Proceedings of the 2017 Australasian Road Safety Conference

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Proceedings Editors

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Preface

We are pleased to welcome you to the third annual Australasian Road Safety Conference, an amalgamation of the Road Safety Research, Policing and Education Conference and the Australasian College of Road Safety Conference. The conference provides the unique opportunity for those involved in all aspects of road safety, including researchers, practitioners, policymakers, police, and educators, to meet, present, and discuss their work.

These proceedings describe research, educational and policing program implementation and policy and management strategies related to all aspects of road safety and especially related to the conference themes of ‘Expanding Our Horizons’. Some of the popular topic areas for this year include young and ageing drivers; human factors related to distraction, inattention, and fatigue; policing, vehicle safety technology; and road design. The authors of accepted Extended Abstracts and Full-Paper represent international and local institutions from all aspects of their respective communities including research centres, private companies, government agencies, and community groups. This great set of papers is a wonderful indication of the work being done in Australia, New Zealand and abroad as part of the United Nations Decade of Action for Road Safety.

The Conference Organising Committee allowed two manuscript types for the Conference: Extended Abstracts and peer-reviewed Full Papers. Using a similar format to the previous successful conference in 2016, the Conference Scientific sub-Committee initially called for submissions in the form of Extended Abstracts (approx. 1 to 3 pages). Groups of submissions around similar themes were assigned to Conference Editors with senior peer status in the respective field of road safety, who then handled the review process for their assigned submissions. Each Extended Abstract was reviewed by two independent expert peer reviewers on the following selection criteria: content consistent with the conference theme, novelty of information or data, clarity, relevance to practice or policy, scientific merit, and interest to audience. Authors were also provided the option of submitting a Full Paper, which is HERDC* compliant. Based on the outcome of the peer review of their Extended Abstract, some authors were provided the opportunity to extend their submission into a full paper, which subsequently underwent further review by two independent peer reviewers. A total of 148 manuscripts were accepted as Extended Abstracts and further 39 submissions were accepted as Full Papers.

Putting together such a high-quality program requires a contribution from many people. The Proceedings Editors would like to thank the Conference Editors for taking the time to handle submissions, allocate appropriate reviewers, and provide useful and constructive feedback to authors. Likewise, we are most grateful for those peers in the road safety field that helped to review a total of 228 submissions. The calibre of the conference proceedings would not be so high without their assistance and we thank them all for giving up their valuable time. The Proceedings Editors would also like to warmly thank all the Keynote Speakers and presenters, the Conference Organising Committee, the Scientific Sub-Committee, the International Sub-Committee, the Social Activity Sub-Committee, the Conference Sponsors, and the Session Chairs. The valuable input and enthusiasm from each person and group has helped to ensure the 2017 Australasian Road Safety Conference meets the needs of the diverse range of participants and contributes to the overall success of the event. Most importantly, we hope that the work described in these proceedings will contribute to the reduction in road trauma in Australia, New Zealand and internationally.

* https://www.education.gov.au/higher-education-research-data-collection

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ARSC2017 Conference Program

Monday 9 October 2017	
1.00pm	**Registration Opens**
1:00pm - 5:00pm	**Pre-Conference Meetings/Events** 1. Early Career Professionals Event 2pm -5pm - Open to all Road Safety Professionals within their first 8 years of professional work ***Sponsored by the ACT Government*** 2. Senior Policing/Enforcement Meeting 3. Road Safety Education Reference Group Australasia Meeting
5:00pm - 6:00pm	**Pre-Conference Networking Function - FOR ALL CONFERENCE DELEGATES - in the Exhibition Hall at Crown Perth**
Tuesday 10 October 2017	
7.30am	**Registration Opens**
7.30am - 8.30am	**Arrival Tea & Coffee & Exhibition Open**
8.30am - 10.30am	***Conference Opening Plenary*** **(Crown Ballroom 1&2)** **Welcome to Country:** Professor Len Collard, Whadjuk Nyungar **Official Opening and Welcome** Mr Lauchlan McIntosh, President Australasian College of Road Safety Mr Nick Koukoulas, Chief Executive Officer, Austroads Hon. Michelle Hopkins Roberts, MLA, Western Australian Minister for Police and Road Safety Mr Iain Cameron FACRS, Interim Commissioner, Road Safety Commission WA **Keynote Speaker *(Sponsored by the Department of Infrastructure and Regional Development)*** Dr Mark Rosekind, Administrator, Chief Safety Innovation Officer, Zoox (Former National Highway Traffic Safety Administration Administrator, USA)
10:00am - 10.30am	**Morning Tea - Conference Exhibition Hall**
11.00am - 12:30pm	***Plenary and Panel Session - Around Australasia in 90 minutes: Showcasing Australia and New Zealand's High Influence Projects*** **(Crown Ballroom 1&2)** This session will showcase some of the significant benefits gained around Australia and New Zealand and the initiatives which have delivered some significant step-change safety improvements. The information presented by Austroads Road Safety Task Force Representatives will provide quick summaries of the initiatives along with before and after performance information from a wide variety of treatments. Examples will include road infrastructure treatments, mass action programs, speed zone reviews, behavioural change programs. Speakers from New South Wales, Victoria, Queensland, New Zealand and Western Australia will relate stories of how these initiatives have been implemented to deliver benefits to road users
12.30pm - 1:30pm	**Lunch - Conference Exhibition & Poster Presentation Session**

	CONCURRENT SESSIONS 1 -TUESDAY						
	Crown Ballroom 1 & 2	**Crown Ballroom 3A**	**Crown Ballroom 3B**	**Crown Ballroom 3C**	**Astral 1**	**Astral 2**	**Astral 3**
	Speed Limits 1	**Older Drivers**	**Driver Impairment**	**Risk Evaluation and Treatment**	**Child Restraints**	**SYMPOSIUM 1**	**SYMPOSIUM 2 (A)** ***Sponsored by WA Road Safety Commission***
1:30pm - 3:00pm	Accuracy of Speed Zone Recorded in the Victorian Police-Reported Crash Database Differs by Speed Zone in Metropolitan Areas *Karen Stephan* *MUARC – Monash University*	Which Objective Visual Measures are Associated with Driving Exposure Among Older Drivers with Bilateral Cataract? *Seraina Agramunt* *C-MARC – Curtin University*	Why don't Australian Drivers with Type 1 Diabetes Check their Blood Glucose before Driving? *Steven Trawley* *Deakin University Faculty of Health*	Application of MRWA RAP and ANRAM for Assessing Upgrades on Great Eastern Highway *Jan Karpinski* *Main Roads Western Australia*	Integrated Booster Seats: Crash Protection, Ease of Use and Child Induced Errors in Use *Julie Brown* *Neuroscience Research Australia*	**Heavy Vehicles- Managing Fatigue** **Moderators** Ann Williamson **Speakers** Ben Maguire Sarah Jones Transport Operator WA Sal Petroccitto Chris Adams	**Developments in Motorcyclist Training, Licensing and PPE Research and Implementation: Presentations and Jurisdiction Discussion Panel** **Moderator** Teresa Senserrick **Speakers** Teresa Senserrick Rodney Blythe Graham Knight Christopher Hurren
	Validation and Applicability of Floating Car Speed Data for Road Safety Chris Jurewicz Australian Road Research Board	Comparison of Findings Reported by Self-report and Objective Measures of Driving Exposure and Behaviours: A Systematic Review *Sherrie-Anne Kaye* *CARRS-Q – Queensland Univ. of Technology*	Alcohol Availability and Road Crashes in Perth: How does Distance Affect the Relationship? *Michelle Hobday* *C-MARC – Curtin University*	An Evaluation of the Effectiveness and Cost-effectiveness of a Rural Run-off-road Crash Program in Western Australia *Kyle Chi Ngok Chow* *C-MARC – Curtin University*	The Effect of Correct Child Restraint Cross-Chest Clip Use on Injury Outcomes in Motor Vehicle Crashes *Lynne Bilston*		
	Safety Effectiveness of Speed Reductions: A Queensland Experience *Simon Harrison* *Queensland Department of Transport and Main Roads*	Enhancing Police Practice with 'Fitness to Drive' *Catherine Wilkins* *Victoria Police*	Distraction in Shift-workers During Naturalistic Driving *Jonny Kuo* *Seeing Machines Ltd*	An Evaluation of the Effectiveness of the State Black Spot Program in Western Australia, 2000-2014 *Kyle Chi Ngok Chow* *C-MARC – Curtin University*	Using Instructional Videos to Promote Correct use of Child Restraint Systems: Qualitative Consumer Input and Quantitative Testing *Alexandra Hall* *Neuroscience Research Australia*		
	From Big Data to Speed and Safety: A Review of Surrogate Safety Measures Based on Speeds from Floating Car Data *Jiri Ambros* *CDV - Transport Research Centre*	Use of Alternative Forms of Transport in Older Drivers in the Suburban Outskirts of Sydney *Lisa Keay* *The George Institute for Global Health*	Electronic Distracted Driving Solutions in the Real World: Insights into the Challenges and Successes of Electronic Distracted Driving Systems *Steve Metlitzky* *TextStopper Pty Ltd*	Calibrating Infrastructure Risk Rating (IRR) for Victorian Roads *Kenn Beer* *Safe System Solutions Pty Ltd*	Using Naturalistic Driving Study Data to Understand Child Vehicle Occupant Behaviour when Travelling in CRS *Suzanne Lee Cross* *MUARC – Monash University*		
3:00pm - 3:30pm	**Afternoon Tea - Conference Exhibition**						

	CONCURRENT SESSIONS 2 - TUESDAY						
	Crown Ballroom 1 & 2	**Crown Ballroom 3A**	**Crown Ballroom 3B**	**Crown Ballroom 3C**	**Astral 1**	**Astral 2**	**Astral 3**
	Speed Limits 2	**Driver Psychology 1**	**Road Safety Data**	**Education and Road Users**	**Heavy Vehicles** *Sponsored by Toll*	**SYMPOSIUM 3** *Sponsored by Suncorp*	**SYMPOSIUM 2 (B)** *Sponsored by WA Road Safety Commission*
3:30pm - 5:00pm	Review of Default Speed Limits Within the City of Wanneroo *Ryan Gibson* *City of Wanneroo*	Insights into Evaluating Road Safety Advertising Based upon the Step Approach to Message Design and Testing (SatMDT) *Ioni Lewis* *Queensland Univ. of Technology*	Trends in the Burden of Serious RoadTraffic Crashes in Victoria, Australia *Ben Beck* *Monash University*	Expanding Young People's Horizons As Leaders Of Change In Their Community: How Could Critical Pedagogy Improve Australasian Transport Safety Education? *Janine Ferris* *University of Waikato, New Zealand*	Findings of the 2015 Heavy Vehicle Compliance Survey *Gregory Dikranian* *Transport for NSW*	**Australia's Collaborative Journey to Safer Roads by Understanding Road Infrastructure Related Risk** **Moderator** Simon Harrison **Speakers** David Bobbermen Rob McInerney Craig Newland Simon Harrison Rita Excell / Chris Jurewicz	**Developments in Motorcyclist Training, Licensing and PPE Research and Implementation: Presentations and Jurisdiction Discussion Panel** **Moderator** Teresa Senserrick **Speakers** Teresa Senserrick Rodney Blythe Max Thompson Graham Knight
	Safe School Speeds *Ryan Gibson* *City of Wanneroo*	Expert Drivers and Situational Awareness *Kristen Pammer* *The Australian National University*	A National Approach to Measuring Non-Fatal Road Injuries *Angela Watson* *CARRS-Q – Queensland Univ. of Technology*	Queensland Road Safety Week 2016 *Mike Keating* *Queensland Police Service*	The Advanced Safe Truck Concept (ASTC) Project: Defining and Developing Future Products to Enhance Heavy Vehicle Safety *Michael Lenne* *Seeing Machines Ltd*		
	Posted Speed Limits: Where the maximum is not the recommended. The need for discussion and review of speed limit settings *Michael Batten* *Victoria Police*	Inattentional Blindness in Expert Drivers *Kristen Pammer* *The Australian National University*	Research vs. Practice: An International Review of Challenges and Opportunities of Crash Prediction Models *Jiri Ambros* *CDV - Transport Research Centre*	Street Wise - Helping Protect Children on their Commutes to School *Mirjam Sidik* *AIP Foundation*	Understanding the Factors Influencing Heavy Vehicle Related Fatal and Serious Injuries in Victoria, Australia *Amir Sobhani* *VicRoads*		
	Use of Crash Data to Select and Deploy Mobile Speed Cameras in Queensland *Warren Anderson* *Queensland Department of Transport and Main Roads*	Integrating Human Factors and Systems Thinking for Transport Design: Rail level Crossing Case Study *Paul Salmon* *University of the Sunshine Coast*	Application of Spatial Analysis to Inform the Transport Accident Commission's Local Enhanced Enforcement Program *Haris Zia* *Abley Transportation Consultants*	Enforcement and Community Education - The Golden Keys to Road Safety - A Developing Nation Case Study of Cambodia. *Ray Shuey* *Strategic Safety Solutions Pty Ltd*	Comparison of Experience-Based and Evidence-Based Safety Risk Management Features for Heavy Vehicle Transport Operations *Lori Mooren* *TARS Centre – Univ. of New South Wales*		
5:30pm - 7:30pm	**CONFERENCE WELCOME RECEPTION** ***Sponsored by Toll*** **Exhibition Hall** **Crown Perth**						

Wednesday 11 October 2017

Time	
8.30am	**Registration Opens**
8.30am - 9:00am	**Arrival Tea and Coffee and Exhibition Open**
9.00am - 10.30am	***Plenary and Panel Session - The Contribution of New Technology for Vehicle Safety*** **(Crown Ballroom 1&2)** **Facilitator:** Stuart Ballingall, Program Director Connected & Automated Vehicles, VicRoads/Austroads Terry Agnew, Chief Executive Officer, RAC WA Rita Excell, Executive Director, Australian Driverless Vehicle Initiative James Goodwin, Chief Executive Officer, ANCAP Antonio Piscetelli, Business Development Specialist, IOT and M2M Telstra **Panel** with Dr Mark Rosekind, Chief Safety Innovation Officer, Zoox, Inc. and Former Administrator, National Highway Traffic Safety Administration (NHTSA), USA
10:30am - 11:00am	**Morning Tea - Conference Exhibition Hall**

CONCURRENT SESSIONS 3 - Wednesday (11:00-12:30)

Crown Ballroom 1 & 2	Crown Ballroom 3A	Crown Ballroom 3B	Crown Ballroom 3C	Astral 1	Astral 2	Astral 3
Motorcycle Helmets and Protective Clothing	**Driver Psychology 2**	**Road Environment and Driver Behaviour**	**SYMPOSIUM 4**	**SYMPOSIUM 5 (A)**	**Educators Workshop** **9am - 12.30pm**	**Police Workshop**
The Motorcycle Protective Clothing Assessment Program: A Star Rating System *Liz de Rome* *Deakin University*	The Psychology of Drivers and Leadership Practices in Predicting Safe Driving *Amanda Warmerdam* *RMIT University*	Prevalence and Perception of Following too Close in Queensland *Sebastien Demmel* *CARRS-Q – Queensland Univ. of Technology*	**Implementing Roads for Safe System - An Exploration of Approaches used in Australia and New Zealand** **Moderator** David Healy **Speakers** Rob McInerney Colin Brodie Michael Nieuwesteeg David Healy	**Australian Naturalistic Driving and Cycling Smposium** **Moderator** Judith Charlton **Speakers** Ann Williamson Andry Rakotonirainy Jeremy Woolley Jude Charlton Sjaan Koppel Seraina Agramunt Lynn Meuleners Narelle Haworth Amy Schramm Jennie Oxley Brendan Lawrence Michelle Fraser	**Keep Left: Changing Road Safety Culture** *Education can play a key role in changing road safety behaviours in early learning and school communities through a best practice approach. This workshop will:* *Explore research that supports 'what works and what doesn't work' in road safety education* *Showcase working examples of road safety education in Western Australian school communities* *Include presentations on teaching and learning resources, policy and guidelines, and parent and community engagement strategies from a range of road safety education organisations* *Provide opportunity for participants to network and reflect on their current road safety efforts to determine how these may be enhanced.*	**Developments in Testing for Drug Drivers** **Speed Enforcement - The Balance Between Automation v Police Officers** **The use of unmarked police motorcycles to target unsafe road user behaviour** **Speakers** TBC
Head Protection for Wheeled Recreational Device Riders: Finding the Right Standard *Greg Dikranian* *Transport for NSW*	The ESRA Approach Towards a Joint Monitoring System on Road Users' Attitudes and Behaviour - Australian Results *Marcus James* *Department of Infrastructure and Regional Development*	A new and novel method for assessing visual clutter in the driving environment Michael Regan Australian Road Research Board				
Love Your Child - Provide a Helmet: Vietnam Take Actions to Protect Kids on Motorbikes *Mirjam Sidik* *AIP Foundation*	Aggressive Driving on Australian Roads *Amanda Stephens* *MUARC – Monash University*	Driver Behaviour at Level Crossings: Too Fast Approach Speeds and too Fast Decisions? *Gregoire Sebastien Larue* *CARRS-Q – Queensland Univ. of Technology*				
Mounting a Video Camera or a Communication Device onto an Approved Motorcycle Helmet *Bernard Carlon* *Transport for NSW*	The Association Between Psychological Distress and Alcohol Consumption Behaviour in Risky Driving *Sara Liu* *MUARC – Monash University*	Transverse Line Marking Trial Undertaken in the Adelaide Hills *Chris Stokes* *University of Adelaide*				

Time	
12.30pm - 1:30pm	**Lunch, Conference Exhibition Hall**

	CONCURRENT SESSIONS 4 - WEDNESDAY						
	Crown Ballroom 1 & 2	**Crown Ballroom 3A**	**Crown Ballroom 3B**	**Crown Ballroom 3C**	**Astral 1**	**Astral 2**	**Astral 3**
	Powered Two-Wheelers	**New Technologies in Road Safety**	**Safer Roads** ***Sponsored by Main Roads WA***	**SYMPOSIUM 6**	**SYMPOSIUM 5 (B)**	**Educator Papers - Young Driver Training**	**Police Papers - Enforcement**
1:30pm - 3:00pm	Motorcycle-Friendly Roads - Applying a Customer Lens on the Journey from Identification to Implementation *Robyn Gardener* *Accident Compensation Corporation*	Development of a Pedestrian Injury Prediction Model for Potential use in an Advanced Automated Crash Notification System *Guilio Ponte* *CASR – Univ. of Adelaide*	Austroads Project: Road Cross Section Design, Road Stereotypes, Network-Wide Safety Plans and Safe System *David Bobbermen* *Austroads*	**Gruen Transfer: The Road Safety Pitch – Safe Together** **Moderator** Marilyn Johnson **Speakers** Terry Birss Teresa SenserrickSydney) Kathryn Collier Jennifer Bonham Rebekah Smith Eve Mitsopoulos-Rubens Kerrie Tregenza	**Australian Naturalistic Driving and Cycling Symposium** **Moderator** Judith Charlton **Speakers** Ann Williamson Andry Rakotonirainy Jeremy Woolley Jude Charlton Sjaan Koppel Seraina Agramunt Lynn Meuleners Narelle Haworth Amy Schramm Jennie Oxley Brendan Lawrence Michelle Fraser	Novice Drivers and Parents: Exploring the Feasibility of Third Party Policing in Reducing Young Driver Offending *David Belsham* *CARRS-Q – Queensland Univ. of Technology*	The Effect of the Implementation of Vehicle Impoundments for 'No Authority to Drive' Offences in Western Australia *Stephen Temby* *Western Australia Police*
	Powered Two and Three Wheeler Safety in Low and Middle Income Countries: Usage, Risk Factors and Effective Interventions for Safety Lisa Keay The George Institute for Global Health	Event Data Recorders (EDRs) in Australia: A New Source of Crash Data *Sam Doecke* *CASR – Univ. of Adelaide*	Hazardous Road Locations Selection through Combining Engineering and Social Aspects on Highway that Passed through Villages: Experience from Bangladesh *M H Md Arif Uddin* *Centre for Injury Prevention and Research (CIPRB), Bangladesh*			Applying Cluster Analysis to Validate a High Risk Young Driver Model: Implications for Tailored Road Safety Intervention *Bridie Scott Parker* *University of the Sunshine Coast*	Paperless Road Policing: New Zealand Police's Implementation of Digital Infringement Notices and Traffic Crash Reporting using Smartphones *Nils van Lamoen* *New Zealand Police*
	Factors Associated with Human Error in Motorcycle Crashes Involving Another Road User *Trevor Allen* *MUARC – Monash University*	Victorian Based Autonomous and Connected Vehicle Trials and Provision of Related Public Advice and Advocacy *Nicholas Platt* *Royal Automobile Club of Victoria (RACV)*	Knowing Where to Start: The New Zealand Approach to Developing Road Safety Infrastructure Programmes *Colin Brodie, Dale Harris & Carl O'Neil* *Abley Transportation Consultants*			Response-inhibition Training: A New Horizon for Young Driver Training? *Julie Hatfield* *TARS – Univ. of New South Wales*	Enhanced Enforcement Program - A High Visibility On-Road Enforcement Partnership Between the NSW Police Force and Transport for NSW *Ruth Graham* *Transport for NSW*
	Amending NSW Legislation to Prohibit the use of Petrol-Powered Bicycles *Dan Leavy* *Transport for New South Wales*	RAC Intellibus™: Australia's First Automated Vehicle Trial- Testing Safety Safely *Anna Sawyer* *RAC*	Improving Road Safety through Integrated Process for Traffic Incident Management Asif Hassan Australian Road Research Board			Mandatory Driver Training and Assessment Relating to Awareness of Vulnerable Road Users *Geoff Davidson* *Justice and Community Safety Directorate, ACT Government*	International Road Policing Assessment Program (IRPAP)- A star-rating system for road safety enforcement *Ray Shuey* *Strategic Safety Solutions Pty Ltd*
3.00pm - 3:30pm	**Afternoon Tea - Conference Exhibition**						

	CONCURRENT SESSIONS 5 - WEDNESDAY						
	Crown Ballroom 1 & 2	**Crown Ballroom 3A**	**Crown Ballroom 3B**	**Crown Ballroom 3C**	**Astral 1**	**Astral 2**	**Astral 3**
	Safe Systems & Transport Planning	**Autonomous Vehicles**	**Roundabouts & High-Risk Curves**	**Cyclists and Passing Distances**	SYMPOSIUM 7	**Educator Papers: Young drivers and GDL**	**Rural Road Safety**
3:30pm - 5.00pm	Towards a Complete Description of the Safe System *James Holgate* *Integrated Road Safety Pty Ltd*	What is the Future of Private Transport? *Brian Fildes* *MUARC – Monash University*	Innovative Estimation of Crash Reduction Factors *Kenn Beer* *Safe System Solutions Pty Ltd*	Drivers Who Pass Cyclists Too Close *Narelle Haworth* *CARRS-Q – Queensland Univ. of Technology*	**Motorcycle Safety Research in Low and Middle Income Countries: Different Approaches to Generate an Evidence Base** **Moderators** Felix Wilhelm Siebert Paolo Perego **Speakers** Guneet Assi Paolo Perego Lwin Aye Moe Moe Felix Wilhelm Siebert Mark King	Examination of the Victorian Graduated Licensing System's Effect on Young Novice Driver Safety *Kelly Imberger* *VicRoads*	Trees in the roadside as factor in road safety in Poland *Marcin Budzynski* *Gdańsk University of Technology*
	Road Safety Management at Main Roads Western Australia *Fritha Argus* *Main Roads Western Australia*	A Community Survey of Attitudes Towards Autonomous Vehicles *Jodi Page-Smith* *Transport Accident Commission*	Getting 10 Roundabouts for the Price of One: Highly Effective Low Cost Intersection Treatments *Christopher Ivan Davis* *Mildura Rural City Council*	Improving Cyclist Safety: Understanding the Relationship Between Road Infrastructure and Passing Distance *Ben Beck* *Monash University*		Impact of Victoria's Enhanced GLS on Novice Driver Crash Involvement *John Catchpole* *Australian Road Research Board*	Township Entry Treatments *Shalendra Ram* *AECOM Australia*
	Opportunities to Refresh the Current NSW Road Safety Strategy and Integrate Safety Priorities with Broader Transport Planning Outcomes *Bernard Carlon* *Transport for NSW*	Hacking Safety: Providing Security for Connected Vehicles in Australia *Philip Lloyd* *Transport Certification Australia*	A Fresh Approach for Prioritising and Treating High Risk Curves *Carl O'Neil* *Abley Transportation Consultants*	Development of a Device Suitable for Naturalistic Studies of Passing Distances Between Cyclists and Vehicles *Jamie Mackenzie* *CASR – Univ. of Adelaide*		Survey Evaluation of Victoria's Graduated Licensing System: Young Driver Behaviour and Experiences of the Graduated Licensing System *Allison McIntyre* *Allison McIntyre Consulting*	Road Safety Study - Candia Road - 'Before' and 'After' Crash Study *Bruno Royce* *Traffic Engineering Solutions Ltd*
	The Development of a Grey Fleet Safety Management Framework *Darren Wishart* *CARRS-Q – Queensland Univ. of Technology*	Exploring the Safe System Approach in a World of Automated Vehicles *David Young* *Arup*	Comparing Speed Behaviour between Roundabouts and Signalised Intersections using Data from the Australian Naturalistic Driving Study *Mario Mongiardini* *TARS Centre – Univ. of New South Wales*	Safer Cycling for Girls and Women: An Evaluation of a Cycling Skills Training Program *Marilyn Johnson* *Institute of Transport Studies – Monash University*		Mismatches Between Trainee and Educator Perceptions Regarding the Use and Value of Driving Simulators *David Rodwell* *CARRS-Q – Queensland Univ. of Technology*	Determining the Efficacy of Different Types of Bull Bars Fitted to Different Types of Light Vehicles *Dan Leavy* *Transport for NSW*
6.30pm - 11pm	**CONFERENCE GALA DINNER & AWARDS CEREMONY** **Grand Ballroom** **Including presentation of the prestigious '3M-ACRS Diamond Australasian Road Safety Awards'** **by the Federal Minister for Infrastructure and Transport, the Hon Darren Chester MP**						

Thursday 12 October 2017							
8.00am	**Registration Opens**						
9.00am - 11.00am	***Plenary Panel Session:*** **Beyond city limits: Meeting the Safe System challenge for rural and remote regions** **(Crown Ballroom 1&2)** **Keynote Speakers and Panel Members** Mr Brendon Wiseman, Main Roads Western Australia Mr Wayne Buckley, Program Manager, DriveSafe NT, Department of Infrastructure, Planning and Logistics Commander Scott Higgins, WA Police Melissa Watts, Assistant Director Strategy, Road Safety Commission WA Dr Andrew Hooper, Deputy Director of Medical Services , Royal Flying Doctor Services, Western Operations Dr Sudhakar Rao, State Director of Trauma, Western Australia						
11.00am - 11.30am	**Morning Tea - Conference Exhibition Hall**						
	CONCURRENT SESSIONS 6 - THURSDAY						
11.30am - 1.00pm	**Crown Ballroom 1 & 2**	**Crown Ballroom 3A**	**Crown Ballroom 3B**	**Crown Ballroom 3C**	**Astral 1**	**Astral 2**	**Astral 3**
	Road Safety in Aboriginal Communities	**Barriers**	**Fatigue & Stress**	**Cycling Issues**	**Design of Safer Roads**	**SYMPOSIUM 8**	**SYMPOSIUM 9**
	Road Crash Trauma amongst Aboriginal and Torres Strait Islander People in New South Wales *Hassan Raisianzadeh* *Transport for NSW*	A Desktop Model for Computing Acceleration Severity Index (ASI) for Rigid Barriers as a Function of Impact Configuration *Andrew Burbridge* *Queensland Government*	Using New Technologies to Evaluate Existing Heavy Vehicle Driver Fatigue Laws *James Williams* *National Transport Commission*	Effects of Bicycle Helmet Legislation on Cycling: A Global Systematic Review *Mahsa Esmaeilikia* *University of New South Wales*	Safety Evaluation of Fully-Controlled Right Turn Phasing at Signalised Intersections: Full-Time and Part-Time Applications *Chris Jurewicz* *Australian Road Research Board*	**Road Safety Challenges in Low and Middle Income Countries** **Moderator** Lori Mooren **Speakers** Mirjam Sidik Raphael Grzebieta Socheata Sann Guneet Assi Lori Mooren Florentina Alina Burlacu Mark King	**Driver Education and Training: An Interactive Workshop for Safer Drivers** **Moderator** Marilyn Johnson **Speakers** Terry Birss Teresa Senserrick Kathryn Collier Jennifer Bonham Rebekah Smith Peter Phillips Eve Mitsopolous-Rubens Kerrie Tregenza
	The Aboriginal Road Trauma (ART) Sorry Business Project, ENOUGH'S ENOUGH Campaign *Tony Fuller & Bettina Danganbarr* *Northern Territory Police Force*	A Crash Testing Evaluation of Road Signs to Mitigate Vehicle Windscreen Spearing Risk *Nilindu Muthabandara* *Transport for NSW*	The Application of a Proxy Measure to Estimate the Incidence and Characteristics of Driver Fatigue in Motor Vehicle Crashes *Peter Palamara* *C-MARC – Curtin University*	Factors Associated With Cyclists Using A Bell Or Calling Out When Overtaking Pedestrians *Matthew Legge* *CARRS-Q – Queensland Univ. of Technologyy*	Identification of High Risk Metropolitan Intersection Sites in Perth Metropolitan Area *Michelle Hobday* *C-MARC – Curtin University*		
	Delivery of a Child Car Seat Program in 12 Aboriginal Communities in NSW: Elements for a Detailed Process Evaluation *Kate Hunter* *The George Institute for Global Health*	The Future of Innovative Safety Crash Barrier Systems *Allan Duff* *KSI Global Australia Pty Ltd*	Lost in Translation? A Humorous International Driver Sleepiness Commercial Viewed by Australian Young Drivers *Alana Hawkins* *CARRS-Q – Queensland Univ. of Technology*	Using Mass Crash Data to Identify the Benefits of Innovative Cycling Infrastructure *Chris Stokes* *CASR – Univ. of Adelaide*	Shared Spaces - Auckland - A Safety and Operational Performance Study *Bruno Royce* *Traffic Engineering Solutions Ltd*		
	On the Right Track Remote: Road Safety and Driver Licencing on the Anangu Pitjantjatjara Yankunytjatjara and Maralinga Tjarutja Lands *Margaret Howard* *State Government of South Australia*	Combating Localized Sand Accumulation on the Highway using Wire Rope Safety Barrier *Miguel Santos* *Ashghal (Public Works Authority)*	Are Happy Drivers Better Drivers? The Impact of Emotion, Life Stress and Mental Health Issues on Driving Performance and Safety *Michael Regan* *Australian Road Research Board*	The Role of Probability and Statistics in Bicycle Helmet Research *Jake Olivier* *University of New South Wales*	Double Tennis Ball Intersection Design (Roe Hwy & Berkshire Rd) *Graeme Nicholls* *Main Roads Western Australia*		
1.00pm - 2.00pm	**Lunch - Conference Exhibition & Poster Presentation Session**						

	CONCURRENT SESSIONS 7 - THURSDAY						
	Crown Ballroom 1 & 2	**Crown Ballroom 3A**	**Crown Ballroom 3B**	**Crown Ballroom 3C**	**Astral 1**	**Astral 2**	**Astral 3**
	School Safety and Young Driver Education	**Road Trauma**	**Drug/Drunk Driving**	**Shared Cycle Paths**	**Safer Vehicles: Vehicle technology and crash assessments**	**SYMPOSIUM 10**	**SYMPOSIUM 11**
2.00pm - 3.30pm	Reducing On Road Risks for Young Drivers, Before Licensure and Beyond: Situation Awareness Fast Tracking Including Identifying Escape Routes *Bridie Scott Parker* *University of the Sunshine Coast*	Incorporating Road Trauma Reduction into the Planning of Rural Single Carriageway Cross Sections *Ryszard Gorell & David Moyses* *Main Roads Western Australia*	Cannabis and Road Crashes: A Close Look at the Best Epidemiological Evidence *Michael White* *University of Adelaide*	Achieving Separated Cycle Facilities in a Constrained Town Centre Environment *Phil Gray* *GTA Consultants*	Threshold-Based Automobile Collision Avoidance System (TACAS) *Sasan Adibi* *Deakin University - Melbourne Burwood Campus*	**Community Road Safety Programs in Low and Middle Income Countries** **Moderator** Mark King **Speakers** Shihiru Date Mark King Socheata Sann Witaya Chadbunchachai	**Is there Space for Safe System within the Movement and Place philosophy?** **Moderator** Chris Jurewicz **Speakers** Chris Jurewicz Bryan Willey Andrew Wall
	Experiential Learning for the 21st Century: Using Interactive Augmented Reality to Demonstrate Risk to Children in Outdoor Simulated Road Environments *David Gribble* *Constable Care Child Safety Foundation*	Incidence and Costs of Transport-Related Injury in Western Australia *Erica Davison* *Western Australia Department of Health*	Comparing Repeat Alcohol Offence Rates Among Post Interlock Scheme Participants And Non-Interlock Participants: A Ten Year Follow-Up. *Tori Lindsay* *University of Adelaide*	The Impact of Environmental Factors on Cycling Speed on Shared Paths. *Soufiane Boufous* *TARS Univ. of New South Wales*	The Extent Of Backover Collisions Internationally *Brian Fildes* *MUARC – Monash University*		
	Expanding Educational Horizons for Teens: The TrackSAFE Education High Schools STEM Competition *Janine Ferris* *TrackSAFE Foundation*	Survivor Story-Telling in Road Trauma Education and Support Programs: Reviewing the Evidence *Christine Harrison* *Road Trauma Support Services Victoria*	Drug Driving: Analysis of Current Trends in South Australia *Lisa Wundersitz* *University of Adelaide*	Strategic Cycling Corridors - Are We Ready? *Phil Gray* *GTA Consultants*	Estimated Fatality Reduction by the use of Electronic Stability Control from 2016 Fatal Crashes *Paulette Goldsmith* *Transport Accident Commission*		
	Safety Town - A Collaborative Approach to Road Safety Education in NSW Schools *Darren Neagle* *Transport for NSW*	Lived Experiences and Impacts of Disabilities in Cambodia Following Road Crashes *Socheata Sann* *CARRS-Q – Queensland Univ. of Technology*	From on High? A Systems Analysis of the Contributory Factors that Lead to the Fatal Five Behaviours *Paul Salmon* *University of the Sunshine Coast*	Bike Boulevards in Perth: Expanding the Safe Cycling Network and Introducing 30km/h Zones *Andrew McClurg* *Department of Transport Western Australia*	Analysis of a Causal Model of Crash Test Pulses *Keiran Gockowiak* *CASR – Univ. of Adelaide*		
3.30pm - 4:15pm	***Conference Closing Plenary*** **(Crown Ballroom 1&2)** Including: **Presentation of the Conference Awards for best papers/posters/presentations - $7,000 in prize money** 1. Peter Vulcan Award for Best Research Paper - $1000 prize plus certificate ***Sponsored by TAC*** 2. Road Safety Practitioners Award - $1,000 prize plus certificate ***Sponsored by TAC*** 3. Best Paper by a New Researcher Award (previously John Kirby Award) - $1,000 prize plus certificate ***Sponsored by TAC*** 4. Road Safety Poster Award - $500 prize plus certificate ***Sponsored by TAC*** 5. Conference Theme Award - $500 prize plus certificate ***Sponsored by TAC*** 6. Best Paper by a New Practitioner Award - $1000 prize plus certificate ***Sponsored by TAC*** 7. Best Paper with Implications for Improving Workplace Road Safety - $1000 plus certificate + Paper to be converted to an NRSPP Thought Leadership Piece & Webinar ***Sponsored by NRSPP*** 8. Policing Practitioner's Paper Award - $1000 plus certificate **Address from the hosts of ARSC2017**						
4.15pm	**Conference Ends**						

Please note this draft program may be subject to change

Which Objective Visual Measures are Associated with Driving Exposure among Older Drivers with Bilateral Cataract?

Seraina Agramunt[a,b], Lynn Meuleners[a,b], Kyle Chow[a,b], Jonathon Ng[b,c], Nigel Morlet[b,c], Vignesh Raja[d], Lisa Keay[e], Mark Young[f]

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Abstract

This cross-sectional study analyses the association between objective visual measures and naturalistic driving behaviour in older drivers with bilateral cataract. Participants completed a questionnaire and underwent testing for visual acuity, contrast sensitivity and stereopsis. Naturalistic driving behaviour was measured with an in-vehicle monitoring device. General linear models were used to analyse the association between objective visual measures and overall/ day time/ night time driving exposure. After controlling for potential confounding factors, only binocular contrast sensitivity, gender and age were significantly associated with overall and day time driving exposure. No objective measures of vision were significantly associated with night time driving exposure.

Background

There has been an increase in the number of older drivers on the roads due to the ageing population, (Bureau of Infrastructure, Transport and Regional Economics, 2014). As driving is a complex task which depends heavily on visual functioning (Owsley & McGwin, 2010), there is increasing evidence that cataract has a negative impact on driving behaviour while waiting for first eye cataract surgery. This study tested the hypothesis that overall driving exposure and day/night time driving exposure would be influenced by the level of visual impairment.

Method

A sample of 111 drivers aged 55+ years with bilateral cataract and waiting for first eye cataract surgery were recruited into the study. Data collection involved a researcher-administered questionnaire, the Mini Mental State Examination (MMSE) as well as visual acuity, contrast sensitivity and stereopsis. An in-vehicle monitoring device with data logger and GPS receiver was used to measure naturalistic driving behaviour for the cohort one week prior to first eye cataract surgery.

Results

The 111 participants (53% of males and 47% of females) were aged 55 to 91 years with a mean age of 73.66 (SD= 8.52) years. The mean number of years driving was 51.84 years (SD=10.31). Regarding the measures of vision, the mean ETDRS visual acuity in both eyes was 0.14 logMAR ±0.16, contrast sensitivity in both eye was 1.65 log units ± 0.15 and mean stereo-acuity was 2.31 seconds of arc ± 0.72. Drivers typically drove an average of 15.56 trips during the week (SD=10.51) and a distance of 115.77 km (SD=98.97). During the day, participants drove an average of 14.04 trips (SD=9.15) and a distance of 101.27km (SD=87.45). At night, participants drove an average of 1.52 trips (SD=3.49) and a distance of 14.84 km (SD=29.47). Eleven percent of participants had at least one episode of hard braking while travelling and 26% at least one episode of hard acceleration. No participants had a crash during data collection.

General linear models were used to analyse the association between objective visual measures and overall/ day time/ night time driving exposure. After controlling for potential confounding factors, only binocular contrast sensitivity ($p<0.05$), gender ($p<0.05$) and age ($p<0.01$) were significantly associated with overall driving exposure. Contrast sensitivity ($p<0.05$), gender ($p<0.05$) and age ($p<0.01$) were also significantly associated with day time driving exposure. Participants with better contrast sensitivity scores drove more kilometres in the week prior to cataract surgery than those who had poorer contrast sensitivity scores. Also males drove more kilometres than women and younger drivers drove more kilometers than older drivers prior to cataract surgery. No objective visual measures of vision were significantly associated with night time driving exposure.

Conclusion

The results found that older drivers with cataract do appear to self-regulate their driving exposure based on poorer visual function. Contrast sensitivity appears to be an important visual measure to consider when determining the impact of cataract on driving behaviour. A better understanding of the role of contrast sensitivity in driving and driver self-regulation practices is required.

References

Bureau of Infrastructure, Transport and Regional Economics (BITRE). (2014). *Road safety of older Australians: recent statistics* [Information Sheet 50]. Retrieved from https://bitre.gov.au/publications/2014/files/is_50_amended_2016_III.pdf

Owsley, C., McGwin, G. (2010). Vision and Driving. *Vision Research*, *50*, 2348–2361.

Factors Associated with Human Error in Motorcycle Crashes Involving another Road User

Trevor Allen[a], Stuart Newstead[a], Mark Symmons[b], Michael Lenné[a], Rod McClure[c], Peter Hillard[a], Lesley Day[a]

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Abstract

The purpose of this study was to investigate factors associated with human error in motorcycle injury crashes involving another road user in Victoria, Australia. A subset of 158 motorcycle injury cases involving another road user were sourced from a larger case-control study (Day et al., 2013). Primary and secondary contributing factors were assigned based on a crash investigation, which included a rider questionnaire-based interview. The primary attribution of human error (by either the case rider or other road user) was significantly associated with four secondary or other factors: rider age, traffic density, inappropriate rider speed, or a road design issue.

Background

Motorcyclists are over-represented in road trauma statistics, due at least in part to their vulnerability in the event of a crash. Less than 1% of all vehicle kilometres travelled are by motorcycle or scooter (ABS, 2012), yet 18% of those seriously injured on Victoria roads in 2013-14 were motorcyclists (including pillions). Previous studies have reported that human error (either on the part of the rider or the other road user) is the most common primary contributor to motorcycle crashes (ACEM, 2004; Haworth et al., 1997). In the safe systems context, this indicates a failure of other elements of the road system to accommodate for human error. Therefore the purpose of this study was to identify secondary factors commonly associated with human error in multi-vehicle motorcycle crashes, based on the potential to find modifiable elements of the road system to prevent future serious injury to motorcyclists.

Methods

Eligibility and recruitment

Cases were riders of motorcycles or scooters who had recently been injured in a crash in Victoria, Australia. Recruitment was conducted between 2012 and 2014 as part of a larger case-control study (Day et al., 2013). Eligibility criteria included that the crash occurred on a public road in Victoria between 6am and midnight, and that the rider was aged 18 years or over. All procedures were approved by the ethics committees of Monash University and study hospitals where case riders were recruited.

Participants completed an interview-based questionnaire, which included questions about the events leading up to the crash, as well as contributing factors from their perspective, including the road environment, other road user(s), and themselves.

Crash investigation and assignment of contributing factors

A trained crash investigator conducted systematic investigations of the crash scene and case motorcycle. All possible contributing factors were then listed based on the crash investigation, rider interview, and police report where available. The first author collated information from each case and coded primary and secondary contributing factors according to the ACEM (2004) definitions, in consultation with the crash investigator where necessary.

Results

Human error was judged as the primary contributing factor in 99% of motorcycle crashes involving another road userwhich was attributed to the other road user in 69% of cases. From a safe systems perspective, at least one secondary factor was judged to have either definitely or probably contributed to the crash in 72% of these cases (overall mean 1.3 ± 1.1 secondary factors).

A stepwise logistic regression was carried out to test if any secondary or other factors were associated with human error as the judged primary contributing factor (ie. other road user error vs. case rider error). Four secondary or other factors were found to be significantly associated with human error (other road user or rider) as the primary contributing factor – age, traffic density, rider inappropriate speed or a road design issue. Increasing age was associated with a decreased likelihood that an error by the case rider was the primary contributing factor. Light traffic density was associated with an error by the other road user error as the primary contributing factor, whereas heavy traffic density was associated with rider error as the primary contributing factor. Inappropriate rider speed was significantly associated with other forms of rider error as the primary contributing factor. A road design issue was significantly associated with an error by the rider as the primary contributing factor.

Conclusions

In a safe systems context, the value of understanding multiple interacting factors to crash and injury outcome must be acknowledged. Younger riders, higher traffic density, inappropriate rider speed and road design issues were all significantly associated with rider error in crashes involving another road user(s). These findings provide a greater understanding of the interaction between rider, other road user and road environment factors in real-world multi-vehicle crashes, with implications for more effective countermeasures.

References

ABS. (2012). Survey of Motor Vehicle Use, 30 June 2012. Australian Bureau of Statistics, Canberra(9208.0).

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Day, L., Lenne, M. G., Symmons, M., Hillard, P., Newstead, S., Allen, T., McClure, R. (2013). Population based case-control study of serious non-fatal motorcycle crashes. BMC Public Health, 13, 72. doi: 10.1186/1471-2458-13-72

Haworth, N., Smith, R., Brumen, I., Pronk, N. (1997). Case-control study of motorcycle crashes (CR 174): Federal Office of Road Safety, Canberra

Research vs. Practice: An International Review of Challenges and Opportunities of Crash Prediction Models

Jiří Ambros[a], Chris Jurewicz[b], Shane Turner[c]

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Abstract

Over the past ten years, crash prediction models (CPMs) have become the fundamental tools of quantitative road safety management. However, there is a gap between state-of-the-art and state-of-the-practice, with the practical applications lagging behind scientific progress. This motivated the review of international experience with CPMs from the practitioner perspective. The main conclusions suggest the need to promote awareness of CPM benefits to road safety strategy and evaluation, policy and programs development, and in guidance development. The paper presents ways to better communicate choice of modelling techniques, CPM results and their practical applications, such as easy-to-use practitioner tools or mapping visualisations.

Background

Crash prediction models (CPMs, also known as safety performance functions, SPFs) enable estimating crash frequency and/or severity for a road section or intersection, using a combination of explanatory variables, which describe exposure (AADT) and other characteristics (e.g. region, treatment presence, road design attributes). Subsequently the models may be applied in estimating effects of individual risk factors, safety treatments or road safety impact assessments – this is why they have been acknowledged world-wide as recommended tools, on which rational road safety management should be based. However, there is a gap between state-of-the-art (what is published in academia) and state-of-the-practice (what is used by practitioners) (Elvik, 2010), and the practical use is lagging behind the scientific progress (Yannis et al., 2014).

Review

The mentioned gap motivated the following review, aiming to summarize international experience with development and application of crash prediction models, using examples from Europe, Australia/New Zealand and North America. The main focus was *practical* (from the perspective of *users*, such as road agency engineers and managers), which required compiling information from the "grey zone" between state-of-the-art and state-of-the-practice and thus often not academically published.

It was found that, although CPMs are based on solid statistical methods and techniques, there are several challenges and opportunities in wider use of the models by road safety decision makers, for example:

- Practitioner reliance on trusted but less robust methods to inform significant road safety decisions (e.g. opinion, single-site trials, pie-chart crash analysis). Opportunities exist for improved communication of available evidence sources.
- Modeller choice of relevant explanatory variables is sometimes driven by statistical robustness but not well aligned with needs of practitioners (e.g. relevance to road design, crash categories). Closer collaboration and inputs from practitioners, and larger data sets help to address this issue (Turner et al., 2012).
- Alternative of combining baseline CPMs with crash modification factors (CMFs) was promoted by US Highway Safety Manual (AASHTO, 2010), and adopted also in recent NZ Crash Estimation Compendium (NZTA, 2016), as well as forthcoming Australasian Crash

Estimation Manual. However, this practice is not straightforward, for example with using combined safety effect of multiple CMFs (Park and Abdel-Aty, 2015).

- Clarity of presentation of statistical modelling results and value to research clients and practitioners is needed. This requires a departure from the purely statistical forms (e.g. model parameters) towards those of direct interest to practitioners, e.g. crash reduction / modification factors, map visualisations, online and spreadsheet toolkits. Road assessment programs (RAP), such as iRAP, AusRAP or KiwiRAP have also provided interesting perspectives.
- Emergence of big data and distributed computing have made it easier to create powerful models at a lower cost, and keeping the models up-to-date. This offers new opportunities to generate CPMs from publically available data (e.g. Victoria's open data directory – https://www.data.vic.gov.au/).

There are also numerous scientific positions and alternatives, highlighting the complexity of choice of modelling techniques, which confound wider understanding and uptake of CPMs. These include issues regarding minimum data sample size, time period of used data, levels of aggregation, road network segmentation, forms of functions and over-dispersion parameter, etc. (Ambros et al., 2016).

Conclusions

Given the wide range of available choices, decisions during the modelling process are often up to the expert modeller. This may explain the broad diversity in models developed world-wide, which not only limits understanding and application by practitioners, but also complicates international comparability or transferability.

The overview enabled critical assessment of existing challenges and opportunities, leading to planning potential solutions. The main conclusions suggest that improved communication of the CPM value directly to research clients and practitioners in achieving their road safety objectives. This includes seeking direct practitioner inputs into model design and presentation of findings, while maintaining credible and transparent statistical methods.

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From Big Data to Speed and Safety: A Review of Surrogate Safety Measures Based on Speeds From Floating Car Data

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Abstract

In order to overcome biases of crash-based safety analyses, research is looking for surrogate safety measures (SSM). One potential SSM is speed from probe vehicles floating in traffic, which enable collecting data not limited in time and space. This paper summarises recent international knowledge on usefulness of speeds from floating car data (FCD) for safety monitoring and evaluation. It also discusses how well these compare with other known sources of speed, and concludes with the next steps needed for utilisation of FCD speeds in road safety.

Background

Traditional crash-based safety analyses have several limitations, including reactive approach, and statistically low occurrence of crashes. Surrogate safety measures (SSM) provide an interesting alternative, however, not all of them proved to have reliable relationship with crashes. For example, mean traffic speed changes were found to be acceptable as a general predictor of crash changes (Nilsson, 2004; Elvik, 2009, 2013); however, using speed as a standalone surrogate measure may be difficult (Tarko et al., 2009). Typically data for speed studies is collected using a mix of methods: hand-held radar guns, roadside traffic counters, or fixed loops or tubes (TRB, 2011), using a range of assumptions, e.g. regarding headway, which all add systemic errors. Also, existing methods assume that speeds measured at a point represent speed characteristics of traffic along an entire road segment or location. These data and model limitations have created a demand for more representative ways of measuring traffic speeds, and eventually, creation of more versatile speed-safety relationships.

Review

This paper explores emerging international research on measuring traffic speeds using big data sampled from vehicle fleets (also known as floating car data, or FCD). It reviews recent and current studies seeking to understand how well these speeds compare with known speed data sources. The paper also explores steps needed to use FCD speed data with confidence in road safety. Examples include:

- Travel speed analysed on approx. 1600 road sections in Israel, with GPS data sampled twice per minute (Bekhor et al., 2013).
- Free-flow speed data collection, using GPS data from 500 selected locations in Belgium (Diependaele et al., 2016).
- Collection of GPS and accelerometer data from more than 400 probe vehicles in Aalborg city (Denmark), with aim of identifying hazardous road locations (Reinau et al., 2016).
- GPS speed data from approx. 1000 company vehicles, sampled 4 times per second, used to identify hazardous curves on Czech national roads (Ambros et al., 2017).
- Jurewicz et al. (2017) looking at comparison between FCD speeds from a large sample of the general vehicle fleet and conventional point speed data (e.g. radar, tubes, TIRTL), across a range of Victorian road network situations.

Current knowledge on the topic is summarized in relation to usefulness of FCD speeds for safety monitoring and evaluation. The summary also highlights limitations which need to be targeted to improve this usefulness, including:

- Emergence of new and useful speed parameters not familiar to practitioners, e.g. safety effects of temporal speed changes, use of all-vehicle data rather than free-flow data.
- Need for FCD sample size guidelines
- Monitoring representativeness of vehicle fleets used in studies
- Uncertainties in determination of free-flow speeds
- Data privacy and licencing issues.

Conclusions

The paper concludes with the next steps needed for utilisation of FCD speeds in road safety, i.e. development of new speed-safety models for road segments and intersections, applications in speed management, speed limit enforcement, driver-vehicle communications, and also in road design.

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Use of Crash Data to Select and Deploy Mobile Speed Cameras in Queensland

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Abstract

Queensland's mobile speed camera program has had great success as a road safety initiative. In 2015 the camera detected offence program was responsible for annual casualty crash savings of approximately 3400 crashes (Newstead, Budd & Cameron, 2017). However, it was also recognized that any incremental improvement of mobile speed camera deployment could have a large road safety benefit. Therefore, a new mobile speed camera scheduler was created in Queensland in 2016 enabling the improved use of crash data in both the selection and scheduling of mobile speed camera sites. As part of the improvement, deployment sectors were created and analysed for crash location, camera location, detailed descriptions of crashes and deterrence areas for each site. The benefits of the changes including the identification and creation of over 200 new camera sites, will be discussed in this paper.

Background

In May 2016 the Queensland Police Service (QPS) introduced a new scheduler for the deployment of mobile speed cameras in Queensland. As part of the development of the new scheduler they approached the Department of Transport and Main Roads to work collaboratively to improve the use of crash data in the selection and deployment of mobile speed cameras.

Method

Road crash data was identified as a potential rich source of information to improve the selection and determination of speed camera selection and deployment. Although the camera detected offence program was responsible for annual casualty crash savings of around 3400 in 2015 (Newstead, Budd & Cameron, 2017), any incremental improvement of camera deployment could have a large road safety benefit. In particular the mobile speed camera program was associated with 98% of the crash savings.

Historically Queensland used circular speed camera zones which meant that there were gaps between the circles which did not allow for the selection of primary speed camera sites. As a first step, therefore, Queensland was remapped into deployment sectors resembling grid cells that provide 100% coverage and allowed for the creation of a new sites anywhere a sector met with crash criteria. An analysis was conducted using the remapped sites. Each new speed camera sector was mapped with crashes where speed was a contributing factor, current location of cameras and key characteristics of crashes including time, day, headed direction, crash type and vehicles involved. This allowed for the easy identification of sectors that had significant speed related crashes but no speed camera locations. This information was provided to QPS and they undertook detailed analysis of the crash data, from which they created over 200 new sites.

The scheduler is based on the principle of the public seeing cameras anywhere at any time. The scheduling of mobile speed cameras was based on the number of speed related crashes in the mobile speed camera zone. The greater the number of crashes, the greater the number of mobile speed camera deployments. For example a zone with eight crashes would be visited twice as often as a zone with two crashes.

Results

The deficiency of the previous scheduling method was that some sites were overvisited as they included crashes that were not influenced by the camera sites. Using a new method, each camera site is assigned its own deterrence area that determines a weighting of how often the site is scheduled. This means that rather than use all the crashes in a sector or zone to decide how often a site is visited, only those crashes that will be influenced by the mobile speed camera site are used. This more tailored road safety approach means that site deployment is now better aligned to reducing the incidence of road trauma.

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Road Safety Management at Main Roads Western Australia

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Abstract

Main Roads Western Australia is committed "To provide world class outcomes for the customer through a safe, reliable and sustainable road-based transport system". A cornerstone of this commitment is the aim to provide improved safety outcomes for all users of the (road) transport network as defined within the State Government's *Towards Zero* Road Safety Strategy 2008-2020 (Office of Road Safety, 2009). To achieve this, Main Roads has implemented a Road Safety Management (ROSMA) system based on Safe System principles. This paper describes ROSMA, one of the first of its kind, and its impact on road safety in Western Australia.

Background

In 2009 the Western Australian Government endorsed the *Towards Zero*, Road Safety Strategy 2008-2020 (Office of Road Safety, 2009). *Towards Zero's* main premise is death and serious injury should not be tolerated as inevitable consequences for using the road transport system. Like the road safety strategies of other high performing jurisdictions, *Towards Zero* is based on Safe System principles and sets ambitious targets for reducing death and serious injury. The Safe System acknowledges that even the most compliant road users make mistakes so the road system needs to be forgiving and cater for these errors. Furthermore, the Safe System views the road transport system holistically by seeking to manage the interaction between the cornerstones of Safe Roads and Roadsides, Safe Speeds, Safe Users and Safe Vehicles.

Strategy

Main Roads has a significant role with regard to road safety within Western Australia. As the state road authority, Main Roads is charged with managing and providing safe road infrastructure and operations to all road users. Therefore the strategy for reducing death and serious injury is focused on areas that Main Roads can directly influence, which include:

- Ensuring that projects implemented on the state road network by Main Roads and others are assessed, selected, developed and delivered with the aim of reducing death and serious injury.
- Ensuring that set speed limits contribute to Safe Speeds on both state and local government roads.
- Implementing policies for road design, for state and local government roads, in line with the Safe Roads and Roadsides cornerstone.
- Developing and delivering effective road safety treatment programs.
- Operating and implementing policies that manage the risk of death or serious injury when using our roads or while working on the road directly or indirectly for Main Roads.

Actions

In June 2016 Main Roads launched ROSMA; a Road Safety Management System. ROSMA has been developed in line with world best practice. Main Roads is one of the first road authorities to implement a road safety management system aligned with the international standard for Road Traffic Safety Management System (ISO39001:2012). The basic premise of ROSMA is a) understand the death and serious injury crash risk (or potential risk), b) determine targets (in line with National, State and Organisational road safety targets) and c) deliver solutions that mitigate the risk and help us reach our road safety targets. Implementation of ROSMA has been supported by training provided to Main Roads employees in all regional offices and key delivery branches within head office. When fully embedded, ROSMA will be ‘business as usual’ for all Main Roads activities, including but not limited to, infrastructure, operational and maintenance projects, and development of corporate practices and policies.

Conclusions

The implementation and adoption of ROSMA ensures the Safe System approach is embedded in all activities undertaken by Main Roads employees. ROSMA has had the additional benefit of promoting increased collaboration between areas within Main Roads and with external stakeholders. This further encourages the ultimate focus; to reduce the number of deaths and serious injury crashes on the WA state road network.

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Safety Effectiveness of Speed Reductions: A Queensland Experience

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Abstract

Previous Queensland Department of Transport and Main Roads (TMR) studies on the effect of speed reductions on crashes have demonstrated promising results for both high and low speed road environments. Recent analysis in Queensland by TMR has shown that a 10km/h reduction in posted speed limit can reduce casualty crashes by up to 39% in high speed environments and 26% in lower speed environments. Road authorities should use these findings to improve stakeholder communications on the safety benefits of speed reduction strategies. This paper shares the learning of Queensland speed reduction initiatives, provides a brief review of the available guide for speed reductions, and suggestions to improve the existing guidelines.

Background

Considering the importance of speed management on roads that have a history of high crash rates. TMR implemented speed reductions on selected high-risk road sections from 100km/h to 90km/h in 2008-09. In April 2009, Brisbane City Council (BCC) also reduced speed limits from 50km/h to 40km/h on the road network in Brisbane CBD to improve safety for vulnerable road users. There was a drop of 26% in casualty crashes if speed limit is reduced in lower speed environments, from 50km/h to 40km/h. This paper aims to share key learnings from TMR speed reduction intervention and suggests further works that could be undertaken to provide a robust framework for developing similar interventions in the future.

Method

A three-step process was implemented in selecting black links (defined as roads having high crash rates) for speed reductions in high speed environment. The following criteria were applied to identify these links in the first step (Edgar and Tripathi, 2011):

- At least two casualty crashes (over a 10 km section) within five years (this was considered because of the definition applied in federal black spot funding program);
- A daily traffic volume of more than 2,000 vehicles; and
- An existing speed limit of 80km/h or greater.

In the second step, the following four performance measures were used to rank the road links in order to identify black links.

- Equivalent Property Damage Only (EPDO) per 100 million Vehicle Kilometres Travelled (VKT);
- DCA (Definition of Coding Accidents) social cost;
- Casualties per kilometre; and
- Casualty per crash ratio.

The third step in the selection of black links for speed reductions involved consultation with stakeholders. The consultation provided opportunities for considering site specific issues in the implementation.

Evaluation of the safety effectiveness of speed reductions is undertaken using a simple comparison of pre- and post-implementation crash data. It is acknowledged that the method has limitations and the results may have been affected by other factors which have not been taken into account by the evaluation, including regression to mean issue.

Speed surveys were also carried out before and after the implementation of speed reductions.

Results

Evaluation of the effectiveness of speed reductions on roads with high speed environments were undertaken in the past and results reported in a number of studies (Edgar and Tripathi, 2011; Stapleton, 2013; Whittaker and Somasundaraswaram, 2013). There were also a number of evaluation studies undertaken in relation to implementing default 50 km/h which demonstrated promising results on crash reductions (Long, Kloeden & Hutchinson, 2006; Hoareau & Newstead, 2004; Hoareau, Newstead, Oxley & Cameron, 2002).

The evaluation of the effectiveness of speed reductions in high speed environments found that:

- Average reduction for fatal/serious injury crashes per year was 26%;
- Average total crash reductions was 39%;
- There was a significant increase in crashes on one road where the speed limit was subsequently increased back to 100km/hr;

Edgar and Tripathi (2011) previously reported that the 85th percentile speeds along all road sections reduced up to 12km/hr except on one road where speed remained almost the same.

Conclusions

There are significant opportunities for improving road safety outcomes in Queensland by implementing speed reduction strategies on roads which have records of high crash rates. Future works should be undertaken to investigate the value of incorporating infrastructure risks in identifying sections of roads with high crash rates for speed reductions. Provided future research works show the benefits of including infrastructure risks, the methodology to implement speed reduction strategies could be based on a combination of collective risks, individual risks and infrastructure risks.

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Posted Speed Limits: Where the Maximum is not Recommended. The Need for Discussion and Review of Speed Limit Settings

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Abstract

Excessive speed accounts for approximately one third of road casualty crashes (Corben, Liu, Oxley & Young, 2012). Speeding, by even a small margin, significantly increases the chance of being involved in a fatal collision (Kloeden, Ponte & McLean, 2001). Small reductions in speed, however, reduce this risk (Doecke, Kloeden & McLean, 2011). Safer roads designed to minimize collision impacts to within human tolerance levels also have an important role within a safe system. However, many roads with high posted speed limits traverse environments that are unforgiving of road user error. Where timely engineering and treatment options may not be possible, speed reduction has a critical role to play in mitigating road trauma in these areas.

Background

Victoria Police Road Policing Command strives to reduce levels of trauma on Victoria's roads. Victoria's Road Safety Strategy & Action Plan 2016//2020 (Victorian Government, 2016) is supported by the Victoria Police Road Safety Strategy 2013 – 2018 (Victoria Police, 2013) and Victoria Police Safer Country Roads Plan 2014 – 2018 (Victoria Police, 2014). The long term vision of police and road safety partners is to achieve zero deaths and serious injuries on our roads. Our target by 2020 is less than 200 road fatalities.

Country road users are three times more likely to be killed and 40 per cent more likely to be seriously injured than drivers in metropolitan Melbourne (Victoria Police, 2014). Accordingly, priorities that include implementing a range of enforcement and prevention activities on both metropolitan and country roads with the assistance of the community and our road safety partners have been developed. Victoria achieved a record low 243 lives lost in 2013 (Transport Accident Commission, 2014). While a number of strategies implemented by Government, our Road Safety Partners and Victoria Police contributed to this record low, speed and road design and conditions were, and continue to be, significant factors in Victorian road trauma. A reduction to speed limits must therefore be considered particularly where timely engineering and road treatment solutions cannot be applied.

Enhancing community safety on our roads

In 2016, there were 291 fatalities on Victorian roads. Frustratingly, 150 of these fatalities occurred on country roads. More than half of these were single vehicle crashes and 72 percent of the crashes occurred in 100 km/h speed zones (Victoria Police, 2017). Under a Safe System approach, Victoria continues to invest significantly in engineering and road treatment options that are designed to accommodate error and minimize impact forces on human tolerance levels.

Notwithstanding, many sections of Victoria's vast road system remain without engineering, design and treatments within the context of a Safe System. An absence of safety features such as roadside and central median barriers and other traffic separation and treatment options, too often expose road users to unforgiving roadside architecture. Multiplying this risk is the fact that many of these roads have high posted speed limits up to 100 km/h. Cognisant of the fact that such roads feature far too often in fatal crashes, the case for reviewing speed limit settings in lieu of applying engineering treatments is compelling.

A case for speed reduction

It is well established that higher speeds in crashes result in more severe impacts, higher crash energy levels and ultimately poor road safety outcomes. Outcomes can be improved by lowering speed limits, as well as investing in road infrastructure (Risby, 2015, p .39). Research tells us however, that some road users may place a high level of importance on mobility and may therefore be inclined or cho0se to drive at excessive speeds exceed speed limits by small margins (Transport Accident Commission, 2015). Drivers may also drive too fast unintentionally by underestimating their speed (Biervliet, Zandvliet, Schalkwijk, & Gier, 2010) overestimate what is considered to be an appropriate or safe speed, underestimate the danger of travelling at speeds that are unsuitable for the prevailing conditions and perceive that driving at speed is not a dangerous activity (Corben et al., 2012). It is essential that road users understand the risk and engage in dialogue regarding speed settings.

Conclusions

Road trauma reductions are achievable through safer speeds. Where timely road engineering and treatment options are not possible it is essential that we initiate informed discussion to revise speed limit settings and reductions on some of our rural roads.

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Head Protection for Wheeled Recreational Device Riders: Finding the Right Standard

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Abstract

To better regulate the wearing of helmets by riders of wheeled recreational devices in NSW, Transport for NSW commissioned a study to identify which local or international standards best met the head-protection needs of riders of wheeled recreational devices (WRDs). The study included a review of head injury risks based on a literature review and analysis of WRD-related fatalities recorded in the National Coronial Information System Database. Local and international standards were compared to identify which best met the head-protection needs of WRD riders. The local standards AS/NZS 2063 were found to be the most suitable for protecting WRD riders.

Background

Bicycle helmet use is mandatory in NSW as helmets have been proven to reduce the risk of serious injury, including traumatic brain injury, following a crash or fall. Only bicycle helmets complying with the standard AS/NZS 2063 may be worn.

Riders of wheeled recreational devices (WRDs), such as skateboards or roller blades, are permitted to ride without a helmet or with a helmet complying to a non-Australian standard, available for sale in Australia. Without guidance on the most appropriate helmet standard, consumers are at risk of using helmets that do not provide adequate protection.

To identify whether there is an existing helmet standard suitable for riders of WRDs, Transport for NSW commissioned research to identify whether there is a current standard suitable to meet the principal requirements for WRD helmet performance, and to assess the performance of helmets meeting current standards.

Method

A literature review relating to WRD crashes and injuries was conducted. The National Coronial Information System database was searched for activity level one category case between 2000 and 2016, and then searched on a case-by-case basis to identify those fatal crashes relating to WRD use. From this research, the head injury risks of WRD users were identified.

From these findings, a list of head protection criteria was developed. Performance testing requirements of Australian, European and American helmet standards that may be appropriate for WRD riders were assessed against these criteria. A sample of helmets meeting local and regional standards were tested to assess impact, retention strength and stability based on test methods described in AS/NZS 2063.

Results

The study, including the results from testing of helmet samples, found that EN1078, ASTM F1447 and AS/NZS 2063 best met the predetermined head protection criteria. AS/NZS 2063 was preferred over the other two as the requirements were more robust, including testing of a larger sample size, consideration of internal and external projections, and ventilation.

A preference for this standard also simplifies usage for younger riders and their parents who may use both WRDs and bicycles, and gives TfNSW the ability to oversee changes to the standard, which is not possible with international standards.

The literature review identified that an ideal helmet would provide additional protection across the occiput (lower rear of the head). However, testing showed that the additional level of protection is marginal, so the potential benefits of regulating this requirement do not justify the financial imposition and likely confusion of different helmet standards for bicycles and WRDs.

To allow for multiple low-impact falls when learning to ride or developing skills, an ideal helmet should also be able to protect against multiple low-severity impacts over a 12-month period. However, only one standard currently allows for repeated impacts (ASTM 1492-15). Testing of helmets complying to this standard showed that helmets did not provide a safe level of head protection in subsequent impacts. Therefore, it is not reasonable to impose this requirement at this time.

Conclusions

The Australian bicycle helmet standard AS/NZS 2063 is most suitable for protecting users of WRDs, providing the most robust protection and reducing the risk of consumers using the wrong helmet for their desired activity.

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Trends in the Burden of Serious Road Traffic Crashes in Victoria, Australia

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Abstract

Road traffic injuries are a major cause of death and disability. We investigated temporal trends in the incidence, mortality, Disability Adjusted Life Years (DALYs) and costs of health loss of serious road traffic injury in Victoria from 2007 to 2015. We observed a reduction in disability burden in motor vehicle occupants, motorcyclists and pedestrians, which was driven by decreases in fatalities. However, there was no change in serious injury rates for these road user groups. In contrast, DALYs increased 47% in pedal cyclists from 2007 to 2015. The costs of health loss from road traffic injury totaled over A$13 billion.

Background

In Australia, road traffic injuries are the second leading cause of hospitalised injury and injury-related deaths (Henley and Harrison 2015). As the likelihood of surviving serious injury increases, greater emphasis needs to be placed on reducing the burden of non-fatal injury (Cameron *et al.* 2006, Gabbe *et al.* 2010, Polinder *et al.* 2012). The aim of this study was to investigate the burden of road traffic injury in major trauma patients and fatalities in Victoria, Australia, from 2007 to 2015.

Methods

We performed a retrospective review of road traffic deaths (prehospital and in-hospital) and major trauma patients (injury severity score >12) using data from the population-based Victorian State Trauma Registry and the National Coronial Information System from 2007 to 2015. Disability-adjusted life years (DALYs) were used to measure disease burden and combined years of life lost (YLLs) and years lived with disability (YLD). Disability weights were calculated from the EQ-5D-3L responses of 10,954 adult VSTR cases with an ISS >12. Poisson regression was used to determine whether the incidence rate increased or decreased over the 9-year period.

Results

There were 10,092 road traffic fatalities and major trauma cases in Victoria over the 9-year study period; 2,026 prehospital deaths and 8066 hospitalised major trauma cases (of which 562 died in-hospital). There was no change in the incidence of hospitalised major trauma for motor vehicle occupants (IRR=1.00, 95% CI: 0.99, 1.01; P=0.70), motorcyclists (IRR=0.99, 95% CI: 0.97, 1.01; P=0.45) and pedestrians (IRR=1.00, 95% CI: 0.97, 1.02; P=0.73) (Figure 1). However, the incidence of hospitalised major trauma for pedal cyclists increased 8% per year (IRR=1.08, 95%

CI: 1.05, 1.10; P<0.001). The incidence of all road traffic deaths declined 4% per year (IRR=0.96, 95% CI: 0.94, 0.97; P<0.001).

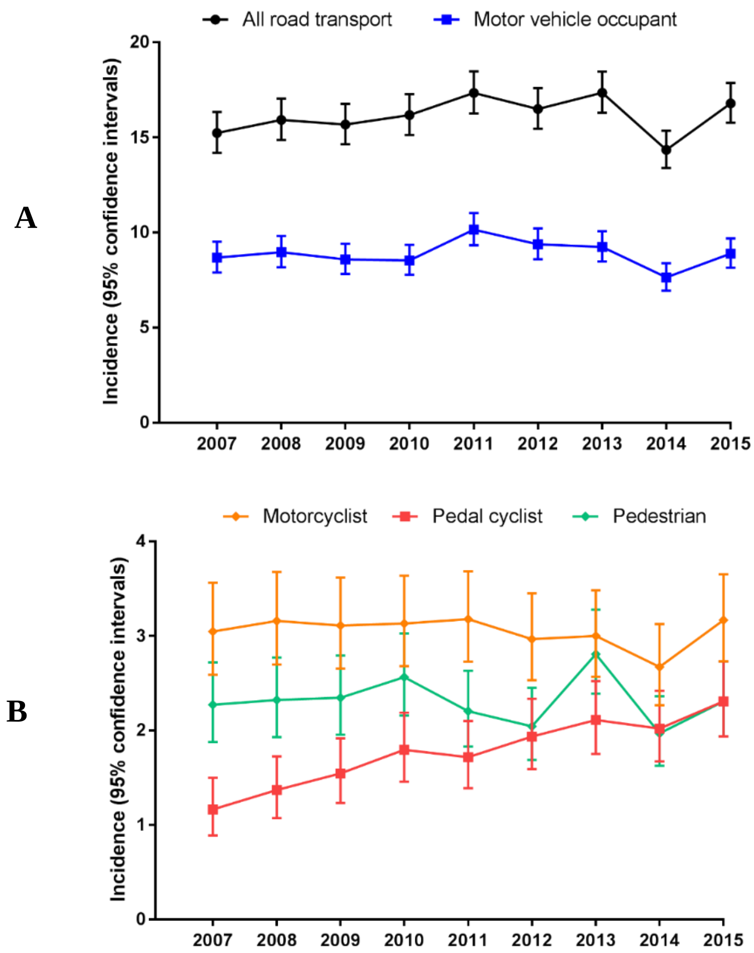

Figure 1. Incidence per 100,000 population (with 95% confidence intervals) over the period of 2007 to 2015 for all hospitalised road traffic major trauma patients and motor vehicle occupants (A) and for motorcyclists, pedal cyclists and pedestrians (B)

For all road traffic cases, there was a 14% reduction in DALYs from 2007 to 2015. Reductions in DALYs over time were also observed in motor vehicle occupants (14%), motorcyclists (34%) and pedestrians (6%). In contrast, there was a 47% increase in DALYs in pedal cyclists from 2007 to 2015. The total costs of health loss for major trauma and deaths over the study period were A$8,572 million for motor vehicle occupants, A$2,115 million for motorcyclists, A$608 million for pedal cyclists and A$1,757 million for pedestrians.

Conclusions

Over a 9-year study period in Victoria, Australia, the total cost of health loss from road traffic injury exceeded A$13 billion. We observed a reduction in disability burden in motor vehicle occupants, motorcyclists and pedestrians, which was driven by decreases in fatalities. However, there was no change in the incidence of hospitalised major trauma for these road user groups. Furthermore, temporal increases were observed in the incidence of hospitalised major trauma and DALYs in pedal cyclists. Given these findings, it is likely that current road safety targets, such as those set by the World Health Organisation and the Victorian State Government, will be difficult to meet. There is a need for greater attention on serious injury and further investment in road safety, particularly in pedal cyclists.

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Improving Cyclist Safety: Understanding the Relationship between Road Infrastructure and Passing Distance

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Abstract

Cycling-related injury rates are on the rise. As the majority of on-road cycling crashes involve interactions with motor vehicles, there is a need for greater understanding of factors that result in unsafe interactons, particularly unsafe passing events between motor vehicles and cyclists. Through the use of a purpose-built and independently calibrated ultrasonic device, this study aims to quantify passing distance and to assess whether passing distance is affected by specific types of road infrastructure. An on-road observational study is currently underway in Victoria that aims to address these knowledge gaps and improve cyclist safety.

Background

Cycling is an alternative mode of transport to motor vehicles that has numerous health and economic benefits (Oja et al., 2011; Grabow et al., 2012), however cyclists are considered vulnerable road users and injury rates are on the rise (Sikic et al., 2009; Henley & Harrison, 2012).

A large proportion of on-road cycling crashes involve interactions with motor vehicles (Teschke et al., 2012; Boufous et al., 2013; Yilmaz et al., 2013; Beck et al., 2016). Furthermore, nearly one quarter of on-road crashes occur when the cyclist is riding in a marked bicycle lane (Beck et al., 2016), demonstrating that current infrastructure for cyclists is inadequate and does not create a safe cycling environment. Furthermore, a recent review of cycling crashes in Victoria demonstrated that overtaking-related crashes are a major cause of cycling crashes with vehicles (Biegler et al., 2012). As a result, identifying situations in which vehicles pass in close proximity to cyclists is needed to develop a greater understanding of factors that lead to unsafe interactions between cyclists and vehicles.

The primary study aims are:

1. To quantify the distance between passing vehicles and cyclists;
2. To quantify where safe and unsafe passing events occur; and
3. To assess whether passing distance is affected by specific types of road infrastructure (such as marked bicycle lanes, the presence of parked cars next to bicycle lanes and road speed limits).

Methods

An on-road observational study is currently underway in Victoria, an Australian state yet to amend the road rules to legislate a minimum passing distance. Volunteer participants, recruited using a convenience sample, are recording all their cycling trips over a two week period. Participants' bicycles are fitted with a purpose-built and independently calibrated device that incorporates ultrasonic sensors that measure the lateral passing distances of all motor vehicles, a video camera and a GPS datalogger. The device will record the lateral passing distance, video footage, speed, and location. In addition, the device is fitted with a handlebar mounted button that participants' press when they feel a motor vehicle has overtaken them too closely. Video analysis will be conducted to quantify the vehicle type and on-road infrastructure, using the Cycling Aspects of Austroads Guides

(Austroads, 2017). Data analysis will focus on the association between actual passing distances, incidents of perceived unsafe passing and correlated with cyclist type, vehicle type and on-road infrastructure. The focus of the analysis will be on the proportion of vehicle passes that are less than 1.0 m.

Expected outcomes

The proposed project will be the first Australian study to quantify the distance motor vehicles provide when passing cyclists and will provide critical data on which road infrastructure types are most effective in reducing injury risk for cyclists. It is envisaged that the outcomes of this body of work will: 1) inform road design and educational campaigns, 2) reduce injury to cyclists, and 3) increase cycling participation through the reduction of perceived safety concerns that remain as a barrier to increased participation (Winters *et al.*, 2011).

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Innovative Estimation of Crash Reduction Factors

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Safe System Solutions Pty Ltd

Abstract

The crash reduction factor (CRF) for road safety treatments is the expected percentage change in crash rate after a treatment is installed. An innovative method was used to estimate CRFs by incorporating literature reviews, quantifying the quality of the study and the quality of the statistics cited, and disaggregating CRFs in terms of treatment, speed and type of crash. For treatments involving horizontal curve alignment, high reliability literature (reliability score greater than 20) was difficult to find. Nevertheless, the findings indicated that for crash types other than "head-on", the CRFs in current use appeared to be too high.

Background

The NSW Centre for Road Safety (CRS) uses an existing set of CRFs, determined some years ago, to calculate the expected percentage change in crash rate after a road treatment. A need was identified to establish revised CRFs based on the best available current evidence, in order to rigorously prioritise proposals for funding in Road Safety Infrastructure Programs.

There are many different methods to calculate CRF (Cairney et al., 2012) yet it is sometimes difficult to claim statistical reliability because the number of crashes is generally low. At the request of CRS, Safe System Solutions Pty Ltd examined CRF identification methods for five treatments related to horizontal curve re-alignment, as shown in the rows of Table 1.

Table 1. Horizontal curve re-alignment categories

Original radius range (metres)	Radius range after horizontal curve re-alignment (metres)
200–600	600–1000
200–600	>1000
<200	600–1000
<200	>1000
600–1000	>1000

Method

The innovative method employed to devise CRFs was a literature-review based method, incorporating statistics, quantifying the quality of the study and the quality of the statistics cited. In addition, CRFs were disaggregated in terms of treatment, speed categories and crash types based on NSW RUM (Road User Movement) codes. Disaggregation was important because CRFs vary greatly by these variables.

Each item of literature was objectively assessed for the reliability of its findings (Austroads, 2010) by calculating two scores: the robustness of the result, depending on the quality of the research (study rating) and the statistical confidence levels (accuracy rating). These were combined to produce a reliability score for each CRF which impacted on the weighted-mean CRF. That is, studies with high reliability scores had greater weighting in the revised CRFs.

Results

Figure 1 depicts an example of the results for treatment of the horizontal alignment from radius <200m to >1000m for two RUM categories (head-on, and ‘off-left on right hand bend’). CRFs reported in the literature for crashes ‘off left on a right hand bend’ were noticeably lower than the existing CRFs used by CRS, indicating that this treatment is less effective at reducing high speed crashes than is presently assumed. For this treatment the existing CRF approximates the literature-weighted mean for head-on crashes but overestimates for all other crash types. This study highlighted that while there is extensive literature that can be used to sub-divide CRFs, high reliability literature (reliability score greater than 20) for horizontal curve re-alignment is difficult to find.

RUM Code groups					20; 50				80			
Crash Description	Total crashes				Head-On				Off Left on R/H Bend			
Speed zone	60k or less	70k or 80k	90k or greater	Reliability	60k or less	70k or 80k	90k or greater	Reliability	60k or less	70k or 80k	90k or greater	Reliability
Existing default CRF used by CRS						20	40			65	95	
US Author 1 (speeds up to 45 mph only)	41.5			4								
Australian Web Site			80.5	1								
Australian Author 1											61.1	8
Australian Author 2			74.4	16								
Australian Author 3			100	2								
US Report 1	16.2	42.1	67.9	16								
Turner, Singh and Nates, 2012					23	23	23	20	16.9	16.9	16.9	20
Ona et al., 2013			25.4	20								
Montella, 2009							68.5	20			89	20
Othman, Thomson, Lanner, 2009										60.4		21
US Web Site Study 1			69.5	15								
US Web Site Study 2										66		15
Average Reliability	10.0	16.0	11.7		20.0	20.0	20.0		20.0	18.7	16.0	
Literature-based weighted-mean	21.3	42.1	58.7		23.0	23.0	45.8		16.9	46.4	54.3	
Confidence (based on the average reliability)	L	M	L		M	M	M		M	M	M	

Figure 1. Extract of results showing CRF values for horizontal alignment treatment from radius < 200 m to > 1000m disaggregated by speed class and RUM code group. Reliability scores 15 to 20 are medium (M) reliability. Studies with reliability scores <20 are kept anonymous.

Conclusion

The study appraised the available published literature to develop a more robust approach to estimating crash reduction factors so as to better quantify the effect that horizontal curve re-alignment treatment has on reducing crashes. The findings demonstrate that for crash types other than “head-on”, the existing CRFs used by CRS appear to be too high.

Though the value assigned to the study reliability is objective, being based on documented criteria, there is a subjective element in deciding whether to incorporate low reliability studies or to exclude them. This abstract has included all studies. Present CRS policy is to exclude low reliability studies.

The same approach has also been used to establish revised CRFs for all road safety treatments used in the NSW Safer Roads Program.

Acknowledgements

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Novice Drivers and Parents: Exploring the Feasibility of Third Party Policing in Reducing Young Driver Offending

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Abstract

Parents are ideally placed to partner police in ensuring their children do not violate traffic laws. While studies in Queensland suggest that Third Party Policing is an appropriate theoretical framework to guide interventions, the effect of jurisdiction is unclear. To explore whether the framework is applicable in different contexts, semi-structured interviews were conducted with 16 parents and 11 of their children in the Australian Capital Territory (ACT). The ACT has a contrasting licensing structure featuring fewer licensing requirements and restrictions and compulsory pre-learner education, making it unique amongst Australian jurisdictions. Results indicate that parents from different jurisdictions approach driving-related parenting in a way that is consistent with the TPP framework. Developing interventions with a TPP framework that involve parents and utilise regional knowledge, may increase compliance amongst novice drivers.

Background

Young newly licensed drivers have higher crash rates than other groups (Bates et al., 2014). To date, the most successful countermeasure to reduce these crashes is Graduated Driver Licensing (GDL). However, young drivers do not always comply with traffic laws (Bates et al., 2014). While traffic law enforcement is used to change driver behaviour (Bates et al., 2014) and seems to have public support (Shaaban, 2017), recent Australian studies have indicated that formal deterrence approaches are not sufficient in policing young drivers (Allen, Murphy & Bates, 2015).

Third Party Policing (TPP) is a form of joint policing or support provided to police in order for them to maintain law and order (Smith & Alpert, 2011). TPP has been successfully applied in contexts such as controlling drug, alcohol and disorder crimes in entertainment areas (Manning, Mazerolle, Mazerolle & Collingwood, 2014) and limiting the production of methamphetamines (Webster, Mazerolle, Ransley & Mazerolle, 2017). However, it is yet to be trialled and evaluated in road policing. Given that there is an implicit assumption within GDL systems that parents should be involved and influence their children at both the learner (Bates, Watson, & King, 2014) and provisional stages (Brookland, Begg, Langley, & Ameratunga, 2014), they are ideal candidates to partner with police within a TPP framework. Recent research with Queensland parents identified that, even when they did not have full knowledge of GDL requirements, parents believed themselves responsible for encouraging their young drivers' compliance with licence restrictions (Belsham, Lennon, Matthews & Bates, 2016). However, given the diverse GDL restrictions across Australia, the impact of jurisdictional differences remains unclear. For instance, Queensland implicitly encourages parental involvement by requiring novices to complete 100 hours of supervised driving practice as a learner. In contrast, new drivers in the Australian Capital Territory complete a compulsory driver education course. Therefore, this study explores the utility of a TPP framework in a jurisdiction with a differing GDL system, the Australian Capital Territory (ACT).

Method

Participants were recruited through *Road Ready* centres (a provider of the compulsory pre-learner driver program) in the ACT, print media, and local radio stations. Semi-structured interviews were conducted with 16 parents (14 mothers and 2 fathers) of 26 provisional drivers (12 girls, 14 boys; age range of 17 to 24 years old). Of these young people, 11 agreed to participate in the study (6 males, 5 females), aged 17 (n = 8) and 18 (n = 3) years. All interviews were conducted by telephone and participants were compensated with gift certificates. Transcripts were then analysed using Nvivo 11 software.

Results

Parents from the ACT reported similar beliefs to Queensland parents and were consistent with the TPP framework being applicable. For instance, ACT parents believed they had a responsibility to support their new driver to comply with the laws. However, jurisdiction does appear to influence the manner in which this occurs. Analysis of parenting styles, which were established through parental and provisional driver reports, also suggests that an authoritative parenting style may be associated with a more accurate understanding of the difficulties faced by novice drivers. Parents with the authoritative style also appear to provide various forms of support to assist their young person to comply with GDL restrictions.

Conclusions

Parental beliefs in relation to their parenting responsibilities, their willingness to support novice driver compliance, together with their lack of knowledge of the GDL system in the ACT suggests that the TPP framework has value particularly when combined with regional knowledge. Specific interventions based on this framework may thus be effective at improving compliance in novice drivers. Moreover, parents appeared to be actively seeking guidance, which suggests the uptake of such interventions may be high. We suggest there is a need to develop an intervention that utilises this framework.

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Austroads Project: Road Cross Section Design, Road Stereotypes, Network-Wide Safety Plans and Safe System

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Abstract

With current and emerging practices in road design and road safety, as they relate to road cross sections, road agencies across Australia, New Zealand and a number of other countries have been making changes to the typical road sections to address context. This presentation will provide road planners, designers and safety practitioners dimensional guidance when implementing recommended treatments proposed under the safe system assessment. It will use road stereotype matrices to proactively support road design and road safety decision making. This is potentially a world-first performance-based road design approach in relation to road attributes for safety.

Introduction

With current and emerging practices in road design and road safety, as they relate to road cross sections, road design practitioners, road safety practitioners and road network managers are requiring guidance in regard to their application. Road agencies across Australia, New Zealand and a number of other countries have been making changes to the typical road sections to address context. Adopting these changes and integrating them into the Austroads Guide to Road Design must be performed with due diligence to ensure that while one functionality of the construction/maintenance lifecycle is enhanced by the changes, a negative impact is not inadvertently introduced at the same time.

The project will provide road planners, designers and safety practitioners dimensional guidance when implementing recommended treatments proposed under the safe system assessment framework with the contemporary outcome statement of "*safe mobility*". It will use road stereotype matrices to proactively support road design and decision making.

This project will deliver an innovative world-first outcome and meet the strategic priorities by supporting:

- Network-wide standard setting for corridors, corridor planning for cross section visions and investment decisions as part of safety plans
- Application of safe system thinking in an informed and measured way and the provision of warrants and dimensional guidance to support safe system
- Combined decision making for road designers and road safety practitioners for the best overall outcome
- An integrated approach to decision making including the disciplines of design, safety, planning and economics
- Capability development of practitioners when making the key road component and treatment decisions
- Use by time-poor road practitioners (for example local government engineers)

Objective and Issues

There have been many requests for the attributes used in calculating the priority of treatments and the priority of treatments across a cross section. There is a priority requirement to make the inherent risk of road components transparent to decision makers for network, corridor and project level decisions. This is particularly true when engineering decisions impact on safety and consequently the legal liability in decision making.

The overarching principles that have driven the design and development of outputs are:

- Harmonise all related for defined set of road stereotypes
- Provide consistency in the practical application of safe system treatments which can be realistically implemented
- Provide the outcome of a self-explaining road
- Support network-wide decision making so that the broader risk compensatory benefits from driver decisions can be realised.

A benefit of this project is to ensure that new design practices will provide value for money in road design as well creating the safest motoring environment.

Scope

The project has studied information on current and emerging practices, particularly those that may be innovative or unusual to ensure that they have been appropriately assessed and considered. The project will confirm their expected benefits and investigate the potential for unexpected adverse consequences.

The expected change will be the ability to use performance-based (safety risk) road design standards to inform network-planning (construction and intervention standards) which will constrain project treatments when ensuring a consistent road corridor. This is expected to be a possible world-first in performance based road design standards which proactively drives the safe system thinking into planning and subsequently into every day projects.

Network planning tasks and all road infrastructure programs, for example, safety programs, network planning programs, infrastructure enhancement programs, capital investment programs.

Providing guidance to designers and network operators in the implementation of safe system principles in light of competing demands associated with asset management, network analysis/management and delivery in the context of a performance based design process.

A key feature of the project was to set up the formats to ensure the stereotypes were easy to use and supported for:

- all road classes and types and scalable for all road jurisdictions
- both state and local government controlled road networks
- Identify the key infrastructure components which can be treated or enhanced to provide the greatest benefit to road user safety.
- both rural and urban situations,

- the range of typical combinations of cross section attributes from existing asset situations to aspirational 5 star safe road environments
- Road characteristics and dimensions (for treatment) which provide a balanced crash risk outcome for all road users and crash types
- Dimensional guidance to aid implementation of the Austroads Safe System Assessment Framework
- Highlight the incremental benefit for staged treatments to meet the higher order objective of a consistent corridor
- link this transparent and proactive decision-making process with star rating values.

The Impact of Environmental Factors on Cycling Speed on Shared Paths

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Abstract

Cycling speed on shared paths is important to the amenity and safety of users.Speed was measured for 5421 riders using shared paths across Sydney. Multivariate analysis indicated that riders were less likely to cycle above the median speed on shared paths with a volume of over 20 pedestrians/hour and more likely to travel above the median speed on paths with a centreline, on wider paths and those with visual segregation between cyclists and pedestrians. The findings suggest that riders adjust their speeds according to shared path conditions and to accommodate pedestrians and highlight the importance of shared path design to the safety of users.

Background

In various countries, shared paths are frequently used to meet demand for cycling facilities that are separate from motorised traffic when space or resources are deemed inadequate for a bike-only path. While they often offer pleasant riding experience, there are increasing concerns about the safety offered by shared paths, particularly for pedestrians (Poulos et al., 2015; De Rome et al., 2015). Cycling speed is a key factor in the likelihood and severity of crashes on shared paths, particularly for collisions between cyclists and pedestrians where the wide difference in speed between these user groups may result in serious injuries to the pedestrians (Chong, Poulos, Olivier, Watson, & Grzebieta, 2010). Despite the importance of cycling speed on shared paths to the amenity and safety of users, few studies have systematically measured it, nor examined circumstances surrounding it.

Method

Speed was measured for 5421 riders who were observed cycling on shared paths across 12 metropolitan and regional locations in Sydney, Australia. At each location an "observation zone" of approximately 30m was selected – to allow good visibility for observers and for videoing. At one end of each observation zone a 4m "speed measurement stretch" [SMS] was marked out by drawing lines on the path. Video equipment (GoPro Hero 3 Black Edition camera) was set up centred on the SMS and at a minimum of 1.5m back from the path-edge to capture the view of bicycle tyres crossing the lines in the SMS for speed measurement. The time taken to cover the 4m speed measurement stretch (determined by video frames) was employed to calculate speed. Multivariate regression analysis was carried out to examine rider and environmental factors that contribute to riders cycling above the median speed.

Results

The study found that observed riders travelled at a median speed of 16 km/h (mean 18.4 km/h). Nearly 80% of riders travelled at 20 km/h or less and 7.8% at speeds of more than 30 km/h. Multivariate regression analysis indicated that riders were significantly less likely to cycle above the median speed on shared paths with an average volume of over 20 pedestrians/hour. Riders were significantly more likely to travel above the median speed on paths with a centreline (OR: 1.71, 95% CI: 1.41-2.07), on wider paths (over 3.5 m) compared to narrower paths (OR: 1.34, 95% CI: 1.12-1.59) and on paths with visual segregation between cyclists and pedestrians. Visual segregation was the strongest predictor of cycling travelling above median speed on shared paths (OR: 3.87, 95% CI: 3.09-4.84).

Table 1. Multivariate regression analysis of factors that contribute to cyclist riding above the median speed of 16 km/h on shared path

	Univariate			Multivariate		
	OR	**95%**	**CI**	**Adjusted OR**	**95%**	**CI**
Width of the path						
3.5 m or less*	1			1		
More than 3.5 m	2.19	1.96	2.45	1.34	1.12	1.59
Centreline						
Absent*	1			1.00		
Present	1.4	1.3	1.6	1.71	1.41	2.07
Visual segregation						
No*				1		
Yes	4.58	3.93	5.34	3.87	3.09	4.84
Commuter path						
No*	1			1		
Yes	2.48	2.22	2.78	1.1	0.98	1.24
Pedestrian volume on path (per hour)						
<20*	1			1		
20-99	0.48	0.42	0.55	0.66	0.54	0.80
100-199	0.09	0.07	0.11	0.15	0.11	0.20
>=200	0.46	0.39	0.53	0.61	0.45	0.81
Gender						
Male*	1			1		
Female	0.45	0.39	0.52	0.42	0.36	0.50
Age **						
20-29*	1			1		
14-19	0.35	0.20	0.61	0.53	0.29	0.96
30-44	0.92	0.81	1.04	0.77	0.67	0.88
45-64	0.68	0.58	0.80	0.55	0.46	0.66
65+	0.25	0.15	0.40	0.18	0.10	0.30
Interaction with pedestrian						
No*	1			1		
Yes	0.66	0.59	0.74	0.85	0.73	0.98
Weekend						
No*	1			1		
Yes	0.52	0.43	0.62	0.52	0.42	0.64
Time of the day						
AM*	1			1		
PM	0.57	0.51	0.64	0.49	0.44	0.56

**Reference category*
*** As estimated by observers*

Conclusions

In the absence of separate cycling infrastructure that is exclusive to cyclists, shared paths are important, particularly for young and inexperienced riders who perceive them to be less risky than roads. The findings suggest that riders adjust their speeds according to shared path conditions and to accommodate pedestrians. They also highlight the importance of shared path design features that are adequate to traffic volume and speed and have the potential to improve the safety of users. These include appropriate width, the presence of a central line and visual or even physical separation.

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Integrated Booster Seats: Crash Protection, Ease of Use and Child Induced Errors in Use

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Abstract

Integrated boosters are approved restraints and have potential to provide superior performance than add-on boosters. However no comparative data is available. This paper presents a program of work examining comparative crash protection, ease of use and likelihood of misuse between integrated and add-on boosters. The results reveal few differences in crash protection. However, good side impact protection in the integrated booster requires the presence of a side curtain, and better lateral support for non-struck side occupants. The integrated booster was easier for parents to install but did not demonstrate any benefit in reducing child induced misuse.

Background

Integrated boosters are treated as approved child restraint systems in Australia, but do not have to comply with the mandatory product standard regulating the performance of other types of child restraints available in Australia. In theory integrated boosters could provide enhanced crash protection, and reduce likelihood of misuse. However, no data on the comparative performance of integrated boosters and Australian add-on boosters is available. The specific aims of this study were to:

- Assess the real world crash performance of integrated boosters.
- Compare integrated boosters and add-on boosters' performance using controlled crash testing.
- Identify challenges faced by families trying to comply with current child restraint legislation and the potential of integrated boosters to alleviate these.
- Evaluate the ergonomics of integrated boosters to establish the potential for improved restraint fit, comfort, and in-vehicle posture.

Method

Existing real world crash data from North America and Sweden was reviewed. Crash performance was examined using four frontal sled impact tests and two full scale vehicle side impact tests. Ease of use was examined by comparing an integrated booster and an add-on booster using CREP protocols, observed parent installations, and a family survey. Ergonomics were investigated using a laboratory observation study.

Results

Review of real world data revealed no evidence of a difference in protection provided by integrated boosters compared to add-on boosters. In terms of crash protection, the integrated booster performed the same, or better than current add-on boosters in frontal impact and side impacts for an occupant on the struck side. However, side impact performance was reliant on the presence of a side curtain airbag, which is not present in all cars.

Compared to an add-on booster, the integrated booster lacked lateral support for the head and torso. Poor control of lateral motion of the non-struck side occupant was observed in the integrated booster. Seatbelt pre-tensioners may rectify this, however this needs to be confirmed.

The primary barriers to compliance with legislation among Australian families were issues surrounding compatibility between child restraint and vehicle design, and the ability to install three restraints across the rear seat. Integrated boosters can solve the compatibility issues, but will not necessarily make it easier to install three restraints.

Parents perceive integrated boosters as easier to use than add-on boosters, and the integrated booster scored very well using the CREP ease of use evaluation. There were also fewer parent induced errors in installation and securing of the child in the integrated booster compared to the add-on booster.

The integrated booster did not reduce child induced errors, posture or improve seat belt fit compared to the add-on booster.

Conclusions

Current Australian legislation is adequate but could be strengthened by including requirements in the relevant Australian Design Rules that integrated boosters be supplied in outboard positions in combination with side curtains. Until policies are in place to ensure good side impact protection for all positions, and to minimise child induced errors, there is no evidence to support active encouragement of integrated boosters. The exception may be in commercial vehicles and in aftermarket third row seats where integrated boosters could address barriers to optimal child restraint use in these situations.

Acknowledgements

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Trees in the Roadside as Factor in Road Safety in Poland

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Abstract

Roadside-related crashes occur when vehicles run off the road. The majority of the crashes have severe outcomes, especially when an object is hit (tree, pole, supports, culvert headwall, or safety barrier). Understanding how the different road and roadside elements affect safety must be based on in-depth studies. Data from sections of Polish national and regional roads were used to building crash-predictive models quantifying effects of road design and traffic factors on and their effect on road safety measures.

Background

Roadside trees are one of Poland's most serious road safety issues. Since 2009 more than 2800 people have been killed as a result of tree collisions. This represents about 15% of all of Poland's accident fatalities between 2009 and 2013. In some of the country's regions striking a tree caused more than 30% of all road accident fatalities. With technical policy, guidelines and practice not based on recent road safety science, roadside environments are posing a serious danger to safety. As we know from a number of studies looking at how specific road factors affect roadside safety, the roadside environment and its components are critical (trees, vegetation, shoulders, embankments, drainage ditches, poles, signs, engineering objects, etc., as per Budzynski and Kustra, 2012; AASHTO, 2010; Lee and Mannering, 1999; Viner, 1995; Zegeer and Forrest, 1995; Jurewicz and Troutbeck, 2012). There is a need to develop more precise road safety analysis tools which can inform revision of technical policy, guidelines and best practice.

Method

Analyses of models of how roadside elements affect road safety (EASTS, 2005; Elvik, 1994; Karim et al., 2012; RISER, 2006) showed that the methodologies and data differ from model to model. Because the models focus on different factors, often dictated by the available data, each has its strengths and weaknesses. The objective of the model is to estimate the expected number of victims of accidents on national roads per kilometre of road over a specific period.

New analytical models for estimation of frequency of roadside casualty crashes (striking a tree, a barrier, hitting a utility pole or sign) and of their severity were developed to serve as comprehensive roadside safety monitoring tools Polish conditions. The methodology has potential to inform future statistical modelling in other jurisdictions including Australia and New Zealand. The design of the model was based on review and lessons learned from relevant recent international studies.

Results

The findings demonstrated the effects of potential roadside safety treatments, focussing on the independent factors influencing density of roadside casualty crashes. The victim density model is described with the following formula:

$$GOF(Y) = \alpha \cdot Q^{\beta_1} \cdot e^{(B^{\beta 2} + S^{\beta 3} + T_1^{\beta 4} + T_2^{\beta 5} + T_3^{\beta 6} + C^{\beta 7} + P_1^{\beta 8} + P_2^{\beta 9} + P_3^{\beta 10})} \quad (1)$$

where:
GOF(Y) - expected number of accident victims per kilometres of road (dependent variable)
A - adjustment coefficient
Q - annual average daily traffic (AADT)

βj (1,2,…,n) - calculation coefficients
B,S,T1,T2,T3, C,P1,P2,P3 - factors related to the risk of an accident.

Another study conclusion is that (Fig. 1 – the effect of trees up to 3.5 m from the edge and barriers, with other parameters averaged) the length of sections with hazardous elements and their safeguards has no real effect on the number of victims. GOF results were almost identical for a 20% rate of section with trees (T1) and barriers (RB) and when both elements had a 60% coverage.

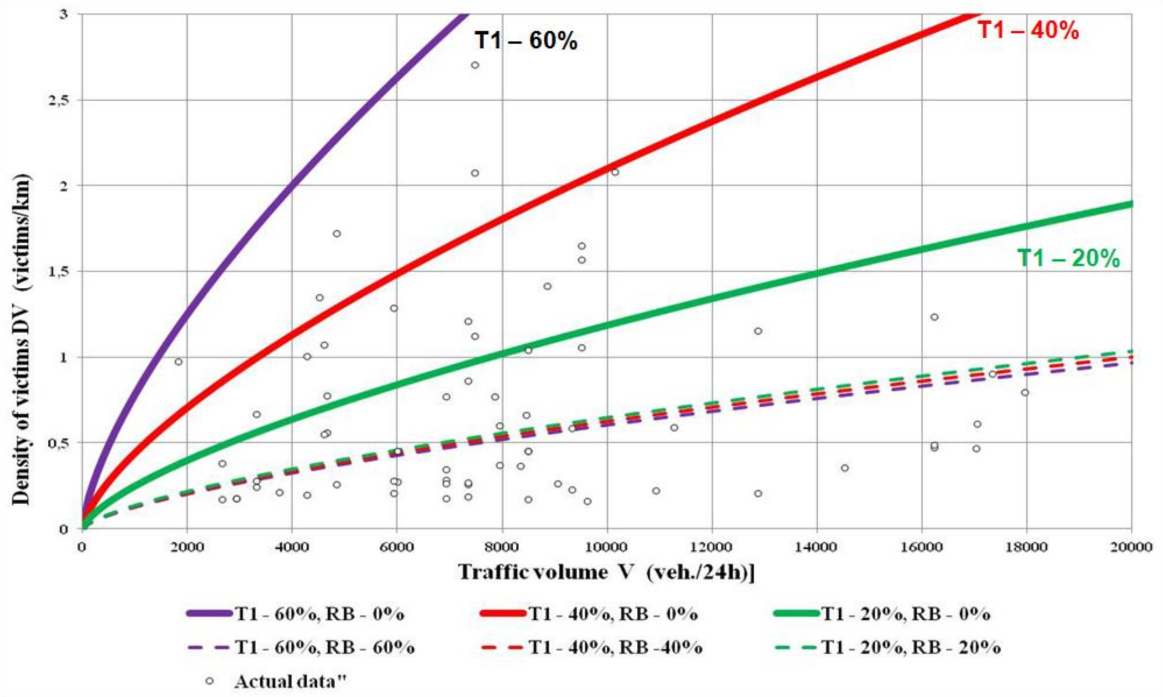

Figure 1. Density of victims (DV) in relation to barriers and trees

Conclusions

The main findings discussed in the paper are:

- characterization and assessment of the safety problem associated with the environment of roads
- analysis of the impact of roads on the environment safety of their users
- modeling the impact of trees on road safety
- the potential choice of measures to improve safety

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A Desktop Model for Computing Acceleration Severity Index (ASI) for Rigid Barriers as a Function of Impact Configuration

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Abstract

Acceleration Severity Index (ASI) is a vehicle occupant risk indicator measured during homologation of road safety barriers. Efforts to correlate occupant injury risk with ASI exist (Li et al., 2015; Roque & Cardoso, 2013; Shojaati, 2003). Hence there is value in exploring how ASI might vary with impact configuration (impacting vehicle mass, speed and angle). This paper describes the development and testing of a desktop model for predicting ASI in impacts with rigid barriers as a function of impact configuration. The efficacy of the model is tested against published data.

Background

Burbridge and Troutbeck (in press) report on the results from full-scale crash tests into a range of road safety barriers, and conclude, among other things, that occupant risk measured in terms of ASI is likely to be a function of the speed, mass and angle of the impact as well as the flexibility of the barrier system. Subsequent review and analysis of the same data (with slight amendment) suggests that the relationship between barrier flexibility and the reciprocal of ASI (1/ASI) is a linear function, and that the shape (slope) of the linear function is a function of impacting vehicle mass, speed and angle (Figure 1).

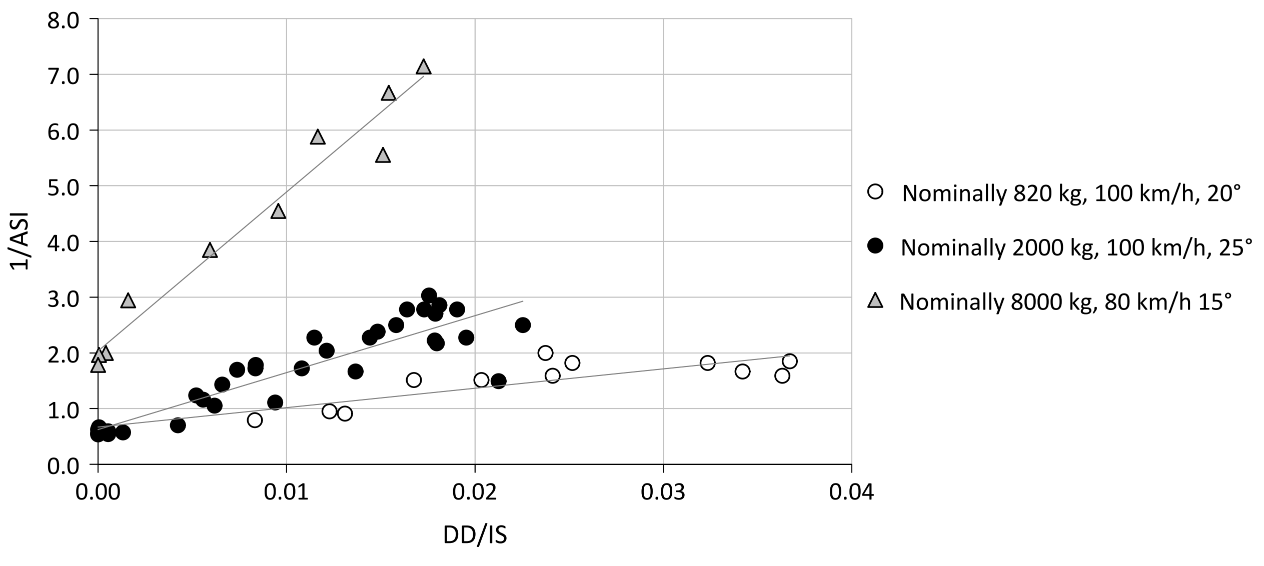

Figure 1. Analysis of data from Burbridge and Troutbeck

Similar relationships are evident in re-analysis of parametric crash testing reported by Hammonds and Troutbeck (2012)(Figure 2), and in analysis of data reported by Anghileri et al (Figure 3).

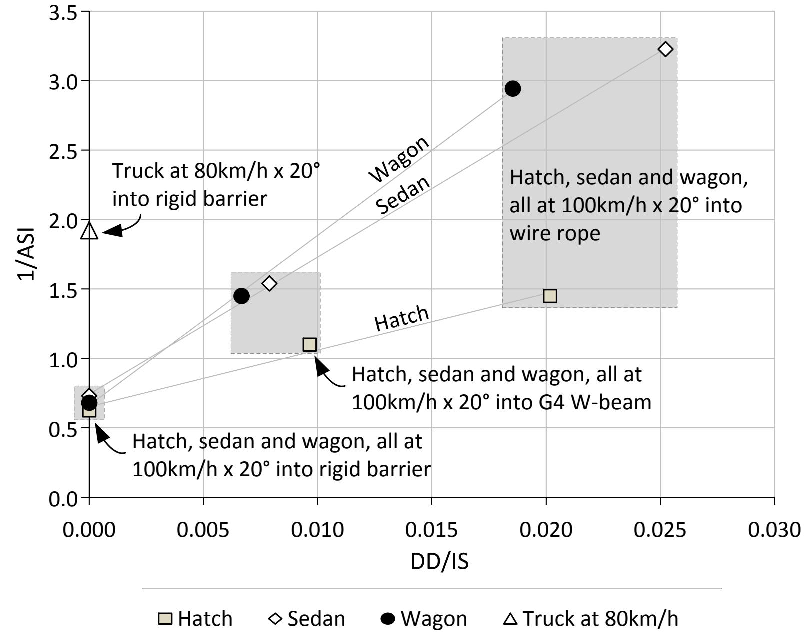

Figure 2. 1/ASI v flexibility plot using data from crash testing reported by Hammonds and Troutbeck (2012)

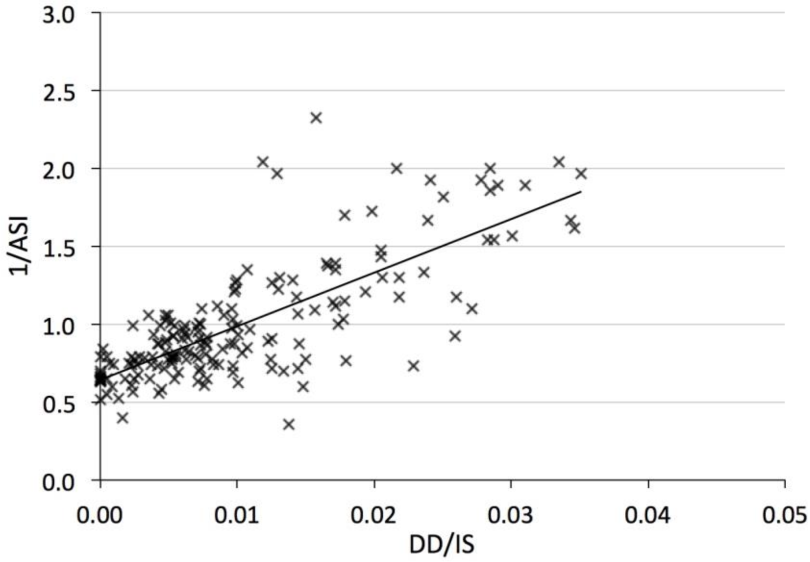

Figure 3. 1/ASI v flexibility plot of 174 no. EN1317 TB11 test results from Anghileri et al (2005)

In summary, it is conjectured that:

$$\frac{1}{ASI} = a\frac{DD}{IS} + b \qquad \text{Equation 1}$$

and thus:

$$ASI = \frac{1}{a\frac{DD}{IS} + b} \qquad \text{Equation 2}$$

where 'a' is the slope of the proportional relationship between 1/ASI and flexibility, while 'b' is the y-intercept. So for rigid barriers (where dynamic deflection is zero):

$$ASI = \frac{1}{b} \quad \text{Equation 3}$$

The hypothesis then is that ‘b’ is a function of mass, speed and angle, such that:

$$b = K_b m^{\alpha_b} v^{\beta_b} (\sin\theta)^{\gamma_b} \quad \text{Equation 4}$$

and thus:

$$ASI = \frac{1}{K_b m^{\alpha_b} v^{\beta_b} (\sin\theta)^{\gamma_b}} \quad \text{Equation 5}$$

where K_b, α_b, β_b and γ_b are constants.

The broad objectives of this study are to construct and then test a desktop model that will predict ASI for impacts into rigid barriers according to the expression in Equation 5.

Method

A least sum of the squared differences (SSD) regression is undertaken for 35 full scale impacts into barriers where impacting vehicle mass, speed, angle, ASI and zero dynamic deflection are reported in order to determine ‘best-fit’ values for K_b, α_b, β_b and γ_b. (Test data will be tabulated and reported with source cited in the full paper submission).

Analysis of the results includes correspondence plotting and CUmulative REsidual (CURE) graphs (Hauer, 2015) for each independent variable, accompanied by some discussion of the limitations of the model.

The model is then used to predict values for ASI for various impact configurations, which are compared with values generated in corresponding parametric simulations conducted earlier by Montella and Pernetti (2004).

Discussion and conclusions

The study is expected to conclude that the model has some level of validity, but is observed to contain some bias which could be attributable to (for example) variation in the stiffness of standard crash test vehicles between and across crash test protocols and questionable independence of the independent variables. The model would benefit from further refinement, ideally based the results from full scale crash testing in configurations beyond those prescribed in the test protocols.

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The Future of Innovative Safety Crash Barrier Systems

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KSI Global Australia Pty Ltd

Abstract

An innovative road side crash barrier re-engineered and internationally accredited to Manual for Assessing Safety Hardware (MASH) TL4 by Australian company KSI Global Australia Pty Ltd, is redefining the future of efficient and effective safety crash barrier systems - Safety Roller Barrier (SRB). The SRB converts collision energy into rotational energy, whilst maintaining the vehicle trajectory post impact, resulting in increased occupant protection to motorists. SRB's MASH TL4's accreditation meets the critical criteria for Structural Adequacy, Occupant Risk and Vehicle Trajectory Post Impact.

Background, Method, Results and Conclusions

Safety Roller Barrier is a safety barrier system that prevents fatal injuries by not only absorbing kinetic energy and maintaining vehicle trajectory, it also converts the kinetic energy into rotational energy. The key to the barrier's effectiveness is the large amount of kinetic energy being transferred from the impacting vehicle into the safety barrier system, improving the ride-down and controlled deceleration for the occupants. The effective energy transfer from the impacting vehicle into the roller barrier, provides sufficient energy loss, reducing the exit speed by 30-50% which in turn, reduces the likelihood and severity of secondary impacts.

The performance of the safety barrier is achieved through its essential design elements being:

rollers absorb the collision shock, converting kinetic energy into rotational energy
front rails absorb the second shock
back rails absorb the third shock
metal pipes with steel pipe inserts support the barrier between the front and back rails
friction (rotational stopper boards) clutch plates fitted top and bottom add braking to rollers and decrease vehicle inertia (Figure 1).

The first Australian SRB trial in Laverton, Victoria (in collaboration with VicRoads) has been very successful since being installed at a busy off-ramp on the Princess Highway in December 2016. This location was selected, as it was a known blackspot where previous guardrail was regularly being significantly damaged by vehicles and had to be replaced as often as every 10 -15 days. On the 99th day of the SRB being installed, it was struck by a vehicle presumed to be travelling over 70 km/h, with no damage found on the SRB. There was no police report of injury or vehicle damage in this location after this incident. The visually distinctive bright yellow Ethylene Vinyl Acetate rollers (EVA), with their yellow retroreflective band performs well to alert drivers of the potential hazard ahead.

The SRB whole of life cost, makes it a cost-effective barrier system when making decisions on choosing the most appropriate barrier to protect traffic from road side hazards (Table 1).

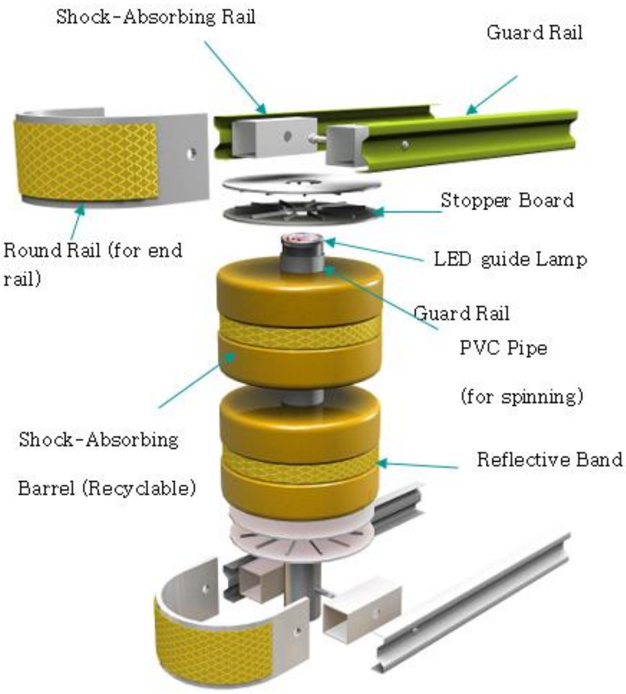
SRB was MASH accredited in December 2012 by Holmes Solutions LP (2012), Christchurch, New Zealand. The objectives of the tests reported herein, were to evaluate safety performance of the KSI Global Australia PTY LTD Safety Roller Barrier system against the requirements of MASH Test Level

4 (TL4). MASH TL4 requires the successful completion of three dynamic vehicle impacts to evaluate the crash worthiness of a barrier system, namely:

- Test 4-10 – (1100kg car, travelling at a nominal 100 km/h, impacting the test article at 25 degrees).
- Test 4-11 – (2270kg pick-up truck, travelling at a nominal 100 km/h, impacting the test article at 25 degrees).
- Test 4-12 – (10000kg single unit truck, travelling at a nominal 90 km/h, impacting the test article at 15 degrees).

SRB International Accreditations include: MASH, European Norm 1317, National Cooperative Highway Research Program Report 350, Austroads, Federal Highways Administration and Korean Safety Barrier TL 4/5 with registered patents across key international markets.

SRB has been installed in Australia, Thailand and Korea, with trials currently pending in United Arab Emarat, India, United States of America, Singapore, Malaysia and Taiwan.



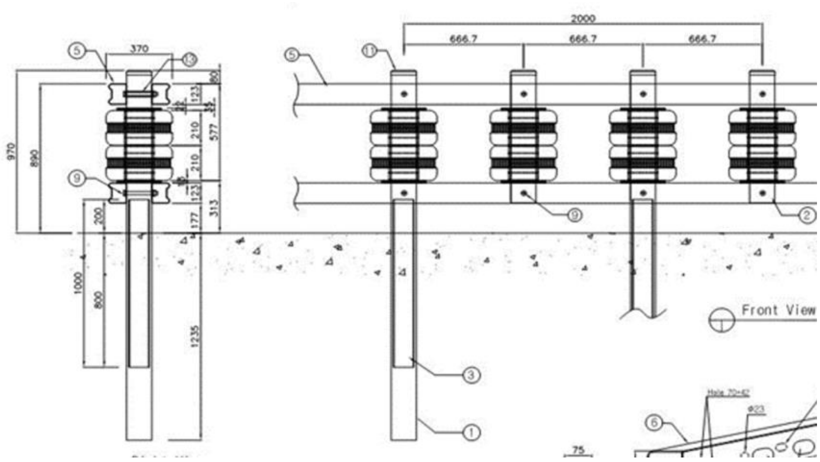


Figure 1. Safety Roller Barrier

Table 1. Cost Benefit - Previous Maintenance Cost with W Beam now replaced by Safety Roller Barrier (projected over 10 Years) Laverton, Victoria

	Benefit ($AUD)	Present Benefit ($AUD)
Present Value of benefit W-Beam	$342,600	$ 300,819
Present Value of benefit of Safety Roller	$ 56,800	$ 55,552
Benefit Cost Ratio Value	5.42	

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Impact of Victoria's Enhanced GLS on Novice Driver Crash Involvement

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Abstract

To address the continuing over-representation of young and inexperienced drivers in crashes, major enhancements were made to Victoria's Graduated Licensing System (GLS) during 2007 and 2008. A multi-faceted evaluation was conducted, of which a key component was investigation of changes in the rate of crash involvement (per year of licence holding) for target groups of young and inexperienced drivers. The enhanced GLS was found to have been most effective for the driver groups with the highest crash involvement rates: significant reductions were found for drivers aged 18 to 20 years and for drivers in their first year since licence issue.

Background

Following the enhancement of the GLS in 2007 and 2008, drivers first licensed when aged less than 21 years are required to:

- have held the learner permit for at least twelve months (previously six)
- have accumulated at least 120 hours of supervised experience as a learner
- hold a probationary licence for at least four years (previously three)
- comply with additional restrictions on towing, peer passengers and mobile phone use during their first year holding a probationary licence.

Other new provisions applying to all new drivers include:

- a complete ban on mobile phone use while driving for learner permit holders
- a new, more challenging practical driving test for licence applicants
- a requirement for a good driving record to graduate from P1 (probationary first stage) to P2 (probationary second stage) or from P2 to a full licence.

Method

To allow for changes in the number of novice drivers who have the opportunity to be involved in crashes, we examined rates of crash involvement per driver-year of licence holding. Crash involvement rates during a period after the changes to the GLS were compared with rates during a period before the changes. To allow for other changes between the pre-GLS and post-GLS periods (such as general improvements to the road network and the vehicle fleet), changes in crash involvement rates for novice drivers were compared with the corresponding changes for suitably chosen groups of experienced drivers. Novice driver groups were broken down by age and number of years since licence issue. Poisson Regression Modelling was used to assess the statistical significance of changes in novice driver crash involvement rates relative to changes for experienced drivers over the same period.

Results

Crash involvement rates showed a generally downward trend throughout the study period, for both novice and experienced drivers.

Pre-GLS to Post-GLS Crash involvement rate reductions were statistically significantly greater for novices aged 18–20 than for the experienced comparison group, both for casualty crashes (13.6%) and for fatal and serious injury (FSI) crashes (20.3%). Within this age group, significant decreases occurred for males, females, metropolitan crashes and country FSI crashes. For novices aged 21–23, the changes in crash involvement rate were not statistically significant.

Among drivers first licensed at ages 18–20, the casualty crash involvement rate for novices in their first year of holding a licence fell by 19.2% and the FSI rate by 21.7% relative to the comparison group, both changes being statistically significant. Crash rate changes for first-year drivers first licensed at 21–23 were not statistically significant.

Among first-year drivers first licensed at 18–20, rates of involvement in crashes when carrying two or more peer passengers fell substantially and significantly (69.8% for casualty crashes, 69.2% for FSI crashes) relative to the experienced comparison group.

Conclusions

Reductions in novice driver crash involvement following the changes to the GLS provide strong support for the GLS provisions aimed at drivers first licensed at ages 18–20 years, particularly those that apply to first-year licence holders.

Calibrating Infrastructure Risk Rating (IRR) for Victorian Roads

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Abstract

IRR, developed in New Zealand, is a simplified-risk based road assessment methodology, based on fewer features than other road risk tools – requiring the input of only ten key road variables. Although early days, IRR seems to perform as well as more complicated, proprietary, road risk tools.

Safe System Solutions Pty Ltd is undertaking a project that involves calibrating New Zealand's IRR by correlating the IRR rating for Victorian roads against real world crashes so as to understand and quantify the strength of the relationship between crash rates and risk as assessed by IRR.

Background

Road and roadside characteristics are a factor in the number of fatalities and serious injuries. Australian and New Zealand road safety engineers developed many tools to quantify the crash risk of existing or proposed roads: the Australian National Risk Assessment Model (ANRAM), the Australian and New Zealand Road Assessment Programs (AusRAP/KiwiRAP), the international Road Assessment Program (iRAP) and New Zealand's Infrastructure Risk Rating tool (IRR) all produce either risk scores or star ratings for road segments.

IRR, a simplified risk-based road assessment methodology, is based on fewer features than other road risk tools – requiring input of only ten road variables (Zia et al., 2016). It outputs ratings over homogeneous road lengths, and can use readily available imagery from Google Earth or Google Maps.

This study seeks to verify the applicability of the infrastructure risk rating (IRR) model on rural Victorian roads by examining the relationship between the IRR model's scores and historical crashes.

Method

IRR scoring is based on input of <u>ten</u> variables to determine <u>nine</u> road features: Road stereotype; Carriageway width; Land Use; Access Density; Speed; Alignment; Roadside Hazard Risk (Left and right side assessed separately and averaged.); Intersection Density; Traffic Volume.

Results

This paper presents the results of Safe System Solutions Pty Ltd's project that involves calibrating New Zealand's IRR by correlating the IRR rating for Victorian roads against real world crashes so as to understand and quantify the strength of the relationship between crash rates and risk as assessed by IRR.

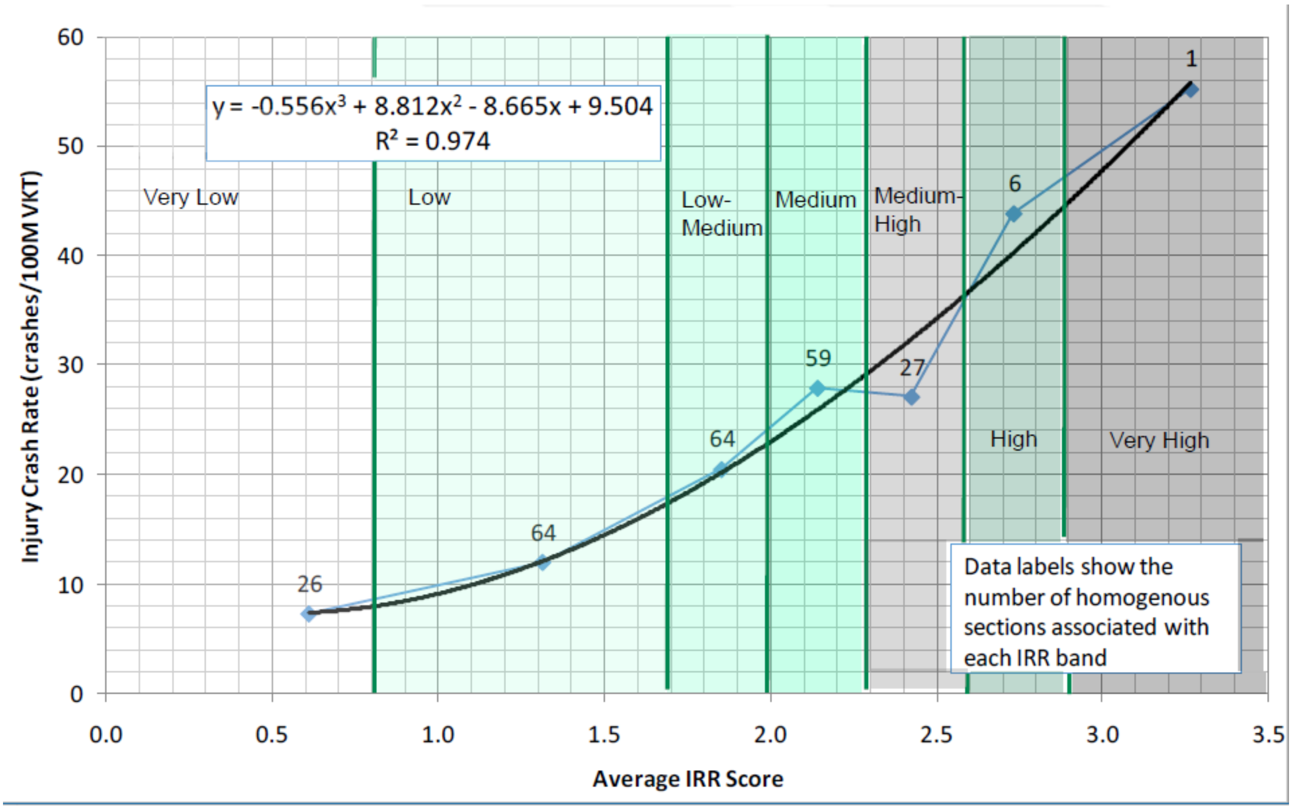

Figure 1. Scatter plot of IRR score against the Injury Crash Rate indicates good correlation on New Zealand roads (Tate, 2015)

Work undertaken in New Zealand (Tate, 2015) shows that IRR correlates with the outputs of more complicated road risk assessment programs such as KiwiRAP. Tate (2015) also shows that IRR is a good predictor of risk in relation to New Zealand roads. He fitted a cubic polynomial to the results of Table 1 ($r^2 = 0.974$) to link crash rate and IRR score (Figure 1).

A similar analysis for 40 Victorian roads for which crash data was readily available is given in Table 1. Roads with zero fatal and serious injury (FSI) crashes have been excluded from the Table.

Comparing the results of Figure 1 and Table 1 indicates that New Zealand roads cover a much greater range of IRR values. No Victorian road that was analysed had an IRR of greater than 1.8. Furthermore, the road with an IRR value of 1.8 (Darlimura Road) had no crashes and was thus excluded from analysis in Table 1. Whether this is a statistical aberration, or whether this indicates Victorian success in road improvement and road toll reduction, needs further examination.

Table 1. Comparison of Injury Crash Rate and Average IRR Scores for Victorian Roads

Number of Victorian Roads used in analysis	Fatal and Serious Injury Crash Rate (FSI Crashes per 100 MVKT)	Average IRR Score of the roads	Road Risk Rating Based on Crash Rate range given in paretheses
3	1.24	0.97	Very Low (0-2.5)
5	3.98	1.04	Low (2.5-5)
4	6.43	1.11	Low-Medium (5-7.5)
7	9.47	1.15	Medium (7.5-12.5)
10	26.43	1.28	Medium-High (>12.5)

Conclusions

The outcomes of this project to calibrate IRR for Victorian roads demonstrate a measure of agreement, at a broad-scale, between the New Zealand results and the Victorian results. The next step will be to develop a Victorian IRR tool for road safety practitioners to assess the risk of their road. This project may also include the production of an App and/or web based application.

Acknowledgements

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An Evaluation of the Effectiveness and Cost-Effectiveness of a Rural Run-Off-Road Crash Program in Western Australia

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Abstract

Single vehicle run-off-road crashes accounted for almost 60% of all road deaths and serious injuries in regional and remote Western Australia (WA) from 2008 to 2012. A total of 984 kilometres of rural WA roads received road treatments under the rural "Run-off-road Crash Program" from 2012 to 2015. This study aims to evaluate the effectiveness of the WA program in reducing the frequency and severity of run-off-road crashes, as well as the program's cost-effectiveness in terms of savings to the community for each dollar invested.

Background

Drivers lose control of their vehicle and run off road for various reasons including distraction or fatigue (Szwed, 2011). In rural areas, drivers of vehicles that come into contact with unsealed road shoulders at high speed are likely to lose traction and control. This loss of control frequently results in rollover crashes or collisions with roadside objects often resulting in fatalities or serious trauma.

The counter measure audible edgelines is a surface treatment applied to the edge of the travel lane that can create noise and vibration to alert inattentive drivers, while s*houlder widening and/or sealing* provides an opportunity to recover safely.

Methods

A quasi-experimental before and after study design was used to compare: (1) run-off-road crashes (all severities); (2) run-off-road casualty crashes (fatal, hospitalisation, and/or medical treatment); and (3) run-off-road killed or serious injury (KSI) crashes (Office of Road Safety, 2014), at sites treated during 2012-2015. An economic analysis estimating the net present value (NPV) and benefit-cost ratio (BCR) was also performed on the treated sites to indicate the cost-effectiveness of the WA program.

Crash data was obtained up to 31st December, 2015, from the Integrated Road Information System maintained by Main Roads WA. The Road Use Movement code was used to identify run-off-road crashes at each site (before and after treatment). On the basis of Nicholson (1986), this study utilised five years of pre-treatment crashes, and up to five years post-treatment (if available). The regression to the mean effect was considered. And in the absence of a comparison group, the general trend of run-off-road crashes in rural WA was also considered.

Main Roads also provided information on treated sites and their costs.

A generalised estimating equation Poisson model (Dupont, 2002; Twisk, 2003) that accounted for exposure was used to compare crashes before and after each treatment. For evaluating the WA program's cost-effectiveness, the NPV and BCR of treatment over each site were calculated taking into account the: (i) initial capital outlay, (ii) ongoing costs, (iii) expected treatment life, (iv) crash reductions, and (v) cost of each crash based on severity, with (v) provided by Main Roads using average costs from rural WA crashes in 2011-2015 based on a Willingness to Pay approach.

Results

The final sample of 57 sites reported a significant 35.5% reduction in run-off-road crashes for all crash severities ($p<0.001$), a significant 18.4% reduction in run-off-road casualty crashes ($p=0.021$), and a significant 25.6% reduction in run-off-road KSI crashes ($p=0.031$).

The NPV and BCR across the 57 sites were estimated to be $100.2 million and 2.1 respectively, indicating there were cost savings to the community of $2.10 for each $1 invested.

Conclusions

Run-off-road crashes are especially problematic in rural WA, with their fatalities and serious trauma placing a great burden on society. Given the positive outcomes in both crash reductions and cost savings, it is recommended WA's "Run-off-road Crash Program" be continued and extended to roads not yet treated by the countermeasures.

Further investigation into crash migration and comparison with programs in other states are ongoing.

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Identification of High Risk Metropolitan Intersection Sites in Perth Metropolitan Area

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Abstract

Because of the greater crash risk at intersections compared to the rest of the road network, it is important to prioritise intersections for safety improvements. A three-stage approach was used to identify these intersections: Road Trauma Risk Analysis, then Comparative Safety Performance Analysis and finally ranking the intersections by the KSI (killed and serious injury) metric. The results ascertained the high risk intersections for each intersection type (by speed environment and control type). Extensions to this process are recommended to improve high risk intersection identification, and the use of a taxonomy to identify candidate treatments.

Background

In 2009, the Government of Western Australia adopted the Towards Zero strategy (Office of Road Safety, 2009), based on the Safe Systems approach to road safety (Corben, Logan, Fanciulli, Farley, & Cameron, 2010). The WA Safe System Matrix was created to set identify road safety initiatives in line with the Safe Systems paradigm. In metropolitan Perth, one of these initiatives was the "Safe System intersection transformation" (Langford, 2009), targeting the higher crash risk at metropolitan intersections. This study aimed to use a three-stage approach (outlined below), accounting for both personal risk and collective risk, to prioritise intersections with a high crash risk for infrastructure improvements.

Method

A retrospective population-based study was undertaken, using crash data from the Integrated Road Information System (IRIS) on intersections which reported at least one casualty crash in the Perth metropolitan area from 2011 to 2015. Traffic volume data was obtained from Main Roads Western Australia. Selected intersections were grouped by: i) Speed environment: built-up, open or low-speed; and ii) Traffic control type: traffic signal; roundabout; or no traffic signal, creating nine intersection types.

Each intersection type was assessed using the Road Trauma Risk Analysis. This methodology compared crash density (a count of killed and serious injury crashes plus factored-up medical crashes, i.e., KSI metric) to crash rate (KSI metric divided by product of flow, measuring exposure to traffic at intersections) for each intersection. Based on this, each intersection was allocated to one of four quadrants: black (highest risk), red, orange and green (lowest risk). The high risk intersections were further analysed using the Comparative Safety Performance Analysis. This methodology compared the performance of each intersection to intersections of the same type by KSI metric, ranking each into a category from I (most safe intersections) to V (least safe intersections). Finally, the identified high risk intersections were ranked by the KSI metric.

Results

Most intersections which reported at least one casualty crash in the Perth metropolitan area fell into three intersection types: i) intersections in the built-up speed environment, with traffic signals (n=310), ii) intersections in the built-up speed environment without traffic signals (n=425), and iii) intersections in the open speed environment without traffic signals (n=135). The majority of intersections in black road trauma risk level were in the built-up speed environment and had traffic signals (n=52). The top-ranked intersection in this category also had the highest KSI metric across all intersection types. Intersections with roundabouts in all speed environments had the lowest number of casualty intersections (n=42) and lowest KSI metrics of all intersection types.

Conclusions

The three-stage approach used in this study provides a method of prioritising high risk intersections by intersection type. The results from the analyses can be used to target the highest crash risk intersections for safety treatments. Recommendations from this study include performing the analyses by crash type, as well as by speed environment and traffic control, and use of Devlin and colleagues' (Devlin, Candappa, Corben, & Logan, 2011) taxonomy to allocate treatments to high risk intersections.

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An Evaluation of the Effectiveness of the State Black Spot Program in Western Australia, 2000-2014

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Abstract

The Western Australian (WA) State Black Spot Program defined a Black Spot as an intersection or non-intersection road section with a high incidence of crashes. All road classifications were eligible for funding. The program targeted existing Black Spots, and potentially hazardous locations selected on the basis of formal road safety audits.

This study aims to evaluate the effectiveness of the WA program in reducing crash frequency and severity at existing Black Spots treated between 2000 and 2014. The results will provide Main Roads WA and other road safety organisations with reliable and objective information for enhancing strategies for future investment.

Methods

A quasi-experimental before and after study design was used to compare the frequencies of: (1) all reported crashes; (2) casualty crashes (fatal, hospitalisation, and/or medical treatment crashes); and (3) killed or serious injury (KSI) crashes (Office of Road Safety, 2014), at existing Black Spot sites which were treated between 2000 and 2014.

Crash data was obtained up to 31st December, 2015, from the Integrated Road Information System (IRIS) which is maintained by Main Roads WA. This data included the crash date, crash severity, specific crash location, and local government area of the crash. On the basis of Nicholson (1986), this study utilised five years of pre-treatment crashes, and up to five years (if available) of post-treatment crashes which excluded the treatment construction period. The regression to the mean effect was considered. And in the absence of a comparison group, the general trend of crashes in WA was also considered.

Main Roads WA also provided information on the treated Black Spots. This included information about the treatment description and treatment start and finish dates. A generalised estimating equation (GEE) Poisson model (Dupont, 2002; Twisk, 2003) was used to take into account the correlated nature of the repeated measures of the study design, as well as the different length of post- treatment exposure available for each site.

Results

The final sample of 903 treated Black Spots included for analysis all had at least one reported crash in the previous five year period prior to treatment. They consisted of 676 metropolitan and 227 rural sites. The average length of follow-up exposure crash data post treatment for the 903 sites was 55.1 months. Overall, they reported a significant reduction of 17.5% in all reported crashes, a significant 30.3% reduction in casualty crashes, and a significant 22.0% reduction in KSI crashes ($p < 0.001$ for all three).

In the metropolitan area ($n = 676$), the treatments analysed were heavily weighted towards intersection treatments ($n = 634$). The effectiveness of the WA Program in the metropolitan area was mainly due to the high crash reductions at these 634 metropolitan intersections, with significant reductions in all reported crashes by 17.5%, casualty crashes by 29.8%, and KSI crashes by 18.3% ($p < 0.001$ for all three) at these 634 intersections.

The evaluation found 119 rural intersections that received treatments showed significant reductions in all reported crashes by 23.1%, casualty crashes by 46.3%, and KSI crashes by 44.7% ($p < 0.001$ for all three). Rural road sections that received treatments ($n = 108$) also showed significant reductions in the same three crash types, by 39.0%, 44.8% and 46.0% respectively ($p < 0.001$ for all three).

Conclusions

The fatalities and serious trauma that result from crashes at Black Spots place a great burden on society. This study found the WA State Black Spot Program to be effective producing positive outcomes for the community in terms of road safety, and recommends the WA program to be continued and extended to hazardous locations not yet treated by the appropriate countermeasures.

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Using Naturalistic Driving Study Data to Understand Child Vehicle Occupant Behaviour When Travelling in Child Restraint Systems

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Abstract

Children's behaviour when travelling in child restraint systems (CRS) may affect injury risk. The aim of this research was to use naturalistic driving study (NDS) video data to explore child vehicle occupant behaviour and out-of-position (OOP) status (i.e., head position in relation to the protective structure of CRS). A total of 414 trips and five epochs per trip were analysed. This paper provides descriptive analyses of children's CRS correct use/misuse, head position, interactions and behavioural affect. Results may propose additional seating positions and postures for future crash testing of CRS, to help reduce injury risk in these less typical user positions.

Background

Motor vehicle crashes remain a leading cause of child fatality and serious injury (Australian Bureau of Statistics, 2016). Full safety benefits of a child restraint system (CRS) require correct use (Brown et al., 2006). Previous observational studies have shown that children are frequently out-of-position (OOP) during everyday trips (Charlton et al., 2010). The aim of this research was to explore child vehicle occupant behavior, including OOP status (head position), restraint use, interactions, behavioural affect and activities, using naturalistic driving study (NDS) video data. This study is part of a broader Australian Research Council Linkage Project (Charlton et al., 2013).

Method

Forty two Melbourne-based families participated in the study. Families had at least one child aged between 1 and 8 years travelling in a CRS/booster seat. Families drove a study vehicle for approximately two weeks. Two study vehicles were fitted with data acquisition systems including a continuous video/audio recording system. Child vehicle occupant behaviours were determined by manual review of the video/audio recordings. For each trip (n = 414), one child occupant was randomly selected for coding at 5 time points during the trip (5%, 25%, 50%, 75% and 95% of trip) for five-second epochs each. A subjective classification was used for head position (Optimal/OOP/extreme OOP - pooled across fore-aft and lateral planes). Restraint use was scored for correct/incorrect use. Behavioural affect was categorised as positive/negative (happy/sad or agitated) and passive/active (still/moving). Children's interactions with other occupants were recorded (yes/no) and their activities were described. Descriptive analyses were used to characterise children's behaviours to explore relationships between head position (optimal vs OOP and extreme OOP, pooled) and variables of interest.

Results

Analysis of children's behaviour in 2070 epochs revealed that children were correctly restrained for more than half of the epochs (56%) and that they were most likely to be displaying a passive behavioural affect (74%). Children's head positions were optimally placed for the majority of epochs (74%). Interactions were common (60%) and conversation was the most frequent activity (49%). Extreme OOP, including far forward, and extreme left/right leaning, was recorded for two percent of epochs and OOP was observed for 24 percent. There was a significant relationship between children's head position and restraint use, $\chi 2$ (df = 1, n = 777) = 16.92, p=<0.000. Optimal head position was more likely if restraint use was correct. The relationship between head position and occupant interaction was statistically significant, $\chi 2$ (df = 1, n = 1919) = 5.52, p = <0.019, with OOP more likely if interactions were present. Head position was also related to passive/active affect, $\chi 2$ (df = 1, n = 1915) = 173.26, p= <0.000, with optimal position more likely when children's affect was passive.

Conclusions

Most epochs revealed correct restraint use and optimal head placement for children travelling in CRS. The findings from this study will inform head placements of ATDs for sled testing that more accurately mimic realistic scenarios to examine injury potential in simulated crashes. Future research will model the relationship between a larger set of child occupant variables and head position to better understand child injury risk.

Table 1. NDS child vehicle occupant behaviour by event (n=2070)

NDS child vehicle occupant behaviour variables	**Total**
	N (% coded)
Restraint use†	
All correct	436 (56)
Incorrect*	341 (44)
Child head position††	
Optimal	1442 (74)
OOP	505 (26)
Behavioural affect†††	
Positive passive	1376 (72)
Positive active	479 (25)
Negative passive	39 (2)
Negative active	21 (1)
Interactions with othersǂ	
Yes	1143 (60)
No	776 (40)
Primary activityǂǂ	
Conversation	890 (49)
Looking	514 (28)
Playing with toys	118 (6)
Sleeping/drowsy	100 (5)
Eating/drinking	90 (5)
Touching/looking at self	89 (5)
Watching DVD	30 (2)

*Incorrect use is not exclusive and may include lap, belt or both lap and belt misuse.
† Unknown restraint use (*n*=1293)
†† Unknown head position (*n*=123)
††† Unclassified behavioural affect (*n*=155)
ǂ Unknown interaction/s (*n*=151)
ǂǂ Unknown activity (*n*=156)

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A New and Novel Method for Assessing Visual Clutter in the Driving Environment

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Abstract

This manuscript outlines a framework for objectively measuring the level of visual clutter along a defined driving route. Based on results of this assessment framework, practitioners can make informed recommendations to improve relatively high visual and sign clutter while maintaining an appropriate level of road user information and navigation guidance. Using this framework in this way will make a innovative contribution to road safety research in terms of (a) allowing us to identify road environments of high clutter and, in turn, (b) helping us assess how we can mitigate potential degradation in driving performance and safety deriving from clutter.

Background

Visual clutter is defined as the non-target or irrelevant information in a visual scene (Ho, Scialfa, Caird, & Graw, 2001). In the realm of driving, and road signage in particular, the level of visual clutter in a given scene is determined by the interactions between the amount and complexity of signage and specifically how difficult it is to detect important objects from the background (Edquist, 2008).

Excessive visual and sign clutter along a road contributes to driver distraction, obscures key navigation cues and increases workload for drivers. This can lead to a reduced ability to detect and react to critical driving tasks and can lead to an increased likelihood of driver errors; and, therefore, an adverse impact on road safety (Edquist, Horberry, Regan, & Johnston, 2007).

Rosenholtz, Li, and Nakano (2007) have developed special code using MATLAB, a high-performance mathematical and computation program, that can produce a numerical and visual measure of visual clutter for a given 'jpg' picture file. That is, for a given picture of a visual scene, this code can determine a clutter scalar (i.e., a visual clutter score) for the visual scene, where a higher score indicates a higher level of visual clutter.

Using the input picture file, the code can also produce a 'clutter map', which highlights the areas of the scene in which clutter is particularly high. These outputs allow two or more driving scenes to be compared based on their visual clutter. The code measures clutter based on the variance of features (e.g. colour, contrast) or 'feature congestion' in a visual scene, where a higher variance of features is associated with higher clutter (known as 'feature congestion'; Rosenholtz et al., 2007).

To the best of our knowledge, this manuscript is the first to document the use of this code in road safety research in terms of allowing the identification of road environments of high clutter (e.g. due to signs, redundant line markings etc.) and, in turn, help assess how to can mitigate potential degradations in driving performance safety.

Method

A proposed framework for objectively measuring visual/sign clutter was developed and described in Table 1.

Table 1. Framework to objectively measure visual clutter

Step no.	Description	Tasks
1	Survey route	A GPS-enabled video camera be positioned securely just below driver eye height on the front windscreen of the vehicle (just left of centre) and used to record video footage during the route survey. Sign locations will be mapped.
2	Identify road segments	Upon completion of the route survey, snapshots of the driver's view will be taken every 100m using the video footage recorded. These snapshots will be used as picture (.jpg) input files into MATLAB
3	Input into MATLAB	MATLAB will be used to compute Feature Congestion scalars (i.e. 'clutter' score) for each picture
4	Relative results of clutter measure	The clutter scores of each picture will be compared. Locations of high clutter (i.e. as having the highest clutter scores) will be noted Feature congestion clutter maps will be visually inspected
5	Identify elements contributing to clutter	Pictures of high clutter locations will be visually assessed, including feature congestion clutter maps Physical elements (e.g. signs, buildings) contributing to the clutter at these locations will be identified
6	Recommended areas for improvement	Review visual/sign clutter issues and propose changes to mitigate clutter and its potential effects on driver performance

Results

An example of the clutter map the MATLAB code provides is depicted in Figure 2 (with the input snapshot of the driving scene depicted in Figure 1). The clutter score, also provided by MATLAB, for this visual scene was considered relatively high. Upon inspection of the pictures by researchers, it was hypothesised that signs, line marking and buildings are all contributing to the relatively high clutter in this visual scene.

Figure 1. Snapshot of southbound travel approaching Sydney Harbour Bridge

Figure 2. Example of feature congestion clutter map using Figure 1 ('hotspots' indicate areas of relatively high clutter)

Discussion and Conclusion

To the best of our knowledge, this framework for objectively measuring the level of visual and sign clutter is novel in the road safety space. The framework can be applied to any defined driving route and, based on the results of the assessment, can be used to make informed recommendations to address the level of visual and sign clutter, while maintaining an appropriate level of road user information and navigation guidance.

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Are Happy Drivers Better Drivers? The Impact of Emotion, Life Stress and Mental Health Issues on Driving Performance and Safety

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Abstract

While observable distractions have been studied extensively (e.g. due to mobile phone use), less obvious sources of distraction, such as that derived from being emotionally aroused, have not. The overarching purpose of this article is to review relevant literature and analyse how emotions may impact on driving behaviour. This manuscript discerns three potential impacts: (a) how elicited emotions may impact on driving performance; (b) the experience of stressful life events (e.g. financial issues) and their impact on driving safety; and (c) mental health issues, such as anxiety, may impair driving performance and safety. The implications of these findings are discussed.

Background

Driver distraction is defined as '…the diversion of attention away from activities critical for safe driving toward a competing activity, which may result in insufficient or no attention to activities critical for safe driving' (Regan, Hallett & Gordon 2011, p. 1776). Driver distraction is a significant road safety problem worldwide and, in Australia, it has been estimated to be a contributing factor in around 16% of fatal and injury crashes (Beanland et al. 2013). While observable distractions have been studied extensively (e.g., visual distraction due to interactions with a mobile phone), less obvious sources of distraction (e.g., daydreaming or driving while emotionally aroused) have not been so frequently examined (National Highway Traffic Administration [NHTSA] 2009). NHTSA has only recently started to classify emotion as a source of distraction (NHTSA 2010).

Driving requires significant attentional resources (Wickens, Toplack & Wiesenthal 2008) in order to manoeuvre, control and plan (Michon 1985). However, emotional stimuli, both internal (e.g. worrying about something) and external (e.g., billboard content) have the ability to be particularly potent in capturing attention, and therefore pose a higher risk of producing driver distraction, compared to other non-emotional stimuli (Compton 2003; Vuilleumier 2005). Testament to this, a recent US naturalistic driving study (Dingus et al. 2016) found that driving in an observable emotional state (e.g., anger, sadness, crying, and/or emotional agitation as observed through footage of the driver) increased crash risk by 9.8 times. Moreover, nascent research also suggests that positive-valence emotions (e.g., happiness, joy) can have a profound impact on driver behaviour. Both positive and negative valanced emotions were in scope when this review was undertaken.

The purpose of this manuscript is to review relevant and current literature and present an analysis of how emotion may impact on driving performance and safety. In achieving this, the current article aims to: 1) provide an overview of simulated driving research that has examined how emotional experiences and emotional stimuli impact on driving performance, and the potential mechanisms that underlie this influence; 2) summarise research assessing the impact of life stress, which can bring about emotional experiences while driving, on driving safety; 3) present research that has attempted to link mental health issues, which are commonly hallmarked by prolonged and/or intense emotional experiences, to driving performance and safety, and lastly 4) discuss the implications of this research in terms of licensing practices and fruitful avenues for future research.

Method

A literature review was undertaken to glean information to address the four research aims noted above. Both journal and conference publications were the focus of this review, and 18 research articles were reviewed in total.

Results, Discussion and Conclusions

In reference to the first aim, four simulated driving studies were reviewed showing that negative-valence emotions (e.g., anger), induced through means such as words on a billboard in the driving environment (Chan & Singhal, 2013) or radio music (Pecher et al., 2009), were associated with performance decrements such as lane keep errors, traffic rule violations and aggressive driving. Interesting, happiness induced in drivers also was found to be related to some decrements in driving performance (e.g., lane keeping errors and poorer speed maintenance) compared to control (neutral) groups.

In reference to the second aim, research (seven studies were reviewed) suggests that life stress (e.g. through financial or interpersonal issues) can ‘spill over’ into one’s driving and be linked to increased driving errors and increased crash risk (e.g., Legree et al., 2003; Legarde et al., 2004). Many of the studies controlled for important covariates (e.g., basis demographics, mileage) which provide further confidence of the validity of the link between life stress and its impact on driving performance.

In reference to the third aim, common mental health concerns, such as anxiety and depression, can also negatively impact on driving performance and safety. For example, studies (seven studies were reviewed) have shown that anxious individuals tend to report more failures of observation while driving (e.g., failing to check mirrors before changing lanes; Shahar, 2009) and an increased number of driving lapses (attentional and memory failures while driving) (Wong, Mahar & Titchener, 2015). Depressive symptoms, also, have been shown to not only be associated with poor driving performance in simulator studies (e.g., slower reaction times to critical road events; Bulmash et al., 2006), but also be linked a four-fold increase in crash risk in Australian heavy vehicle drivers (Hilton et al., 2009).

In relation to the fourth aim, the implications of this research linking both positive and negative emotions to impaired driving performance, the link between life stress and driving safety, and the association between mental health issues (anxiety and depression) and driving performance and safety, are lastly discussed. Specifically, we will illuminate how the outcomes of such research impact on driver licensing requirements (e.g., ‘fitness to drive’ guidelines) as well as the need for prospective naturalistic driving studies to attempt to investigate the link between emotional experiences (both negative and positive) and crash risk.

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Mandatory Driver Training and Assessment Relating to Awareness of Vulnerable Road Users

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Abstract

The ACT Government is taking the lead nationally with mandatory driver training and assessment on driving safely around vulnerable road users (cyclists, pedestrians and motorcyclists). Learner drivers must now achieve 100% in the road rules test for questions relating to vulnerable road users. In the practical driving test, a new 'vulnerable road user driver competency' applies in which the applicant is required to demonstrate a range of skills. The skill requirements are – good observation, recognition and risk management and display appropriate and calm decision making to mitigate and avoid risk and harm to any vulnerable road users.

Background

Vulnerable road users are over-represented in Australian Capital Territory (ACT) road crash statistics (ACT Government, 2016). In 2015, five fatalities and 244 injuries involved vulnerable road users – which represented 33% of fatalities and 31% of reported injuries in the ACT. In relation to cyclists, the number of high threat to life injuries in the ACT has increased at a much higher rate than nationally (Australian Institute of Health and Welfare, 2015). The ACT rate per 100,000 population was 1.5 in 2001, increasing to 7.0 in 2010 compared with a national increase from 2.4 in 2001 to 4.9 in 2010.

The ACT Road Safety Strategy 2011-2020 is supported by multi-year action plans. The ACT Road Safety Action Plan 2016–2020 is the second action plan under the current strategy and seeks to improve the ACT’s road safety performance by targeting key road safety issues for the ACT. Improving road safety for vulnerable road users is one of the key issues being targeted under this action plan, with a number of measures including a commitment to establish the new driver competency and to introduce specific content in the ACT’s road rules knowledge test, relating to vulnerable road users.

Method

A project implementation paper was developed which identified the implementation stages (e.g. research, policy development, development of a legislative framework, information technology changes, development of publications etc), implementation issues – and how these would be addressed, and a communications and consultation strategy including workshops and training with the ACT driver training industry.

The only implementation issue which was identified was whether the new driver competency should apply to people who obtained their learner licence before the implementation of the new competency. The implementation paper proposed that the new competency apply only to drivers who obtained their learner licence on or after the implementation date and that branding changes to learner driver logbooks be introduced to assist Accredited Driving Instructors and Government Licence Examiners in distinguishing between the two groups of learners.

Importantly, the ACT’s new driver competency is evidence based having been informed by findings from a study which was being completed at the time by Dr Marilyn Johnson from Monash

University with Dr Jennifer Bonham from the University of Adelaide.[1] This study was investigating current gaps and opportunities for teaching new drivers safe driving skills when sharing the road. The draft driver competency was provided to Dr Johnson for review and comment and her suggested changes were adopted.

Results

New driver competency

The new driver competency sets out a range of requirements for how a learner is to drive responsibly – recognising the potential harm they could cause to a vulnerable road user. The learner must perform the tasks of the competency throughout an entire assessment and unaided by the licence examiner. Training and assessment of the competency is undertaken using a wide variety of different road and traffic conditions where vulnerable road users may be encountered. This includes roads with green bicycle lanes and marked bicycle lanes, and areas with high numbers of cyclists and pedestrians, such as shared zones, town centres, group centres, aged care facilities, and school zones.

Enhanced theoretical testing

On the changes to the road rules test, a new section was introduced which relates specifically to vulnerable road users. This section of the test includes five questions randomly selected from a large pool of questions relating to this topic. The applicant must answer all questions correctly in order to pass the test.

Evaluation

Data from practical driving assessments and the online knowledge test system will be used to identify the number of assessments failed as a result of not passing the vulnerable road user content. This will allow the directorate to develop enhanced materials on driving around vulnerable road users to support learner drivers in the licensing process. There are future research opportunities which will be considered by the ACT Government. Vulnerable road users is a priority funding area under the ACT Road Safety Fund and research into the impact of this initiative will be given a greater weighting when future research proposals are considered by the ACT Road Safety Advisory Board.

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[1] As at 23 August 2017, the report is yet to be published.

Getting 10 Roundabouts for the Price of One: Highly Effective Low Cost Intersection Treatments

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Abstract

During the 2011 Black-Spot bids the Mildura CBD intersection of Ninth Street and Pine Avenue, in our preliminary roundabout design, returned a Benefit Cost Ratio that would have failed. Alternative options needed to be considered. The final innovative roundabout design cost 1/10th the price, significantly reduced vehicle speeds, was mostly constructed under traffic management conditions and did not involve the usual extensive civil works and business access disruption required in traditional roundabout construction. Following completion of works there have been no crashes reported. This paper examines the process, design and advantages of implanting low cost roundabout options in urban areas.

Background

In the five years prior to 2011 the CBD intersection of Ninth Street and Pine Avenue recorded one fatality, one serious injury and one injury crash.

The site had many constraints. In particular varying road widths, frequent semi-trailer movements and non-compliance with the 40km/h zone.

Given these and many other constraints a fully mountable roundabout Gateway Treatment was deemed the most appropriate option to not only reduce the speed of vehicles entering the roundabout but also as a control into the CBD precinct . Problematic to retro fitting a roundabout can be inadequate circulating path curvatures. To counter this speed cushions were installed to manage vehicle speeds within the intersection. Council successfully submitted the design and subsequently received $55,000 Black-Spot funding.

Method

The installation of spike down speed cushions was integral to the overall success of the project. The speed cushions provide three major functions:

- Reduce the speed of vehicles travelling into and through the intersection (see table 1).
- Reduce the speed of vehicles on the approach to the intersection to increase pedestrian safety.
- To negate the need for significant civil works. In traditional retrofit design, kerb outstands are installed to create the required circulating path curvatures. However carefully considered placement of the speed cushions in the approach are used as the speed reduction treatment.

The simplicity of the spike down concrete filled roundabout used is also critical to the design. It does not contain any furniture within the roundabout - thereby allowing heavy vehicles to run their trailers over the structure without damage.

Figure 1. Before and After Photos

Table 1. Speed data results

Control site of Eighth Street and Pine Avenue Intersection departure at 25m
Exceeding = 34.9%,
85% Speed = 44.6 km/h,
95% Speed = 49.3 km/h,
Post installation Ninth Street and Pine Avenue – Speed cushion approach 200mm from ramp
Exceeding = 0.0%,
85% Speed = 18.2 km/h,
95% Speed = 20.4 km/h,
Post installation Ninth Street and Pine Ave – Intersection departure at 25m
Exceeding = 4.9%,
85% Speed = 35.7 km/h,
95% Speed = 39.2 km/h,
Note - Pre-construction speed data was not available for Ninth Street and Pine Avenue. However Eighth Street and Pine Avenue presents very similar conditions road and traffic conditions. Eighth Street and Pine Avenue will receive the new roundabout treatment in July 2017 and Mildura Rural City Council will conduct additional data collection to verify the above results.

Results

The results are:

- reduced risk based on lower observed speeds
- reduced raw crash numbers
- an example of a low cost roundabout design and installation that minimises impact on local businesses during construction.

- that VicRoads crash data reveals that no FSI or injury crashes have occurred at this location since the installation in February 2012.

- that during interviews conducted with staff of local businesses they reported not having witnessed nor of heard of any crashes, including minor, since the installation of the roundabout four years ago.

Conclusions

The civil works required for a traditional roundabout can take many weeks and, along with diversion of traffic, can have a devastating effect on local business trade. Sweep paths to suit heavy vehicles can be near impossible to achieve on retrofit roundabout sites and if crash history consists of minor injury type crashes competitive BCRs cannot be achieved.

In contrast this design incorporates speed cushions on all approaches slowing vehicles to less than 20km/h thereby significantly reducing impact speeds if a crash occurs. Reduced speed also improves crash outcomes for vulnerable road users. Within the intersection the spike down roundabout manages traffic flow. Construction can take less than two days and the cost is less than 10% of a traditional roundabout.

With no known crashes occurring at the site since the February 2012 installation, the benefit in safety and financial savings to the community has been significant.

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Findings of the 2015 NSW Heavy Vehicle Compliance Survey

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Abstract

The results from the 2015 Heavy Vehicle Compliance Survey will assist policy makers to understand the level of compliance for heavy vehicles operating within NSW. The survey measures the level of heavy compliance for roadworthiness, licensing, registration, load restraint, mass and work and rest hours. The results are comparable with earlier periodical surveys conducted in NSW and provide useful information and trends that can be used to evaulate the effectiveness of current compliance and road safety activities. The survey also assists policy makers in the deployment of future compliance and road safety resources targeted for heavy vehicles.

Background

The 2015 Heavy Vehicle Compliance Survey is the latest in a series tracking the roadworthiness and compliance of heavy vehicles using NSW roads. Seven previous compliance surveys have been undertaken, in 1992, 1995, 1998, 2003, 2006, 2009 and 2012. The findings of the survey are useful in indicating the compliance of heavy vehicles operating in NSW, and establish a statistical trend for comparison with earlier surveys.

Method

For the 2015 survey an overall target quota of 1600 vehicles was designed with specific quotas for vehicle types within six NSW regions. The overall sample size was the same as that set for the 2012 Survey. For the 2015 survey, Roads and Maritime Inspectors inspected 1,715 heavy vehicles in total. The survey required compliance checks of a random selection of vehicles, with no bias towards selecting vehicles thought to be in poor condition or newer vehicles that may require less time to inspect because there may be fewer defects.

The rate of defects has been used as a key measure for vehicle compliance. Vehicles found with a defect were classified in a hierarchal manner. Major defects applied where there was an imminent and serious safety risk and minor defects applied where the deficiencies of the vehicle, if allowed to operate after a specific time, may have consituted a safety risk.

Results

The 2015 survey showed an overall 4.4 per cent decrease in all defects, both major and minor, for hauling units. Hauling units had a major defect rate of 4.5 per cent, similar to 4.0 per cent in 2012 and 4.6 per cent in 2009; see figure 1. The decreases have been almost exclusively among minor defects.

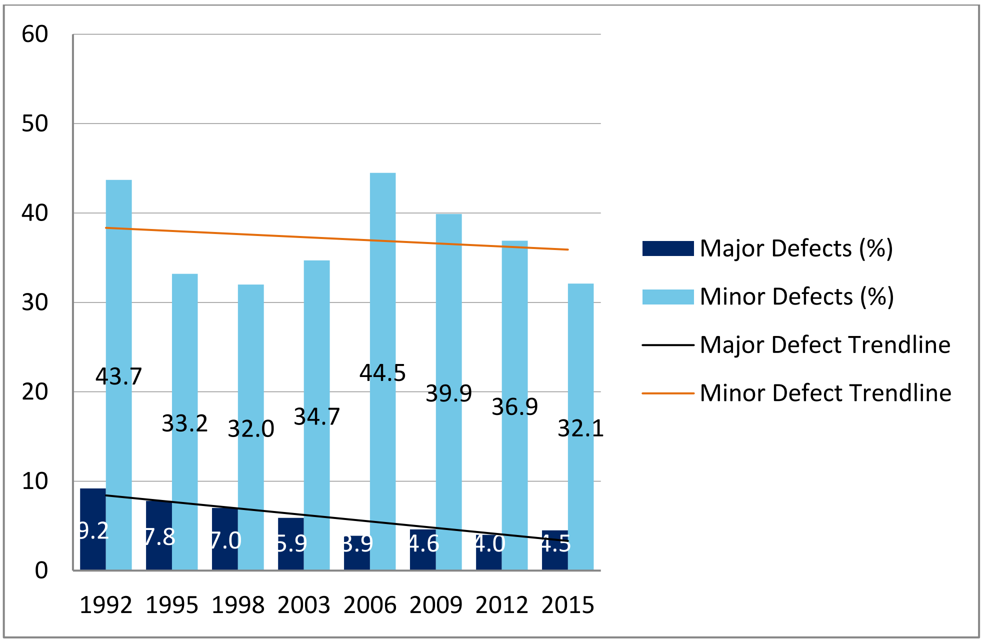

Figure 1. Hauling units with major and minor defects, 1992-2015

The most common defects found on vehicle combinations were related to the braking system, with over a quarter (29.4 per cent) having a brake defect, including 5.4 per cent of vehicle combinations having at least one major brake defect. The rate of major brake defects has progressively increased from 3.6 per cent in 2006 to 5.4 per cent in 2015.

The highest incidence of major defects among hauling units was for rigid vehicles at 7.4 per cent, and this was highest for rigid vehicles hauling trailers, at 11.2 per cent.

Conclusions

The results of the 2015 survey show that statistically significant changes in defect rates for certain heavy vehicles types have occurred since the 2012 survey. Two emerging issues have been identified, relating to major defect rate pertaining to rigid vehicles and vehicles participating in an alternate compliance scheme.

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Event Data Recorders (EDRs) in Australia: A New Source of Pre-Crash Speed and other Crash Data

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Abstract

Speed is one of the pillars of the Safe System approach to road safety. In recent years Event Data Recorders (EDRs) have allowed public access to safety related crash data from some Australian vehicles. The Centre for Automotive Safety Research (CASR) began to download EDR data from vehicles in 2014 as part of its ongoing in-depth crash investigation activities. This extended abstract describes the data provided by the 15 EDR downloads to date. EDR data provides pre and post-crash information on a range of variables that are useful for road safety research. These include, but are not limited to: travel speed, impact speed, change in velocity (DeltaV) belt use and brake use.

Background

Speed, one of the pillars of the Safe System, can usually only be determined after a crash by performing a detailed investigation and a highly qualified individual performing a reconstruction. Modern vehicles are equipped with many sensors. Since the 1990's some vehicles have used event data recorders (EDR) to record selected sensor data in the event of a crash (Bellion, 2002), including speed. In recent years a publicly available tool that can download EDR data began supporting some Australian vehicles, including many Holdens models from 2007 onwards and Toyotas built as early as 2002. The Centre for Automotive Safety Research (CASR) has recently started using this tool to download EDR data from vehicles as part of its ongoing in-depth crash investigation activities. This extended abstract details early experiences with EDR downloads, focusing on the data, such as speed, that can be gained using this resource.

Method

CASR started downloading EDR data in its most recent series of in-depth crash investigations, beginning in October 2014. If an involved vehicle was supported, an attempt was made to download the EDR data. Trial downloads were also conducted separate to in-depth crash investigations. In some instances, supported vehicles could not be downloaded from, due to lack of permission or technical reasons. The data of particular interest for road safety is presented in this paper.

Results

Table 1 summarises the data available in 15 EDR downloads, by vehicle, and Figure 1 provides examples of the pre-crash data in the actual download. Speed was recorded in all but one of the EDR files. Pre-crash data was usually recorded at a rate of 2Hz, though it varied from 1 to 10Hz, for 2.5 to 5 seconds prior to the crash. Earlier models of Toyota only provide accelerator position as a voltage. Steering wheel angle, yaw rate and longitudinal acceleration appear to be limited to more recent models of Toyota, and the Jeep (minus the acceleration), while Holdens lack this data. Earlier models did not provide information on belt use, while in recent Toyotas it is listed as 'SNA', signal not available. Lateral change in velocity was not provided for earlier Toyota models, and one recent Toyota. Roll rate and angle are not shown in the table as they were only recorded on certain vehicles, potentially only when a possible rollover was sensed. Ignition cycles (at crash and at download) validate that the data is from the crash in question. This information was only lacking in early Toyota models.

Table 1. A summary of EDR data by vehicle

Vehicle	Impact type	EDR Data													
		General data from EDR					EDR Pre crash data (presence and time span in seconds)								
		Passive Safety deploy	Long. ΔV km/h	Lat. ΔV km/h	Ignition cycles	Belt use	Data Rate (Hz)	Speed	Acc. pedal %	Brake Use	Cruise Control	Steer angle	Yaw rate	Long. Acc.
In-depth crash investigation EDR data downloads														
2007 Toyota Yaris	Corner	Yes	14.3	No	No	No	1	4.8	V**	4.8	No	No	No	No
2008 Toyota Yaris	Front	Yes	31.7	No	No	No	2	4.3	V**	4.3	No	No	No	No
2009 Toyota Aurion	Front	Yes	21.8	11.2	No	Yes	2	4.3	V**	4.3	No	No	No	No
2011 Toyota Camry	Front	Yes	23.2	6	Yes	SNA*	2	5	5	5	5	5	5	5
2012 Toyota Yaris	Front	Yes	23.4	2.7	Yes	SNA*	2	SNA	4.55	4.55	No	No	No	No
2014 Toyota Corolla	Front	Yes	38.9	3.1	Yes	SNA*	2	4.85	4.85	4.85	4.85	4.85	4.85	No
2015 Toyota Camry	Rear	Yes	19.3	No	Yes	SNA*	2	4.65	4.65	4.65	4.65	4.65	4.65	4.65
2009 Holden Commodore	Front	Yes	13.49	2.25	Yes	No	2	2.5	2.5	2.5	1	No	No	No
2010 Holden Commodore	Side	Yes	0***	0***	Yes	Yes	2	2.5	2.5	2.5	1	No	No	No
2014 Holden Commodore	Front	Yes	15	9	Yes	Yes	2	5	5	5	2	No	No	No
2013 Mazda 3****	Side	Yes	0***	0***	Yes	Yes	2	5	No	Yes	No	No	No	No
2013 Jeep Grand Cherokee	Rear	Yes	7.0	0.0	Yes	Yes	10	5	5	5	5	5	5	No
Trial EDR data downloads														
2007 Toyota Camry	Rear	Yes	17.4	No	No	Yes	1	4.2	V**	4.2	No	No	No	No
2008 Toyota Landcruiser	Roll	Yes	2.8	3.2	No	Yes	1	4.2	V**	4.2	No	No	No	No
2016 Holden Cruze	Front	Yes	24	2.5	Yes	Yes	2	5	5	5	2	No	No	No

* SNA stands for signal not available

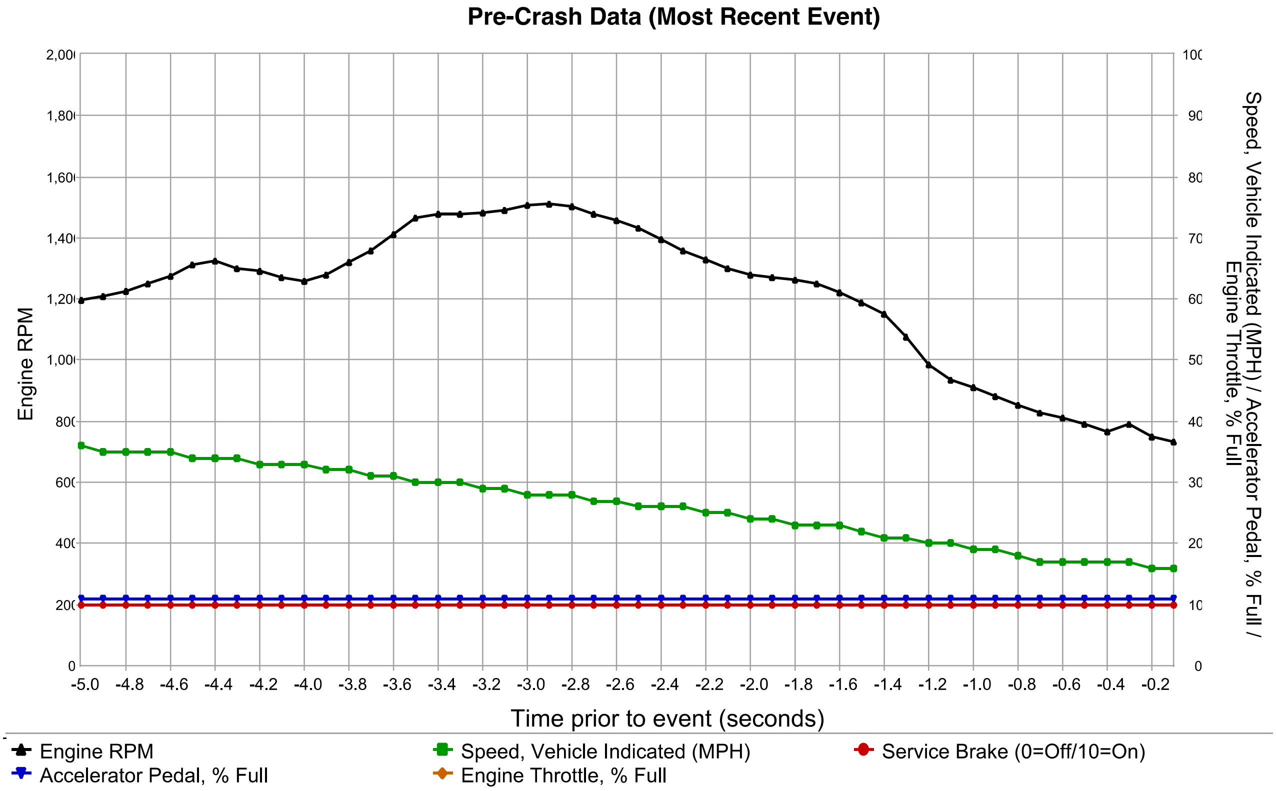
** The accelerator pedal percentage is given in Volts rather than a true percentage.

*** These ΔV values are clearly incorrect

**** This vehicle is not officially supported in Australia. The data downloaded did not appear to be related to the crash

Pre-Crash Data -5.0 to -0.5 sec (Event Record 1)

Times (sec)	Accelerator Pedal, % Full (Accelerator Pedal Position)	Service Brake (Brake Switch Circuit State)	Engine RPM (Engine Speed)	Engine Throttle, % Full (Throttle Position)	Speed, Vehicle Indicated (Vehicle Speed) (MPH [km/h])
-5.0	0	Off	1472	10	55 [88]
-4.5	0	On	1472	10	55 [88]
-4.0	0	On	1472	10	54 [87]
-3.5	0	On	1472	13	53 [86]
-3.0	0	On	1472	12	53 [86]
-2.5	0	On	1408	12	53 [85]
-2.0	0	On	1408	12	52 [84]
-1.5	0	On	1408	12	52 [83]
-1.0	0	On	1088	15	41 [66]
-0.5	0	On	1024	16	36 [58]



Pre-Crash Data, -5 to 0 seconds (Most Recent Event, TRG 2)

Time (sec)	-5	-4.5	-4	-3.5	-3	-2.5	-2	-1.5	-1	-0.5	0 (TRG)
Vehicle Speed (MPH [km/h])	15.5 [25]	15.5 [25]	15.5 [25]	15.5 [25]	13.7 [22]	11.8 [19]	9.9 [16]	9.9 [16]	9.9 [16]	11.8 [19]	13 [21]
Accelerator Pedal, % Full (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.0	28.5	0.0
Percentage of Engine Throttle	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.5	14.5	0.0
Engine RPM (RPM)	1,000	1,100	1,100	1,000	1,000	900	800	700	1,000	1,900	1,500
Motor RPM (RPM)	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid
Service Brake, ON/OFF	ON	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	ON
Brake Oil Pressure (Mpa)	0.34	0.29	0.43	1.44	1.49	1.49	1.49	0.00	0.00	0.00	5.66
Longitudinal Acceleration ,	-0.646	-1.005	-0.861	-2.297	-2.297	-2.297	-2.369	-0.287	0.000	1.651	-6.245
Yaw Rate (deg/sec)	3.42	3.42	2.44	2.93	1.46	1.46	1.46	-0.98	-6.34	-5.86	-1.46
Steering Input (degrees)	27	27	24	24	18	18	15	-9	-60	-45	-15

Figure 1. Examples of selected pre crash data from a Holden (top), Jeep (middle) and Toyota (bottom)

Discussion and Conclusion

EDR data is currently only available from a limited number of vehicle models, and is further limited to crashes with a change in velocity above approximately 7km/h. To date only 12 of the 131 light vehicles involved in crashes investigated by CASR have had EDR data successfully downloaded. An ADR, similar to the rule in the United States (NHTSA 49 CFR Part 563), that specifies that manufacturers must make vehicles equipped with an EDR downloadable by commercially available tools could greatly increase the availability of EDR data in Australia.

EDR data provides pre and post-crash information on a range of variables that are useful for road safety research. These include, but are not limited to: travel speed, impact speed, change in velocity (DeltaV) belt use and brake use.

Future Work

CASR has just begun a pilot study to downloaded a much larger sample of EDR data from vehicles that have been crashes and written off, or have been involved in a fatal crash. This will provide further insight into the data available and it uses.

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Knowing where to Start: The New Zealand Approach to Developing Road Safety Infrastructure Programmes

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Abstract

Identifying locations that have the potential to yield significant reductions in road trauma is the first and most critical aspect in developing road safety investment programmes (RSIP). The New Zealand Transport Agency has developed a strategic approach to identifying high-benefit opportunities that moves away from a focus on sites with High Collective Risk alone. This strategic approach helps avoid a perennial problem of identifying locations with an apparent safety problem, but little potential for improvement without transformational change. Analysis indicate the approach is a more reliable way to develop RSIP and to realise the benefits they are designed to achieve.

State Highway Gap Analysis Approach

The New Zealand Transport Agency has adopted a 'Gap Analysis' approach to understanding risk across the entire State Highway network using GIS analysis techniques and a variety of risk metrics within SafetyNET (Durdin & Janssen, 2012). All 'high-risk' locations are identified before excluding locations where improvements are programmed to take place. The remaining high-risk locations are then prioritised based on reactive measures of current safety performance using fatal and serious crash density, and estimated deaths and serious injuries (DSi) per km (Brodie et al.), as well as a proactive Star Rating measure. The prioritised sites are then analysed for potential countermeasures either by the Safe Roads Alliance, or by the regional State Highway offices.

The strategic approach to identifying and prioritising high-risk sites is helping the New Zealand Transport Agency deliver a more targeted RSIP across the State Highway network that is expected to outperform traditional site-by-site analysis approaches in terms of road trauma reduction.

Local Authority RSIP Proposal

Since 2010, the New Zealand Transport Agency and their Safer Journeys partners have commissioned the development of a number assessment tools and techniques that move away from traditional methods of identifying high-risk locations. Reliance on total crash numbers and the social cost of crashes are replaced with approaches that are based around risk and the likelihood of death and serious casualties occurring in the future.

These evidence-based risk assessment techniques have been encapsulated in the suite of "High-Risk" guides and recognised as the best practice methods for determining 'high crash risk' within the Strategic Fit component of project and programme funding assessment profiles.

The outputs of these assessments have been used to identify approximately 4,000 km of high-risk roads managed by Local Authorities, which account for 36% of all fatal and serious crashes on local roads over the past 5 years, yet only represent 5% of that network by length. The New Zealand Transport Agency is developing a RSIP proposal formulated from these high-risk roads.

Because the roads managed by local authorities are complex and exhibit a broader range of characteristics than the State Highway network, a different approach is used to prioritise high-risk locations within the RSIP proposal. Here, high-risk locations are prioritised based on the potential for improvement using Personal Risk and Level of Safety Service (LoSS) metrics rather than applying a risk reduction factor to Collective Risk. The RSIP is then populated based on estimated DSi reduction per $100 million spend. The approach is considered a more reliable and cost effective way for developing RSIP to realise the benefits they are designed to achieve.

Selecting Countermeasures

Whilst identifying the locations is the first and most important step, identifying the appropriate level of intervention becomes the next. Nirvana would have us implement a fully Safe System compliant infrastructure solutions, however in many instances this may not be practical, nor affordable or publically acceptable. Hence a pragmatic approach has been developed with a mix of traditional and Safe System solutions.

This paper will be of interest to everyone involved in the development and delivery of RSIP.

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Effects of Bicycle Helmet Legislation on Cycling: A Global Systematic Review

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Abstract

The effect of mandatory bicycle helmet legislation (MHL) on cycling has been a controversial issue since it was first introduced in Australia in 1990. Since then, multiple studies have assessed the effect of MHL on cycling, with mixed findings in relation to its effect. Furthermore, although there are 26 countries with some form of MHL, the literature has focused almost solely on Australia, Canada, New Zealand and the US. The current systematic review includes peer-reviewed and the grey literature studies conducted across the 26 countries. There have been no systematic reviews on this topic to date.

Background

In an effort to increase bicycle helmet wearing, several jurisdictions around the world have enacted MHL, and these countries have observed a sustained increase in helmet wearing. In response, critics of MHL and the promotion of helmet wearing in general cite declines in ridership as an unintended consequence. For example, Robinson (1996) used the counts of cyclists from the NSW and Victorian helmet use reports to conclude cycling ridership declined by 30-40% following legislation. This research is often cited as a reason to not mandate helmet use or repeal current laws (see, for example, SWOV, 2012; Rojas-Rueda, Cole-Hunter & Nieuwenhuijsen, 2013).

Conversely, a substantial body of research has found MHL is not associated with declines in cycling. For example, Macpherson, Parkin and To (2001), and Dennis, Potter, Ramsay and Zarychanski (2010) did not find cycling declines in Canada while more recent Australian studies have drawn similar conclusions (Haworth, Schramm, King & Steinhardt, 2010; Olivier, Boufous & Grzebieta, 2016). Consequently, the literature is decidedly mixed on the effect MHL has on cycling ridership.

A limitation of the literature relates to its lack of comprehensiveness in examining MHL outcomes across countries. Even though there are 26 countries with some form of MHL, the literature has focused almost solely on Australia, Canada, New Zealand and the US. However, the effects of MHL in other 22 countries have been largely overlooked. Given that peer-reviewed publications are not the standard mode of communication for government agencies, relevant reports and/or data might exist for our purposes in the grey literature. Therefore, a systematic review through the peer-reviewed and the grey literature would greatly improve identifying relevant data which in turn would improve our knowledge of the effects of MHL on cycling. The aim of the present study is to conduct and report the findings from such a review. The review adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Moher, Liberati, Tetzlaff & Altman, 2009).

Method

A search of five databases (Embase, Medline, Compendex, Scopus, and Web of Science) for peer-reviewed articles was conducted on 16 February 2017. The grey literature will be identified by contacting road safety organisations in countries with existing MHL, searching through abstracts of international conferences and websites sponsored by pro- and anti-helmet organisations. Other grey literature platforms (e.g., Trove and Worldcat) and datasets (e.g., ProQuest) will also be searched. The exact details of each law (e.g., effective date, age of cyclists, level of enforcement) will also be identified from government websites and by contacting government representatives or road safety researchers. In compliance with PRISMA, documents for this review will be independently searched and extracted by two reviewers.

Results and Conclusions

The findings of this ongoing systematic review will enhance our knowledge of the effects of MHL. Past reviews have focused primarily on the peer-reviewed literature from English speaking countries (e.g., Machperson & Spinks, 2008; Ontario Agency for Health Protection and Promotion (Public Health Ontario), 2015), while our review will attempt to gather relevant data from all 26 MHL countries.

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Opportunities to Refresh the Current NSW Road Safety Strategy and Integrate Safety Priorities with Broader Transport Planning Outcomes

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Abstract

Transport for NSW has commenced refreshing the strategic approach to long-term transport planning in NSW with the release of the Future Transport Plan. The University of Melbourne was commissioned to identify opportunities to refresh the current NSW Road Safety Strategy, and to better integrate it with transport planning outcomes. Specific opportunities identified relate to integrated land use and transport, transport modal shift, enhancing accessibility, and intelligent transport systems. A new framework for an integrated Safe System is also presented, which will influence development of a new five-year Road Safety Plan to underpin the Future Transport Plan.

Background

The NSW Road Safety Strategy 2012-2021 (the Strategy) establishes the ten-year direction of road safety in NSW. The Strategy is based on the Safe System approach.

Presently Transport for NSW (TfNSW) has commenced refreshing our approach to long-term transport planning with the release of the Future Transport Plan. The Future Transport Plan will have a view to 2056 and seeks to meet the future transport needs of all NSW customers. It is therefore timely to integrate the current Strategy with the Future Transport Plan to ensure that road safety is embedded in all aspects of our transport services, network, assets and infrastructure.

This project assumes that road safety strategies must now be considered from a perspective of complex systems for the delivery of a safe and sustainable transport network.

As a first step to reviewing the Strategy, the University of Melbourne was commissioned to:

- Identify effective approaches to developing road safety strategies
- Review progress of the current Strategy implementation
- Identify opportunities to refresh the Strategy, and to integrate it with transport planning.

Method

Tasks for this work included:

- A comprehensive review of international best practice in strategy development.
- A strategic stocktake of the current Strategy, in terms of its vision, targets and directions.
- A desktop review of initiatives implemented since the release of the current Strategy.
- Semi-structured interviews with senior TfNSW management and key external stakeholders.
- Analysis of NSW crash data trends.

Results

In addition to opportunities to intensify current initiatives for further road safety improvements across the NSW road network, this work also identified the following opportunities for integrating the Strategy with long-term strategic transport planning:

- Integrated land use and transport: prioritising better matching of vehicle operating speeds, vehicle safety features, road user behaviours and the designed environment;
- Transport modal shift: accelerating the shift to public transport, and to active transport by prioritising the design and delivery of safe walking and cycling facilities;
- Enhancing accessibility: facilitating the shift to safer modes of transport for seniors and disadvantaged people in rural and regional NSW; and
- Intelligent transport systems: promoting innovative technologies to enhance and monitor safety outcomes.

A refreshed Strategy framework is at Figure 1. The framework introduces the NSW Future Transport Plan as the overarching context driving the Strategy and identifies four priorities for safety that must be addressed in the refreshed Strategy. Safe and sustainable transport for all is identified as the ultimate goal, with safety determined in accordance with desired Safe System outcomes (i.e. elimination of road fatalities and serious injuries).

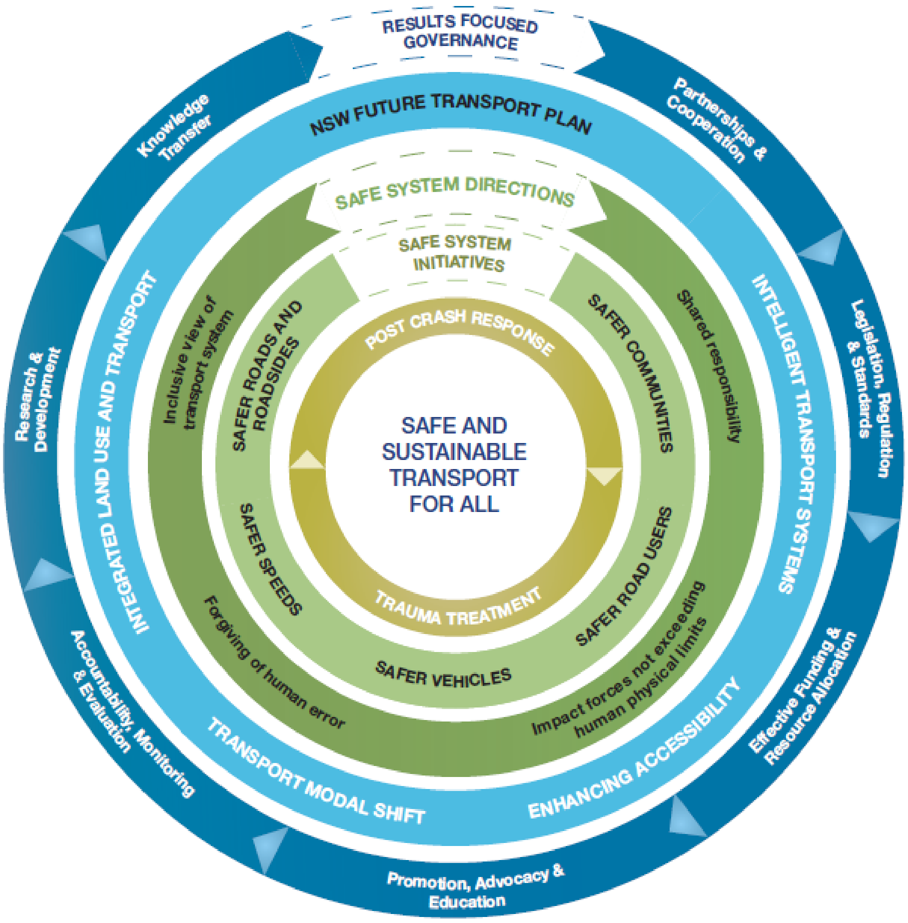

Figure 1. Refreshed road safety strategy framework

Conclusions

This work identifies several opportunities to refresh the current NSW Road Safety Strategy, and to better integrate road safety with transport planning outcomes. It presents a new way of thinking about Safe System principles within a broader transport planning context. TfNSW has commenced work to develop a new five-year Road Safety Plan to underpin the broader NSW Future Transport Plan, which will be influenced by outcomes from this work.

Expanding Young People's Horizons as Leaders of Change in their Community: How Could Critical Pedagogy Improve Australasian Transport Safety Education?

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Abstract

Transport safety education programs in Australasia continue to default to traditional pedagogical methods despite the lack of evidence of their effectiveness in improving safety learning outcomes. Top down approaches promoting a singular view of 'proper' attitudes and behaviours are didactic and position young people as needing to be controlled (Kincheloe, 2004). Embedding critical pedagogical approaches such as Knowledge Producing Schools (KPS) (Rowan & Bigum, 2010), systems and critical thinking within transport safety education programs could reposition young people to drive change in their own communities and make real-world contributions to improving safety on our roads, around trains, and near tracks.

Theoretical background

Traditional pedagogy focusses on 'knowledge giving'; little consideration is given to young people and their genuine potential to solve real-world problems. Scholars of critical pedagogy (Friere, Giroux, Kincheloe) reject these didactic approaches, with Kincheloe (2004) arguing critical pedagogy leads students to want to make a difference through their actions. When teachers facilitate student enquiry, students learn to pose problems and in turn gain the freedom "to become self-directed human beings capable of producing their own knowledge" (Kincheloe, 2004, p. 17). Rowan and Bigum (2010) expand on this idea with Bigum's KPS framework, which gives education program designers, schools and teachers the ability to create educational projects which transform the learning experience for students by asking them to produce rather than consume knowledge, and connects the learner to a real-world audience in the broader community.

Real-world application

In their transport safety education materials, the New Zealand Transport Agency's (NZTA's) transport safety 'Education Portal' (NZTA, n.d.-a) in New Zealand and the TrackSAFE Foundation's (TrackSAFE's) rail safety program 'TrackSAFE Education' (TrackSAFE, n.d.) in Australia utilise critical pedagogical approaches. They incorporate the KPS framework as well as student-driven tasks encouraging systems thinking and critical thinking to encourage students to solve transport safety problems in their own communities. This approach is not however seen consistently throughout transport safety education programs across Australasia: many are information-based, which have shown little success in achieving positive safety change (NZTA, n.d.-b).

Expanding program horizons

There is a need to shift from traditional, information-giving pedagogical methods used across transport safety education towards approaches which focus less on the power of the institution, such as schools, road or rail organisations or the police; less on the adult doing the 'teaching', such as the Subject Matter Expert (SME) or classroom teacher; and more on the learner: the student who the safety education activity is designed for.

In a fact sheet synthesising an in-depth literature review, NZTA emphasises that transport safety education should enable young people to use their learning to make a difference for themselves and others (NZTA, n.d.-b). In New Zealand, students as young as five are positioned as the producers of knowledge and the drivers of social change in their own community, and case studies reveal young people themselves are making a tangible difference to their own and others' safety in their communities as a result of participating in NZTA's lessons (New Zealand Curriculum Online, 2011).

Discussion

A framework shift in Australasian transport safety education from 'knowledge giving' to 'knowledge producing' has the potential to help young people make meaningful contributions to transport safety in their own communities. What if, instead of asking, "What problems do we have with young people, and how do we change their behaviour?" transport safety educators asked, "How could we enable young people to improve transport safety within their own communities?" If critical pedagogical approaches were adopted as a framework in more transport safety education programs, could the changes we need in transport safety actually be led and achieved by young people themselves?

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Expanding Educational Horizons: High School Students Creating Innovative Designs for Safer Pedestrian Level Crossings in the TrackSAFE Education STEM Competition

Janine Ferris

TrackSAFE Foundation

Abstract

In 2017 the TrackSAFE Foundation (TrackSAFE) issued a challenge to young people to use design thinking to create an innovative solution to make pedestrian level crossings safer using science, technology, engineering and mathematics (STEM) principles. Year 7 to 10 students (aged 12 to 16) from across Australia entered the inaugural TrackSAFE Education Rail Safety Competition for High Schools. This was an opportunity for students to expand their horizons through developing their research skills, and designing an original mechanical or electronic device with the potential to make a real difference to people's safety, for a genuine purpose beyond their classroom walls.

The challenge

According to the Australian Institute of Health and Wellbeing, young people aged 0 to 14 represent eight percent of pedestrian serious injuries at level crossings in Australia (Henley & Harrison, 2009). For the 15 to 24 years cohort, this figure jumps to thirty one percent (Henley & Harrison, 2009). TrackSAFE, a not for profit organisation aiming to reduce near collisions, injuries and fatalities on the rail network, asked young Australians themselves to help reduce these statistics through a meaningful, authentic STEM task.

Students investigated a pedestrian level crossing safety issue in their community and, working in small groups of two to four, applied 'design thinking' (Empathise/Define/Ideate/Prototype/Test) to create an innovation to address this issue. They then created a video pitch to describe why their chosen safety issue is important; explain how they used design thinking to create their idea; and justify why they think their idea will help improve safety. The competition aligned with the Australian Government's National Innovation and Science Agenda to improve student participation in STEM (Department of Education and Training, n.d.).

Promotion and registration

The competition ran between March and July and was promoted via Facebook advertising (reach of 33,649/480 link clicks); website (1051 unique pageviews); general social media posts; and through TrackSAFE Education's Reference Group member network. Fifty seven teachers registered for a digital competition pack. These teachers indicated between 1000 and 1250 students would participate.

Results

All entrants chose distraction or inattention as their safety issue. Their innovative design solutions included a series of obstacle course gates to walk through; poles with flags which swing open to smack the pedestrian in the face if they are looking at their mobile device; and a reflective junction which reflects light into the pedestrian's eyes, forcing them to look up and concentrate on crossing.

Five entries in the Year 7/8 category and one in the Year 9/10 category progressed to the expert judging panel. The panel comprised of three judges from engineering, human factors and safety standards backgrounds from TrackSAFE's rail industry partners. The public voted on their favourite innovation in the People's Choice Awards during Rail Safety Week (14-20 August 2017). Prizes with a total value of $5000 were awarded to the winning students, schools and teachers. The winning entries and teams will be showcased during the conference session.

Key learnings

Registered teachers whose students did not enter were asked to provide feedback for insight into why they registered but did not enter the competition. Key themes from the feedback included changes to priority, and limited class time, including a request for advertising a term in advance. Some teachers facilitated the lessons with their students but did not enter due to poor quality entries, or asked their students submit their own entries, however they were not received. Many teachers praised the competition concept and high quality of the accompanying materials. The website and social media analytics; and future strategies to improve engagement based on teacher feedback, will be discussed during the conference session.

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The Extent of Backover Collisions Internationally

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Abstract

This study reports good consistency in international comparisons of the number and severity of backover crashes. More than half occurred to pedestrians aged 60 years and older. Children less than 9 years comprised 5% of these crashes with a similar percent aged 10 to 19 years. A significant 41% reduction in real-world backover crashes was found for Australian vehicles with reversing cameras. A range of driver and pedestrian manoeuvres were found and 11 crash scenarios identified in backover collisions. Mandating the fitment of reversing cameras in all vehicles and enhancements would likely enhance the safety of pedestrians in reversing manoeuvres.

Introduction

Reports from the USA have highlighted the extent and severity of backover in this country (NHTSA 2008). Of particular interest is how widespread these collisions are across other international regions (including from the States New South Wales, Queensland, South Australia, and Victoria in Australia as well as New Zealand. The study also examined what can be done to help prevent these injurious events.

Method

An analysis was undertaken using data from several regions to gauge the extent of these collisions, their crash characteristics, and potential solutions. National data were provided from UK, Germany, Europe (CARE database) and Australasia to address this question. In addition, several in-depth and police cases were made available to examine the extent and crash causation circumstances.

Results

The findings (Fildes *et al*, 2016) revealed consistency in the national statistics across the regions analysed. Most reversing crashes occurred in low speed urban areas, involving predominantly passenger cars and light utilities. Sport Utility Vehicle involvement was higher in USA and Australia, possibly because a high proportion of these vehicle types are registered in these two countries.

Most pedestrians injured (50%) were aged 60 years or older in all countries apart from the USA and were predominantly female in most, except for Europe. Fatal outcomes were associated with 7.5% of collisions while 90% involved severe injury outcomes in these data.

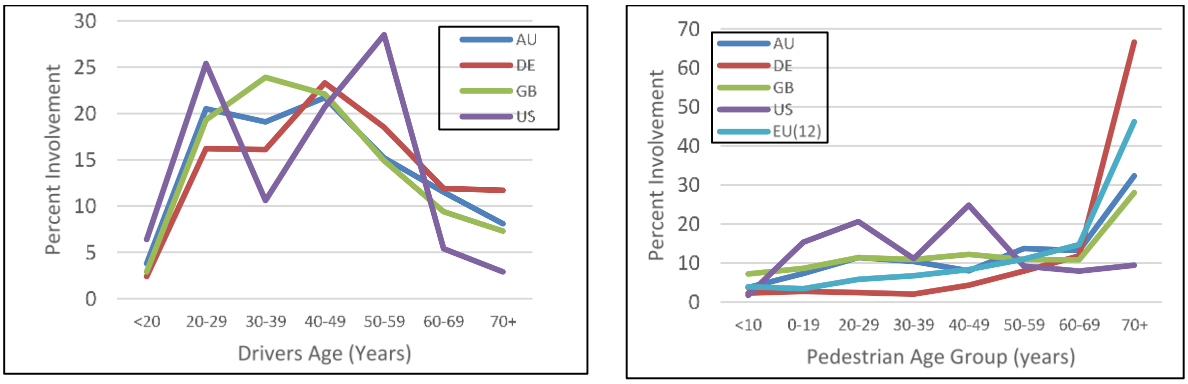

Figure 1. Drivers age by percent involvement (Left) and Pedestrian's age by percent involvement (Right)

Fatal backover collisions involving children aged 0-9 years comprised only 7% of these police-reported crashes, many reported in drive-ways (Fildes *et al*, 2014). However, the degree of under-reporting of these collisions, in an off-road environment could not be assessed in this analysis because of the lack of suitable data. Findings by Austin (2008) suggested that this could be substantial for all crashes and ages.

Crash Scenarios

An analysis of an extended set of police causal assessments data in the UK revealed interesting trends. The top six of these included the driver (25.3%) and/or pedestrian (16.7%) failed to look properly, pedestrian failed to judge vehicle's path or speed (8.2%), driver failed to see pedestrian in vehicle blind spot (6.9%), driver and/or pedestrian was careless, reckless or in a hurry (6.5%), and the driver made a poor turn or manoeuvre (6.3%).

Table 1: The 20 most common contributory factors coded from backover crashes (UK data, 2010-2012)

Contributory factor (up to 6 per crash)	Frequency	Percent
Driver failed to look properly	3956	25.28
Pedestrian failed to look properly	2619	16.74
Pedestrian failed to judge vehicle's path or speed	1288	8.23
Vehicle blind spot	1083	6.92
Driver and/or pedestrian was careless, reckless or in a hurry	1021	6.53
Poor turn or maneuver	989	6.32
Pedestrian careless, reckless or in a hurry	491	3.14
Failed to judge other person's path or speed	364	2.33
Pedestrian dangerous action in carriageway	307	1.96
Pedestrian crossing road masked by stationary or parked vehicle	302	1.93
Driver loss of control	300	1.92
Pedestrian impaired by alcohol	275	1.76
Aggressive driving	271	1.73
Pedestrian disability or illness, mental or physical	229	1.46
Stationary or parked vehicle(s)	150	0.96
Impaired by alcohol	143	0.91
Nervous, uncertain or panic	143	0.91
Pedestrian wearing dark clothing at night	140	0.89
Too close to cyclist, horse rider or pedestrian	120	0.77
Illegal turn or direction of travel	93	0.59

In addition, the in-depth crash data of backover collisions made available by BASt (Germany) and DfT (UK) revealed eleven typical crash scenarios in backover collisions. These findings are useful in pin-pointing areas where technology may be required to help prevent these collisions.

Interventions

Vehicles fitted with reversing cameras were 41% less involved in backover collisions (Keall *et al*, 2017). While the rate for Sports and Utility Vehicles (SUVs) appeared to be greater, this finding was not statistically significant due to relatively small numbers.

Enhancements in reversing technologies (radar units and more sensitive bumper-mounted sensors with full 250deg vision) have the potential to further reduce these harmful reversing collisions (Fildes *et al*, 2016). Estimates of the costs of fitting these technologies were quite expensive and unlikely to be cost effective.

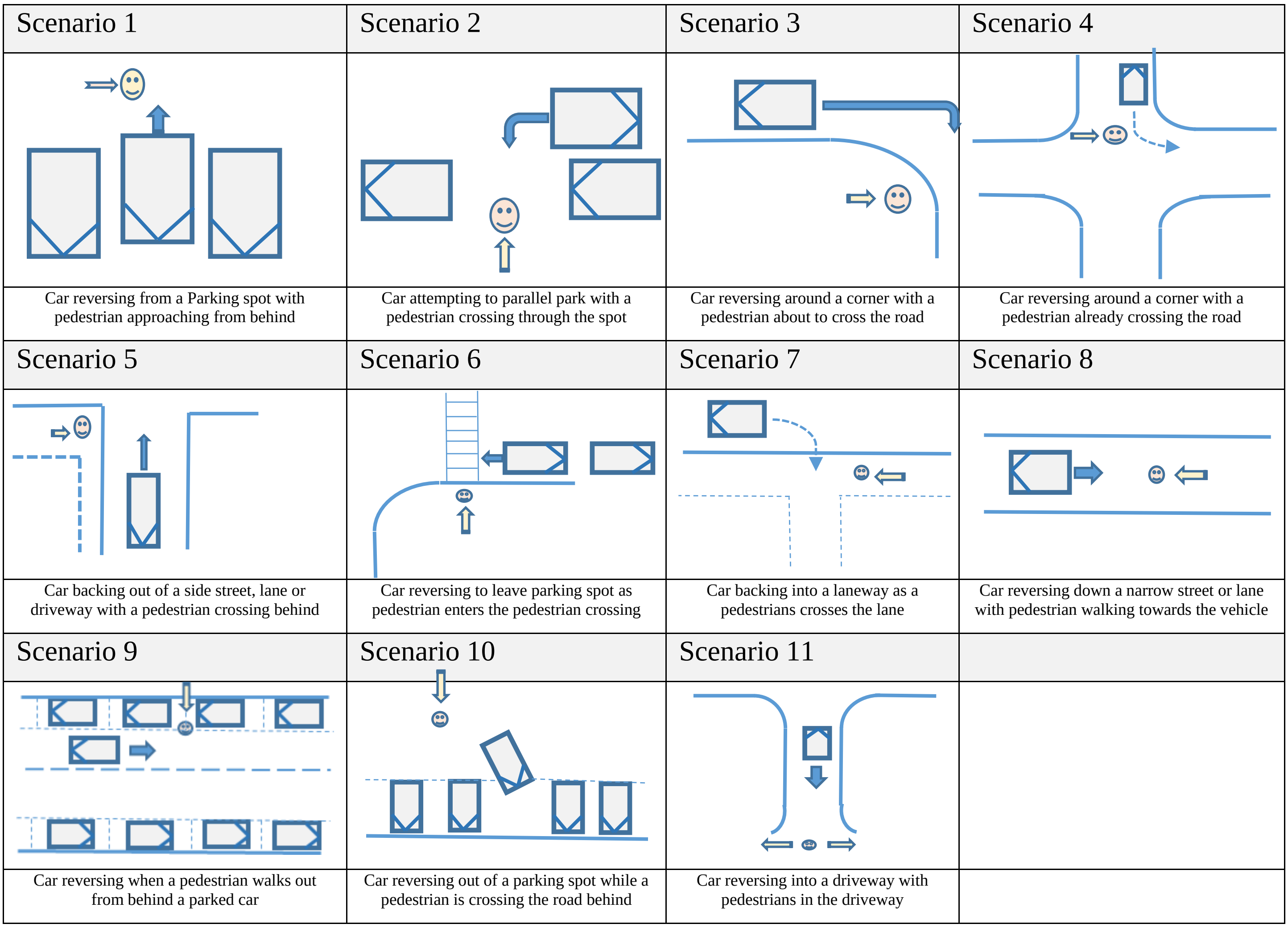

Figure 2 The 11 most frequent crash scenarios from the total sample of 26 in-depth crashes provided

Conclusions

This is the first study found that examined the full extent of the backover problem in several international regions and has confirmed findings from a previous study of backover crashes in the USA. While the number of crashes were relatively small (even allowing for under-reporting), nevertheless, associated injury severity was high and young children were involved. Several potential solutions were identified to address this unnecessary and severe trauma. In particular, mandating the fitment of reversing cameras in all vehicles and enhancements would likely enhance the safety of pedestrians in reversing manoeuvres.

Acknowledgements

The authors are especially grateful to Margaret Prendergast and Bernard Carlon of NSW Transport for sponsorship of this study and to Robert Hogan of the Commonwealth Department of Infrastructure and Regional Development in initiating this research. We are also grateful to the international partners for providing their data on reversing collisions to pedestrians in the UK (Bernie Frost), Germany (Claus Pastor and Bernd Lorenz), and the European Commission (Maria-Teresa Sanz-Villegas). While the US data were downloaded for the NHTSA website, our thanks for earlier advice by Christopher Bonanti, David Hines, Markus Price and Jonathon Roth and Jesse Chang at NHTSA's Headquarters.

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What is the Future of Private Transport?

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Abstract

Technological disruptions in energy and transportation in coming years will have substantial impact on future private transportation (Saba 2014). It is claimed that by 2030, vehicles will be electrically driven, autonomous, and ownership will shift to car sharing. These changes will have a profound effect on today's societies. They will also come with considerable implications for governments and society in personal mobility, licensing needs, and government legal and regulatory regimes. Successful introduction may lead to road trauma reductions, cleaner and more liveable cities, and enhanced mobility. The paper addresses areas affected and the need for greater knowledge to address the potential challenges.

Background,

Saba (2014) claimed that a number of "disruptors" (major technological developments) are likely to have a significant impact on private transport in the coming years, most notably, electric autonomous vehicles, with a shift from owning to using service vehicles. He claimed that this could happen as early as 2025. Even if these bold predictions only partially eventuate, they are likely to have a profound effect on today's societies (up to a 20% reduction in the number of vehicles on our roads is predicted) with fewer crashes, reduced congestion, less need for parking facilities, environment improvements, greater use of public transport, potential changes in urban living, type of housing, vehicle ownership, etc. A detailed review paper was initially prepared and presented at the Urban Design 2016 Conference in Canberra for information (Fildes, *et al*, 2016).

A workshop was also held in November 2016 comprising members of local and national governments, vehicle industry, consumer groups, and researchers, to identify key issues of concern for autonomous vehicles for each of these organisations. The workshop was initiated by MUARC and Professor Claes Tingvall, Chalmers University, Sweden, also participated. Many of the items, above, were raised as issues requiring further research and knowledge. The need of considering the likely impact of these developments was raised to ensure we are well prepared for this change.

Method

Subsequently, a collaborative research partnership was established between six faculties at Monash University to review and address some of these issues. The partnership was funded by the Monash Infrastructure Institute (MI) and comprises members from the Accident Research Centre (MUARC), Institute of Transport Studies (ITS), Mobility Design Laboratory (MADA), SensiLab (IT), ClimateWorks Australia (Monash Sustainable Development Institute), and Monash Law (Fildes *et al*, 2017). Each participant group was assigned a Work Package to address relevant issues in their area of concern.

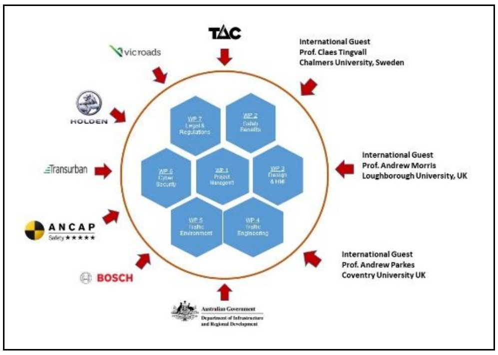

Figure 1. MI Consortium

While these vehicles are expected to offer improvements in traffic flow, social change, and their impact on urban design for Australian cities (Fildes *et al*, 2016), Of particular interest here is the ability of these vehicles in achieveing a ”Towards ZERO” outcome. The need for an onroad trial of autonomous eTaxis in a suitable precinct was especially noted to identify further key issues in their safe use and implementation.

Findings to Date

While this is still very much work in progress, a number of preliminary findings have been identified to date. While a fully autonomous fleet has the potential to achieve zero road deaths and serious injuries among vehicle crashes, the safety outcome among a mixed fleet (non-autonomous and autonomous vehicles) is less clear.

Figure 2. Example of Intersection Complexity (Source: Google.com.au)

Human intervention may play a role (drivers of non-autonomous vehicles or vulnerable road users may take advantage of programmed vehicles). Will drivers of autonomous vehicles rely on the technology completely or choose to take control, appropriately of inappropriately? What is the likely demand and supply of autonomous vehicles when they become available?

Furthermore, other questions arise with the technology and its limitations. While the technology appears to be inevitable, will it be capable of preventing all collisions? Will autonomous vehicles be able to cope with poor road delineation and infrastructure and avoid issues such as the ”trolley problem” (Thomson 1985)? Given the possible delays associated with numerous stoppages, will occupants continue to be attracted with the technology or through frustration, revert back to manual driving.

A number of vehicle scenarios are under development to address these potential safety issues and model the various safety outcomes in terms of savings in deaths and serious injuries. Key to assessing the potential savings in serious injuries and deaths will be the progressive take-up of autonomous vehicles and the rate of fade out of current vehicles in the fleet in the coming years. The work of Dresner and Stone (2005; 2007), IIHS (2008), Litman (2015) and Sivak and Schoettle (2015) has proven valuable in developing these model outcomes.

Discussion

There is little doubt that many of these changes will be forced upon society through disruption and community demand and we need to be prepared for these changes. Considerable public discussions, planning and innovation is required. Science will play a major role in identifying appropriate improved knowledge through new research and development. Greater appreciation of the public’s willingness to accept and embrace these new technologies will be key.

There will be innovative industry opportunities for this new transportation business model that need to be identified and promoted. Government strategies and policies are required in terms of necessary legislation and licensing for these vehicles, as well as a more societal approach. Potentially, the new technology will drive these private transport innovations and governments and communities need to keep up with this progress to ensure it is safe and beneficial for all Australians.

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Aboriginal Road Trauma (ART) Sorry Business Project, ENOUGH'S ENOUGH Campaign

Rebecca Forrest

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Abstract

The Northern Territory (NT) has the highest incidence of road fatalities per capita in high income countries. The Northern Territory Police Force (NTPF) and Motor Accidents Compensation Commission (MACC) developed a campaign to appeal to Indigenous audiences entitled Aboriginal Road Trauma (ART) ENOUGH'S ENOUGH campaign. Consultations with Indigenous groups took place to ensure messages are received and understood within indigenous communities where there is a high rate of illiteracy. Storytelling by respected leaders sharing real road trauma stories that deeply impacted their community and a showcase of art was adopted to convey that alcohol is not part of Aboriginal culture.

Background

More Indigenous Australians die on NT roads than anywhere else and this campaign aims to address the root of the problem by discussing culture. A distribution of the road-crash fatalities among Indigenous territorians in NT is shown in Figure 1.

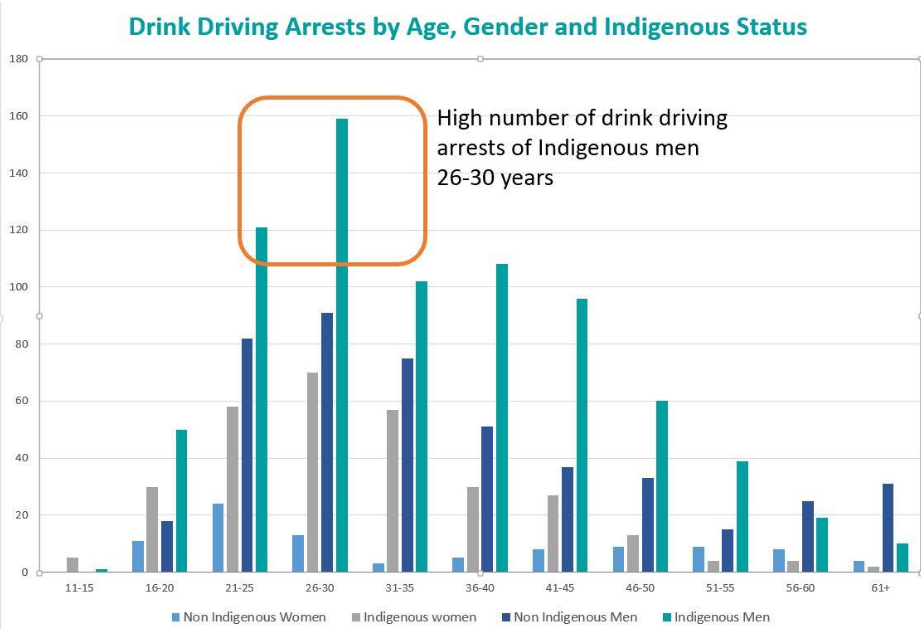

Figure 1. Road-crash fatalities among Indigenous territorians in NT

The National Drug Law Enforcement Research Fund (2016) identified that Indigenous people involved in their studies reported a strong sense of 'family obligations' which referred to situations where they described pressure from members of their extended families to drive after drinking. The underlying responsibility for transporting family members appeared to be difficult to avoid and related to cultural values that involved responding to family needs as a priority. One of the key objectives for the ENOUGH'S ENOUGH Road Safety Campaign was for Indigenous communities to adopt a culture-led response to the problem of drink driving.

Influencers play a vital role in educating and changing behaviours in local communities – especially Elders, community leaders, women and children and it is through their story telling that speaks to their communities and reminds them about the cultural values and helps communities understand the impact that drink driving can have on everyone.

Method

Story telling was a key element for this campaign. Interviews with First Circle members, a group of Aboriginal leaders from across the Territory, revealed that there is little knowledge at a community level in how to begin to deal with serious issues such as drink and drug driving, pedestrian safety and passenger safety.

Community leaders from across the Territory were identified and the creative team from Brand and Story developed compelling stories that are genuine, culturally relevant and featured influential representatives from community. The campaign comes to life through the stories that Aboriginal artists tell in their own unique style. Each leader has created artwork and we hear them recount a 'sorry business' story from their community – a real story of road trauma caused by drink driving that has deeply impacted their community.

The key to the successful execution of this film series was in creating visually stunning works with engaging stories. The consultancy engaged to produce the campaign was Brand and Story – an organisation renowned for telling business stories. Brand and Story utilised a small crew to ensure they were fast, flexible and reactive and the production was approached like a documentary with cinematic values.

Results

Following the official launch of the campaign, the campaign materials were distributed across the NT to all remote and urban media outlets and stakeholder groups as well as through Police Stations and our Community Engagement Police teams. The Indigenous representatives used in the campaign, were engaged to communicate and showcase the campaign in their community with their artwork on display to reiterate the cultural message that "alcohol is not a part of our culture. ENOUGH'S ENOUGH.

A number of barriers were identified including: lack of awareness of the impact of drink driving. The need for ongoing education on driver awareness and stakeholder partnerships to provide training was highlighted. This campaign is merely one step in a myriad of initiatives that need to be implement to instigate real change in behaviours in remote Indigenous communities.

Conclusions

The Aboriginal Road Trauma (ART) Campaign is the first that has sought to undertake targeted consultation of Indigenous Territorians and give them a voice to say that drink driving is not a part of Indigenous culture. Through the engagement of leaders in remote communities to standing up and saying ENOUGH'S ENOUGH, the campaign has been embraced across the NT.

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Factors Associated with Cyclists Using a Bell or Calling Out When Overtaking Pedestrians

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Queensland University of Technology (QUT), Centre for Accident Research and Road Safety – Queensland (CARRS-Q)

Abstract

Authorities recommend that cyclists issue an auditory warning when overtaking pedestrians to reduce the risk of collision on shared infrastructure, however, little research has examined this behaviour. An online survey of Queensland cyclists investigated factors influencing the frequency of warning behaviours. Results suggest that demographic and cycle use characteristics may not play a large role, but that perceptions of what other cyclists do and expect of them, and expectations that issuing a warning will reduce the risk of a collision with a pedestrian, may be more important. These findings may inform intervention campaigns to encourage safer use of shared infrastructure.

Background

Cycling and walking have been identified as activities that can reduce the rate of obesity in the community. However, the availability of safe routes is a factor affecting the willingness and ability of individuals to engage in these activities (Fraser & Lock, 2011).

Separating cyclists and pedestrians from motor vehicle traffic has improved the level safety for these vulnerable road users, especially for cyclists. In Australasia, the guidelines state that ‘off-road bicycle facilities typically take the form of shared pathways for use by both cyclists and pedestrians’ (Austroads, 2017) However, mixing cyclists and pedestrians exposes both to the risk of a collision (Taverner Research, 2010). While rare, these collisions can result in serious injuries to both parties (Chong, Poulos, Olivier, Watson, & Grzebieta, 2010).

Shared infrastructure is a relatively unregulated environment, but it has important implications for user safety. In Australia, many authorities recommend that cyclists should give pedestrians an auditory warning when overtaking them, either by calling out or using a bell or horn. The aim of the current research was to investigate cyclist factors that may be associated with how often they warn pedestrians when passing.

Method

Members of Bicycle Queensland completed an anonymous online questionnaire that asked about their cycling experiences, the frequency and nature of auditory warnings they provide when overtaking pedestrians and information on normative warning behaviours. The 275 eligible participants were 18 years and older, had ridden on a shared path or footpath in Queensland in the previous 12 months, and had a bell fitted to their bicycle.

Logistic regression analyses were undertaken to investigate how these characteristics of the cyclists may be associated with the reported auditory warning behaviours.

Results

The results of the logistic regression analyses suggest that bicycle usage patterns and demographics, were generally not associated with the frequency of auditory warnings by using a bell or calling out. The exceptions were that female cyclists were more likely to call out a warning than males and cyclists riding to complete errands were less likely to warn pedestrians using a bell. Those who rode for recreation or exercise were less likely to call out a warning. Cyclists were also more likely to warn pedestrians if they perceived a higher prevalence of warnings to pedestrians by other cyclists (descriptive norms) and if giving a warning was the type of behaviour that they believe is expected of them by other cyclists (injunctive norms). The frequency of bell warnings was also higher if they expected that they would benefit by being less likely to be involved in a collision with a pedestrian.

Conclusions

The results suggest that interventions for improving safety on shared infrastructure should seek to strengthen cyclists' perceptions that other cyclists provide warnings and expect them to do so, and strengthen their belief that issuing a warning will reduce the risk of a collision with a pedestrian, and will benefit all cyclists. These interventions should not be focussed solely on cyclists, but, should also involve pedestrians so that both user groups are more aware of how they contribute to their safety when using shared infrastructure.

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Motorcycle-Friendly Roads – Applying a Customer Lens on the Journey from Identification to Implementation

Robyn Gardener[a], Iain M Auley[b], Dr Hamish Mackie[c], Dr Alex Stedmon[d], Bridget Southey-Jensen[e]

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Abstract

Last year there were 54 motorcyclist deaths on New Zealand roads and more than 1,000 injuries. The costs to the Accident Compensation Corporation Scheme are higher for this group of road user than for any other.

A joint initiative between Accident Compensation Corporation (ACC), Motorcycle Safety Advisory Council (MSAC), New Zealand Transport Agency (NZTA) and Local Authorities (LAs) aims to make motorcycling safer by developing a programme of motorcycle-friendly roads.

This paper follows the journey of identifying the highest risk motorcycle routes, engaging motorcyclists to find their most favoured riding routes, implementing safety improvements, along with some key insights from the motorcyclist's perspective.

The Journey

The first step on the journey was to identify the highest risk roads for motorcyclists from a technical engineering perspective. For the analysis an adaptation of the Urban KiwiRAP model done specifically for motorcyclists was used. This model identified that around 48% of the serious and fatal crashes involving motorcyclists in the last 5 years occurred on just 3.1% of the road network or 2,798 kilometers. Seventy percent of those crashes were on rural road with speed limits greater that 70km/h. Ninety percent of the road network has had less that 1 injury crash in the last 10 years.

Understanding the customer perspective is the key to delivering successful road safety interventions on our roads, so the next step was to engage with motorcyclists and apply their lens to the data. Risk maps were made available on a website alongside some 135+ routes that had been identified by motorcyclists as 'good rides'. Motorcyclists were surveyed online and 1,566 responses were received from a pool of around 120,000 licensed motorcyclists.

Gaining visibility of the risk for motorcyclists alongside where the riders were actually riding through the use of GIS mapping has provided insight that has not been available in the past. Sections of high risk that are popular to motorcyclists can be viewed alongside information about safety improvement work under construction, allowing contributions to be made to motorcycle-friendly infrastructure improvements in a timely and cost effective manner.

Case studies showcase motorcycle –friendly treatments and perceptual countermeasures trials. New Zealand's first motorcycle-friendly demonstration project on the Coromandel Loop has been completed by the NZTA and highlights the benefits of using a participatory design process involving motorcycle riders.

One of the most prevalent crashes for motorcyclists on rural roads is the failure to negotiate curves. The NZTA's Crash Analysis System identifies common curve factors of; speed too fast, swinging wide and braking in the bend causing loss of control. Perceptual countermeasures designed to correctly position riders on entry to a bend and encourage braking before curve entry are being trialed on the Coromandel Loop and results will be available mid 2017.

Having technical data overlaid with the favoured routes that motorcyclists ride will help target investment and efforts to improve safety to the right places. This should make sure that the motorcyclist's safety levy will provide the greatest safety benefit for riders, at the same time reducing claim costs to ACC. With international interest in the findings, this work has the potential to contribute to motorcycle safety around the world.

Review of Default Open Speed Limits within the City of Wanneroo

Ryan Gibson

City of Wanneroo

Abstract

The City of Wanneroo is one of the fastest growing Local Governments in Western Australia. The increased population means more road users and more vehicles on roads that were not built to a rural standard now performing an urban function resulting in an increased road safety risk.
As a result, the City undertook a desktop review of all roads that operated under the state default speed limit of 110km/h. The review identified 20 roads that required a speed limit review which were submitted to Main Roads WA which has approved lower speeds for all 20 roads.

Background

The City of Wanneroo is located 22 km from Perth CBD and has undergone a significant amount of redevelopment and growth in the last 10 years. As a result a large number of roads within the City have undergone significant functional change with the City receiving a significant amount of complaints from residents regarding speeding.

Rather than attempting to answer each complaint individually the City conducted a desktop review of all roads within the City's jurisdiction that do not have a posted speed limit and therefore operate under the state default speed limit of 110km/h.

The goal of the project was to reduce death and serious injury due to speeds inconsistent with safe speed thresholds on the City's rural road network.

Method

The City of Wanneroo undertook a desktop review in 2013 of all rural roads within the City's jurisdiction to identify roads that have undergone significant functional change. The main criteria used was to identify roads that do not have a posted speed limit and operate under the State default speed limit of 110km/h but excluding;

a. Roads defined as a 'built-up area' in the Road Traffic Code 2000
b. Roads that are less then 500m in length
c. Roads that do not have sufficient traffic to warrant speed zoning.

The review identified 20 roads that operated at the state default speed of 110km/h but have undergone significant functional change. A report was tabled with Council to gain community and political support for the review of the roads identified and Council recommended to request speed limit reductions from Main Roads WA as Main Roads WA set all speed limits for WA.

All roads considered in this project operated under the State default speed limit of 110km/h which is above the survivable limit for frontal conflicts of 70km/h. The 40km/h speed difference between the current speed and the survivable speed limit results in a 89% increase in fatality risk (Road Safety Council of Western Australia, 2008).

Results

The review identified 20 roads that required a speed limit review. Correspondence was sent to Main Roads requesting speed limit reviews for these 20 roads with Main Road WA and the City has had all 20 speed limit request approved. Each road was assessed by Main Roads WA with 15 roads reduced to 60km/h, 3 roads reduced to 70km/h, one road to 80km/h and one road to 90km/h. Additionally each of the roads has had pre and post traffic counts collected after the speed limit changes which have recorded significant reductions in the operating speed of the majority of the 20 roads. Further evaluation of the crash data is scheduled to be undertaken 5 years post implementation to assess if the reductions have resulted in a better road safety outcome for these roads.

Conclusions

Safe speeds are an important cornerstone in reducing death and serious injury by reducing the risk of being involved in a crash and the outcomes should a crash occur. The review of default speed limits has not been conducted by any Local Government in Western Australia before but can easily be replicated by reviewing any roads that do not meet the built up area definition and have not been speed zoned. The reduction in speed on these roads is moving the speeds for these roads closer to the survivable limits for the crash types likely to occur on these roads. The decrease in opeating speeds for the roads provides a positive indication that the speed limit reductions will likely contribute to a lower killed and serious injury rate for these roads.

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Safer School Speeds

Ryan Gibson

City of Wanneroo

Abstract

The City of Wanneroo safe school speeds project aimed to prevent death and serious injury by ensuring speeds in school zones were being adhered to. The project strategically reviewed all 50 schools within the City of Wanneroo to identify areas with significant safety issues with the road environment around schools and take measures to address these issues. As a result of the review the City referred 35 school zones to WA police for enhanced enforcement, advocated for the installation of electronic school zone signage at 4 high risk sites, identified 22 children's crossing locations and installed 8 children's crossings.

Background

The City of Wanneroo is located 22 km from Perth CBD and has undergone a significant amount of redevelopment and growth in the last 10 years. The City of Wanneroo currently has 50 schools within its Local Government Area and limited resources to address the significant road safety issues that exist around each school. In addition to to the 50 schools currently within the City of Wanneroo, 2 to 4 new schools are being built each year to cater for the population growth. As part of the City of Wanneroo RoadWise Working Group Strategic Action Plan a review of speeds within 40km/h school speed zones was listed as an action under the Safe Speeds cornerstone. Based on this action, a review of the 85th percentile speeds and traffic volumes for all roads that had a 40km/h school zone was conducted within the City.

Method

As part of the RoadWise Working Group Strategic Action Plan 2013/2014 a review of speeds within 40km/h school speed zones was listed as an action under the Safe Speeds cornerstone. Based on this action, a review of the 85th percentile speeds and traffic volumes for all roads within the City that had a 40km/h school zone was conducted. Careful consideration of available traffic data was required as school zones only operate from 7.30am to 9am and 2.30pm to 4pm on school days. The review identified 4 key areas that the City can address promptly to improve the safety around schools. The City reviewed the provision of 40km/h electronic school zone signage, 40km/h pavement markings, children's crossings and operating speeds of roads around the schools against the criteria outlined by Main Roads WA and WA Police. The City then worked with the schools to advocate for the installation of infrastructure, with WA Police to conduct enhanced Enforcement and with Main Roads WA to arrange the prompt installation of inrastructure.

Results

The outcomes of the project include:

- The identification and referral to WA police for targeted enforcement of 35 school zones with high operating speeds (85^{th} percentile)
- Installation of electronic school zone signage at 4 high priority sites within the City of Wanneroo
- The identification of 22 roads that abut schools that meet the minimum vehicles warrants for the installation of a guarded children's crossing.

- The installation of 8 guarded childrens crossings and applications for a further 4 more guarded children's crossings

Conclusions

The strategic nature of the school safe speeds project enabled the City of Wanneroo to address a number of road safety issues around schools in a holistic manner providing significant safety improvements to the road environment around a number of schools.

Analysis of a Causal Model of Crash Test Pulses

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[a]Centre for Automotive Safety Research, The University of Adelaide, [b]Hall Technical Pty. Ltd.

Abstract

This study first examines the theoretical basis for a differential equation model of vehicle crash response. It then describes the crash test data used to assess the validity of the differential equation, the criteria for selection of this crash test data, and the simple results that were obtained when the differential equation model was applied to this test data. These results are interpreted in terms of the theory, and the implications and limitations of this interpretation are discussed. Conclusions are drawn on the basis of this discussion, and possible future work related to the study is suggested.

Background

Crash testing in which a vehicle strikes a rigid barrier is common. However, published tests are usually limited to those performed for consumer programs or regulatory requirements, and crash performance at test velocities may not predict crash performance at other velocities (Searson, Hutchinson & Anderson, 2012). A differential equation model of vehicle behaviour can overcome some deficiencies of limited testing. Such a model is causal; vehicle behaviour may be extrapolated from starting conditions (impact velocity) and crash structure properties. It may therefore use published crash tests results to predict vehicle impact response at velocities not tested.

With the advent of primary safety technologies that modify crash velocities, assessment of overall vehicle crash safety should account for both secondary safety performance and active speed reductions. The model may therefore provide a basis for integrating the assessment of primary and secondary safety. Models in which crash performance is dependent on impact velocity have been applied in pedestrian crash analysis (Hutchinson, Anderson & Searson, 2012; Edwards, Nathanson & Wisch, 2014; Searson, Anderson & Hutchinson, 2014).

Theory

A differential equation (1) relating acceleration (x''), velocity (x') and deformation (x) may be used to model a deforming vehicle crash test structure (Hunt & Crossley, 1975; Herbert & McWhannell, 1977). For a given vehicle, m, k, b and n are constant. n describes the non-linearity of the vehicle crash structure's force-deformation function, and is investigated in this study.

$$mx'' - kx^n \left[1 + \left(\frac{b}{v_0}\right) x'\right] = 0 \qquad (1)$$

Eqs. (2-4), relating impact velocity (v_0) to dynamic crush (C, maximum vehicle deformation), peak acceleration (a_{peak}) and time of dynamic crush (t_m) may be derived from Eq. (1). n may be determined from Eqs. (2-4) and known values of C, a_{peak} and t_m.

$$C \propto {v_0}^{2/(n+1)} \qquad (2)$$
$$a_{\text{peak}} \propto {v_0}^{2.n/(n+1)} \qquad (3)$$
$$t_m \propto {v_0}^{(1-n)/(n+1)} \qquad (4)$$

Method

Tests were selected from the NHTSA crash test database. Vehicles were mid-size/full-size, transverse-front-engine passenger sedans from model years 2004 to 2014. Inclusion criteria required at least two tests conducted on each vehicle at significantly different impact velocities (11.1 ms-1 and 15.7 ms-1) with relevant accelerometer and video data. Crash pulse kinematics were resolved from accelerometer data. C, t_m and a_{peak} were calculated. Eqs. (2-4) were used to determine n from existing crash pulses by regressing known values of C, t_m and a_{peak} against v_0. C data was used to calculate n; t_m and a_{peak} were found to be ill-suited for determination of n. Due to the small number of crash tests that fulfilled the inclusion criteria, tests were aggregated and a common n was calculated for all vehicles.

Results

Values of n calculated for individual vehicles ranged from 0.09 to 1.61. Confidence intervals calculated for n were wide due to the small number of tests for each vehicle. Differences in n values between individual vehicles were marginally significant. When all tests were aggregated, the point estimate of a common n was 0.78, with a confidence interval of (0.62, 0.98). n for one vehicle varied significantly from the common n.

Conclusions

Aggregating data from all tests used in the analysis suggests that n may be approximately 0.78 for modern mid-size/full-size transverse-front-engine passenger sedans. This finding remains tentative due to the lack of available data.

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Estimated Fatality Reduction by the Use of Electronic Stability Control from 2016 Fatal Crashes

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Abstract

The Transport Accident Commission has persistently campaigned in support of the safety benefits of various vehicle technologies, including Electronic Stability Control (ESC). ESC has been demonstrated to be an effective countermeasure in Australia, leading to reductions in loss of control situations resulting in serious injuries and fatalities (Scully & Newstead, 2010). Recent analysis of 2016 Victorian fatal crashes where ESC could have been effective (lane departure crashes, n=140) estimated the potential for ESC to have saved lives in these crashes. It was estimated that 41 deaths could have been avoided, had the crash involved vehicles been fitted with ESC.

Background

Since 2011, ESC technology has been mandated for most newly registered Australian vehicles. However, approximately 31% of cars registered in Victoria in 2016 were fitted with ESC (2016, ABS census). ESC is demonstrated to be highly effective at reducing loss of control typically seen in single vehicle and head-on crashes.

Method

The Transport Accident Commission, Monash University Accident Research Centre and the Swedish Transport Administration conducted a desk based analysis of Victorian road deaths in 2016, using fatality data reported by Victoria Police, to assess the role that ESC could have played in preventing fatalities. For each of the 140 lane departure crashes recorded in Victoria in 2016, the likelihood that ESC would have prevented the fatal outcome had it been installed in the vehicles was determined. Evidence of ESC's effectiveness under different circumstances was applied to determine the likelihood of fatality avoidance for each crash. The lane departure crashes included ”loss of control” crashes and those crashes without ”loss of control”. The study sample contained both cars with and without ESC.

Results

Of 291 road deaths in 2016, 140 deaths occurred in lane departure crashes. It was determined that of the 140 fatalities, 41 deaths would have been avoided had the involved vehicles had ESC. Of the preventable deaths, 10 were of the head on crash type, the remaining 31 were single vehicle run-off-road crashes into fixed objects or roll-overs.

There were 91 single vehicle and 49 head on crashes analysed. Head on fatalities at 60km/hr or less were more likely (44%) to be avoided than single vehicle fatalities (19%). This analysis showed at 70km/hr plus, ESC has limited effectiveness in head on crashes, being more effective for single vehicle crashes. At 100 – 110km/hr, 29% of fatalities from lane departure crashes were potentially avoided with ESC. Table 1 shows the numbers of fatal crashes and those likely to be avoided with ESC.

Table 1. Lane departure fatalities and number determined to have been avoided, by crash type and speed zone

	Head On		Single Vehicle		TOTAL		
Speed Zone *(km/hr)*	**Number of fatalities**	**Fatalities avoided**	**Number of fatalities**	**Fatalities avoided**	**Number of fatalities**	**Fatalities avoided**	**Proportion of fatalities avoided**
< 60	8	3.5	16	3	24	6.5	27%
70 - 90	9	1.6	15	6.4	24	8	33%
100 - 110	32	5	60	22	92	27	29%
TOTAL	**49**	**10.1**	**91**	**31.4**	**140**	**41.5**	**29%**

Conclusions

ESC's effectiveness is dependent on many factors including road type and conditions; vehicle age and type; speed and driver behaviour. Modern ESC systems are highly effective in circumstances when there is high speed, low friction and if the driver is impaired as they both mitigate over-steering and constantly apply small corrections to prevent instability occurring, with minimal driver input required.

This analysis determed that 41 (29%) of the 140 fatal crashes in 2016 that involved lane departure, death could have been prevented had the vehicle been fitted with ESC. Also, that ESC was far more effective in single vehicle loss of control crashes compared to head on crashes, particularly at higher speeds.

Acknowledgments

Transport Accident Commission - James Scully

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Independent Road Safety Expert - David Healy

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Incorporating Road Trauma Reduction into the Planning of Rural Single Carriageway Cross Sections

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Abstract

Main Roads Western Australia's traditional approach for developing the rural state road network is to plan road cross sections based on existing standards for the anticipated level of traffic flow. However, this approach may not necessarily deliver the reduction in killed and serious injury (KSI) crashes required by the State Government's Road Safety Strategy Towards Zero (ORS, 2009). Through development of a cross section tool incorporating KSI crash reduction factors for various countermeasures, it has been possible to first evaluate and then improve the proposed rural single carriageway cross sections, thus delivering greatly improved safety, maintenance and cost outcomes.

Background

Main Roads is responsible for the planning, development, and maintenance of the state road network in Western Australia (~18000 km). As part of this work, it is required to plan the development of the rural single carriageway network. The traditional approach is to forecast the traffic flow on each road and then develop future cross section based on standards (Austroads, 2016).

Through its commitment to the Safe System as set out in the State Government's Road Safety Strategy *Towards Zero 2008-2020* (ORS, 2009), Main Roads has set targets for reducing killed and serious injury crashes. It was therefore necessary to evaluate the future cross sections to establish if the target would be met given the forecast volumes.

Method

To carry out the evaluation, Main Roads pulled together two elements of its recently implemented Road Safety Management System (ROSMA). The first of these is a tool which uses the killed and serious (KSI) crash history associated with each road to generate the percentage reduction in KSI crash risk required for it to perform in line with the target. The second is a treatment resource which incorporates KSI crash reduction factors for treatments that could be applied to reduce the risk of crashes associated with the cross section. These include shoulder sealing, audible edge and centre lines and wide painted medians. These crash reduction factors take into account the existing configuration for each road.

The two elements were combined into a single tool which could evaluate the impact of treatments or combinations of treatments on lane departure KSI crashes. Thus it could determine whether or not as a whole the rural single carriageway state road network could deliver on the required target.

Result

The evaluation indicated that while there would be a reduction in killed and serious injury crashes as a result of implementing the cross sections based on standards, this reduction was not enough to achieve the target.

However, by either maximising seal widths on the existing carriageways (an interim solution) or maximising seal widths on the proposed Austroads configurations (the ultimate solution) the target would be exceeded. Furthermore, by sealing the full carriageway width, ongoing maintenance costs would be reduced as well as the need to identify further sources of gravel for unsealed shoulder rehabilitation.

The results of the evaluation have been shared with regional asset managers who have applied their knowledge to refine the cross sections to suit local circumstances and regional procedures without compromising on safety performance. These agreed cross sections now provide the basis of planning the rural single carriageway network for 2031 that greatly reduces the risk of KSI crashes.

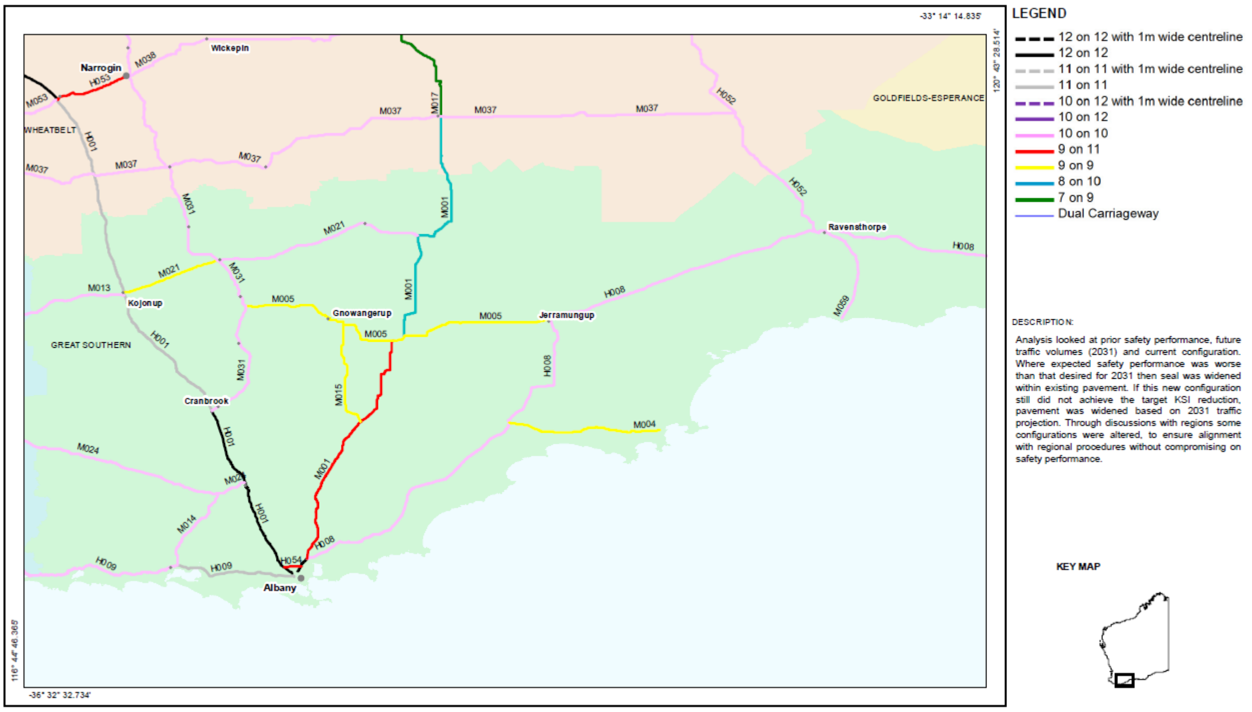

Figure 1. Example of Cross Section map

Conclusions

The application of this evaluation process has resulted in planned rural single carriageway road cross sections that address both traffic and safety needs. The evaluation has resulted in cross sections that are less costly, more sustainable and easier to maintain.

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Enhanced Enforcement Program – a High Visibility on-Road Enforcement Partnership between the NSW Police Force and Transport for NSW

Ruth Graham

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Abstract

The Enhanced Enforcement Program is a unique partnership between the NSW Police Force and Transport for NSW (administered through the Centre for Road Safety) that targets behaviours known to contribute to road trauma in NSW. The program has been running since 1996 and has evolved significantly over that time. Each year it delivers approximately 210,000 additional highly visible on-road enforcement hours, targeted at locations with a demonstrated crash history. Several operation types run through this program, including statewide operations that support double demerit point periods, major route operations, and locally run enforcement operations targeting a particular geographic area.

Background

The Enhanced Enforcement Program began in 1996 as a trial on the Pacific Highway in northern NSW. This was the first time Roads and Maritime Services (which managed the program before it transferred to Transport for NSW) funded Police to undertake additional on-road enforcement. The program now funds approximately 135 additional operations per annum, as well as eight statewide operations (run over long weekend or holiday periods), and seven major route operations. It is unique in its scale and its targeted yet flexible approach.

Key Program Components

The Enhanced Enforcement Program is currently funded at $14.5 million per annum through the Community Road Safety Fund, which reinvests speed and red-light camera fines into road safety initiatives. It is the most high-profile and financially significant partnership between Transport for NSW and NSW Police.

The program delivers approximately 210,000 additional on-road enforcement hours in NSW each year. Program guidelines are produced trimesterly by the Centre for Road Safety (CRS) in agreement with the NSW Police Force Traffic and Highway Patrol Command. These guidelines provide high-level crash data. Regional Roads and Maritime staff supply each Highway Patrol Local Area Command with additional crash data, and support local enhanced operations by providing marketing opportunities to complement the enforcement being undertaken.

Program funding is applied in three distinct ways. The first, and most common, is overtime for Highway Patrol Officers to undertake tasked enforcement at locations within their geographical area with a demonstrated crash history. The Police apply for funding by submitting an evidence-based application that utilises crash data, outlines the behavioural issue the operation will address, and nominates the day of week and time of day the operation will target.

The second way is through funding cancelled rest days: days that officers would not otherwise be working when they are recalled to duty to target a specific road safety issue. Applications are also based on crash data and target significant increases in the road toll, either along a specific route or in a geographical area.

The third, and less common, approach is funding shift penalties. This allows officers to commence work at times other than usual start times, so as to provide on-road profile and enforcement for longer hours at certain locations.

The three funding methods realise benefits in different ways but all aim to reduce road trauma on NSW roads. Case studies of funded operations and outcomes will be provided in the presentation.

To complement the program and maximise the benefit of on-road enforcement, CRS also funds high-visibility markings with road safety messaging on Highway Patrol vehicles. This measure ensures that funding for additional on-road enforcement is reinforced by extending the reach of public education campaign messaging.

Conclusion

The Enhanced Enforcement Program has established an ongoing and unique partnership between Transport for NSW and NSW Police. It delivers a significant increase in on-road, high-profile enforcement at locations with a demonstrated crash history. It ensures behavioural issues contributing to road trauma are targeted to a higher degree than would otherwise be possible.

Strategic Cycling Corridors – Are we Ready?

Phil Gray

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Abstract

VicRoads is planning for a cycling renaissance through the establishment of a metropolitan-wide network of high quality Strategic Cycling Corridors (SCCs). If developed in their entirety (and to the standard proposed), this network could radically transform the way Melbournians move around the city.

To provide this network of cycling corridors in heavily constrained urban environments, however, require tough decisions to be made. Through GTA's work in developing SCCs we ask the question: Are we ready?

Overview, The Process, Challenges and Questions

A key electoral commitment of the current Government was to establish a $100 million Safer Cyclists and Pedestrians Fund that invested in new, dedicated paths and segregated routes across Victoria. VicRoads and the Transport Accident Commission (TAC) was tasked with prioritising and investing in infrastructure that keeps cyclists and pedestrians safe through this fund. Prioritising the development of certain Strategic Cycling Corridors formed a significant part of this commitment.

The development of the Strategic Cycling Corridors is aimed at creating safe, direct and accessible corridors that attract and encourage bicycle commuter trips (increased bicycle mode share) as well as short, local trips through the provision of dedicated cycling infrastructure.

GTA Consultants was engaged to review and develop a number of SCCs, including two that travel through the Melbounrne CBD. While the whole routes are long, due to various constraints, a focus was given to addressing the challenges associated within the CBD.

The corridor treatments seek to reduce the occurrence of serious injury crashes wherever possible while balancing the requirements of all network users. The treatments developed were guided by Safe System principles. The desirable treatment type for a SCC is a fully separated cycling facility. These facilities are generally considered to be international best practice and afford a high level of safety and assurance to riders of all ages and abilities.

Achieving separated facilities on major vehicle and public transport roads within a heavily constrained CBD environment presents significant challenges. Challenging decisions need to be made with respect to the allocation of road space to ensure equity. SCCs have the potential to create a transformational shift in the way the City prioritises modes.

This presentation charts the process of developing sections of two SCCs and highlights the hurdles and challenges associated with parking loss, lane reductions, targeted crash reduction measures and changes to signalling priorities.

Conclusions

The proposed SCC treatments for the CBD included protected intersection treatments. It was generally agreed by stakeholders that while these treatments have drawbacks, they also deliver improved safety outcomes for riders. The challenge for a number of sites, however, was not being able to achieve approval to reallocate road space to provide a continuous protected bike path on the approach and departure sides of the intersections which can undermine the benefits.

On a positive note, most councils were generally very supportive of high quality infrastructure treatments that priortise cycling, with one Council comfortable with the potential increased congestion and delays that this may cause to vehicle traffic. The implementation of SCCs require a step-change in thinking around how we priortise our road space to be more equitable for vulnerable road users.

At the time of writing, the proposals were being presented for funding with the outcome to be determined. Tune in to the presentation to find out the results!

Achieving Separated Cycle Facilities in a Constrained Town Centre Environment

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Abstract

The Woden Town Centre is entering a new phase of development. To support and encourage active travel modes through the precinct, preliminary sketch plan designs were prepared for cycling facilities on the key roads (Corinna Street, Furzer Street and Matilda Street) through the Town Centre. The designs sought to maximise safety through separated facilities and coordinated treatments that directly benefit pedestrians and cyclists – facilitating ease of movement and encouraging increased walking and cycling. In addition to being pragmatic and able to be implemented in the short-term, the designs also had to negotiate challenging urban constraints and eight government stakeholders.

Overview, Challenges and Outcomes

The Woden Town Centre is an established and significant employment Centre, with 14,500 people employed there, primarily by the Australian Government and the retail sector. The Centre is entering a new phase of development, including both ACT Government and private initiatives. An aerial view of the area is shown in Figure 1.

Figure 1. Aerial view of the Woden Town Centre Study Area

The Woden Town Centre is well connected to a regional street network. Its inner spine and backbone, Corinna Street and, further north, Furzer Street, weave their way through the centre. Both streets present as primary vehicular access routes with few amenities for cyclists and pedestrians. The installation of cycling facilities through the Town Centre provides an excellent opportunity to continue the positive changes visible in other parts of the Town Centre and to create a, continuous design response that welcomes cycling along the main corridor through the Town Centre.

GTA Consultants was engaged to review, and develop potential design solutions for protected cycling facilities and improved pedestrian amenity along Furzer Street, Matilda Street and Corinna Street in Woden.

In order to compare the relative advantages and disadvantages of the potential treatment options for Woden Town Centre, the options have been broadly evaluated using the following criteria: 1) Safety, 2) Cost and Constructability, 3) Amenity, 4) Compliance with Austroads and best practice 5) Pedestrian permeability and 6) Parking Impact.

The designs seek to provide separation for cyclists wherever possible, within the constraints imposed by the existing road reservations. The design seeks to provide a solution that increases the safety of riders, while also increasing the amenity of pedestrians through reducing crossing distances, and creating improved crossing opportunities.

The study investigated a number of treatment options and determined that, on balance, the preferred treatment were separated bi-directional cycleways, with enhanced crossing opportunities. The existing constrained road reservation width was the primary factor for adopting a bi-directional (one-sided) facility rather than a one-way pair design. The typical cross-section is shown in Figure 2.

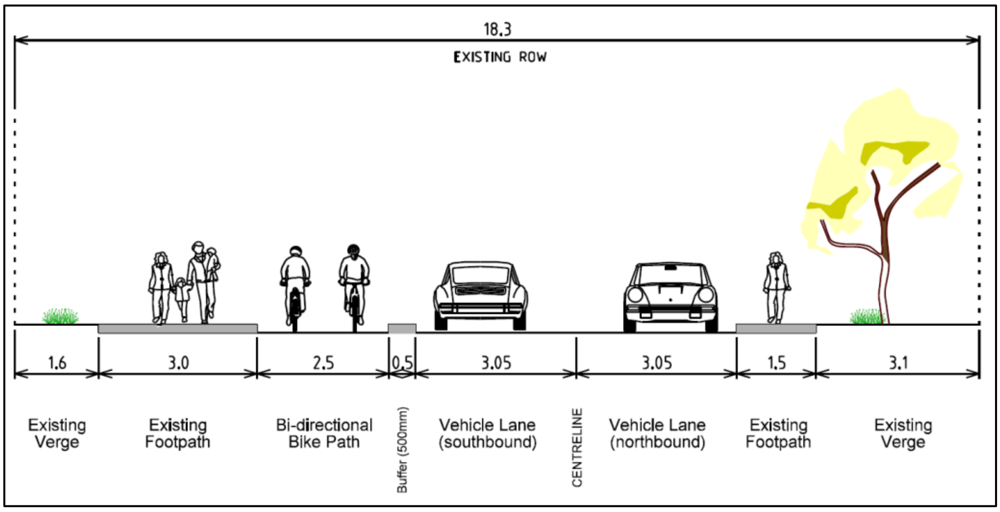

Figure 2. Typical bi-directional cross-section within existing carriageway (Furzer Street)

The design had to negotiate various existing changing road conditions along the corridor, including high pedestrian activity and retail areas, constrained widths, changing road layouts and geometry, bus routes and future development.

Experiential Learning for the 21st Century: Using Interactive Augmented Reality to Demonstrate Risk to Children in Outdoor Simulated Road Environments

David Gribble

Constable Care Child Safety Foundation, Maylands, WA - AUSTRALIA

Abstract

Constable Care Child Safety Foundation commenced operation of WA´s only children's road safety experiential learning centre in July 2017. The Safety School provides a hands-on road safety excursion for primary-aged students, combining a fully-functional pedestrian, bike and public transport layout with the latest in education technology. In a world-first, the Safety School uses a purpose-built augmented reality application on handheld tablet devices to allow students and teachers to interact with and make decisions about travel risks overlaid throughout the 3,500 sqm outdoor environment. The curriculum-linked app allows real-time measurement and post-excursion analysis of students´ knowledge and understanding of road safety.

Background

Road trauma is the leading cause of death for children in WA, and the second leading cause of hospitalisation for serious injury, and the state has one of the worst children’s road safety records in the country. As an innovative strategy to address this issue, Constable Care Child Safety Foundation (CCCSF) has developed an experiential early-intervention centre designed to help children become more aware of their travel surroundings and other road users, and to assist them in developing safer transport-related behaviours.

Based on the best-practice early education principles of learning through play and simulation, CCCSF, the WA Department of Education and key community and corporate partners, have built and commenced operation of WA’s only road Safety School, where children aged 4-11 years can practice road and public transport safety skills in a simulated urban environment that links WA classroom curriculum resources to practical skills training outcomes.

Method

The 4,000 square metre $1.7 million Safety School includes a classroom, railway station, train and bus models, fully functional road layout, including working traffic lights, rail crossing boom gates and pedestrian maze, pedestrian crossings, school zone, bus stop, roundabout, road signage and shared use path layouts. School groups of up to 60 students attend twice daily undertaking practical cycling education and augmented reality-enhanced pedestrian risk experiences.

Working with augmented reality design company DSBS, and the state’s road safety curriculum resource developer SDERA, a tablet-based app was developed that allows children to select an avatar to represent them and then see the character involved in travel-related risk situations using the tablet camera at custom Wi-Fi enabled bollards located throughout the site.

The app was developed to provide a goal-focused reason for pedestrian movement around the centre, but then became a key teaching and learning vehicle in itself through the inclusion of interactive decision-making in relation to portrayed risks such as road crossing, school zone risks, bus stop and rail platform safety etc. A “gamification” approach was taken as a motivation strategy to rewards students for correctly identifying risk. Two separate app experiences tailored to younger

(4 to 7 years) and older (8 to 11 years) children were developed, offering different risks appropriate for their stage of development.

Teachers can control the experience for their students, starting it and stopping it through a master app, seeing which students have successfully completed the learning exercises, and accessing additional context-specific road safety teaching notes to allow them to enhance the experience further for their class.

Visiting school groups are encouraged to complete tailored, relevant exercises in-class from the SDERA road safety learning resources before the excursion, and additional exercises after they return to school. This allows the Safety School excursion to actively promote and reinforce in-class road safety teaching and learning outcomes for participating schools. Pre and post measurement of student knowledge, attitude and intent to behave are collected from participating classes (opt-in) and the app also supports a back-end database which allows post-analysis of student learning patterns.

Results and Conclusions

Data is not yet available to support the Safety School's effectiveness or otherwise as a teaching and reinforcement strategy for school road safety programs, as the centre has only recently commenced operation. Once 12 months of pre-post evaluation, app data, and student and teacher case study material has been collected, a full analysis will be undertaken to ascertain if a measurable benefit is occurring for students who participate.

From a systemic road safety promotion perspective, the Safety School's location on a major artery road near the Perth CBD, with 36,000+ passing vehicles per day able to clearly see the activity occurring onsite, makes it a visible symbol of road safety education in action for WA's most vulnerable road users.

Using Instructional Videos to Promote Correct Use of Child Restraint Systems: Qualitative Consumer Input and Quantitative Testing

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Abstract

Despite efforts to increase best-practice child restraint system (CRS) use, incorrect use remains a significant threat to child passengers. Although users are receptive to audiovisual instructions, current videos are not designed based on user needs and there is no research on how to increase adoption of information delivered by video. We developed instructional videos using a novel method of consumer-input and testing, with accompanying guidelines for use by manufacturers. This paper presents a summary of the qualitative input into the first prototype of new videos and preliminary observations from the iterative testing process used to refine the videos for translation.

Background

The incorrect use of a CRS in motor vehicles greatly increases a child's risk of injury during a crash and is extremely widespread (Bilston et al., 2007). Correct use of a CRS requires it is used as specified by the manufacturer. We found previously that redesigning manuals using consumer input is effective at increasing correct use in the laboratory and that users (particularly culturally and linguistically diverse users) are receptive to instructional videos. Current videos accompanying CRS products have not been designed according to user needs thus we aimed to develop new instructional videos using a novel method of consumer input and testing.

Method

Experienced and naive users were asked to participate in focus groups or consumer testing. We used a Western Sydney playgroup to capture CALD participants from a regional location with a low SEIFA rating (ABS, 2013) and a sample of high education participants.

Consumer input: Participants were shown instructional videos. We used a semi-structured discussion guide to elicit feedback, audio recorded and transcribed groups, and coded transcripts using InVivo. Themes were used to guide design of prototype instructional videos.

Consumer testing: To ensure videos were effective at communicating correct CRS use, we tested groups of participants installing a CRS in a car using the videos. We objectively assessed installation performance and asked participants for subjective feedback. Instructional videos were amended after each round to match feedback, and then re-tested. This process was repeated until 90% of participants achieved 90% correct use.

Results

One high SES (n = 10) and one combined low SES and CALD (n = 7) group provided consumer input into the first prototype.

While a home videos had the most negative comments (n=24), a manufacturer video was received positively (n = 32) based on the use of demonstrations (n=8) and videography (n=9). There was consensus that videos should be accessible on mobile (n=9) and endorsed for credibility (n=10). Low SES/CALD participants preferred more professional and authoritative demonstrators (n=5), children (not mannequins; n=6), and full-length installation videos supplemented by short clips (n=5). The high SES group preferred videos to provide an orientation (n=6), number tasks (n=4), and remind of correct use (n=5).

These findings guided the development of new videos. The pilot round of consumer testing has found high user acceptance and likeability.

Conclusions and Discussion

There is paucity of research on designing video instructions for safety products, even though education through video is effective (Shenoi et al., 2010). Manufacturers are increasingly producing videos accompanying manuals, yet there is no evidence on effective techniques. Although we did not reach saturation of themes in the input stage, this study provides new insights into user-centered content/format guidelines to be used by manufacturers in developing instructional videos. We have learnt previously that using consumer testing ensures optimal content and presentation for use. Preliminary observations from testing of our newly developed videos also indicate this is likely to be the case for audiovisual communication. This testing method may be a model that can be used by manufacturers.

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Survivor Story-Telling in Road Trauma Education and Support Programs: Reviewing the Evidence

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Abstract

Survivor story-telling is used in many road trauma education and support programs, yet the impact on both the narrator and their audiences is not well understood. A scoping review of the published literature was undertaken to determine the range of survivor story-telling approaches currently used, identified risks and benefits, and any mitigation strategies to support the well-being of the survivor story-teller and program participants. This paper presents the review findings, and implications given the major gap that exists in the evidence-base relating to the practice of involving and supporting road trauma survivors presenting direct testimony in prevention and post-vention programs.

Background

Many organisations, such as the Road Trauma Support Services Victoria, engage survivors as speakers (volunteer or paid) in their support and education programs. This practice is evident internationally in various health, mental health and trauma recovery or safety programs. This participation is seen as contributing to survivors' own recovery and healing processes, motivated by a wish to prevent a recurrence of traumatic events or influence the community in other ways in relation to their trauma experience as well as promoting road safety behaviours in audiences. This study sought to identify the current evidence for and impacts of this use of survivor engagement (volunteer or paid) in road trauma story-telling activities.

Method

Arksey and O'Malley's (2005) six stage scoping review method was adopted. The research question was: *What evidence exists in relation to the experiences of road trauma survivor storytelling and/or listening?* Subsidiary questions were: (1) What is the range of approaches to the use of road trauma survivor storytelling and listening; (2) What are the identified benefits, risks and ethical issues associated with these approaches; and (3) What are any identified mitigation strategies, including screening, selecting, training and supporting volunteers. Based on the search terms in multiple combinations and selected databases, 564 articles published between January 2010 and June 2016 were initially retrieved, with 31 articles identified as potentially relevant to the study. Study selection focused on articles that were peer-reviewed, specifically road trauma related and referred to the use of direct testimony or survivor story-telling in some form of intervention. Two researchers (LH and MA) independently examined the article titles and abstracts for possible inclusion and a further 21 articles were excluded.

Results

Ten publications met the inclusion criteria (Buckmaster et al., 2015; Cuenen et al., 2016; Elliott, 2011; Feenstra et al., 2014; Fylan & Stradling, 2014; Guttman, 2015; Poulter & McKenna, 2010; Ricketts et al., 2010; Tuong et al., 2014; Twisk et al., 2014). Seven were empirical studies and three were theoretical contributions. Six of the seven empirical studies established small to moderate support for the use of survivor accounts in some form in the evaluated programs. None of these programs was targeted towards road traffic offenders. No evidence was found in any of the seven studies for any negative emotional impacts on survivors or participants. However, two studies identified some negative attitudinal changes towards road safety. Only three studies referred specifically to the use of face-to-face survivor stories in programs, and only very briefly described training and support needs for these story-tellers.

Conclusions

Since 2010, very few studies can be identified that evaluate the use of survivor story-telling in road trauma programs, particularly those oriented to offender groups. However, the majority of studies that were identified provide support for the practice. A major gap exists in the evidence-base relating to the practice of involving and supporting road trauma survivors giving direct testimony in prevention and post-vention programs, and the impact on their audiences.

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A National Approach to Measuring Non-Fatal Road Injuries

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Abstract

Austroads project SS2034 aims to provide proof of concept for a national approach to obtaining routine national data on non-fatal hospitalised road injuries in Australia, using data linkage. We report here on the first part of the project: seeking approvals to use necessary data.

Background

Road safety agencies recognise that data on non-fatal road injuries, as well as deaths, should guide programs. Available data on non-fatal cases are thought to be insufficiently complete and reliable and improvement was foreshadowed in the National Road Safety Strategy Review and action plan.

Linkage of crash data with health sector data has potential to provide better information, and projects have been done in some jurisdictions. Linkage at national level could provide additional benefits including consistency of method, capacity to measure cross-border flows and extension to all jurisdictions.

Protocols and facilities for data linkage have been developing in Australia, particularly in the past decade and in the health sector. While national projects have been envisaged, few completed projects have been national or multi-jurisdictional, none using crash data.

Objectives

The objectives are to:

1. Learn whether relevant ethics committees and data custodians will allow the required use of data. Seek necessary approvals.
2. Test the technical feasibility of the method by applying it to one year of data.
3. Assess the utility of the linked data.
4. Communicate the results.

Methods

The sources are: admitted patients databases, police-reported road crash databases and the National Death Index (NDI), a total of 17 collections.

Ethics committee and data custodian approvals are required in each jurisdiction, from the Australian Institute of Health and Welfare (for NDI data) and the participating universities.

The process being used (Figure 1) is consistent with the separation principle that underpins the health data linkage framework in Australia.

Progress

Work began in December 2015 and 13 ethical and 11 custodian approvals have been sought. As at February 2017, approvals had been granted by university ethics committees, for the NDI and for hospital and crash data in four jurisdictions, plus ethical approval in two more jurisdictions. Other applications were in progress. In WA, the process is being clarified following legislative change. Provision of data to the AIHW DLU began in February 2017.

As required by Austroads, two versions of the project design were assessed for administrative and ethical feasibility. Design 1 applies the separation principle. Linked files do not contain identifying data, are held in a secure repository and are accessible only to authorised investigators. In design 2, linked data would contain identifying information and be available for use by road safety agencies. Design 1 has been found to be acceptable to ethics committees and data custodians. Requirements essential for the acceptability of design 1 could not be met by design 2, which was assessed not to be feasible and was therefore put aside.

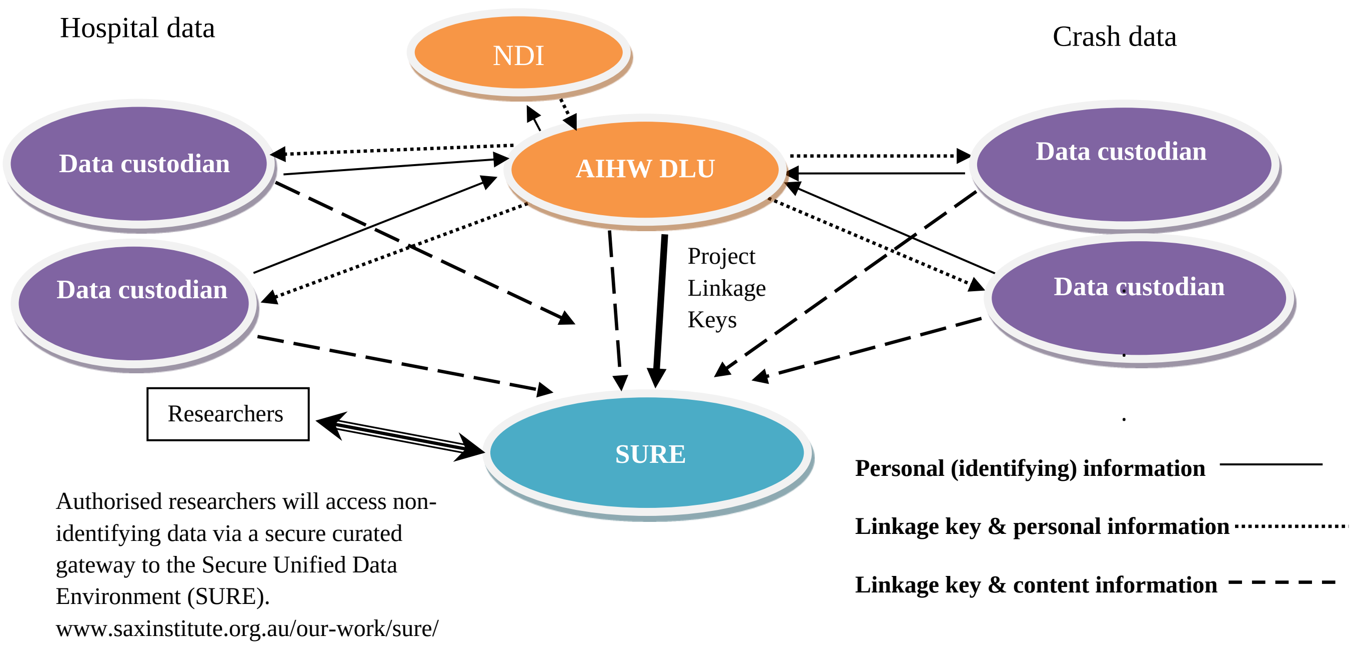

Figure 1: Data linkage process

Conclusions

Some relevant ethics committees and data custodians have confirmed that they will allow the linkage and analysis of required data in a design that employs the separation principle and will hold the non-identifying linked data file in the SURE repository. Whether outstanding approvals will be granted is not yet known. Other unknowns include the time to delivery of remaining data to AIHW-DLU, duration and quality of the matching process and the time to delivery of linked data to SURE.

Response-Inhibition Training: A New Horizon for Young Driver Training?

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Abstract

Impulsiveness contributes to young drivers' risky driving. Three studies tested whether response-inhibition training reduced young drivers' risky simulated driving. Study 1 participants completed 600 or 1200 Go/No-go trials. Performance worsened with training, and test drive speeding increased (relative to controls). Study 2 participants completed 2200 trials of driving-relevant Go/No-go task, Stop Signal and Collision Detection tasks over five days. Study 3 participants completed 1800 Go/No-go and Stop Signal Task enhanced-feedback trials over 10 days. Task performance improved in both studies. Risky driving reduced slightly in Study 3. Any effect of response-inhibition training on simulated driving is likely to be small and difficult to achieve.

Background

There is growing interest in young driver training that addresses age-related factors, including incompletely developed impulse control (e.g. Hatakka et al., 2002). Four of seven studies that have examined transfer of impulse control training amongst young people showed post-training improvements in impulsive behaviours (i.e. consumption of high-calorie foods and alcohol consumption, gambling, and ADHD symptoms; Spierer, Chavan, & Manuel, 2013). The present research sought to investigate the effect of impulse control training on young drivers' risky driving. Training parameters were refined over three studies.

Methods

In each of three studies young drivers (aged 16-24 years) were recruited via UNSW and randomly allocated to a Training or Control group. Response inhibition training tasks were:

- Go/No-go tasks which require that participants respond on Go stimuli (e.g. an X) and withhold responding on the relatively few No-go stimuli (e.g. an X with any arm removed).
- A Stop Signal Task (SST) which require that participants respond in one way to stimulus A (say a green disc) and another way to stimulus B (say a green arrow) but withhold responding if they hear a "Stop signal" soon after stimulus onset.
- A Collision Detection Task in which participants were required to predict whether two vehicles moving toward an intersection (in an overhead view presented on-screen) would collide. Waiting to respond should increase accuracy.

In Studies 1 and 2 Control participants completed "filler" tasks comprising the same number of trials as the training group. These were often Choice Reaction Time tasks.

In Study 1 (n=62), Short Training participants completed 600 of a Go/No-go task, while Long Training participants completed or 1200 trials. In Study 2 (n=65) training was altered to increase engagement and strengthen learning. The training group completed a total of 2,200 trials of three response inhibition tasks featuring driving-relevant stimuli (Go/No-go task, SST and a Collision Detection Task) over five days. The Go/No-go and SST tasks were adaptive (i.e. difficulty increased as performance improved). Performance feedback was provided in all tasks, and participants were compensated based partly on their performance. In Study 3 (n=63), further measures were taken to increase the chance of observing a transfer effect. The training group completed 1800 trials of the driving-relevant Go/No-go and SST tasks, with enhanced response feedback, spaced over 10 days. A “no treatment” Control group was employed.

All participants completed simulated drives in which measures such as speeding, risky passing, and compliance with traffic controls, were recorded. In Study 1, drives were immediately, and 1-2 weeks, after training. In Studies 2 and 3, drives were before training, half-way through training (Day 3 or 5, respectively) and after training (Days 5 and 10, respectively).

Results

In Study 1, performance on trained tasks worsened with training. In the tests of transfer to risky driving, the Short Training group showed no difference from the Control group. The Long Training group showed evidence of worsened driving.

In Studies 2 and 3, performance on trained tasks improved with training. However, transfer of training to the simulated drive was weak and inconsistent. In Study 2 speed tended to increase from Day 1 to Day 5, with lesser increases in the Treatment group for five of six measures. However, the Day x Group interaction effect was not significant for any driving measure. In Study 3, this pattern of speeding results was not observed, and only one significant effect was consistent with transfer of training. Specifically, an increased proportion of participants in the Training group (but not the Control group) stopped at the red light.

Discussion and Conclusions

Training appeared to benefit from the use of multiple, adaptive, driving-relevant tasks delivered over several days. Nonetheless, findings suggest that any effect of training using response inhibition tasks on simulated driving is likely to be small and difficult to achieve. There may be more scope for impulse control training to improve risky driving in a more representative sample of young drivers, and in the context of real-world motivations for risky driving.

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Lost in Translation? A Humorous International Driver Sleepiness Advertisement Viewed by Australian Young Drivers

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Abstract

Young drivers have more control over the media they consume than previous generations. Humour is one strategy which may increase the likelihood of a video being watched and remembered. Advertisements available on internet sites have a global audience. Ten young, Australian drivers were asked to view and discuss an international, humorous, animated driver sleepiness advertisement that had more than 1 million YouTube views. Participants reported humour and animation to be video features which made inappropriate light of a serious topic. This negative reception was minimized if viewers were able to interpret actions of how to manage sleepiness from the video.

Background

Media on demand, such as YouTube and streaming services means that consumers have greater control over what they watch, including the advertising to which they are exposed. One of the challenges for communicating road safety messages that this curation presents is the potential for advertisements to be easily skipped if not engaging for their intended audience. Humour is a way to potentially increase 'watch-ability' of road safety advertisements. The globalization of media means that international road safety messages are easily accessible to Australian drivers. Young drivers are both large consumers of media on demand and at high risk of crashes on the road. Driver sleepiness prevention largely relies on drivers self-managing their sleepiness because of the inability of law enforcers to test or monitor this activity in the same way as other driving impairments (e.g., alcohol). The aim of this research was to understand the impact and impressions of a road safety advertisement with proven video on demand popularity, for young drivers in Australia.

Method

One focus group and seven individual interviews were conducted with young Australian drivers (5 female, Mage= 25.9 years, range= 23-30 years). Participants were shown an animated road safety advertisement depicting a car full of anthropomorphic critters that, one by one, fall asleep until the driver falls asleep and swerves off road over a cliff causing everyone to bounce and roll, followed by Korean language text. The selected video was identified in a previous study as being the most viewed driver sleepiness related video on YouTube in 2014 (Hawkins & Filtness, 2017). Participants were asked to take a moment to reflect on what they had seen and then share their thoughts and reactions. Thematic coding of transcripts was carried out by author AH and emerging themes were discussed by the research team for confirmation.

Results

Participants frequently discussed previously seen road safety advertisements. This gave some participants expectations that a road safety advertisement 'should' be shocking. An advertisement that violated this expectation was viewed as inappropriate. One participant remarked, "I was just thinking about …campaigns that I have seen previously and comparing them to that and I just didn't find that was doing the same job as …the scare tactic ones." Many participants expressed that a light hearted approach was inappropriate for the subject matter.

Participants who did not find the humour inappropriate interpreted prompts from the advertisement as to how to avoid driver sleepiness. These included being a responsible passenger, speaking to friends about road safety, self-awareness of driving late at night with friends and educating children to wake up driving parents.

Conclusion

Humorous advertisements may be appropriate for some road safety topics (e.g., anti-drink driving messages; Lewis, Watson, & White, 2008). However, this small sample study suggests a need for more research to determine if this approach is appropriate for driver sleepiness advertising. Using humour to increase 'watch-ability' may limit the effectiveness of a driver sleepiness advertisement if drivers dismiss the video due to it failing to meet their expectations of road safety messages. It is possible that it is the juxtaposition from expectation rather than the humour per sae which results in dismissal. Drivers who dismiss an advertisement because of its humour appear unable to extrapolate positive calls to action.

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Drivers Who Pass Cyclists Too Close

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Abstract

Minimum passing distance laws have been introduced in many Australian jurisdictions to prevent crashes occurring when motorists overtake cyclists. This study aimed to understand the factors underlying noncompliance, to increase the benefits of these laws. Findings showed that the 47.6% of drivers who self-reported that they did not comply were more likely to disagree with the rule being introduced, agree that it makes passing more difficult, disagree that it makes the roads safer for cyclists, and be uncertain about their ability to judge whether they have left a metre. These findings suggest messaging to drivers is critical for increasing compliance.

Background

Drivers passing cyclists too close contribute to rear-end and sideswipe crashes (and arguably falls) as well as intimidation, which may discourage cycling. In response, minimum passing distance (MPD) laws have been introduced on a permanent or trial basis in many Australian jurisdictions, in 26 US states (National Conference of State Legislators, 2016) and in some European countries. Queensland observations show that 88% of drivers comply with the requirement to give at least one metre distance in 60 km/h or lower speed zones, and 79% comply with the 1.5 metre requirement in higher speed zones (Schramm, Haworth, Heesch, Watson, & Debnath, 2016).

Previous research shows greater passing distances when there are more (Mehta, Mehran, & Hellinga, 2015) and wider or bicycle lanes (Love et al., 2012; Mehta et al, 2015), when cars rather than vans or trucks are passing (Walker, 2007; Parkin & Meyers, 2010), and in higher speed zones (Chapman & Noyce, 2012 but not Parkin & Meyers, 2010). Findings regarding the influence of cyclist characteristics are mixed (Basford, Reid, Lester, Thomson, & Tolmie, 2002; Olivier & Walter, 2013; Walker, 2007; Walker, Garrard, & Jowitt, 2014) and little is known about the influence of driver characteristics. This paper compares the characteristics of drivers who self-reported complying with the Queensland MPD rule to those who did not to inform future educational and other approaches to improving compliance.

Method

For the evaluation of the Queensland MPD trial (which began on 7 April, 2014), 3,759 members of the Royal Automobile Club of Queensland (RACQ) completed an online survey between April and July, 2015. They were asked about their compliance with, knowledge of, and attitudes towards the rule. Members were aged 18 years or over, and had driven a car but not ridden a bicycle on Queensland public roads in the previous year. Drivers who reported they "sometimes", "most of the time" or "almost always" left less than one metre when passing a cyclist on roads with a speed limit of 60 km/h or less were classified as "non-compliant". Drivers who responded they "almost never" or "rarely" did so were classified as "compliant". Multiple variable logistic regression modeling examined whether demographic, driving "exposure" and attitudinal variables were associated with noncompliance among RACQ members who were aware of the rule.

Results

Only 4.6% of drivers reported they were not aware of the rule. Of those who were aware, 47.6% were non-compliant. Non-compliance was associated with disagreement with the rule being introduced, agreement that the rule “makes it more difficult to pass a cyclist,” uncertainty that, as a driver, they could judge if they were leaving at least one metre, and disagreement that “it has made it safer for cyclists”. Compliance was not associated with demographic characteristics, driving “exposure” or agreement that police were enforcing the rule.

Conclusions

Ways of helping drivers to judge passing distance and to improve their understanding of the importance for cyclist safety of leaving a metre should be investigated. It is unclear whether the results would be similar for drivers who were also cyclists (not asked in this study). The relationship between actual and self-reported non-compliance needs further research.

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Incidence and Costs of Transport-Related Injury in Western Australia

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Abstract

The aim of this study was to investigate the incidence and costs of transport-related injury in Western Australia. Data were obtained from linked administrative health and personal motor injury claims data. Costs allocated to injury events included health sector costs, longer term care costs, loss of productivity and quality of life loss. The number of transport-related injury events in 2012 was 12,997, with total costs of $1.3bn. Incidence and mean costs varied across multiple dimensions including sex, age group, Aboriginality, socio-economic quintile and health region. The study provides a useful evidence base for policymakers in planning injury prevention strategies.

Background

Transport-related injuries are a leading cause of injury, accounting for 13.6% of fatalities and 11.5% of hospitalisations (Hendrie, Miller, Randall, Brameld, & Moorin, 2016). Quantifying costs associated with types of injury is important in providing a measure of the size of the problem, thus enabling priorities for prevention to be set (Hendrie & Miller, 2004). The aim of this study was to describe the burden of transport-related injury in Western Australia in 2012, including incidence and costs stratified across multiple dimensions.

Method

Data on transport-related injuries were drawn from linked administrative health and personal motor injury claims data. Incidence counts were based on injury events in 2012, with episodes relating to a specific injury combined into a single event. Injury costs included were health sector costs, costs relating to long-term care, loss of productivity and quality of life loss. Costs were calculated using an incidence-based approach computed by assessing lifetime costs of injuries in 2012. Methods for allocating costs to injury events included direct mapping of unit costs drawn from relevant sources and cost modelling using regression analysis. Costs were expressed in 2014 Australian dollars.

Results

The number of transport-related injury events was 12,997 or 5.3 injuries per 1000 population. Fatal injuries comprised 1.4% of injuries, non-fatal injuries requiring hospitalisation 44.4%, and those only requiring emergency department presentations 54.2%. However, fatalities accounted for 68% of the total costs of $1.3bn.

In terms of cost components, health sector costs accounted for 9.0% of total costs, long term care costs for 3.1%, loss of productivity for 21.6%, and quality of life loss for 66.2%.

Males had higher rates of injury events than females, accounting for 78% of all injury costs. The injury rate was highest in the 15 to 24 year age group and lowest in the 65 years and above age group. Mean costs of injury increased with age, from $25,800 per injury event for younger people to over $173,000 for the 65 years and above age group.

Aboriginal people had a higher rate of transport-related injuries than non-Aboriginal people. Compared with a share of 3.6% of total population in WA, Aboriginal people accounted for 8.3% of transport-related injury costs. Mean costs were almost twice as high.

Those in the most disadvantaged socioeconomic quintile had a higher incidence rate of transport-related injuries when compared to the least disadvantaged socioeconomic quintile, and total costs were 1.7 times higher. Rates of injury could only be meaningfully compared across regions for fatalities and hospitalisations, given missing values in coding of external cause in non-metropolitan hospitals. Incidence rates were higher in non-metropolitan regions, especially in the Wheatbelt and Kimberley health regions. Mean costs per injury event were also generally higher in non-metropolitan regions.

Conclusion

In comparing the incidence and costs of transport-related injury across multiple dimensions, this study provides information to policymakers and other injury prevention stakeholders to identify areas where further prevention efforts are most needed. The study also provides estimates for determining savings that can be achieved through successful intervention programs.

Table 1. Incidence and costs of transport injury events by demographic and socio-economic characteristics and alcohol related status

Injury severity	Incidence n	Rate[a]	Total costs $m	Mean cost $
Total	12,997	5.3	1,268	97,537
Sex				
Males	8,753	7.1	933	106,621
Females	4,241	3.5	334	78,829
Age (years)				
<15	2,310	4.9	60	25,807
15-24	3,593	10.6	319	88,151
25-64	6,296	4.7	753	119,549
≥65	798	2.6	139	173,769
Aboriginality				
Aboriginal	588	6.6	105	177,956
Non-Aboriginal	12,409	5.3	1,163	93,726
SEIFA[b]				
Quintile1	2,718	5.9	335	123,367
Quintile 2	2,501	5.2	230	91,922
Quintile 3	2,525	5.2	232	92,009
Quintile 4	2,542	5.0	242	95,138
Quintile 5	2,449	4.8	189	77,130
Health regions [c]				
North metro	2,025	2.0	300	148,233
South metro	1,904	2.1	358	187,994
Goldfields	206	3.4	53	255,493
Great Southern	129	2.2	28	219,071
Kimberly	187	4.9	29	154,653
Midwest	222	3.3	53	239,384
Pilbara	196	3.1	32	161,770
Southwest	403	2.4	105	261,550
Wheatbelt	421	5.5	131	311,404

a. Rate per 1000 populaion.
b. SEIFA = Socio-economic indexes for areas; Quintile 1 = most disadvantaged, 5= least disadvantaged.
c. Excludes emergency department presentations as large number of missing codes for external cause of injury for non-metropolitan hospitals.

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Alcohol Availability and Road Crashes in Perth: How Does Distance Affect the Relationship?

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Abstract

This study aims to examine the effects of road network distance from alcohol outlets to alcohol- and non-alcohol-involved road crashes across the Perth metropolitan area. A retrospective population-based study (2005-2015) was undertaken using measures of alcohol- and non-alcohol-involved crashes, and their proximity to alcohol outlets. Using a geographic information system and logistic regression, this study found that, as distances to the closest on-premise alcohol outlets increase, crashes were more likely to be alcohol-involved than non-alcohol-involved. Recommendations about the timing and location of police enforcement and blood alcohol concentration testing are made.

Background

Previous research has examined the effects of alcohol outlet density on various alcohol-related harms including road crashes and driving while drinking (Cameron et al., 2012; Gruenewald, 2010; Gruenewald & Ponicki, 1995; LaScala, Johnson, & Gruenewald, 2001) with inconsistent results found (e.g. Cameron et al., 2012; McCarthy, 2003). There is minimal research examining how the effects of licensed outlets on road crashes differ i) at varying distances from outlets, ii) between on and off-premise outlets, and iii) in different parts of cities. The study aims to fill this gap.

Method

A retrospective population-based study (2005-2015) was undertaken in the Perth metropolitan area. Measures of alcohol availability were counts of off-premise outlets (bottleshops) and on-premise outlets (e.g. hotels, nightclubs) per postcode, obtained from the Department of Racing, Gaming and Liquor Western Australia. Crash data (including crash location) were obtained from the Integrated Road Information System which is maintained by Main Roads Western Australia. All crashes with at least one driver with a blood alcohol concentration (BAC) of 0.05% or more were included. An internationally validated surrogate measure of non-alcohol-involved crashes, all day-time crashes (07h00 to 17h59), was used in this study.

A geographic information system was created, and postcode-level boundaries, the road network, all relevant crashes and alcohol outlets were plotted. Heat maps were also created to demonstrate the patterns of crash concentration across the metropolitan area. Road network distance was calculated between each crash and the closest alcohol outlet by type. Logistic regression was undertaken, comparing the distance from alcohol outlets to alcohol-involved versus non-alcohol-involved crashes, and controlling for postcode-level socioeconomic and demographic factors.

Results

There were 7,564 (2.2%) crashes with drivers with a BAC of 0.05% or more and 252,923 (74%) day-time crashes between 2005 and 2015. The heat maps (Figure 1) demonstrated that there were focused areas of high concentrations of crashes involving drivers with confirmed BAC of 0.05% or more, especially in the inner city and certain coastal areas. In contrast, high concentrations of day-time crashes were spread across the central and middle parts of Perth with lower concentrations of crashes in the outer parts of the metropolitan area.

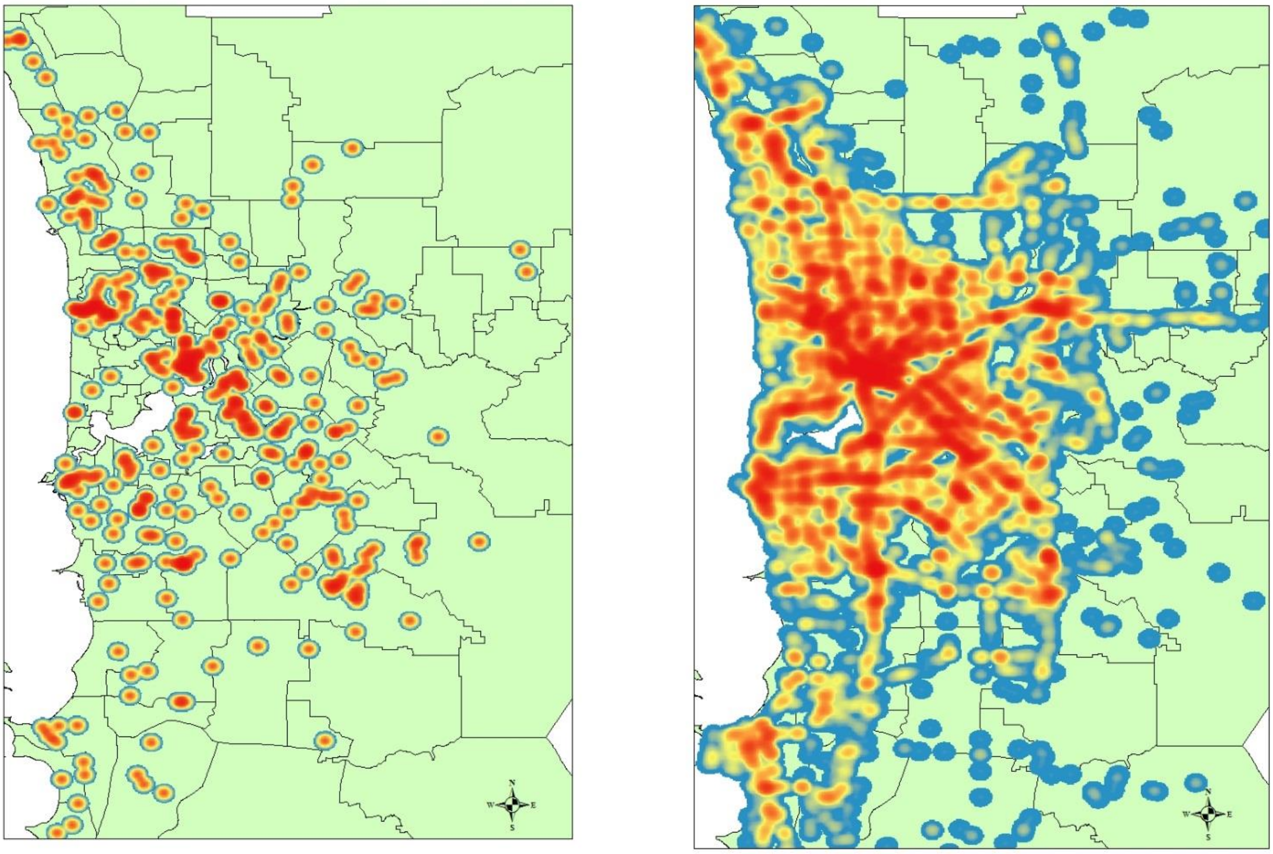

Figure 1. Heat maps of crashes with a driver with a BAC of 0.05% or more (left) and all day-time crashes (right) in Perth metropolitan area in 2015[1]

Increasing distances from the closest on-premise outlets to crashes were significantly more likely to be associated with an alcohol-involved crash compared with a day-time crash (OR: 1.061; 95% CI: 1.044-1.078). Compared to crashes in the central business district (CBD), crashes occurring in postcodes in middle and outer zones beyond the CBD (middle: OR=1.420; 95% CI: 1.163-1.733, and outer: OR=2.761; 95% CI: 2.266-3.364) were more likely to be alcohol-involved than non-alcohol-involved crashes.

Conclusions

Crashes were more likely to be alcohol-involved as distance to the closest on-premise outlet increased. The results suggest that police enforcement, including random breath testing, should take place not only near the areas with high densities of alcohol outlets, but closer to primarily residential areas, particularly in the early hours of the morning. Future research should investigate how these relationships vary across regional and remote parts of Western Australia.

[1] Areas with the highest concentration of crashes are indicated in red, and areas with the lowest concentration of crashes are in blue. Intermediate areas are in yellow.

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Towards a Complete Description of the Safe System

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Abstract

The Safe System has been described in a range of strategies and other publications. Consistently, these describe a number of factors, typically infrastructure, speed, people and vehicles, to indicate that a safe or safer system will be achieved by actions across all of these. This paper examines an alternative model in which these "pillars" are not inputs to achieve safety but are outputs of the interactions within the system. Speed, vehicle and environment describe the system state for each individual. Some implications of describing system risk as a function of these three variables are also discussed.

Introduction

Common early representations of the Safe System, such as those originally included in Australia's National Road Safety Strategy, show the components of the system in ways that reinforce the linkages and interactions between them (ATC, 2009). More recently, these linkages have been simplified and adapted focus on the main "pillars" on which actions will be based. (ATC, 2011). It could be argued that this segmentation of the strategy into discrete actions is contradicts a view of the Safe System as a system.

This paper returns to a more system-based representation and goes further by proposing a model in which the original Safe System components of speed, infrastructure and vehicles are not areas of action but, instead describe the state of an individual within the system.

The paper is in two parts, the first describes a conceptual risk model to derive the risk for an individual in this system state. The second outlines a model of the system that indicates the actions and interactions that influence the speed, infrastructure protection and vehicle protection that represent the system state.

The risk model

If the system state of an individual can be described by their combination of speed (s), the road environment (e) and the vehicle (v), system risk can be described as a function R(s, e, v).

For the purpose of this model, it is further assumed that this function can be described as $R(s,e,v)=R_s.R_e.R_v$ or that the overall risk is the product of individual risks associated with each factor. For example, on a typical undivided rural highway, with current vehicles, the product $R_e.R_v$ remains high and the only way a safe system can be achieved is that by reducing R_s. In other words, by reducing travel speed to the safe system speed for that particular environment.

Hence the risk associated with the road system can be described as a four-dimensional function. More familiar relationships can be represented as cross sections through this function into two dimensions.

Figure 1 shows an example of this. Holding $R_e.R_v$ constant at values that represent a fleet and network average, yields the relationship of risk to speed as promoted in documents such as Wramborg, 2005. It can be noted in this figure that cross sections of the function at different values of R_v yield different overall risk, the curve for pedestrians, with little protection from vehicles, showing the curve as R_v approaches 1.

This model allows other relationships to be explored. Figure 1 also shows the result of projecting this function in another direction. The difference between pedestrian risk curve and the curves representing different levels of occupant protection provides an estimate of how R_v varies with speed. At low speeds, the protection is low as it is unused because R_s is low, at higher speeds, the performance limits of the vehicle are exceeded, which happens at a lower speed for side impacts. In other words R_v is a function of speed as well as of the individual vehicle, v.

Hence the individual risk factors are not independent and demonstrate the complex interactions between variables that need to be understood for a complete understanding of the Safe System

Describing the system

The paper explores the system interactions that determine s, e &v, from macro economic and social factors that determine road investment levels, to individual choice about vehicle, route and speed selection.

Conclusions

The model presented in this paper is incomplete and dependent on some very broad assumptions. However, it is presented to provide an alternative view of the Safe System and one that may assist practitioners in applying a Safe System approach to the development of effective policies and programs.

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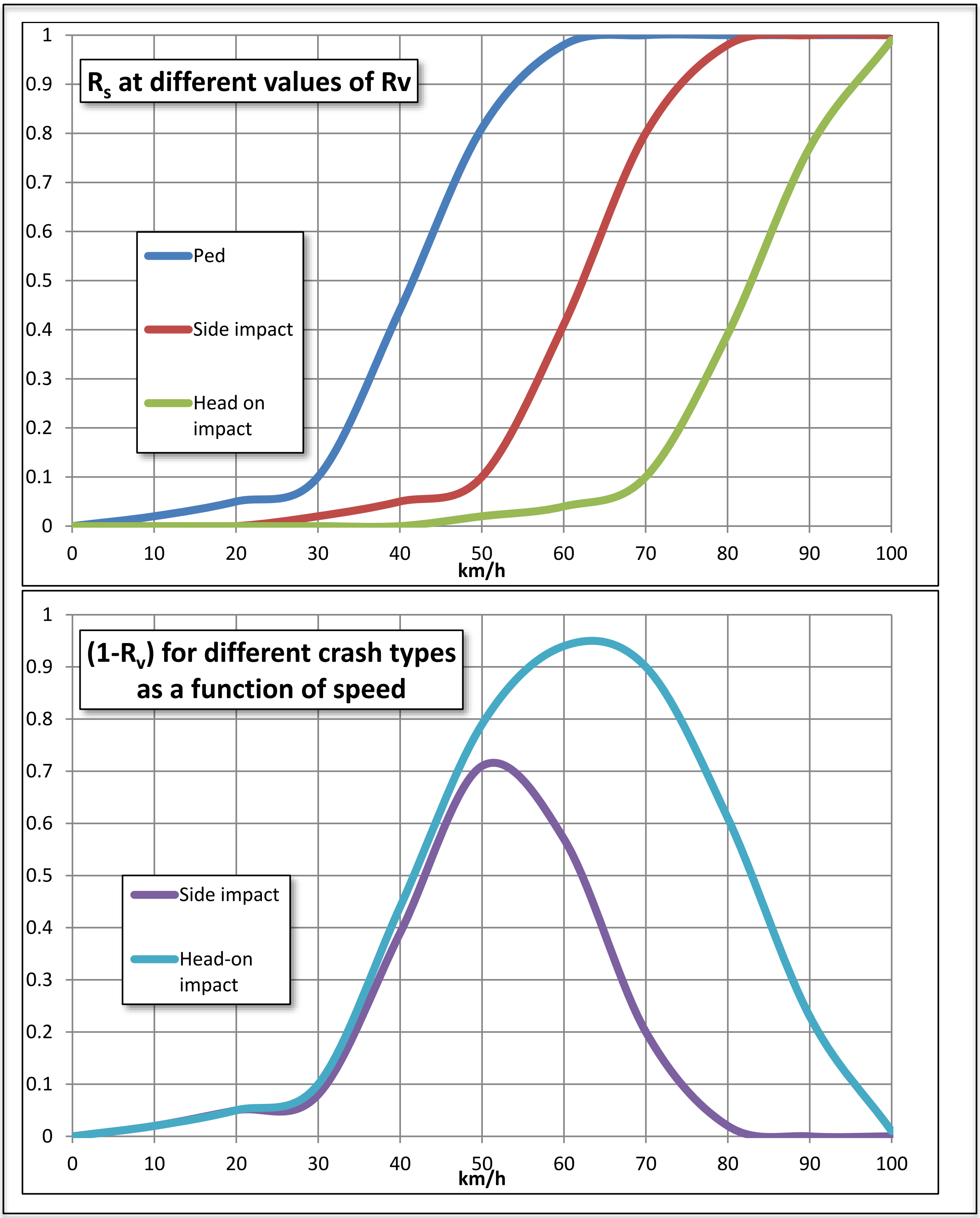

Figure 1. Various projections of the system risk function

On the Right Track Remote: Road Safety and Driver Licencing on the Anangu Pitjantjatjara Yankunytjatjara (APY) and Maralinga Tjarutja (MT) Lands.

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Department of Planning, Transport and Infrastructure

Abstract

'On the Right Track Remote' is a program conceived and delivered by the South Australian Department of Planning, Transport and Infrastructure (DPTI) to improve licensing outcomes for Aboriginal people living in the Anangu Pitjantjatjara Yankunytjatjara (APY) and Maralinga Tjarutja (MT) Lands. An independent qualitative evaluation of the program, including the capture of 'significant change' stories on film of clients, community members and other service providers, was undertaken in 2016 to complement the ongoing collection and monitoring of quantitative data. After only two years of delivery licensing rates have doubled and positive effects are being felt across communities.

Background

The program areas are the in the remote north and west of South Australia. The APY Lands consist of 102,650 km^2 with a population of approximately 3000 people; the MT Lands 102,863 km^2 and approximately 100 people.

The Program became possible because of amendments to the Motor Vehicles Act 1959 and a 4-year funding arrangement from July 2014.

Four Program Officers are employed to assist clients to get their driver's licence. Two are authorised to conduct the Learner Theory Test. Professional Motor Driving Instructors (MDIs) are contracted for in-vehicle services. 27 week long trips to the Lands are scheduled each calendar year.

An individual 'case management' approach is used to map a licensing pathway, looking at a client's circumstances, driving experience and history (if it exists) to create achievable goals. Exemptions are applied where appropriate. Clients pay significantly reduced fees at all stages of the licensing process.

Services provided include:

- Learner permit testing
- Instruction by MDIs in program vehicles
- Vehicle on Road Tests to obtain a provisional licence.

Long term measures of success are licensing rates commensurate with those for non-Aboriginal people and no over-representation of Aboriginal people in crash data.

While the Program is focussed on these outcomes its clear message is that having a driver's license is about love for family and care for community.

Evaluation

The info graphic in Figure 1 shows program statistics after 20 months of delivery. Prior to program commencement the licencing rate (across all licence types including Learner's Permits) for Aboriginal people living in the Lands was 17%, compared with 89% of the overall population.

The licensing rate for Aboriginal people on the Lands has now more than doubled to approximately 36%.

Figure 1. Statistics of the 'On Right Track Remote' program (after 20 months of delivery)

In 2016 40 significant change stories were gathered from clients and stakeholders on the Lands about the effects of the Program. Communities were involved in choosing the four most significant stories, which have formed the basis of a visual report.

Conclusion and other initiatives

The evaluation's written report found:

- The program has been highly effective in achieving Aboriginal licensing outcomes and increased culture of safety in communities
- The success of the program is evident in the Program data … and the collection of systematic qualitative data, showing an undeniable, positive impact on individuals and communities.

It concluded:
"… the Program is outstanding and producing real, sustainable licensing outcomes for Indigenous people. The changes at the individual, family and community levels are significant.

The Program is well planned and implemented and, because it is well managed, it is efficient. There is a clear need for the Program and little overlap with other services available on the Lands."

Complementary initiatives include:

- supply of child restraints
- supply of tow straps to reduce the practice of seat belts being cut from vehicles for towing
- assistance with Light/Medium Rigid licensing.

The Motorcycle Protective Clothing Assessment Program: A Star Rating System

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Abstract

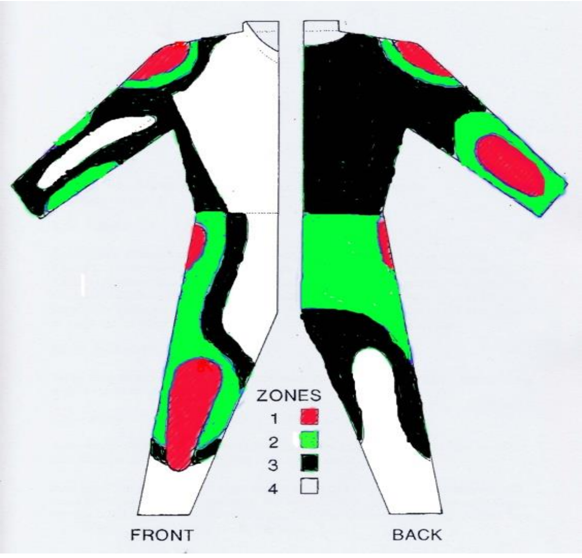
Motorcyclists wear protective clothing and helmets to reduce their injury risk. However the protective performance of motorcycle clothing in crashes is variable and many garments are poorly designed for use hot climates. In the absence of objective evidence, motorcyclists must rely on advertising, brand reputation and social networks when buying protective clothing. The objective was to develop an independent process for testing and publicizing the protective and thermal management performance of motorcycle clothing to encourage usage and reduce injury rates. Protocols were based on existing standards to allow a smooth transition for industry to improve their products where necessary.

Background

Despite the benefits of personal protective equipment (PPE), a substantial proportion of motorcycle clothing (jackets, pants and gloves) fail under crash conditions, with neither brand nor price a reliable predictor of protection (de Rome 2011a). In addition, many motorcyclists ride unprotected and are three times less likely to wear protective clothing in hot conditions (de Rome 2011b). Consultations and research suggested an evidence-based ratings scheme could increase usage of protective clothing and reduce the incidence and severity of crash injuries (de Rome 2003, de Rome 2005, Haworth 2006, Haworth 2007, de Rome 2012, de Rome 2014, Hurren 2016). The Motorcycle Protective Clothing Assessment Program is coordinated by the NSW Centre for Road Safety to provide independent ratings of injury protection and thermal management performance by motorcycle protective jackets, pants and gloves in the Australasian market.

Methods

The ratings are based on established standards and consistent with existing industry testing regimes. Ratings for injury protection are based on tests of impact abrasion, burst strength and impact energy attenuation for the relevant impact risk zone (Figure 1) as specified in the European Standard (EN13595-1:2002). EN13595 is the most comprehensive and objective means of assessing garments' likely performance under crash conditions. Additional test protocols were included for harvesting material samples from constructed garments, because the Standard's certification methods often rely on pre-production flat samples provided by manufacturers. Thermal management ratings are based on tests of thermal and moisture vapour resistance (Kar 2007).



Zone 1. High risk - needs impact protectors & high abrasion resistance (4.0 – 7.0seconds)

Zone 2. High risk - needs high abrasion resistance (4.0 - 7.0 seconds)

Zone 3. Moderate risk - moderate abrasion resistance (1.8 - 2.5 seconds)

Zone 4. Relatively low risk (1.0 - 1.5 seconds)

Figure 1. Motorcycle rider crash impact risk zones

Results and discussion

The ratings for injury protection are based on a weighted combination of scores for impact protection (30%), impact abrasion (50%) and burst strength (20%) resistance, based on their observed prevalence in crash-damaged PPE. Samples from each of the four defined impact risk zones are tested for abrasion resistance and the results weighted by zone (Zones 1/2:60%, Zone 3:25% and Zone 4:15%). Penalties are included to discourage manufacturers from minimizing garments' area of Zones 1/2. The final abrasion rating is expressed in time-to-hole seconds.

Burst strength of garment seams is also weighted by risk zones. The highest risk seams are those within and around Zones 1/2, the burst resistance scores of lower risk body seams are weighted to 50% of high risk seams. Burst strength for jackets and pants is tested using hydraulic pressure, whereas gloves are tested with tensile force due to their exposure to different types of impact forces.

The tests of impact protectors for the shoulders, elbows, hips and knees measure the transmitted force, which is scaled using body location, retention and coverage of the Zone 1 area. The impact protection rating method can be applied to aftermarket impact protectors. Thermal management is assessed as the extent to which clothing traps metabolic heat, thereby restricting the body's thermoregulatory system. The thermal management ratings are derived from measuring garments' evaporative resistance (breathability) and thermal resistance (dry heat insulation) to calculate scores on the Relative Vapour Permeability Index.

The challenges are to fully fund and manage the introduction of the scheme to allow local industry to improve their products where necessary.

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Examination of the Victorian Graduated Licensing System's Effect on Young Novice Driver Safety

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Abstract

Against a background of strong community support, the Victorian Government introduced an enhanced Graduated Licensing System (GLS) during 2007 and 2008. Key enhancements included the requirement for learner drivers aged less than 21 years to complete a minimum of 120 hours of supervised driving practice and a requirement for first year probationary drivers to carry no more than one peer passenger. Our evaluation examined the effect of the enhanced GLS on novice driver crash involvement and other measures. The results show that the enhanced GLS is an effective countermeasure.

Background

In the early 2000s, inexperienced drivers aged 18 to 25 years continued to be greatly over-represented in road crashes in comparison with older and more experienced drivers. Therefore an enhanced GLS was introduced progressively during 2007 and 2008. Some key components include:

- minimum 120 hours supervised driving practice – if aged under 21 years at time of licensing
- no more than one peer aged passenger for P1 (first year) drivers unless accompanied by a fully licensed driver
- duration of the probationary period increased from three to four years.

Method

The evaluation was guided by a series of questions clustered into eight topic areas:

- crashes
- offences
- learner permit and licensing trends
- learner driver supervised practice
- carriage of peer passengers
- drink-driving
- speeding
- compliance with other requirements (e.g., mobile phone use).

To address the evaluation questions, five data sets were used to examine changes from a pre-GLS period to a post-GLS period:

1. Crash involvement counts and rates - Generalised Linear Modelling was used to determine statistical significance of the changes in crash rates of novice groups compared with experienced driver groups.
2. Offence rates: offence rates - offence rate odds ratios and Z-scores were used to determine statistical significance of the changes in offence rates of novice groups compared with experienced driver groups.

3. Learner driver self-reported experience: a series of cross-sectional surveys concerning learner driver experience, with statistical testing of changes.
4. Probationary self-reported driver behaviour: a series of cross-sectional surveys and longitudinal surveys concerning probationary driver behaviour, with statistical testing of changes.
5. Learner permit and licensing trends: patterns in learner permit and licence issue and tenure.

Results

The enhanced GLS was successful in reducing young driver crash involvement rates for drivers aged 18 to 20 at crash involvement and in their first year of holding a licence, but there was no reduction for older young driver (21 to 23 years) crashes. For drivers first licensed at 18 to 23 years and in their first four years of driving, crashes were estimated to reduce in the longer term.

Typical learner permit tenure was longer post-GLS and there was an increase in the numbers of drivers getting their licence when older than 18 years.

The impact of the enhanced GLS on young driver offence rates was mixed, with no clear patterns emerging.

Findings from all topic areas with statistical results answering the evaluation questions will be presented in the full paper.

Discussion and Conclusions

The enhanced GLS has improved the safety of young drivers on Victoria’s roads and is an effective countermeasure. However, the benefit appears limited to those aged 18 to 20 and in their first year of driving. Further interventions will be required to address the crash rates of those aged 21 to 23 years, who are not subject to the 120 hour learner supervision requirement or the P1 licence.

More detailed results of the evaluation will be published in a forthcoming report (VicRoads 2017).

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Powered Two and Three Wheeler Safety in Low and Middle Income Countries: Usage, Risk Factors and Effective Interventions for Safety

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Abstract

Powered two and three wheeler (PTW) vehicles are widely used throughout low and middle income countries (LMIC) globally, particularly in the Asia Pacific region. They are used for personal transport, often for whole families, and for commuters and transport of goods, but are also implicated in high crash and injury rates. While there has been significant research in high income countries on risk factors and development of interventions focused on safety, much less has been done in LMIC. We sought to identify burden, risk factors and effective interventions for safety, and disseminate these via a Good Practice Guide (WHO, 2017).

Background

In 2013, there were 516 million PTWs worldwide, accounting for 29% of all registered vehicles, most in LMIC. They were implicated in 286,000 deaths; around 23% of all road deaths in 2013 (WHO, 2015). PTW are used differently around the world: in high income countries they are used primarily for transport and recreation. In LMIC they are used for transport (of goods and people), and as an income source. The WHO South East Asian region has the highest proportion of PTW, with 74.5% of the registered fleet (WHO, 2015). Growth of the PTW has been particularly rapid in China, which has the largest local motorcycle production facilities (Haworth, 2012). Between 2007 and 2013 the number of motorcycles in China increased by 21%, to 109 million (PRC, 2014). There has been rapid growth in use of E-bikes in China and fatality rates rose 5 fold between 2004 and 2008 (Yao & Wu, 2012).

Risk factors

There is little research on risk factors for crashes for PTW in LMIC. The available research highlights helmet non-use as a major risk factor for death and injury (UN, 2016). Other risk factors include alcohol use, speed, mixed traffic design of road infrastructure, PTW stability and lack of protective equipment.

Effective interventions for safety in LMIC settings

We assessed interventions and graded them (Table 1), according to the following criteria adapted from public health evidence assessment frameworks (Atkins et al., 2004; Gill, King, Webb, & Hector, 2005).

1. Effective intervention: evidence from studies demonstrate these interventions are effective in reducing PTW-related fatalities and injuries, or bring about desired behaviour change, combined with likely feasibility or cost-effectiveness.

2. Promising intervention: some safety benefits have resulted, but further evaluations from diverse settings are required and thus caution is needed when implementing such an intervention.

3. Insufficient evidence: evaluation has not reached a firm conclusion about its ability to reduce fatalities and injuries or bring about desired behaviour change (lack of evidence, or no effect).

Table 1. Key measures and specific interventions for improved PTW safety

Key measures	**Specific interventions**	**Effectiveness**		
		Proven	**Promising**	**Insufficient evidence**
Safer roads and mobility	Exclusive motorcycle lanes	■		
	Protected turn lanes and widened shoulders or lanes		■	
	Removal of roadside hazards		■	
	Improving road surface conditions			■
	Modifying the composition of roadside barrier building material			■
Safer vehicles	Antilock brake system	■		
	Daytime running headlights		■	
	Configuration to enhance stability			■
	Intelligent transport system			■
	Airbags for motorcycles			■
	Brake lights			■
	Periodic inspection for mechanical defects			■
Safer road users	*Setting and enforcing helmet legislation*			
	Mandatory helmets	■		
	Helmet standards	■		
	Strengthening penalties			
	Criminalizing offences (eg alcohol, speed)	■		
	Demerit point system		■	
	Wearing reflective and protective clothing			
	Reflective clothing use		■	
	Protective clothing use		■	
	Thermal resistant shields			■
	Regulating and licensing of PTWs			
	Mandatory registration of vehicles and licensing of PTW operators	■		
	Graduated licensing system		■	
	Age restrictions for children riding or as passengers on PTWs			■
	Restriction on multiple pillion passengers			■
	Minimum eight as pillion passenger			■
	Smaller engine size for learner riders			■
	Training			
	Compulsory skill test for motorcycle permit	■		
	Post-licence training			■
Post-crash response	On-site helmet/collar brace removal		■	

Interventions that were found to be effective and promising are as follows;

1. Road safety management: include strong government role in setting legislation and policy enforcement, in licensing PTW operators and registering vehicles.

2. Safer roads and mobility: separation of PTWs from other traffic, where at least 20–30% of road users are PTWs.

3. Safer vehicles: advanced braking systems, such as antilock braking systems (ABS) and addressing mechanical defects in all PTWs.

4. Safer road users: legislation and enforcement related to alcohol use, speeding, helmet and protective clothing use; instituting a programme for graduated licensing; increased visibility of PTWs.

5. Post-crash response: introduction of uniform treatment protocols and quick and accurate mechanisms for rapid activation of emergency care systems.

Summary

There is a significant burden of death and injury due to PTW use globally, particularly in LMIC. While improving safety in such settings has various challenges, there are effective proven and promising interventions specific to improving PTW safety. General interventions effective for other road safety issues that are of equal benefit to PTW safety can also readily be applied in LMIC settings. Such interventions should be implemented in LMIC in the context of a Safe System approach, which provides a framework for the planning and implementation of effective and promising interventions.

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Validation and Applicability of Floating Car Speed Data for Road Safety

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Abstract

Traffic speeds are one of the most important factors influencing road safety outcomes. The project compares floating car data (FCD) speeds with conventionally collected point-speed data for different parts of the road network in Victoria. Analysis showed a clear relationship between the two data types. Simple calibration models were developed to interpret FCD speeds in the context of conventionally measured free-flow speeds. Availability of FCD speed data was much greater than for point-speed data, covering most of the public road network. The project also noted some limitations, but pointed to opportunities for more sophisticated speed-safety models than currently available.

Background

Traffic speeds are one of the most significant factors in road safety performance, one which has been relatively well understood through development of speed-safety Power Models (e.g. Nilsson 2004, Elvik 2009, 2013). Conventionally, speed is measured at a chosen point on the road (e.g. radar, tubes, loops, etc.) on the assumption that the measurement is applicable to the whole section of interest (TRB, 2011). This approach limits practitioners' access to traffic speed data across the road network to defined locations and time periods when the measurements can be made.

In recent years, big data available from vehicle navigation and fleet monitoring devices has offered a sizeable sample of traffic speeds across the entire road network. This floating car data (FCD) is available averaged over defined road segments. This study sought to better understand if this source can be harnessed for speeding trends monitoring and road safety evaluations. The study objectives included exploring the relationship of FCD speeds to conventional point-speeds, road network coverage, latency/availability and other feasibility questions.

Method

The study sampled FCD speeds from several commercial providers, and conventional point-speed data from VicRoads Traffic Information System. Data was sampled in Victoria only, from a range of roads starting with motorways and ending with local streets. The data was geographically and temporally matched. The statistical distributions and other available key performance indicators for speed were compared between the two sets.

Interviews with the industry representatives were carried out to better understand licencing and costs of using FCD data to create a state-wide speed monitoring and evaluation system.

Findings

The study provided a significant leap in the understanding of FCD and its application to road safety. While the FCD sample represents only 2-4% of the fleet, overseas studies have shown good relationships to point speed data (Ambros et al. 2017, Reinau et al. 2016, Bekhor et al. 2013). This was confirmed in case of Victoria, showing some need for calibration of FCD speeds data if it was to be used in the same way as point-speed data (e.g. in Elvik's Power Model for crash reductions). FCD was able to deliver the key road safety performance indicators related to speed such as mean, 85th percentile speeds, percentage speeding, standard variation, and to observe changes in these across time.

Also, the study showed the limitations of FCD, including availability: long collection periods may be needed on low volume roads (e.g. rural, local) to build statistically viable samples. Availability of historical FCD can overcome this (typically last three years). The study also found that the industry is keen to licence the data to institutional stakeholders in bulk (e.g. service for the whole state), with only one providing a limited retail interface for interrogation of specific locations (e.g. for before/after speed evaluations). Arrangements could be made to provide new data daily.

There is a new understanding of traffic speeds emerging from analysis of this data source. It offers an ability to see speed variations along routes in response to traffic management features and road geometry. Further, it provides speed changes across times of day, reflecting differences between free- and all-speeds. This provides a link between safety and broader transportation and network management questions.

Conclusions

The study concluded that FCD is a viable source for monitoring key speed-related safety performance indicators. The data could be used to develop more sophisticated models of speed effect on safety, including additional aspects such as operating speed and speed variation.

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Safety Evaluation of Fully-Controlled Right Turn Phasing at Signalised Intersections: Full-Time and Part-Time Applications

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Abstract

This paper presents results of safety evaluation of fully-controlled right turn (FCRT) phasing at signalised intersections in Melbourne, Australia. Full-time and part-time (off-peak only) applications of the treatment were evaluated. The evaluation produced full-time FCRT crash reduction factor (CRF) of 52% for all-casualty crashes and 69% for severe casualty crashes, both statistically significant. Part-time FCRT showed lesser safety benefits: CRF of 11% for all-casualty crashes, and 36% for severe casualty crashes (lower statistical significance). This research provides valuable inputs into revision of road agency policies, especially in relation to choice between safer full-time FCRT and a more efficient part-time FCRT.

Background

Risk of casualty and serious casualty crashes due to right turns at signalised intersections (left turns in the right-hand-drive traffic) is greatly increased if drivers have to select gaps in opposing traffic. For many years, road agencies made efforts to provide signal phasing which fully controls right turn movements with intent to reduce incidence of right-through casualty crashes. Effectiveness of this treatment is very high (45%), but has not been evaluated in Australia for a long time (Bui, Cameron & Foong 1991).

This paper presents results of an evaluation of all-casualty and severe casualty crash reduction effectiveness of fully-controlled right turn (FCRT) phasing at signalised intersections in Melbourne, Australia. Two applications of this treatment were evaluated: full-time and part-time.

The full-time application of FCRT was evaluated to test if the effectiveness has been retained since the original evaluation in 1991. The part-time application of FCRT, which means FCRT is activated only during off-peak periods, was evaluated separately. This application permits filter right turns during peak periods, when speeds are deemed to be lower, to reduce traffic delays. This evaluation sought to test the current assumption that effectiveness of part-time FCRT application is equally as safe as of full-time FCRT application.

Methods

The authors used a quasi-experimental, retrospective, matched-control study design to develop generalized linear models (GLM) models to estimate all-casualty and severe casualty crash modification factors (CMFs) for each of the treatment types. The approach is well established for this purpose (Bruhning & Ernst 1985; Scully, Newstead & Corben 2008). All crash types were considered to maximise the available sample size. Crash data was obtained from past signalised intersection black-spot projects completed by VicRoads, where at least one approach was retrofitted with FCRT phasing and hardware (typically two or four approaches). Sites where part-time operation of FCRT was part of the retrofit design were set aside accordingly.

Full-time FCRT evaluation was based on 35 sites for all-casualty crash analysis, and 16 sites for severe casualty crash analysis. Part-time FCRT evaluation was based on 31 sites for all-casualty crash analysis, and 16 sites for severe casualty crash analysis.

The treatment sites were matched with signalised comparison sites which were not treated during the same period. These sites were of similar size, similar traffic flow and road function, with emphasis on selecting sites in the same part of the city, but without FCRT installed.

The part-time FCRT evaluation did not explicitly control for the differences in traffic flows during peak and off-peak times. The same methods were used to evaluate the two applications of FCRT treatment.

Results

The findings for the full-time application of FCRT phasing confirmed the earlier findings by Bui, Cameron & Foong (1991), also based on Melbourne sites, showing the CMF of 0.48 for all-casualty crashes and 0.31 for severe casualty crashes (i.e. crash reductions of 52% and 69% respectively), both statistically significant ($p \leq 0.05$).

The part-time application of FCRT phasing produced lesser safety benefits: a CMF of 0.89 for all-casualty crashes, and 0.64 for severe casualty crashes (i.e. crash reductions of 11% and 36% respectively). Statistical significance of the all-casualty crash result was low ($p=0.32$), but the finding for severe casualty crashes was significant at $p=0.08$, i.e. close to the desirable standard. The lack of robustness was due the lower treatment effects combined with a limited number of sites and crashes available for the study.

Conclusions

These findings show that full-time application of FCRT phasing maintained its safety effectiveness since the original evaluation in the early 1990s. The part-time application of FCRT, during off-peak periods, also provided some safety improvement, especially for severe crashes. Importantly, the evaluation showed that this approach was not as effective for safety improvement as the full-time application. This raises policy questions about future trading-off of safety improvement for assumed delay reduction.

This research can provide valuable inputs into future revisions of road agency traffic signal design policies.

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Improving Road Safety through Integrated Process for Incident Traffic Management

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Abstract

Austroads has identified the lack of a mutually agreed incident management framework across the member organizations as a gap in the traffic incident management practice in Australia and New Zealand. A research project has been undertaken to develop such framework based on a review of current local and international incident management techniques and understanding. This paper presents a review outcome and the proposed framework with a focus on advanced traffic incident management techniques to minimise traffic disruption and road safety risks while maintaining a safe workplace for responders.

Background

The responsibility of implementing traffic incident management (TIM) in Australia and New Zealand primarily lies with road and traffic authorities and private toll operators who are vested with managing the public road networks. Given its complexity in managing multiagency, multi-jurisdictional responses to road traffic disruptions and the emergence of intelligent transport systems (ITS) and other transport technologies (e.g. smartphone and connected vehicle technology), the practice of TIM is evolving. By reinforcing an aim to provide a quick, effective and coordinated incident response to safely return normal traffic flow, an integrated TIM process would improve traffic safety for road users and responders.

Method

The research method involved a review of the literature on the TIM topic and a review of the current techniques employed by the Australasian road transport agencies in order to identify contemporary leading TIM techniques. An incident management framework was subsequently developed to provide overarching incident management guidance at various implementation stages, ranging from inter-agency collaboration, planning and traffic incident management through to performance evaluation and training.

Baseline and emerging traffic incident management techniques

Baseline TIM techniques for incident detection and response can be established based generally on the TIM practices discussed in the research reports published by Austroads (2007a; 2007b). These include emergency phones, service patrols and incident response units. The majority of incident detection and response practices utilise road and traffic sensing technology. In the area of traffic data collection technologies, infrastructure-based detection systems with stationary measurement devices distributed across the network have dominated. Such static sensing systems can be classified into in-road or over-road (Klein, Mills, & Gibson, 2006). Examples of these devices are inductive loops, infrared, pneumatic tubes, radar, CCTV and in-vehicle emergency sensors.

New and emerging techniques for managing incident traffic falls within the scope of advanced traffic management tools and techniques that are employed in road network operations. These techniques include:

- Smartphones and global nagivation satellite systems (GNSS)
- Cooperative-ITS and dedicated short range communications (DSRC)

- Social media, participatory sensing and crown sourcing
- Drones for traffic and incident data (Geers & Karndacharuk, 2016).

Summary matrix of incident management techniques

Table 1 shows the role and relevance of the variety of incident management techniques and practices for collecting and processing road and traffic data in response to incident management needs. The 'enable' or 'support' terms are assigned to each technique to differentiate its role in traffic management during an incident from detection to traveller information dissemination (Karndacharuk & Hassan, 2017).

It can be observed that all of the new and emerging techniques have an ability to carry out or support the implementation of all traffic management steps (c.f. only the manual operation of service patrols and incident response units in the baseline practice).

The framework and principles

Given the word limit, it is impossible to adequately include the newly developed TIM framework in this extended abstract. The framework, underpinned by principles, will provide road network managers an overarching guidance and a common understanding of the on-going process for integrating traffic incident management approaches. It incorporates contemporary leading incident management techniques that can be employed to provide a quick, effective and coordinated incident response to safely return normal traffic flow. The implementation of the framework is anticipated to not only enhance the operation of the road network, but also safety of road users and responders.

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Table 1. Role and relevance of traffic management techniques in the traffic incident management process

Practice	Traffic Incident Management Step					Note
	Detection	Verification	Response	Traffic Management	Traveller Information	
New and emerging technique						
Smartphones and GNSS	Enable (Link)	Enable	Enable	Support	Enable	Features of a smartphone enable incident response and traveller information
C-ITS and DSRC	Enable (Lane)	Support	Support	Enable	Enable	C-ITS using DSRC enables traffic management by providing traffic control information to approaching vehicles
Social media and crowdsourcing	Enable (Link)	Support	Support	Support	Enable	Examples are Waze and Twitter
Drones for traffic data	Enable (Lane)	Enable	Support	Support	Support	Restricted use is allowed in Australia
Baseline technique						
Emergency phone call and hotline by general public	Enable	Support	–	–	–	
In-road sensors (e.g. inductive loop)	Enable	Support	–	–	–	Sensors provide traffic data to AID for incident detection
Over-road sensors (e.g. radar and infrared)	Enable	Support	–	–	–	
Automatic Incident Detection (algorithm)	Enable	Support	Support	–	–	AID analyses traffic data from other sources
Traffic incident watch (by professional drivers)	Enable	Enable	Support	–	–	Participants collaborate with transport agency and the Police for incident verification
In-vehicle emergency (e.g. Mayday and e-Call)	Enable	Enable	Enable	–	–	Voice link enables proper incident response
CCTV	Enable	Enable	Enable	Support	–	
Static traffic and road space management devices	–	–	Enable	Enable	Support	
Adaptive traffic control and communication devices (e.g. VMS and VSLS)	–	–	Enable	Enable	Enable	
Service patrol and incident response unit	Enable	Enable	Enable	Enable	Support	

Source: Karndacharuk and Hassaon (2017)

Application of MRWA RAP and ANRAM for Assessing Upgrades on Great Eastern Highway

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Abstract

A methodology has been previously developed to provide the required data for the iRAP Star Rating model using data sourced from corporate inventory and condition information supplemented by other data sources. This is referred to as MRWA RAP to distinguish from data collected in accordance with iRAP protocols which provides data for AusRAP. This same information is used by the Australian National Risk Assessment Model (ANRAM). This paper describes the work done on updating MRWA RAP as well as the application of the ANRAM model to assess proposed treatments on Great Eastern Highway to improve road safety.

Background

As documented in Karpinski (2014) a methodology had been developed to assemble the required data for the iRAP Star Rating model using data sourced from corporate inventory and condition information supplemented by other data sources.

This data is referred to as MRWA RAP to avoid confusion between it and AusRAP. The focus of MRWA RAP to date has been to produce star ratings for vehicle occupants and to provide the necessary input data for the Australian National Risk Assessment Model (ANRAM).

As the data used by MRWA RAP and AusRAP is different the results of the star rating using both data sets will be different. Comparison of the differences and of both the inputs into the star rating model as well as the outputs can be found in Karpinski (2014).

An assessment of proposed interim upgrades to Great Eastern Highway from the intersection of Great Southern Highway to Mitchell Avenue intersection at Northam, a distance of approximately 40 km was made using Star Ratings and ANRAM.

Method

The original MRWA RAP data set was created in 2014 and in order to be able to produce star rating of the highway as it currently is as well as being able to use the ANRAM model it had to be updated.

This was done by making comparisons between the inventory and condition as currently recorded versus the original data sets used. To simplify the process iRAP codes were assigned to the data.

For some attributes there is a range of values e.g. for paved shoulder width a rating of 3 which corresponds to Narrow applies to a shoulder >= 0m to < 1.0m. If between the years the paved shoulder had been increased in width but was still within the range then the data was still current. Comparisons were done either using Excel macros or by using Beyound Compare. Key data sets were checked for changes.

Additional information such intersection volumes was also used to update the data, locations of driveways were checked against previous proxy methods and different geometry data sets compared.

Once the base data had been updated it was loaded into ANRAM and used to set the basecase, the highway as it currently is.

The following treatments were then assessed:

- Introduction of 1 m central median – separating one lane in both directions
- Extension of existing overtaking lanes – not only to increase their length but to improve their start and end locations as a number had poor sight distances.
- Addition of overtaking lanes
- Intersection upgrades – provision of left and right turn pockets. Note that ANRAM will only assess right turn pockets.
- Provision of roadside verge barriers at targeted locations.
- Clearing at specific locations.

Treatments were assessed individually by the "backdoor" approach in which the codes in the raw data were modified to reflect the treatment being applied. For example as part of the introduction of the 1 m central median the median type was changed to wide centerline, centreline rumble strips were set to being present, paved shoulder widths set to medium (as their width would be 1.5 m) etc.

Based on the number of predicted crashes compared to the baseline crash modification factors were determined which was then used to calculate the number of crashes saved and used as the basis of an economic assessment. This was used to priortise a program of treatments for an interim upgrade of the highway.

Results and Conclusions

The results of the ANRAM modelling indicates that the proposed treatments will make significant safety improvements to this section of Great Eastern Highway. The star rating of the highway will also be improved.

If iRAP data is to be generated from other methods other than from video there needs to be protocols developed to provide guidance on governance associated with the data (iRAP data has requirement for 10% to be checked), rules or guidance on how the data can be converted into a rating e.g. using condition data such as roughness, rutting how does this translate into iRAP road condition rating?

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Comparison of Findings Reported by Self-report and Objective Measures of Driving Exposure and Behaviours: A Systematic Review

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Abstract

We reviewed the peer reviewed scientific literature for road safety studies which had incorporated both self-report and objective measures of driving exposure and on-road behaviours. Utlising the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines, a total of 4,426 articles were identified during the initial search phase, with 20 studies retained for review. Overall, the findings were mixed, with some studies showing general correspondence between self-report and objective measures and other studies showing inconsistences between these two types of measurement techniques. The implications of the findings for future research will be discussed in the presentation.

Background

Previous research in road safety has relied heavily upon self-report measures to assess on-road driving behaviours. However, while there has been some evidence supporting the use of these measures as reliable indicators of actual driving behaviour (Taubman- Ben-Ari, Eherenfreund-Hager, & Prato, 2016), self-reports have been criticised for having a number of biases. These bias include, social desirability effects (af Wåhlberg, 2010) and reports of either overestimating or underestimating driving distances (Huebner, Porter, & Marshall, 2006). More recently, and due to technological advancements, more studies are including objective measures in the attempt to understand driving behaviour. To evaluate if disparities (or similarities) exist between these measures, this research systematically reviewed the extant literature in regards to studies which have used both self-report and objective measures of actual driving behaviour.

Method

The review followed the PRIMSA guidelines (Moher, Liberati, Tetzlaff, Altamn, and the PRISMA Group, 2009). The search strategy was developed by SK, in consultation with IL and JF and conducted in February, 2017. Table 1 presents the search terms. The review comprised of articles published in PsycINFO, PubMed, and Scopus. Due to the large number of articles identified in Scopus, limits were put on language (English) and journals (i.e., road safety and psychophysiology journals). No limits were applied to the remaining two databases. Further, no limits were applied to dates.

In total, 4,426 records were identified (see Figure 1). To proceed to full-text data extraction, articles were required to meet the following criteria, 1). peer-reviewed full-text articles, 2). focused on road safety, and 3). included both subjective and objective measures. Sixteen articles met the criteria, with an additional two articles identified via cross-reference and one article which was known to the authors. One article consisted of two studies (i.e., Taubman-Be-Ari et al., 2016) and therefore, a total of 20 studies were included as part of the review.

Results

All studies were published in English between 2005 and 2017, with the research conducted in developed counties (i.e., six studies in Australia, six studies in Canada, three studies in the US, three studies in Israel, and one study each in Ireland and Germany). Overall, the studies were found to report mixed findings regarding the correspondence between self-report and objective measures. For example, and in terms of driving exposure, Potter et al. (2015) reported that 45.3% of their sample made errors of both under- and over-estimation when estimating their driving exposure. Marshall et al. (2007), however, reported a significant strong positive relationship between self-reported driving, as reported in a driving diary, and in-vehicle devices. In terms of assessing drivers' speeding behavior following exposure to anti-speeding road safety advertisements, Kaye, Lewis, Algie, and White (2016) found that drivers' self-reports, as assessed in a survey, corresponded with objective measures as gained via in-vehicle devices. In contrast, Plant, Irwin, and Chekaluk (2017), also in regards to assessing behavior following exposure to an anti-speeding message, found that actual behaviour change was not associated significantly with self-reported intentions to reduce speeding.

Conclusions

More research is needed to determine the extent to which disparities (or similarities) exist between self-report and objective measures. Given that research in this field has traditionally relied heavily upon self-report measures, and given the mixed findings that this review has found, further research is needed to examine the correspondence between self-report and objective measures of driving exposure and behaviour. To do so would help to ensure that the methods used offer the most reliable means of assessing on-road behaviours.

Table 1. Search terms

	Search terms
Objective measures	objective measure OR driving simulator OR in-vehicle device OR in-vehicle data OR CarChip OR global positioning system OR GPS OR on-board diagnostic system OR OBDII OR physiological OR intelligent speed adaption device OR ISA device OR electronic device
Subjective measures	subjective measure OR self-report OR driving diary OR travel diary OR survey OR questionnaire OR estimate
Behaviours	driving behaviour OR driving behavior OR driving ablit* OR driving exposure OR speed OR distraction OR fatigue OR drink driving OR seat belt OR seat-belt OR driving distance OR persuasi* OR actual behavio* OR on-road behavio* OR self-regulation

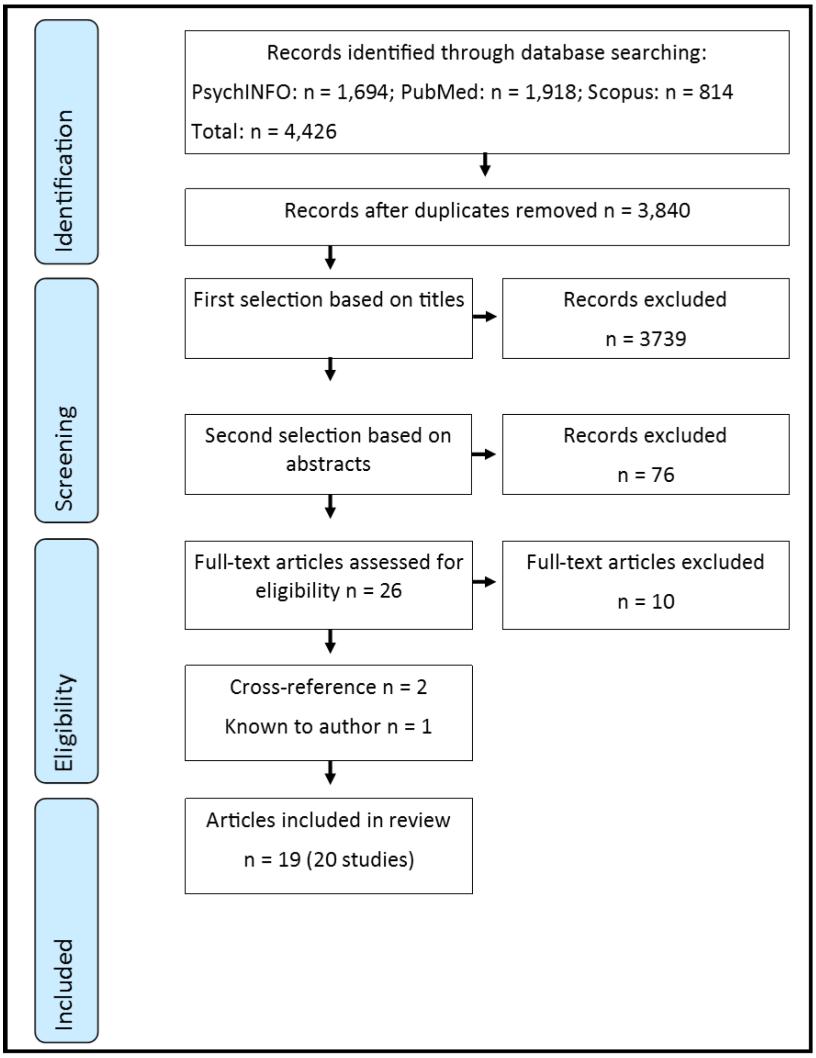

Figure 1. Review and selection process

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Queensland Road Safety Week 2016

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Abstract

Queensland Road Safety Week (QRSW) began in 2015 as a joint initiative of the Queensland Police Service (QPS) and Department of Transport and Main Roads (TMR); encouraging Queenslanders to 'speak up for road safety'. Communities, schools, and workplaces were encouraged to support QRSW2016 by hosting local events or sharing road safety information. Focused on the 'Fatal Five', campaign themes were delivered through three mediums: education, engagement, and enforcement. QRSW2016 was a successful expansion of QRSW2015; yielding a large online presence and reaching a wide audience, positive responses from event attendees and hosts, and an increase in road policing enforcement hours were achieved.

Background

QRSW is an expansion of the successful Central Police Region Road Safety Week, which occurred in 2014. In support of the Queensland Road Safety Action Plan 2015-17, QRSW aimed to engage the community in important conversations about road safety. With the successful launch of QRSW in 2015 the initiative was repeated in 2016 with a third QRSW envisioned for 2017.

QRSW2016 was held between 22–28 August, and was collaboratively hosted by QPS, TMR, and the Motor Accident Insurance Commission (MAIC). The Royal Automobile Club of Queensland (RACQ) and the Centre for Accident Research and Road Safety - Queensland (CARRS-Q) were also engaged as representatives on the advisory group. The theme of QRSW2016 was 'speak up for road safety'. QRSW2016 focused on the 'Fatal Five'; with each business day dedicated to a different road user behaviour. There were three mediums of delivery for QRSW; education, engagement and enforcement.

QRSW activities

Education

A focus on school-aged children helps build positive road safety attitudes, an essential element for future safe road users. A school toolkit was promoted to all Queensland schools through the Department of Education and Training, Queensland. The toolkit included: Background information and key messages; suggestions for events and activities; factsheets; and decorative bunting.

A 'road safety in my town' competition was also designed to encourage primary school-aged students to consider what road safety means to them. An illustrative prompt was provided for children to encourage creativity. Forty entries were submitted, resulting in five winners. Each winning child was awarded an iPad for themselves and their school.

Engagement

QPS and TMR promoted QRSW2016 through their organisation's Blogs, Facebook, and Twitter feeds. Engagement via the 'Join the Drive' (JTD) website increased in QRSW2016 compared to QRSW2015 (note statistics accounted for a two-month period to measure residual activity), including the number of website users (419% to 12,254), website sessions (366% to 14,652), and page views (203% to 10,155).

To encourage people to become actively involved in QRSW2016, TMR ran a #SpeakUpSelfie competition resulting in 136 entrants. Facebook and Instagram proved the most successful channels for engagement.

Community groups, government agencies, and businesses were asked to promote QRSW2016. Organisations were provided with a toolkit which included: Background information; event and activity ideas; fact sheets; and promotional items. Feedback indicates that activities included internal communication, sharing of social media content, staff barbecues, and in-office presentations.

Event hosts were encouraged to register their event online via the JTD website. One-hundred-seventy-nine events were registered, with 64 hosts completing a post event survey. There were approximately 18,300 attendees at the 64 events. All hosts were willing to host an event in 2017 (dependent on approval and budget); and 96.7% said their event was successful.

Enforcement

Throughout QRSW2016 additional resources were provided by the Road Policing Command to QPS Regions to increase service delivery, and media efforts focused on safe, legal, and responsible road user behaviours.

When compared to QRSW2015, QRSW2016 saw an increase in approximately 8,150 road policing enforcement hours, a 25% increase in the number of driver's breath tested (to 116,049), and a 138% increase in the number of drink drivers detected (to 486). The drink driving detection rate increased from 1:144 in 2015 to 1:239 in 2016. It is unknown why the detection rate increased. There was a slight increase in the number of speeding traffic infringement notices issued, and a slight decrease in the number of seatbelt and mobile phone traffic infringement notices issued.

Conclusion

The activities in QRSW were successful in achieving their goals, and were an improvement on the previous QRSW. Recommendations for future QRSWs include: Engaging with stakeholders, and schools earlier to enhance participation; earlier engagement with the evaluation team to best utilise knowledge garnered from QRSW2016 to develop the strategy and organise the collation of required data for a report; utilise results from QRSW2016 surveys to enhance the engagement strategy; ensure a high level of media coverage is repeated, with a focus on including details of upcoming events and the inclusion of high quality and eye catching photos; and consult with other jurisdictions on the benefits of QRSW to encourage the adoption of the initiative across Australia.

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Use of Alternative Forms of Transport in Older Drivers in the Suburban Outskirts of Sydney

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Abstract

Retirement from driving is a major life decision and can result in loss of independent mobility. We investigated the impact of an individualized safe mobility program on alternative transport use among 380 drivers aged 75+ years resident in the suburban outskirts of Sydney in a RCT. The use of alternative transport was low, regardless of public transport accessibility and did not increase with the Behind The Wheel program which provided individual advice about transport. This study suggests that it is difficult to shift patterns of transport use amongst residents of outer suburban areas who rely on driving for transport.

Background

Many older Australians rely on driving as their primary mode of transport and the numbers of licensed drivers in older age groups are increasing rapidly.(Bureau of Intrastructure 2014) Research in Australia and other highly motorised countries such as the US has consistently shown that older driver don't plan for retirement from driving, prefer door to door transport and demonstrate low uptake of public transport services.(Kostyniuk and Shope 2003) We delivered an individualised safe transport program, the Behind The Wheel program(Coxon and Keay 2015) which included practical solutions and planning for use of alternatives forms of transport including public transport.

Method

Licensed drivers, aged 75 years or older, who spoke English and who were resident in four local government areas in northwest Sydney were recruited to participate in a randomised controlled trial evaluating The Behind The Wheel program.(Keay, Coxon et al. 2013) The participants were randomly allocated to the Behind The Wheel program (intervention) or usual practice (control) with 190 in each group. The Behind The Wheel program was tailored to the individual driver according to the stage of their involvement in self-regulation of driving and delivered over 2 sessions in the participants own home. An inventory of usual trips for the study participant was taken at the first visit. On the return visit, a package of information was provided with available alternative transport in the local area which matched the desired trips. The participants were encouranged to select preferred alternatives and gain familiarity, develop skills and gain confidence in their use. The participant was given the opportunity to develop a safe mobility plan and retirement from driving plan.

The residential address of each participant was allocated a score (0-3), this describes the percentage of residents who can reach this address using public transport in within 45 minutes during the morning peak hour (0=<5%, 1=5-10%, 2=10-15%, 3=>15%). Self-reported trips taken in the last month using alternate transport including bus, train, taxi, and community transport were an outcome measure and recorded at baseline and the 12 month follow-up assessment. Return trips were scored as two trips and total trips summed. Generalised linear models were used to investigate the influence of the Behind the Wheel program and transport accessibility on use of alternative transport, adjusted for transport accessibility, age and sex.

Results

A total of 380 participants aged 75 to 94 years (mean:80±4) enrolled in the study between July 2012 and October 2013. More males (61%,230/380) were enrolled than females (150/230). There was minimal loss to follow-up (4%,14/380) and a few (3%,10/366) ceased driving during the trial. The public transport accessibility was generally low 300/380 scored 0, 75/380 scored 1 (2 scored '2' and 1 scored '3') and this was collapsed into 0 or 1-3 for analysis. The reported number of trips was a median of 2 per month but highly varied with average number of trips 4.7±8.0 and a range of 0-56. The number of trips was the same (p=0.9, GLM) in the intervention (4.6, 95% CI 3.4-5.9) and control groups (4.5, 95% CI 3.3-5.7) and those who lived in a home with ≥1 transport access (4.62, 95% CI 2.8-6.4) compared to 0 transport access (4.5, 95% CI 3.6-5.5). There was no difference with age but men used more alternative transport (p=0.046). Men took 5.4 trips per month (95% CI 4.2-6.7) and women took 3.7 trips per month (95% CI 2.3-5.1).

Conclusions and Discussion

This cohort of older drivers did not make many trips with alternative forms of transport and this was unchanged after participating in the Behind The Wheel program or influenced by accessibility of alternative transport. The low uptake of alternative transport may be a reflection of the strong preference for driving. Uptake was higher amongst men.

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Distraction in Shift-Workers During Naturalistic Driving

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Abstract

Driver drowsiness is a significant public health problem and has previously been linked to an increase in driver distraction (Anderson & Horne, 2013). This relationship has yet to be examined under naturalistic driving conditions, where task demands may differ from lab-based experimental studies. Using a continuous driver monitoring system, shift-workers (N=20) were observed on their commutes to and from work. Our findings showed that measures of visual distraction increased significantly with drowsiness in real-world driving. This study presents a world-first application of continuous monitoring of behavioural and physiological signals associated with distraction in real-world driving.

Background

Driver drowsiness is attributable to between 13 – 21% of all crashes and has previously been shown to be associated with an increased propensity to become distracted (Anderson & Horne, 2013; Tefft, 2012). Assessment of such driver states in previous studies been a significant challenge due to a reliance on manual analysis of video data. Real-time driver monitoring, as used in this study, presents significant advantages in this context in terms of supporting the collecting of a wider range of driver features and with greater accuracy while also removing the need for hundreds of hours of video analysis. This study aimed to examine the behavioural and physiological antecedents to driver distraction and under naturalistic driving conditions where task demands may differ from controlled experimental studies and where drivers may freely engage in additional secondary behaviours.

Method

The current study observed shift-workers (N=20) during their commutes to and from work over alternating periods of day and night shifts. Participants drove a study vehicle (Honda Jazz with automatic transmission) equipped with Seeing Machines' proprietary automotive-grade driver monitoring system. For the purposes of this study the DMS classifies a driver's direction of attention through a real-time analysis of head pose, gaze and pupil metrics and eyelid opening.

Participants drove the instrumented study vehicle for a period of up to two weeks, balanced across baseline and night shift driving. No constraints were placed on participants' usage of the study vehicle or engagement in secondary behaviours.

Drowsiness was assessed via PERCLOS, a measure of the proportion of time that the eyes are closed over a given percentage calculated as percentage eye closure > 80% over a 20-minute window (Wierwille et al., 1994). Trips with max PERCLOS levels of at least 0.15 were classified as drowsy.

Driver attention was assessed via total eyes-off-road, lap glances, and centre console glances. Total eyes-off-road was operationalised as the rate per hour of glances away from the forward roadway for durations of at least 3 seconds. Lap and centre console glances were defined as the rate per hour of glances toward the respective regions of any duration. All gaze-based metrics (including PERCLOS) were derived automatically from the driver monitoring system.

Linear models with participant as random factor were specified for each of the dependent variables, with drowsiness as the independent variable.

Results

All models showed statistically significant differences between drowsy and non-drowsy trips, with drowsy trips generally being associated with increases in potentially distracting glance behaviours except for console glances which demonstrated a small decrease (Table 1).

Table 1 – Descriptive statistics and linear modelling outputs for glance based metrics

	Drowsy		Not Drowsy		Linear Modelling		
	M	SEM	M	SEM	F (1,255)	β	*P*
Off-road glance rate (>3s)	29.77	2.12	25.86	1.68	9.88	0.09	0.002
Lap glance rate (all)	309.31	27.80	289.30	18.94	54.52	-0.07	<0.000
Console glance rate (all)	14.76	1.37	15.84	0.81	19.46	0.18	<0.000

Impact

This study presents the first application of a continuous automated and real-time analysis of naturalistic driver-facing video. The present findings on visual distraction closely follow previous lab- and simulator-based studies on drowsy drivers showing increased propensity to distraction following sleep deprivation. Our findings carry substantial impact not only within the topics of drowsiness and distraction, but are also broadly applicable in the context of naturalistic driving methodology where real-time assessment of driver state can facilitate the analysis of large naturalistic datasets.

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Driver Behaviour at Level Crossings: Too Fast Approach Speeds and Too Fast Decisions?

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Abstract

Collisions at level crossings are a concern worldwide, but the contributing factors for such collisions are not well understood. The aim of the study was to further investigate driver behaviour at level crossings, during day and night-time driving. A 50-minute rural route was driven by 27 participants; GPS position and speed of the vehicle were recorded. Drivers approached level crossings without boom gates significantly faster than road intersections, resulting in more abrupt braking. Drivers spent a lot less time assessing the situation as compared to road intersections without traffic. Drivers slightly reduced their travelling speed under night-time conditions.

Background

There are 22 collisions per year between trains and motor vehicles on public railway crossings in New Zealand (Ministry of Transport, 2017; trackSAFE Foundation NZ, 2017). These collisions can occur at crossings with all types of protection. While most collisions occur during the daytime in good conditions, many occur at night, with the motorist driving into the side of the train (trackSAFE Foundation NZ, 2017). No studies have investigated the effect of night-time on driver behaviour at a variety of level crossings.

Method

Twenty-seven participants (M_{age}=42.7±13 years; 14 females) were recruited to drive a 50-minute rural route around Marton, New Zealand. Eleven of the participants also drove the same route at night in a counterbalanced order.

The position and speed of the vehicle was recorded every second by the GPS of a smartphone. The measures considered for analysis were the approach speed profile, the stopping rate and the amount of time stopped to make the decision regarding whether to enter the crossing/intersection. These measures were extracted for a passive level crossing with a stop sign, two active crossings with flashing lights (one with boom barriers), and a cross-roads intersection with a stop sign.

Statistical analyses were conducted with Generalised Linear/Additive Mixed Models to consider the repeated measures design of this study.

Results

Drivers slowed down for all crossings and intersections. However, drivers prepared to stop for the road intersection earlier than for the passive crossing (75m/30m to the intersection/crossing). Drivers also slowed down quite abruptly before the active crossings with flashing lights only, before deciding to proceed through (Figure 1).

Drivers almost always completely stopped at the passive crossing (Table 1). The stopping behaviour was not statistically different to the intersection with a stop sign (97.4% vs 93.5%; t=0.84, DF=160, p=.402), but was (as expected) for the active crossings (8.0% vs 93.5%; t=-5.11, DF=160, p<.001). Further, there was a difference between the active crossing with boom barriers and the one with flashing lights only (2.8% vs 12.8%; t=-2.52, DF=46, p<.001). When stopping, the amount of time stopped at the passive crossing was 0.8s shorter (t=2.44, DF=71, p=.017) when compared to the road intersection with a stop sign.

There were no differences between day and night driving behaviour for the stopping rate and amount of time stopped. Drivers drove at slightly slower speed at night. As in day conditions, braking for the intersection tended to occur earlier than for the two non-boom-gate controlled level crossings (Figure 1).

Table 1. Mean stopping behaviour at the different level crossings and the road intersection

			Day (N=27)		Night (N=11)	
			Stopping rate (%)	**Time stopped (s)**	**Stopping rate (%)**	**Time stopped (s)**
Level crossings	Passive protection	Stop sign only	96.1	1.9	90.9	2.2
	Active protection	Flashing lights only	11.5	-	18.2	-
		Flashing lights and boom barriers	0	-	10	-
Road intersection	Stop sign		100	3.2	90.9	3.2

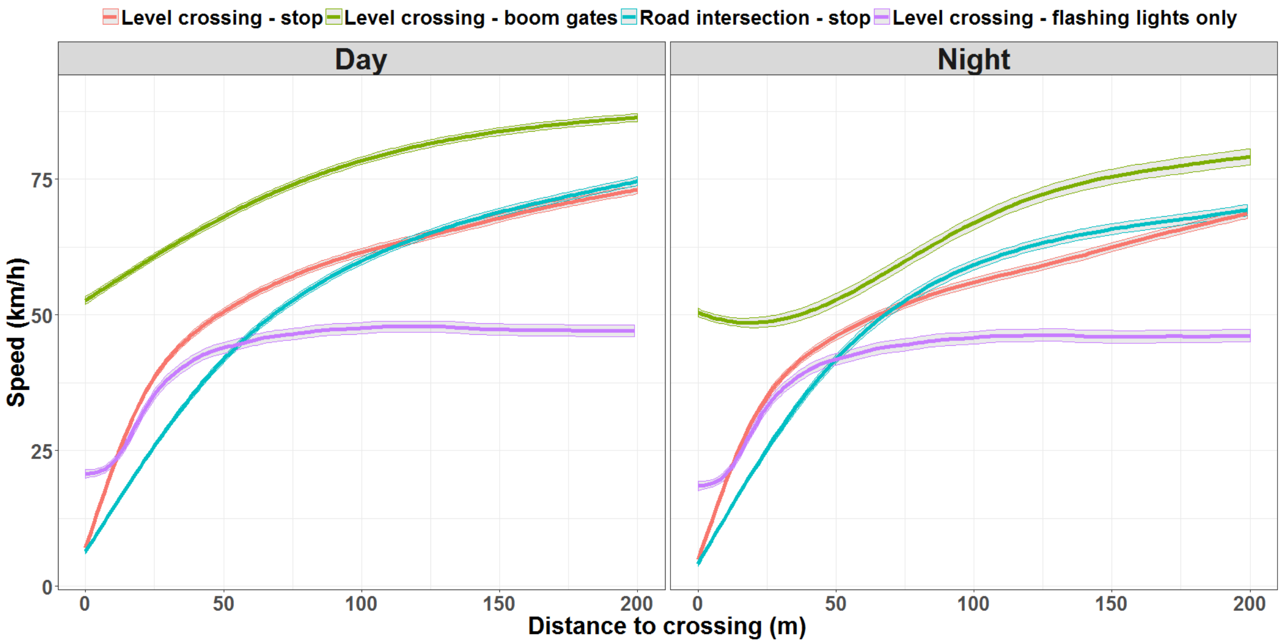

Figure 1. Mean approach speed of the different railway crossings and the road intersection (with standard error) during day and night-time driving

Conclusions

Drivers complied with the road rules, stopping for the passive crossing and the road intersection. However, drivers decelerated for level crossings late and abruptly when compared to the road intersection, sometimes at level crossings where they did not need to. They also spent less time assessing the situation when stopped at the crossing. Further, drivers did not appropriately adapt their driving behaviour to the reduced visibility conditions of night-time driving. This suggests that drivers may experience some difficulties in recognising the presence of the level crossing, or identifying the actions required for the type of level crossing they are approaching. These findings have implications for the development of effective road safety initiatives targeted at level crossings, and development of active advanced warnings could be considered for passive level crossings.

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Determining the Efficacy of Different Types of Bull Bars Fitted to Different Types of Light Vehicles

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Abstract

Under NSW regulations, bull bars must comply with AS 4876.1. The Standard provides illustrations of "acceptable" and "not acceptable" bull bars. Some bull bars, typically fitted to 4WDs in rural regions, resemble the "not acceptable" bull bars. The different bull bars became a matter of contention following a campaign targeting "non-complying" bull bars in 2014. To inform this matter, the Centre for Road Safety undertook research to compare the performance of different types of bull bars. This found that bull bars provide no additional occupant protection in a crash, but they may have some road safety and cost benefits.

Background

There are two general categories of bull bars: "Urban bull bars" resemble the "acceptable" examples given in AS 4876.1, a mandatory standard in NSW; while "rural bull bars", typically fitted to 4WDs in rural regions, resemble the "not acceptable" examples. Rural bull bar advocates claim that they provide better protection in an animal strike; while their detractors maintain that "urban bull bars" are just as effective, and that rural bull bars adversely affect the vehicle's crashworthiness.

The legality of rural bull bars became a matter of contention in 2014 when some vehicle owners received infringement notices for rural bull bars fitted to their vehicles. In response, the Centre for Road Safety undertook research at the RMS Crashlab facility to compare the performance of the different bull bars; and the effect a rural bull bar has on 4WDs' crashworthiness.

Method

These tests were the first of their kind, so there were no established standards to use. Test protocols were developed to replicate a large kangaroo impacting low and high points on a bull bar in a high-speed crash. A sedan and a 4WD, with and without bull bars, were crashed into a kangaroo crash-test dummy positioned at different heights above the testbed (see Figure 1). After each test, the vehicle was examined to determine the damage, if it was driveable and the cost of repairing it to a roadworthy condition.

Additionally, two 4WDs were subjected to the ANCAP frontal offset test, and the results compared to the ANCAP results.

Results

In a high speed crash with a kangaroo –

- vehicles fitted with bull bars provide no safety benefits to their occupants;
- bull bars can better protect a vehicle against damage; and
- rural bull bars provide better protection to 4WDs, but can increase the damage to sedans.

A rural bull bar does not affect the crashworthiness of a 4WD.

Discussion

Although bull bars provide no direct benefit to vehicle occupants in a high-speed crash with a kangaroo, there are some road safety benefits if a vehicle is fitted with a bull bar that reduces the damage to the vehicle so it remains driveable and its occupants are not stranded on high-speed country roads. The reduced damage also reduces the cost of repairing a vehicle to a roadworthy condition. 4WDs are able to accommodate heavier rural bull bars and they receive more protection from them than from urban bull bars. In contrast, the weight of the rural bull bars can exacerbate the damage to a sedan to the extent that the vehicle becomes undriveable.

Conclusions

The conclusions are:

- Bull bars provide no direct benefit to vehicle occupants in a high-speed crash with a kangaroo.
- A 4WD with any bull bar fitted and a sedan with an urban bull bar are more likely to remain driveable after such a crash.
- Rural bull bars are unsuitable for sedans.
- There may be some cost benefits in fitting an appropriate bull bar to a vehicle.
- Rural bull bars do not affect the crashworthiness of a 4WD.

Figure 1.1 Sedan with (L-R): no bull bar, low dummy; urban bull bar, low dummy; rural bull bar, high dummy

Figure 1.2 4WD with (L-R): no bull bar, high dummy; urban bull bar, high dummy; rural bull bar, low dummy

Figure 1. Test configurations for the first part of the research

Amending NSW Legislation to Prohibit the Use of Petrol-Powered Bicycles

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Abstract

Commonwealth legislation defines a power-assisted pedal cycle (PAPC) as either a bicycle fitted with a motor with a maximum 200W output; or a type of electric bicycle known as a "pedalec". PAPCs are deemed to be a form of bicycle, and are subject to the same rules and regulations. In NSW, bicycles fitted with petrol engines were formerly permitted to be used as PAPCs, despite concerns about their safety. Following the death of a boy in October 2013, the Centre for Road Safety carried out research on PAPCs that led to petrol-powered bicycles being banned from the NSW road network.

Background

Commonwealth legislaton defines a power-assisted pedal cycle (PAPC) as either a bicycle fitted with a motor with a maximum power output of 200 watts, or a type of eletrically powered bicycle known as a "pedalec". Across Australia, PAPCs that meet this definition are deemed to be a form of bicycle, and are covered by the same registration, licensing and usage regulations that apply to standard bicycles.

The definition does not specify the type of motor that can be used, and in NSW bicycles fitted with petrol engines were formerly permitted to be used as PAPCs, despite concerns about their high speeds and the associated road safety risk. These dangers were highlighted in October 2013 by the death of a boy riding a petrol-powered bicycle.

Petrol engines fitted to bicycles were controversial as they were capable of producing far more than 200W. Suppliers had to mechanically reduce their power output to meet the definition, but there was evidence that the restricting devices were frequently removed. Bicycles with unrestricted engines were also supplied to the market, ostensibly for "off-road" use. Difficulties in identifying the different engines meant NSW Police were reluctant to take enforcement action against petrol-powered bicycle riders.

Method

The Centre for Road Safety investigated the performance characteristics of petrol-powered bicycles, and compared them with a pedalec. Braking distances at maximum speed were assesed at the Roads and Maritime Services' Crashlab research facility, and their speeds and power outputs were determined using a dyonometer at a motorcycle test centre. The effectiveness of a typical device used to limit the power to 200W was also assessed.

Results

The results showed that:

- the limiting device used to reduce the power to 200W could be defeated using a Phillips-head screwdriver in less than five minutes, and the power output could be further increased by minor tweaks to the engine;

- petrol-powered bicycles could travel without any assistance from the rider at continuous speeds of 22km/h for a 200W limited engine and 43km/h for an unrestricted engine;
- the engine set-up required the use of a complex clutch mechanism to prevent the engine from stalling when braking; and
- bicycles with petrol engines fitted were typically cheap models, their brakes were not compatible with the speeds generated, and fitting the mechanism created a number of hazards from the exposed engine and moving parts.

Conclusions

Petrol-powered bicycles are not a bona fide PAPC as they require no input from the rider to travel at comparatively fast speeds, and are more likely to be ridden as a small motorcycle. NSW legislation was amended in October 2014 to prohibit their use on roads and road related areas. The report produced by the Centre for Road Safety was presented in the coronial hearing into the 2013 fatality. It transpired in that case that the chain had been removed from the bicycle turning it into a motorcycle, and the front brake had been disconnected to avoid the engine stalling. NSW Police welcomed the ban as it simpified on-road enforcement.

The Advanced Safe Truck Concept (ASTC) Project: Defining and Developing Future Concepts to Enhance Heavy Vehicle Safety

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Abstract

The need to address heavy vehicle safety, both in terms of reducing the number of crashes and the flow-on impacts on productivity, is acknowledged by the industry itself as well as the broader road safety community. Advances in technology now enable transport operators to strengthen their ability to measure and monitor in-cab driver performance in real-time as a way of complementing existing company safety policies and further ensuring they meet OHS requirements. This paper outlines a new Commonwealth-funded program, the Advanced Safe Truck Concept project, led by Seeing Machines in collaboration with Monash University Accident Research Centre, Ron Finemore Transport, and Volvo Trucks Australia. This program is aimed at better understanding the real-world risks faced by trucking operations and their drivers, and the research undertaken to generate new technological solutions.

Background

According to BITRE, 2462 Australians were killed as a result of involvement in a heavy vehicle crashes between 2005-2014, representing 17.5% of deaths on Australian roads. The need to eliminate these crashes and flow-on negative impacts to productivity is obvious. Any improvement in driver safety will also likely deliver other productivity gains to businesses and the sector more broadly. As driver fatigue and distraction are known problems, these represent key target areas to address.

Recent advances in technology afford new opportunities for companies to strengthen their ability to measure and monitor in-cab driver performance in real-time as a way of complementing existing company safety policies. The National Transport Commission (NTC), along with state and national road safety strategies recognise these as priority issues. Funded under the Cooperative Research Centre Projects (CRC-P) scheme, the Advanced Safe Truck Concept (ASTC) project brings together techology, research and operational expertise to develop an innovative driver state sensing concept for use in commercial vehicles. This paper outlines the purpose of the ASTC and how the project will ultimately be used to improve commercial transport operations.

Method

This three-year project has three elements. First, and the focus of this paper, an engineering plan was developed that defined the driver sensing technology and platforms that would be used to generate the novel data. This plan was informed by the research literature, available human sensing technologies, and expert and practical input from the project's industry partner, Ron Finemore Transport (RFT). Second, driving simulator studies will examine the impact of drowsiness and distraction using the newly developed technology platform. Third, driver performance will be examined through in-cab obervation of drivers in up to 10 RFT trucks over a 6 month period. Finally, this knowledge will collectively be used to define a safety concept that aims to enhance the operational performance of commercial vehicle drivers.

Results

Assessments of the literature confirmed that driver drowsiness, distraction and workload correlated with poorer safety outcomes. Moreover, industry professionals highighted the risks these driver states present in the commercial vehicle sector. This knowledge informed the development of an engineering plan which defined a range of sensing needs. This included Seeing Machines' core driver monitoring technology, which records metrics related to driver head and eyelid position, gaze direction and fixation points (where they are looking). In combination, forward roadway facing cameras, along with wearable technologies for health and sleep state monitoring will bring new insights to driver performance. Having developed this sensing platform, driver performance will next be assessed in the the MUARC car and new truck simulator developed for this program. The same sensing platform is to be used in RFT trucks to collect naturalistic data. Details of the sensing platforms and early testing will be presented.

Conclusion

The advanced sensing platform has been developed and implemented and is now generating novel data on driver state and operational performance in real-time. This information is fundamental to achieving the goal of this project, this being the production of an advanced driver state sensing technology concept aimed at improving driver safety and commercial vehicle operations.

Insights into Evaluating Road Safety Advertising Based upon the Step Approach to Message Design and Testing (SatMDT)

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Abstract

This conceptual paper aims to provide an important methodological contribution in regards to evaluating the effectiveness, or persuasiveness, of road safety advertising messages. The methods and measures identified are offered in accordance with recommendations posited within Lewis, Watson, and White's (2016) social-psychological framework of persuasion, the Step approach to Message Design and Evaluation (SatMDT). Insights are offered into how greater confidence may be placed upon conclusions drawn regarding the effectiveness of messages when an array of outcome measures is implemented. These measures must assess both message acceptance and rejection and acceptance should be assessed using both direct and indirect measures.

Background

Mass media advertising is a key component of the road safety countermeasures that Australian governments invest in annually. Meta-analytical evidence has identified that theory plays a crucial role in message development and evaluation (Elliott, 1993). Theory aids evaluation because it facilitates the clear identification, and subsequent testing, of key constructs (Elliott, 1993). Somewhat recently, however, there have been calls for more frequent, formal and thorough evaluations of road safety advertising (Hoekstra & Wegman, 2011). The paper will discuss how the Step approach to Message Design and Testing (SatMDT) framework may assist when evaluating road safety advertising.

The theoretical framework: Step approach to Message Design and Testing (SatMDT)

The SatMDT consolidates the substantial evidence base regarding the design and evluation of road safety messages (see Lewis et al., 2016). The framework is informed by social psychological theories of decision making, attitude-behaviour relations, and persuasion including the Theory of Planned Behaviour (Ajzen, 1991), the Extended Parallel Process Model (Witte, 1992), the Elaboration Likelihood Model (Petty & Cacioppo, 1986), and Social Learning Theory (Bandura, 1969). As Figure 1 shows, the SatMDT provides guidance via a four step-based process. The framework also includes method-related aspects as intervening steps. It is Step 4 "Message outcomes" and evalution which is the focus of this paper.

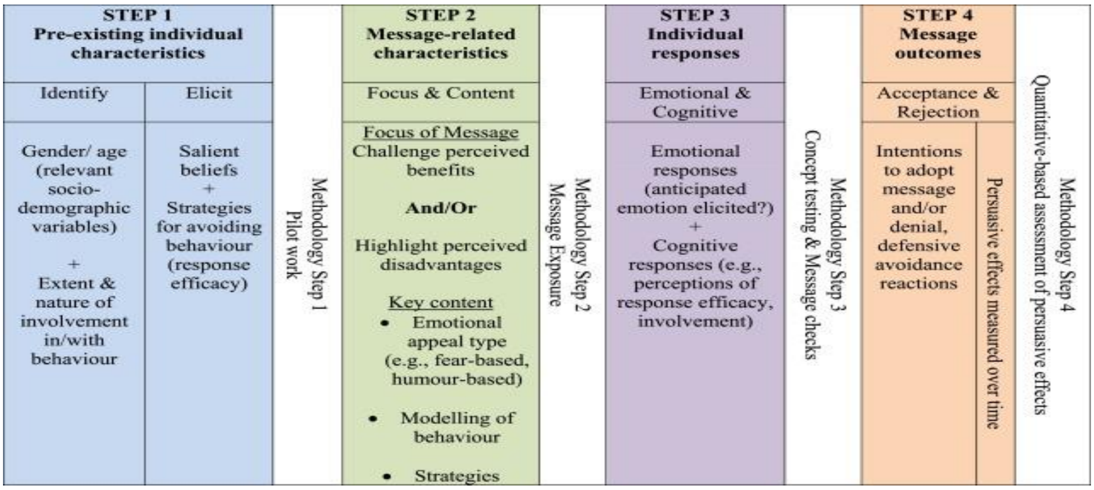

Figure 1. The Step approach to Message Design and Testing ([SatMDT]; Lewis et al., 2016)

Methods and measures

In accordance with the SatMDT (Lewis et al., 2016), message outcomes should be evaluated via quantitative methods involving large(r) samples which comprise members of the intended target audience. Non-intended audience members may also be included for comparative purposes. Large-scale self-report online surveys represent a cost-effective and efficient method within which messages may be embedded and individuals' responses subsequently sought both immediately after exposure and at a follow-up period so as to assess persuasive effects over time.

Underpinning the SatMDT's approach to evaluation is the premise that greater confidence may be gained from the use of a number of different outcome measures. For instance, evidence supports the need for measures of effectiveness to be assessed in terms of both the extent to which individuals accept as well as the extent to which they reject a message. Relative to message acceptance, however, message rejection is seldom assessed (Lewis, Watson, & White, 2010).

In addition, both direct as well as a range of indirect measures of effectiveness should feature. Direct measures enquire directly about the perceived persuasiveness of a message. In contrast, indirect measures may include items assessing individuals' broader attitudes, intentions, and/or behaviours in regards to the particular behaviour in a road safety message (e.g., speeding). Indirect measures, because they are not tied specifically with reference to a message, may also be assessed within individuals not exposed to a message (i.e., control group).

Concluding comments

This paper will demonstrate the value of applying the SatMDT to evaluate road safety advertising. With the aid of concrete examples of measures used in previous evaluations, this paper will demonstrate how comprehensive insights of message persuasiveness can be gained.

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The Association between Psychological Distress and Alcohol Consumption Behaviour in Risky Driving

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Abstract

The present research explores how mental health related factors such as psychological distress and alcohol consumption patterns predict risky driving behaviour, as measured by the Driver Behaviour Questionnaire (DBQ). Questionnaire data from 1,365 drivers who took part in a case-control study were used. Psychological distress was seen to be predictive of errors, lapses, violations and aggressive violations, whilst alcohol consumption was associated with violations and aggressive violations only. These findings demonstrate the significant contribution of mental health in risky driving behaviour.

Background

Risky driving behaviour is a well-established contributor to crashes on Australian roads. However, limited understanding exists on how complex factors such as mental health might influence dangerous or illegal driving behaviours. A small number of studies have begun to address this gap, although these studies largely focused on young novice drivers (McDonald, Sommers, & Fargo, 2014; Scott-Parker, Watson, King, & Hyde, 2011). Hence, this research aimed to explore the influence of psychological distress and alcohol consumption patterns on risky driving behaviours, as defined by four facets of the DBQ: *errors*, *lapses*, *violations* and *aggressive violations*, using a range of drivers with varied driving experience.

Method

Data presented are part of the Enhanced Crash Investigation Study (ECIS), which focused on the causes and consequences of serious injury crashes in Victoria. Refer to Fitzharris et al. (2015; 2016) and Stephens et al. (2016) for project and study methods. The data reported in this paper relates to the ECIS control arm. Participants were drivers who safely passed through a known crash location, had their speed covertly recorded, and later completed a questionnaire, which included information related to their driving, mental health and alcohol consumption patterns.

Results

Demographics

Of the 1,365 drivers (*m*=48.32 years, *SD*=15.66 years), 694 were male (*m*=49.76 years, *SD*=16.16 years; 50.8%) and 671 were female (*m*=46.83 years, *SD*=14.99 years; 49.2%). Licence status was as follows: 92 (6.74%) held a restricted car licence, 944 (69.16%) held an unrestricted (full) car licence, 94 (6.89%) held an unrestricted (full) car licence plus motorcycle licence, 161 (11.79%) held a commercial vehicle licence, and 74 (5.42%) held a commercial vehicle plus motorcycle licence.

Psychological Distress and Alcohol Consumption

Psychological distress was measured using the Kessler Psychological Distress Scale (K10) (Kessler et al., 2002). The mean K10 score was 14.30 (*SD*=4.73), with 88.72% falling within the normal range and 11.28% indicating elevated levels of psychological distress: 95 (7%) reported low levels, 30 (2.20%) reported moderate levels, and 29 (2.12%) indicated severe levels of distress.

Alcohol consumption patterns were measured using the Alcohol Use Disorders Identification Tool (AUDIT) (Babor, Higgins-Biddle, Saunders, & Monteiro, 2001). The mean AUDIT score reported was 3.92 (*SD*=3.80). Most participants (1183, 86.67%) were classified as low-risk, while 154 (11.28%), 20 (1.47%) and 8 (0.59%) indicated risky / hazardous, harmful and high-risk levels of drinking, respectively.

Risky Driving Behaviour

Risky driving behaviour was examined using four facets of the 28-item DBQ (Stephens & Fitzharris, 2016). The mean total scores for errors, lapses, violations and aggressive violations were 13.68 (*SD*=2.96), 9.41 (*SD*=2.66), 12.17 (*SD*=3.68) and 4.61 (*SD*=1.71), respectively.

Regression Modelling

Four stepwise regression models were built to examine how gender, age, licence class, psychological distress and alcohol consumption predicted different risky driving behaviours. Psychological distress was predictive of all four risky driving behaviour facets, whilst alcohol consumption level was associated with only violations and aggressive violations (Table 1).

Table 1. Regression models predicting DBQ facet total scores for errors, lapses, violations and aggressive violations

Predictors	***b***	**95% CI**	**Adjusted R^2**	**$\triangle R^2$**
Model 1: DBQ - Errors				
Block 1				
Gender				
Male	Reference			
Female	-0.12	-0.43, 0.20		
Age	-0.04***	-0.05, -0.03	0.03	0.04***
Block 2				
Licence class				
Restricted	Reference			
Unrestricted (full) car	-0.76*	-1.42, -0.10		
Unrestricted (full) car and motorbike	-0.91*	-1.77, -0.05		
Commercial vehicle licence	-0.50	-1.30, 0.30		
Commercial vehicle and motorbike	-1.19	-2.12, -0.26	0.04	0.01
Block 3				
K10 total score	0.14***	0.11, 0.17		
AUDIT total score	0.02	-0.02, 0.06	0.09	0.05***

/ Table 1 (continued)

Model 2: DBQ - Lapses				
Block 1				
Gender				
Male	Reference			
Female	0.79***	0.52, 1.07		
Age	-0.03***	-0.04, -0.02	0.05	0.06***
Block 2				
Licence class				
Restricted	Reference			
Unrestricted (full) car	-0.10	-0.70, 0.49		
Unrestricted (full) car and motorbike	0.04	-0.73, 0.80		
Commercial vehicle licence	-0.03	-0.74, 0.68		
Commercial vehicle and motorbike	-0.47	-1.30, 0.36	0.05	0.00
Block 3				
K10 total score	0.12***	0.09, 0.15		
AUDIT total score	0.03	-0.01, 0.07	0.10	0.05***
Model 3: DBQ - Violations				
Block 1				
Gender				
Male	Reference			
Female	-1.02***	-1.39, -0.65		
Age	-0.08***	-0.09, -0.07	0.12	0.12***
Block 2				
Licence class				
Restricted	Reference			
Unrestricted (full) car	0.07	-0.72, 0.86		
Unrestricted (full) car and motorbike	0.64	-0.38, 1.66		
Commercial vehicle licence	0.04	-0.91, 0.99		
Commercial vehicle and motorbike	-0.62	-1.73, 0.49	0.12	0.01
Block 3				
K10 total scores	0.11***	0.07, 0.15		
AUDIT total score	0.19***	0.14, 0.24	0.18	0.06***
Model 4: Aggressive Violations				
Block 1				
Gender				
Male	Reference			
Female	-0.36***	-0.53, -0.18		
Age	-0.02***	-0.03, -0.02	0.05	0.50***
Block 2				
Licence class				
Restricted	Reference			
Unrestricted (full) car	0.65***	0.27, 1.03		
Unrestricted (full) car and motorbike	0.47	-0.02, 0.96		
Commercial vehicle licence	0.61**	0.15, 1.06		
Commercial vehicle and motorbike	0.13	-0.41, 0.66	0.06	0.01**
Block 3				
K10 total score	0.06***	0.05, 0.08		
AUDIT total score	0.04**	0.01, 0.06	0.10	0.04***

DV = DBQ facet total scores: Model 1- Errors; Model 2 – Lapses; Model 3 – Violations; Model 4 - Aggressive Violations.

IV = Gender; Age; Licence Class; K10 total score (Kessler Psychological Distress Scale); AUDIT total score (Alcohol Use Disorders Identification Tool);

Significance level: *$p \leq .05$; **$p \leq .01$; ***$p \leq .001$

Conclusions

Findings from this study demonstrate the significant influence that mental health has on risky driving behaviour, irrespective of age, gender or driving experience. Implications will be discussed.

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Development of a Device Suitable for Naturalistic Studies of Passing Distances Between Cyclists and Vehicles

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Abstract

The Centre for Automotive Safety Research has designed a device intended for use in naturalistic studies of passing distances between cyclists and vehicles. Ten of these devices were built and deployed in a small trial to evaluate their effectiveness. This paper describes the device and its data collecting capabilities along with its performance during the trial. Performance was based on analysing objective data collected from the device as well as survey responses from the participants. Potential improvements to the design of the device and its implementation in naturalistic studies are suggested. Examples of the collected data are used to give an indication of the types of analysis that may be possible in a larger study.

Background

A commonly proposed solution to crashes between bicycles and vehicles is the implementation of a one metre passing law, which requires drivers to provide at least one metre of lateral distance between their vehicle and the cyclist's handlebars. However, it is not yet clear how a one metre passing law effects cyclist safety. Haworth & Schramm (2014) noted that there is limited knowledge regarding what affects the lateral distance at which a driver chooses to pass a cyclist and what effect the introduction of a one metre passing laws may have on this distance.

Several previous studies have investigated the distance at which bicycles are passed by vehicles (Walker, 2007; Parkin & Meyers, 2010; Love et al., 2012; Savolainen, Gates, Todd, Datta, & Morena, 2012; Chapman & Noyce, 2012; Chuang, Hsu, Lai, Doong, & Jeng, 2013; Walker, Gerrard, & Jowitt, 2014; Kay, Savolainen, Gates, & Datta, 2014). These studies have investigated how passing distance is altered by various factors. However, many of these studies utilised an instrumented bicycle that was ridden by only one (Walker, 2007; Chapman & Noyce, 2012; Walker et al., 2014) or just a few cyclists (Parkin & Meyers, 2010; Love et al., 2012; Chuang et al., 2013). Additionally, some studies restricted data collection to a specific set of streets or travel routes where cycling infrastructure details were collected beforehand (Parkin & Meyers, 2010; Love et al., 2012; Chapman & Noyce, 2012; Chuang et al., 2013; Walker et al., 2014).

Because of these limitations, the results of such studies cannot claim to be representative of the average riding experience or be used to make generalised predictions about passing events and crash risk. Naturalistic studies of vehicle-bicycle passing distances, in which cyclists ride their own bicycles and select their own routes, would provide results that were free from the bias of earlier studies and provide mass data for improved statistical analysis.

Device description

The Centre for Automotive Safety Research (CASR) has designed and built a cyclist passing device that is relatively small, lightweight and able to be easily attached to almost any bicycle (see Figure 1). The device is intended to be used in naturalistic studies where a cyclist rides their own bicycle and travels their usual routes.

The device is comprised of the following parts:

- Two ultrasonic sensors mounted at the front and rear (measures lateral distance to closest object)
- GPS sensor (measures cyclist location and speed)
- Microcontroller with data logger (records GPS and ultrasonic data to memory card)
- Battery

Figure 1. Passing device (circled in red) attached to a bicycle

Trial description

A small trial of the device was instigated to evaluate its suitability for naturalistic studies, assess how user friendly it is for volunteer cyclists, and determine what the full data collection capabilities may be.

Ten devices were built and attached to the private bicycles of volunteer cyclists for a period of two weeks. A survey of the volunteer cyclists was administered before and after the trial to assess their attitudes to one metre passing laws and gauge their acceptance of the device.

Discussion

Based on the data collected during the trial and the survey responses of the participants, several potential improvements to the design of the device and its implementation in naturalistic studies are suggested. Examples of the collected data indicate the device is likely to be a useful research tool in larger studies of passing distances between bicycles and vehicles.

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Street Wise – Helping Protect Children on their Commutes to School

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Abstract

This abstract explores the impact of introducing comprehensive motorcycle and pedestrian safety programming in a region affected by industrial activities. The program has focused efforts in Songkhla Province, an area hosting substantial oil and gas operations. With support from Chevron Corporation, AIP Foundation developed and implemented Street Wise, a program that introduced a multi-faceted, grassroots campaign to provide road safety education, mobilize community participation in road safety activities, and raise awareness about key road risks and methods for staying safe. The combined efforts have resulted in improved road safety behaviors and knowledge across various indicators.

Background

Thailand has the second highest road crash fatality rate in the world, with more than 36 deaths per 100,000 people (World Health Organization, 2015). Road crash injuries are the number one cause of injury-related mortality for those 10 years and older, and are the second leading cause of injury-related death for children younger than 10 (Ministry of Public Health of Thailand, 2014). An estimated 1.3 million children across Thailand ride on motorcycles regularly, but only 7 percent wear helmets, contributing to the 2,600 children killed and 72,000 injured every year in crashes (New York Magazine, 2016.).

In 2014, AIP Foundation introduced *Street Wise,* a program supported by Chevron Corporation that provided road safety education and awareness raising activities to communities in Songkhla Province, a region hosting oil and gas activities. A baseline assessment found that only 3% of children in Shinghanakorn District, Songkhla Province, wore helmets and nearly one-quarter (23%) of students had experienced a road crash in the past six months. Of these road crash victims, most were traveling by motorcycle at the time of the crash (44%), followed by pedestrian (39%) and bicycle (17%) travel. Nearly two-thirds (63%) were injured, and one in four crashes (26%) resulted in hospital visits (Rapid Asia, 2014).

Based on these findings, *Street Wise* developed a plan to address road safety through education, awareness building, and community engagement. Over two years, the program provided 14 road safety master training courses to teachers, educational staff, and police officers to build their capacities. Additionally, *Street Wise* hosted 28 extracurricular activities, ceremonies, meetings, and workshops that reinforced safety messages and engaged parents, and community stakeholders.

Methodology

The program's effectiveness was measured through a mixed-method study comprised of helmet observations using an innovative filming methodology developed with support from the U.S. Centers for Disease Control and Prevention, as well as in-depth interviews, focus groups, and student knowledge surveys. Students from six schools in grades two and four were surveyed.

Table 1. Number of students observed in this study

	Baseline (December 2014)	Mid-line (October 2015)	End-line (October 2016)
# Students Observed	517	238	394
# Students Surveyed	203	672	828

Results

Observed student helmet use increased from 3% at baseline to 38% at end-line. Observed crossing behaviors improved as well, with student crosswalk usage increasing from 29% to 91%, and the percentage of students crossing without running increased from 47% to 86%. This corresponded with a 23-percentage point increase in correct student knowledge of proper crossing behaviors. However, the percentage of children surveyed that knew the ability to see a driver does not guarantee the driver can see the pedestrian only increased from 8% to 13%. The percentage of students who knew one should cross at a corner in the absence of a crosswalk decreased from 48% to 34%.

Conclusions

Based on measured outcomes, the *Street Wise* interventions have contributed to improved safety knowledge and practices among students. Students have stronger knowledge of how to cross roads safely, are more likely to wear helmets as passengers, and are more likely to use pedestrian crossings. However, helmet use among students is still low. Future interventions may be needed to reinforce child helmet wearing awareness and practices.

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Love Your Child – Provide a Helmet: Vietnam Takes Action to Protect Children on Motorbikes

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Abstract

This abstract examines the implementation of the National Child Helmet Action Plan (NCHAP) and explores the effect it has had on promoting child helmet use in Vietnam since its launch in January 2015. Key activities of the NCHAP include public awareness-raising and mass media communications on child helmet use, school-based education, and increased police enforcement on a national scale to crack down on violations of the child helmet regulation. The plan is supported by many organizations, including AIP Foundation, Global Road Safety Partnership, FIA Foundation, World Health Organization, The United Nations Children's Fund (UNICEF), and The UPS Foundation. (98 words)

Background

In Vietnam, road crashes kill an estimated 22,000 people each year and injure over 400,000 more (WHO, 2015). Motorcycles are the primary mode of transport; in 2016, there were approximately 93 million people in Vietnam and over 47 million motorbikes (Vietnam NTSC, 2016). Nearly 60% of road deaths in Vietnam involve a motorcyclist, with almost 80% of these deaths attributed to head injuries (Hoa NP, et al., 2012). Children are particularly vulnerable: most do not wear helmets, and annually, around 2,000 children die in road crashes (Vietnam Traffic Police, 2016)

Wearing a helmet reduces the risk of death by 42% and injury by 69% in the event of a crash (Lui BC, et al., 2008). Motorcycle helmet use has been compulsory in Vietnam for adults since 2007 and children since 2010. However, the law has not been policed effectively and child helmet use remains significantly lower than that of adults (WHO, 2009; Nguyen HT, et al., 2012; Nguyen PN, et.al., 2013).

The Vietnamese Government launched NCHAP in 2015 to raise awareness about the child helmet law, shift attitudes towards child helmet use, and increase compliance with the regulation. NCHAP activities include public awareness campaigns, enhanced enforcement, and the approval and implementation of school guidelines for child helmet use (Vietnam NTSC, 2015).

Method

Evaluations of NCHAP were organized in Hanoi, Danang, and Ho Chi Minh City. Filmed helmet observations were conducted at 100 schools. Pre-implementation observations were conducted in March 2014 (31,677 students). Subsequent observations were conducted in April 2015 (30,750 students), December 2015 (38,225 students), and May 2016 (24,123 students). Two cross-sectional evaluation surveys were conducted in November 2015 and May 2016 with nine hundred parents from 45 schools to measure the effectiveness of NCHAP's communication activites, which disseminated the key message, “Love your child, provide a helmet.”

Results

Prior to implementation of NCHAP, 36.1% of students were observed wearing helmets. The first post-implementation observation was conducted in April 2015, one week after an increased police enforcement effort, and showed that the child helmet wearing rate had nearly doubled (69.3%). The helmet wearing rate fell to 49.8% by December 2015 and slightly increased to 51.3% by May 2016.

Based on a cross-sectional evaluation survey of communication activities, 95% of parents reported awareness of the child helmet law, 82% had heard the key NCHAP message, and 97% believed that helmets protect children on the roads. However, only 70% of parents knew the minimum required age for child helmet use and only 45% of parents always put a helmet on their child. For those whose children did not wear a helmet, parents reported forgetting to check to make sure their child did so.

Conclusions

A preliminary evaluation of NCHAP indicates that it contributed to increased awareness of child helmet use. After implementation of NCHAP, children are more likely to wear helmets; however, the helmet use rate remains low. The first post initiative measurement recorded the highest child helmet use rate at 69.3%. This suggests that increased enforcement is required for sustained, increased child helmet usage. (500 words)

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Survey Evaluation of Victoria's Graduated Licensing System: Young Driver Behaviour and Experiences of the Graduated Licensing System

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Abstract

As a part of the evaluation of the Graduated Licensing System (GLS) introduced in Victoria across 2007 and 2008, two survey projects (cohort and cross-sectional) were undertaken. Participants licensed before and after the enhanced GLS were recruited from the VicRoads' licensing database. Over 9,000 young drivers were surveyed. Results included getting the licence, risky driving and compliance with licence conditions. Consistent with the GLS measures, results showed improved learner driver practice hours, a more challenging on-road driving test, a lower level of young driver exposure to some high risk driving situations and fewer drink-drivers, post GLS compared with pre-GLS.

Background

To address over-representation of Victorian young drivers in road trauma, an enhanced GLS was introduced across 2007-2008. Some GLS measures targeting those aged under 21 at licensing included:

- a minimum 120 hours supervised driving practice as a learner
- a restriction on travel with peer passengers and hands-free mobile phone use (first year drivers)
- extending the probationary period from three to four years.

In addition, all drivers sit a new on-road driving test, must maintain a clean driving record to graduate through the licensing system and are subject to tougher drink-driving sanctions.

Method

Two survey projects were undertaken. Participants were recruited from the VicRoads' licensing database. The cohort study followed groups licensed before and after the introduction of the GLS, surveying each four times (first survey total 2,332). The cross-sectional study took four separate samples of drivers licensed before and after the GLS (total 7010).

Topics covered in the questionnaires included:

- getting driving practice
- drive test and hazard perception test
- risky driving
- compliance with licence conditions
- self-assessed driving skill
- attitudes about the GLS
- vehicle purchase.

Results

Data were analysed using Generalised Linear Modelling or chi-squared tests. To address longitudinal changes within the cohorts, a repeated measures component was used. Results from both studies were reasonably consistent. Some of the main findings are outlined here.

Getting the licence

Results showed:

- hours of practice were significantly higher post GLS than pre-GLS (up 28-30%)
- significantly more drivers experienced no barriers to getting practice post GLS than pre-GLS (cross-section: 40% pre vs 30% post; cohort: 40% pre vs 31% post)
- the new Drive Test had a significantly lower pass rate than the previous test (81-82% pre vs 70-72% post).

P1 licence

Compared with the pre-GLS groups, post-GLS young drivers in their first year (P1) drove significantly fewer trips with two or more peer passengers (cross-section: 13.2% pre vs 3.5% post; cohort: 13.0% pre vs 4.5% post).

The cross-section study examined experiences of the passenger restriction:

- 93% P1 drivers were aware it applied to them
- two-thirds of P1 drivers reported it affected their travel plans at least once per fortnight
- 63.4% of P1 drivers never violated the restriction and 19% violated it once a month or less often
- 4% of P1 drivers had in the last 6 months been caught violating the restriction.

Risky Driving

The cross-section study showed significantly fewer 1st-3rd year drivers had 'driven after drinking when shouldn't have' in the last ten trips (7.5% pre v 5.3% post). Other risky driving measures showed no consistent differences pre versus post-GLS.

Conclusions

The enhanced GLS has resulted in increased learner drivers' practice hours. The new driving test is more challenging than the previous. Consistent with the GLS measures, the exposure of young drivers to some high risk driving situations was lower post-GLS than before. Most young drivers complied with the new measures. The survey research complements other evaluations of Victoria's GLS (Meyer et al., 2015; VicRoads, 2012).

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Hacking Safety: Providing Security for Connected Vehicles in Australia

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Abstract

Connected vehicles are being deployed to make our roads safer and smarter. The benefits of this technology are widely discussed; less so the risks. These risks are familiar to the ICT/cybersecurity sphere; but they are safety threats for the connected transport network. A Cooperative Credential Management System provides security for the 'internet of cars' and is being deployed in the US and Europe. Australia has co-led CCMS development, and is proposing to implement its own CCMS. Combining Australian and international perspectives, this paper provides an update on this work, and gives insights into new methods of safety and security management.

Background.

Connected and automated vehicles (vehicle-to-vehicle [V2V], vehicle-to-infrastructure [V2I] and vehicle-to-elsewhere [V2X]) will see the progressive introduction of connected systems that will change the way transport networks function and how they are managed. Widespread adoption will progressively link vehicles and infrastructure to build real-time situational awareness, increasing the safety and productivity of the transport network. These technologies are a critical part of the disruptive transformation occurring to our vehicles, roads and cities – including automated vehicles, smart cities and smart infrastructure, and the Internet of Things.

Providing security for this new environment has emerged as one of the key deployment challenges (and it will be a permanently ongoing challenge). The paradox is that by introducing technologies intended to boost safety, we introduce an entirely new set of safety threats and challenges. This is not simply because these are new types of technologies – many are commonplace in other spheres of our lives. But this type of technology – and the scale of its proposed deployment – is new for the automotive industry, and will be new for drivers, road managers, and all transportation users. As the barriers between being on the road and being 'online' become indistinct, it is becoming apparent that *(physical) safety and (digital) security are one and the same*.

Moreover, the safety benefits of cooperative vehicle technology can only be realised with substantial user uptake, and this uptake will be driven by non-safety 'pull factors' (such as infotainment, mobility etc.) that do not prioritise so much as assume that safety and security risks have been managed (by industry and by government) – not to mention secure communications and interoperability requirements. For these reasons, a commercially sustainable global market for connected vehicles will not be possible without security, and neither will safety nor true connectivity.

Cooperative Credential Management System (CCMS)

While not the only solution to these challenges, a cryptosystem system that enrols new vehicles into the connected environment, and provides lifecycle security services through the creation, management, distribution and revocation of digital certificates ('electronic passports') for vehicles has been internationally co-developed by technical and policy experts across the United States, Europe and Australia (the lead agencies are United States Department of Transportation, the European Commission and Transport Certfication Australia, respectively).

The system, called a Cooperative/Security Credential Management System (CCMS/SCMS), builds on widespread implementations and experiences with Public Key Infrastructure (PKI) (frameworks that consist of cryptographic technologies, standards, organisational and policy controls and procedures to provide security for exchanges of data e.g. in e-commerce) and adds some entirely novel concepts and functions that are designed to provide security infrastructure and services for what can be rightly described as the 'internet of cars.'

Australia has been a key player in developing the CCMS (which is currently being deployed in the United States and across Europe) and is now proposing to implement a CCMS of its own. The design, implementation and operation of a CCMS in Australia will require new and existing parties across government and industry to rethink the nature of their role in providing safety for end-users. This paper lays out the safety challenges posed by connected vehicle technology, those involved in effectively overhauling what safety means for the sector, and highlights how safety and security can be achieved through the provision of such a distributed cryptosystem whose design and deployment is imminent in Australia.

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The ESRA Approach towards a Joint Monitoring System on Road Users' Attitudes and Behaviour – Australian Results

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Abstract

The ESRA project (E-Survey of Road user' Attitudes) is a joint initiative of research organizations and road safety institutes from 25 countries (four continents). The project aims at collecting comparable (inter)national data on road users' opinions, attitudes and behaviour with respect to road safety risks. The overall aim is to provide a solid contribution to a joint monitoring system on road safety attitudes and behaviour for policy measures. The next edition of this survey will be launched in 2018. The presentation will highlight the Australian results in comparison to the results of countries from Europe, North America and Asia.

Background

ESRA, an acronym for "E-Survey of Road users' Attitudes", is a joint initiative of research institutes, road safety organizations and authorities to establish comparable and reliable road safety performance indicators based on opinions and self-declared behaviour of road users. The ESRA network already includes 25 countries from four continents, in which the first ESRA survey was conducted in 2015/2016. The ESRA network is expected to grow substantially by 2018, when the second ESRA survey will be launched.

Method

The first ESRA survey was conducted online using representative samples (N=1,000) of the national adult populations. A common questionnaire was developed in 30 different country-language versions. The subjects covered in the survey are, amongst others: 'attitudes towards unsafe traffic behaviour', 'self-reported behaviour in traffic', and 'support for road safety policy measures'. The field work was carried out in two waves: (1) June 2015 (17 European countries), and (2) November 2016 (eight additional countries). In total, the first ESRA survey covers almost 27,000 respondents from 25 countries across four continents, including 21,397 respondents from 20 European countries and 1,002 respondents from Australia.

Results

The results of the first ESRA survey (2015/2016) show that in all participating countries driving too fast is the most frequently reported unsafe traffic behaviour, followed by mobile phone use while driving and driving under the influence of alcohol, medication and drugs. Comparing the Australian results (N=1,002) with the European means (N=21,397; 20 countries), differences with respect to self-reported behaviour and enforcement are striking (BRSI, 2016). Australians report e.g. less speeding offences for all road types, less talking on a hand-held mobile phone while driving, less cycling without a helmet, and more seat belt use in the back of the car. On the other hand, Australians report more often cycling on the road next to the cycle lane and cycle while listening to music through a headphone. The largest difference between Australia and the European countries was observed for reported alcohol checks. In Australia, 50% of the respondents report having been checked for alcohol in the last 12 months, in Europe this was only 19%. For drugs, the difference was smaller: Australian mean 14%, European mean 4%. Interestingly the perceived likelihood of getting checked by the police concerning all investigated traffic offences is higher in Australia than in Europe.

Figure 1. Comparison of self-reported (un)safe traffic behaviour: Australian mean (green) and European mean (white; 20 countries)

Conclusions

The ESRA project has shown the feasibility and the added value of joint data collection by a network of road safety organizations. The intention is to extend the ESRA survey to an increasing number of countries and to repeat it every three years. The next edition (ESRA2) will be launched in 2018. More information can be found on: www.esranet.eu.

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Electronic Distracted Driving Solutions in the Real World

Steve Metlitzky

TextStopper Pty LTd

Abstract

Having now spent over two years deploying electronic distracted driving solutions to a number of families and Fleets in Australia and beyond, there has been a lot of learning in terms of what has worked and what hasn't. The human factors and challenges in deploying solutions, both engaging and those experienced by management, fleet OH&S and end users in these organisations. There is good anecdotal evidence in terms of the influence and change affected by these systems and we will present case studies along with supporting data to show changes over time with reference to actual Fleet experiences in Australia.

Background

Having spent over two years deploying electronic distracted driving solutions to a number of families and large Fleets in Australia and beyond, there has been a lot of learning in terms of what has worked and what hasn’t. The human factors and challenges in deploying solutions, both engaging and then those experienced by the management, fleet OH&S and end users in these organisations. There is good anecdotal evidence in terms of the influence and change affected by these systems and we will present case studies along with supporting data to show changes over time with reference to actual Fleet experiences in Australia.

Steve Metlitzky, as CEO of TextStopper and his team have evaluated and then deployed selevral electronic distracted driving solutions in Australia. We also have several excellent case studies from the parent company in the USA, having deployed to large organisations including Walmart etc. If inappropriate, we are happy not to mention our product name.

Our focus is to provide real-world experience in terms of how these solutions can make a difference, what was being experienced inside these Fleets prior to installation of a solution, the human challenges involved and experienced by various groups, from the fleet managers, through the safety teams, management teams and then the end users themselves. We will explore and discuss the ‘political correctness’ challenges that affect management in pursuing deployment of a solution and how ‘buy-in’ and getting end users to participate and support the change was critical and methods used. Often users have both work and personal phones and how do organisations manage this aspect? We will also discuss a range of solutions considered and their relative effectiveness or lack thereof.

Results

We will explore and explain, with supporting data, the evolution of selected fleets in terms of initial behavior, transitional behavior and then current behavior and the affects we believe this is having on removing a significant number of distractions. Our case studies, including some from the USA that have been running for many years at large organisations, will also provide more tangible end results in terms of actual reduction of accident rates and resultant reduction in insurance claims, providing a financial benefit over and above the human safety benefit.

Conclusions

The link between distracted driving and road safety is no longer a tenuous one, it is apparent to anyone and everyone in road safety that we are seeing a significant and increasing impact that driver distraction is having on road injuries and death. The effects, human and financial are tangible and visible. Driver education and enforcement, although crucial, miss the opportunity to directly impact and affect change in a real and rapid way. Through our presentation, we will share our learning and evidence-based effects within business fleets that are a significant part of our driving population and why believe this is an important element of the discussion.

Comparison of Experience-Based and Evidence-Based Safety Risk Management Features for Heavy Vehicle Transport Operations

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Abstract

The main findings of recent research into important safety management characteristics were compared against risk management factors included in the risk assessment process adopted by a major truck insurer. Independent research[1] into safety management features that distinguish between lower insurance claimers and higher insurance claimers identified 14 characteristics that show clear evidence of efficacy in safety management in trucking operations. When these were compared with the Zurich Risk Engineering grading criteria substantial consistency was found.

Background

Insurance companies have an interest in the progressive reduction in financial losses by those that that hold policies with them. Zurich Financial Services Australia employs risk engineers to provide expert advice to insurance policyholders about their specific risks and risk control practices. As there has been scant research evidence to base this advice on, risk engineers have used their experience and observations to define risk and risk control criteria. A study of evidence-based safety management practices (Mooren, 2016) can now inform the approach taken to risk assessment and safety management

Method

The 14 characteristics found by a study involving a strategic literature review, a survey of companies that operate heavy vehicles and an in-depth investigation (to validate survey findings) were compared with characteristics of the Zurich Risk Grading system for Motor – Fleet - Truck.

Results

While the 14 characteristics found in a recent study do not represent a comprehensive set of safety management characteristics, the Zurich Risk Engineering (ZRE) program includes all 14 characteristics.

With respect to vehicle risk management ZRE includes safety features for heavy vehicles, vehicle age and specifications, and vehicle maintenance and inspections. The specific evidence-based characteristics that mirror these are:

- All appropriate safety equipment, including safety features on trucks, is provided, and
- Maintenance and pre-trip vehicle checks ensure that trucks are in a safe condition for all trips.

Regarding journey and site risk assessments, ZRE includes route planning for safe operations. The specific evidence-based characteristics found in the study that relate to this include:

- Route risk assessments are done for all delivery journeys, and
- Site and job risk assessments are regularly carried out.

[1] This research was funded by an Australian Council Research Linkage Grant, supported by Partner Organisations including Motor Accidents Authority of NSW, Transport for NSW, National Transport Commission, Zurich Australia and Transport Certification Australia.

Under the topics work monitoring and response to safety concerns, ZRE include fatigue risk management, vehicle maintenance and inspections, and safety management and quality assurance. The important safety management characteristics found in the research are:

- Monitor fatigue management practices, and
- All managers respond quickly to safety concerns raised by drivers.

With regard to recruitment, employment of, and payment to drivers, ZRE include driver selection and qualifications, driver maturity and health management, and driver work conditions and turnover. The related evidence-based characteristics are:

- Recruitment criteria focus on safe driving records,
- Driver fitness is assessed to ensure drivers' abilities to safely carry out all job duties, and
- Drivers are paid for all hours worked regardless of task or activity.

Regarding training, discipline and incentives, ZRE include driver assessment and training, incident reporting and investigation and fleet performance management. The study found evidence to include:

- Training for drivers is based on individual tuition by experienced drivers,
- Identified unsafe behaviours are formally investigated, and
- Drivers are given incentives, including monetary incentives, clearly linked to work safety efforts.

Finally, with respect to communications, ZRE include communication factors in incident reporting and investigation, and safety management and quality assurance. The study specifically found that two important characteristics are:

- Managers encourage driver input to WHS decision-making, and
- Managers take responsibility and show leadership in making safety a clear priority.

Conclusions

The similarities between the important risk management elements determined by the experience of an insurance company's risk engineering experts and those found by independent scientific research provides a cross-validation of important safety management characteristics.

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A Crash Testing Evaluation of Road Signs to Mitigate Vehicle Windscreen Spearing Risk

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Abstract

Fatal incidents have occurred in Queensland and New South Wales involving sight boards spearing through vehicle windscreens. These crashes occurred at T-intersections where the impacting vehicle was travelling at high speed on the continuing carriageway. An innovative research program was undertaken to test various end treatments which could be applied to both new sign designs and existing signs. The research showed that windscreen penetration could be prevented by utilising cost-effective treatments.

Background

Beginning in 2016, Transport for New South Wales and Queensland Department of Transport and Main Roads began a joint research program into road sign safety where vehicles have collided with sight boards (bi-directional hazard signs) causing them to spear through the windscreen. The research identified a number of factors associated with a large increase in risk: run-off-road (to the left) crash type, sight boards at T-intersections on rural roads with higher speed limits (≥ 80 km/h) and 4WD vehicles. The research was aimed at finding ways to improve the safety of these road signs.

Method

A series of vehicle crash-tests were conducted at the Roads and Maritime Services Crashlab facility in New South Wales. The research program utilised various treatments which could be retrofitted to existing high-risk signs and also applied to new sign designs. Eight crash tests were conducted using two vehicle types, a small passenger vehicle (Daihatsu Charade) and a 4WD (Nissan Patrol). Various sign sizes and arrangements were crash tested with different treatments (Table 1), with all tests conducted at a collision speed of 100 km/h.

Results

Test 1 was a baseline test of a standard sign and post configuration. Upon impact the pop rivets easily sheared and the aluminium sign face crumpled but did not significantly enter the occupant space. However the Type 1 stiffener rails became detached and acted as spears. The top stiffener rail safely travelled over the top of the vehicle cabin. The bottom stiffener rail pierced the windscreen into the vehicle compartment in the general area of the passenger's head and through the seat, hitting the rear passenger side window. Figure 1 shows the damage from the collision and the high likelihood of a fatal outcome to the occupant in the front passenger seat (and possibly the rear LHS seat).

Figure 1. Pre-, during, and post-crash test photos for Test 1

Test 2 was similar to Test 1 with the exception that the front of the sign had an aluminium cover fitted to prevent detachment of the stiffener rails. After Tests 1 and 2 it became clear the sign should not be permitted to come in contact with the windscreen. This was because the windscreen could not provide the necessary force to deflect the sign safely over the vehicle. Various tethering designs were developed where the sign face was tethered to the support post (Test 3 to 8). During this series of tests the post(s) successfully pulled the sign down and away from the windscreen. The key criteria for a successful sign treatment were cost-effectiveness and ease of installation of the treatment. The summary of test results is shown in Table 1

Table 1. Summary of testing conditions

	Treatment	Sign width (mm)	Sign depth (mm)	Posts	Post size (mm)	Rail type	Rivet type	Vehicle type	Windscreen penetration
Test 1	Baseline test - No Treatment	4000	400	4	50NB	Continuous	Pop rivets	4WD	YES
Test 2	Aluminium wrap sign end	4000	400	4	50NB	Continuous	Henrob solid rivets	4WD	YES
Test 3	Leading edge tethered - 5mm cable	4000	400	4	50NB	Cut	Pop rivets	4WD	NO
Test 4	Leading edge tethered - Flat strap	6000	600	4	65NB	Cut	Pop rivets	4WD	NO
Test 5	Leading edge tethered - HD clamp	3200	400	3	50NB	Cut	Henrob solid rivets	4WD	NO
Test 6	Flat steel clamp connection with Henrob Rivets	3200	400	3	50NB	Cut	Henrob solid rivets	Passenger vehicle	NO
Test 7	Leading edge tethered - HD clamp	6400	800	6	65NB	Continuous	Pop rivets	Passenger vehicle	NO
		4112	856						
		2633	976	2	80NB				
Test 8	Leading edge tethered - HD clamp	3200	400	3	50NB	Continuous	Henrob solid rivets	4WD	Test under planning

Conclusion

It was found that both currently installed and new signs could be successfully treated. Once treated, the signs would not penetrate the occupant space in an end-on collision at 100 km/h. This new research will lead to a safer road environment for motorists.

Acknowledgement

The authors would like to thank Colin Jackson and Drew Sherry of Roads and Maritime Services Crashlab for their support and assistance with this project.

Safety Town – A Collaborative Approach to Road Safety Education in NSW Schools

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Abstract

Transport-related fatalities are a leading cause of death of NSW children aged 5 to 14. The NSW Road Safety Strategy 2012-2021 highlights road safety education as a key countermeasure to reduce casualties in this vulnerable road user group. Developed as part of an enduring partnership between Transport for NSW (TfNSW) and the education sectors, Safety Town is a novel, interactive online road safety tool for primary schools. Authentic collaborative partnerships were pivotal in developing this resource. Augmented by professional learning for teachers, Safety Town positions road safety education within a Safe System framework, and meets the needs of all partners.

Background

In NSW, transport-related fatalities are a leading cause of death of children aged 5 to 14 (NSW Child Death Review Team, 2016). Road safety is taught in schools as part of the mandatory NSW Personal Development, Health and Physical Education (PDHPE) curriculum.

Local road safety issues are addressed using a whole-school approach. This recognises that schools, families and local communities can sustain positive, reciprocal interactions beyond the classroom to support road safety education.

Road safety education is a crucial element of the Safe System. While road systems should be designed to accommodate human fragility and error, road users also have crucial roles to play by complying with legislation and road safety guidelines.

Our collaborative partnership

A 30-year partnership exists in NSW between TfNSW, NSW Department of Education, Association of Independent Schools NSW, Catholic Education Commission and the Kids and Traffic Early Childhood Road Safety Education Program. This unique partnership extends beyond resource development to joint initiatives, dissemination of policy advice and filtering of educational insights into statutory and policy documents.

There are 36 road safety education specialists who support schools K–12 and early childhood services. They provide road safety professessional learning to teachers, with a focus on quality teaching and consistent road safety messages for families, teachers and students.

Development of Safety Town was a hands-on collaboration between TfNSWand the education sectors. Regular consultation, writing, evaluation and feedback were pivotal to producing a quality road safety education resource.

Safety Town

Safety Town (www.safetytown.com.au) is a 'one-stop-road-safety-shop' designed to actively engage primary teachers, students and their families in road safety education. It promotes adult–child road safety conversations at home, at school and in communities. The website can be freely accessed in classrooms and by families at home. It encourages sharing of consistent road safety messages – a key success factor in promoting safe travel practices.

Students are acknowledged as active participants in their road safety learning. Many of the activities support their developing understandings of how the human body is impacted by involvement in a crash –a key principle underpinning the Safe System approach. Students are not only engaged with learning what they and the adults in their lives need to do to keep safe, but also why they should adopt specific road safety behaviours and how these behaviours can prevent death or serious injury (Kids and Traffic, 2016).

Response to Safety Town

Teachers are responding very enthusiastically. Feedback indicates teaching materials that meet a number of different syllabus outcomes, along with activities that make road safety more engaging for students are especially valued. July–December 2016 saw a 54% increase in visitors in comparison to the same period the previous year.

Conclusion

TfNSW's long-term collaborative education partnership is pivotal to the ongoing success of Safety Town and continues to meet the needs of all road safety partners.

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Double Tennis Ball Intersection Design (Roe Hwy & Berkshire Rd)

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Abstract

Built as part of the Gateway WA project, the Roe Berkshire interchange delivered an innovative design providing the safest possible road environment for road users. This interchange incorporates a 'double tennis ball' intersection design which is the first of its kind in Australia. The intersection manages impact angles and / or speeds to be within survivable limits for vehicle occupants. This design occurred as a result of a multi stakeholder Trauma Review Group being established, as well as excellent innovative design work by the project team.

Situation

Previous to the Gateway WA project; the Roe Berkshire intersection was an at grade staggered T junction, with the intersection servicing Berkshire Road to the east being signalised and a giveway controlled intersection servicing the western side. Queue lengths were up to 1km long and the intersections had recorded 170 crashes over 5 years. The intersection was the 6th worst in the state in terms of crash cost. Predominant crash types for the intersections were rear end and right angle crashes.

Typically for a location such as this a diamond interchange incorporating two traffic signalised intersections would have been constructed. Land had already been acquired to enable this type of intersection to be constructed, however diamond interchanges are typically not forgiving of human error. This is because they fail to manage impact speeds or impact angles and present a high number of right angle conflict points.

Task

To develop a safe system compliant intersection design that catered for the expected traffic volume and composition, within the land constraints provided. Traffic volumes on Roe Hwy are in the order of 40,000 vpd, Berkshire Rd has 2,500 vpd (west) and 5,000 vpd (east). Both legs of Berkshire are expected to increase 400% by 2031 due to a planned airport park and ride rail facility. Berkshire Rd west services an industrial area with 36.5m road trains, traffic to the east of the intersection are predominantly residential commuters.

Action

The signalised diamond interchange was dismissed from a road safety perspective. A number of other options were explored including a grade separated roundabout, dog bone, diverging diamond and a roundabout cut through option. All of these options were considered and were not possible in their standard form due to items such as land availability, level of service and inability to provide for the 36.5 metre road trains.

The double tennis ball concept drew on some of the design principles associated with a cut through round about, dog bone and signalised intersections. The intersection design provides for the 36.5m road trains while minimising the number of side impact conflict points and managing vehicle travel speeds.

Result

The Roe Berkshire double tennis ball interchange was completed March 2016. The design has delivered an excellent result given the land constraints and large vehicle types that it needed to cater for. Although it could not eliminate all right angle conflicts an assessment of traffic speed has been undertaken and shows that only 1% of vehicles are exceeding 50km/h through these conflict points.

It is acknowledged that the intersection has only recently been installed so the crash performance of the intersection cannot be accurately determined, however preliminary (unaudited) reported crash results from April 2016 to end December 2016 indicate no crashes have occurred since the intersection was built.

Figure 1. Satellite image of Roe Berkshire interchange

Acknowledgements

Trauma Review and Project Members: Mark Hazebroek, Patrick Ryan, Steve Troughton, Bruce Corben, David Moyses and Ryszard Gorell.

A Fresh Approach for Prioritising and Treating High Risk Curves

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Abstract

The Centre for Road Safety at Transport for NSW sought guidance on focussed implementation methods to decrease the number of fatal and serious crashes occurring outside of metropolitan areas on high speed roads, especially on curves. A geospatial method based on the Austroads Operating Speed Model was used to identify out-of-context curves on 37,000 km of State and Regional rural roads in NSW. Road corridors were then prioritised for treatment based on the crash record at curves along each corridor. A treatment hierarchy was also developed to ensure that a standardised approach was applied when assessing corridors for safety improvements.

Background

Following a gradual reduction in the New South Wales (NSW) road toll from January 2011 through to March 2015, the road toll increased sharply the following year. The increasing road toll was naturally of serious concern and the Centre for Road Safety at Transport for NSW urgently sought guidance on focussed implementation methods to reverse the trend. One of the identified focus areas was reducing the number of fatal and serious crashes occurring outside of metropolitan areas on high speed roads, especially on curves. To address this focus, a strategy for prioritising and treating high risk curves was devised.

Methodology

Vehicle Speed Model and Identification of High Risk Curves

The Austroads (2009) Operating Speed Model for rural roads was used to identify out-of-context curves using a geospatial based methodology (Haris et al, 2015). A curve is considered out-of-context if a typical driver must decelerate significantly to negotiate a curve at a safe speed. For this reason, out-of-context curves (OoCCs) are at a higher risk of being the location of loss-of-control crashes.

Prioritising High Risk Curves for Treatment

Rather than simply prioritising individual curves for safety interventions, prioritisation was carried out at a corridor level to ensure consistency from a driver's perspective. Corridors were prioritised based on the number of injury crashes occurring on OoCCs (Out-of-Context Curve Risk) and the number of injury crashes occurring on all curves normalised for traffic volume (Overall Curve Risk). The first metric is a good proxy for the number of crashes that can be targeted if OoCCs along a section are improved to a higher standard. The second metric is useful as it filters out roads which have a high number of crashes relative to the number of curves, but a low crash rate considering the number of vehicles traversing the section. Low crash rates indicate that safety improvements may not provide much safety benefit when compared to sections with high crash rates. Corridors were prioritised into five priority bands based on the two metrics described in this section (Table 1).

Table 1: Combined metric calculation

		Out-of-Context Curve Risk				
		LOW	LOW MEDIUM	MEDIUM	MEDIUM HIGH	HIGH
Overall Curve Risk	HIGH	MEDIUM	MEDIUM HIGH	MEDIUM HIGH	HIGH	HIGH
	MEDIUM HIGH	MEDIUM	MEDIUM	MEDIUM HIGH	MEDIUM HIGH	HIGH
	MEDIUM	LOW MEDIUM	MEDIUM	MEDIUM	MEDIUM HIGH	MEDIUM HIGH
	LOW MEDIUM	LOW MEDIUM	LOW MEDIUM	MEDIUM	MEDIUM	MEDIUM HIGH
	LOW	LOW	LOW MEDIUM	LOW MEDIUM	MEDIUM	MEDIUM

Results

Figure 1 shows that corridors classified as HIGH had 2.5 times the rate of loss-of-control injury crashes compared to sections classified as MEDIUM HIGH and ninety times the rate compared to sections classified as LOW when normalised by traffic exposure. These results show that the prioritisation process is highly effective for targeting crash risk on curves.

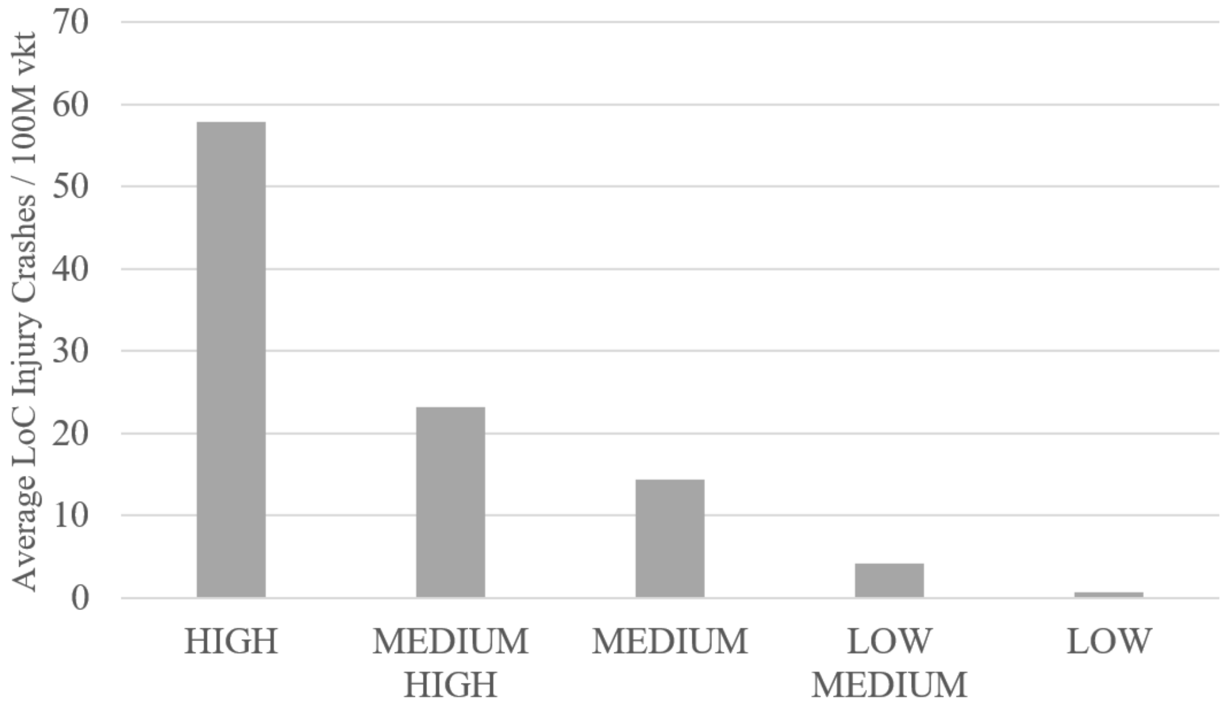

Figure 1. Average loss-of-control injury crashes per 100 million vehicle kilometres travelled in each priority band

High Risk Curve Treatment Hierarchy

Following prioritisation, a 'treatment hierarchy' was developed for assessing individual curves within corridors for safety improvements. The treatment hierarchy was developed to ensure that a standardised approach was applied to all identified high-risk curves when deciding upon appropriate treatments.

Conclusion

The high-risk curve prioritisation and treatment hierarchy represents an innovative and consistent approach to rural curve safety and will be of interest to everyone involved with the targeted identification, prioritisation and funding of curve safety improvements.

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The Role of Probability and Statistics in Bicycle Helmet Research

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Abstract

Bicycle helmets have been consistently shown to be efficacious in biomechanical studies and effective in epidemiological studies of crash data to mitigate the risk of head injury. However, there is still an ongoing debate regarding the appropriateness of case-control studies of crash data, the possibility of a mediating factor such as risk compensation, and whether bicycle helmet legislation leads to fewer people cycling. In this paper, it will be demonstrated that better understanding of statistics and probability can help us differentiate which of these questions already have reasonable answers and which ones require further research.

Background

There is an ongoing debate regarding the effectiveness of bicycle helmets and bicycle helmet legislation to mitigate the risk of head injury (Olivier, Wang, Walter & Grzebieta, 2014). This topic has been thoroughly discussed in the literature with a recent systematic review identifying over 1,000 relevant articles (Olivier & Creighton, *in press*). However, there has been very little discussion regarding the information that can be discerned from current study designs such as case-control designs of crash data or counts of cyclists from helmet use surveys.

This discussion requires an understanding of basic probability. We will therefore begin with a brief revision of the fundamental concepts of probability including notation. In the remainder of the paper, we will derive probabilities with regards to bicycle helmet effectiveness, risk compensation and helmet wearing, and probabilities of measuring changes in cycling exposure.

Bicycle helmet effectiveness

With the exception of possible confounding, crash data can directly estimate helmet effectiveness if helmet use and crash occurrence are independent. There have been many discussions for and against this assumption, although there is a paucity of original research on this topic.

Bicycle helmet effectiveness can be represented in terms of probability. If we let H indicate helmet wearing, I a head injury and C a crash, the relative risk for bicycle helmet effectiveness is

$$RR = \frac{P(I|H)}{P(I|\overline{H})}$$

This can be interpreted as the probability of a head injury for those wearing helmets versus those that do not. Helmets are effective when $RR < 1$. Unfortunately, crash data cannot estimate this RR.

Suppose we partition crashes into those that have been reported and those that have not, i.e., $C = C_R \cup C_{\overline{R}}$ where R denotes that a crash has been reported. It can be shown the relative risk is approximately

$$RR \approx \frac{P(C_R|H)}{P\left(C_R|\overline{H}\right)} RR_C$$

where RR_C is the relative risk from crash data. This result demonstrates the relative risk using crash data is a good estimate of the *true* relative risk when helmet use is independent of having a crash.

Risk compensation and bicycle helmets

The risk compensation hypothesis posits cyclists wearing helmets increase risk which offsets any benefit afforded by the helmet. Risk can be thought of as the probability of a binary event such as a crash, injury or fatality. However, no articles in the existing literature estimates risk and instead focuses on cycling speed (Phillips, Fyhri & Sagberg, 2011) or motor vehicle passing distance (Olivier & Walter, 2013).

Bicycle helmet legislation and measures of cycling exposure

It is often argued bicycle helmet legislation deters cycling. This hypothesis appears to have originated from counts of cyclists taken from helmet use surveys (Olivier, Boufous & Grzebieta, 2016). We will demonstrate that estimating changes in cycling using cyclist counts at various locations requires (1) the random selection of sites and (2) a total count of travelers at each site.

Discussion

In this paper, we will demonstrate estimates of helmet effectiveness using crash data are likely accurate; however, a definitive answer requires other study designs such as a large cohort study. Such a study design could also provide evidence for or against risk compensation. Further, the use of cycling counts from helmet use surveys are inappropriate for estimating cycling exposure and we encourage others to provide more appropriate measures in the future.

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A Community Survey of Attitudes Towards Autonomous Vehicles

Jodi Page-Smith, Amanda Northrop

Transport Accident Commission

Abstract

As the availability of different vehicle technologies increases, the use of completely autonomous vehicles is no longer the stuff of science fiction. The TAC sought to investigate community attitudes to autonomous vehicles. This paper discusses the results of the last two major surveys carried out by the TAC. Probabilistic Graphical Modelling was used to identify the variables that have the highest effect on Willingness to Use autonomous vehicles. Finally, it proposes a hypothesis that the enjoyment of mobile use for social media and other activities directly influences their acceptance of autonomous vehicles.

Background and Methods

Autonomous cars have the potential to reduce the number of people killed and seriously injured on our roads. More in-car technologies are becoming available and vehicles are getting closer to being completely autonomous. Since 2010, the TAC has conducted a regular survey of Victorian road users to determine the acceptability of a variety of driving and non-driving behaviours. In 2014 and again in 2016, the TAC asked participants about their awareness of a number of new and existing vehicle technologies Participants were also asked their opinion about autonomous vehicles. In 2016, 1107 participants were recruited via an online panel.

Results

The study found that most drivers are largely supportive of letting the car take on the more boring aspects of driving. However, only a minority are supportive of letting the car do all the work.

Respondents were asked about their attitudes and concerns around self-driving cars. Almost three quarters (74%) of participants were concerned about the technology of self-driving cars failing. This was unchanged from 2014.

Respondents were most likely to agree that ‘I would like a car that can take care of some aspects of the driving process but not all’ (59% strongly/somewhat agree). More than half of participants would not be comfortable in a car that could completely drive itself (29% strongly disagree - an increase compared to 2014 at 25%). Participants in 2016 were also more likely to state that ‘I would like a car that would park itself but not do other driving tasks’ than in 2014.

Older participants aged 40-75 years of age were most concerned about technology failing. They were also more likely to not feel safe in a vehicle they could not control than their younger counterparts.

Probabilistic Graphical Modelling was carried out to profile participants based on their Willingness to Use (WTU) autonomous vehicles. The model showed the following variables had the greatest effect on WTU:

- Participant age. This had the highest effect, with younger individuals being more willing than older.
- Involvement in an accident where an injury resulted in the last 12 months. Participants that had been in an accident in the last 12 months were more willing than the general population

- Number of friends and family that drink-drive. Participants with more peers that drink-drive were more willing.

Interestingly, non-driving related social questions came out as having an important impact on WTU autonomous vehicles. These included whether the person would judge someone who checked social media at dinner, and whether they would judge someone who used a younger picture on a dating profile.

Conclusion

Younger people, those who have been in an accident that resulted in an injury, and those who had friends and family that drink drive had a higher WTU autonomous vehicles. From this modeling, we believe that those participants who enjoy using their mobiles for social media and other activities are the most supportive of autonomous vehicles.

The Application of a Proxy Measure to Estimate the Incidence and Characteristics of Driver Fatigue in Motor Vehicle Crashes

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Abstract

This research sought to describe the incidence and characteristics of fatigue as a contributing factor in reported road crashes in Western Australia, 2009-2013, through a comparative analysis of police reported fatigue-related crashes and the application of the Australian Transport Safety Bureau (Dobbie, 2002) post-crash operational definition for fatigue crashes. The two measures showed differences in the number and type of crashes identified to be fatigue-related. A combination of the two showed that up to 17.6% of all reported fatal crashes and 8.3% of all reported hospitalisation crashes could be identified as fatigue-related. A revised post-crash measure of fatigue was recommended.

Background

The reported incidence of fatigue in road crashes range from 2.6% of fatalities in the USA (NHTSA, 2014) to 16.5% of fatal crashes in New South Wales (NSW Centre for Road Safety, 2015). Most Australian jurisdictions, including Western Australia, do not formally report statistics for fatigue-related crashes because of validity and reliability measurement concerns. New South Wales and Queensland apply a post-crash proxy of fatigue to supplement the police identification of fatigue using variations of an operational definition advanced by the Australian Transport Safety Bureau (ATSB) (Dobbie, 2002). This study compares crashes assessed by WA Police for fatigue with those identified from the application of the ATSB definition to improve the estimate of the incidence in Western Australia and to identify common risk factors for fatigue-related crashes.

Method

All reported Western Australian motor vehicle crash records (n=186,585) involving drivers/riders of motorised vehicles for the period 2009-2013 were retrieved from the Integrated Road Information System. The subset of police attended crashes (n=16,741) were analysed to describe the incidence of police reported fatigue crashes and associated risk factors. The ATSB operational definition (Table 1) was subsequently applied to the dataset of police attended crashes and the analyses repeated and the findings compared. The ATSB operational definition was also applied to the larger dataset of all reported crashes to estimate the incidence beyond just police-attended crashes.

Table 1. Australian Transport Safety Bureau operational criteria for a fatigue crash

Exclusion Criteria	Crash occurred on a road with a posted speed limit below 80km/hour
	Crash involved a pedestrian
	Crash involved a driver who had no authority (i.e., unlicensed) to drive at the time of crash
	Crash involved a driver with a Blood Alcohol Concentration level ≥0.0500gm%
Inclusion Criteria	Single vehicle crash occurring between midnight-6.00am or 2.00pm-4.00pm
	Head-on crash in which neither of the involved vehicles was overtaking at the time of the crash

Adapted from Dobbie (2002)

Summary Results and Discussion

Selected summary results are presented in Table 2. For police attended crashes, the incidence of fatigue was highest when assessed by police compared with that determined from the application of the ATSB definition across all outcomes (9.8% versus 4.8%) and by injury severity (fatalities and hospitalisation). The correspondence between the two measures in the identification of fatigue was highest for fatal crashes (27.3%) compared with hospitalisation crashes (20.5%) and all injury outcomes (16.1%). The relatively low level of correspondence between the measures was due to the restrictive exclusion and inclusion criteria of the ATSB operational definition. For example, 65% (n=633) of police reported single vehicle fatigue-related crashes were excluded because they occurred outside the ATSB critical inclusion time. Application of the ATSB definition to all reported crashes (attended and non-police attended) increased the total number of possible fatigue-related crashes to n=2,498. After adjusting for the number of crashes that were mutually identified to be fatigue-related, a combination of the measures suggested that up to 17.6% of all reported fatal crashes, 8.3% of all reported hospitalisation crashes, and 2% of all reported crashes across all injury outcomes for the period could be fatigue-related.

Table 2. The number and proportion of fatigue-related crashes identified from WA Police reports and the application of the ATSB operational definition, by injury outcome, Western Australia 2009-2013

Source of Identification/Severity	Fatigue Yes		Fatigue No		Total	
	n	%	n	%	n	%
WA Police Report						
Crashes attended by police and assessed for fatigue (all severities)	1,644	9.8	15,097	90.2	16,741	100
-Hospitalisation	419	12.8	2,856	87.2	3,275	100
-Fatality	55	19.2	231	80.8	286	100
ATSB Operational Definition						
Crashes attended by police and assessed for fatigue (all severities)	811	4.8	15,930	95.2	16,741	100
-Hospitalisation	230	7.0	3.045	93.0	3,275	100
-Fatality	38	13.3	248	86.7	286	100
All reported motor vehicle crashes (all severities)	2,498	1.3	184,087	98.7	186,585	100
-Hospitalisation	479	4.9	9,305	95.1	9,784	100
-Fatality	104	12.7	718	87.3	822	100

Separate multivariate analysis of police identified and ATSB identified fatigue-related crashes revealed a number of common driver (age) and crash risk (injury severity; location, day of week) factors but inconsistent findings for driver sex (males) and vehicle type (trucks and heavy vehicles).

Conclusions

A post-crash proxy measure has the potential to supplement the identification of fatigue among crashes not attended by police but the definition must reflect an evolving 24-hour lifestyle and associated changes in driving behaviour that may influence the occurrence of fatigue.

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Expert Drivers and Situational Awareness

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Abstract

Situational Awareness (SA) refers to knowing what is happening around you, and is closely related to task performance and safety. Here, we were interested in how SA differs between expert (paramedics) and non-expert drivers, controlling for memory, driving experience and age. We demonstrated that non-experts were better at reporting low-level perceptual features (e.g., "there is a blue car"), but experts were better at understanding the situation and predicting future events (e.g.,"that car may pull out into the lane we are in"). The results are discussed in terms of rapid strategy development that might occur with experts compared with non-expert drivers.

Background

Situation awareness is defined as the capacity to know what is going on in a given situation, to integrate relevant information, evaluate the importance of elements in the situation, and predict future events based on this information (Endsley, 1995). Thus a traditional conceptualisation of SA is: perceiving elements in the current situation; integrating and comprehending those elements; and projecting what the future status of those elements will be. Failures of SA in driving have been associated with more collisions, speeding violations, and more missed stop signs and turns (Kass, Cole & Sanny, 2007).

Through driver training, expert drivers gain better understanding and advanced skills (Walker, Stanton, Kazi, Salmon, & Jenkins, 2009), and they should, therefore, be able to outperform non-experts with similar experience in all three levels of SA. Specifically we would expect higher levels of SA in terms of their ability to comprehend and anticipate the future state when driving, compared with non-expert drivers.

Method

The expert group (N = 25) was comprised of paramedic officers, who receive considerable systematic training in driving, including explicit training in low risk thinking when driving. The non-expert group (N = 25) consisted of normal drivers who, as a group, and regardless of years driving, have not undertaken any formal driving courses, thus separating experience and expertise – a common confound in the expertise literature. All participants were between the ages of 23-55 years, and all participants held a current drivers licence. Participants engaged in a novel SA task, based on the What Happend Next task (Jackson, Chapman & Crundall 2009) in which they reported on videoed driving scenarios. The scenarios depicted a range of normal driving conditions that an average driver would be expected to encounter, and ranged from 3 – 16 seconds. There were no staged or obvious hazards other than those that occur in normal driving situations, and participants were not explicitly instructed to look for hazards. Participants were asked to describe what they had just seen in the video, imediately after each scenario.

Results and Conclusions

The recorded responses for each participant was transcribed, coded and categorized into the 3 levels of SA (Perception, Comprehension and Projection). A grounded theory approach (Glaser & Strauss, 1967) was taken to the categorisation of participant responses. The first step was to open code the response data by breaking it down into smaller response units that ranged from a word to several sentences (Strauss & Corbin, 1990). Secondly, response units that referred to similar phenomenon were grouped into response categories (Strauss & Corbin, 1990). Thirdly, the response categories were divided into different levels of SA according to Endsley's (1988) definitions, which specifies propositions (suggested the generalised relationships among different categories) in grounded theory.

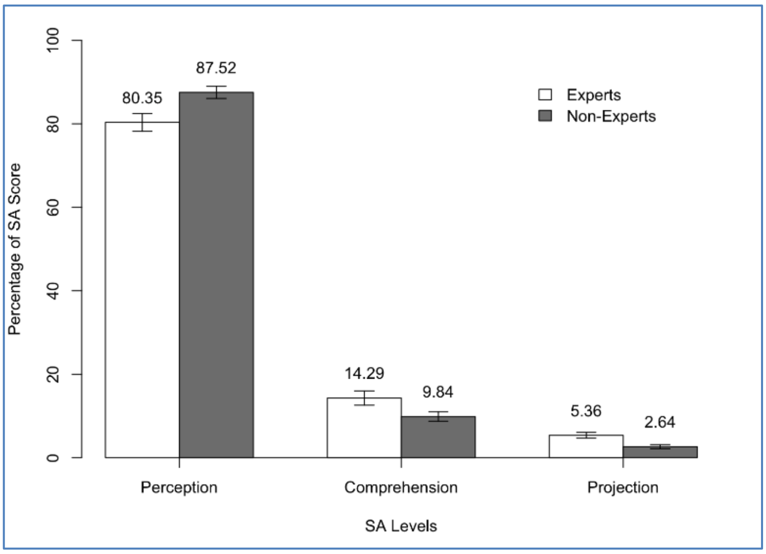

Figure 1. Elements of situational awareness in the three levels, demonstrated by expert and non-expert drivers

Regarding the proportion of verbalisations that were categorised into the 3 levels (relative to the number of verbalisations overall for each participant, refer to Figure 1), experts reported more 'comprehension' and 'projection' level information compared with non-experts, and this appeared not to be due to simply reporting more information, as non-experts reported more 'perception' level information. Moreover, the pattern of reporting differed for the two groups over time, suggesting that the experts adopted a different strategy for coding SA compared with non-experts.

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Inattentional Blindness in Expert Drivers

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Abstract

A failure to detect an obvious, but unexpected object when attention is engaged elsewhere, is known as Inattentional Blindness (IB) (Mack & Rock, 1998), and in driving tasks, can be an indication of situation awareness and hazard detection. In this study we used a static, driving-related IB paradigm to investigate how experts allocate attention and filter information when driving. We demonstrated that expert drivers were better than non-expert drivers in selectively filtering important and unimportant information in driving scenarios. The results are central in understanding how expert drivers allocate attention when driving, and have implications for driver training programs.

Background

Attentional set theory in IB suggests that we can tune our attention to search for specific information in our environment that is relevant to the task at hand, and is one of the several possible mechanisms through which IB occurs (Most et al, 2005). Thus, attention can be considered as a ‘filter’ that rejects unimportant information from the attentional system allowing important information to be attended. We hypothesised that expert drivers would have a more developed attentional filter for driving-related IB stimuli than non-experts because of their better situatioanl awareness (Underwoord et al, 2013) and hazard perception (Crundall et al, 2003), however this results in at least two predictions: Expert drivers either have a ’wider’ attentional filter in which they detect a greater range of driving-relaed objects in a simulated driving scenario, or they have a more ’focal’ filter in which they are more likely to detect more relevant objects in driving scenarios.

Method

Expert drivers (Paramedics, N = 150) received considerable systematic training in driving. The non-expert drivers (N = 196) consisted of normal drivers who did not drive as part of their profession. The groups differed in general experience measures, but there was no difference in age, or safety measures such as fines or collisions.

Participants were required to make safety judgements on briefly flashed photos of driving scenarios. After a sequence of 7 scenarios, a ‘critical’ scenario was presented which contained an additional object: either a child standing, a child running, an adult standing, a garbage bin, or a stroller, each one located on the median strip to the right (Pammer et al, 2012; 2015). After the critical trial, participants were asked whether they could identify the additional object on the side of the road from a series of plausible objects. If expert drivers have a wider attentional window, we would expect them to be better at detecting all objects compared to non-experts. However if expert drivers have a more ’focal’ attentional window, then we would expect them to detect objects of greater relevance compared with non-experts.

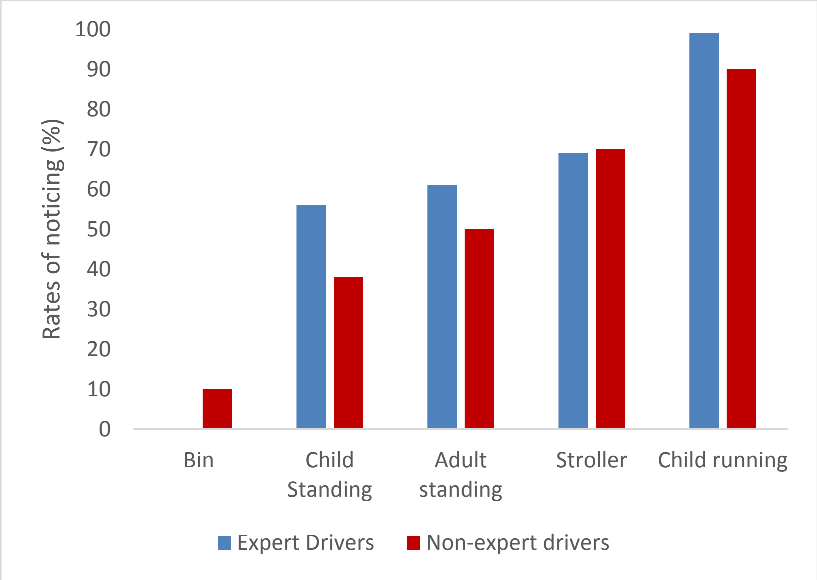

Figure 1. Rates of Inattentional Blindness for expert and non-expert drivers

Results and conclusions

IB is indicated by the number of people who fail to detect the additional object in the critical trial. The results indicate that while both experts and non-expert drivers detected the high threat stimuli such as the stroller and child running, the experts were better at detecting the mid-range threat stimuli $\chi 2$ (2, N = 160) = 5.2, p = .01 (, but also demonstrated a clear ability to reject unimportant information, as no experts noticed a garbage bin on the side of the road (Figure 1) $\chi 2$ (1, N = 66) = 7.6, p = .006. This result implicates a more 'focal' attentional filter for expert drivers. Moreover, such attentional filtering may occur at a fast, pre-conscious level, as we also demonstrated that experts who reported not seeing the unexpected object in the critical trial, were nevertheless more likely to accurately choose the additional object in a subsequent forced-choice task. These results are important in understanding the role of attentional allocation when driving.

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Bike Boulevards in Perth: Expanding the Safe Cycling Network and Introducing 30km/h Zones

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Abstract

With fear of sharing the road with motorists being a major barrier to cycling, and limited opportunities to retrofit off-road cycling paths in existing built-up areas, an innovative WA State Government initiative is trialling the implementation of Bicycle Boulevards on local streets of inner-to-middle suburban Perth. Each Bike Boulevard is planned to form part of the wider Perth Bicycle Network, applying traffic calming measures to achieve a self-enforcing 30km/h speed limit and a safer, more comfortable environment for cyclists and pedestrians. The paper will discuss the route selection, design processes and present survey results from users and residents.

Background

A major barrier to cycling in Australia is a fear of sharing the road with motorists (see, e.g., RAC 2015), but it is a major challenge to retrofit urban areas with safe facilities that can attract cyclists with differing levels of confidence and experience. Where land is available along infrastructure corridors or linear parks, it is often possible to install off-road paths, which are among the safest and most comfortable cycling facilities. Between these corridors, however, large network gaps exist.

On arterial roads, high utilisation of existing road capacity and restrictions on further expansion often limit the options for segregated bicycle paths, especially if paths are to be protected from general traffic by more than a painted line. This typically leaves the local street network; and in older suburbs with grid street patterns, these local street-based routes can still provide direct connections which are largely free from high volumes of motor vehicles.

In Perth, however, traffic operating speeds on many of these streets are too high (above 50 km/h) to attract less confident bike riders, and frequent stops for traffic controls (often intended to discourage motorist 'rat running') also discourage cyclists. Building segregated cycle paths along such streets, while still maintaining vehicular access to properties and on-street parking, would likely require property acquisition, paving of nature strips or verges, relocation of services and/or removal of street trees, making projects unpopular and financially unviable. Safe interaction between paths and driveways would also be problematic.

Perth's bike boulevard program

An innovative approach, less disruptive to local streets and more likely to gain the support of residents and municipalities, is currently being trialled by the Western Australian Department of Transport and local government partners. As part of the 'Safe Active Streets' program (DoT 2017), several Bike Boulevards are being implemented in the inner-to-middle suburbs of Perth, inspired by examples from Europe and North America, in particular by the Netherlands' *fietsstraat* or 'bicycle street.'

Without adopting Dutch-style regulations, these projects aim to use traffic reduction and calming measures to fill the missing links in a larger strategic bicycle network (all projects form part of an eventual one-by-one kilometre route grid). They also support WA's road safety strategy *Towards Zero* by protecting pedestrians through traffic calming and providing "demonstration projects to illustrate the effects of speed limit reduction" (ORS 2009, pp. 36, 40). The goal is to create attractive, comfortable riding environments in low-speed streets that can be shared safely by cars, bicycles and pedestrians. Schools and other community groups are involved to raise awareness, develop a sense of ownership and increase comfort levels with riding bikes to local destinations. Awareness and education for motorists is also being addressed.

Streets are designed to achieve a self-enforcing 30 km/h speed limit, by applying measures such as narrowed carriageways, one-way slow points, raised plateaus at intersections, turn bans, and reduced lines-of-sight through horizontal deflection and streetscaping. Existing kerb lines are retained where possible to reduce costs. Given the importance of street design in adherence to posted speed limits (TRB 1998), the program also trials measures needed to support potential wider introduction of 30km/h limits on residential streets, which would cut serious injuries and fatalities for pedestrians and cyclists (ORS 2009, pp. 37–38; Austroads 2012, pp. 4–5).

Approach of the paper

This paper/presentation will discuss the process for bike boulevard route selection, steps and considerations in design, the traffic speeds and numbers of cyclists measured (before and after implementation), and any other survey results of users and residents available at the time of submission (covering demographic characteristics, trip purposes and connectedness with the street).

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Victorian Based Autonomous and Connected Vehicle Trials and Provision of Related Public Advice and Advocacy

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Abstract

RACV has commenced a program of large scale investment and participation in four Victorian based Autonomous and Connected Vehicle trials to underpin development of an information, advice and advocacy framework. As part of RACV commitment to member and community engagement, advice and education RACV will promote public interest and discussion in these trials and distribute associated advocacy.

Building on existing RACV research into the impact of Autonomous and Connected Vehicles RACV new program analyses data from the trials to define the issues and benefits of autonomous vehicles and promote the safety and mobility benefits to the broader motoring public.

RACV's Role in Connected and Autonomous Vehicle Information & Advocacy Autonomous and Connected Vehicle Trials

RACV represents the interest of over 2.1 members and acts as a well-respected advocate for vehicle technology and road safety. RACV is now expanding this role of engagement, credibility and leadership into the area of Vehicle Automation.

The RACV engagement in Victorian based Autonomous and Connected vehicle trials will allow continued and relevant provision of related advice and advocacy to Members.

- RACV is now involved in four connected and autonomous vehicle trials in Victoria:
    - HMI Technologies has procured a NAVYA autonomous bus to be deployed in Melbourne to trial usage at airports, universities and last-mile transport connections.
    - Melbourne University National Connected Multimodal Transport Test Bed (NCMT) developing the world's first urban laboratory for testing of emerging connected transport technologies at a large scale and in a complex urban environment
    - Eastlink Trial involving VicRoads (grant), La Trobe University with AARB as project manager. Using current production vehicles in addition to technology demonstrators all with high level automated features the trial is intended to gain an understanding of how current technology fares in a modern Australian major arterial road environment. Essentially representing a best case environment in terms of road infrastructure, issues apparent in this trial will almost certainly manifest in other less optimal roads.
    - Transurban (Citylink) Trial with the Victorian Government to better understand how automated vehicle technology works with roadside equipment. Testing a similar environment to the Eastlink trial, the Transurban trial, also using highly automated production vehicle will face a higher traffic load with more diverse operating environment.

RACV's role in each of these trials is to provide engagement with the community, information and advocacy through our various media and connection with the vehicle industry. All trials involve partnerships, research, expertise and development of advocacy positions.

RACV also believes that looking forward beyond trials, there needs to be debate as to which set of legislative instruments are the most appropriate to capture Automated vehicles and the presentation will outline RACV's extensive advocacy efforts in lobbying for efficient and enabling legislation framework that enables a safe and structured adoption of Autonomous vehicle technology. This involves continued engagement with the federal Government of Australia and the Government of the State of Victoria through their respective Agencies.

RACVs has considerable reach to the motoring public and is well placed to become a major source of reliable information on what is a complex and many faceted issue. RACV approaches the advocacy role with dedicated teams concentrating on vehicles, Roads, Road, Users, Environment and broader transportational perspectives.

Technology Acceptance Research

However it is far from clear how well this is understood or accepted by the larger non-expert population whose involvement will be ultimately essential.

Leveraging the considerable expertise of engaging a non-expert audience on complex and multi-faceted technology issue RACV has developed a program to educate and promote discussion on a topic that will extend far beyond the typical road safety aspects of emergent vehicle technologies. This program consists of blend of media to involve as broad a spectrum of the community as possible ranging from traditional print media platform, web based activities, extensive social media engagement and a virtual reality demonstrator road show designed to attend community events.

Previous research on user acceptance such as the 'University of Michigan Survey of Public Opinion about Autonomous and Self-Driving Vehicles in the U.S The U.K and Australia', the 'Opinium Survey in the U.K.' commissioned fir the Observer Newspaper and the 'ThinkGoodMobility' Survey have indicated a genuine consumer interest in Automated Technologies, however viewpoints tend to be significantly polarised.

RACV is currently undertaking fresh research in this area and associated mobilty topics and will be in a position to share this information with conference delegates at the 2017 ACRS in October. Of particular interest will be to understand if there is a shift in public sentiment since user acceptance is transcient. Such studies inevitably can be viewed as a snapshot.

Such snapshots are valuable however since they can be used to indentify the success or otherwise of exisitng education programs and identify areas that it can be expanded to.

Development of a Pedestrian Injury Prediction Model for Potential Use in an Advanced Automated Crash Notification System

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Abstract

Advanced Automated Crash Notification (AACN) systems can inform emergency services of a serious road crash with minimal delay, giving the precise location of the crash, and transmitting key information from the vehicle's event data recorder, including: the crashed vehicle's delta-V, occupant seatbelt use, airbag deployment and travelling speed. This information can be used to determine the likelihood of serious injury within the crashed vehicle using a suitable injury prediction algorithm. The focus of this paper is to present a proof of concept AACN pedestrian injury prediction model using South Australia crash data.

Background

Vehicle speed in a pedestrian collision influences pedestrian injury severity (Davis, 2001; Rosén & Sander, 2009) and vehicle speed can assist with injury prediction if it can be transmitted easily from a vehicle event data recorder (EDR) to emergency services. Advanced Automated Crash Notification (AACN) systems have been developed that can do this, but the focus has predominantly been on benefiting vehicle occupants (Champion et al., 2004; Kononen, Flannagan & Wang, 2011; Nishimoto et al., 2016). Pedestrians and other vulnerable road users may also benefit from the development of an AACN injury prediction model and some initial research has commenced in Japan (Nishimoto et al., 2015).

Detection of pedestrian crashes requires specialised contact sensors similar to those discussed in Fredriksson, Haland and Yang (2001) and Ito, Mizuno, Ueyama, Nakane and Wanami (2014) or non-contact pedestrian detection sensors such as those discussed in Oikawa, Matsui, Doi and Sakurai (2015). Some pedestrian impact sensors already exist in vehicles that deploy the vehicle's bonnet to mitigate pedestrian head injury in a pedestrian collision.

The aim of the present study was to develop a proof of concept Australian crash-based AACN pedestrian injury prediction model using South Australia data.

Method

Crashes investigated as part of CASR's in-depth crash investigation program (1999-2005) were used as one data source. Cases in which vehicle travel speed could be determined and injury severity was coded according to maximum abbreviated injury score (MAIS) were used for constructing two injury prediction models. The dataset consisted of pedestrian crashes with MAIS2+ injuries (N=84) and MAIS3+ injuries (N=62). The second data source was mass crash data from the South Australian Traffic Accident Reporting system (TARS) for the years 2000 – 2013. Injury from TARS was disaggregated into serious injuries (hospital admission or fatal) and minor injuries (hospital or private doctor treated) and cases were only included if a police reported vehicle speed was available (N=4,312).

Using the two sources of data, three base pedestrian injury prediction models were developed using a logistic regression model where the response variables were coded as Y=1 for AIS2+ and AIS3+ (Y=0 for no injury) and Y=1 for TARS serious injury (and Y=0 for minor injury). Vehicle travel speed was used as the predominant pedestrian injury risk predictor variable. The probability of injury (injury risk) for each model was then p(Y=1 | x), where speed was the predictor variable.

$$p = \frac{1}{1 + \exp[-(\beta_0 + \beta_1 x_1)]}$$

Results

The three regression models were found to be acceptable predictors of pedestrian injury ($p < 0.005$) and the pedestrian injury risk curves from those models are shown in Figure 1 for risk of MAIS 2+ and MAIS 3+ injury and TARS ‘serious injury’, for increasing vehicle travel speed.

The CASR in-depth model indicates that if a pedestrian collision occurred, and the vehicle involved had been travelling at 60 km/h, the likely risk of MAIS 2+ injury would be around 80%, MAIS 3+ injury would be around 45% and TARS data indicates around 50% risk of a serious injury.

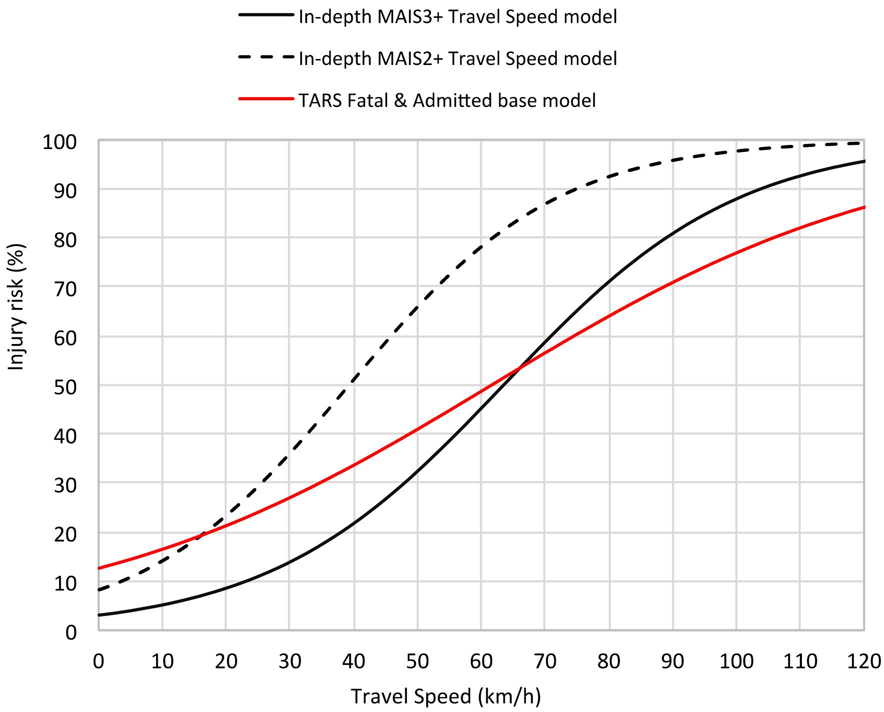

Figure 1. Injury risk curves based on in-depth data and TARS data.

Conclusions

This research indicates that the development of proof of concept pedestrian injury risk prediction model is feasible using South Australian crash data and provides a starting point for further development for use in a pedestrian AACN system. A validated and refined model, when combined with an automatic crash notification system, could be used to provide an initial guide to assist with medical triage and could theoretically reduce the time to initial post-crash medical treatment and subsequent emergency transport to medical facilities. Such a system, if widely implemented, would potentially reduce pedestrian collision serious injuries and fatalities.

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Delivery of a Child Car Seat Program in 12 Aboriginal Communities in NSW: Elements for a Detailed Process Evaluation

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Abstract

Aboriginal and Torres Strait Islander children are over-represented in road related deaths and serious injury. *Buckle-Up Safely* was a community-based pragmatic trial of a multifaceted program promoting correct use of age-appropriate restraints for Aboriginal and Torres Strait Islander children aged 0-7 years in New South Wales. In a culturally respectful way the program was deliverered in partnership with 12 Aboriginal communities. We assessed the program in terms of what was delivered and how it was delivered and show while message content and resources were consistent, the program delivery varied across the sites. Core program elements will be incorporated into assessing the impact of the program on optimal restraint use.

Background

Despite the over-representation of Aboriginal and Torres Strait Islander children in road related deaths and serious injuries (Henley G & Harrison JE, 2013), Buckle-Up Safely is the first large scale child car seat program to be delivered and evaluated in this population group. Health promotion researchers have highlighted the importance of tailoring programs to suit community needs and capacity (Martinuik, Ivers, Senserrick, Boufous, & Clapham, 2010). However, such tailoring to individual communities would likely impact a program's effectiveness (Gearing et al., 2011). This paper describes the Buckle-Up Safely program delivery and process evaluation of this end-to-end community based program targeting correct use of an age-appropriate restraint.

Method

The *Buckle-Up Safely* program, guided by the Precaution Adoption Process Model for behavioural change (Weinstein, 1988), was developed to help parents and carers ensure their child was properly secured in a correctly installed, age-appropriate child restraint every time the child travels in the car (Hunter K et al., 2011). The approach was multifaceted comprising an education-based program focused on correct use of age appropriate restraints alongside disbursement of subsidised restraints.

Local Aboriginal Community Workers delivered the program, and training was provided to advise parents and carers in restraint selection and installation. Community Workers were equipped with both child restraint educational resources developed by the program and pre-exisiting resources available through early childhood road safety organisations and the NSW Centre for Road Safety. A comprehensive child restraint information booklet was created for parent information sessions. Local early childhood education centres and Aboriginal Community Controlled Organisations were linked in with pre-existing child road safety services to facilitate continued long lasting relationships.

Program dosage

We report on how the program was implemented across the sites. This includes reporting the number of: community service staff who attended the Kids & Traffic Early Childhood Road Safety professional development program on child road safety education; attendees at parent/carer information sessions; community events; restraints distributed; community restraint checking and fitting days; the distribution of road safety resources; and, Community Workers' completion of the certified restraint fitting course and staff turnover (consistency of Community Workers at each site).

Results

In 2016, eighteen Community Workers delivered the program (range per site: 1-4); three sites had a change of Community Worker and sixteen Community Workers completed the certified child restraint training course. Table 1 presents a summary of program components delivered across the sites.

Table 1. Summary of the number of Buckle-Up Safely program components delivered across the services

Buckle-Up Safely **program components**	**Total (range per site)**
Restraints distributed	469 (17-56)
Families attending car seat fitting and checking days	71 (2-22)
Parent/carer information sessions	33 (0-100)
Local community events	17 (0-4)
Attendees at *Kids & Traffic* Road Safety Education program	89 (1-22)

Conclusion

This was a pragmatic trial with consistent messaging and resources yet with varied program delivery. While the need to tailor a program to meet community needs is necessary, the inherent variability in how the program is delivered must be taken into consideration when assessing program effectiveness. This paper described a program to suit community needs and capacity and highlighted the importance of monitoring program components to inform interpretation of measures of effectiveness. Outcome evaluation will be completed in 2017.

Acknowledgements

The authors acknowledge the work and commitment of all the Local Aboriginal Community Controlled Organisations involved in this project and the Aboriginal and Torres Strait Islander People who have worked in any capacity on the program. The project was overseen by a Steering Committee comprising representatives from local Aboriginal Community Controlled Organisations, and key government and non-government organisations. This project is funded by NSW Health Aboriginal Injury Prevention Demonstration Grands Scheme and Transport for NSW. Dr. Hunter was supported by a Post-Doctoral Research Fellowship with The Poche Centre for Indigenous Health (2014-2016) and NSW Health Early Mid Career Fellowship (2017-2019). This study was approved by the Aboriginal Health Council of NSW (Ref. No. 1011/14).

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Road Crash Trauma amongst Aboriginal and Torres Strait Islander People in New South Wales

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Abstract

Aboriginal and Torres Strait Islander road users are over-represented in road trauma in NSW, but few details have been known about this issue as crash reports from NSW Police do not identify Aboriginality for people involved in the crash. Linkage between CRS crash data and NSW Health data has allowed reporting of Aboriginality using a weight of evidence approach. Of 931,203 people involved in crashes in NSW between 2005 and 2015, 18,452 were reported as Aboriginal. A comprehensive statistical profile has been produced to improve understanding of crash factors and health implications for Aboriginal and Torres Strait Islander road users.

Background

This paper aims to descibe the data linkage process and methodology for identification of aboriginality status as well as presenting a detailed profile of fatality and serious injury crashes for Aboriginal and Torres Strait Islander road users in NSW.

The aboriginal road users are over-represented in road trauma but the development of countermeasures is hampered by challenges in the accurate reporting of Aboriginality. Previously, the NSW Centre for Road Safety (CRS) only had data from Police crash reports, which do not contain information on a person's Aboriginal status. Record linkage between CRS crash data and NSW Health data has allowed this information to be sourced from multiple datasets. However, Aboriginality is known to be under-reported in health data, particulary those involving self-report or self-identification (Australian Insitute of Health and Welfare, 2010). Therefore, a nuanced approach is required.

Method

Aboriginal status was derived using variables from any linked record (not just road crash-related) in the NSW Admitted Patient Data Collection and NSW Emergency Department Data Collection. The method used an algorithm endorsed by the NSW Ministry of Health (2012). Each record of Aboriginal status was treated as a "unit of information" contributing to a weight of evidence as to whether a person should be reported as Aboriginal. The method will be discussed in detail in the presentation

A statistical profile was produced of road trauma amongst Aboriginal and Torres Strait Islander people in NSW between 2005 and 2015. The profile focused on serious injuries and fatalities and compared the factors underlying Aboriginal and non-Aboriginal casualties.

Results

Between 2005 and 2015, 931,203 people were recorded as being involved in crashes in NSW. Of these people, 18,452 (2.0%) were reported as being Aboriginal or Torres Strait Islander. They made up 4.0% of serious injuries and 3.2% of moderate injuries. Key findings include:

- Aboriginal and Torres Strait Islander people are 2.7 times more likely than non-Aboriginal people to be fatally injured, and 1.7 times more likely to be seriously injured, in a road crash.

- The crash and serious injury profile of Aboriginal and Torres Strait Islander road users is significantly different to that of other road users.
- The fatality rate for Aboriginal and Torres Strait Islander people increased by 182.1 per cent in 2005–2015, from 3.7 to 10.3 deaths per 100,000. The rate for other road users decreased by 43.2 per cent during this time, from 7.6 to 4.3 deaths per 100,000.
- Over the same period, the serious injury rate for Aboriginal and Torres Strait Islander people increased by 22.9 per cent, from 221.9 to 272.6 per 100,000, while the rate for other road users decreased by 11.4 per cent from 175.5 to 155.5 per 100,000.
- Illegal alcohol, fatigue, restraint non-usage and speeding were more commonly involved among Aboriginal and Torres Strait Islander road users compared to other motor vehicle controller fatalities.

Conclusions

The use of linked data and a weight-of-evidence approach in reporting Aboriginality has resulted in a wealth of information not previously available to the CRS. This study clarifies the over-representation of Aboriginal and Torres Strait Islander people in road trauma. However this analysis cannot account for differences in exposures between Aboriginal and non-Aboriginal road users, which might account for some of the findings. For example, a higher rate of passenger injury and overcrowding are known issues for Aboriginal road users and therfore it is possible that the contributing factors identified are not necessarily higher among Aboriginal drivers per se. Nevertheless a more accurate identification will aid understanding of the causes and implications of road crashes and inform development of effective initiatives to move towards zero deaths and serious injuries for Aboriginal and Torres Strait Islander road users.

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Prevalence and Perception of Following Too Close in Queensland

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Abstract

This paper reports on a three year multidisciplinary research project for Motor Accident Insurance Commission investigating the relationship between rear-end crashes and unsafe car-following behaviours in Queensland. The methodology combined on-road data collection, crash data and self-report behavioural data. On-road measurements (3 million data-points) confirmed that tailgating is a major contributor to rear-end crashes. Results from the community survey ($N = 495$) indicated that most drivers expressed the belief that they are keeping safe distances. However, objective measurements from the larger on-road analysis showed that this is generally not the case. Our findings and the policy implications will be discussed in detail.

Background

Rear-end crashes account for a large part of road casualties and road safety-associated costs. In Queensland, they accounted for 21% of police-reported collisions and 36% of claims in the state's compulsory third party scheme over 2000-2010 (Schramm, McKenzie, & Williamson, 2012), for a social cost of $1.7 billion (e.g. medical treatments associated with whiplash). Tailgating has been reported as a contributing factor to rear-end crashes: for example it was reported as the principal circumstance in 11.4% of crashes in Queensland (Schramm et al., 2012; Austroads, 2015). However, no previous study had provided empirical evidence to support the hypothesised link between tailgating behaviour and rear-end crashes.

Method

The methodology combined crash and offender data analysis, on-road data collection, and data from a community survey of Queensland drivers. Crash and offender data were used to profile drivers involved in rear-end crashes and identify rear-end hotspots in South East Queensland. Comparisons were made between rear-end crash characteristics and other crashes; the same was done for driver characteristics. We identified rear-end crash hotspots and used Safety Performance Functions to classify them as black-spots where observed crashes exceeded predicted crashes. Ten locations were shortlisted for objective data collection (including both black-spots and locations with less than expected crashes); three million headway observations were taken using TMR induction loops and CCTV cameras. Drivers recruited from a list of MAIC rear-end claimants and general media releases were surveyed online ($N = 495$) on their perception regarding safe following distances, rear-end crash involvement, and awareness of enforcement practices.

Results

Crash profiling showed that compared to "other multi-vehicle" crashes, rear-end crashes were more likely to occur along roads with a posted speed limit of 70-90 km/hr. They were also more likely to result in less serious injuries. In terms of drivers' characteristics, compared to other multi-vehicle crash-involved drivers, rear-end crash-involved drivers were more likely to be aged 30-59 years. They were less likely to be aged 60+, be learners, or motorcyclists.

Community survey results revealed that most drivers believed that they were keeping safe distances, using seconds as their favoured measurement method (40%). Most drivers reported keeping the same gap regardless of traffic flow or road type. The majority of the sample (85%) perceived that there is an extremely low chance of being caught by police if tailgating.

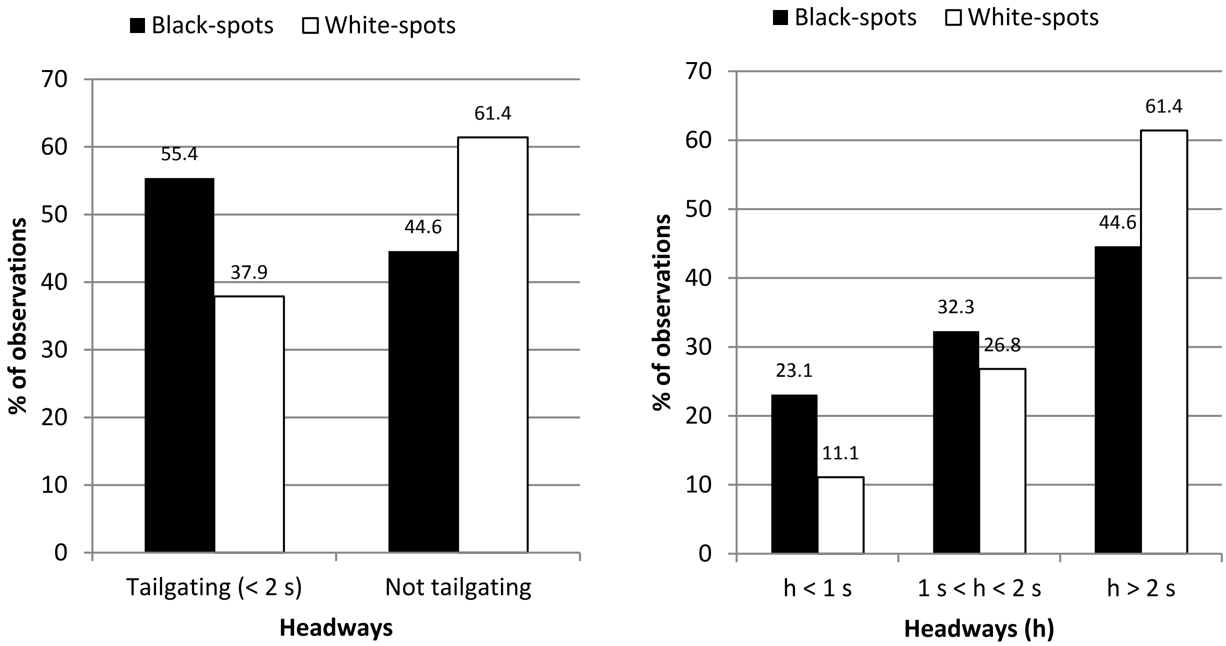

Figure 1. Distribution of headway measurements at black and white-spots; tailgating vs. non tailgating (left), detailed measurements (right). N.B. white-spots are defined as locations where the observed amount of rear-end crashes was lower than the predicted one

At black-spots, 55.4% of observations were identified as tailgating (less than 2 seconds), compared to only 38.6% at other sites. For all observations, tailgating was identified at 49.2%. These objective results seem to contradict surveyed drivers' subjective assessment of their behaviour if this assessment can be generalised to the whole population (no direct assessment of the surveyed drivers' actual following behaviour could be made in this study). Higher levels of tailgating were associated with higher crash rates even when characteristics such as traffic volume, average speeds, and vehicle mix were taken into account. We also showed that relative speed is a key behaviour associated with both tailgating and high rear-end crash rates.

Conclusion

Our results support the hypothesis that tailgating is a major contributor to rear-end crashes, which had not previously been empirically confirmed. Contributing factors to unsafe following behaviour were identified from both the objective and subjective analyses. This research suggests that efficacy of existing interventions on rear-end crashes need to be re-evaluated, in particular the need for consistent education and messaging (including a standardised definition of "safe following distance") around the importance of safe following distances.

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Township Entry Treatments

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Abstract

A pilot project was undertaken to determine the benefits of Township Entry Treatments (TET) for use in Queensland. The overall intention was to introduce TETs using a pilot and subsequently expanding the pilot using a mass action program (MAP). The pilot gauged stakeholder expectations and assessed the resultant speed changes. The methodology included site identification, data analysis, ranking and prioritisation using benefit cost ratio. The TET included signage and pavement marking at six towns to gain an initial assessment of its effectiveness in reducing vehicle speeds. Lessons learnt from the pilot were considered in the implementation of a MAP.

Background

The paper discusses a project undertaken by Queensland Department of Transport and Main Roads to determine the benefits of a Township Entry Treatment (TET), through a researched pilot study. The project also involved development of technical guidelines for use in Queensland and the pilot was undertaken to gauge stakeholder and community acceptance and expectations of this new treatment and to assess the speed limit changes that resulted. A review was undertaken of TET "Before-After" Studies in United Kingdom and New Zealand. Evaluation of crashes before and after treatment showed a 26% reduction in crashes as a result of entry treatment implementation at 102 sites across New Zealand.

Method

A process of introducing a new road safety initiative from research phase followed by implementation of a pilot project and eventual MAP was adopted. Lessons learnt and suggestions for improvement when running a road safety initiative project were considered. Especially the importance of "before and after" evidence based approach that is defendable on a number of different levels. Stakeholder (including political), community and road user considerations were factors explored in the implementation of TETs. A methodology was developed for the pilot that included: site identification, site data analysis, site ranking and site prioritisation using BCR. The treatment composed of signage and pavement marking and was applied to a pilot program of six towns to establish the treatment and to gain an initial assessment of the effectiveness of TETs in reducing vehicle speeds, and to assess community views.

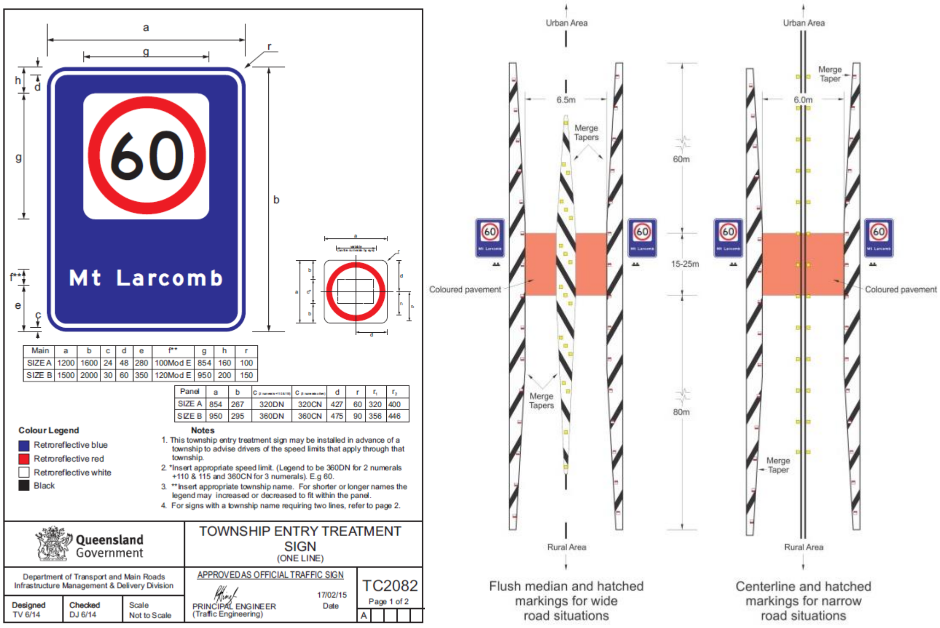
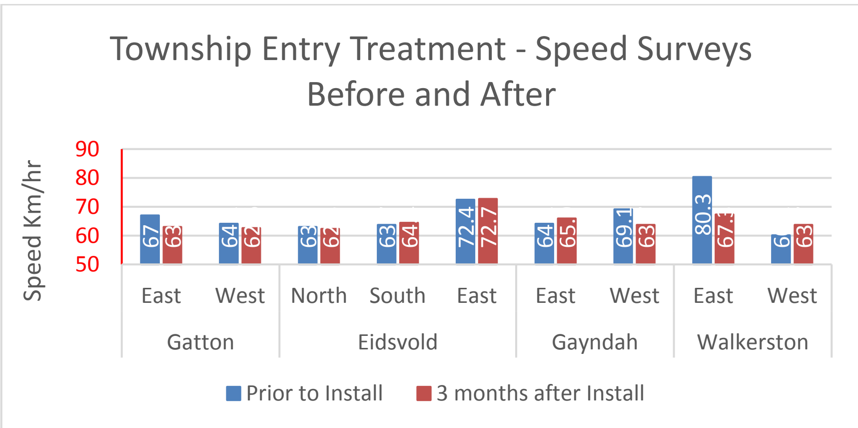


Figure 1. TET Signage and Pavement Markings

Results

As part of the pilot project four towns have completed their implementation and speed survey comparisons were made with the average speed reduction of 2.0km/h across the nine test sites. Feedback was also received about the entry treatment design for future implementation. The pilots need to be evaluated for crash analysis over 1, 3 and 5 year periods.

Table 1. TET – Speed Surveys Before and After



Conclusions

As with any road safety initiatives, it is important to consider lessons learnt and the effectiveness of TETs from past projects and to run a pilot program prior to any extended implementation via a MAP. TETs have proven to be working in UK and NZ and their introduction in Queensland at regional towns are seen as a good road safety initiative from the community and road user perspective. Future directions received from the pilot feedback included potential redesign of the physical signage and introduction of complementary projects such as the use of 'Speed limit AHEAD' sign, undertaking speed limit review of Township Entry Treatment and the introduction of 50 km/h speed limit through townships.

Integrating Human Factors and Systems Thinking for Transport Design: Rail level Crossing Case Study

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Abstract

Rail level crossings (RLXs) represent an intractable problem. Safety gains achieved through traditional approaches appear to have plateaued. We describe a program of research that took an innovative research approach to this longstanding problem. This involved integrating human factors and systems thinking methods to provide a whole of design lifecycle approach to analyze the performance of existing RLXs, design novel RLX environments, and evaluate and test these designs. The research program culminated in a series of tested design concepts, recommendations for further research into promising infrastructure changes, as well as recommendations for improving management of RLXs more generally.

Background

Collisions at rail level crossings (RLXs) are a longstanding transportation safety issue. These represent a persistent source of trauma, accounting for approximately 45% of Australian rail fatalities (ONRSR, 2015). Worringly, in line with broader road safety trends, such as increases in the road toll in several states (BITRE, 2016), safety gains at RLXs appear to have plateaued.

To improve RLX safety, it is argued that new approaches are required. Specifically, there is a need to depart from traditional reductionist approaches which focus on improving individual parts of the system (e.g. preventing driver errors, making a warning more conspicuous), to approaches that consider how these parts interact, and how the functioning of the overall transport system can be optimized.

Approach

Systems thinking involves taking the overall system as the unit of analysis, looking beyond the individual, and considering the interactions between humans and between humans and technology within a system. This view also considers factors relating to the wider organisational, social and political environment. Taking this perspective, safety emerges not from the decisions or actions of an individual, but from interactions between humans and technology across the wider system. This approach was adopted as part of a research program that aimed to improve safety at RLXs.

The research program comprised the following four phases:

1. Data collection. On-road and questionnaire-based studies were conducted to understand road user and pedestrian behavior at RLXs, in addition to document review and interviews with subject matter experts (e.g. Beanland, Lenné, Salmon & Stanton, 2016; Salmon, Lenné, Young & Walker, 2013).

2. Systems analysis. Systems analysis methods were applied to understand the behavior of RLX systems (e.g. Mulvihill et al., 2016; Salmon et al., 2016).

3. Generation of innovative designs. A participatory design approach, the CWA Design Toolkit, was used to generate novel designs for RLXs (Read, Salmon & Lenne, 2016).

4. Evaluation of designs. Following initial desktop evaluation incorporating the systems analyses from phase 2, the design concepts were formally testing through driving simulation and questionnaire-based studies.

A number of human factors and systems thinking methods were applied throughout the research program (Figure 1). A number of the methods were used across multiple phases. For example, vehicle measures were collected at the beginning of the research program during on-road studies to understand driving behavior at existing crossings and again in the final phase during driving simulator studies to understand responses to the innovative RLX designs.

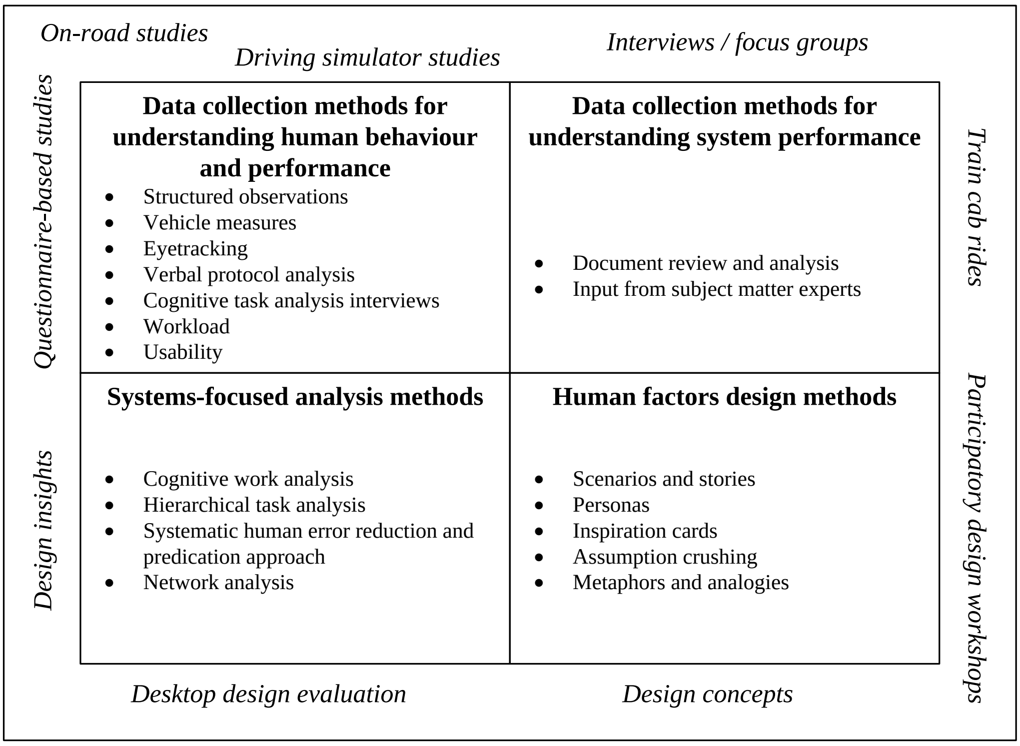

Figure 1. Human factors and systems thinking methods and approaches applied

Findings and implications

The research program produced novel findings about user behavior at RLXs, identified risks associated with RLX functioning, generated innovative design concepts for RLXs and provided initial evidence of the likely effectiveness of the designs. A core outcome was a set of recommendations which addressed the development of in-vehicle devices, changes to infrastructure at RLXs, and improvements to RLX safety management. An important recommendation was the integration of systems thinking approaches into various aspects of safety management including risk assessment processes, investigation methodologies and data collection tools.

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Mismatches between Trainee and Educator Perceptions Regarding the Use and Value of Driving Simulators

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Abstract

Driving simulation has become increasingly sophisticated. However, perceptions regarding the use and acceptability of simulators for driver education have received little research attention. An online survey with inexperienced drivers and focus groups with driver educators explored perceptions regarding the inclusion of driving simulators within novice driver education. There was a difference in the level of acceptance of simulators between groups with young drivers being highly accepting and driver educators displaying a high degree of scepticism regarding their efficacy as training tools. Moreover, education regarding the effective evidence-based use of simulators in training is warranted.

Background

Driving simulators have increased in technical sophistication and can be used to train a range of higher-order cognitive and procedural driving skills (Fisher, Rizzo, Caird, & Lee, 2011). Research suggests that simulators are, at present, more effective for training higher-order cognitive skills (Pollatsek, Vlakveld, Kappe, Pradhan, & Fisher, 2011). Little, if any, research has attended to perceptions about what driving simulators can or should be used for in driver education and their level of acceptance by young drivers and driver educators.

Method

This study consisted of an online survey of young drivers (n = 100; M_{age} = 17.9 years, SD = .86; female = 68%) and three focus groups with driver educators (n = 10) which involved a drawing task centered on driving simulators. The young drivers had completed a driver education course operated by an organisation in regional Queensland prior to participating. All driver educator participants were employed to facilitate this course. Young drivers provided Likert-type responses to a modified version of the Technology Acceptance Model (TAM; Davis, 1989) and free text short-answer responses to two questions asking about driving skills that could be 'better mastered' or 'mastered more quickly' in a simulator. Examples of driving skills were provided. Skills suggested by young drivers were categorized as procedural skills, higher-order cognitive skills, or a combination of both. The study was approved by the Queensland University of Technology Human Research Ethics Committee (1500001083) and funded by the Australian Research Council (LP140100409).

Results

Young drivers held a positive view of simulators with a mean TAM perceived usefulness score of 5.10 (SD = 1.30) and mean TAM perceived ease of use score of 5.19 (SD =1.18) out of 7. A range of skills that could be trained in simulators were nominated by the young drivers (Table 1). Aproximately, 62% of the total number of suggested skills that could be 'better mastered' or 'mastered more quickly' in a driving simulator were procedural skills. Comparatively, around 24% of the nominated skills were categorised as higher-order cognitive skills.

In contrast,the driver educators were highly ambivalent about the use of driving simulators. After discussion during the groups, there was general agreement amongst educators that, for both procedural and higher-order cognitive skills, only simulators with the highest level of fidelity could potentially be an effective training tool. However, the efficacy of even the most technologically advanced simulator continued to be strongly questioned by most participants throughout each focus group. It is possible that this scepticism is the result of a lack of knowledge about simulators and what can be effectively trained using them.

Table 1. Driving skills that young drivers perceive could be trained in a driving simulator

Category	Skill	Question and Frequency	
Procedural skills		Driving knowledge – 'better mastered'	Driving knowledge – 'mastered more quickly'
	Changing gears	50	64
	Vehicle manoeuvres	34	27
	Vision skills	22	21
	Lane position	20	21
	Road rules	12	-
	Braking	10	16
	Turning corners	10	14
	Checking blind spots	10	-
Higher-order cognitive skills			
	Practicing managing distraction	27	39
	Planning ahead	25	11
	Awareness and Observation	12	12
	Other Road Users	2	-
Combined			
	Driving under specific conditions	36	39

Note. Participants (n = 100) could nominate multiple answers and some chose not to make a response. Therefore, the total number of responses does not reflect the total number of participants in the study.

Conclusions

There is a mismatch between the high acceptance of simulators as a training tool by inexperienced drivers and the high level of scepticism towards them by the driver educators. There is disparity between the lay perception of driving simulators as predominantly useful for training procedural driving skills and research evidence suggesting greater efficacy for simulator training of higher-order cognitive skills. Promotion of evidence-based use of driving simulators in driver education is warranted.

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Road Safety Study – Candia Road – 'Before' and 'After' Crash Study

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Traffic Engineering Solutions Ltd

Abstract

In 2009 a crash study determined that a substantial rural road loss-of-control crash problem existed along Candia Road (Auckland). Crash remedial works were recommended, designed and installed along the study cordon (early 2010). In 2017 reported crash statistics were studied along the study cordon for a 7-year period 'before' and 'after' the crash remedial works were installed. The crash remedial works reduced reported crashes substantially, by 87%. Furthermore, $24 million in lifetime crash cost savings was achieved, with a very high Benefit Cost Ratio (19) and an average of 1.4 Death/serious injury crashes saved per year.

Background

During a crash reduction study in 2009 Traffic Engineering Solutions Ltd (TES) established that a substantial rural road loss-of-control crash problem existed along Candia Road (Henderson, Auckland). The reported crashes appeared particularly adverse along a southern section of the road, from Henderson Valley Road to Sturges Road; this route becoming the focus of the investigation.

Method

Crash remedial works were recommended, designed and installed along the study cordon route (early 2010). The crash remedial works were mainly focussed at two bends within the study cordon, and the works were consistent with the Safe System principles of achieving '*Safe Roads and Roadsides', 'Safe Speeds', and 'Safe Road Use*'.

A package of crash remedial measures was proposed with reference to general recommendations in technical guidelines (Austroads, 2009a; Austroads, 2009b; Transit New Zealand, 2009). The works were focussed mainly at two sharper bends, and included shoulder widening, highly skid-resistant road surfacing, shape correction, guardrail, curve warning signs, embankment cutback, roadmarking upgrade, and signage improvements.

Results

In order to determine the effectiveness of the implemented works in terms of reducing crashes, reported crash statistics were studied in 2017 for a seven-year period 'before' the works were installed, and a seven-year period 'after' the works were installed. The crash monitoring study has indicated that the combined package of constructed works reduced crashes substantially. Prior to works, 45 crashes were reported along the study cordon over seven years, including 1 fatality and 9 serious injury crashes. After works, only 6 crashes were reported over seven years, with zero death/serious injury crashes (DSI), and no evidence of crash migration.

Effectively, reported crashes reduced by 87%, with substantial lifetime crash cost savings of $24 million (including a downward crash trend). Also, a very high Benefit Cost Ratio (19) was achieved, and an average of 1.4 Death/Serious Injury crashes saved per year.

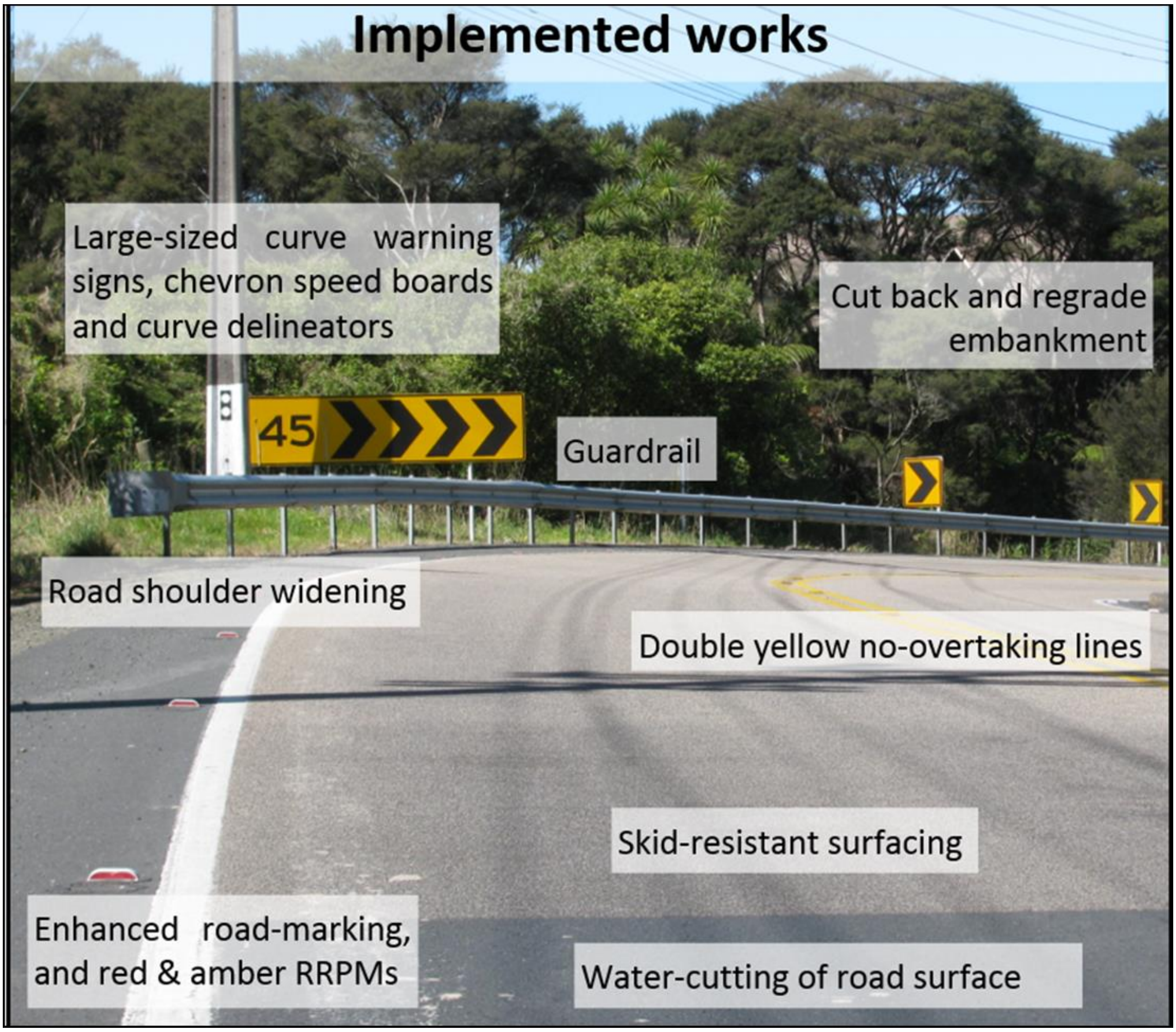

Figure 1. Candia Road - Typical Implemented Crash Remedial Works

The crash remedial works were **innovative** because the key causal factors relating to the crash patterns were precisely identified by examining Traffic Crash Reports and replotting the crash diagram. Also, a large number of complementary crash remedial measures were implemented simultaneously.

The package of remedial works was **cost effective**, as evidenced by the substantial benefit-cost ratio achieved by the crash savings.

The works stand out **beyond traditional activities** in terms of the extremely high percentage of crash savings (87%), proven to have been achieved over a long period of time (seven years).

Conclusions

Crash studies can achieve substantial crash savings with very high BCR far exceeding typical expectations by using several techniques, such as:

- Precisely locating and plotting crashes, and using all available crash data;
- Focus the crash remedial works at the locations where most crashes have been reported, while applying the 'Safe Systems' approach to the remainder of the route; and

- Designing a large package of complementary remedial works, focussed at key locations along routes, as determined by in-depth crash analysis.

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Shared Spaces – Auckland – A Safety and Operational Performance Study

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Abstract

In 2017, a safety and operational performance study was undertaken of Shared Spaces (spaces) in the Auckland CBD. These spaces are public streets intended to be shared by people and motorists. The study included an international literature review and operational surveys at five spaces. The spaces were generally considered to be operating reasonably successfully. However, excessive traffic speeds and volumes were evident at two spaces. Various measures were recommended for reducing traffic speeds and volumes within the spaces, which would be expected to enhance their safety and operational performance, and should also be considered for incorporation into future spaces.

Background

In 2017 Traffic Engineering Solutions (TES) undertook an operational safety review of spaces in the Auckland CBD, New Zealand. The aim of the study was to review these spaces with respect to their safety record and operational performance from a transportation and public perspective, and to consider how well the design elements within the spaces were performing to enable the safe and appropriate use of these areas.

Method

The study included an international literature review, and site observations, measurements, and surveys throughout an entire day at five Shared Spaces in the Auckland CBD.

Results

The five spaces reviewed in this study were generally considered to be operating reasonably successfully in terms of safety and operational performance. However, excessive traffic speeds (around 25 km/h 85th%tile) were evident at two spaces. Also, traffic volumes were considered higher than desirable (above 3,000 vehicles/day) at two spaces.

Excessive traffic speeds and vehicle volumes are key factors adversely affecting pedestrian safety and amenity within a space. Reducing both traffic speeds and traffic volumes is important for achieving a fully successful outcome for spaces.

From site inspections and as identified in previous research (Carmine et al 2012)(Karndacharuk et al 2016), key features identified as being included in the design of each existing space in Auckland were (1) Entry/exit gateways, (2) Level textured Surface, (3) Accessible Zone, (4) Activity Zone, and (5) Trafficable Zone.

Features considered to be desirable for a Shared Space were: (1) Reduced traffic speeds, (2) Improved road safety, (3) Reduced traffic volumes, (4) Increased pedestrian volumes, (5) Active building frontage, (6) Circulation Zone lateral shift, (7) Circulation zone narrow width, (8) Restricted loading, and (9) No parking.

Many of these features are illustrated in Figure 1.

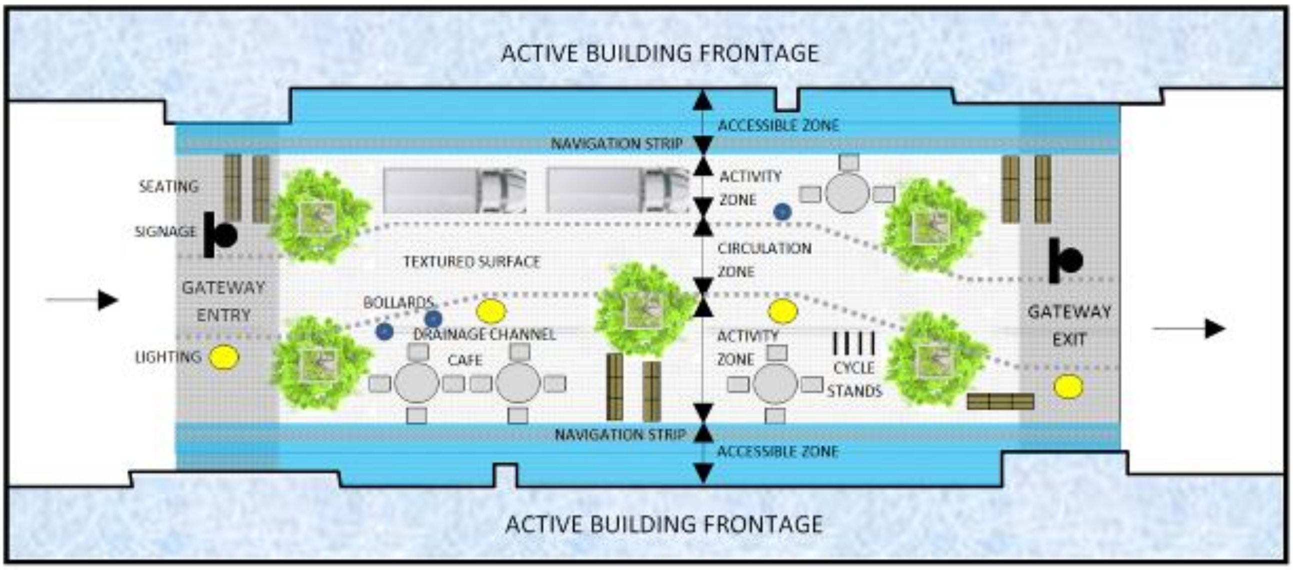

Figure 1: Key Design Features and Desired Design Features for a Shared Space

In relation to Figure 1, the following design attributes are worth noting:

- Lower traffic speeds are encouraged by the trafficable zone having lateral deflection, a narrow width, adequate 'side friction', and no adjacent drainage channel;
- Street furniture adjacent to the trafficable zone with high bulk/height is likely to increase 'side friction'. Large street furniture (such as trees) are effective at enhancing the impact of 'Gateways', and are robust at the rear of loading areas;
- The navigational strips are unobstructed, define the accessible zone, and are located within the accessible zone; and
- Pedestrian seating is not exposed to the trafficable zone or loading areas. Bollards provide added protection for seating, and prevent loading at inappropriate locations.

Conclusions

Various measures have been recommended for reducing traffic speeds and volumes within Shared Spaces. These remedial measures would be expected to enhance safety and operational performance in existing spaces, and should also be considered for incorporation into future spaces. In general terms the key recommendations include:

- Introduce trafficable zone lateral shift, particularly if midblock sections are greater than 50 metres;
- Narrow the trafficable zone to around 5.5 metres (two-way) or 4.0 metres (one-way);
- Increase trafficable zone side friction by increasing height/bulk of adjacent street furniture;
- Ensure navigational strips within the accessible zone are clear of street furniture;
- Position pedestrian seating clear of traffic.

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From on High? A Systems Analysis of the Contributory Factors that Lead to the Fatal Five Behaviours

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Abstract

This article presents the findings from a study in which a systems thinking framework was used to collect and analyse a range of data on the factors underpinning the so called fatal five driver behaviours. The study included an analysis of crash data, a series of surveys on drivers' perceptions on the causes of fatal five behaviours and an expert workshop. The data was analysed and mapped onto a systems model of the Queensland road transport system. In addition to well-known contributory factors, additional factors related to policy, transport system design, road rules and regulations, and societal issues were identified.

Background

In the last decade the potential utility of applying systems theory and methods in transportation safety research and practice has been recognised (Larsson et al, 2010; Salmon et al, 2012). In response researchers have undertaken various applications of systems theory and methods to investigate the causes of road trauma. Whilst these initial applications have shed new light on the system-wide causes of road trauma, a significant limitation is the fact that the majority of crash analysis studies have focused only on a single catastrophic event and/or analysis of existing crash data only (e.g. Newnam & Goode, 2015; Newnam at al, 2017; Salmon et al, 2013). This has impacted the generalizability and validity of findings and has raised the requirement for further research utilising other data sources.

In response to this, this article describes a study that aimed to go beyond limited accident data to investigate the system-wide factors underpinning drivers' engagement in the so-called fatal five behaviours known to lead to road crashes (drug and drink driving, distraction, seat belt wearing, speeding, and fatigue). The study involved building on a recently developed systems model of the Queensland (Qld) road transport system (Salmon et al, 2016, see Figure 1) by combining accident data, driver surveys and an expert workshop to identify fatal five contributory factors across the Qld road transport system. The aim was to identify a. what factors lead to drivers engaging in each of the fatal five behaviours; and b. where these factors reside in the Qld road transport system control structure presented in Figure 1.

Method

The aims were achieved through the conduct of three studies:

1. *Surveys of road user perceptions on the causes of each fatal five behaviour*. A total of 316 participants completed surveys designed to elicit their perceptions on why drivers engage in each fatal five behaviour;

2. *A road safety subject matter expert workshop*. Six road safety experts took part in a workshop designed to elicit their perceptions on the causes of each fatal five behaviour.

3. *Fatal road crash data analysis*. Fatal road traffic crash data for Qld between 2010 and 2015 was assessed to identify the contributory factors involved in the crashes caused by fatal five behaviours.

Results

The data derived from each activity was analysed to identify factors across the Qld road transport system that play a role in drivers' engagement in the fatal five behaviours. Following this, the factors identified were mapped onto the Qld road transport control structure in Figure 1 based on where in the system they were perceived by the authors to reside (e.g. 'Stupid drivers' resides at the 'Operating process: Driving' level whereas 'Unclear rules and regulations' resides at 'Parliament and Legislatures').

The results from the three studies demonstrated that, in addition to well-known factors related to the driver, vehicle and road environment, additional factors related to road safety policy, transport system design, road rules and regulations, and societal issues were identified.

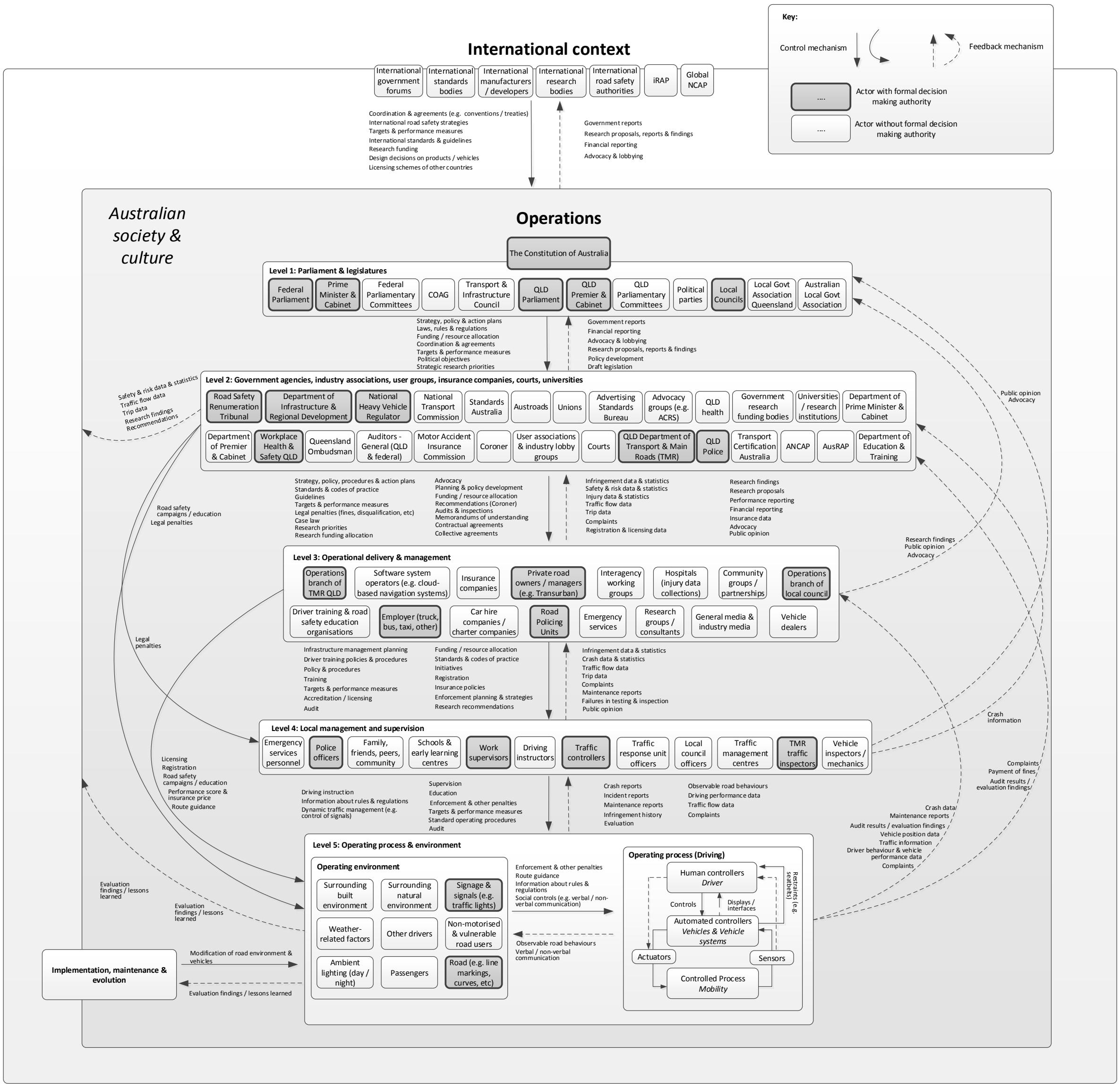

Figure 1. QLD road transport system control structure (Source: Salmon et al, 2016) - Analysis of contributory factors will be presented in the final conference article and presentation

Discussion

In summary, the analysis revealed that there is a complex web of interacting factors that lead to drivers engaging in the fatal five behaviours. Notably the findings show that these factors reside across all levels of the road transport system from the driver, vehicle and road environment levels to the higher government levels. The findings show the importance of targeting all levels of the system when developing road crash prevention strategies.

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Lived Experiences and Impacts of Disabilities in Cambodia Following Road Crashes

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Abstract

The study aimed to explore the impacts of disabilities following road crashes in Cambodia. Primary data collection was conducted via structured observations and in-depth interviews with the persons with disabilities as a result of a road crash and their families. They were asked about their perceptions of road crash characteristics and causes, experiences related to emergency responses and post-crash treatment, support on discharge and impacts on them and their families. The study illustrated the disability-poverty cycle and the need for interventions and a disability inclusive approach to road safety.

Background

Road crashes and injuries have become a growing issue worldwide and disability has been recognised as a global public health issue. Persons with disabilities, especially in developing countries, experience more disadvantages in education, employment and health care (Ingstad & Eide, 2011; WHO, 2014). Additionally, the perspective of persons with disability about their lives has not been captured.

The main objective of this study was to identify and explore the self-reported impacts of disabilities following a road crash on the lived experiences of casualties and their families.

Method

Primary data collection was conducted through in-depth interviews with 46 persons with disabilities (due to road crashes) and 31 family members, and 44 associated observations in seven provinces in Cambodia. Initially, preliminary semi-structured interviews were conducted with the persons with disabilities and their families to collect general information (name, family status, etc.), an overview of the road crash that had led to their disability and overall lived experience. Subsequent, in-depth interviews were arranged around six to nine months after the first stage. Continuous, iterative thematic analysis was conducted throughout the data collection. The information gathered from new participant built up previous information and contributed to successive data collection and analysis (Corbin & Strauss, 2008).

Results

After their crashes, persons with disabilities experienced inadequate emergency response and insufficient post-crash treatment that might have increased the severity of their long term impairments and contributed to their disabilities. Impacts of disabilities on participants and their families included reductions in their sense of physical, psychological, economic and social well-being and limited inclusion due to societal barriers.

The study also illustrated the effect of road crashes on poorer communities. Poorer living conditions were observed in rural areas compared to urban areas among the persons with disabilities. The analyses also highlighted the unaffordability of safer transport modes for people in low-socio economic groups, which made them more vulnerable. Additionally, incidents of hit and run crashes, unfair compensation, and a lack bargaining power were evidence of shortcomings in enforcement and the justice system.

There were varying perceptions about crash causation with a spectrum of beliefs in *karma*, blackspots and *reasey* as a cause of road crashes and disabilities. This demonstrated the important role of cultural and religious beliefs among some participants in their perceptions of road crash causes, which led to an acceptance that crashes could not be prevented.

The findings confirmed the disability poverty cycle. Families experienced decreased income and increasing family expenses and debt. Additionally, persons with disability, children or siblings frequently dropped out of school.

Conclusions

The findings suggest that there are gaps in road crash prevention, long term impairment intervention, and disability inclusion. The experiences of the participants highlighted the lack of a social protection scheme, the insufficient implementation of current policies and the absence of relevant policy development. Additionally, this study illustrated the need for interventions and a disability inclusive approach to road safety.

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RAC Intellibus^{TM}: Australia's First Automated Vehicle Trial- Testing Safety Safely

Anne Still, Anna Sawyer, Matthew Hamilton

RAC Western Australia

Abstract

Since the project's inception in 2015, RAC has been testing and evaluating a Level Four High Automation and fully electric shuttle bus. Having now launched a public on-road trial in August 2016, RAC's IntellibusTM takes passengers along a 2.8 kilometre route in South Perth. The Trial has three broad aims which seek to understand autonomous vehicle (AV) technology in a live environment and to consider their likely impact. This paper provides a summary of the Trial's three stage methodology as well as the findings thus far.

Background

Road injury is one of the largest causes of hospitalisation and death for Australians under 45 years of age, and serious injuries accounted for $27 billion per year or 18 per cent of Australia's total health expenditure. According to the Australasian New Car Assessment Program, or ANCAP, about 90 per cent of crashes on Australian roads currently involve some form of human error and the implementation of AV technology in vehicles is likely to alleviate the seriousness of injury and even death.

Autonomous vehicle (AV) technology is rapidly advancing, with vehicles becoming increasingly automated requiring less driver intervention. The reduction of human intervention in vehicle operation represents an opportunity to increase commuter safety, whilst enhancing mobility and reducing congestion . However, incorporating driverless vehicles into modern traffic systems and road design will present a number of challenges that require further research such as public perception, passenger safety, traffic flow, integration, and deployment .

Importantly, as an incremental innovation consumer adoption of AVs such as the RAC's IntellibusTM are facilitated by mere exposure to the innovation through contact and exposure of the general public to users Shih & Venkatesh, 2004). The RAC's IntellibusTM trial seeks to evaluate AV performance in a real world environment while increasing the exposure of the public to AV technology and thus influence discussion, perception and adoption of the technology.

Method

Invite members of the public to register and take part in an on-road Trial over a 12 month period where a condition of participation includes the completion of a post-ride feedback survey. This public stage involves open public testing on a fixed 2.8 kilometre route on the South Perth foreshore at reduced speed (15km/h). Each ride consists of 6 to 8 participants, who take a single 25 minute curated journey with a chaperone on hand to explain AV technology and control of the vehicle if necessary. Prior to the public launch, RAC undertook closed testing on a private track as well as closed testing on a public road- the staged and incremental complexity of the trial are planned in the near future.

Results

Initial results will be presented in relation to trial methodology and public perceptions of AV performance and safety in a real world environment. Discussion will focus on the future direction of the safe deployment of AV technology onto the Australia road environment and the importance of technology trials.

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Applying Cluster Analysis to Validate a High Risk Young Driver Model: Implications for Tailored Road Safety Intervention

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Abstract

This project explored the feasibility and efficacy of a model that could be used to identify high risk young drivers (HRYD). The present findings pertain to the final stage, which was to assess the predictive ability of the HRYD model. The two-step cluster analysis method was employed with de-identified Police records of 2,973 Sunshine Coast residents aged 17-24 years. The four clusters in the final solution aligned relatively consistently with the HRYD clusters developed during the earlier phases (literature review, focus groups) of this pioneering project. The HRYD model can be used to guide intervention targeting high risk youth behaviour.

Background

In 2014, funding was secured for a large-scale multi-disciplinary project to explore the feasibility and efficacy of a model to identify HRYD, a group of young drivers who exhibit particularly risky driving styles. This project commenced with a literature review of profiling of offending youth, including HRYD, and a qualitative study into the behaviours and characteristics that can identify HRYD. Subsequently these findings were integrated within the theoretical framework of systems thinking which asserts that young driver safety emerges as a result of a wealth of interactions between a multitude of key stakeholders, including police, and government licensing authorities (Scott-Parker, Goode, & Salmon, 2015; Scott-Parker, Goode, Salmon, & Senserrick, 2016), culminating in a HRYD model featuring on-road (eg, offences), and other (eg, shoplifting, risky peers) behaviours/characteristics. The final stage of this project, reported here, assessed the predictive ability of the HRYD model.

Method

Queensland Police Service provided de-identified data of all driving and non-driving-related occurrences (eg, fingerprinting for security licences) pertaining to Sunshine Coast residents aged 17-24 years (as of 30 June 2016), via records from age 14 years. Following an extensive cleaning process,[1] records of 2,973 individuals remained (98% of the original data). The two-step cluster analysis method was employed, with guidance from Hair, Black, Babin and Anderson's (2010) six-stage model-building approach. The cluster variate for the final solution comprised 10 variables pertaining to traffic crashes, drink/drug-driving, registration, dangerous/careless driving, driving causing death/grievous bodily harm, and driving while unlicensed/suspended/disqualified offences.

Results

The cluster quality[2] was 'Good' (0.6 out of 1.0). Four clusters were identified in the final solution (see Figure 1, Table 1). While individuals in both Clusters-2 and -4 were more likely to be male, broadly speaking Cluster-2 (HRYD) was distinct from Cluster-4; individuals in Cluster-2 having

[1] E.g., to remove rows of redundant data and occurrences where the individual was not classified as an "offender", "charged", and/or "driver" etc.

[2] A measure of the cohesion and separation of the final solution.

longer offence histories which contained significantly more driving and non-driving related offences in most instances (compared to any other cluster). Cluster-4, the smallest cluster, is distinct from Cluster-2 in that these individuals contain records that show few offences other than those pertaining to substance misuse. Conversely, Clusters-1 and -3 exhibited much more overlap. Individuals in Cluster-1 had records with few offences (often no driving offences) and little involvement in crashes other than those without injury. Cluster-3 individuals exhibited significantly more involvement in crashes with injury. Relatedly, individuals in Cluster 3-also exhibited more driving-related offences than Cluster-1.

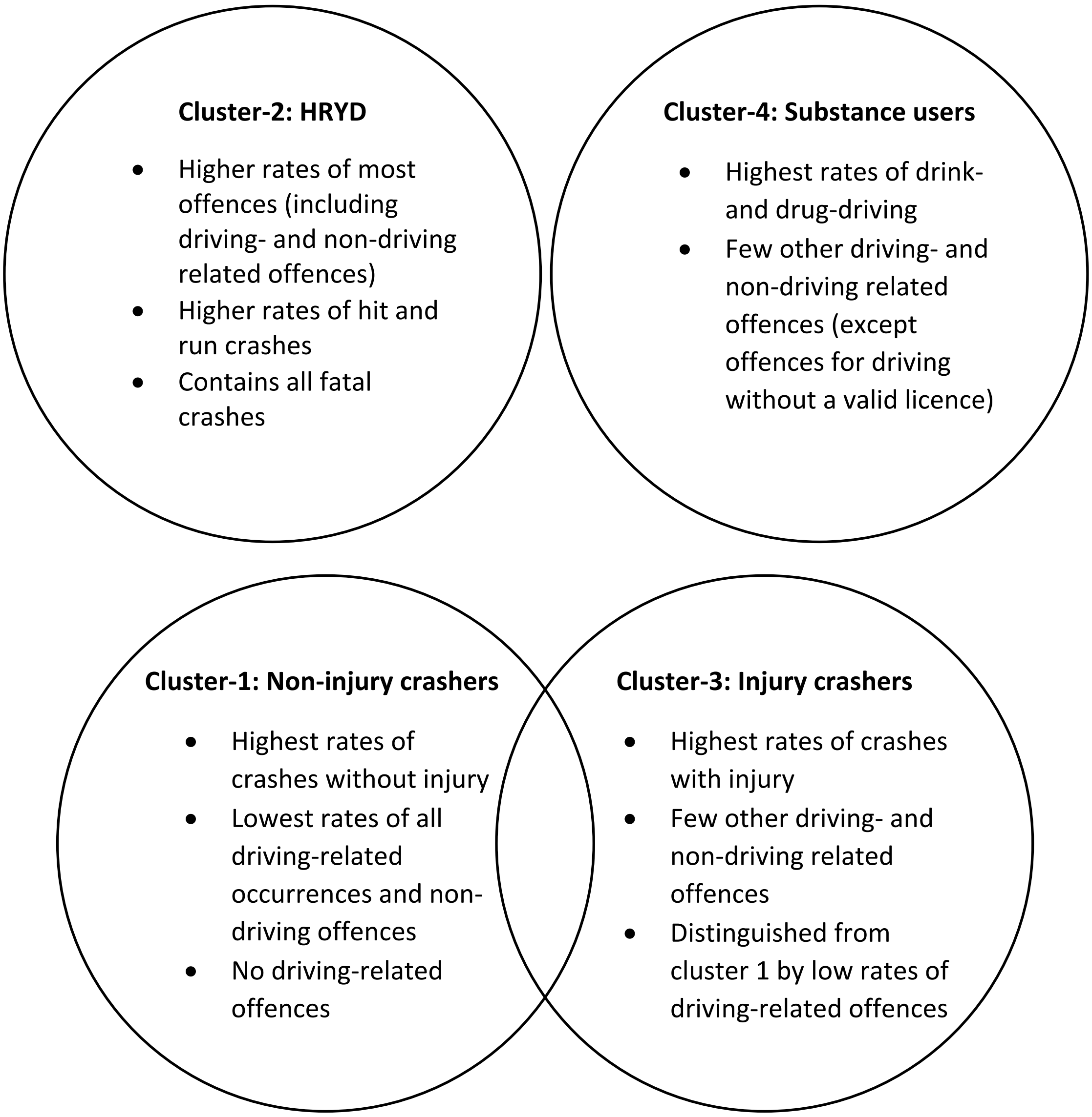

Figure 1. Cluster summary, illustrating that while Clusters 2 and 4 are generally distinct from all other Clusters, Clusters 1 and 3 are not always distinct

Conclusions

The findings of the cluster analysis as they pertain to HRYD specifically were found to align relatively consistently with the characteristics of a HRYD model developed during the earlier phases (literature review, focus groups) of this pioneering project, validating the findings of these earlier research stages. Thus this methodologically-rigorous multi-stage process has provided a theoretically-sound model that can be tested in other youth offender populations. Moreover, the model can be used to guide the development, application, and evaluation of intervention targeting a variety of high risk youth behaviours, including on-road driving behaviours. Such targeted intervention (eg., Cluster 4 youth are likely to benefit most from harm minimisation interventions targeting substance use/abuse difficulties; the characteristics of youth in Cluster 1 suggests that early, multi-faceted intervention is required) is likely to result in the improvement of the health and wellbeing not only of the targeted youth themselves, but also all with whom the youth shares the road.

Table 1. Summary of the profiles of the four clusters

Characteristic/factor	**Cluster 1: Non-injury crashers**	**Cluster 2: HRYD**	**Cluster 3: Injury crashers**	**Cluster 4: Substance users**
% of sample (*n*)[a]	21.4 (636)	40.1 (1,191)	23.8 (709)	14.7 (437)
% of 17-24 years population [b]	2.5	4.6	2.8	1.7
Gender [c]	More likely to be female* (59.9%, *n*=381 male)	More likely to be male* (80.0%, *n*=953 male)	More likely to be female* (53.2%, *n*=377 male)	More likely to be male* (77.8%, *n*=340 male)
Age at offending (years)	Older at first offence ($\bar{x}$=18.2), younger at last offence ($\bar{x}$=18.9)*	Younger at first offence ($\bar{x}$=17.3), older at last offence ($\bar{x}$=19.8)*	Older at first offence ($\bar{x}$=18.1), younger at last offence ($\bar{x}$=19.2)*	Older at first offence ($\bar{x}$=18.3), younger at last offence ($\bar{x}$=19.6)*
Non-driving offences	Few	Highest	Few, not as few as Cluster 1	Generally few, except for substance-related**
Crashes	Non-injury only	Fatal, hit and run, injury, non-injury	Non-injury and injury	None
Driving offences	None	Many	Few	Generally few, except for substance-related
Dangerous/careless driving	None	Highest	Few	None
Licence-related	None	Highest	Few, not as few as Cluster 4	Few
Registration-related	None	Highest	Few	None
Substance-related	None	Many	Few	Highest

[a] Sample population *n*=2,973
[b] 17-24 years population on the Sunshine Coast, data compiled for postcodes present in the dataset only, *n*=25,770 (ABS, 2016).
[c] Compared to the overall sample (of which 69.0%, *n*=2051 were male).
* Chi square analyses, $p<0.001$.
** Krukal-Wallis pairwise cluster comparisons $p<.001$ for all cluster comparisons except between clusters 1 and 3.

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Reducing On-Road Risks for Young Drivers, before Licensure and Beyond: Situation Awareness Fast Tracking Including Identifying Escape Routes (SAFER)

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Abstract

Around the world, young drivers remain at greatest risk of being injured in a car crash during the earliest period of independent driving. To accelerate driving skill acquisition and thus to reduce car crash risk, Situation Awareness Fast Tracking including identifying Escape Routes (SAFER), is a pre-Learner intervention for parents to teach situation awareness skills (SAS) and escape route skills (ERS) to their teen even before they are licensed, and to continue this teaching style throughout the learner phase. SAS and ERS of 60 parent-teen dyads randomly assigned to intervention or control is currently being analysed and will be reported.

Background

To mitigate young driver crash risks during the earliest period of independent driving, Australian states and territories require young novice drivers to progress through a graduated driver licensing (GDL) program starting with mandatory reportable practice requirements during a learner phase before a provisional (restricted/independent) licence phase (Scott-Parker & Rune, 2016). It has been suggested, however, that road safety benefits arising from GDL may have plateaued (Williams, 2011). Recent driver training research recognises that driver learning and training should proceed through sequenced stages of increasing complexity, culminating in higher order instruction which can accelerate acquisition of situation awareness skills (SAS). While SAS in which drivers perceive, understand and project risks associated with driving hazards take time to develop in the novice driver (Deery, 1999), a recent pilot study by the first author revealed the acquisition of SAS can occur even before the teen gains a license, suggesting the utility of a SAS-acquisition acceleration program that could benefit all young novice drivers. Additionally, the role of escape route skills (ERS) in which young drivers actively seek safe routes of passage that can be taken in the event of an emergency remains unknown as it is absent in current curriculum. While some domains of safe driving research consider the role of ERS (Kaplan & Prato, 2016; Yan, Harb & Radwan, 2008), it is often overlooked or is an assumed aspect of SA. Therefore, our pilot program included ERS as a separate measureable construct.

Method

Sixty parent/pre-learner dyads were randomly allocated to intervention (n=30) and control conditions. As part of a larger project currently underway, SAS and ERS was/will be measured via simulator-based verbal commentary protocol at baseline (dyads recruited 4-6 months before anticipated learner licensure), at learner licensure, after six months of learner licensure, and at provisional licensure. The intervention educated parents regarding SAS and ERS and an engaging manner in which to teach SAS to their teen, a technique that should continue through the learner license phase.

Results

Data collection and analysis is currently underway and the pre-learner and learner study findings are expected to be presented at the conference. Process and impact implications for a larger, more-representative evaluation of SAFER will also briefly be presented. Based on participant (parent) feedback, improvement in parent SAS and ERS is also anticipated.

Conclusion

While the initial pilot study revealed it is possible to teach SAS and ERS to pre-licence teens, the current, larger, longitudinal pilot study operationalising random allocation will reveal (a) if it is possible to teach parents how to accelerate the acquisition of robust SAS in their novice driver child, (b) if young novice drivers are able to fast-track acquisition of robust SAS from their parent(s)'s instruction, (c) if young novice drivers develop skills in identifying escape routes, and (d) the impact of SAS and ERS strengths and deficits upon traffic offences and road crashes during the novice license phases. Moreover, any 'upward' education benefits will also become apparent as the evaluation will compare the SAS and ERS of parents in intervention and control groups, with preliminary feedback suggesting broader road safety benefits as a result of targeting the wicked global problem of young driver road safety.

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International Road Policing Assessment Program (IRPAP) – A Star-Rating System for Road Safety Enforcement

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Abstract

This paper establishes the criteria for a star-rating assessment of road policing. The aim is to achieve a quality based self-assessment of police law enforcement, performance, activities and current practices. Simple, useful and affordable measures are provided as pathways towards improvement. The outcomes of the assessment will enable: benchmarking within the jurisdiction and between countries; monitoring of traffic police performance before and after enhancements; an assessment of common police practices, policies, training and operations against a star-rating model for good practice; and, capacity building in traffic law enforcement and improvements in police professionalism.

Background

Research and participant observations working internationally with police has identified an urgent need for a structured approach to benchmark performance, build capacity and implement road safety reform. Research studies often conclude with recommendations that ‘there should be more law enforcement’ as remedial actions, without investigating how this can be achieved or what methods should be applied at either a strategic or operational level.

Star-ratings are a demonstrably useful method for assessing and benchmarking performance in road safety programs. They have been adopted internationally in the New Car Assessment Program (NCAP and its country derivatives), for rating standards, quality and safety features of new vehicles and in the International Road Assessment Program (iRAP and its country derivatives) in rating road quality, standards, safety and serviceability of the road network. Multi-national organisations such as hotels apply star-ratings as a reliable means of measuring quality and value of accommodation and amenities. So too, some commercial enterprises chose to benchmark performance internationally to achieve more productive and competitive outcomes.

Method

This research by project was undertaken using a mixed-method approach of qualitative and quantitative research and employed a literature review and analysis; interviews with road safety experts; a survey involving 216 senior police practitioners; and participant observations undertaken in ten low-to middle income countries. The study then examined avenues to address the problem through a thematic approach to road policing. The research seeks to confirm traffic law enforcement as having a meaningful impact on road user behaviour and thus road trauma reduction.

Results

The study has identified star-ratings as having direct application in road policing. The ratings enable self-assessment of key performance areas, categories and attributes on a graduated benchmark scale, where five stars indicate best practice and one star indicates extremely poor performance and capability. Each attribute within the self-assessment categories has a direct link to a road safety benefit or outcome. To achieve high ratings, attributes must be consistently present and practiced by the organisation. Organisational features that can positively influence ratings include published or documented strategic and operational plans, training documentation, equipment and technology, targeted enforcement operations and dynamic inter-agency partnerships.

The five consolidated key performance areas (Fig 1) with which to assess and compare road policing are identified as: Data and analysis capability; community relationships; road policing support infrastructure; professionalism of the traffic police and operational capability and capacity.

The concepts of Sweden's Vision Zero and the OECD Safe Systems Approach provide acceptable foundations that can be embraced to ensure a companion law enforcement model is holistic in its approach and systematic in its application.

Conclusion

These key performance areas provide a universal framework for a systematic approach to building capacity across all sectors of road policing. The performance areas have been sub-divided into the most practical categories with each category assigned an attribute that is graded towards good practice. The thresholds within the scaled attributes are intended as simple descriptors that are easily identifiable for police as statements of commonplace activities or achievements. Pathways are provided for continuous improvement.

Figure 1. Basic themes for a star-rating assessment

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Enforcement and Community Education – The Golden Keys to Road Safety – A Developing Nation Case Study of Cambodia

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Abstract

This study reviews road trauma in the Kingdom of Cambodia and the concerted endeavours to implement road safety strategies through enhanced enforcement combined with specific education and community programs. The political, socio-economic and cultural issues are considered together with the impact of elections, demonstrations, festivals and floods, as impediments to effective campaigns. The commitment of champions, donor organisations, development of coordination bodies, intensive campaigns, capacity building in policing, improved technology and enhanced operational police practices are reviewed. Acknowledgement of challenges and persistence in approach together with monitoring and evaluation has led to positive outcomes and a foundation for future success.

Background

Road crashes have emerged as a modern humanitarian catastrophe affecting individuals, families, communities and the nation. Many families have been driven deeply into poverty by the loss of breadwinners and the added burden of caring for disabled family members. Moreover, it is the youth of Cambodia who are most severely affected by this tragedy, robbing families of their next generation.

By recognizing this catastrophe, the government established the National Road Safety Committee (NRSC) in 2005 as the coordinating body with high level representatives from 18 ministries. The Road Crash and Victim Information System (RCVIS) has been progressively developed since 2004, as the road trauma data source providing a strong evidence-base for road safety reform.

The 2013 annual RCVIS Report, recorded 4,353 crashes and 16,227 casualties – 1950 fatalities and 5,671 serious injuries. The economic loss was claimed as USD $337 million. Disturbingly, vulnerable road users such as bicyclists, motorbike riders and passengers, motorised tricycles and pedestrians accounted for almost 90% of casualties. The fatality rate per 100,000 populations was (13.0).

Via donor organisations and technical assistance from Handicap International (HI) the Global Road Safety Partnership (GRSP), AIP Foundation, the World Health Organisation(WHO) and the International Alliance of Responsible Drinking (IARD), the country stakeholders and decision-makers have been able to develop critical action plans to prevent and reduce road crashes.

These international consortium partners have worked collaboratively with responsible ministries and stakeholders focusing on risk factors, capacity building, enhanced enforcement, advocacy, policy and legislative reform, improvement of the road crash data system, development of national road safety strategies, action plans, guidelines and operating procedures, conducting social marketing campaigns, and promoting government ownership on project coordination and collaboration.

Method

The study uses a mixed method approach including research, analysis and trends of crash data, reviews of critical evaluations, participant observation, interviews with key stakeholders, news reports, focus group discussions, assessment of police workloads and responsibilities, as well as recognizing compounding factors of increases in the vehicle fleet and driver numbers.

Results

The study identified critical issues of impact during the strategic process of capacity building. These include the political environment (pre-election, election and post-election) resulting in enforcement restrictions, non-enforcement, as well as the drain on police resources with national demonstrations, natural disasters (floods) and festivals. The imperative of sustained road policing, enforcement and education campaigns is highlighted through the overlay of these impediments on the crash data. Existing community programs have notably been strengthened together with the establishment of new coordination bodies such as 'CamSafe' and its youth programs combine to provide a solid foundation upon which Cambodia Road Safety Reform can mature.

Conclusions

The direct correlation between enforcement and education and road trauma reduction is reinforced in the findings from this study. Conversely, reduced enforcement, non-enforcement and the lack of focus on road safety education has a neutral and at times negative impact on road safety. The importance of political support, community initiative and involvement is identified as paramount to the success of road safety reform.

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Understanding the Factors Influencing Heavy Vehicle Related Fatal and Serious Injuries in Victoria, Australia

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Abstract

Limited number of studies were identified to investigate factors contributing to injury severity of heavy vehicle crashes in Victoria. This gap indicates a key need to further analyse the factors influencing injury severity of heavy vehicle crashes. In this study, an analysis of crash data was conducted using crash data provided by the TAC. The analysis was conducted using descriptive analysis, chi-square test and the binary probit model. Results showed that time of day, crash type, road pavement condition, crash location, speed limit, age, license type, restraint usage and vehicle type were the factors significantly affted the serious injury outcomes.

Background

With the growing importance of heavy vehicle transport in Australia, there has been sustained growth in the vehicle fleet, composition and vehicle technologies. These have led to associated increases in heavy vehicle crashes as reflected in the Victorian statistics which indicate a doubling in the number of fatalities in heavy vehicles crashes from 28 in 2013 to 56 in 2014 before falling to 41 in 2015 (VicRoads 2016).

According to the Bureau of Infrastructure, Transport and Regional Economics (BITRE 2016), there were 23 fatalities from crashes involving articulated trucks in Victoria in 2011, followed by 30 in 2012 and a reduction to 14 in 2013 before increasing to 20 in 2015. Over the same period, the number of fatalities from crashes involving heavy rigid trucks was 14 in both 2011 and 2012, increasing to 23 in 2014 before falling to 18 in 2015.

Literature review of factors influencing heavy vehicle crashes revealed that limited number of studies were identified to investigate factors contributing to injury severity of heavy vehicle crashes in Victoria. This gap indicates a key need to further analyse the factors influencing injury severity of heavy vehicle crashes.

Method

To gain a better understanding of factors contributing to heavy vehicle crashes in Victoria, a brief literature review was conducted. The review identified key characteristics, methodologies, data and assessment periods used in analysing heavy vehicle crashes in Victoria between 2000 and 2016.

Following the literature review, an extensive analysis of crash data was conducted using crash data provided by Transport Accident Commission (TAC). This is an injury based data linking insurance, hospital and VicRoads RCIS (i.e. police data) data bases. In this data, 16.7% and 83.3% of fatal and serious injuries were sustained by heavy vehicles and other vehicles occupants respectively. This statistics is 26.4% and 73.6% for total injuries respectively. The analyses involved:

- identifying key factors associated with fatal and serious injuries (FSIs) resulted from heavy vehicle crashes. This analysis includes all user types involved in heavy vehicle crashes.
- identifying key risks in casualties sustained from heavy vehicle crashes.

The analysis was conducted using descriptive analysis, chi-square test and the binary probit model.

1. A Pearson's Chi-square test of independence was performed to identify significant variables affecting the dependent variable (injury severity)
2. A binary probit model was developed to determine the strength and importance of significant variables (identified using Chi-square test) in the crash serious injury outcome.

All the statistical analyses were conducted using IBM's Statistical Package for the Social Sciences (SPSS) version 22.

To establish the relationship between contributing factors and injury severity of heavy vehicle related crashes, a binary probit model was developed. The dependent variable in this analysis is the injury outcome which is a binary variable, with the response of interest referring to fatality and serious injury (FSI) and the response of contrast to slight injury or no injury (non-FSI). The model is a form of Generalised Linear Regression model which uses the maximum likelihood method to calibrate the model parameters. The model estimates the probability of being killed or seriously injured (FSI) in a heavy vehicle crash against sustaining a slight injury (non-FSI).

Results and Conclusions

The key findings indicated that:

1. Time of injury has a statistically significant impact on the probability of an FSI injury. Specifically, an FSI injury is less likely to occur from 6:00 am up to midnight relative to between midnight and 6:00 am as indicated by the negative coefficients.
2. The probability of an FSI injury decreases in a pedestrian crash relative to vehicle-to-vehicle crashes as indicated by the statistically significant estimate for pedestrian crash type.
3. The probability of an FSI injury increases for crashes at non-intersection locations compared to intersection.
4. While the results indicated a reduction in the probability of an FSI injury on unknown pavement conditions relative to dry pavement conditions, this result is difficult to interpret due to the uncertainties surrounding the true nature of the pavement conditions.
5. The analysis showed statistically significant results for all the vehicle types included in the analysis. The results indicated increases in the likelihood of an FSI injury for all vehicle types (except buses) relative to heavy vehicles. The probability of an FSI injury decreases where buses are involved compared to heavy vehicles.
6. There is a higher probability of an FSI injury from a crash involving a vehicle 'leaving a driveway' versus changing lanes while crashes involving slow or stopping vehicles or parking vehicles are less likely to result in an FSI injury compared to vehicles changing lanes.
7. The analysis of traffic control showed that the probability of an FSI injury is lower at roundabout and stop controlled locations compared to locations without traffic controls. Similar to pavement conditions, there was a statistically significant result for unknown traffic control; this will be treated as a non-result as it does not inform the overall analyses.
8. The results indicated a reduction in the likelihood of an FSI injury outcome for road users who wear restraints compared to those who do not.

9. The probability of an FSI injury increases for probationary licence holders compared to standard licence holders.
10. The results for licence status showed an increase in the probability of an FSI injury for holders of invalid licences compared to valid licences.
11. A rollover on or off a carriageway increases the likelihood of an FSI injury compared to a collision. Additionally, the probability of sustaining an FSI injury decreases for road users struck by stone projectile or those that fall from a vehicle.
12. An analysis of the DCA groups indicated that the probability of sustaining an FSI injury increases in head on collisions relative to adjacent approach at intersection crashes. Conversely, the likelihood of an FSI injury decreases in same direction and manoeuvre/overtaking crashes compared to adjacent approach at intersection crashes.
13. The probability of suffering an FSI injury increases for road users aged 60 years and older compared to those younger than 18 years of age.
14. Traffic volumes (proxied by average annual daily traffic – AADT) are associated with reductions in the probability of FSI injuries.

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Accuracy of Speed Zone Recorded in the Victorian Police-Reported Crash Database Differs by Speed Zone in Metropolitan Areas

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Abstract

We aimed to investigate the accuracy of the speed zone recorded for crashes in Victorian police-reported crash data. Data on crashes that occurred on 111 road segments (where the true speed limit was known) in the Melbourne metropolitan area were obtained. The speed zone recorded for each crash was compared to the true speed limit. Speed zone was recorded incorrectly for one-third of crashes. The positive predictive value was low; for example, almost 90% of crashes recorded as occurring in 50 km/h zones did not occur in 50 km/h zones. Implications and recommendations for rectifying the problem are discussed.

Background

Administrative crash databases held by road authorities are an important data source. Such data are used to measure the size of the road safety problem, identify risk factors and evaluate countermeasures with the goal of informing evidence-based policy to reduce crashes and injuries.

Much of the data on crashes is sourced from reports completed by police and thus subject to human error in recording the circumstances. There is potential in future, however, to relieve police of the need to collect data that are available from other sources, for example, geo-spatial databases of speed zones.

The aim of this study was to investigate how accurately the speed zone in which crashes occur is recorded in Victorian police-reported crash data.

Method

Data was collected on the characteristics of 142 urban road segments in the Melbourne metropolitan area as part of a larger research project (Stephan, 2015). The speed zone of each road segment was obtained from VicRoads. For the purposes of this investigation, road segments with variable speed limits (either for schools (n=17) or for strip shopping (n=14)) were excluded. Therefore, 111 road segments were included in this study.

Crashes occurring on the road segments between 2005 and 2009 were identified using the publicly accessible Victorian CrashStats (VicRoads 2008). Crash data were downloaded including information on the police-reported speed zone of the crash location.

Crashes that occurred on midblock road segments (not at an intersection) were identified. For each road segment, the number of crashes that were recorded in each speed zone was counted and compared to the true speed zone for that road segment. Data were collated across speed zones and the sensitivity (% of crashes in each speed zone that were recorded correctly) and the positive predictive value (PPV: % of crashes recorded as being in a particular speed zone, that were actually in that speed zone) were calculated for each speed zone.

Results

Table 1 displays the number of crashes in each speed zone (columns) and how they were recorded in the Victorian crash data (rows). One-third of the crashes did not have the correct speed zone assigned to them. The sensitivity of the speed zone recording varied by speed zone. Sensitivity was lowest for 70 km/h zones (21.8%) and highest for 50 km/h and 60 km/h zones (77.8% and 74.3% respectively).

PPV was highest for crashes recorded as occurring in 60 km/h zones (85.9%) but relatively poor for other speed zones; from 10.4% for 50 km/h zones to 60% for 80 km/h zones.

Conclusions

The speed zone was recorded incorrectly for almost one-third of the crashes occurring on these midblock road segments. The low PPV for most speed zones is concerning. For example, almost 90% of crashes that were recorded as occurring in 50 km/h zones did not, in fact, occur in 50 km/h zones. The implications for researchers and practitioners planning to use the Victorian crash data to conduct analyses by speed zone will be discussed. Recommendations for rectifying the problem will be made.

Table 1. The number of crashes in each speed zone against the speed zone they are recorded as

	Actual speed zone						
Speed zone recorded in crash data	**40 km/h**	**50 km/h**	**60 km/h**	**70 km/h**	**80 km/h**	**Total**	**Positive predictive value**
40 km/h	13	0	12	1	5	31	41.9%
50 km/h	2	7	46	6	6	67	10.4%
60 km/h	4	1	421	49	15	490	85.9%
70 km/h	0	0	51	17	0	68	25.0%
80 km/h	0	0	17	3	30	50	60.0%
Missing	2	1	20	2	1	26	0%
Total	21	9	567	78	57	732	
Sensitivity (% recorded correctly)	61.9%	77.8%	74.3%	21.8%	52.6%	66.7%	

Key: cells shaded in grey indicate crashes where speed zone was correctly recorded

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Aggressive Driving on Australian Roads

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Abstract

A national study was conducted to understand the prevalence of driver aggression, the type of drivers who are likely to exhibit aggressive behaviour, and whether this is emblematic of a broader pattern of dangerous driving behaviour. The majority of drivers reported some form of aggressive driving, with age and gender differences apparent. Young male drivers (aged 22-39) reported the most extreme aggression, with 36% having chased another driver when angry at least once. Aggressive driving was associated with drink-driving, speeding, and the use of a hand-held phone, suggesting it may be part of a larger suite of problem behaviours.

Background

Anecdotally, aggressive driving appears to be common in Australia. However current data on the prevalence and nature of this is lacking. A national study conducted in 2004 showed that 93% of those surveyed (N=1,880) had been subjected to aggression from other motorists during their driving lifetime, while 43% had perpetrated aggressive driving in retaliation to the behaviour of others (AAMI, 2004).

As aggressive driving has been linked to increased crash risk (American Automobile Association, 2009), targeting the reduction of these behaviours is imperative to improving road safety. For this reason it is important to understand who demonstrates aggressive behaviour, as well as the frequency and nature of these behaviours. Extrapolating from international studies, it is likely that aggressive driving is a common behaviour exhibited by mainly younger drivers (Paleti, Eluru, & Bhat, 2010; Roberts & Indermaur, 2005), and may form part of a larger suite of problematic driving behaviours (Vanlaar, Simpson, Mayhew, & Robertson, 2008). The aim of the study was to explore self-reported aggressive driving in a large Australian sample, and to investigate associations with other dangerous behaviours including speeding, drink-driving and illegal mobile phone use while driving.

Method

A large cross-sectional survey was conducted over two phases, inviting drivers from all Australian jurisdictions to participate. Participants were asked to report the frequency over the previous two-year period (1=never, 6= almost always, later recoded into “never”, “very infrequently”, “occasionally” and “frequently”) of aggressive driving behaviours, such as sounding the horn when angry, chasing another driver when angry, tailgating and expressing anger any way possible. Data on speeding, drink-driving, mobile phone usage while driving and crash history were also obtained.

Results

The final sample contained 2,916 drivers (males=45%; average age=42 ±16 years). Aggressive behaviours such as expressing annoyance to other drivers and sounding the horn in anger were reported by the majority of the sample (60% and 70% respectively). More extreme behaviour such as chasing another driver when angry was less common, however still reported by 18% of the overall sample.

Aggressive driving behaviours were more common in younger, male drivers (see Figure 1) with 36% of drivers aged 22 to 39 reporting extreme aggression. Associations were found between crash involvement and aggression with 96% of drivers involved in a crash also reporting aggressive behaviour. When compared to non-aggressive drivers, aggressive drivers were also more likely to report using a hand-held mobile phone while driving (18.3% cf. 5.2%), drink-driving (8.6% cf 3.7%) and speeding (60.4% cf 32.9%).

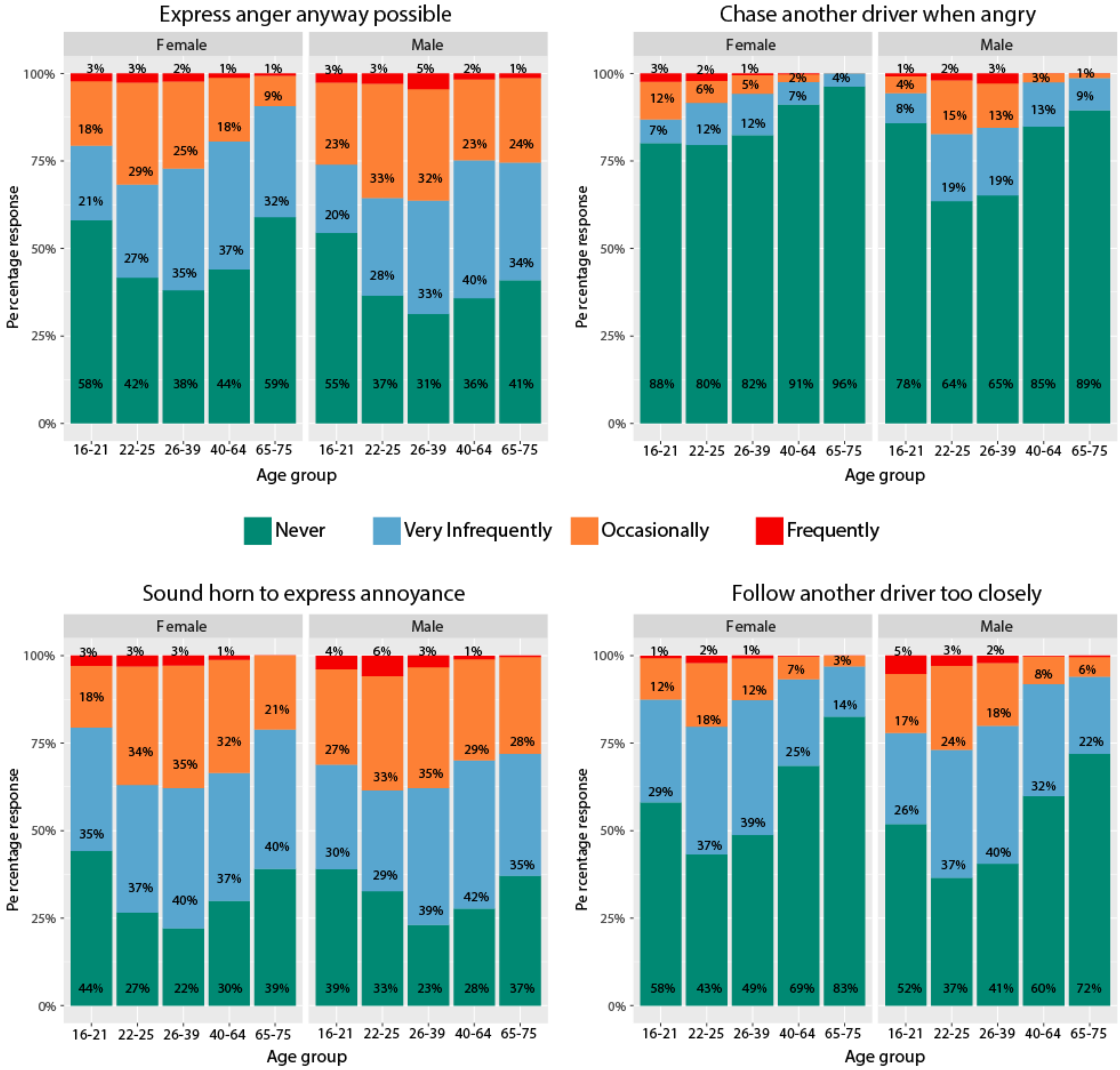

Figure 1. Gender, age and aggressive driving frequency

Conclusions

The findings highlight that aggressive driving in Australia is prevalent and forms part of a broader pattern of dangerous driving behaviour. Aggressive driving appears to be widespread and related to other dangerous behaviours, including speeding, drink-driving and the use of a hand-held phone while driving. Therefore, targeting the social acceptability of these behaviours and the perceived enforcement for failure to comply with road safety rules may prove to be an effective intervention. More research is needed to understand where aggressive driving fits within an overall risky driving pattern of behaviour, what attitudes drivers hold toward aggressive driving and how to target the reduction of these.

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Transverse line marking trial undertaken in the Adelaide Hills

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Abstract

Transverse line marking has been used previously to reduce approach speeds before hazardous intersections. This treatment was selected for use at one approach leg of a hazardous intersection in the Adelaide Hills, South Australia. Speed measurements were taken over two-week periods before and after implementation of the treatment in July 2015, and again in 2016. Inconsistent results meant that it was unclear whether the treatment was effective at reducing traffic speeds. The results of this study highlight the importance of replicating treatments at multiple locations in order to garner robust results.

Background

While the use of line markings to warn motorists of hazards and encourage reduced speeds is not new (e.g. zig-zag markings prior to school zones in Australia), transverse line marking as a means of reducing speeds on approach to hazardous intersections from the major (right of way) road is a relatively new concept in Australia. The limited numbers of real-world and simulator trials undertaken in Australia and New Zealand have been somewhat successful in reducing intersection approach speeds (Charlton, 2003; Macaulay et al., 2004; Martindale & Urlich, 2010). Some studies showed that speed reductions were greatest at the start of the transverse line markings but dissipated before the end of the treatments. Experience in the United Kingdom, where transverse line marking is more commonly used, has shown the treatment as effective for reducing the number of crashes at intersections (Helliar-Symons, 1981).

Cudlee Creek trial

In July 2015, the Department for Planning, Transport and Infrastructure (DPTI) undertook the trial installation of transverse line marking at an intersection in Cudlee Creek, located in the Adelaide Hills in South Australia. Since 2008, five crashes, including four casualty crashes, have occurred at this location. All five involved a vehicle travelling westbound along Cudlee Creek Road (80 km/h speed limit) colliding with a vehicle turning right from Fox Creek Road (four crashes) or turning right from Cudlee Creek Road onto Fox Creek Road (one crash). As such, it was decided to trial the treatment along the westbound approach leg (Figure 1).

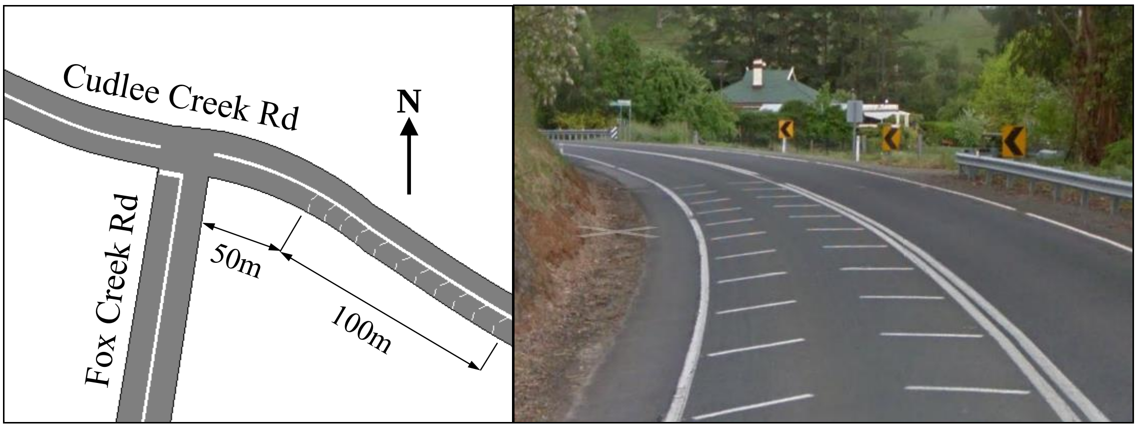

Figure 1. Illustration of transverse line marking (left) and photo of transverse line marking looking westbound along Cudlee Creek Rd (right)

Methodology

Speed measurements were taken over two-week long periods immediately before and after the transverse line markings were implemented, and again six months after implementation in February 2016. Measurements were taken along Cudlee Creek Road for both directions of travel 250m, 150m and 50m east of the intersection and 50m west of the intersection.

Results and discussion

Reductions in 85th percentile speed were observed 50m west, 50m east and 250m east of the intersection in the westbound direction. A very slight reduction in speed was seen 150m east of the intersection, where the treatment began. The greatest speed reduction was seen 50m before the intersection at the end of the treatment (2.0 km/h).

Reductions in 85th percentile speed were also observed in the eastbound direction and were comparable to those in the westbound direction. As no transverse line markings were implemented for eastbound traffic, these results suggest that speed reductions at the site were due to effects other than road user response to the transverse line marking.

Reductions in 85th percentile speeds six months after the installation of the transverse line marking were similar in magnitude in both the westbound and eastbound directions. The largest of these speed reductions was at a location where the transverse line marking was not visible (250m east the intersection). These results add further credence to the idea that speed reductions were not due to the installation of the transverse line marking.

Table 1. Speed measurement results (all speeds in km/h)

	Direction	50m West	50m East	150m East	250m East
85th percentile speed (before)	West	76.9	78.4	82.8	86.8
	East	81.6	78.7	86.7	86.8
85th percentile speed (after)	West	75.7	76.4	82.7	86.1
	East	81.2	77.6	86.5	85.6
85th percentile speed (6-month)	West	75.7	78.5	81.8	83.8
	East	78.5	79.3	85.2	83.3
Change in 85th percentile speed (before to immediately after)	West	-1.2	-2.0	-0.1	-0.7
	East	-0.4	-1.1	-0.2	-1.2
Change in 85th percentile speed (before to six months after)	West	-1.2	+0.1	-1.0	-3.0
	East	-3.1	+0.6	-1.5	-3.5

Conclusions

The results of this study suggest that 85th percentile speeds reduced after the installation of transverse line marking, but that this may not be a result of the installation. A major drawback of this study is that only one site was treated. For this reason, it is unknown whether the seeming lack of effectiveness of the treatment was site-specific or would be seen on a wider basis. The results of this study highlight the importance of replicating such treatments at multiple locations in order to garner robust results. This is especially important for treatments such as transverse line marking, where the magnitude of expected outcomes could be overshadowed by the effects of background conditions.

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Using Mass Crash Data to Identify the Benefits of Innovative Cycling Infrastructure

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Abstract

Innovating bicycle infrastructure treatments are gaining popularity in Australia. There is a need to identify which treatments can be beneficial for treating prominent bicycle crashes. The methodology presented in this study is used to align treatments with prominent crash types identified through the use of mass crash data. The results of this study suggest that mass crash data, analysed at an aggregated level, may be used to relate the benefits of treatments to prominent crash types through the identification of crash mechanisms. However, gaps within the data were identified that prevent this method from being used to fully appreciate the benefits of certain treatments, especially those used at intersections.

Background

Cycling is gaining in popularity around Australia. In order to both promote cycling as a mainstream mode of transportation and improve cyclist safety, jurisdictions are turning to innovative infrastructure treatments more commonly used in countries such as Denmark and the Netherlands (TMR 2015), such as separated bicycle paths, and offset and raised bicycle crossings at intersections. There remains a need to identify which treatments are more likely to be beneficial in the Australian context. To do this, a methodology is proposed that uses mass crash data to align innovative treatments with prominent crash types to identify the benefits of their use.

Methodology

This project required the alignment of crash types to infrastructure treatments. To achieve this, the methodology was split into three phases:

- Innovative bicycle infrastructure treatments were identified through a number of jurisdictional guidelines (Vicroads 2016a, Vicroads 2016b, TMR 2015, Government of South Australia 2012). Conflict points between bicycles and vehicles were identified for each treatment.
- Prominent crash types were identified for two case study areas using mass crash data collected by South Australian Police and coded by the Department of Planning, Transport and Infrastructure. An analysis of the aggregated data was undertaken to identify crashes mechanisms of the most prominent crash types.
- Treatments were judged on their theoretical ability to eliminate conflict points and hence associated crash types, to reduce the severity of crashes by reducing vehicle speeds at associated conflict points, or to reduce the likelihood of crashes.

Results

From the analysis of the mass crash data, a number of prominent crash types were identified in the two case study areas: at midblock was predominantly dooring and manoeuvring type crashes, while at intersections were mainly manoeuvring and turning vehicle type crashes. At midblock, separation was identified as the most beneficial solution though the ability to eliminate conflicts associated with most crash types. At intersections, raised and offset bicycle crossings were identified as being most beneficial due the elimination of manoeuvring type crashes and reduction in severity of turning type crashes.

Confidence was placed in the ability of innovative midblock treatments to eliminate most prominent crash types identified in the case study areas, as sufficient information was obtained through the mass crash data to identify where and how these crashes occurred. Less confidence was placed in the ability of some intersection treatments, as not enough information was obtained through the analysis of crash locations and configurations to understand whether these crashes were associated with conflict points that were either eliminated or associated with reduced severity or likelihood.

Conclusions

Understanding the benefits of innovative bicycle infrastructure treatments through the analysis of mass crash data was explored in this study. While the benefits of midblock treatments were confidently identified, gaps in the mass crash data meant that less confidence was placed on the results showing the benefits of some intersection treatments. Such gaps in the mass crash data need to be filled if this data source is to be used to inform decisions regarding infrastructure treatment selection and used to analyse the performance of implemented treatments. Other data sources, such as in-depth crash investigation, may also be needed to supplement our understanding and decision making processes.

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Attachments Mounted onto an Approved Motorcycle Helmet

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Abstract

There has been a growing demand for fitting aftermarket attachments onto motorcycle helmets. A recent study aimed to determine whether mounting two types of attachments – a video camera and a Bluetooth communications device – affected motorcycle helmet compliance with design standards. A series of tests were conducted, And the results indicated that in some cases, attaching the devices caused the helmet to fail one of the tests specified in a number of design standards. A further study now underway is investigating how this relates to an increased risk of injury to the wearer in a crash.

Background

In NSW, the Road Rules 2014 require motorcyclists wear an approved helmet, which is one that complies with either the Australian Standard (AS/NZS) 1698 or the UNECE Regulation 22.05. Both have strict conditions for fitting attachments – AS/NZS 1698 requires the attachment be approved by the helmet manufacturer, while UNECE R22.05 requires evidence that the attachment does not affect the helmets compliance with the standard. Both standards require helmets with projections be tested by dropping the helmet fitted to a head form onto an anvil that measures the force at impact. The peak longitudinal force and the duration of the positive impulse on the anvil are recorded. If these exceed specified levels, the helmet fails the test and does not comply with the standard.

Previous tests

Method

A popular motorcycle helmet was fitted with either a video camera or a communications device – two types of aftermarket attachments most commonly used by motorcyclists. Two different sizes for each device were examined, designated as “large” and “slim-line”. The attachments were mounted onto the helmet using the adhesive mounting provided by their respective manufacturers in accordance with their mounting instructions.

The oblique impact test as specified in both AS/NZS 1698 and UNECE R22.05 were conducted on the helmets fitted with an attachment. A new helmet was used for each test. The peak longitudinal force and its impulse (integral with respect to time) measured from the load cell in the anvil were recorded in each test. The test matrix is outlined in the first three columns of Table 1 and examples of the fitting configurations are shown in Figure 1.

The helmets fitted with a device were also tested to the energy attenuation test specified in AS/NZS 1698 to determine if their ability to attenuate impact energy is compromised, and if the attachment penetrates through the helmet shell. A series of punch tests were also conducted to investigate the whiplash force created by snagging the attachment.

Results

The results of the oblique impact tests are presented in Table 1. The maximum limit for peak longitudinal force specified in the standards is 2.5kN and 12.5N.s for its impulse, and the helmet fitted with the slim-line Camera Type 3 failed the oblique impact requirements in both tests as the peak longitudinal forces exceeded the maximum limit. The helmet fitted with the slim-line Bluetooth Type 2 device and its battery pack also failed the oblique impact requirements, while the helmet fitted with the large Bluetooth Type 1 device was still under the maximum limits allowed by the Standards.

Table 1. Results from oblique impact tests

Test	Device – Make & Model	Device Position	Peak Longitudinal Force (kN) (max 2.5 kN)	Impulse (N.S) (max 12.5 N.s)	Pass/ Fail
1	Camera Type 1 – Large	Helmet crown	1.4	1.1	Pass
2	Camera Type 1 – Large	Helmet LH side	1.84	1.19	Pass
3	Camera Type 2 – Large	Helmet crown	0.88	0.0	Pass
4	Camera Type 2 – Large	Helmet LH side	1.88	0.58	Pass
5	Camera Type 3 – Slim-line	Helmet crown	3.51	2.90	Fail
6	Camera Type 3 – Slim-line	Helmet LH side	2.82	2.21	Fail
7	Bluetooth Type 1 – Large	Lower LH side	2.07	7.68	Pass
8	Bluetooth Type 2 – Slim-line	Lower LH side	2.96	4.90	Fail
9	Battery pack	Rear	3.29	7.95	Fail

Figure 1. Examples of mounting camera and communication device onto the helmet

Further research

The tests stipulated in the standards were introduced in 1986 and focuses on ensuring external projections incorporated within the helmet design would detach easily, rather than causing the helmet to catch during impact. This testing arrangement does not form a reliable indicator of a head injury risk as a result of helmet attachments, as the testing focuses on the performance of the helmet.

Crash test technology has advanced considerably, with the ability to now undertake world first testing with an instrumented more biofidelic headform (Hybrid III head form), which could provide a more realistic response to the forces imposed on a person in a crash when wearing a helmet fitted with an attachment.

A series of tests in accordance with the current test requirements is currently being conducted. This will provide insight into the level of trauma sustained to the head, neck and body. Additional tests will also be carried out using a unique test rig developed specially for the Consumer Rating and Assessment of Safety Helmets (CRASH) test program. The design of this rig has undergone scientific peer review. This testing is now underway and outcomes of the testing regime are expected to be available soon.

This further research is also investigating whether the material used to attach a device to a helmet affects the injury outcome, and if an adhesive can be used that will allow the helmet pass the oblique impact test regardless of the type of device attached to it

As the implications of this research may be far reaching and affect established design standards, it is intended that the reserach will be subjected to a rigorous peer review process to verify its findings.

Conclusions

The previous study found that mounting an attachment such as a video camera or a communication device to an approved motorcycle helmet can cause the helmet to become non-complying with the AS/NZS 1698 and UNECE R22.05, which affects its status as an approved helmet under the Road Rules 2014. Results from all energy attenuation and punch tests remained under the prescribed limit.

The new research currently being conducted will provide a more realistic profile of the injury risks of attaching devices to motorcycle helmets Once the peer review process is completed, the results and test methodology will be made available to key stakehoders for their consideration, including helment maufacturers, and the AS 1698 and UNECE R22.05 drafting committees.

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The Effect of the Implementation of Vehicle Impoundments for 'No Authority to Drive' Offences in Western Australia

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Abstract

'Unauthorised drivers' represent a disproportionately high number of those who are involved in road trauma incidents as well as minor crashes and other traffic offences in Western Australia. In response to the risks to community and to further deter unauthorised drivers from driving, impounding of vehicles for selected 'No Authority to Drive' (NATD) offences was introduced in July 2009. This paper compares the detection and prosecution of unauthorised drivers prior to and post implementation of vehicle impoundments for NATD offences, and seeks to establish the effectiveness of vehicle impoundments as a deterrent to unauthorised driving.

Background

Legislation for impounding vehicles was introduced in Western Australia in 2004 to address community outrage over "hoon" type driving behaviour. The objective of impounding vehicles is to immediately remove the opportunity for re-offending following the commission of serious driving offences.

On 1 July 2009, the circumstance by which a vehicle may be impounded or confiscated was expanded to include certain types of unauthorised driving offences under s49 of the *Road Traffic Act 1974*. These amendments to the *Road Traffic Act 1974* enabled police to impound a vehicle for 28 days for certain driver's licence offences.

A vehicle can be impounded for 28 days for the following offences:

- Unauthorised Driving - licence has been suspended, cancelled or disqualified by a court
- Unauthorised Driving – The WA Department of Transport have refused to renew a person's driver's licence, or refused to issue a person with a driver's licence;
- Unauthorised Driving - licence is subject to demerit point disqualification; or
- The person has an extraordinary licence and is driving contrary to a condition relating to the time, purpose or location.

Police cannot seize and impound a vehicle for an unauthorised driving offence associated with:

- Expired Licence
- Never held
- Driving out of class
- Driving contrary to driver's licence conditions
- Fine Suspension
- Learner driver without instructor
- Novice driver breaching curfew

Method

This paper is intended as an expository assessment of the effect of the implementation of vehicle impoundments for NATD offences in Western Australia. Comparisons have been made for periods prior to and post the implementation of vehicle impoundments for NATD offences in July 2009.

Contributing factors such as volumes of on –road traffic enforcement hours and vehicles stopped by police have been assessed using linear time comparisons and Pearson Correlation Coefficients to estimate the relevance of the effect of each factor to any overall observations.

Results

A decrease in the number of charges for all NATD offences, even when weighed against the decreases in traffic enforcement hours and variations in vehicles stopped volumes, shows that the impact of the implementation is likely to have contributed towards a positive result. This finding may also support the conclusion that the introduction of vehicle impoundments for NATD offences has contributed to raising the awareness of the risk of detection for all NATD offences among the driving population of Western Australia.

Conclusions

While these assessments support the contention that the implementation of vehicle impoundments for NATD offences in Western Australia has contributed to a decline NATD offences, issues that hinder conclusive findings were uncovered. The inability to accurately quantify the unauthorised driver population is the greatest obstacle to conclusively assessing the success of the implementation of vehicle impoundments for NATD offences.

A more accurate assessment of the effectiveness of the implementation on key factors such as the involvement of unauthorised drivers in fatal and serious crashes and the recidivist offending of unauthorised drivers will be better understood when assessed over a greater period of time, with greater sample volumes.

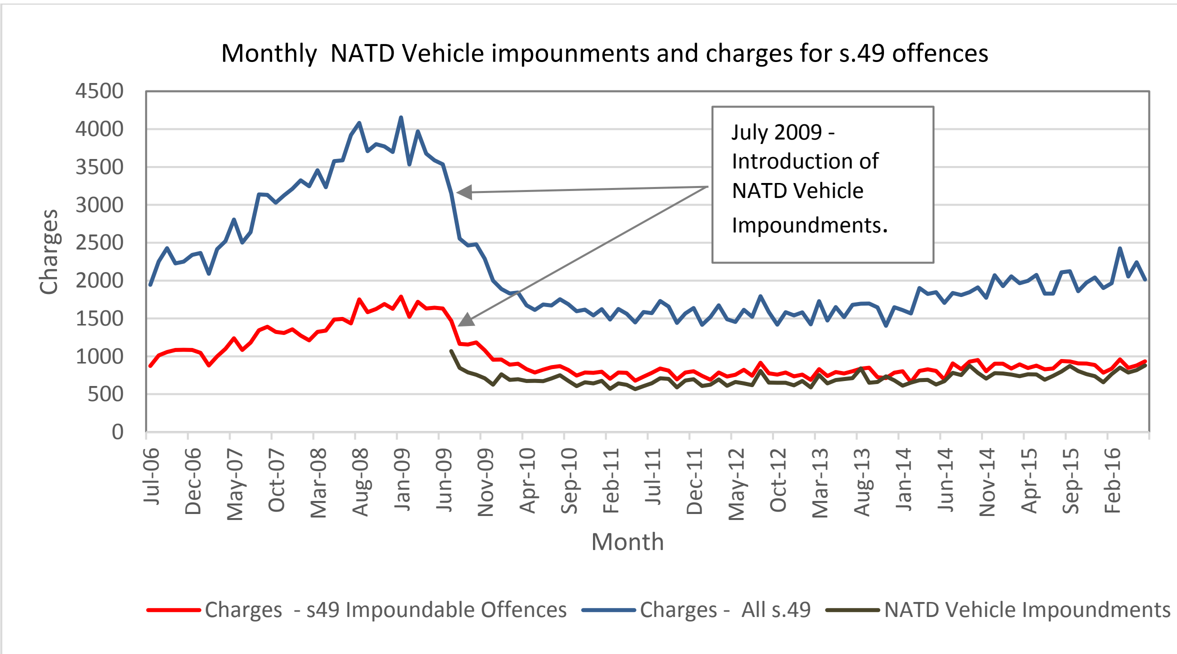

Figure 1. Monthly NATD Vehicle Impoundment and s.49 charges

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Why Don't Australian Drivers with Type 1 Diabetes Check their Blood Glucose before Driving?

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Abstract

Australian guidelines for people who manage their diabetes with insulin indicate that they should check their blood glucose before driving (Austroads, 2016). An Australian survey of 539 drivers with type 1 diabetes (T1D) has shown that three-quarters did not perform a pre-drive blood glucose check (Trawley, Holmes-Truscott, & Speight, 2016). Analysis of how often drivers did not follow these guidelines and the reasons why was beyond the scope of that report. In the present paper, these data are re-visited to further explore the self-reported reasons and whether these drivers were at increased risk for motor vehicle crashes.

Background

Australian drivers who manage their diabetes with insulin are automatically issued with a conditional licence, which is reviewed regularly to ensure they meet specific fitness-to-drive criteria. These criteria stem from research that indicates an increase in motor vehicle crash risk for "at-risk" drivers (Cox et al., 2010; Signorovitch et al., 2013; Songer & Dorsey, 2006). "At-risk" is defined typically as those who have a history of severe hypoglycaemia (very low blood glucose, requiring the assistance of another person for recovery (Seaquist et al., 2013)) or the syndrome of impaired awareness of hypoglycaemia (IAH, i.e. reduced autonomic symptoms or recognition of such symptoms (Little et al., 2014)).

In addition to attending a periodic medical licence review, these drivers are also required to perform self-monitoring of blood glucose (SMBG) before driving (Austroads, 2016). The rationale for these requirements is the neuroglycopenic effect of hypoglycaemia (i.e. cognitive disruption caused by brain glucose deprivation), which impairs driving performance (Cox, Gonder-Frederick, Kovatchev, Julian, & Clarke, 2000).

Recently, Trawley et al. (2016) surveyed over 500 Australian drivers with type 1 diabetes (T1D) and found that three-quarters did not perform SMBG consistently before driving. However, their self-reported reasons and "at-risk" status was not examined in detail. This paper aims to further explore these important issues.

Method

The data were derived from the YourSAY: Glucose Monitoring study, which was a national, cross-sectional online survey designed to explore SMBG attitudes and self-reported behaviours amongst Australian adults with T1D. From a total of 539 drivers, 406 (64% (n=260) women; mean±SD age 44±14 years, T1D duration 23±14 years) indicated that they did not (never/rarely/sometimes) perform SMBG consistently before driving and provided reasons for this via fixed-choice responses and free text. A subgroup (n=341; demographics consistent with larger sample) also provided information regarding their recent history (past 6 months) of severe hypoglycaemic events and IAH.

Results/Discussion

The most commonly reported reasons for not performing SMBG before driving was that it was inconvenient, closely followed by food consumption (see Table 1). Food consumption as an alternative to checking is potentially problematic for three reasons. First, even fast-acting carbohydrate (e.g. fruit juice) takes 10–15 minutes to produce an effect, during which time driving performance may be impaired if blood glucose is already low. Second, ingesting carbohydrate when blood glucose is not low will result in higher glucose levels, which can also disrupt cognition (Cox et al., 2005) and adversely affect driving performance (Cox, Ford, Ritterband, Singh, & Gonder-Frederick, 2011). Finally, this behaviour may increase the time spent in hyperglycaemia, with important ramifications for overall glycaemic control and risk of long-term complications.

Table 1 Why drivers with T1D do not check their blood glucose consistently before driving, and their risk profile as a function of not doing so

	Do you check your blood glucose level immediately before you drive a motor vehicle?			
What are the reasons you may not check your blood glucose regularly when driving?	**Never/Rarely/Sometimes (N=406)**	**Never (n=82)**	**Rarely (n=86)**	**Sometimes (n=238)**
It is inconvenient [a]	41.4% (168/406)	42.7% (35/82)	39.5% (34/86)	41.6% (99/238)
I prefer to eat so I know my blood glucose is OK while driving (e.g. jelly beans)	36.2% (147/406)	41.5% (34/82)	37.2% (32/86)	34% (81/238)
I don't have test strips or lancets at hand	5.7% (23/406)	8.5% (7/82)	8.1% (7/86)	3.8% (9/238)
I have good awareness of my blood glucose	5.7% (23/406)	11% (9/82)	5.8% (5/86)	3.8% (9/238)
Checking is painful	4.4% (18/406)	3.7% (3/82)	4.7% (4/86)	4.6% (11/238)
I have checked recently [b]	2.2% (9/406)	1.2% (1/82)	1.2% (1/86)	2.9% (7/238)
Short trip [b]	1% (4/406)	0% (0/82)	0% (0/86)	1.7% (4/238)
I forgot [b]	1% (4/406)	0% (0/82)	1.2% (1/86)	1.3% (3/238)
Didn't know you should [b]	0.5% (2/406)	1.2% (1/82)	1.2% (1/86)	0% (0/238)
	Do you check your blood glucose level immediately before you drive a motor vehicle?			
Risk profile of driver	**Never/Rarely/Sometimes (N=341)**	**Never (n=68)**	**Rarely (n=67)**	**Sometimes (n=206)**
One or more severe hypoglycaemic events during the past 6 months	15.2% (52/341)	8.8% (6/68)	20.9% (14/67)	15.5% (32/206)
Impaired awareness of hypoglycaemia	23.2% (79/341)	13.2% (9/68)	23.9% (16/67)	26.2% (54/206)
Impaired awareness of hypoglycaemia *AND* one or more severe hypoglycaemic events during the past 6 months	6.7% (23/341)	1.5% (1/68)	10.4% (7/67)	7.3% (15/206)

[a] This is a composite of four predefined options that fall within the reason of "inconvenience", namely; "It is fiddly and inconvenient to check in a vehicle"; "I can't properly dispose of used test strips or

lancet"; "Checking takes too long"; and "Checking requires a suitable place". If a respondent indicated any one of these reasons it was marked under "inconvenience".
[b] Taken from open text box.

Of those drivers who had experienced a severe hypoglycaemic event in the past six months, 15% rarely, if at all, performed SMBG before driving. Furthermore, 6% of these drivers reported both a history of severe hypoglycaemia and IAH. There is a clear need for intervention to improve pre-driving SMBG consistency, especially for drivers with T1D who fall within the "at-risk" category.

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Hazardous Road Locations Selection through Combining Engineering and Social Aspects on Highway that Passed through Villages: Experience from Bangladesh

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Abstract

Road traffic injury is the leading cause of injury-induced death among adults in Bangladesh. Research shows that most of the crashes take place mainly at some specific sites along the highway1. This study aimed to analyze 147 km segment of Dhaka- Sylhet highway (N2), one of the deadliest roads across the world. It also suggested site-specific cost effective countermeasure plan. As road traffic injury is a complex phenomenon associated with human and road environmental factors, those aspects were specially focused during the study.

Background and Objective

Road traffic crash, one of the leading causes of death around the world, kills 1.2 million people every year and causes 3% GDP loss for the low-and middle-income countries2. In Bangladesh, recent nationwide survey on the cause and effect of injuries (BHIS II) revealed that 23,166 people are being killed annually on roads with a rate of 14.4/100,000 fatal road traffic injury irrespective of age3. Here, about 43 percent of national highway crashes concentrated on 5 percent of the total length1, demonstrating that crashes are highly clustered at few sections and they are amenable to targeted and site-specific treatments. Among the highways of Bangladesh, Dhaka-Sylhet (N2) highway has many hazardous risky locations and a high number of pedestrian fatalities where 391 people have been killed and 1104 injured from 2008 to 2015 as reported by the four major local newspapers. The major crash types were hit pedestrian, head-on and rear end collision whereas in most of the cases driver fault is predominant such as over speeding as well as over taking tendency.

The main objective of this study was to identify hazardous road location along with a countermeasure scheme through the analyzed crash data and field survey with a specific focus on vulnerable road user, specially the pedestrians.

Methodology

Preparation of intervention scheme requires identification of hazardous road location and proposing evidence-based countermeasure. Within 147km segment of N2 highway, 30 locations have been identified based on the report of newspaper and local Roads and Highways Divisions (RHD). In addition, the audit team also studied few other locations which seemed risky for the road users. Along with stakeholder analysis, related risky factors were observed from the engineering perspective. The audit team consisted of road safety engineer, social scientists and anthropologists. Detailed engineering and social data were compiled and assessed to prepare the countermeasure scheme. Specific criteria were used to rank those locations based on their risk existence.

Results

Based on the observation and field study, audit team found multifaceted characteristics of the locations. Considering all those facts, the team found 10 potential locations that call for immediate intervention. Nearly all the road sections are two lanes undivided rural carriageway having village side roads as well as heavy roadside business on both direction. Social survey and on-site investigation reveal that pedestrians are the most victimized group as hit pedestrian and head-on collision are mostly observed crash types whereas excessive speed , poor delineation and access control , unauthorized parking and road side business as well as unauthorized slow moving vehicles are the main causes of crashes. Lack of safe pedestrian behavior was also observed in all locations. These findings are nearly in line with the findings from newspaper data.

Conclusions and Recommendations

Through providing effective interventions, existing risky situation can be improved in this segment. Hence, cost effective and site specific countermeasures are suggested that consist of low cost engineering (viz. delineation improvement, speed management, side road correction; shoulder treatment) and community engagement with a special focus on school-based education. As such intervention scheme has been proved effective in a previous pilot program on this highway that showed massive improvement with an overall crash reduction by more than 60% and a socio economic return of 6000%4, it can be said that the proposed scheme will be a highly beneficial one to improve the overall crash scenario on this highway.

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Paperless Road Policing: New Zealand Police's Implementation of Digital Infringement Notices and Traffic Crash Reporting Using Smartphones

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New Zealand Police

Abstract

New Zealand Police has transitioned from the use of paper forms to issue traffic infringement offence notices (ION) and complete traffic crash reports (TCR) to smartphone applications. The primary objective of this initiative was to free up officers' time traditionally tied up with administrative tasks and be *more street than station.* A time-and-motion study on officers' ION issuance indicated that a significant mean time saving of 38% was associated with digital notice completion, which when annualised amounts to freeing the equivalent of about 30 full time staff. The move to electronic IONs shows major potential for delivering more efficient Policing.

Introduction

Internationally, mobile technology is increasingly becoming part of everyday police work, showing promise to deliver better and more efficient policing (Carter & Grommon, 2015). It offers not only the ability to provide up to date information and intelligence on the street or at the road side, but the promise of conducting a range of tasks traditionally undertaken at the station. New Zealand Police has embraced this notion, and every sworn officer is now equipped with an iPhone 6 with applications to undertake a range of functions. Two additional functions were introduced in 2016: the ability to issue IONs and complete TCRs.

Mobility ION allows officers to fully complete traffic IONs using a mobility device. Notices are automatically generated through bulk print and sent out at New Zealand Post. Mobility TCR similarly allows for electronic forms and crash diagrams to be created in the application, which are automatically saved and sent after 24 hours.

The move to a digital means of completing common administrative road policing tasks was to a) create efficiencies in time saving, allowing officers to spend more time on the road and less at the station, b) improve data quality and timeliness of recording, c) create back-end efficiencies (e.g. notice processing).

Method

An observational time and motion study was carried out to map the ION completion process and collect time data for ION completion and roadside stops. Forty-three road policing officers were observed for the duration of their shift.

Results

The results of the time study indicated a mean difference for completing the stop of -3.16 minutes was associated with for electronic notice completion compared to paper forms. An independent samples *t*-test confirmed the statistical significance of the reduced completion time for electronic IONs $t(31) = -4.84$ [95% CI: -4.39, -1.53], $p < .001$; $d = 1.54$. These results indicate that the time taken to complete infringement notices reduces the time of road-side stops on average by 38%. The average time savings of 3.16 minutes per infringement notice equates to an annual time saving of 30 sworn full time equivalent staff (FTE).

In addition to time saved at the roadside, substantial reductions in workload at the processing-end have resulted. Where previously 37 FTE staff would be tied up in processing officer-issued IONs, this workload has reduced to just 3 FTEs, providing an efficiency of 34 non-sworn staff.

Conclusion

Electronic delivery of IONs was found to significantly reduce the mean time of traffic stops for detected offences. The average time saving per infringement notice equates to an annual time saving of 30 sworn FTE. Delivering IONs electronically through iPhone applications has successfully reduced officers time spent on administrative tasks while on patrol or at the station, allowing staff to spend more time to conduct high-value activities. In addition to officers' time saved there were substantial reductions in the workload associated with processing notices; to the equivalent of 34 non-sworn staff.

The implementation of electronic notices and traffic crash reporting in New Zealand supports Police officers to be 'more street than station'.

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The Psychology of Drivers and Leadership Practices in Predicting Safe Driving

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Abstract

Work-related driving in Australia is a major risk for employers. Many organisations face the challenge of balancing productivity and safety. Considerable attention has been given to risk management practices of organisations. This paper extends previous research by going beyond risk management to understand how bundled human resource management (HRM) practices contribute to developing a safer work environment. Consideration is also given to the extensive research examining individual differences contributing to driving behaviour. In this way, the research aims to understand how senior management and individual drivers interact in the organisational system and how this supports or constrains safe driving behaviour.

Background

This study aims to overcome this gap in the literature by examining the HRM practices operating in organisations employing work-related drivers in Australia. A configuration of HRM practices that is receiving attention in the literature is High Performance Workplace Systems (HPWS). HPWS are defined as a set of distinct yet interconnected human resource management practices. This study will explore the relationship between HPWS and driver behaviour. Furthermore, this study will investigate how HPWS functions together with drivers' individual attributes. Evidence for the importance of understanding the individual-level perspective is drawn from research which demonstrated that the level of control and discretion an employee has in their work impacts the way HPWS is perceived and utilised, which further impacts employees' behaviours and wellbeing (Jensen, Patel, & Messersmith, 2013). Particular attention is paid to attitudes, as attitude strength has been shown to influence decision making. That is, attitudes can contribute to employee discretion and behavioural outcomes.

H1 Positive safety attitudes will have a positive impact on driver behavior.

H2 HPWS will moderate the relationship between attitudes and behavior.

Method

Recruitment of senior managers, occupational drivers and supervisors was facilitated through a government injury database spanning over 13 industries according to ANZIC. Large organisations (500+ employees; n=52; 64%) were more highly represented in the sample compared with small to medium (1-199 employees; n=22; 27%) and large organisations (200-500 employees, n=7; 9%). Three stages of recruitment were conducted, the first stage involved recruitment of senior managers who completed a HPWS questionnaire. The second stage of recruitment involved occupational drivers. A minimum of five drivers were required from each organisation and were recruited to complete a telephone interview completing measures of safety climate, self-efficacy, and attitudes. The final stage of recruitment involved supervisors of drivers. This group was recruited by asking the drivers who completed the interview to identify their supervisors and provide their email address. Emails with an embedded link to an online questionnaire containing the HPWS items were subsequently sent inviting supervisors to participate. This process allowed the research team to match individual, supervisor-level and senior management responses in a multi-level structure and maintain anonymity. The final sample consisted of 911 drivers and 161 supervisors from 83 organisations. Multi-level modeling was applied to test three hypotheses in Mplus 7.0. The model nested drivers within a two-level multi-level model, where senior management and supervisor's scores on HPWS represented Level 2 data.

Results

Both hypotheses were supported by outcomes of the multi-level modeling. More positive safety attitudes resulted in improved driver behavior and this relationship was moderated by HPWS. The interaction is graphed in Figure 1.

Conclusions

This demonstrates that attitude strength plays a key role in the uptake of organisational policy and procedure (ie., HPWS). The results also demonstrate the HRM practices are not designed with consideration of the safety of drivers, highlighting senior management's role in the safety of work-related drivers. The key implication of these findings is the need for multi-level interventions, such that, support is found for previously effective individual level interventions (eg., feedback sessions and goal setting exercises) which much be augmented by senior management commitment to safety (ie., designing policies and procedures that support safety).

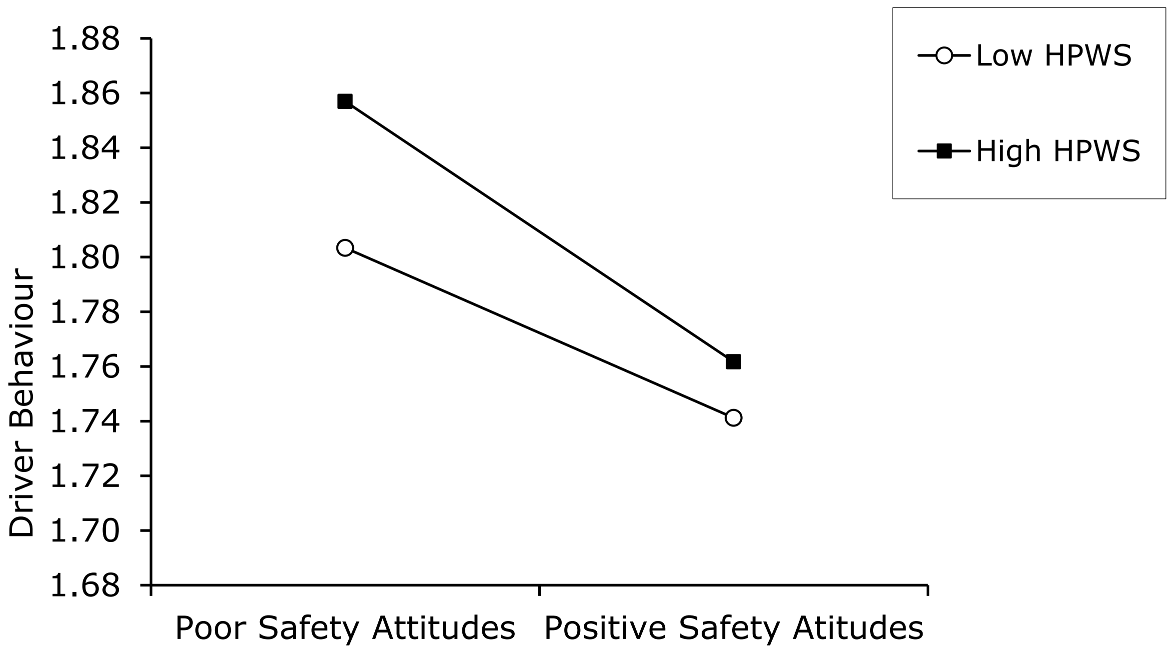

Figure 1. The interaction between attitudes and behaviour moderated by HPWS

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Cannabis and Road Crashes: A Close Look at the Best Epidemiological Evidence

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Abstract

A literature search identified eleven epidemiological studies of the relationship between the prior use of cannabis and crashing. The studies were scrutinised to investigate potential bias. Many of the studies were found to be affected by biases that would exaggerate the apparent effect of cannabis. Accounting for the biases, it is concluded that, if cannabis *does* increase the risk of crashing, the increase is unlikely to exceed 30% (equivalent to driving with a BAC of below 0.05). Even the null hypothesis of no increase cannot be rejected.

Background

The 'Cannabis & Road Safety' page of the Vicroads road safety website (accessed in February 2017), states that the crash risk for driving after smoking cannabis is equivalent to that of driving with a BAC of about 0.15 (a high-level drink-driving offence in Australia). However, in an ABC news report (Bowden & Sales, 2015), the manager of road safety for New South Wales stated that prior use of cannabis increased the risk of crashing by only about 30% (equivalent to driving with a BAC of below 0.05 – a legal level for most drivers). The confusion about the crash risk is not limited to Australian road-safety authorities. There is much inconsistency in the basic research literature; and a number of reviews have reached conflicting conclusions - with a recent meta-analysis (Rogeberg & Elvik, 2016) exposing serious over-estimation biases in two earlier meta-analyses (Asbridge, Hayden & Cartwright, 2012; Li *et al*., 2012).

Method

This paper summarises some of the main parts of a detailed review of the epidemiological research on the relationship between the use of cannabis and crashing (White, 2017).

The review did not involve an independent literature search, because such searches formed part of five previously published reviews: Asbridge, Hayden & Cartwright (2012); Elvik (2013); Hartman & Huestis (2013); Li *et al*. (2012); Rogeberg & Elvik (2016). Details of how eleven studies were selected for review are provided in White (2017, pp. 16-18).

The title of this paper identifies the unique characteristics of the review. Only the *best* studies were included (responsibility and case-control studies where the use of cannabis was determined toxicologically through the presence of THC in blood or oral fluid). Each selected study was subjected to a very *close look* to identify the possible involvement of any biases.

Results and Conclusion

Many of the included studies were found to suffer from over-estimation biases. No under-estimation bias was identified. The review does *not* include a meta-analysis because, while meta-analyses can give low weightings to poor research designs, they cannot adequately compensate for a high prevalence of uni-directional biases.

After accounting for the identified biases, it is concluded that, if cannabis *does* increase the risk of crashing, the increase is unlikely to be more than about 30%. Even the null hypothesis of no increase cannot be rejected.

Discussion

Ross Homel, whose early work on deterrence theory (Homel, 1988) was instrumental in the introduction of Random Breath Testing in Australia, considers that the inclusion of cannabis in the Australian Roadside Drug Testing (RDT) protocols is a disingenuous attempt to prosecute the War on Drugs under the guise of road safety (Hall & Homel, 2007). The results of this review support that opinion.

The inclusion of cannabis in the RDT protocols trivializes drug-driving road safety campaigns and government media releases. For example, when there is a news item such as “Drug driving peril: Surge in positive detections among P-platers alarms authorities” (The Adelaide Advertiser, 23 March, 2015), the reader cannot know to what extent the ‘peril’ is due to stimulants such as methamphetamine and of some real danger, or to cannabis and of little or no danger.

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Enhancing Police Practice with 'Fitness To Drive'

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Abstract

Police play a significant role in identifying potentially unfit drivers and riders on our roads and keeping our roads safe. This presentation explains how Victoria Police has enhanced its referral practices in dealing with fitness to drive issues through the development of a Licence Review Field to enable monitoring of collision associated referrals, the introduction of a new Licence Review Referral form and the implementation of a letter for police to give to drivers where there has been direct police involvement in the referral process.

Background

Over the last three years, the Victoria Police, Road Policing Strategy Division (RPSD) has been working to better understand fitness to drive issues and to enhance the Licence Review Referral processes. Victoria Police members may become aware of potential fitness to drive issues through collision investigations, direct observations of driving, traffic camera files, attendance at an incident or through professionals, family members or the community reporting their concerns.

Enhancing police practice with fitness to drive

Monitoring referrals

In November 2015 a new Licence Review field was created in the Traffic Incident System (TIS) to record when members submit a licence review request associated with a collision. A 12 month review of this data from the 13 Nov 2015 to 13 Nov 2016 (Victoria Police, 2016) shows that there were 1,933 police reported collisions where a Licence Review was submitted for a motorist. This represents 11% of all police reported trauma collisions, including 16 fatal and 477 serious injury collisions. Drivers were aged between 16 and 99 years with a median age of 68 years. Older drivers (75 plus) were over represented. This age group accounted for 6% of licence holders, yet represented 39% of the drivers subject to a licence review.

Making referrals

In October 2016, Victoria Police introduced a new electronic Licence Review Form to enhance the information collected by police and referred to the VicRoads Medical Review section. This form is assisting to distinguish the reasons for referral and is providing enhanced information for the Medical Review Section. Initial findings from VicRoads show that the form has enhanced targeted data capture from police which is contributing to a more efficient analysis and assessment of the driver's situation. In the early stages, some members experienced problems with the new electronic process.

Raising awareness

In October 2016, Victoria Police introduced a letter to send to drivers when police submit a licence review as a result of direct police involvement. This letter was introduced to provide transparency and a police point of contact for the driver. Further, it was hoped that the letter would prompt drivers to self-reflect on their driving status. Previously, the driver would only receive a letter from VicRoads. Initial feedback from VicRoads is that the letter allows drivers to go directly to the source of their referral and seek clarification if required.

Conclusion

Police play a key role in referring potentially at risk drivers and riders to VicRoads through the submission of a Licence Review Referral. New changes implemented in 2015 and 2016 are assisting to enhance understanding of police referrals and to refine the referral and assessment process. Fitness to drive is an issue affecting all drivers and riders, irrespective of age. However, older drivers are overrepresented in collisions in Victoria involving fitness to drive concerns. Further work is needed, by all stakeholders, to ensure early identification of fitness to drive issues and appropriate intervention prior to the onset of a collision.

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Using New Technologies to Evaluate Existing Heavy Vehicle Driver Fatigue Laws

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Abstract

The presentation describes a National Transport Commission (NTC) and Alertness CRC project to scientifically evaluate fatigue provisions in the Heavy Vehicle National Law (HVNL). The two-year research project has an allocated $1 million budget, principally funded by the Commonwealth Government. The research is naturalistic and laboratory-based, utilising alertness monitoring and actigraphy devices to measure alertness and sleep quantity and quality of drivers undertaking maximum hours of work and minimum hours of rest. The presentation focuses on the challenges of evaluating in a laboratory setting the fatigue impact of so-called “nose-to-tail schedules” (whereby a driver works two 12-hour shifts with a seven hour rest break).

Overview of the Heavy Vehicle Driver Fatigue research project

The presentation will summarise the research project, including the 2014 ministerial direction to increase our evidence base before further national reforms to the HVNL are considered. The presentation will outline the research methodology. The research comprises of two phases. Preliminary results from Phase 1 will be described.

Phase 1

is an on-road field trial that will assess drivers’ alertness levels, sleep, and driving impairments in naturalistic/real-life driving conditions. Used as an appraisal of available alertness monitoring technologies, such as Optalert, phase 1 drivers will be monitored during work shifts (day, evening and night) across a one month shift cycle, in addition to sleep monitoring during work shifts and on days off. The purpose of phase 1 is to validate the alertness technologies against external indicators (primarily lane departures) and to establish objective alertness bio-markers to be used to translate research data in Phase 2 of the project. 15 drivers will participate in phase 1.

Phase 2

combines laboratory and on-road evaluation of driver fatigue. In the laboratory setting (phase 2a), the study will evaluate how simulated shift patterns impact drivers’ alertness levels and driving performance. Following each simulated shift, the participant will be transferred to a closed-loop continuous-driving test track and will undertake a 2-hour fully monitored drive. The participant will undertake two simulated shifts: a nose-to-tail and an alternative schedule against which the fatigue risk of the nose-to-tail is compared. 15 drivers will participate in phase 2a.

In phase 2b, 40 heavy vehicle drivers will each be measured for alertness and sleep monitoring over a one week period. Drivers will undertake routine on-road and related activities and will be selected to ensure a representative sample. The study will target drivers that work maximum hours and have minimum rest allowed under the law. The study will seek a cross-section of urban and rural driving, general freight and livestock transportation, and drivers employed across a range of large- and small-scale operations.

Explanation of the Counting Time Rule and Nose-to-Tail phenomenon

The presentation will concisely explain how 24-hour periods are counted in the HVNL, and how the current rules allow a driver to work up to 16 hours in 24. The presentation will illustrate the complexity of measuring the fatigue impact of a nose-to-tail given that the longer work hours are separated by a minimum rest of seven hours. At issue is the extent to which this minimum rest sufficiently offsets the fatigue risk at the end of the second work period.

Challenges of simulating and comparing a Nose-to-Tail in a laboratory

To scientifically evaluate the fatigue impact of nose-to-tails, the research necessitates a comparative analysis to benchmark the nose-to-tail results. Using this comparative analysis in a controlled environment, we will have the tools to evaluate objectively the degree of impairment attributable to a nose-to-tail schedule.

The presentation will highlight the benefits and disadvantages of a number of alternative schedules canvassed with industry and government stakeholders, including:

- increasing the major rest period in the nose-to-tail
- reducing the second work period in the nose-to-tail
- increasing minor rest periods throughout the two work opportunities
- adjusting night-driving.

A key challenge is to develop a robust and measurable comparison, while seeking to ensure that the alternative schedule does not predetermine a policy intervention.

Potential way forward

The presentation will conclude with a summary of a potential way forward: the nose-to-tail schedule is compared to a driver that is well-rested and has an increased rest breaks from 7 hours to 11 hours. By adopting this approach, the research would be able to evaluate the fatigue of a driver at the end of a 12 hour shift in the 'best case scenario' allowed in the HVNL (completing 12 hours of work after a 24-hour stationary rest break) with the 'worst case scenario' allowed in the HVNL (completing more than 12 hours of work in a 24-hour period, with minimum rest).

In both schedules, the driver is operating legally and in accordance with the current rules of the HVNL and there are no potential policy interventions included in the alternative schedule.

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The Development of a Grey Fleet Safety Management Framework

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Abstract

Many organisations are moving towards a model of reducing the number of organisationally owned vehicles in favour of increasing Grey Fleet (privately owned vehicles used for work purposes). Despite legislation outlining responsibilities and obligations associated with the management and safety of Grey Fleet, there are a number of inherent challenges relating to Grey Fleet risk management. A series of industry attended workshops were conducted across three states in Australia seeking input from stakeholders representing in excess of 50 organisations proving input into development of a Grey Fleet management framework. The Grey Fleet management framework incorporates results from case studies used to highlight themes such as stakeholder responsibilities relevant to safety issues, along with including processes and guidance designed to improve Grey Fleet safety through risk mitigation.

Background

Work driving safety has previously been identified as potentially one of the most at risk work activities undertaken by workers while working (Wishart 2015; Mitchell, Friswell, & Mooren, 2012; WHO, 2004; Haworth, Tingvall, & Kowadlo, 2000; Wishart, Rowland, Freeman, & Davey, 2011). An area of work related driving that is gaining increased attention is known as Grey Fleet. Grey Fleet is a term used to depict vehicles used for work purposes that are not owned or leased by the organisation but rather primarily involve the use of private vehicles for work purposes. Grey Fleet is a particularly problematic area of Fleet safety management as although legislation specifically states obligations and responsibilities associated with the safe use of a vehicle used for work, a greater range of challenges are present due to the organisation not having the same control over those vehicles as those they directly own. Furthermore, safety issues associated with Grey Fleet are expected to increase as organisations decrease traditional Fleet sizes in response to reducing the organisations measurable environmental impact and directly attributable crash costs.

Aim & Methodology

To assist organisations in better managing risk and safety associated with Grey Fleet this project aimed to develop a comprehensive Grey Fleet safety management framework. A series of workshops are currently being conducted across three Australian states involving key Grey Fleet operators and stakeholders representing over fifty organisations utilising Grey Fleet operations. The workshops are being conducted inviting stakeholders to identify and define Grey Fleet, highlight specific safety issues relevant to Grey Fleet and diverse industry settings, and develop potential strategies and solutions to be included within the Grey Fleet safety management framework. Each workshop involves a structured focus group approach and qualitative analysis is being undertaken to identify current and recurring themes particularly relevant to industry to be incorporated within the Grey Fleet safety management framework.

Outcomes

As a result of focus group workshops and industry and academic feedback, a Grey Fleet risk management safety guide framework has been developed incorporating content applicable to themes, issues and strategies identified relating to the driver and the organisation. Upon completion of the initial draft Grey Fleet safety management guide (March 2017), a panel of experts were consulted for final feedback and comment. This feedback was then incorporated into the second stage development of the Grey Fleet Safety Risk Management Framework Guide applicable to industry. This version was further disseminated to industry stakeholders for additional review in July 2017 to ensure practical applicability of the guide across all sectors of business, utility and health care Grey Fleet operations. The final version of the Grey Fleet Safety Management Framework will be subsequently made freely available to industry and stakeholders along with future development of a series of educational workshops.

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The Effect of Correct Child Restraint Cross-Chest Clip Use on Injury Outcomes in Motor Vehicle Crashes

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Abstract

While correctly used age-appropriate child restraints offer excellent protection to young children in crashes, misuse of shoulder harness straps is common. Australian regulations discourage the use of cross-chest clips on harnesses that can assist in keeping shoulder straps in place, due to concerns about potential neck injury from the clips. This study used the US NASS-CDS database to examine the relationship between cross chest clip use and injury outcomes. For all children aged 0-4 years, correct chest clip use was associated with decreased AIS2+ injury, but it was not associated with neck injury. However, outcomes varied by age.

Background

Cross-chest clips join the two shoulder straps of a child restraint harness, and are meant to help keep the harness in position in a crash (Klinich, Manary, & Weber, 2012). They are designed to connect the two shoulder harness straps with a clip at the level of the axilla (Bulgur, Kaufman, & Mock, 2008), thereby preventing the shoulder straps from slipping off the shoulder. The latter is associated with child's ejection from the restraint or vehicle, and thus high injury risk. However, there has been historical concern about the potential for clip-induced neck injuries during a crash, including in Australia and has resulted in restrictions on their use in The Australian and New Zealand Standards for Child restraints (AS/NZS 1754:2013). No large-scale studies of chest clips' influence on injury or this potential neck injury mechanism have been undertaken. This study aimed to examine the relationship between injury and cross chest clips, using US data where they are common.

Methods

Child passengers aged between 0-4 years of age were identified in the US National Automotive Sampling System (NASS) Crashworthiness Data System datasets (2003-2014). Overall AIS 2+ injury, and the presence of any neck injury were the primary outcome variables. Logistic regression analysis was used to determine associations between chest clip correct use and injury outcomes while controlling for age, crash severity, crash direction and restraint type.

Results

In the whole sample of children aged 0-4 years, correct chest clip use was associated with decreased moderate to severe injury (OR 0.44, 95%CI 0.21-0.91) compared to incorrect/absent chest clip use, and was not associated with neck injury. However, in children <12 months old, chest clip use was associated with decreased AIS2+ injury (OR 0.09, 95%CI 0.02-0.44) and the seven minor neck injuries observed (all AIS1, mostly minor contusions or abrasions) all occurred with correct cross-chest clip use. Of these 7 neck injuries, 3 could have occurred due to contact with the chest clip. For 1-4 year old children, cross-chest clip use was not associated with AIS2+ injury, and correct use carried decreased odds of neck injury (OR = 0.49; 95%CI 0.27-0.87) compared to an incorrectly used or absent cross-chest clip. No serious injuries were directly caused by the chest clips.

Conclusions

Correct cross-chest clip use appeared to reduce injury in crashes, and there was no evidence of serious clip-induced injury.

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Drug Driving: Analysis of Current Trends IN South Australia

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Abstract

This study uses a wide range of data sources to provide an overview of current trends in drug use and drug driving in South Australia. We investigate the incidence of drug use within the general population, examine drug detection rates for roadside drug testing and analyse the prevalence of drugs in crashes. The analysis indicates that the increasing prevalence of driving under the influence of drugs, particularly methamphetamine, appears to reflect general drug use trends observed in the wider community.

Background

The use of illicit drugs is widely recognised as a major community problem that has vast social and economic impacts, not only on our roads but in society more generally. The reporting of illicit drug driving in Australian jurisdictions has traditionally focused on relatively small samples of fatally injured drivers and has not considered the wider context in which drug driving occurs (Palamara, 2015). Previous research has also been hampered by the availability of appropriate data sets. Through a collaborative approach, this study provides an overview of the current state of drug use in the context of road safety and investigates the prevalence of drug driving within South Australia for the three proscribed drugs: methamphetamine (Speed, Ice), MDMA (Ecstasy), and THC (Cannabis).

Method

A number of drug-related data sources are analysed to offer an evidence-based platform for strategic decision making not only within a road safety context, but also wider government priorities. To investigate current trends in drug use within the wider South Australian community, we use data from the 2013 National Drug Strategy Household Survey, the Drug Use Monitoring in Australia program and the University of South Australia wastewater analysis study. We also examine drug detection rates for roadside drug testing and the prevalence of drugs in crashes using data supplied by SAPOL. In addition, basic demographic profiles of drivers testing positive to a roadside drug test are explored to further inform targeted communication campaigns and enforcement strategies.

Results

Cannabis is the most common illicit drug used in the general population and in offender samples within South Australia. However, recent drug use data based on wastewater analysis in metropolitan Adelaide indicates that rates of use of methamphetamine have more than doubled from 2012 to 2016. Levels of MDMA use remain low.

Roadside drug testing indicates that the proportion of drivers testing positive for illicit drugs has almost doubled in the last five years to 9.4% in 2015, despite relatively consistent enforcement operations. The rate of detections for methamphetamine increased more rapidly than cannabis. Of the drivers testing positive for drugs, methamphetamine (77%) was detected more frequently than cannabis (51%), despite cannabis being considerably more prevalent in the general population. This reversal may be partly explained by the different metabolisms of the drugs and the differential sensitivity of the roadside screening equipment.

During the last five years, an average of 22% of fatally injured drivers tested positive for drugs. For casualty crashes, cannabis is the most common drug detected in drivers and the level has remained relatively stable from 2010 to 2014. In contrast, the number of casualty crash involved drivers testing positive for methamphetamine doubled during this period.

Conclusions

The increasing incidence of driving under the influence of drugs, particularly methamphetamine, evident in roadside drug testing and crash statistics, appears to reflect general drug use trends observed in the wider community. Our findings agitate for a more expansive, collaborative approach in which road safety stakeholders partner with non-traditional road safety agencies such as social services, health and community groups to reduce the incidence of drug driving. The wider promulgation of drug related road safety data (i.e. de-identified driver blood test results) might also inform drug driving enforcement strategies and interventions.

Acknowledgements

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Exploring the Safe System in a World of Autonomous Vehicles

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Abstract

The Safe System is built on the principles that death and serious injury are an unacceptable trade-off, having considered that humans make mistakes and that humans can only tolerate certain forces. There are five key elements: Safe Roads; Safe Speeds; Safe Vehicles; Safe People and Post-Crash Response. The introduction of autonomous vehicles is leading to a shift in the way the road safety challenge should be framed. This paper discusses, with real world application, the way in which the Safe System should be adapted for an AV world.

Introduction

This research aims to address the challenges that road safety will face with the introduction of Autonomous Vehicles (AVs). It answers key questions that face the industry including "Will all the effects be beneficial?", "How can road safety and the Safe System adapt and respond to this challenge?" and "How will each users groups role in the Safe System need to adapt?"

Many publications predict that the introduction of AV technology will have significant benefits (ITS World Congress, 2016), including the potential to reduce road trauma by anything up to 95% (Willimason., 2016). This research considers the journey to that point including the effect of taking control out of the driver's hands and how this impacts road trauma levels. The research focusses on the relationship between AVs and vulnerable road users, which is a particular challenge (Siulagi et al., 2016; Vissers et al., 2016). Through considering the framework of the Safe System the research aims to identify the complementary and conflicting elements of Safe System in an AV world and how the approach could adapt to protect vulnerable road users.

Levels of Automation

The journey to a fully autonomous transport network is mapped out by the levels of vehicle automation. Experts have defined six levels (SAE, 2016):

- Level 0 – No automation
- Level 1 – Driver Assistance
- Level 2 – Partial Driving Automation
- Level 3 – Conditional Driving Automation
- Level 4 – High driving Automation
- Level 5 – Full Automation

At this point the research is considering all phases of the transition but this presentation will focus particularly on Levels 3 and 4. These stages of automation represents a particular challenge for road trauma reduction. The authors have also identified the vulnerable road user group as a particular focus when considering these stages of automation (Siulagi et al., 2016; Vissers et al., 2016) and this will again be a particular focus of the research presented.

Mapping the Safe System

The first task in the research is to map the key individuals or groups in control of each of the five Safe System pillars for the existing and Level 3 case.

Table 1. Mapping the Safe System for Level 3 Automation

	Current	**Level 3/4**
Safe Roads	Road authority	Road authority
Safe Speeds	Road authority and Driver	**Road authority and Vehicle/Driver**
Safe Vehicles	Manufacturers	Manufacturers
Safe People	Driver and other road users*	**Other road users* and driver**
Post-Crash Response	All road users and emergency services	**All road users, AVs and emergency services**

* This could include: non-automated vehicles or vulnerable road users (e.g. motorcyclists; cyclists; pedestrians).

Application

The authors have developed an adapted safe System framework, using the above mapping. As a part of the presentation the authors will present the process undertaken to develop this methodology and apply it for sites which previous Safe Systems Assessments have been undertaken. The authors will then present the hurdles and limitations of the adapted framework as well as how they envisage it being utilized in the future.

References

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Application of Spatial Analysis to Inform the Transport Accident Commission's Local Enhanced Enforcement Program

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Abstract

The Local Enhanced Enforcement Program, a grants program funded by the Transport Accident Commission, enables members of Victoria Police to apply for funding to target dangerous road user behaviour, such as speeding and drink driving, in their local areas. In a revamp of the program, a geospatial methodology was developed to identify parts of the road network where enforcement is likely to reduce road trauma. The results were displayed on a web mapping application assisting Victoria Police to plan and prioritise their enforcement activities. This new approach has enabled police members to quickly identify high-risk locations for local enforcement operations.

Background

Recognising the influence of police enforcement on road user behaviour, the Transport Accident Commission (TAC) invests in police enforcement activity. One example of this investment is the Local Enhanced Enforcement Program (LEEP). For over a decade, LEEP has encouraged Victoria Police members to submit applications for funding to conduct operations targeting road safety issues in their local areas, over and above their usual enforcement capacity.

Previously, applicants gathered their own data to provide evidence of a road safety issue. Feedback indicated this process was time consuming and at times difficult for those whose expertise lies in planning and deploying enforcement rather than data analysis.

In July 2016, the TAC launched a revamp of the LEEP. As part of this revamp, Abley Transportation Consultants developed a geospatial methodology and a web-based application to support police in identifying high-risk locations for targeting in LEEP funding applications.

Methodology

The first round of the revamped LEEP specifically targeted speeding on high-speed rural roads. This decision to initially focus on these roads was made because Victoria's *Towards Zero Strategy* highlighted rural roads as an area for action, due to their disproportionate levels of trauma.

The methodology to identify rural road corridors with a history of speed, high-severity crashes was based on ten years of injury crash data extracted from VicRoads' Road Crash Information System.

Using this data, each crash movement was assigned a killed or severely injured (KSI) probability in a high-speed environment. For example, it was estimated that a high-speed head-on crash results in 1.03 KSI compared to a rear end crash which results in 0.44 KSI. Using estimated KSI rather than actual KSI ensures that the approach is not wholly reactive.

A Victorian road dataset, excluding Melbourne, was segmented into corridors in GIS based on the road name, posted speed limit and hierarchy resulting in an average corridor length of 5km. Only corridors that matched the criteria given in Table 1 were analysed.

The road stereotype criteria were used to exclude motorways and other Safe Systems compliant roads where the proportion of KSI is expected to be lower than undivided roads.

Only crashes caused by speeding were used to inform the analysis. To estimate cause, speeding was assumed to be a causal factor in all overtaking and loss of control crashes. Furthermore, only crashes that occurred during clear weather conditions were included (Highway Safety Information Systems, 2010).

Table 1. Criteria for High-Speed Rural Roads Analysis

Attribute	Criteria
Road Hierarchy	Sub-Arterial or above
Road Stereotype	Undivided only
Speed Limit	≥ 80 km/h

A corridor risk value was calculated as the sum of the estimated KSI of all speed-related injury crashes along the corridor. This value was then moderated by the corridor length and used to rank corridors in terms of speeding risk. ‘High’ and ‘Medium-High’ risk corridors equated to 10 percent of Victoria’s high-speed rural road network and targeted more than 50 percent of estimated KSI.

Application

Figure 1 shows a screenshot of the web application displaying the results of the high-speed rural roads analysis.

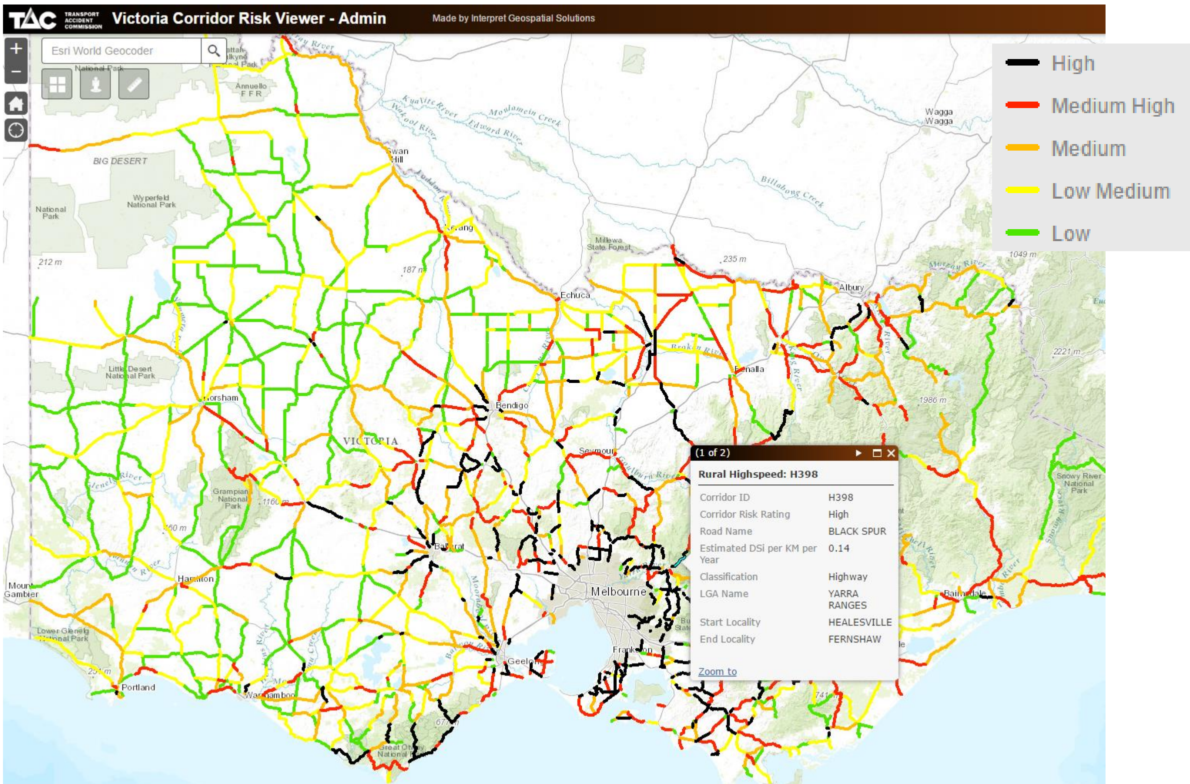

Figure 1. Screenshot of Web Application Showing High-Speed Rural Roads Analysis Results

Since the launch of the web application, the TAC has received over 220 applications to fund enforcement operations. Feedback from police indicates that the application is also being used to inform business-as-usual road policing. The web application provides the TAC and Victoria Police with a robust evidence base for local enforcement activity.

References

Highway Safety Information Systems. (2010). Development of a Speeding-Related Crash Typology – Summary Report. McLean, VA: Author.