Nine, the same questions and images were repeated, but participants were asked to answer from the perspective of a driver instead. At the end of each block, participants could also include additional comments or opinions about the road infrastructures mentioned.

Results

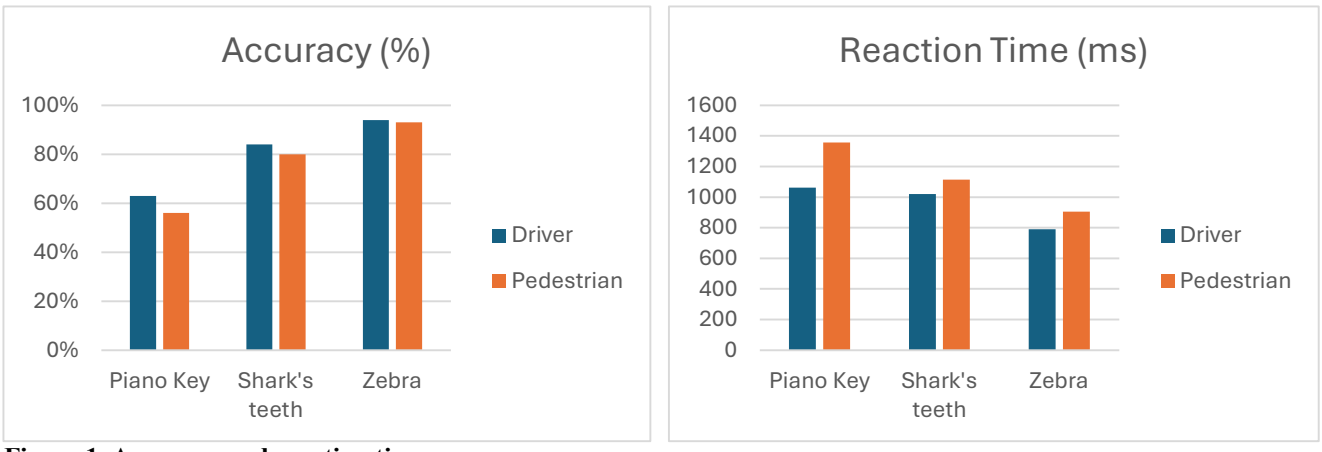


Figure 1. Accuracy and reaction time

A Related-Samples Friedman's Analysis of Variance by Ranks for accuracy was significant ($p < .001$) and all pairwise comparisons were significant ($p < .001$) using Bonferroni correction for multiple comparisons. Both shark's teeth markings and piano key markings created more response errors than zebra crossings, but the shark's teeth marking error rate was significantly less than the piano key error rate.

Analysis of variance for reaction time (RT) produced a main effect of infrastructure type; $F(3,66) = 15.55$, $p < .001$, showing that RT differed between infrastructure types. There was no interaction with Perspective ($p > .1$), showing that there was no differential effect on RT from taking the driver versus pedestrian perspective. All pairwise comparisons were significant ($p < .01$) using Bonferroni correction for multiple comparisons. Both shark's teeth markings and piano key markings were responded to more slowly than zebra crossings, but the shark's teeth reaction time was significantly faster than the piano key reaction time.

Questionnaire

Pedestrian Perspective questions	Driver Perspective Questions
1. How likely are you to use this as a pedestrian crossing?	7. How likely are you to reduce your speed when you see this?
2. Do you feel safe crossing here?	8. How likely is it that other drivers will reduce their speed when they see this?
3. How likely is it that other pedestrians will use this as a pedestrian crossing?	9. How likely is it that pedestrians will use this as a crossing?
4. Do you think it is legal to cross here?	10. How likely are you to stop and give way to pedestrians when you see this?
5. How likely is it that drivers will give way to you here?	11. How likely is it that other drivers will stop and give way to pedestrians when they see this?
6. How likely is it that drivers will stop to let you cross here?	12. How safe is it for pedestrians to cross here?
	13. Do you think it is legal for pedestrians to cross here?

For questions 1 to 6, Related-Samples Friedman's Analysis of Variance by Ranks were significant ($p <0.01$). For questions 1, 2, 5 and 6, pairwise comparisons were significant ($p < .05$) using Bonferroni correction for multiple comparisons. However, for questions 3 and 4, pairwise comparisons showed that there was no difference between Shark's teeth and Piano key, but those between Shark's teeth and Zebra crossing and Piano key and Zebra crossing were significant ($p < .001$), using Bonferroni correction for multiple comparisons.

For questions 7 and 8, no pairwise comparisons were significant ($p>0.01$). For question 9, a Related-Samples Friedman's Analysis of Variance by Ranks was significant ($p < .001$) and all pairwise comparisons were significant ($p < .01$) using Bonferroni correction for multiple comparisons. For questions 10, 11, 12 and 13, a Related-Samples Friedman's Analysis of Variance by Ranks was significant ($p < .01$). Pairwise comparisons showed that there was no difference between Shark's teeth and Piano key, but those between Shark's teeth and Zebra crossing and Piano key and Zebra crossing were significant ($p < .001$), using Bonferroni correction for multiple comparisons.

Conclusion

Both the experimental and questionnaire results show that piano key markings are more confusing than shark's teeth markings. While participants quickly and accurately identified zebra crossings, shark's teeth and piano key markings were responded to correctly less often and more slowly. However, shark's teeth markings were superior to piano key markings in terms of speed and accuracy, suggesting that in the real world, shark's teeth markings will elicit less confusion. This interpretation is further supported by the questionnaire results. Importantly, when asked to take a pedestrian's perspective, participants were significantly more likely to be willing to use a piano key marking as a pedestrian crossing, to feel safer doing so, and be more likely to think that drivers would give way to them compared to a shark's teeth marking. However, when asked to take a driver's perspective, even though participants thought it was more likely that pedestrians would use a piano key marking as a crossing, they were no more likely to be willing to give way to pedestrians at a piano key marking than a shark's teeth marking.

References

Boddington, K., Roberts, P. & Ralston, K. (2014) *Kwinana Freeway ALR Sign Comprehension Study*. Contract Report for MRWA, ARRB Group Ltd.

Goodsell, R. & Roberts, P. (2018) *WCLT Comprehension Study*. Contract Report for MRWA, ARRB Group Ltd.

Piloting the Safe System Crash Investigation Program

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Abstract
The Transport Accident Commission has been working with Victorian road safety partners to develop and deliver in-depth crash investigation program. Development commenced in 2020, while crash investigations on local government roads have been underway since early 2024. The pilot program was informed by international best practice and involved the development of a collaborative process focusing on the collection of a comprehensive in-depth dataset. The process currently being refined enables the presentation and discussion of crashes in a truly Safe System context. Over 1,000 individual variables are acquired across the Safe System cornerstones encompassing data collected from Victorian administrative systems, vehicle and site inspections, and comprehensive photography. Complementing this, case panels aim to synthesise the collected data to give attendees a balanced picture of each crash and therefore facilitate discussions aimed at fostering a better understanding of Safe System best practice.

Social media post
Crash investigations often focus on human error and road deficiencies. The TAC, working with Victorian road safety partners, has piloted a fatal crash investigation program on local roads that incorporates the Safe System to improve understanding of road safety issues.

Background
The Safe System underpins Victoria's Road Safety Strategy 2021-2030, providing a framework to enable the successful attainment of Victoria's 2030 and 2050 trauma reduction targets. The Safe System approach is recommended by the World Health Organization (WHO), which has called on governments "to prioritise and implement an integrated Safe System approach that squarely positions road safety as a key driver of sustainable development." (WHO, 2025).

This scientific and evidence-based approach includes mechanisms for achieving zero road deaths and serious injuries and involves all elements of the road transport system. That is, the road environment, vehicles, travel speeds, and road user behaviour work together to either prevent fatal and serious injury crashes or limit crash forces reduce the severity of injury. Despite this clear prioritisation of the Safe System there are gaps between the theory and its application (Green et al., 2024; Woolley et al., 2018).

Conference theme
Evolution: The work being undertaken focusses on addressing identified gaps for practitioners understanding of Safe System. The work adopts existing programs to a Victorian specific context and will present the process undertaken to achieve and test this translation and application.

Overview
At present in Victoria only a limited number of crashes are investigated in-depth. Victoria Police investigates selected fatal crashes with a focus on prosecution while the Department of Transport and Planning (DTP) investigates fatal crashes that have occurred solely on state managed roads, with in-depth investigations only being undertaken in cases where infrastructure is noted as a contributing factor.

In response to this, the TAC – in collaboration with Victoria Police, DTP and Department of Justice and Community Services (DJCS), has established the Safe System Crash Investigation Program (SSCIP). The SSCIP pilot investigates fatal crashes that have occurred on local government roads and mirrors successful best practice models aiming to:

- Examine what is involved in, and the key requirements for, establishing an in-depth crash investigation program in Victoria.
- Understand how SSCIP could complement current crash investigation activities in Victoria.
- Understand the governance, data gathering and information sharing models that would support the delivery such a program.

- Investigate the benefits of establishing a prevention focused, 'no-blame' Safe System crash investigation of every road fatality in Victoria conducted by expert crash investigators.
    - Guide future opportunities for the Partnership to strengthen safety and better protect road users from fatal and serious injury crashes in Victoria.

The specific aims of the SSCIP pilot were to:

- Establish a crash data collection and review process to facilitate a better understanding of crashes, particularly regarding the management of force and energy on road users.
- Identify readily available data inputs available across the road safety partnership and identify any new data sources to enhance a Safe System crash investigation and review process. This will include identifying issues or barriers which limit the process currently.
- Establish a framework to:
    - report crash investigation findings.
    - review and document learnings with owners and influencers of the system

The primary outcome for the pilot will be to understand the potential benefits of such a program for Victoria. Given these programs focus on fatal crashes this has also been the primary focus of the SSCIP pilot. In the future this model may extend to serious injury crashes also.

Approach

Data collection

To establish what data should be collected, data elements for several crash investigation programs were reviewed – including programs from Australia, Sweden (SRA, 2005), the UK (Talbot et al., 2024), Finland (FMIC, 2002), and the USA (Dinh-Zarr et al., 2024). Data available to the TAC through existing arrangements with Victorian road safety partners then formed the 'Minimum Viable Dataset' (MVD).

The main data source supporting the MVD was collected by Victoria Police. Victoria Police collects data for every crash its members attend, with the collected data provided to TAC under existing data sharing agreements to support road safety in Victoria. Expert crash investigators collate and review this information before inspecting the crash site. The SSCIP team works with working group partners[2] and stakeholders, including representatives from the relevant Local Government Area in which the crash occurred, to arrange a visit to the location of the crash. The objective of the site visit is to obtain measurements and crash evidence.

Information sharing

Cases that have been investigated by crash investigators are presented at case panel meetings, which facilitate the:

- Identification of any local context or factors which may assist in the review of the crash.
- Discussion of crash contributing factors resulting in fatal injuries.
- Discussion of the gap between the current state of the road system at the crash site and a Safe System state that may have prevented the fatal injuries.
- Identification of potential Safe System countermeasures that may have prevented fatal injuries.

Case panel meetings include attendees from DTP, Victoria Police, DJCS, and representatives from the Local Government Area within which the crash occurred. Subject Matter Experts with backgrounds in crash investigation and reconstruction were also invited to attend and input to the pilot.

In addition to presenting crash information from the context of the Safe System, the case panel meetings also involve presentation of crash events using the Enhanced Crash Investigation Study (ECIS) Integrated Safety Chain (Fitzharris et al., 2022). The Integrated Safety Chain was originally developed by Claes Tingvall (2008) and represents a time-based conceptual model of the driving process, involving the sequence of phases from normal driving to having a crash, and consequently sustaining injuries. The Integrated Safety Chain helps to understand the 'why, where and how' of the driving process to allow intervention at the appropriate point in the chain to prevent crash occurrence or injury outcomes, preferably as early as possible in the chain. Figure 1 summarises the phases of the ECIS Integrated Safety Chain.

[2] The working group is made up of representatives from the TAC, Victoria Police, DTP and DJCS.



Figure 1. Summary of the stages of the ECIS Integrated Safety Chain (Fitzharris et al., 2022)

In addition to the Integrated Safety Chain the use of the concept of contributing factors was also adopted as a part of case panel presentations. A contributing factor is defined as, "Any circumstance that leads up to or affects the outcome of the crash event." A valid contributing factor is one that, if eliminated or removed, would have prevented the fatal injury from occurring. For each contributing factor, a level of confidence (based on available evidence) is assigned. As a part of the pilot the SSCIP team tested out using crash contributing factors as a way of describing and classifying failures that led up to the crash and loss of life. Each crash is classified under one or more of the following categories: Excessive force, Excessive risk, or Outside system boundaries, as shown in Figure 2.

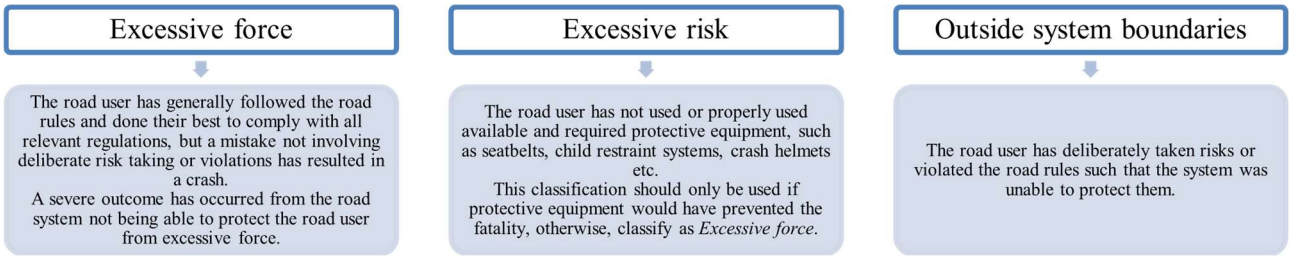


Figure 2. SSCIP Safe System Failure classification – adopted from Swedish fatal investigations process developed by STA (Whitelegg & Haq, 2006)

Conclusions

To date, 28 crashes that occurred on local roads, involving 30 fatally injured road users have been investigated during the SSCIP pilot, comprising 18 vehicle occupants, eight motorcyclists, one pedestrian and one cyclist. Two case panels meetings have convened, with four crashes presented. The pilot has demonstrated the robustness of the overall process for policy and practice.

The case panel meetings presented so far have generated productive conversations and feedback following the presentation. At the conclusion of the pilot, the program will be reviewed and assessed for its potential long-term benefits.

Acknowledgements

The authors of this paper would like to acknowledge the contributions of representatives of Road Safety partners who supported the pilot to date. These include representatives from Victoria Police (Ben Morris and Chris Hayes), Victorian Department of Transport and Planning (Luke Sherwell, Xin Li, Chris Jones and James Soo) and Department of Justice and Community Services (Pierre J Philippeau). The authors would also like to acknowledge the representatives of Local Government Areas who supported site investigation activities and attended case panel meetings.

References

Dinh-Zarr, T. B., Shuey, R., & Mooren, L. (2024). The Five "I" Framework of crash investigation: Linking investigation practices to safety reform. Accident Analysis & Prevention, 194, 107296. https://doi.org/10.1016/j.aap.2023.107296

Finnish Motor Insurers' Centre (2002). VALT Method 2003: Finnish Motor Insurers' Centre, Helsinki, 2002

Fitzharris, M.P., Corben, B., Lenné, M.G., Liu, S., Peiris, S., Pok Arundell, T., Stephens, A., Bowman, D.M., Morris, A., Tingvall, C., 2022. Enhanced Crash Investigation Study (ECIS): Report 3: Understanding contributing factors for serious injury crashes using crash chain analysis. MUARC Report 345, December 2022, Melbourne, Australia.

Green, M., Muir, C., & Oxley, J. (2024). What is the purpose? Practitioners' perspectives of the Safe System approach to road safety in Australia. IATSS Research, 48(1), 84-99. https://doi.org/10.1016/j.iatssr.2024.01.004

Swedish Road Administration (2005). In-depth studies of fatal accidents save lives, Swedish Road Administration Database of Publications

Talbot, R., Filtness, A., & Morris, A. (2024). Proposing a framework for evidence-based road safety policy-making: Connecting crash causation, countermeasures and policy. Accident Analysis & Prevention, 195, 107409. https://doi.org/10.1016/j.aap.2023.107409

Tingvall C. (2008). Distraction from the view of governmental policy making. Subsection of the chapter: Government and Industry Perspectives on Driver Distraction. In Regan, M. A., Lee, J. D., & Young, K. *Driver distraction: Theory, effects, and mitigation*. CRC press.

Whitelegg, J., & Haq, G. (2006). Vision Zero: Adopting a target of zero for road traffic fatalities and serious injuries: The Institute.

Woolley, J., Stokes, C., Turner, B., & Jurewicz, C. (2018). Towards Safe System Infrastructure: A Compendium of Current Knowledge (AP-R560-18). Retrieved from https://austroads.gov.au/publications/road-safety/ap-r560-18

World Health Organisation. (2025). Decade of Action for Road Safety 2021 - 2030. Retrieved from https://www.who.int/teams/social-determinants-of-health/safety-and-mobility/decade-of-action-for-road-safety-2021-2030

Inequity in protection levels of female and male motorcycle gear

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Abstract

MotoCAP is a valuable resource of scientifically measured protection and breathability performance of motorcycle protective clothing aimed at enhancing rider safety and potentially reducing injuries. Various types of protective gear were tested using standardised laboratory methods for impact abrasion resistance, burst strength, and impact protection, following the MotoCAP rating system to ensure consistent and credible assessment. Over six years, the program has revealed notable differences in the star ratings of protective clothing for male and female riders. Differences in protective performance between male and female gear were evaluated using one-way ANOVA statistical analysis. In the market, female riders have far fewer options for protective clothing compared to their male counterparts. The average level of protection offered by female-specific garments is lower than that of male gear. These findings highlight the need for female riders to be more cautious when selecting protective gear. They underscore the urgent necessity of improving the protection offered by female motorcycle gear. It is important for manufacturers to understand that female riders have limited protection and to implement changes that address this inequity.

Social media post

MotoCAP testing highlights the protection divide in motorcycle clothing with female riders sold gear that has, on average, less protection than their male counterparts. It is important that manufacturers understand that female riders are less protected, and changes are put in place to remove this inequity.

Introduction

Protective clothing plays a vital role in reducing injuries during a crash (de Rome, 2019). As safety awareness grows, consumer interest and the market for motorcycle protective clothing is expanding rapidly. With the increasing variety of products available, however, several important questions remain unanswered: Do all these products offer sufficient protection for riders? How can riders identify which products are effective in ensuring their safety? Given that riders cannot "try out" protective gear in real-world crash scenarios, there is a critical need for reliable methods to assess and compare the performance of these products before purchase.

To address these concerns, the Motorcycle Clothing Assessment Program – MotoCAP (MotoCAP, 2024) plays a pivotal role by providing independent, reliable, and scientifically validated information on the safety and comfort of motorcycle protective clothing. It employs a star rating system that evaluates clothing based on rigorous testing for protective capabilities and breathability. MotoCAP positively influences the market by ensuring credibility for manufacturers and providing valuable insights for the development of standards and policies (Yu et al., 2024).

While motorcycling is dominated by male participation (e.g., as of March 2021, 87% of the 445,000 motorcycle license holders in Victoria, Australia, were men (Fortune Business Insights, 2023), there is a growing number of female motorcyclists and an increasing demand for safety gear that is not only functional but also fashionable, comfortable and tailored to meet the specific needs of women (Mali, 2024). With the rise in female riders, however, the question of whether products designed for women provide adequate protection remains largely unexamined. This gap in research presents a critical area of study.

This project is a comprehensive analysis of more than 480 jackets and 250 pants tested by MotoCAP over six years. These garments came from a range of products purchased in the Australasian market. The research used standardised tests to measure key mechanical properties such as abrasion resistance, seam strength, and impact energy absorption, providing a clear picture of the protection offered by the products. Statistical analysis was conducted using one-way ANOVA to evaluate the differences in protective performance between male and female motorcycle gear. The aim was to investigate whether female-specific gear offers the same level of protection as male gear. Accordingly, it aligns with the Equity theme of the conference by addressing disparities in rider safety across genders. This study provides an overview of existing patterns and gaps to inform future targeted research.

Results and Discussion

Figure 1 illustrates the distribution of garments by gender tested in the MotoCAP program between 2018 and 2024. MotoCAP intentionally selects more garments for females than what is proportionally supplied to the market so that female riders have an adequate selection of rated clothing to choose from. The market offers a much lower percentage of female garments than shown in Figure 1. This highlights the ongoing need for further development and diversification of motorcycle protective clothing to better address the requirements of female riders.

In addition to the limited product range, issues such as restricted size, fitness, comfort, styles, and designs persist (Black et al., 2005). Many plus-sized women claim difficulties finding suitable gear and are often forced to purchase men's products, which are not tailored to their needs (Grigaite-Kjeldsen, 2022). The MotoCAP protection star rating system provides an overall assessment, ranging from half a star to 5 stars. This rating is determined through a complex calculation that considers three main protection indexes: abrasion resistance, seam strength, and impact protection. A higher star rating indicates superior overall protection. The differences in rating results between male and female gear were evaluated using one-way ANOVA statistical analysis. Figures 2a and 2b illustrate the protection rating ranges for male and female motorcycle jackets and pants, respectively, from 2018 to 2024. The mean rating represents the average of all data collected throughout each year. As shown in Figure 2, male jackets generally provide better protection than female jackets, with mean ratings consistently above 2 stars, whereas female jackets tend to have mean ratings below 2 stars, (p=0.021). Similarly, MotoCAP protection star ratings across all years clearly show that male pants offer higher levels of protection compared to female pants, from 2018 to 2024 (p=0.002). This finding aligns with previous research on female leggings and jeans, which also highlighted the lower protection levels of female-specific gear (Hurren et al., 2023). This suggests that male riders not only have more options in the market but also benefit from generally better protection. Additionally, jackets tend to have higher protection ratings than pants, regardless of gender-specific design. This indicates a need for improved protection in motorcycle pants, particularly for female riders.

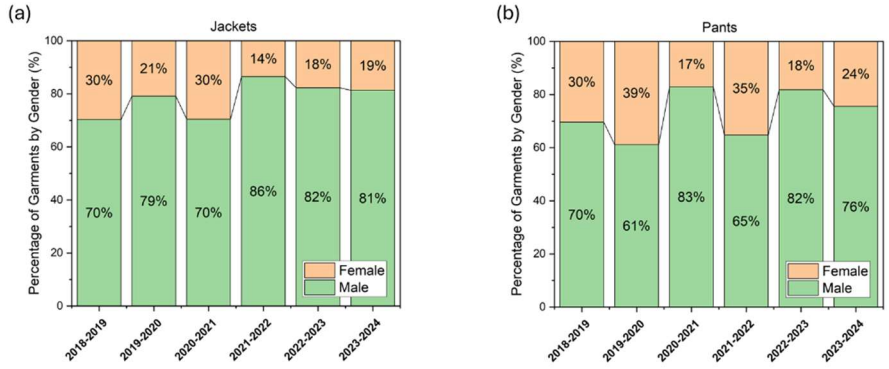


Figure 1. Percentage of garments tested, by gender, from 2018 to 2024

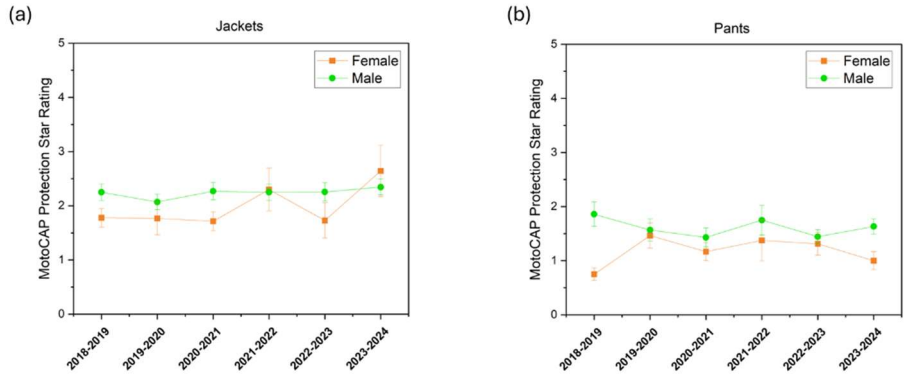


Figure 2. MotoCAP protection star rating for female and male garments from 2018 to 2024

Figure 3 provides a detailed explanation of the factors contributing to the results observed in Figure 2. It separately presents the trends in abrasion resistance, seam strength (burst strength), and impact protection. With female jackets there was no clear single parameter that reduced protection when compared to male jackets (Figures 3a, 3c and 3e). Lower performance in two or three of the measured factors (abrasion, burst and impact) combined to give lower performance in the female jackets. Seam strength (burst) in female pants was consistently lower over all years of the MotoCAP test program (Figure 3d). Lower seam strength may be due to difference in garment styles and materials between female and male pants. Female pants were commonly made from thinner fabrics with elements of stretch.

These materials typically have lower burst and abrasion strength (Hurren et al., 2023). This hypothesis is supported by the lower abrasion resistance observed for female garments over five of the six examined years (Figure 3b).

Jackets generally offer better impact protection than pants for both male and female products. Manufacturers tend to omit hip impact protection from both male and female pants resulting in lower impact ratings. Over time, the MotoCAP program confirms that impact protection in motorcycle protective clothing has advanced (Yu et al., 2024), female pants have not kept pace with the improvements seen in male pants.

Between 2017 and 2021 the Traffic Accident Commission (TAC) in Victoria showed that male riders dominate motorcycle fatalities (96%) and injuries (91%) given that they were 87% of motorcycle license holders (TAC, 2021). Although female riders generally have lower injury and fatality rates, this does not imply that they require less protection. Ensuring adequate protection in female-specific gear remains essential.

Conclusions

By examining standardised testing with real-world validation and transparent reporting, MotoCAP has established a crucial benchmark for evaluating motorcycle protective clothing. This study compares male and female motorcycle gear, revealing that female riders face limited product options and lower protection levels in the gear available to them compared to their male counterparts. The findings highlight the need for targeted improvements in the quality, design, and availability of female-specific protective clothing. Manufacturers must prioritise protection to ensure that female riders are not left behind in the ongoing development of motorcycle safety technology. This analysis is based exclusively on MotoCAP-rated garments available in the Australian and New Zealand markets. Therefore, the findings may not be generalisable to protective gear in other regions, where consumer preferences may differ. Additionally, the future study will examine and investigate user-related factors such as fit, design preferences, price, or comfort elements that may influence gear selection and, consequently, rider safety. We acknowledge the essential role of the MotoCAP program in providing the data and insights that drive this research.

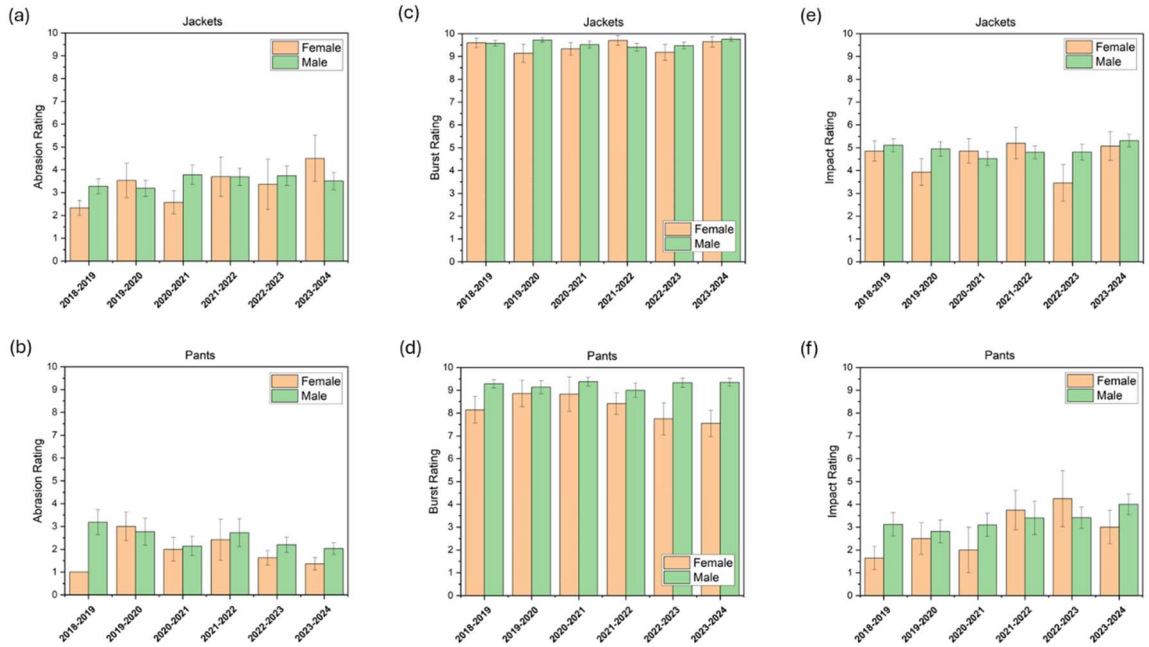


Figure 3. Abrasion, burst and impact rating for female and male garments from 2018 to 2024

References

Black, S., Kapsali, V., & Bougourd, J. (2005). Fashion and function ą factors affecting the design and use of protective clothing. Textiles for protection, 60.

de Rome, L. (2019). Could wearing motorcycle protective clothing compromise rider safety in hot weather? Accident Analysis & Prevention, 128, 240-247. https://doi.org/https://doi.org/10.1016/j.aap.2019.04.011

FortuneBusisnessInsights. (2023). Motorcycle Apparel Market Size, Share, and Industry Analysis. https://www.fortunebusinessinsights.com/motorcycle-apparel-market-109880

Grigaite-Kjeldsen, R. (2022). Why is there a shortage of motorcycle clothing for women? Moto Lounge Blog.

Hurren, C., Liu, X., & Toffolon, L. (2023). Lower protection levels observed in women's motorcycle leggings and jeggings 2023 Australasian Road Safety Conference, Cairns, Queensland, Australia.
Mali, S. (2024). Motorcycle Leather Jackets Market Report 2025 (Global Edition). Cognitive Market Research.
MotoCAP. (2024). Motorcycle Clothing Assessment Program: Methodology and Ratings. https://www.motocap.com.au/
TAC. (2021). Motorcycle crash data (Statistics by Topic, Issue. https://www.tac.vic.gov.au/road-safety/statistics/summaries/motorcycle-crash-data
Yu, Y., Xie, A., & Hurren, C. (2024). MotoCAP program enhances motorcycle clothing safety in Australasia 2024 Australasian Road Safety Conference (ARSC), Tasmania.

Insights from Road Safety Camera Technology

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Abstract

New safety camera technology has facilitated quantitative analysis of driving behaviour. This will assist evidence-based decision making in improving driving behaviour. The first month of smart camera usage detected over 47,100 incidents in the Perth Metropolitan region. Data show that speeding in the freeway is inversely correlated with volume. Most speeding incidents were observed in the hours of early morning. An 80% decrease in the level of speeding vehicles past the freeway cameras has been observed since January 2022 despite no speeding infringement or caution notices being mailed out. Temporal analysis on the collected incorrect seatbelt and illegal mobile phone usage data has suggested a significant spike in offending on a Sunday in the Metropolitan area. It is currently unknown why this trend is observed. Since caution notices started to be mailed out, an initial downward trend has been detected in the incorrect seatbelt and illegal mobile phone usage.

Background

Western Australia (WA) has one of the highest road trauma rates in the country. The deterrent effect of safety cameras and other technologies has long been credited with changing driver behaviour and lowering the rate of road trauma on roads. Research shows that the increased use of safety cameras leads to an overall reduction in serious casualty crashes (Wilson et al., 2010; Gao et al., 2025).

Safety camera use in WA has not kept pace with our changing society and population growth. WA has one of the lowest rates of safety cameras per capita when compared with other Australian states but has one of the highest road fatality rates per capita. In 2024, WA recorded a rate of 6.3 fatalities per 100,000 which was second only to the Northern Territories. The Road Safety Commission currently has two safety camera trailers with the ability to detect average speed, spot speed offences and using the latest artificial intelligence to identify other high-risk behaviours, including using a mobile phone while driving and seatbelt non-compliance. Fixed safety cameras with similar capabilities are also being trialled on the Kwinana Freeway.

This new safety camera technology has facilitated quantitative analysis of driving behaviour. This will assist evidence-based decision making in improving driving behaviour. The first month of using mobile and fixed smart camera assets together had over 5 million vehicles pass the cameras which detected over 47,100 incidents in the Perth Metropolitan region. Initial analysis of detection rates have shown that the Metropolitan region has much rates of non compliance for both mobile phone (17x higher) and incorrect use of seatbelts (9x higher) than Regional WA. Given the low number of mobile sites currently available to analyse, it is possible that this may change as more data becomes available.

Conference theme

The use of safety camera technology marks an **evolution** in how rogue road behaviour can be identified, quantified and intervened.

Results

Current data show that speeding in the freeway is inversely correlated with volume. Most speeding incidents were observed in the hours of early morning. The heat map below shows the rate of speed non-compliance over a week for the fixed cameras on the Kwinana Freeway (Figure 1). It clearly shows that speeding occurs most often during the hours of late night and early evening.

Figure 2 shows the number of speeding incidents per month on the Kwinana Freeway. An 80% decrease in the level of speeding vehicles past the freeway cameras has been observed since January 2022 despite no speeding infringement or caution notices being mailed out. The only cue that drivers receive that they have not complied with the posted speed limit is a camera flash.

Temporal analysis on the collected incorrect seatbelt and illegal mobile phone usage data has suggested a significant spike in offending on a Sunday in the Metropolitan area. This trend is evident in the two heat maps (Figure 3) below

which visualise the rate of offending for mobile phone and incorrect seat belt use for the fixed camera on the Kwinana Freeway.

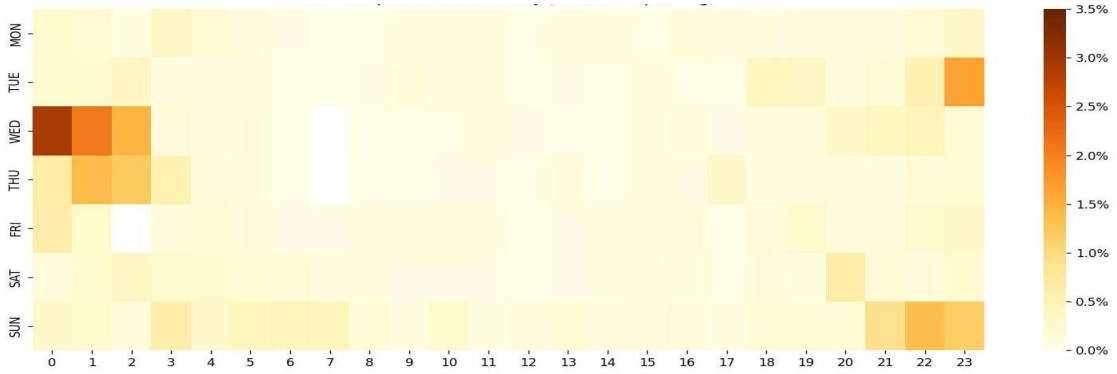


Figure 1. Heat map of rate of speed noncompliance on Kwinana Freeway

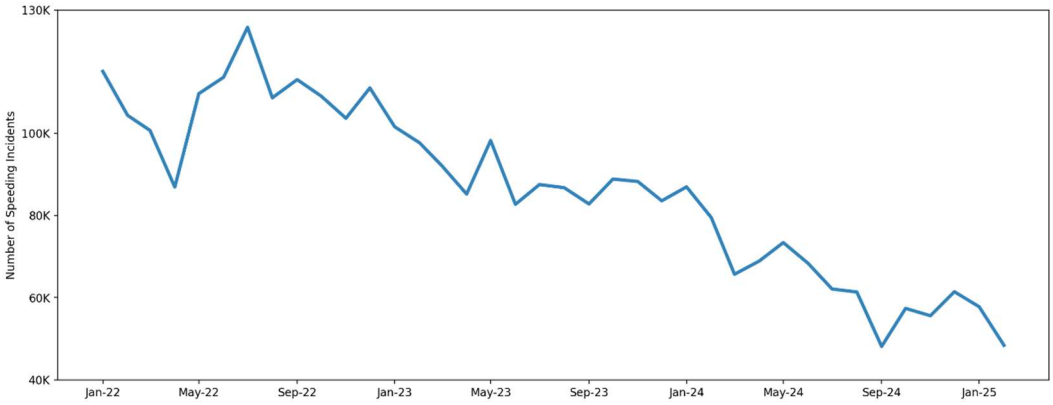


Figure 2. Number of speeding incidents on Kwinana Freeway over time

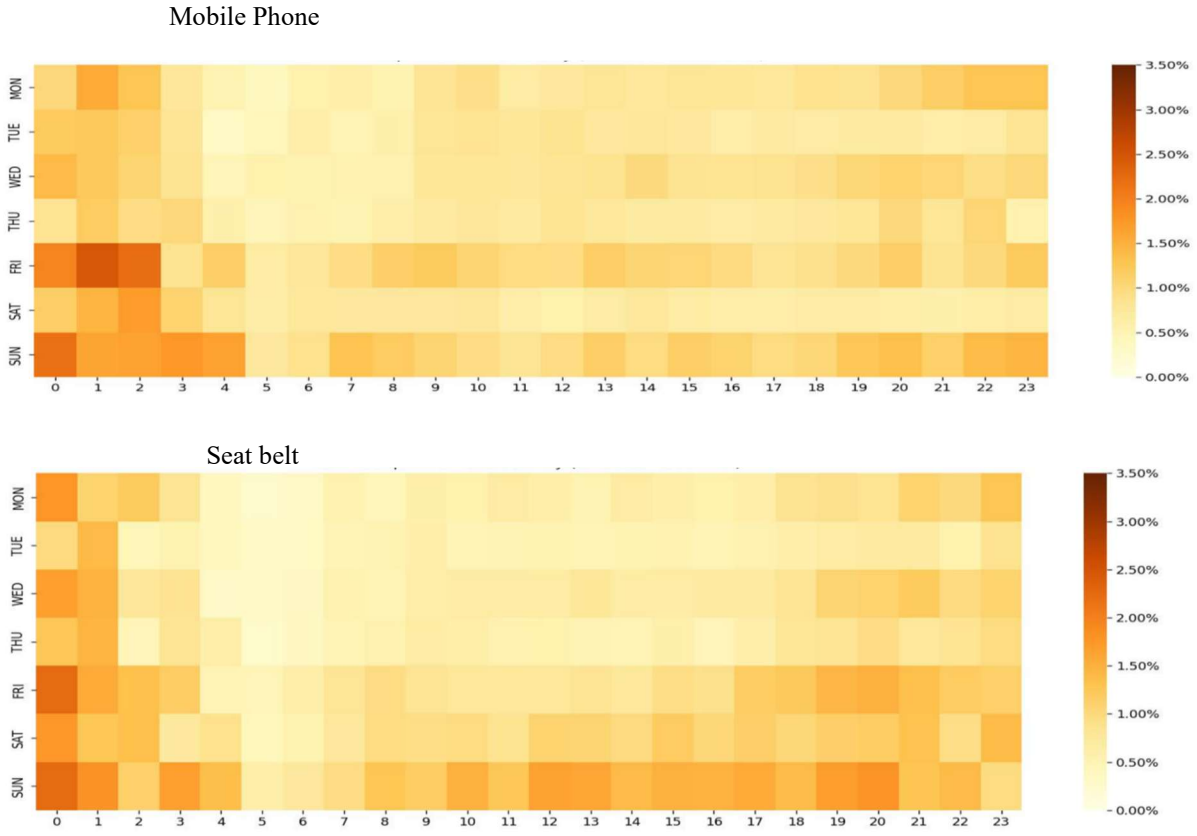


Figure 3. Heat map of rate of seatbelt and mobile phone noncompliance on Kwinana Freeway

Caution notices were sent out to people listed as the registered owners of the vehicles detected by the cameras. The intent is to highlight the fact that they are engaging in risky behaviour and that they would have lost demerit points and received a monetary fine. Caution notices commenced on the February 5 and subsequently on each Wednesday. Since caution notices started, an initial downward trend has been detected in the incorrect seatbelt and illegal mobile phone usage (see Figures 4 and 5).

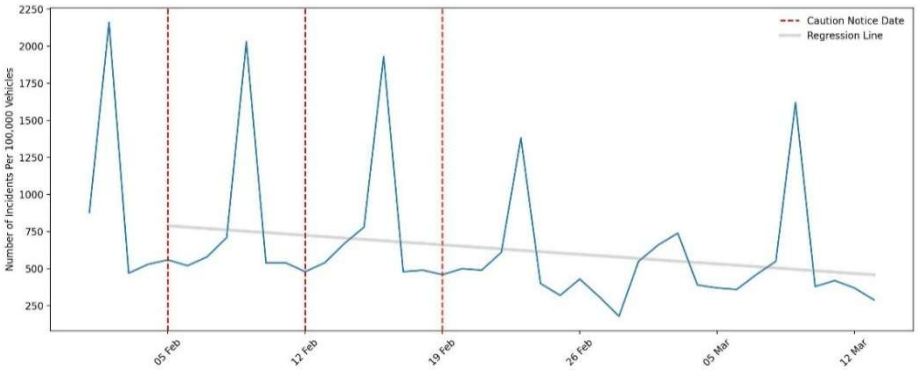


Figure 4. Rate of incorrect seatbelt usage per 100,000 vehicles on Kwinana Freeway

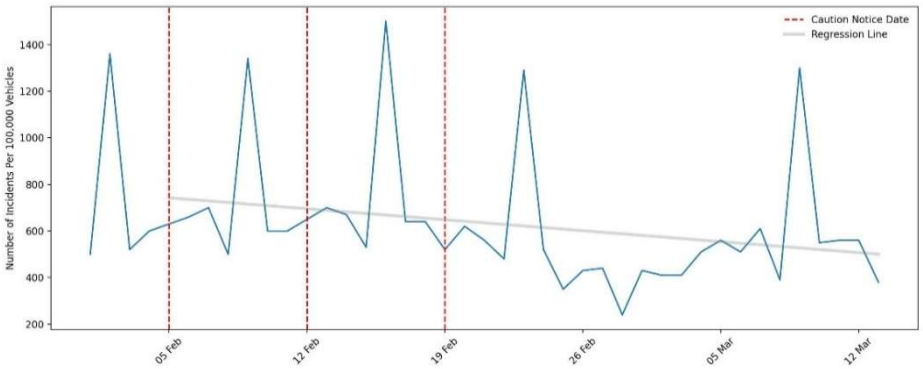


Figure 5. Rate of illegal mobile phone usage per 100,000 vehicles on Kwinana Freeway

Conclusions and Implications for Policy and Practice

Non-infringement approaches present as an opportunity to shape road user behaviours. Improvements in speeding, illegal mobile phone use and incorrect use of seatbelts identified are evident after use of cautions and the visual cue to drivers of a flashing camera; it doesn't have to be "all stick".

References

Gao, J., Yang, D., Xu, C., Ozbay, K., & Sharma, S. (2025). Assessing the impact of fixed speed cameras on speeding behaviour and crashes: A longitudinal study in New York City. *Transportation Research Interdisciplinary Perspectives 30,* https://doi.org/10.1016/j.trip.2025.101373

Wilson, C., Willis, C., Hendrikz, J.K., Le Brocque, R., & Bellamy, N. (2010). Speed cameras for the prevention of road traffic injuries and deaths. *Cochrane Database of Systematic Reviews, 11*. https://doi.org/10.1002/14651858.CD004607.pub4.