



Journal of the **Australasian College of Road Safety**

Formerly RoadWise – Australia's First Road Safety Journal



Peer-reviewed papers

Original Road Safety Research

- A Crash Testing Evaluation to Prevent Injuries and Fatalities by Mitigating Vehicle Windscreen Spearing Risk from Road Signs
- Exploring the frangibility of steel circular hollow section small sign support posts
- Risk factors associated with severity of hospitalised injury outcome for vulnerable-road users in New South Wales, Australia: A population-based study

Contributed articles

Letter to the Editors

- Review of the graduated driver licensing programs in Australasia
- Response: Review of the graduated driver licensing programs in Australasia

Commentary on Road Safety

- A collaborative road safety survivor mission: the sacred work of sorrow

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Cover image

Dr Wendy Sarkissian is arguably Australia's most experienced community planner. The author of four major books on planning, housing, and community engagement and recipient of over forty professional awards, she has pioneered innovative community engagement processes in most Australian states and territories over several decades. Educated in Arts, education and planning, Wendy holds a doctorate in professional ethics from Murdoch University. Recovering from her injuries and the loss of her husband, Karl Langheinrich, she now lives in Vancouver, Canada.

See her personal story in the *Commentary on Road Safety* article (Sarkissian. (2018). A collaborative road safety survivor mission: the sacred work of sorrow. *Journal of the Australasian College of Road Safety*, 29(1), 42-48).

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From the President



Dear ACRS members,
Welcome to all our readers for 2018. I hope that our efforts in reducing road trauma will be effective.

As always there is so much to do in so many areas. There are rapid developments not only in technology which will assist all road users to avoid crashes, but also in road users' acceptance of rules and

enforcement brought about by their increased confidence via a range of social media channels.

Increasingly "evidence" based data is being run in parallel with "fake news". This makes it more important that we all actively promote the work published in the Journal in a range of media to ensure that research results are understood and accepted.

Communication of good research is essential and while we often recognise the "disruption" caused by new technology and new businesses, we often ignore or feel it is unnecessary to be as innovative in the way we present those research results.

There are a range of users of the research and news published in the Journal, and they receive messages from many sources, including the often deafening unsubstantiated opinions of many. While our role is predominantly to publish, and inform, we have a responsibility to advocate best practice, based on sound work.

The challenge is for us to ensure we are innovative and perhaps disruptive with our communications so we can assist in the promotion of the Vision Zero concept to reduce road trauma.

*Lauchlan McIntosh AM FACRS FAICD
ACRS President*

ACRS Chapter reports

Chapter reports were sought from all Chapter Representatives. We greatly appreciate the reports we received from ACT, Victoria, Queensland and NSW.

Australian Capital Territory (ACT) and Region

2017 ACT Road Safety Forum: Achieving Safe Systems for ACT Roads

On 5 December, 2017, the Australasian College of Road Safety, ACT and Region Chapter (ACRS) facilitated a Road Safety Forum for the ACT Justice and Community Safety Directorate (JACS). The objective was to discuss how Safe System elements can be better used in achieving the ACT's Road Safety Strategy targets for 2020 and realising "Vision Zero" as early as possible. Associate Professor Jeremy Woolley and Mr Lauchlan McIntosh, generously led the Forum's discussion.

With the ACT determined to be the first jurisdiction to get to Vision Zero, this forum provided an opportunity to look at Safe Systems thinking and how it could be made an integral element of the Strategy and Action Plans; setting up an inclusive approach for all groups and establishing ways to reduce risks.

The Forum found that at the present time it is doubtful if the ACT will be able to achieve its 2020 Road Safety Target unless special actions are taken to accelerate its performance over the next two years.

Australia wide the majority of fatal crashes are "single vehicle run off road", "intersections" or "head on". These crash types are very adaptable to safe systems treatments to eliminate crashes or mitigate the degree of harm incurred in a crash.

A report is being finalised for consideration by the ACT Government. Broadly it will recommend that: the ACT:

- gives close consideration to recommendations of the Ministerial Inquiry into the effectiveness of the National Road Safety Strategy that will accelerate ACT performance;
- reviews the actions set out in the ACT Road Safety Action Plan 2016-2020 and focus on those actions that will accelerate ACT performance and be able to be implemented quickly (and nominate implementation dates);
- uses the Austroads Safe System Assessment Framework to identify and prioritise projects for the strategy and achievement of Vision Zero; and

- implements a program is required to assist the community to gain a better understanding of Safe Systems in the road safety context, and of the actions that may be required to achieve "Vision Zero".

Drug driving policy

As previously reported, the Chapter managed the Road Safety Forum 2016: Drug Driving for the ACT Government in July 2016. The ACT established an ongoing review of these issues which continues to address the issues.

Focus is being placed on the areas of: education and communications; research and data; and drug driving regulation (including penalties and an impairment based approaches to regulation). A Communications and Education Group report has been finalised and presented to the Minister for Road Safety.

Progress has commenced on the review of drug driving regulation. Dr Jeremy Davey from CARRS Q, Queensland university of Technology, has been engaged to prepare a discussion paper to inform the Working Group on drug regulation. The report is well under way. Terms of reference for the working group have been agreed.

Other activities

The Chapter unsuccessfully sought funding from the 2017 ACT Road Safety Grants to conduct two forums- one on a proposed ACT Aboriginal & Torres Islander Driver Licensing Pilot Project; and another on wildlife crashes in the ACT.

A grant was awarded to the Aboriginal and Torres Islander Legal Service NSW/ACT for the driver licensing pilot project. The Chapter will be represented on the management committee for this project.

Discussions will be held with the ACT Branch of the Royal Australasian College of Surgeons on the issue of wildlife crashes project.

*ACT Chapter Chair and Secretary
Mr Eric Chalmers & Mr Keith Wheatley*

Victoria (VIC)

The Victorian chapter presented two seminars in 2017 and entered the digital age, using technology to bring interstate speakers and audiences to Victoria.

April seminar – Fatigue and Distraction

Our April seminar included presentations from state government and researchers from Victoria and Queensland.

Kelly Imberger, Senior Policy Officer, Driver Performance, Road User and Vehicle Access at VicRoads provided an overview of research and policy action on performance decrements from mobile phone use and other distracting activities and potential countermeasures. Brook Shiferaw, PhD candidate from Swinburne University of Technology presented an informative overview of saccade velocity (how fast the eye moves between points) to predict lane departure events among sleep-deprived drivers. Brook's findings could have implications for driver-alerting systems that could incorporate individual variance. We look forward to the final results from Brook's research. Dr Christopher Watling from CARRS-Q also presented on the relationship between sleepiness and distraction and the differences between acute and chronic sleep deprivation. Christopher was our first test, and success, of an online video link which extended to the Q&A session which allowed our audience to ask questions and involve Christopher in the discussions in the room.

September seminar - Community perceptions and the reality of managing speeds locally from the Bay to the Murray

Kelly Imberger led a series of questions on speed in a pub-quiz format with wide ranging questions including public attitudes, technology and crash statistics. Special thanks to Kenn Beer and the team at Safe System Solutions for the slide design assist.

Our speakers from regional Victoria included Chris Davis from the City of Mildura and Doug Bradbrook from the Mornington Peninsula Shire. Both presenters shared their experiences of a holistic approach and broad community consultation to successfully reduce speeds on local roads. Doug highlighted the need to integrate speed management with other aims including mobility, active transport, liveability and place making to improve community acceptance. From metropolitan Melbourne, Danny Millican from the City of Yarra presented on managing speeds and the introduction of 40kph with an emphasis on local area place making. From South Australia, Richard Blackwell, Motor Accident Commission and Sarah Zanker, Colmar Brunton presented on the evolution of road safety messaging about speed in the South Australian context. They described the changing tone of messaging from images of shock and crashes to engaging through humour.

Technology fail – buoyed by our success in May, we attempted another video link in September, this time to bring an online audience into the room. But a different venue and limited broadband access worked against us and it was not successful. We will continue to test and refine the tech to help us deliver the important seminar content to a wider range of speakers to a broader audience.

I am very pleased to report that heading into 2018, the Victorian chapter is returning to good health. Our 2017 Chair, David Healy, was taken ill with a serious lung infection in August and he continues to recover and return to good health and we look forward to welcoming him back in 2018. We also welcome Melinda Spiteri back as our Chair for 2018 after maternity leave. I am thrilled to return to my role as Deputy Chair to the Chapter for this year.

Chapter members played a significant role in the successful delivery of our seminars in 2017 and represented the College at various conferences and forums. I would like to thank all the members of the Victorian chapter for their support and continued involvement in the work of the College with special thanks to Wendy Taylor, Rebekah Smith, Kelly Imberger, Kenn Beer, Tahlee Norton, Richard Tay, Jude Charlton and Sam Buckis.

Finally, thank you to Claire Howe and Lauchlan McIntosh and the staff at the Canberra Office for their ongoing support to the chapters and for their broader advocacy to keep road safety a priority issue on the national agenda.

VIC Chapter Deputy Chair
Dr Marilyn Johnson

Queensland (QLD)

Queensland Chapter Report, 4th quarter 2017

The Queensland Chapter held its final seminar for 2017 on 5th December. We were pleased to welcome as our speaker Dr Marilyn Johnson, Senior Research Fellow with the Institute of Transport Studies at Monash University, who hosted a highly engaging interactive quiz on the history and future of cycling in Australia. Marilyn highlighted Australia's strong cycling history and reflected on future possibilities. She also touched on some of her cycling research projects. The seminar was well attended and included some first-time attendees.

A State election was recently held in Queensland, marking the end of the first term of Queensland's first ever Minister for Road Safety, Mark Bailey. Along with CARRS-Q, RACQ, Bicycle Queensland and Kidsafe Queensland, the Chapter was a signatory to a letter to the Premier urging her to appoint a Road Safety Minister in her new government. Unfortunately we were unsuccessful in persuading the Premier, however Mark Bailey continues to be responsible for road safety in a portfolio which reunites Transport and Main Roads. We look forward to a continuing dialogue with the Minister regarding road safety in Queensland.

At its final meeting, the Chapter agreed to host a workshop on the Safe System approach in early 2018, with a combination of guest speakers and group discussion. The aim is to highlight the philosophy and implications of the Safe System approach among road safety professionals. Details will be announced in the near future.

QLD Chapter Chair
Dr Mark King

New South Wales (NSW)

No events have occurred since the last Chapter Report in the NOV2017 Issue.

NSW Chapter Representative
Mr David McTiernan

ACRS News

ACRS wishes all our members a happy new year! 2018 also marks the college's 30th birthday

Please join us at ARSC2018 to celebrate the college's 30th anniversary!!!!

The Australasian College of Road Safety was founded in 1988 by a small but committed (and forward-thinking!) group of individuals who were looking for a way to network and collaborate more effectively to reduce road trauma. The College has come a very long way since our inaugural meeting held 19 February 1988 at the University of New England during the National Traffic Education Conference. In our first year of operation we had 29 personal members and 26 corporates - how we have grown!

We look forward to holding a very special celebration of the history and achievements of the College since its inception 30 years ago, and look forward to many members and supporters joining us to mark the occasion during the 2018 Australasian Road Safety Conference to be held in Sydney, 3-5 October 2018: <http://australasianroadsafetyconference.com.au/>

ACRS recognised with prestigious Prince Michael International Road Safety Award

*Joint statement
Prince Michael of Kent GCVO CD &
Lauchlan McIntosh AM
Tuesday 12 December 2017 (London time)*

The Australasian College of Road Safety has been recognised with a prestigious 2017 Prince Michael International Road Safety Award (PMIRSA) for excellence

in Road Safety Management. Each year the most outstanding examples of international road safety initiatives receive public recognition through these awards. This year the College was invited to a Gala Presentation held in London at the Savoy Hotel, and was presented with the Award by His Royal Highness Prince Michael of Kent.

In presenting the Award, Prince Michael congratulated the College as follows: 'The ACRS is approaching its 30th anniversary and has become a thoroughly well-respected, inclusive and truly collaborative organisation bringing together the wide stakeholder networks across Australasia.'

ACRS President Lauchlan McIntosh AM said, 'The Prince Michael Awards play a vital role in recognising the immense amount of work that takes place in road safety worldwide, and as President of the College I am delighted to accept this award on behalf of the College's many members who continue to work tirelessly to reduce road trauma.'

'For those who work in road safety it can sometimes feel like a never-ending or thankless task, however those who find themselves in this field often develop a life-long passion for it. As President of the College I thank our members and supporters for your ongoing commitment and perseverance - without your support the College would not succeed. I am proud to say that our College Executive Committee and Fellows, and our hundreds of members, constitute a strong and cohesive team across Australasia, supporting a unique and apolitical partnership between all levels of government through to all other sectors such as research, community organisations, police and educators, economists, and on through to interested members of the public.'

'There is so much more that can be done, there are actions and solutions that we know work and that can be implemented now. There are also emerging opportunities



Above right: Dr Chika Sakashita (ACRS Journal Managing Editor), Mr Lauchlan McIntosh AM FACRS (ACRS President, Chair Global New Car Assessment Program), HRH Prince Michael, Ms Claire Howe (ACRS CEO), Professor Narelle Haworth FACRS (Director, CARRS-Q), Dr Soames Job FACRS (Global Road Safety Lead, World Bank, Washington DC)



Top photo: From left: Mr Lauchlan McIntosh AM FACRS (President, ACRS), HRH Prince Michael, Ms Claire Howe (CEO, ACRS); Middle left photo: HRH Prince Michael speech. Bottom left photo: From left: Mr Llew O'Brien MP (co-Chair, Parl Friends of Road Safety - Australia), Dr Chika Sakashita (Journal Managing Editor, ACRS & International Road Safety Consultant, Global Road Safety Solutions), Ms Claire Howe (CEO, ACRS), Mr Lauchlan McIntosh AM (ACRS President, Chair Global New Car Assessment Program), Mr Rob McInerney FACRS (CEO, International Road Assessment Program), Senator Alex Gallacher (co-Chair, Parl Friends of Road Safety - Australia), Mr Iain Cameron FACRS (Commissioner, WA Road Safety Commission & Chair, International Transport Forum/OECD Safe System Implementation Working Group)

to reduce road trauma, and we look forward to supporting their implementation as we move Towards Zero’, said Mr McIntosh.

Over the past 30 years the College has grown to become a well-respected institution by building on a strong foundation of experts, and with it a reputation for providing evidence-based, reliable advice to politicians and the wider road safety community. In 2014 the College fostered a successful partnership with all Australasian jurisdictions and jointly founded an annual road safety conference which now attracts 600-800 stakeholders annually. At this conference the College also rewards outstanding achievement by individuals and project teams through the annual ACRS Awards. Together with the conference these awards have become a highlight on the road safety calendar across the region. Other unique programs run by the College include the quarterly *Journal of the Australasian College of Road Safety*, which is developing into a world class peer-

reviewed journal showcasing the latest and best road trauma reduction research and projects.

JACRS paper featured in ABC News

A paper published in the *Journal of the Australasian College of Road Safety* (JACRS) — Cross, S. L., Charlton, J.L., & Koppel, S. (2017). Understanding parental beliefs relating to child restraint system (CRS) use and child vehicle occupant safety. *Journal of the Australasian College of Road Safety*, 28(3), 43-54. — was featured in an ABC News Opinion piece “What age is it safe for children to use a standard seatbelt? You’ve probably got it wrong”. This story has been shared from Facebook nearly 2,000 times. See full story: <http://www.abc.net.au/news/2017-12-26/booster-seats-in-the-car-five-step-test/9266522>

Journal of the Australian College of Road Safety – Volume 28 No. 3, 2017

Understanding parental beliefs relating to child restraint system (CRS) use and child vehicle occupant safety.

Suzanne L. Cross¹, Judith L. Charlton PhD¹ and Sjaan Koppel PhD¹

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Key Findings

- Despite motor vehicle crashes being a leading cause of childhood death and serious injury in Australia, significant gaps remain in parents’ knowledge regarding child restraint system (CRS) use and child occupant safety.
- More than half of the parents who completed an online survey (59%) reported that the minimum recommended height (145cm), for a child to most safely transition from a CRS to an adult seatbelt, would be reached by most children by the age of seven years.
- Parents tended to attribute the responsibility of child vehicle occupant safety to internal factors such as their own driving abilities and their own safety compliance, rather than external factors such as fate.
- Results suggest that there are still significant gaps in parents’ understanding about CRS use and child occupant safety which is important for the development and success of future child occupant safety initiatives.

Abstract

The aim of the current study was to understand Australian parents’ beliefs relating to child restraint system (CRS) use and child vehicle occupant safety. Three hundred and eighty parents completed an online survey related to CRS knowledge and their beliefs about which factors (the influence of internal and external) influence child vehicle occupant safety. The online survey was active from June 2013 until November 2014. Results revealed a wide variation in parents’ beliefs relating to CRS use and child vehicle occupant safety. The majority of parents responded correctly to CRS related questions, including: the appropriate CRS for child vehicle occupants aged between four and seven years (95%); and the need to adjust CRS harnesses for each trip for optimal safety (91%). However, half of the parents (50%) held the misconception that the after-market H-harness accessory, provided additional protection to their child/ren, regardless of the context of use and 41 percent of parents incorrectly believed that their child/ren would reach the recommended height (145cm) for a safe adult seatbelt fit by the age of seven years. Parents tended to attribute the responsibility of child/ren’s vehicle occupant safety to internal factors such as their own driving abilities (64%) and their own safety compliance (64%), rather than external factors (e.g., fate [7%]). The results of the current study suggest that there are still significant gaps in Australian parents’ understanding about CRS use and child occupant safety which is important for the development and success of future child occupant safety initiatives.

Keywords

Child vehicle occupant safety, child restraint systems (CRS), CRS use, CRS misuse

ACRS releases 2018/19 pre-budget submission: a proposal for resourcing national road safety to reduce the tragedy of increasing deaths and injuries on our roads

Executive Summary

Australia's collective performance against our National Road Safety Strategy (NRSS) (Australian Transport Council, 2011) target of a 30% reduction in deaths and serious injuries by 2020 is unlikely to succeed. Current projections indicate that we are on track to reduce deaths by under 20%, and that serious injuries are in fact continuing to rise, estimated to reach over 40,000 per year by 2020 (Figure 1, BITRE, 2017 & ACRS and Figure 2, BITRE, 2016).

The Australasian College of Road Safety (ACRS) strongly supports the Minister for Infrastructure and Transport, Hon Darren Chester, in his call for national leadership to address this tragic situation. The College requests the Federal Government recognise and fund the NRSS within its budget processes, provide significant additional national road safety funding, and in particular fund a credible response to the Independent Inquiry into the Effectiveness of the National Road Safety Strategy chaired by Dr Jeremy Woolley and Dr John Crozier.

This request updates previous requests from the College in 2015, 2016 and 2017, and comes after we have seen the deeply concerning statistics relating to the number of both deaths and serious injuries on Australian roads over the last couple of years. Around 100 Australians are dying every year over what has been predicted, and the number of Australians seriously injured are rising such that at least 37,000 people are hospitalised each year - of which 4400 become permanently disabled.

This request includes specifically a collaborative program between the Commonwealth Government and the Australasian College of Road Safety to assist in building knowledge and capacity for road safety professionals and practitioners, especially in rural and regional Australia where 66% of the trauma occurred during 2015 (Transport and Infrastructure Council, 2016). The collaborative program would allow the Commonwealth Government to leverage a stronger road safety response from existing road safety activities of the College.

Our collaborative efforts to reduce road trauma are tragically stalling after decades of reductions. Our performance when compared internationally has fallen from among the top ten to the bottom of the top 20 countries. The cost of this trauma to our nation has risen to around A\$30bn per year in 2015 and continues to rise (AAA, 2017).

The Federal Government has specific road and vehicle safety responsibilities, including the allocation of significant infrastructure resources.

In February 2017, the College called on:

- All Federal Parliamentarians to unanimously reject the current increasing rate of road death and injury, and commit to the ultimate goal of eliminating fatalities and serious injuries on the road.
- The Federal Government to:
 - Task the Productivity Commission with undertaking a full enquiry into the impact of road trauma on Australia's productivity, and the national investment and policy decisions required to achieve the nation's policy goals of a safe road transport system
 - Make the publication of targeted safety star ratings on the National Road Network a condition for any Commonwealth investment in the network, from 2017/18 onwards
 - Undertake a full policy review in 2017/18 of how to leverage greater safety results from its current investment in road transport.
 - Ensure all new vehicles (cars, vans, motorcycles, buses and trucks) are equipped with world best practice safety technology and meet world best practice crashworthiness.

It is our hope that the Independent Inquiry will address these matters more fully. The College also called on the Federal Government to establish a six-monthly forum for national stakeholders seeking to support significant improvements in road safety. The purpose of the forum would be review progress in road safety at a national level, and discuss key initiatives for significantly improving results. This request includes a specific proposal to address this.

A recent OECD ITF 2016 report (OECD, 2016) and a BITRE report in 2014 (BITRE, 2014) recommended a paradigm shift in management of road safety, in building research and in leadership with emphasis on a "Safe Systems" approach. While such a "Safe Systems" approach has been recognised for some time in Australian road safety strategies and plans, the messages and techniques need to be urgently communicated to the many "on ground" practitioners and community groups across the country.

Over the last 5 years the ACRS has successfully implemented a range of activities at low cost, and developed enhanced road safety communication programs through weekly online e-newsletters, professional journals, city-based chapter meetings, and a significantly expanded annual conference in partnership with Austroads (the Australasian Road Safety Conference series (ARSC 2015->) which has attracted 600-700 delegates per event. This combined conference has supported an increase of almost 50% in number of attendees and there has been corresponding increase in collaborative programs which have specifically encouraged breakdown of silos within portfolios and across portfolios. The Conference has been successful with sponsored outreach programs with rural and remote and with Low- and Middle-Income Country participants.

The College is in a unique independent position to build on that success to expand current programs beyond its membership of direct stakeholders and politicians to a much wider audience of local engineers, road and vehicle designers, social and community workers, local administrators, police, health professionals, insurers, vehicle importers and technology companies for example. As testament to the high regard in which the College ACRS is held, on 12 November 2017 the College was awarded a prestigious 2017 Prince Michael International Road Safety Award for excellence in work supporting the Management Pillar recommended in the UN Decade of Action agenda. This award is recognition of both the collaborative and inclusive nature of the College as well as reliance on a strong multi-sectoral network of experts to support the provision of evidence-based strategies for road trauma reduction.

The College is a very cost-effective organisation, with a small, efficient secretariat supported voluntarily by a range of specialist practitioners, professionals and leading academic researchers. This efficient model has demonstrated success with increased awareness and research. A collaborative program with the Government would allow an extension of the programs and contribute directly to reduction in road trauma.

The College reaffirms its previous request for funding, detailing a revised set of proposals to the value of \$3.1m over 3 years, and encourages the Government to commit to an adequately resourced national budget for successful implementation of the NRSS.

Read the entire ACRS 2018/19 pre-Budget Submission here: [file:///C:/Users/csakashita/Downloads/ACRS%20Pre-budget%20Submission%20FINAL.docx%20\(1\).pdf](file:///C:/Users/csakashita/Downloads/ACRS%20Pre-budget%20Submission%20FINAL.docx%20(1).pdf).

ACRS President Lauchan McIntosh AM responds to holiday period road trauma

Following intense media coverage of particularly horrific crashes over the holiday period, ACRS President Lauchan McIntosh AM was interviewed on ABC News: “Everyone needs to play their part in a paradigm shift in our response to road trauma”. The interview covered a variety of issues, including:

- Our Defence Secretary just pointed out how important it is to recapitalise our technology
- A lot of talk from the Defence point of view about keeping Australians safe. We need to keep Australians safe on the roads as well - drivers, insurance companies, vehicle importers, governments etc all need to be involved.
- Government finds a lot of money on Defence - why not on road trauma?
- Road trauma costs 30b per year - we need to invest in new technology
- Both short term and long term gains from new technology

- Drivers need to understand that driving up to the speed limit is really important - new technologies can help such as fatigue monitoring, Intelligent Speed Assist tech, radar etc
- Drivers need to understand the speed limit is a limit, not a target.
- The cars most people have can exceed the benefits that the roads can provide.
- AAA shows that around \$5b over the next 4 years will be collected by the government in tariffs etc, which was really put in to protect the local car industry - which no longer exists. Removing these extra tariffs would encourage people to buy safer cars.
- AAA report shows a 5% saving if we were all in the safest cars
- Autonomous Emergency Braking can reduce rear end crashes by 20-40% - trucks sold in Europe today have that as standard, whereas it's taken out of trucks that are brought in to Australia

Watch the entire interview here: <https://twitter.com/abcnews/status/946251599034253314>

ACRS President comments on recent media from outgoing Infrastructure and Transport Minister, Darren Chester MP

Former Minister Darren Chester blasts 'timid' state governments, laments lack of leadership on road deaths. This elicited the following response from ACRS President Lauchan McIntosh AM FACRS:

Fighting the war on our roads to keep Australians safe requires a paradigm shift in thinking from everyone, with aggressive leadership as Darren Chester MP says. We have achieved major change in the past, we can and must do that again.

The Article by Darren Chester is as follows:

Dumped Turnbull government minister Darren Chester has denounced a lack of national leadership on curbing the road toll and regrets not being more "aggressive" on road safety during his time in the infrastructure and transport portfolio.

The Victorian Nationals MP also chastised state governments and federal bureaucrats for a "timid" approach to curbing the road carnage.

His comments follow a Fairfax Media report on Thursday in which government expert Dr John Crozier declared the national black spot program a "Band-aid" road safety solution that should be scrapped, and claimed inertia by successive federal governments was contributing to a rising number of road deaths.

Mr Chester lost the infrastructure and transport portfolio to Nationals leader Barnaby Joyce in a Turnbull government reshuffle last month, after 20 months in the job.

In September last year he announced an independent inquiry, co-chaired by Dr Crozier, into the national road safety strategy after road crash deaths increased over the previous two years, reversing 40 years of improvements.

Mr Chester said he ordered the review because "I was frustrated that there wasn't enough action being taken to implement all the key recommendations of that strategy", which aims to reduce the annual numbers of deaths and serious injuries on Australian roads by at least 30 per cent between 2011 and 2020. "Our state ministers and our federal bureaucrats are too timid in their response to road safety and I encouraged them to take a bolder outlook and more innovative approaches, because too many people are being killed and injured on our roads," Mr Chester said. Asked whether his and previous federal governments should also shoulder blame, Mr Chester conceded a "lack of a national focus over 10 or 20 years".

"If I had my time again as minister for infrastructure and transport I would be more aggressive in my efforts on road safety. Notwithstanding that I had made it a personal priority, I didn't achieve the ... transformation I was hoping for," he said.

Mr Chester echoed Dr Crozier's call for better harmonisation of laws across states, and his criticism of NSW for refusing to target cars and light vehicles with point-to-point speed cameras. He accused the Berejiklian government of "not

wanting to make politically unpopular decisions ... yet we know speed is a major killer on regional roads." Among his "unfinished business" Mr Chester cited work to encourage motorists to buy the safest vehicle they could afford, and withholding or providing extra funding to states to "incentivise good practice" on road safety.

Labor's infrastructure and transport spokesman Anthony Albanese on Friday called on the government to act urgently on road safety. Mr Albanese said \$100 million was allocated to the black spot program in the 2016-17 budget, of which just \$25 million had been spent.

"It's not good enough for Barnaby Joyce to put out the odd thought bubble. He needs to actually get the transport ministers and people with authority and get that process underway of reversing the worrying trend that's out there when it comes to road safety," Mr Albanese said.

A spokesman for Mr Joyce challenged Mr Albanese to stipulate how much funding Bill Shorten and Labor were promising to the Blackspot program. "Shorten and Labor cannot put a dollar figure on Labor's commitment because there is no commitment from them."

Read the entire story here: <http://www.smh.com.au/federal-politics/political-news/former-minister-darren-chester-blasts-timid-state-governments-laments-lack-of-leadership-on-road-deaths-20180105-h0dxvt.html>

Diary

20-23 February 2018

XV PIARC International Winter Road Congress
Gdansk, Poland
<https://www.piarc.org/en/calendar/International-Winter-Road-Congresses-World-Road-Association/International-Winter-Road-Congress-Gdansk-2018/>

7 March 2018

Road Safety Conference
Coventry, UK
<https://www.rospace.com/events/road/>

20 March 2018

11th ASECAP Road Safety Conference
Brussels, Belgium
<http://www.asecap.com/eventasecap.html?layout=edit&id=167>

20 – 23 March 2018

Intertraffic
Amsterdam, Netherlands
<https://www.intertraffic.com/amsterdam/>

26 – 28 March 2018

PPRS 2018
Nice, France
<http://www.pprs2018.com/en/>

16 – 19 April 2018

Transport Research Arena
Vienna, Austria
<http://www.traconference.eu/>

25 April 2018

Young Driver Focus 2018
London, UK
<http://youngdriverfocus.org.uk/>

29 April 2018

28th Australian Road Research Board (ARRB)
Brisbane, Australia
<https://www.ivvy.com/event/ARRB18/>

2 – 4 May 2018

SURF 2018
Brisbane, Australia
<https://www.ivvy.com.au/event/SURF18>

23 – 25 May 2018

ITF Summit 2018: Transport Safety and Security
Leipzig, Germany
<http://2018.itf-oecd.org/>

29 May – 1 June 2018

50th CIECA Congress 2018
Belfast, Northern Ireland
<http://www.cieca.eu/calendar/799>

10 – 13 June 2018

CARSP Conference 2018

Victoria, Canada

<http://www.carsp.ca/carsp-conference/carsp-conference-2018/>

12 – 15 June 2018

Velo-City

Rio de Janeiro, Brazil

<https://www.velo-city2018.rio/>

17 – 21 September 2018

25th ITS World Congress

Copenhagen, Denmark

<https://itsworldcongress.com/>

19 – 22 September 2018

15th Romanian National Congress of Roads and Bridges

Lasi, Romania

<http://www.apdp.ro/en/>

3 – 5 October 2018

Australasian Road Safety Conference

Sydney, Australia

<http://australasianroadsafetyconference.com.au/>

8 – 12 October 2018

Walk21

Bogotá, Colombia

<https://www.walk21.com/>

29 – 30 October 2018

20th International Conference on Road Traffic Safety and Public Transport Vehicles

Paris, France

<https://www.waset.org/conference/2018/10/paris/ICRTSPTV/home>



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Peer-reviewed Papers

Original Road Safety Research

A Crash Testing Evaluation to Prevent Injuries and Fatalities by Mitigating Vehicle Windscreen Spearing Risk from Road Signs

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Key Findings

- Sightboards installed at rural T-intersections are a potential hazard for motorists.
- Sight boards spearing through vehicle windscreens are found as a common road safety issue for both New South Wales and Queensland.
- An innovative research program was undertaken to develop a simple and low cost treatment with the aim of preventing penetration of the sign into the occupant space.
- This treatment can also be applied to any existing signs and new designs at T- intersections to improve road safety.

Abstract

Fatal incidents have occurred in Queensland and New South Wales involving sight boards spearing through vehicle windscreens. These crashes occurred at rural 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 with the aim of preventing penetration of the sign into the occupant space. The research outcome sought was a low cost end treatment that could be applied to both new sign designs and existing signs. The testing program involved ten crashes at 100km/h with both four wheel drive vehicles and light passenger vehicles. The research showed that windscreen penetration could be prevented by utilising cost effective treatments.

Keywords

Crash Testing, Road Signs, Windscreen Spearing, Crash Reconstruction, T-intersections, Innovative Treatment

Introduction

A collision with a road sign is one of many potential hazards motorists are exposed to when driving on NSW roads. Road signs are struck relatively infrequently in terms of all crashes that occur on NSW roads; however, 43 fatal and 511 serious injury crashes involved a first or second impact with road signs over the six-year period, 2010 – 2015. This comes at a time when the NSW and QLD road toll is on the rise, with an increase of 14% and 9% at the close of 2015 on 2014 figures (BITRE, 2016). This type of collision has the potential to result in a fatal or serious injury (FSI) of vehicle occupants and riders.

Transport for NSW and Queensland Department of Transport supports the Safe Systems approach to road safety, and so action must be taken to reduce both the likelihood of a crash occurring and the severity of a crash should it occur. Transport for NSW has also shown a strong commitment to road safety, typified by programs such as the 'Towards Zero' campaign, which treats any fatality or serious injury on our roads as unacceptable (TfNSW, 2016).

In NSW from 2010 to 2015, two fatalities were recorded that have resulted from road signs spearing the impacting vehicles. In Queensland three serious crashes were recorded over the same period resulting in two fatalities and one serious injury. Although the crash data does not indicate this to be a particularly common incident, a review of these crashes identifies a number of factors that suggest a large exposure to the risk. These include the type of crash – run-off-road to the left, the impacting sign – intersection ‘sight boards’ on rural roads with higher (≥ 80 km/h) speed limits, and the type of impacting vehicle – mainly, but not exclusively, 4WD vehicles. These crashes occurred at T-intersections where the impacting vehicle was travelling at high speed on the continuing carriageway.

The sight boards are provided to give clear warning to traffic approaching the intersection from the terminating leg. However the existence of a sign may not be obvious to through traffic as its view of the sign consists only of a few sign posts and the edge of a thin sheet metal sign. With the large setback distance, it is not anticipated that signs of this type would present a hazard to traffic. It was thought that these signs were safe as the most likely impact scenario would be traffic impacting squarely from the terminating leg. The sign posts and the aluminum sign face are frangible.

The distance from the road surface to the bottom of the sign is variable as it can depend on the environment (rural or urban), vertical alignment geometry of the approaching terminating leg and how quickly the roadside embankment tapers away from the road. The Australian Standard for Manual of Uniform Traffic Control Devices (AS 1742.2-2009) limits the mounting height of signs not to be less than 1.5 m above the nearest edge of the travel way for visibility under headlight illumination at night in rural and a minimum of 2m above the top of the kerb to prevent obstruction to pedestrian and parked vehicles in urban environments.

For a particular crash involving a fatality, the road terrain was flat and the through leg had a slight bend. The distance from the road surface to the bottom of the sign was 1500mm. The vehicle involved was a four wheel drive and the distance from the road surface to the engine bonnet surface was approximately 1500mm. The traffic sign speared through the windscreen and entered the occupant space — refer to Figure 1. Despite the sign being installed according to the required standard, it was struck in such a way that it became a road side hazard, penetrated the vehicle and possibly injured the occupant - an unintended consequence of the design and placement. Moreover, end on crashes with signs set at a lower height showed that they have the ability to slice and spear through the body panels of motor vehicles. Early in 2016, Queensland Department of Transport and Main Roads and Transport for New South Wales began a joint research program into the issue of end on collisions with sight boards. The project team drew upon input from a range of specialists from both agencies and industries in Queensland and New South Wales.

The danger associated with end-on crashed with road signs has only recently come to the attention of road agencies. While these road traffic signs are frangible, their end-on



Figure 1. Sign spearing incident

impact directly with a vehicle windscreen is an unforeseen event. There is no review of any literature can be found under this topic.

For streamlining purposes other Australian state and territory road authorities were not involved in the project. It was reasoned that if this issue was evident in two large Australian states then the issue was likely to occur in other states as the road traffic sign designs are similar. The current practice is to share learnings from research projects with all Australian and New Zealand jurisdictions through Austroads.

Method

Between February 2016 and May 2017, ten vehicle crash-tests were conducted at the Roads and Maritime Services Crashlab in New South Wales. The research program utilised various cost effective treatments which could be retrofitted to existing high-risk signs. The approach was that any cost effective end treatment adopted should preferably be applicable to future new sign installations. A number of different sign sizes were also tested. The treatments were designed so that they could be performed in the field and were critically examined for practicality, value for money and crash outcomes. The ten 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 (summarised in Table 1) with all tests conducted at a collision speed of 100 km/h.

Before the signs were modified a base line test was performed which had no treatment. This was followed by a number of tests with a progressive range of treatments. As the testing progressed, a knowledge base was built. This helped converging the design treatments for subsequent tests.

Table 1. Summary of crash tests

Test#	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 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 rivets	4WD	NO
Test 6	Flat steel clamp connection with Henrob Rivets	3200	400	3	50NB	Cut	Henrob 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 rivets	4WD	NO
Test 9	Leading edge tethered - HD clamp	3200	400	3	50NB	Continuous	Henrob rivets	4WD	NO
Test 10	Leading edge tethered - HD clamp	3200	400	3	50NB	Continuous	Henrob rivets	Passenger vehicle	NO

The testing was performed in a controlled manner with an instrumented vehicle and all crashes were captured on high speed video from various angles. In the past, Roads and Maritime Services Crashlab had crashed passenger vehicles into a range of obstacles. However they had never undertaken crash testing of this type before and it is believed to be the first of its kind in the world. The testing allowed the dynamics of crashes to be explored in detail and consequently the development of various sign treatments. The Crashlab provided a full technical report and high speed videos of each crash.

Sign Manufacturing Methods

To assist in understanding the various tests, refer to Table 1. In practice, signs have a range of sizes and manufacturing methods. The larger sign sizes have larger post diameters to overcome wind forces. In some sign designs the sign face and stiffener rails are held together with pop rivets and others Henrob rivets. A general description of the two riveting processes is as follows:

- Pop rivets — a hole is drilled through the rail and sign face and a pop rivet is installed. After installation, the pop rivet head is not flush with the surface but is raised. This manufacturing process is relatively slow. In all the crash tests involving pop rivets, the rivets fail very early in a crash. In some tests where the installed stiffener rails were cut with a saw, a number of pop rivets failed without any significant force being applied.
- Henrob rivets — Henrob rivets are a proprietary product utilising a solid stainless steel rivet with a countersunk head. Holes are not drilled in the Henrob process. The solid rivet is pushed through the sign face and stiffener rail with a hydraulic ram creating plastic deformation of the aluminum around the rivet. An anvil supports the stiffener rail on the opposite side and resists the installation force. During installation, the final step is for the rivet's leading cutting end and stiffener rail material to be deformed. This creates a splayed/mushroomed end which prevents rivet pullout. The rivets are supplied in a long plastic strip

from a magazine and can be installed as fast as the operator can maneuver the sign. The Henrob rivets are exceedingly strong and where they do fail it is typically by shearing a complete circular piece from road sign face. As the rivet material is stronger than the aluminum sign face or stiffener, the aluminum will fail in preference to the rivet. Installed Henrob rivets are flush with the sign face and can be sheathed over with the retroreflective sign material.

Results & Discussion

The pertinent points of the ten crash tests undertaken are discussed below.

Test 1 (baseline) - This was a baseline test of a standard sight board sign with a four post configuration. Upon impact the pop rivets easily sheared and the aluminium sign face crumpled but did not significantly enter the occupant space as it impact the metal roof line above the windscreen. However, the Type 1 stiffener rails became detached and acted as spears. The top stiffener rail 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, continuing on past the seat, hitting the rear passenger side window. Figure 2 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 left hand side seat).

Test 2 (aluminium wrap sign end) — It became evident from Test 1 that not only does the sign face present a danger but also the aluminum stiffener rails. In Test 2 the front of the sign was encapsulated with 3mm aluminum sheet to tie the sign face and stiffener rails together as one unit. A deflector plate was incorporated into the bottom of this plate —refers to Figure 3.

The encapsulating plate added strength to the front of the sign which resulted in more damage to the vehicle roofline above the windscreen — refer to Figure 4. After Test 1 and 2, it was thought that the inertial forces were so significant that a windscreen could not develop enough resistance to deflect a sign over the vehicle. Even with the sign end having a special energy absorbing treatment and the impact area increased, windscreen damage was likely. When a crash occurs and the first post is bent out of the way, the remaining posts downstream hold the sign horizontally and provide restraining forces. Hence if a windscreen were to deflect a sign, it must overcome the sign's high inertial forces and the horizontal and vertical restraining forces provided by the intact posts.



Figure 2. Test 1 – sign layout & vehicle damage after crash



Figure 3. Test 2 - sign end reinforcement



Figure 4. Test 2 - significant vehicle damage



Figure 5. Test 3 – left - cut rails & stainless rope tether, right- successful crash deflection crash

The future research direction adopted was that the sign end must be prevented from impacting the windscreen. It was thought that some minor impact was tolerable as long as the sign face had been turned by approximately 90° which would present a large flat impact area to the windscreen and there would be no large concentrated inertial forces.

Test 3 (tethered with 5mm cable) — The leading edge of the sign was tethered to the first steel post with 5mm diameter stainless steel wire rope — refer to Figure 5. The stiffener rails were weakened at strategic points. The concept was for the post to pull the sign down and away from the windscreen. The test was a success but the field swaging of the stainless steel was considered to be time consuming. The field cutting of the stiffener rails was performed with a small battery powered circular saw fitted with an aluminum cutting blade. However it was difficult to saw cut the stiffener rails without cutting through the sign face was. Cutting the stiffener rails in this test and subsequent tests greatly facilitated the buckling of the sign during the crash.

Test 4 (tethered with flat strap & cut rails) — The sign face for this test was significantly larger (6 x 0.6m) hence 65NB posts were used — refer to Figure 6. In this test, the tethered design was refined by replacing the 5mm wire rope with 40mm x 3mm steel flat straps to simplify the field installation. As the sign was comprised of four separate



Figure 6. Test 4 - cut rails & flat straps

aluminum sheets, pull down straps were required to be fitted to each post. The stiffener rails were cut to facilitate failure. As a result of Test 3 learnings, a depth gauge was fitted to the circular saw which made cutting far simpler minimizing the damage to the sign face. This was the only test where the larger modified Type 2A stiffener rails were used.

Test 5 (heavy duty clamp & cut rails) — In the development of the project many ideas were explored. One simple approach that was suggested was to fasten the post directly to the sign. This idea was sidelined at the time over a concern than signs with large end cantilevers could pose a risk due to the downward slicing action during initial impact. In Test 5 the relative weak standard sign bracket was replaced with an off-the-shelf heavy duty clamp made from 40mm x 5mm flat steel — refer to Figures 7 & 8.

The clamp was fastened with two M10 bolts which passed through the sign face and stiffener rail. A large flat washer was placed under the head of the bolt to resist it being pulled through the sign face.

The clamp was fastened to the post with two self-drilling 14g x 20 screws which would act as shear restraints to



Figure 7. Test 5 onward – heavy duty clamps used



Figure 8. Test 5 - Shortened rails & HD anchored clamps

prevent longitudinal sliding. The cutting of the aluminum stiffener rails process was improved by lubricating the cutting blade with lanolin liquid lubricant.

Test 6 (heavy duty clamp & cut rails) — This test was identical to Test 5 with the exception that a small passenger vehicle was used in lieu of a four wheel drive – refer to Figure 9. Figure 8 and 9 both show the downward slicing action of the sign. A future consideration for low mounted traffic signs is to limit the sign end cantilever distance. The clamps successfully pulled the sign down to prevent impact with the windscreen. A significant drawback with the design approach in Tests 5 & 6 was it was difficult to install the sign while maintaining a flat front face due to shorter sections of stiffener rail. The heavy duty clamps gripped the posts tightly and would rotate the sign face as each clamping bolt was tightened. The sign installer had to be very diligent to ensure the finished sign face was acceptably flat. The performance of these signs in high wind conditions was an unknown.

Test 7 (heavy duty clamp & continuous rails) — The test involved a combination of large signs at a typical T intersection with intersection directional signs and a sight board — refer to Figure 10.

A component of the test was to witness the effect on a small car with crashing into larger diameter posts (65NB & 80NB) – refer to Figure 11. Heavy duty anchored clamps



Figure 10. Test 7 – large sign structures



Figure 9. Test 6 - Shortened rails & HD anchored clamps

were employed as per Tests 5 & 6. The design exception was that the longitudinal stiffener rails were not cut. Despite considerable vehicle damage the test was a success.

Test 8 (heavy duty clamp & continuous rails) — The learnings so far indicated that the sign end could be successfully deflected downward to prevent sign spearing into the occupant space. From studying the high speed video of the crashes it was felt that the two screws securing the heavy duty clamps to the posts sheared too early in the crash. If the screws were stronger they would allow a longer pull down time before failure.

For Test 8 these shear restraint screws were replaced with high tensile Taptite M8 x 20 hex head screws. These screws were self-tapping but a 7.3mm-diameter pilot hole had to be pre-drilled to accept the screw. Drilling a small diameter pilot hole was not considered to be a significant issue for field installation. The object behind the testing was to find solutions for both new signs and existing signs. For existing signs it was felt that the concept of a heavy duty clamp bolted through the sign face was a viable option. Although better performance would be gained through stronger shear screws.

However if the stiffener rails were fastened with Henrob rivets and with extra rivets in the vicinity of the posts then it may be possible to achieve a successful outcome without bolting through the sign face. From an aesthetics aspect, it would be preferable for a new installation not through bolt the sign face.

Test 8 was designed to test this scenario. The heavy duty clamp was fastened to the stiffener rail with the standard cup head bolts mounted in the groove in the rail — no though bolt was used. Cutting the stiffener rails were found to be too laborious in the field and for sign manufacturing hence continuous rails were used.

The purpose of this test was to confirm that heavy duty clamps fastened to stiffener rail would work in conjunction with the closer spaced Henrob rivets at the posts.

Although the sign did not penetrate the occupant space, Test 8 was not considered to be successful – refer to Figure 12. The high speed video showed the bolts and heavy duty



Figure 11. Test 7 – left-small vehicle on impact, right- large area signs & large posts

clamps could not generate enough force to prevent sliding along the stiffener rail. When a large axial and transverse force was applied to the cup head bolts, the channel shaped aluminum stiffener rail bent open allowing the bolt heads to escape. During the initial pulldown, the bottom edge of the sign face had sliced through the vehicle bonnet.

Once the bolts were pulled free of the stiffener rail, the sign continued to slice open the bonnet until it hit a strong bonnet cross member where it was forced to buckle. The additional Henrob rivets placed in the vicinity of the posts stiffened the sign further which worsened the situation.

Test 9 (Heavy duty clamp, continuous rails) — The same sign configuration and vehicle used in Test 8 was again used in Test 9. Notable points were:

- The heavy duty clamps were bolted through the sign with large diameter washers located under the hexagonal bolt heads on the sign face — refer to Figure 13.
- Two Taptite M8 x 20 hex head screws per clamp were again used.
- The standard spacing of Henrob rivets was adopted (~200mm centers) to streamline manufacturing.
- Type 1 stiffener rails were used.
- Heavy duty clamps were installed on all posts.

Prior to Test 9, a sign manufacturer was consulted about the testing program and research findings so far. From a manufacturer's point of view, the installation procedure must be simplified. In the previous tests, the last post was fitted with the standard low strength clamps. In practice this could lead to the possibility that this clamp could be inadvertently fitted to the leading post. Hence to minimize the risk of incorrect installation, a safer solution is to make all clamps the same type. This has the added benefit that impacts from the other direction were also catered for although with much less probability of occurring.

This test was considered a success as the sign buckled at initial impact and was pulled down — refers to Figure 14.

Test 10 — Before the testing program could be declared a success, Test 10 had to confirm that the final design would work with both a large and small passenger vehicle. This test replicated Test 9 with the exception that the test vehicle was a small passenger car — refer to Figure 15. This test was considered a success with only minor windscreen cracks and no sign spearing through the windscreen. During the testing program some minor windscreen cracking occurred through unpredictable hits by deformed sign components.

Flexible road signs were investigated as an alternative solution in eliminating the potential of sign spearing under the above tested conditions. These signs offer little



Figure 12. Test 8 – No through bolts and slicing of the bonnet

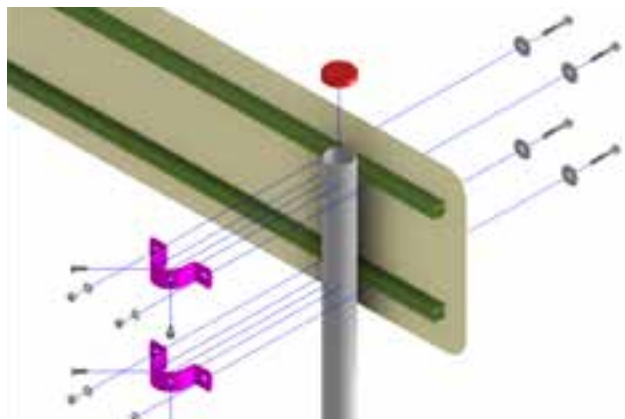


Figure 13. Test 9 - HD clamps & bolted through



Figure 14. Test 9 – successful pull down



Figure 15. Test 10 – successful use of HD clamps & bolted through design

resistance to the colliding object and thereby causing virtually no impact force to be imparted on the vehicle and its occupants or riders. A commercially available product has been tested and was found to require complete replacement after one collision. While this protected the vehicle occupants, the installed sign was prohibitively expensive. Its application would be not address the vast number of existing signs that require treatment. Therefore the replacement of traffic signs with flexible “plastic” signs is not considered as an alternative approach.

Conclusion

The crash testing program has proven that both currently installed and new signs could be successfully treated with the use of heavy duty bolted clamps in combination with shear connectors. High speed vehicle crashes with both four wheel drives and small passenger vehicles have demonstrated that the signs can be prevented from entering the occupant space of the vehicle.

The findings of this research will be implemented through changes to traffic sign manuals in Queensland and New South Wales. The learnings will be disseminated to other road agencies through the Austroads Road Safety Task Force, national traffic engineering conferences and traffic

management industry groups. The additional cost of the treatment is considered to be minimal with huge benefits in reducing the cost of fatalities. Adopting the outputs of this new and innovative research will lead to a safer road environment for motorists.

Acknowledgement

The project team would like to acknowledge the professionalism of the Crashlab staff in undertaking this test program. Their work was of a high calibre and contributed greatly to the success of the project

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Figure 16. Testing of flexible signs

Exploring the frangibility of steel circular hollow section small sign support posts

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Key Findings

- Guidance to practitioners on frangible small sign support posts varies between jurisdictions.
- Australian/New Zealand Standard AS/NZS 3845.2:2017 prescribes a definitive testing protocol to establish frangibility.
- The largest steel section that is expected to meet the requirements of Australian/New Zealand Standard AS/NZS 3845.2:2017 for a small sign support is a 76.1 mm OD x 3.2 mm Grade 350 CHS.

Abstract

Desirably sign support posts should be frangible if not shielded. Review of technical governance in the Australian/New Zealand context suggests that guidance to practitioners on what is frangible varies between jurisdictions. Australian/New Zealand Standard AS/NZS 3845.2:2017 prescribes test requirements for frangibility. This study uses results from full-scale crash testing combined with theoretical analysis to explore the expected crash performance of circular hollow section (CHS) sign supports. The study recommends the CHS sign support that is expected to represent an upper threshold of frangibility that would satisfy the provisions of Australian/New Zealand Standard AS/NZS 3845.2:2017.

Keywords

Frangibility, Crash testing, Sign support posts

Introduction

Australian Standard AS 1742.2:2009 (Standards Australia, 2009) prescribes (in terms of nominal bore and wall thickness) the sizes of grade C350 steel circular hollow section small sign support posts that are regarded as frangible. However, jurisdictional practice for small sign supports in Australia and New Zealand varies, as is documented in Table 1.

In the interests of informed and harmonised technical governance, objective evidence of what constitutes a “frangible” small sign support post is required, as recommended by McInerney et al (2002). Usefully, the recently published Australian/New Zealand Standard AS/NZS 3845.2:2017 (2017) provides a definitive testing protocol. The scope of section 9 of AS/NZS 3845.2:2017 includes that a “...*sign support structure or pole is to be frangible, readily activated in a predictable manner by breaking away, fracturing or yielding*”. The concept of frangibility is then introduced as a failure mechanism of a breakaway (sign) support structure, and a test matrix is established for this classification of objects.

Consistent with European Normative EN 12767 (European Committee for Standardization, 2007), which prescribes a test impact by a passenger car with a test inertial mass of 825

kg impacting at 35 km/h, AS/NZS 3845.2:2017 requires that frangible sign supports meet prescribed occupant risk criteria when subjected to an impact by an 1100 kg car travelling at 30 km/h. This lower speed (lower energy) test is described in the Standard as being designed to evaluate kinetic energy to activate the frangible mechanism. Occupant risk criteria to be met are specified in Table 5.1 of the Manual for Assessing Safety Hardware (MASH) (American Association of State Highway and Transportation Officials (AASHTO), 2009). Thresholds of occupant risk exist in terms of the flail space indicators (OIV and ORA), but also in terms of occupant compartment intrusion/deformation.

Additionally, the full test matrix for frangibility of a sign support post to be (for example) 100 km/h rated requires testing with a light car (1100 kg) and a heavy utility (2270 kg) at 100 km/h and evaluation of, among other things, detached elements, vehicle trajectory and occupant risk. The important point to note is that for an object to be rated “frangible” speeds of 100 km/h, it needs to be tested at both 100 km/h and 30 km/h.

Consequently, a low energy test (1100 kg car travelling at 30 km/h) is required regardless of the speed for which the sign support is to be rated, which may be considered

Table 1. Examples of variations in jurisdictional practice for small sign support posts^a

Speed (km/h) ^b	AS 1742.2 ^c	NSW ^d	NZ ^e	QLD ^f	SA ^g	VIC ^{h, l}	WA ^{i, m}
<60	90 NB x 2.6	88.9 OD x 3.2 ^j	76 OD x 3.2	100 NB x 3.6	Footnote k	50 NB or less ^l	101.6 OD x 2.6
60 to 80	65 NB x 2.3			80 NB x 3.2			76.1 OD x 2.3
>80	50 NB x 2.9			65 NB x 3.2			60.3 OD x 2.9

Footnotes

- Some jurisdictional governance references post sizes in terms of Nominal Bore (NB) whereas some governance uses Outside Diameter (OD). This is a practice inconsistency that might benefit from harmonized approach.
- Speed can mean “likely collision speed”, “posted speed” and/or “speed zone”, depending on jurisdiction.
- Manual of Uniform Traffic Control Devices: Traffic control devices for general use (Standards Australia, 2009).
- Installation and maintenance of signs (New South Wales Roads and Traffic Authority, 2010).
- Specification TNZ P/24 (New Zealand Transport Agency, 2008) and associated industry guide (Road Safety Manufacturers’ Association, 2008).
- Design Guide for Roadside Signs (Queensland Department of Transport and Main Roads, 2001).
- DPTI Specification Part R49 Installation of signs (South Australia DPTI, 2016).
- Supplement to AS 1742.2:2009 (VicRoads, 2015).
- Large Multiple Post Signs – Sign Structural Design (Main Roads WA, 2015).
- NSW document identifies a grade C350 steel section equivalent to 88.9 OD x 4.0 Grade C250 CHS.
- DPTI South Australia specification R49 requires RHS for small sign supports and states “Circular Hollow Sections must not be used for small to medium size signs under any circumstances”. For larger signs, the document prescribes section sizes deemed to be frangible as a function of speed zone (km/h). For a speed zone ≤ 60 km/h, an 80 NB x 5.0 or 100 NB x 3.5 Grade C350 is deemed frangible.
- VicRoads’ document (VicRoads, 2015) states: “Posts of 50 mm nom. bore or less are not breakaway types, but are considered light enough to present a minimal hazard to out-of-control vehicles”.
- Note that the guidance from Main Roads WA is for multiple sign support posts.

inconsistent with what Australian Standard AS 1742.2:2009 presents (see Table 1) as “frangible”, which is larger posts at lower speeds. In this regard it might be conjectured that Australian Standard AS 1742.2:2009 may have intended that larger posts would present reduced likelihood of adverse consequence if impacted at lower speeds, perhaps implying that the interpretation of “frangible” in Australian Standard AS 1742.2 is different to what is intended in Australian/New Zealand Standard AS/NZS 3845.2. This inconsistency attracts the need for clarification.

Objective

Ross et al (1989) propose a “*methodology for estimating velocity change in small sign support impacts for small vehicles based on test results of other vehicles*”. The methodology assumes (with caveats) that energy loss is independent of vehicle mass, and that vehicular velocity change for a small vehicle mass can be estimated based on energy lost measured during crash testing using a larger vehicle. The same premise is employed in this study.

The central hypothesis here is that a given sign support section might represent a level of resistance to deformation requiring a quantum of energy to precipitate displacement or deformation. Further, it is expected that the energy requirement would be a function of the sectional properties of the sign support post.

The broad aim is to present a preliminary exploration of the aggressiveness (or resistance to failure) of single circular hollow section sign supports when subjected to vehicular impact with the intent to inform future work in this area. The primary objective is to use a combination of full-scale crash testing combined with theoretical analysis in the context of testing conducted by others in order to predict the largest post (in terms of sectional properties) that would be expected to satisfy the critical low-energy test requirements of AS/NZS 3845.2 (2017).

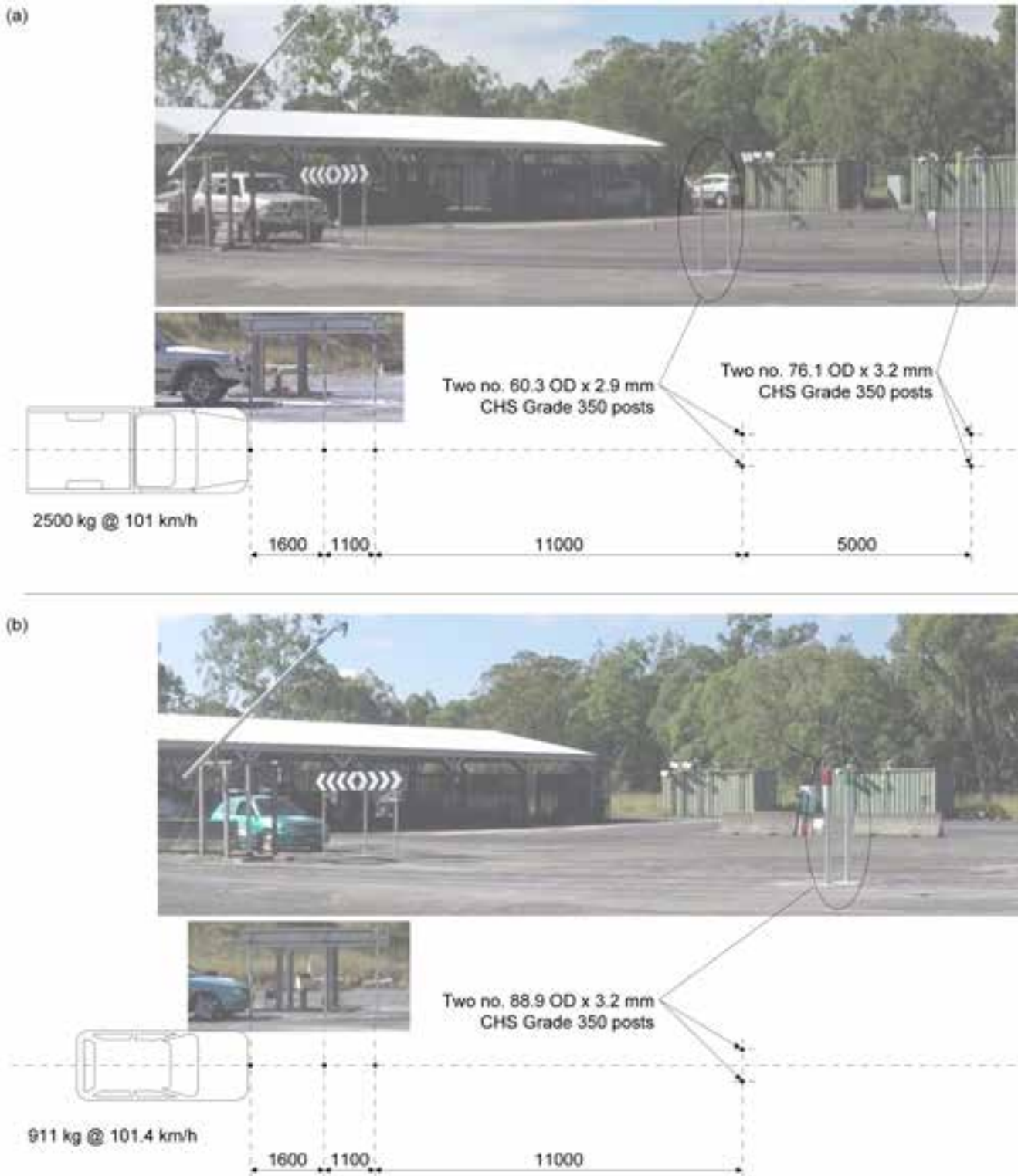


Figure 1. Number of injury hospitalisations and percentage of hospitalised serious injuries of pedestrians, pedal cyclists and motorcyclists in NSW hospitalisation-mortality linked data, 1 January 2010 to 30 December 2013

Methodology

Background

Muthubandara et al. (2017) present an evaluation of treatments of multi-post road intersection hazard-board signs to mitigate risk of windscreen penetration in end-on impacts. A series of ten full-scale crash tests were conducted. Initial intentions were to utilise the same crash test data to derive some knowledge of the aggressiveness of different CHS sections when impacted. However during the evolution of the testing program it became apparent that the resistance to failure of the posts could not be confidently discerned from the testing of the sign configuration as the structure of the sign itself and its fixings to the posts appeared to influence the resistance to deformation of the system. As such, the testing program was subsequently modified to include standalone posts. Two tests, which are the focus of this study, were conducted with standalone posts.

Crash testing

In these two tests, pairs of Grade 350 CHS posts were arranged symmetrically about the line of vehicle trajectory downstream of the multi-post road intersection sign being tested by others (Muthubandara, et al., 2017) with the intention that both posts in each pair would be impacted simultaneously. The configurations of the two test articles are depicted in Figure 1.

In the first test (ref. B17013) two pairs of posts each 700 mm apart were located respectively 13.7 m and 18.7 m downstream from the initial impact point with the multi-post road intersection sign. The first pair of posts were 60.3 mm OD x 2.9 mm CHS Grade 350 and the second pair were 76.1 mm OD x 3.2 CHS Grade 350. A separation distance of 5.0 m was considered sufficient for the effects of the impacted article on the vehicle to have been completed. The 11.0 m separation between the multi-post sign and the first pair of posts was for the convenience of the test-house. This test configuration is depicted in panel (a) of Figure 1.

In the second test (ref. B17018), a single pair of 88.9 mm OD x 3.2 mm CHS Grade 350 posts was placed symmetrically (600 mm apart) about the projected vehicle trajectory, 11.0 m downstream of the multi-post road intersection sign test article. This test configuration is depicted in panel (b) of Figure 1.

For test ref. B17013 the impacting vehicle was a 1998 Nissan Patrol SUV with inertial mass of 2500 kg and initial impact speed 101.0 km/h. It is noted that the test vehicle was equipped with a bull-bar. For test ref. B17018 the impacting vehicle was a 1996 Daihatsu Charade Hatchback with inertial mass of 911 kg and initial impact speed of 101.4 km/h.

Analysis

For each test, longitudinal vehicular acceleration (CFC180) was recorded at a frequency of 20000 Hz. Mean acceleration

across each time increment was used to compute the longitudinal change in the velocity of the impacting vehicle across the same time increment (Equation 1). The velocity of the vehicle after each time increment was determined by aggregating the initial impact velocity and the summation of the velocity changes across each time increment (Equation 2). Displacement (of the accelerometer on-board the impacting vehicle) during each time increment was then calculated as a product of the time increment and the average velocity across it (Equation 3). Total displacement was then computed as the summation of the preceding displacements (Equation 4).

$$\Delta v_i = \frac{1}{2}(a_i + a_{i-1})(t_i - t_{i-1}) \quad (1)$$

$$v_i = v_0 + \sum_{i=1}^i \Delta v_i \quad (2)$$

$$\Delta d_i = \frac{1}{2}(v_i + v_{i-1})(t_i - t_{i-1}) \quad (3)$$

$$d_i = \sum_{i=1}^i \Delta d_i \quad (4)$$

where

a_i = longitudinal acceleration (CFC180)(m/s²) of test vehicle after time increment i .

t_i = time elapsed (s) after time increment i .

v_i = longitudinal velocity (m/s) of test vehicle after time increment i .

d_i = longitudinal displacement (m) of test vehicle after time increment i .

The resulting data was used to calculate kinetic energy change throughout the test article. As far as possible, 5 metres beyond the test article was adopted as the point at which interaction with the test article was deemed complete, in order to be consistent with similar testing undertaken by Savin (2003).

Results

Test B17013

Having impacted the upstream hazard-board assembly (which is not part of this study) the test vehicle impacted the pair of 60.3 mm OD x 2.9 mm posts at a computed 10 ms average velocity of 25.84 m/s. The video footage suggests that the impact was approximately symmetrical and simultaneous. These posts yielded at the base, folding forwards as the test vehicle passed over the top. The test vehicle then impacted the pair of 76.1 mm OD x 3.2 mm posts at a computed 10 ms average velocity of 25.43 m/s. While the video footage suggests that the left side post was impacted slightly earlier than the right side post was impacted, possibly due to asymmetrical bumper deformation, both posts were observed to fail similarly, yielding at the base, and folding forwards while the test

vehicle passed over the top. It is observed that some components of the upstream hazard-board assembly remained in contact with the test vehicle throughout the duration of both subsequent freestanding post impacts. The velocity of the test vehicle at 5 m downstream of the test article was computed as 24.78 m/s.

Figure 2 shows longitudinal acceleration and velocity (m/s) plotted against both time and horizontal displacement for the vehicle in test ref. B17013. Key observations are summarised in Table 2. This data indicates a velocity change while yielding two 60.3 mm OD x 2.9 mm posts of 0.42 m/s, representing a change in kinetic energy of 26.67 kJ, or 13.3 kJ per post. Likewise the data indicates a velocity change while yielding two 76.1 mm OD x 3.2 mm posts of 0.65 m/s, representing a change in kinetic energy of 40.80 kJ, or 20.4 kJ per post. This is summarised in Table 3.

Test B17018

The test vehicle was observed to become airborne due to impact with the upstream hazard-board assembly, and did not land “true” being rotated slightly towards the left. The

impact velocity with the pair of 88.9 mm OD x 3.2 mm posts based on distance travelled in the longitudinal direction was computed as 17.39 m/s. The left side post was impacted more or less at the centreline of the test vehicle while the right side post appears to have missed being impacted by any structural elements of the vehicle chassis, and being impacted by the front-right wheel and suspension assembly. While the impact was not as clean as intended, both posts were observed to fail similarly, yielding at the base, and folding forwards while the test vehicle passed over the top. The velocity of the test vehicle at 3.2 m downstream of the test article was computed as 11.96 m/s.

Figure 3 shows longitudinal acceleration and velocity (m/s) plotted against both time and horizontal displacement for the vehicle in test ref. B17018. Key observations are summarised in Table 4. This data indicates a velocity change while yielding two 88.9 mm OD x 3.2 mm posts of 5.43 m/s, representing a change in kinetic energy of 72.6 kJ, or 36.3 kJ per post. This is summarised in Table 5.

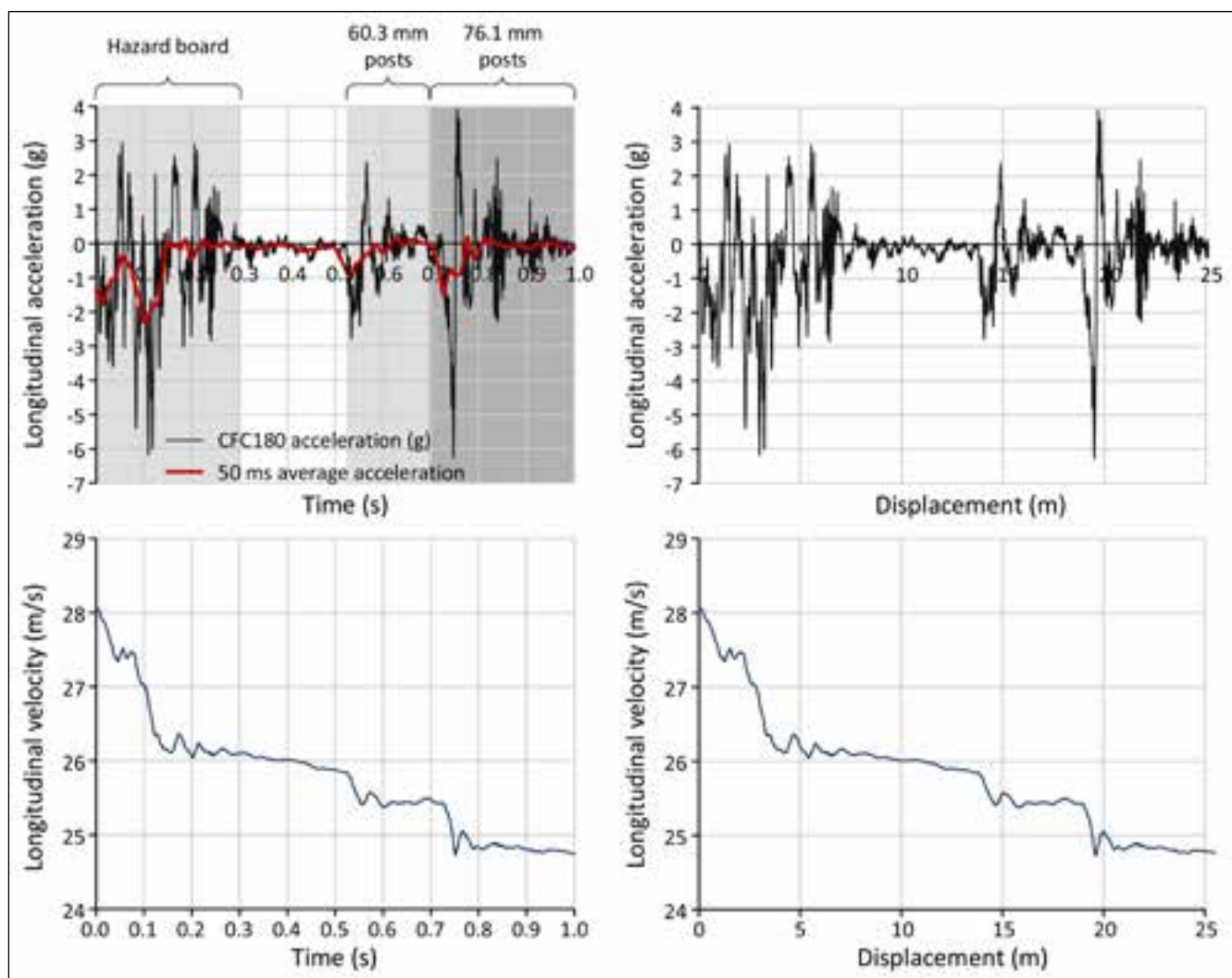


Figure 2. B17013 test data

Table 2. Key observations from Test B17013

Impact Point	Distance (m)	Time (ms)	Ave 10 ms velocity (m/s)	ΔV (m/s)	Ave 10 ms Energy (kJ)	ΔE (kJ)
HB_Post 1	0.00	0.00	28.06	-	983.89	-
HB_Post 2	1.60	57.85	27.46	0.59	942.85	41.04
HB_Post 3	2.70	98.10	27.03	0.44	913.13	29.72
HB_Post 3 + 5m	7.70	288.65	26.09	0.94	850.59	62.54
60.3 OD x 2	13.70	519.55	25.84	0.24	834.91	15.68
76.1 OD x 2	18.70	715.70	25.43	0.42	808.24	26.67
76.1 OD + 5 m	23.70	916.35	24.78	0.65	767.42	40.82

Table 3. Summary of key observations from test B17013

	Distance (m)	Time (ms)	ΔV (m/s)	ΔV (m/s) (per post)	ΔE (kJ)	ΔE (kJ)(per post)	Peak 50 ms accn (g)
Sign (3 posts)	0.00 – 7.70	288.65	1.97	0.66	133.30	-	-2.29
60.3 OD x 2	13.70-18.70	196.20	0.42	0.21	26.67	13.3	-0.93
76.1 OD x 2	18.70-23.70	200.60	0.65	0.33	40.82	20.4	-1.50

Analysis and discussion

Three data points, being the energy loss for each of three circular hollow sections when impacted, are the primary focus of this study.

This data is considered and discussed in the context of research by others (Savin, 2003), who reports on three full scale test impacts into circular hollow section sign support posts. Savin's results are reproduced in summary here at Table 6.

Sectional properties for the posts tested by Savin (2003), combined with similar data recorded in this study, are provided at Table 7 and presented in Figure 4

By method of least squares regression, a simple power function of best fit to the data is given by Equation 5.

$$\Delta E = 72.847 \times I^{1.309} \quad (5)$$

Australian/New Zealand Standard AS/NZS 3845.2 (2017) defines the requirements for frangibility for a breakaway sign support. The critical occupant test is an 1100 kg vehicle impacting at 30 km/h (8.33 m/s). The evaluation criteria include that the Occupant Impact Velocity (OIV) should preferably not exceed 3.0 m/s and must not exceed 4.9 m/s. Hence, on the basis that vehicular velocity change occurs only during the impact, the OIV criterion indicates an upper threshold of velocity change of 4.9 m/s. The kinetic energy of the critical occupant test is 38.19 kJ. In order that the velocity change through the impact does not exceed 4.9 m/s, the residual velocity of the test vehicle after impact would need to be 3.43 m/s (8.33 m/s minus 4.9 m/s), which represents a kinetic energy of 6.48 kJ. So the maximum permissible kinetic energy loss is 31.69 kJ.

Use of Equation 5 would suggest that the permissible maximum kinetic energy loss of 31.69 kJ would be produced by a section with Moment of Inertia $0.529 \times 10^6 \text{ mm}^4$.

With reference to standard section sizes under Australian/New Zealand Standard AS/NZS 1163 (Standards Australia, 2016) the largest circular hollow section with Moment of Inertia less than $0.529 \times 10^6 \text{ mm}^4$ is a 76.1 mm OD x 3.2 mm ($I = 0.488 \times 10^6 \text{ mm}^4$). It may be that a 38.19 kJ impact is sufficient energy to deform/displace a larger section (for example 76.1 mm OD x 3.6 mm; $I = 0.540 \times 10^6 \text{ mm}^4$), but the evidence suggests that the occupant injury criteria ($OIV \leq 4.9 \text{ m/s}$) of the crash test may be exceeded by that section in the low energy test.

Of course, there are obvious difficulties in being definitive from such limited data. For example, an immediate observation is that Savin (2003) conducted two tests on an 88.9 mm OD x 4.0 mm post both with a light vehicle (~840 kg) but travelling at different speeds, and obtained very different results in terms of kinetic energy loss. In the 102 km/h test, the computed kinetic energy change based on velocity is 119.5 kJ, whereas in a test at 35 km/h, the vehicle came to rest 4.6 m downstream of the test article, recording a kinetic energy loss of 39.7 kJ. Both of these data points are included in this analysis. However it is possible that if the initial energy of the low speed test were increased, the vehicle may still have been arrested and so a higher energy loss would have been recorded.

A second observation is that the test articles and test vehicles differ. Specifically, test B17013 of this study was conducted with a large vehicle equipped with a bull-bar, while the test vehicle used in test B17018 was a small vehicle without a bull-bar. It is possible that stiffness of the test vehicles as well as any pre-impact damage may have influenced the outcomes.

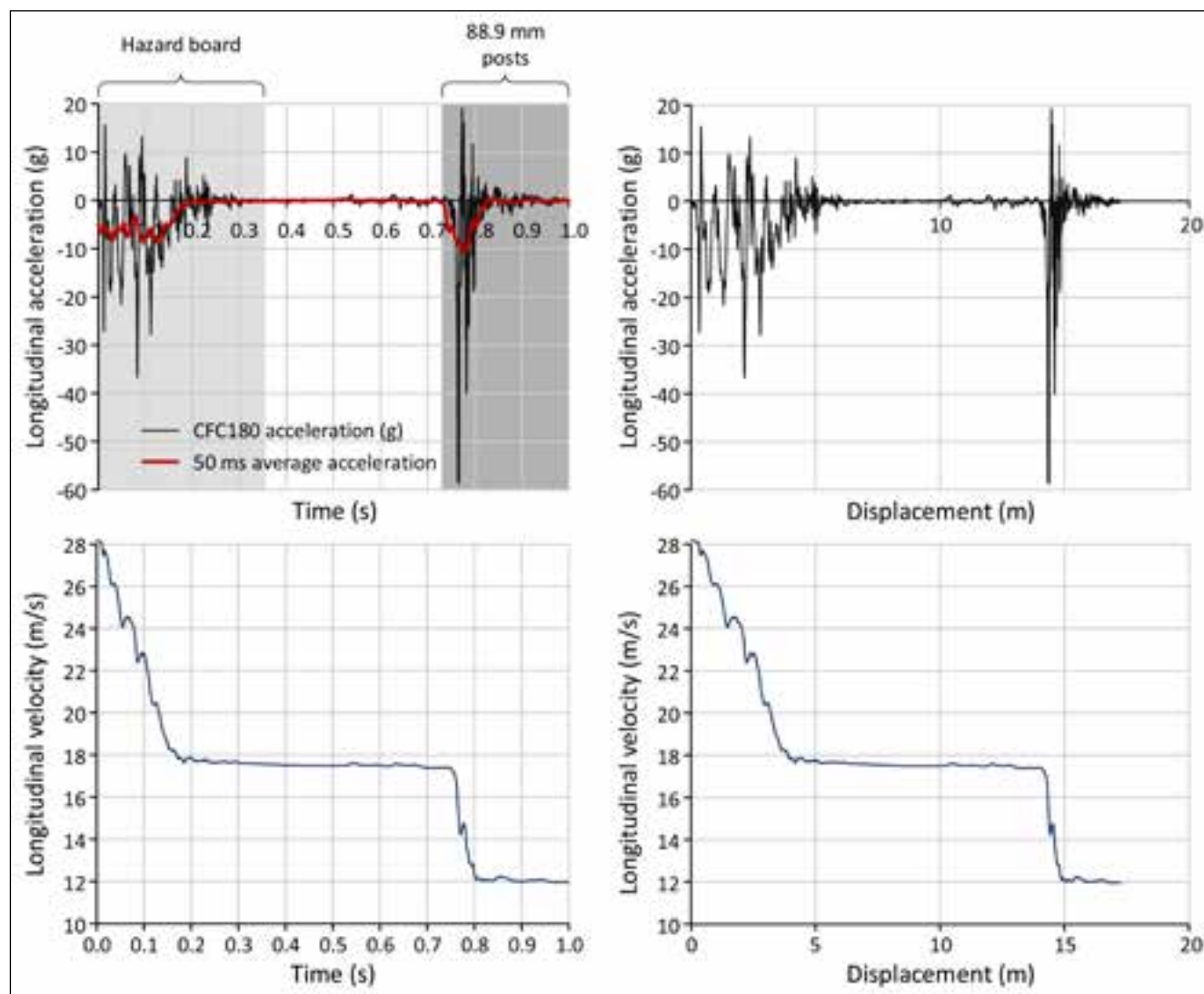


Figure 3. B17018 test data

Table 4. Key observations from Test B17018

Impact Point	Distance (m)	Time (ms)	Ave 10 ms velocity (m/s)	ΔV (m/s)	Ave 10 ms Energy (kJ)	ΔE (kJ)
Post 1	0.00	0.00	28.17	-	361.45	-
Post 2	1.60	60.65	24.39	3.78	270.94	90.51
Post 3	2.70	107.65	21.99	2.40	220.36	50.58
Post 3 + 5m	7.70	384.40	17.54	4.45	140.12	80.24
88.9 OD x 2	13.70	727.30	17.39	0.15	137.77	2.35
88.9 OD + 3.2 m*	17.00	979.80	11.96	5.43	65.20	72.57

Table 5. Summary of key observations from test B17018

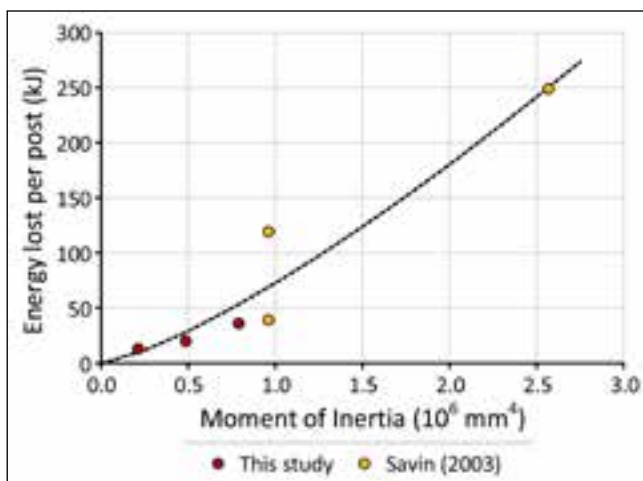
	Distance (m)	Time (ms)	ΔV (m/s)	ΔV (m/s) (per post)	ΔE (kJ)	ΔE (kJ) (per post)	Peak 50 ms accn (g)
Sign (3 posts)	0.00 - 7.70	384.40	10.63	3.5	221.33	-	-8.89
2 x 88.9 x 3.2	13.70 - 17.00	269.20	5.43	2.7	72.57	36.3	-10.45

Table 6. Results from Savin (2003)

Post size	88.9 mm OD x 4.0	114.3 mm OD x 5.0	88.9 mm OD x 4.0
Inertial mass (kg)	842	839	840
Impact speed (km/h)	102	102	35
Exit speed (km/h)	82	52	-
Delta-v (m/s)	5.6	13.9	9.7
Kinetic Energy change (kJ)	119.5	249.2	39.7

Table 7. Combined results

Test	Outside diameter (mm)	Wall thickness (mm)	Moment of Inertia (10^6 mm^4)	Energy loss (kJ)
B17013	60.3	2.9	0.216	13.3
B17013	76.1	3.2	0.488	20.4
B17018	88.9	3.2	0.792	36.3
Savin (2003), 01	88.9	4.0	0.963	119.5
Savin (2003), 02	114.3	5.0	2.569	249.2
Savin (2003), 03	88.9	4.0	0.963	39.7

**Figure 4. Energy lost per post (kJ) v CHS Moment of Inertia calculated from six crash tests**

Further, test articles utilised in this study were in the order of 2 m tall with no sign attachments. The test articles used by Savin (2003) were continuous tube fitted with sign attachments typically measuring 2100 mm to the base of the sign. In the tests conducted by Savin (2003), the sign typically detaches from the top of the post, but the post yields forwards with the motion for the vehicle as observed in this study. For comparison, Bligh et al. (2017) presented analysis in terms of crashworthiness of a 73 mm OD x 3.4 mm pipe support fitted with a breakaway mechanism and conclude that signs with area 1.30 m^2 “as the minimum sign area applicable for all types of frangible sign support connections when the sign panel and support post are released from the base and rotate as a rigid body after vehicle impact”. It is noted that in the work presented by

Bligh, et al. (2017) the breakaway mechanism facilitates rotation of the test article so that the vehicle passes beneath the article, without causing critical occupant compartment deformation.

Hence, it is implicit that the height and size of the sign face may be expected to influence progression of the failure mechanism throughout the impact. Notably, the MASH test protocol does specify that for tests of a sign support system, the area of the sign panel should approximate the largest panel that would normally be used on the support system, and that the height-to-width ratio of the sign should be typical of the largest panel that would normally be used on the support system, mounting height of the sign panel (distance from ground to bottom of panel) should be the minimum height that the panel would normally be mounted in service.

No attempt has been made here to adjust for differences between test articles or test vehicles. That said, it is appropriate to recall that this study was opportunistic, leveraging off crash testing being conducted for another purpose, and is at best to be considered as research and development testing to inform a possible future test program. The data and discussion is provided here to inform such future work. In that context, the recommendation from this study is that a program of surrogate vehicle testing could be undertaken using a 76.1 mm OD x 3.2 mm Grade 350 CHS small sign support post fitted with a typical large face-area sign ($\sim 1 \text{ m}^2$), to ensure both (i) that the assembly is not likely to present unacceptable occupant risk due to high accelerations in low energy impacts and (ii) that the assembly is not likely to present unacceptable risk in terms of detached elements, vehicle trajectory and occupant compartment intrusion/deformation. Should such

testing indicate likelihood of successful outcomes, full-scale compliance crash testing of the same circular hollow section and evaluation in accordance with the requirements of AS/NZS 3845.2 (Standards Australia, 2017) could be undertaken.

It should be noted that analysis of arrays of posts each of which individually may be frangible but which may not be frangible when in combination might usefully be the subject of further research. Additionally, it should also be noted that the standardised testing targets assessment of risk to only one road user group (i.e., occupants of light passenger vehicles) but makes no provision for assessment of risk to other road users, especially motorcyclists. Understanding how sign support posts that are considered frangible to light passenger vehicle occupants continue to present risk to vulnerable users and how such risk can be mitigated also attracts attention.

Conclusion

The objective was to present a preliminary exploration of the aggressiveness (or resistance to failure) of circular hollow section sign support posts when subjected to vehicular impact. This has been done, and results are presented.

Based on the results derived in this study, combined with the results from published literature, the circular hollow section sign support that is expected to represent an upper threshold of frangibility that would satisfy the requirements of AS/NZS3845.2 (Standards Australia, 2017) is a 76.1 mm OD x 3.2 mm Grade 350 CHS. The recommendation from this study is that a program of surrogate vehicle testing followed by full-scale compliance testing and evaluation of the same circular hollow section with a sign attachment is undertaken in accordance with the requirements of AS/NZS 3845.2 (Standards Australia, 2017).

To close, it is suggested that any such test program would include contingency to conduct testing on a different section size depending on the results of the initial testing.

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Risk factors associated with severity of hospitalised injury outcome for vulnerable-road users in New South Wales, Australia: A population-based study

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Key Findings

- Hospitalisations for pedal cycle and motorcycle injuries increased between 2010-13.
- Thirty-day mortality was highest for pedestrians (n=174; 2.9%).
- The total hospital treatment cost for vulnerable road users was AUD \$349.8 million.

Abstract

Vulnerable road users (VRU) – pedestrians, cyclists and motorcyclists account for a large proportion of road fatalities and injuries. The current study identifies injury risk factors associated with the severity of injury outcomes for VRUs. A retrospective analysis was conducted of transport injuries using linked hospitalisation and mortality records during 1 January 2010 to 30 June 2014 in New South Wales, Australia. Of the 73,314 land transport injuries identified, 37,428 (51.1%) consisted of injuries sustained by VRUs. Univariate and multi-variable logistic regression was conducted to examine factors associated with injury severity for each VRU. There were 6,007 pedestrians, 12,619 pedal cyclists, and 18,802 motorcyclists identified. All VRUs ≥ 65 years and those that collided with a motor-vehicle had a higher-odds of sustaining a serious compared to a minor injury. Pedestrians with a head or neck injury had almost 9 times the odds (OR:8.87, 95%CI: 4.13-19.06) and pedestrians with a trunk injury had 10 times the odds (OR: 10.01, 95%CI: 4.55-22.03) of sustaining a serious compared to minor injury. For pedal cyclists, the odds of sustaining a serious compared to minor injury was four times higher (OR:4.11, 95%CI: 1.70-9.93) for trunk injuries. Thirty-day mortality was higher for pedestrians (2.9%) compared to motorcyclists (0.5%) and pedal cyclists (0.4%). The total hospital treatment cost for VRUs was AUD \$349.8 million, with serious injuries accounting for 62.4% of the total cost. Injury preventive initiatives, such as improved infrastructure, educational awareness campaigns to promote safe travel are advocated to reduce injury among VRUs.

Keywords

Vulnerable road users; Injury mechanism; Injury severity; Mortality

Introduction

Transport-related injuries are an important global health issue due to its significant contribution to morbidity, mortality and disability (MacKenzie & Fowler, 2000). Currently, it is estimated to be the ninth leading cause of death, with an annual economic burden estimated to be US\$518 billion (World Health Organization, 2015; World Health Organization and World Bank, 2004). Vulnerable road users (VRUs) such as pedestrians, cyclists and motorcyclists, are at greater risk of a traffic-related injury because they are relatively unprotected and have a relatively small mass compared to other vehicles (SWOV, 2007). Whilst there are fewer VRUs in high income countries, compared to motor-vehicles, they account for almost 50% of road fatalities (Haworth, 2006; World Health Organization, 2009; World Health Organization and World Bank, 2004).

Notwithstanding the risk of injury, the health benefits of walking and cycling compared to driving a vehicle in

an urban environment have been estimated to be 3 to 14 months gained in life expectancy (Basset, Pucher, Buehler, Thompson, & Crouter, 2008; de Hartog, Boohaard, Nijland, & Hoek, 2010). Moreover, walking and cycling are promoted not only to improve health, but to reduce air-pollution, traffic congestion and noise (Austroads, 2010; US Department of Transportation, 2010). Policy makers face the challenge of promoting both walking and cycling as viable primary modes of transport, without compromising an individual's safety in the road environment. Thus, the need to identify and monitor areas where injury risk is greatest is imperative.

In Australia, routinely collected hospitalisation data contain useful information about diagnoses and treatment of injuries admitted to hospital. Moreover, injury severity can be estimated from hospital records using a diagnosis-based injury severity scale and information on survival outcome (Stephenson, Henley, Harrison, & Langley, 2004). Injury severity is a useful health outcome measure as it is

equivalent to assessing mortality risk in patients (Stephenson et al., 2004). By identifying risk factors associated with the severity of injury outcomes, targeted interventions and safety measures can be developed and implemented. The current study, therefore, aims to identify risk factors associated with the severity of injury outcomes for VRUs using linked hospitalisation and mortality data during 2010 to 2014 in New South Wales (NSW), Australia.

Methods

A retrospective analysis of injury following land transport incidents identified in linked hospitalisation and mortality records during 1 January 2010 to 30 June 2014 was conducted. Ethical approval was obtained from the NSW Population and Health Services Research Ethics Committee (2015/08/599).

Data Sources and Inclusion Criteria

The hospitalisation data in NSW includes information on all inpatient admissions from private and public hospitals. The hospitalisation data contains information on patient demographics, source of referral, diagnoses, external cause(s), separation mode and Australian Refined-Diagnosis Related Groups (AR-DRGs). The principle diagnoses and external cause codes are classified using the International Statistical Classification of Diseases, 10th revision, Australian Modification (ICD-10-AM) (National Centre for Classification in Health, 2006). Patients admitted for a transport injury were identified as those with an injury principal diagnosis (i.e. ICD-10-AM: S00-T78) and an external cause code for a land transport incident (ICD-10-AM: V00-V89). All VRUs were identified using their respective ICD-10-AM codes (Pedestrians: V00-V09; Pedal cyclists: V10-V19; Motorcyclists: V20-V29). Mortality data was obtained from the NSW Registry of Births, Deaths and Marriages (RBDM) and was available for the period 1 January 2010 to 31 March 2015. The RBDM includes information collected from death certificates and this includes demographic information and fact of death.

Injury Severity

The International Classification of Disease Injury Severity Score (ICISS) was used to calculate injury severity scores. The ICISS is calculated for each person by multiplying the probability of survival for each injury diagnosis using survival risk ratios (SRR) calculated for each diagnosis (Stephenson et al., 2004). The ICISS was divided into three severity categories; minor (≥ 0.99), moderate (0.941–0.99) and serious (≤ 0.941) injury (Dayal, Wren, & Wright, 2008).

Urban and rural residents in NSW were identified using the Australian Statistical Geographical Standard Remoteness Area (ASGS RA) (Australian Bureau of Statistics, 2013). The ASGS RA uses defined index scores of distances to service centres to assign residents to one of five categories. For ease of analysis and reporting, these categories were collapsed into: urban (i.e. major cities) and rural (i.e. inner regional, outer regional, remote, and very remote).

Hospital treatment cost estimates

Hospital treatment cost estimates were obtained from the *National Hospital Costing Data Collection, Round 14 2009–10* (Independent Hospital Pricing Authority, 2013) and the *NSW Costs of Care Standards (2009–10)* cost-calculation guidelines applied (NSW Ministry of Health, 2011). Using the hospitalisation data, the AR-DRGs, episode of care length of stay (LOS) and episode of care type (e.g. acute or subacute non-acute patient) were used to estimate hospitalisation cost. Average cost per AR-DRG included hospital operation and medical services and staff on-costs (Department of Health and Ageing, 2007). The average daily cost per AR-DRG was multiplied by the episode of care LOS to 120 days. Where an episode of care exceeded 120 days, a flat rate of \$200 per day was applied (NSW Ministry of Health, 2011). Public hospital costs were used as an approximation of private hospital cost. All costs were calculated in 2009–10 Australian dollars.

Data management and analysis

All statistical analyses were performed using SAS 9.4 (SAS Institute, 2014). All hospital episodes of care related to the VRU injury were linked to form a period of care (i.e. all episodes of care related to the VRU injury until discharge from the health system). Descriptive statistics were used to identify the most common principle injury type and 30-day mortality. Thirty-day mortality is calculated from the date of admission of the first VRU-related injury hospital admission. For the description of VRU hospitalisations by year only data from 1 January 2010 to 31 December 2013 were examined.

Individual (e.g. age group and sex), environmental (i.e. time of day and day of week related to hospital admission, urban or rural area) and type of collision risk factors for each VRU by injury severity were examined. Univariate predictors of injury severity were examined using logistic regression for each VRU. Significant univariate predictors of injury severity were then included in multivariable logistic regression models for each VRU using backward selection, where statistical significance was assessed at 0.25 (Hosmer & Lemeshow, 2005). In the multivariable model, each interaction effect was assessed separately, and all significant interaction effects were re-inserted back into the multivariable model. In the multivariable model, the dependent variable was injury severity for each VRU. For pedestrians, the independent variables included in the final model included age group, time of day, area and type of collision. For pedal cyclists, the final model included sex, age group, time of day, day of the week, area and type of collision. For motorcyclists, the final model included age group, time of day, day of the week, area and type of collision.

Results

Of the 73,314 land transport injuries identified within the hospitalisation data, 37,428 (51.1%) were sustained by VRUs in NSW. There were 6,007 (8.2%) pedestrians, 12,619 (17.2%) pedal cyclists, and 18,802 (25.7%)

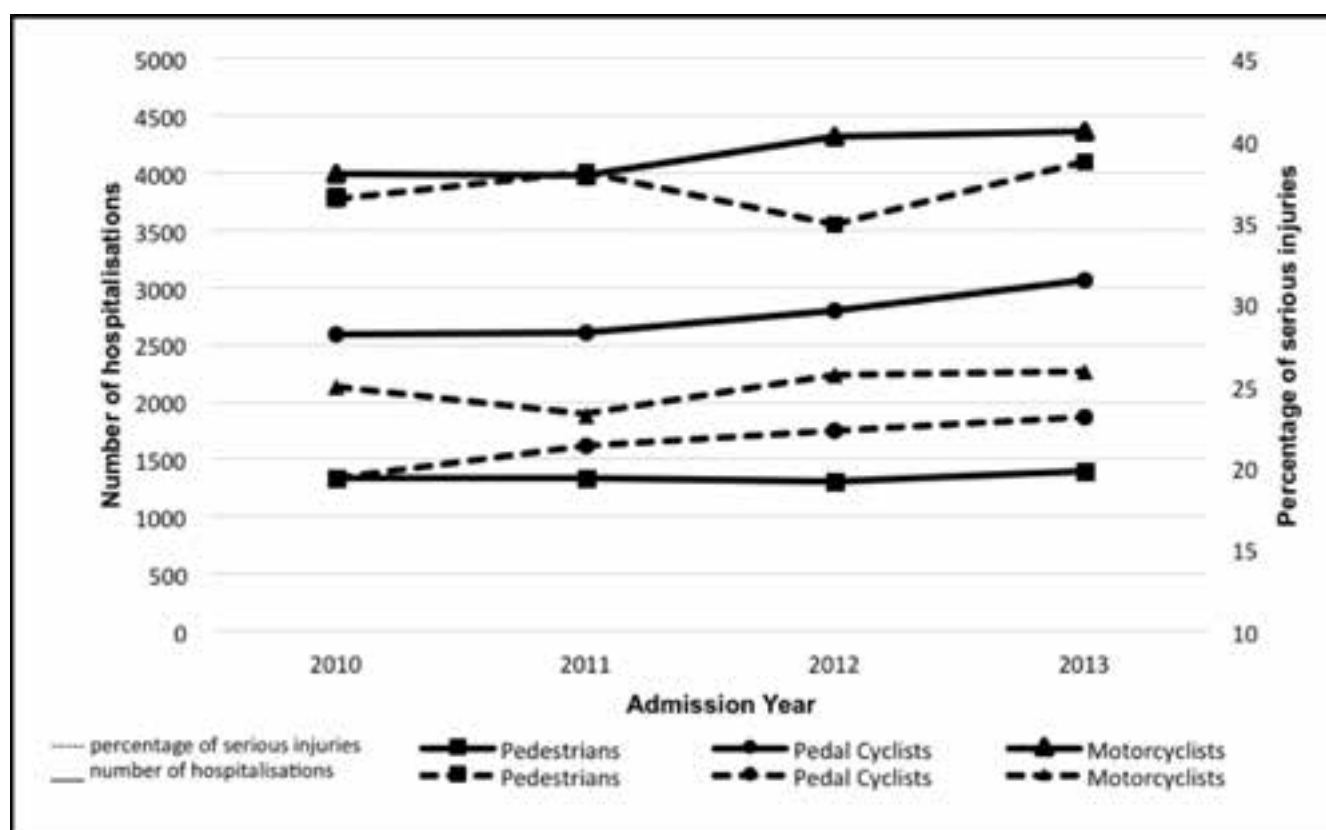


Figure 1. Number of injury hospitalisations and percentage of hospitalised serious injuries of pedestrians, pedal cyclists and motorcyclists in NSW hospitalisation-mortality linked data, 1 January 2010 to 30 December 2013

motorcyclists hospitalised following an injury. The number of hospitalisations due to pedal cycle and motorcycle injuries increased between 2010 and 2013 (Figure 1). In contrast, the number of hospitalisations due to pedestrian injuries decreased slightly between 2010 and 2012, and then increased between 2012 and 2013. The proportion of serious injuries sustained by VRUs remained high for pedestrians compared to other VRUs over the study period.

Figure 2 outlines the proportion of principal injury diagnoses by severity category for each VRU category. For pedestrians and pedal cyclists, both serious and moderate injuries were more commonly sustained to the head and neck. Minor injuries were more commonly sustained for the ankle and foot for pedestrians (26.0%) and to the wrist and hand for pedal cyclists (15.8%). For motorcyclists, serious injuries were more commonly sustained to the wrist and hand (25.3%), moderate injuries to the ankle and foot (30%), and minor injuries to the head and neck (23.6%).

Principal injury diagnosis by injury severity

Figure 2 outlines the proportion of principal injury diagnoses by severity category for each VRU category. For pedestrians and pedal cyclists, both serious and moderate injuries were more commonly sustained to the head and neck. Minor injuries were more commonly sustained for the ankle and foot for pedestrians (26.0%) and to the wrist and hand for pedal cyclists (15.8%). For motorcyclists, serious injuries

were more commonly sustained to the wrist and hand (25.3%), moderate injuries to the ankle and foot (30%), and minor injuries to the head and neck (23.6%).

Multivariable logistic regression

For the multivariable analyses, all VRUs ≥ 65 years had higher odds of sustaining a serious compared to a minor injury. Pedestrians were less likely to sustain a serious compared to a minor injury if the injury occurred between 6am-5pm compared to if the incident occurred between 12am-5am. Pedestrians who sustained an injury to the head and neck had almost 9 times the odds (OR:8.87, 95%CI:4.13-19.06, $p<0.0001$) of sustaining a serious compared to a minor injury. Further, if an injury was sustained to the trunk pedestrians had 10 times the odds (OR:10.01, 95%CI:4.55-22.03, $p<0.0001$) of sustaining a serious injury compared to minor injury. Compared to females, male pedal cyclists had twice the odds (OR:2.06, 95%CI:1.75-2.42, $p<0.0001$) of sustaining a serious compared to minor injury. Compared to the weekday, both pedal cyclists and motorcyclists had higher odds of sustaining a serious compared to minor injury on a weekend. For pedal cyclists, the odds of sustaining a serious compared to minor injury was more than three times higher (OR:3.42, 95%CI:1.36-9.58, $p<0.001$) if the injury was sustained to the trunk. If the collision occurred with a motor-vehicle, all VRUs were more likely to sustain a serious compared to a minor injury (Table 1).

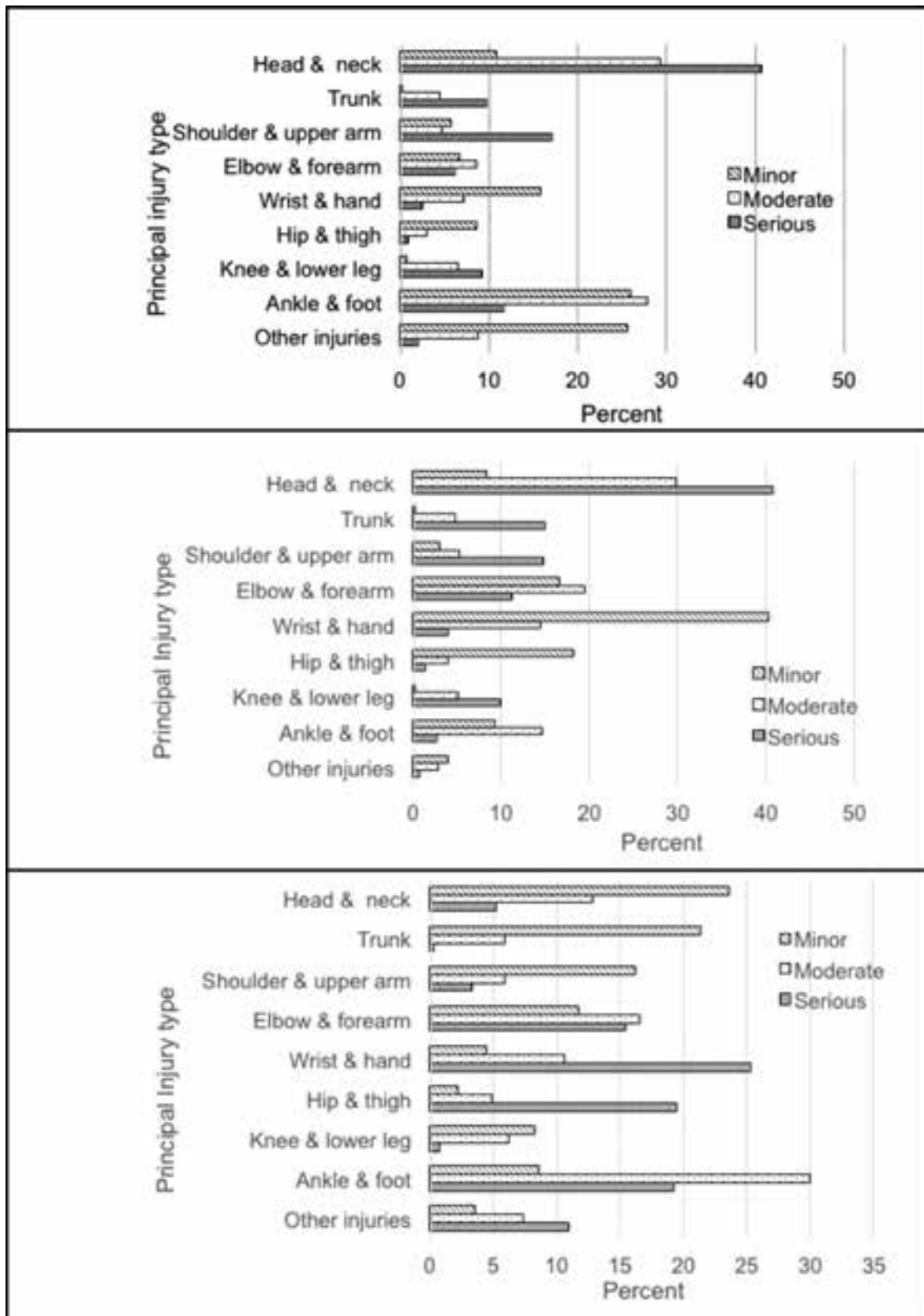


Figure 2. Proportion of principal diagnosis of injury for (a) pedestrians, (b) pedal cyclists, and (c) motorcyclists by injury severity in NSW hospitalisation-mortality linked data, 1 January 2010 to 30 June 2013

Mortality and hospitalisation cost

Thirty-day mortality was higher for pedestrians ($n=174$; 2.9%) than for motorcyclists ($n=99$; 0.5%) and pedal cyclists ($n=45$; 0.4%). Across all injury severity categories, the mean hospitalisation costs were higher for pedestrians than for motorcyclists and pedal cyclists (Table 2). Unsurprisingly, serious injuries incurred higher mean hospitalisation costs than both moderate and minor injuries across all VRUs.

Discussion

During the 4.5-year timeframe, there were 37,428 hospitalised injuries sustained by VRUs in NSW. Across all VRUs, the number of hospitalisations remained relatively consistent, as did the proportion of serious injuries. Injuries sustained by older individuals were more severe. Moreover, all VRUs were at higher odds of sustaining a serious compared to a minor injury if the incident involved a collision with a motor-vehicle. As expected, motorcyclists incurred the highest hospitalisation costs as they sustained the highest proportion of injuries. Despite accounting for the smallest proportion of hospitalised injuries, pedestrians had the highest 30-day mortality. Such findings may be explained by pedestrians sustaining the highest proportion of serious head and neck injuries. Consistent with previous studies, head and neck injuries sustained by pedestrians in a motor vehicle collision often tend to be fatal and severe, with long-term morbidity and higher mortality (Chakravarthy, Lotfipour, & E Vaca, 2007; Martin, Lardy, & Laumon, 2011; Prang, Ruseckaite, & Collie, 2012).

This study found that VRUs ≥ 65 years and incidents involved in a collision with a motor vehicle had higher odds of sustaining a serious injury versus a minor injury. Moreover, injuries sustained to the head and neck were the most serious among both pedestrians and pedal cyclists, whilst injuries sustained to the wrist and hand by motorcyclists were among the most serious. In general, the odds of sustaining a serious injury for all VRUs compared to a minor injury increases with age. Although older people are less involved in transport-related incidents, they tend to experience higher levels of morbidity and mortality compared to their younger counterparts (Welsh, Morris, Hassan, Charlton, & Fildes, 2006). Older people face reduced cognitive and perceptual capabilities with age. This leads to increased difficulties navigating safely in complex traffic conditions, or the ability to react quickly or safely in the event of a traffic emergency (Braver & Trempe, 2004). Moreover, older pedestrians have consistently been found to be at a higher risk of mortality or serious injury following a VRU incident (Chakravarthy et al., 2007; Small, Sheedy, & Grabs, 2006).

Pedestrians had a higher odds of having a serious, compared to minor injury if the injury was sustained to the head and neck. While head injuries sustained by pedestrians depend on crash and vehicle type (Ballesteros, Dischinger, & Langenberg, 2004; Martin et al., 2011), studies from the United States, Australia and India all suggest that head injuries tend to be the most severe (Peng & Bongard,

1999; Pruthi et al., 2012; Small et al., 2006). Overall pedal cyclists had higher odds of sustaining a serious injury to the trunk compared to a minor injury. Injuries to this area has previously been found to common among cyclist-motor vehicle incidents (de Geus et al., 2012; Olds, Bryard, & Langlois, 2015), and also in the event of an acute cycling injury (Schwellnus & Derman, 2005).

Head and neck injuries resulted in 70.5% of moderate or serious injuries. Although the use of helmets has been found to reduce the risk of sustaining a serious head injury, the current study did not have information on whether helmets were worn (Bambach, Mitchell, Grzebieta, & Olivier, 2013). However, in the current study, head and neck injuries were not associated with increased odds of serious injury in pedal cyclists and motorcyclists. It is possible that helmets may have played a role in reducing the severity of head and neck injuries among those who did wear them.

In the current study, both pedal cyclists and motorcyclists had higher odds of sustaining a serious versus minor injury if the transport incident occurred during the weekend. It is possible that the higher odds are due to cycling being used as a leisure activity. In Australia, work related riding has been found to reduce the risk of traffic incidents (Haworth, Smith, Brumen, & Pronk, 1997). Among motorcyclists, data suggests that the number of motorcycle registrations, particularly among older people have increased (Australian Bureau of Statistics, 2015). However, many of these riders, ride for recreation rather than for commuting, which may explain the increased odds of injury during the weekend. Indeed, previous studies have suggested that motorcycling for recreation increased the risk of crashes (Jamson & Chorlton, 2009; Moskal, Martin, & Laumon, 2012).

Transport injuries sustained by VRUs place a heavy social and economic burden on both the individual and society. This includes loss of productivity, potential long-term disability and other negative psychosocial outcomes (Peden et al., 2004; Pointer, 2015). The 'safety in numbers' concept suggests that the likelihood of a pedal cyclist being struck by a motorist decreases with the increasing prevalence of walking and cycling in the local population (Jacobsen, 2003). However, pedal cyclists in large urban areas often tend to be deterred by the perceived dangers of cycling on major roadways (Amr Interactive, 2009). Thus, road safety strategies need to focus on improving and investing in infrastructure that allows for a safe, shared spaces (e.g. more cycle pathways). Continued enforcement of legislation that promotes safe riding, such as helmet wearing, will also likely reduce the risk of sustaining a serious head injury (Schwellnus & Derman, 2005).

As pedestrians are not offered the same protection as other VRUs, appropriate infrastructure in terms of safe and clear walkways and road crossings are imperative. Moreover, educational initiatives that promote safe crossing are also recommended. This includes limiting mobile phone use when crossing streets, and not jaywalking at busy intersections. Stronger enforcement of road rules that aims to prevent motorists from running red lights or not stopping before turning, and slowing down in residential and school

areas will also serve to protect pedestrians from motorists (Cinnamon, Schuurman, & Hameed, 2011). Reinforcing safe crossing methods, and greater road awareness in conjunction with environmental changes through traffic calming methods (e.g. speed bumps) are potential ways to reduce the risk of serious pedestrian injuries. With an increasing ageing population, it is expected that the number of older road users will also increase. Elderly road users, such as pedestrians, can often have difficulty seeing and reacting quickly enough to oncoming traffic and navigating complex intersections (Oxley, Corben, Fildes, & Charlton, 2005). Future initiatives that will meet the needs of older pedestrians will require strategies that encompass both convenient and accessible road environments for walking. Finally, strategies that may help reduce motorcycle collisions include, improved licensing staging and possible skill and risk awareness training for both motorcyclist motor-vehicle drivers (Begg, Stephenson, Alsop, & Langley, 2001). Countermeasures to reduce injury severity include advocating the use of protective clothing designed to protect both the upper body and the lower limbs in conjunction with helmet use (de Rome et al., 2011).

Limitations

There are several limitations to the current study. The time of hospitalisation was used as a proxy of the time of when the injurious event occurred. It is possible that the time of the incident may have occurred earlier than what was recorded. The classification of urban/rural locations were based on the residence of the injured person. Thus, it may not necessarily reflect the location of the injurious incident. The validity of hospitalisation data was not assessed. Thus, it is possible that there was some misclassification of hospital records. In addition, some of the confidence intervals for the regression analyses were relatively wide and should be interpreted with caution. Finally, detailed circumstances of each VRU's transport-related injury and protective equipment worn, such as helmets, were not available and this limited the type of risk factors able to be examined. These limitations should be taken into consideration when interpreting the findings of this study. Future studies should endeavour to use linked police crash data that contain information on crash characteristics and hospitalisation records to overcome some of these limitations.

Conclusions

Whilst many transport incidents are preventable, results from the current study do not indicate that the number of hospitalisations and proportion of serious injuries from transport injuries among VRUs in NSW has decreased over the study period. The current findings also suggest that VRUs are susceptible to sustaining serious injuries if a collision occurs with a motor-vehicle. Thus, injury preventive initiatives such as improved infrastructure, stronger enforcement of traffic safety laws, and educational initiatives encouraging road safety, are advocated.

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Appendix

Table 1. Multivariable logistic regression models of transport-related injury for pedestrians, pedal cyclists and motorcyclists in NSW, hospitalisation-mortality linked data, 1 January 2010 to 30 June 2014

	Pedestrians				Pedal cyclists				Motorcyclists			
	Moderate injury ^a		Serious injury ^a		Moderate injury ^a		Serious injury ^a		Moderate injury ^a		Serious injury ^a	
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
Sex												
Male	-	-	-	-	1.30*	1.16-1.46	2.06*	1.75-2.42	0.83***	0.73-0.95	1.16**	0.98-1.38
Female	-	-	-	-	1		1		-	-	-	-
Age group												
<17	1		1		1		1		1		1	
18-25	0.95	0.73-1.23	0.79	0.59-1.06	1.41*	1.20-1.66	2.69*	2.15-3.36	1.13****	1.02-1.26	1.66*	1.43-1.92
26-64	1.14	0.59-1.06	1.06	0.84-1.34	2.38*	2.15-3.36	6.89*	5.92-8.02	1.45*	1.31-1.59	2.78*	2.43-3.16
65+	1.62*	1.27-2.06	3.10*	2.39-4.03	2.69*	2.09-3.46	14.78*	11.12-19.64	1.91*	1.43-2.54	4.90*	3.54-6.79
Time												
12am-5am	1		1		1		1		1		1	
6am-11am	0.72****	0.52-0.99	0.42*	0.30-0.60	0.60**	0.44-0.80	0.53**	0.38-0.76	0.41*	0.32-0.51	0.22*	0.17-0.29
12pm-5pm	0.95	0.69-1.31	0.57**	0.41-0.80	0.91	0.68-1.23	0.85	0.60-1.20	0.87	0.69-1.10	0.69***	0.53-0.90
6pm-11pm	1.08	0.78-1.50	0.89	0.63-1.25	1.16	0.85-1.57	1.04	0.72-1.49	1.07	0.84-1.36	0.81	0.62-1.06
Day												
Weekday	1		1		1		1		1		1	
Weekend	1.09	0.92-1.29	0.94	0.78-1.13	1.04	0.94-1.15	1.14****	1.00-1.30	1.14****	1.05-1.23	1.23*	1.11-1.36
Area	1.03	0.85-1.24	1.16	0.94-1.44	-	-	-	-	1.09****	1.01-1.17	1.07	0.97-1.18
Urban	1.03	0.85-1.24	1.16	0.94-1.44	-	-	-	-	1.09****	1.01-1.17	1.07	0.97-1.18
Rural	1		1		-	-	-	-	1		1	
Principal injury												
Head and neck	1.86****	1.01-3.40	8.90*	4.14-19.11	0.61	0.30-1.27	2.25	0.91-5.60	0.33*	0.20-0.54	0.62	0.37-1.05
Trunk ^a	1.06	0.56-2.01	10.03*	4.56-22.07	0.47****	0.22-0.98	3.42***	1.36-8.58	0.41**	0.25-0.68	1.20	0.71-2.02
Upper extremities ^b	0.44	0.25-0.80****	0.75	0.35-1.61	0.08*	0.04-0.16	0.08*	0.03-0.20	0.08*	0.05-0.13	0.04*	0.03-0.07
Lower extremities ^c	0.57	0.32-1.02	1.03	0.49-2.17	0.25**	0.12-0.51	0.34****	0.14-0.85	0.18*	0.11-0.29	0.08*	0.05-0.13
Other injuries	1		1		1		1		1		1	
Type of collision												
Conveyance ^d /other pedal cyclists	0.85	0.57-1.26	0.57****	0.35-0.93	-	-	-	-	-	-	-	-
Pedal cyclists, pedestrian or animal	-	-	-	-	1.60*	1.30-1.98	2.15*	1.66-2.77	1.88**	1.36-2.61	2.44*	1.69-3.53
Motor vehicles ^e	1.89*	1.44-2.49	2.20*	1.58-3.04	1.98*	1.71-2.30	2.37*	1.99-2.83	1.72*	1.55-1.91	2.52*	2.23-2.85
Other/unspecified vehicles ^f	1		1		1		1		1		1	

^a Minor injury=reference group. ^b This includes thorax, Abdomen, lower-back, lumbar spine and pelvis. ^c This includes shoulder and upper arm, elbow and forearm, wrist and hand. ^d This includes hip and thigh, knee and lower leg, ankle and foot. ^e These include pedestrians on foot injured in collision with roller-skaters, skateboarders, non-powered and powered scooters, non-powered and powered wheelchairs, and or otherwise specified. ^f These include cars, pick-up trucks or vans, heavy transport vehicles or bus. ^g These include railway train or railway vehicle, collision with fixed or stationary objects or non-collision transport incidents.

*p<0.0001, **p<0.001, ***p<0.01, ****p<0.05.

Table 2. Total hospitalisation costs of individuals with a road transport-related injury hospitalisation by injury severity for pedestrians, pedal cyclists and motorcyclists in NSW, linked hospitalisation and mortality data, 2010-2014

Injury severity	Pedestrians (n=6,007)				Pedal cyclists (n=12,619)				Motorcyclists (n=18,802)			
	n ^b	Mean (\$)	Median (\$)	Total (\$)	n ^b	Mean (\$)	Median (\$)	Total (\$)	n ^b	Mean (\$)	Median (\$)	Total (\$)
Minor (ICISS ≤ 0.99)	990	5,214	2,211	5,162,287	4,683	3,330	2,523	15,589,725	5,564	3,944	2,875	21,944,845
Moderate (ICISS 0.942-0.99)	2,788	7,835	1,239	21,845,642	5,192	3,721	2,103	19,316,748	8,559	5,583	2,293	47,814,550
Serious (ICISS <0.942)	2,229	36,849	11,100	82,136,600	2,744	12,794	4,400	35,105,809	4,679	21,564	6,357	100,898,342

^a Total costs include both acute and non-acute costs. ^bWhere valid AR-DRG was present

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Contributed articles

Letter to the Editors

Review of the graduated driver licensing programs in Australasia

Nicole Middleton and Fiona Cartwright

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We write regarding the peer reviewed article: Scott-Parker, B. and Rune, K. (2017). Review of the graduated driver licensing programs in Australasia. *Journal of the Australasian College of Road Safety*, 27(2), 15-22. We wish to correct a number of relevant details in the paper.

We have listed those GLS amendments of most significance below. They include:

- Page 17, Table 1, Prior to licensure, Minimum age (years) – there is no pre-learner phase in South Australia. Learner drivers are eligible to apply for a learner's permit from 16 years of age (similar to other jurisdictions), upon passing the Learner's Theory Test.
- Page 19, Table 2, Conditions and Restrictions, Minimum age for full licence (years) – the minimum age for a provisional licence in South Australia is 20 years and not 19 years as stated. A longer provisional licence period (3 years) was introduced at the same time as the passenger and night driving restrictions for P1 drivers in July 2014. Age 20 was specified on our website in July 2014 (<http://mylicence.sa.gov.au/gls/home>).
- Page 20, GDL changes according to Australasian jurisdiction – the passenger restrictions introduced in South Australia apply at all times of the day and not only between midnight and 5am.

Other comments:

1. The journal article presents a snapshot of the GLS in each jurisdiction as at August 2014. However, some GLS enhancements implemented in South Australia prior to this date have not been captured.
2. Table 1 (page 17) shows that South Australia is the only jurisdiction not requiring an eyesight test before a learner's permit may be issued. While this is true, it is worthy of note that in SA all health professionals (including doctors and opticians), and drivers

themselves are legally required to report any medical condition that could affect a person's ability to drive safely, such as poor eyesight, to the Registrar of Motor Vehicles. Research on the connection between road crashes and vision problems shows this may only become a significant road safety issue when drivers become elderly. The SWOV Fact Sheet, 'Visual impairments and their influence on road safety' (2010) states the effects of visual impairments on crash rate are limited, most likely because people with visual impairments often compensate by avoiding driving in busy situations or in the dark, and by using other visual strategies. Moreover, visual impairment generally develops gradually over time (hence the need for GPs and ophthalmologists to report visually impaired drivers). After considering introducing a compulsory visual acuity test for drivers (e.g. Snellen chart), the Netherlands discounted the proposal because visual acuity is not an accurate indication of fitness to drive and would not on its own detect problems such as poor Useful Field of View, glare sensitivity and contrast sensitivity, which are linked to crash rate. Similarly, the Austroads Assessing Fitness to Drive Guidelines 2016 state that the evidence is incomplete regarding visual fields, visual acuity and crash risk. In light of this research, not requiring an eyesight test before a learner's permit may be issued is not seen as detrimental in South Australia given our existing mandatory reporting regime.

3. Table 2 (page 19) has a footnote for SA under the Hazard Perception Test (HPT) on page 20, reporting that the HPT has to be passed before a probationary licence (P1) can be issued. SA has a provisional licence phase, not probationary. In South Australia, a probationary licence refers to a licence issued to a full licence holder following a drink or drug driving disqualification.

4. On page 20, South Australia is discussed as being the only jurisdiction not to have automatic only licences if the CBT/VORT was done in an automatic vehicle. The reason for this is that the research and crash data does not support it. Rogerson (1989, Accident Risk of First Year Drivers: Automatic v Manual Transmission, Road Traffic Authority, Victoria) found weak evidence of a higher crash risk for drivers who took the driving test in an automatic car and subsequently drove a manual, but that any extra crashes were too few in number to change the overall proportion of first year drivers involved in crashes. Haworth (1994, Young Driver Research Program: Evaluation of Australian Graduated Licensing Schemes, Federal Office of Road Safety, Canberra) found that ‘automatic only’ licences discouraged some drivers from obtaining
 5. their licence in an automatic vehicle, while preventing drivers subject to the requirement from driving manual vehicles with no clear road safety benefits. Also, while important in the early stages of learning to drive, vehicle control skills (including changing gear) are not as important as accumulating substantial amounts of supervised driving experience and development of higher order cognitive and perceptual skills such as scanning the road ahead, hazard perception and speed control as the novice driver approaches assessment for a first licence (RACV, 2016, The Effectiveness of Driver Training/Education as a Road Safety Measure, RACV, Melbourne).
- These issues may have led to an inaccurate conclusion regarding South Australia’s “GDL strength rating”.

Response: Review of the graduated driver licensing programs in Australasia

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We write regarding the comments provided by Ms Fiona Cartwright and Ms Nicole Middleton as representatives of the Department of Planning, Transport and Infrastructure, and we have noted our responses below. We note also that PDF versions of Tables 1 and 2 will be made available on the Adolescent Risk Research Unit (ARRU) website (usc.edu.au/arru) in 2018, and that this resource will be reviewed, and revised as necessary, quarterly.

Page 17, Table 1, Prior to licensure, Minimum age (years) – there is no pre-learner phase in South Australia. Learner drivers are eligible to apply for a learner’s permit from 16 years of age (similar to other jurisdictions), upon passing the Learner’s Theory Test.

Information regarding the licensing programs and procedures was gleaned from the respective licensing bodies in each state and authority. A search of the South Australian website reveals the following website which clearly refers to a *pre-learner stage*, including the title “Pre learners stage”, followed by the “Learner’s stage”, suggesting to the reader that the pre-learner period precedes the learner period in a sequenced licensing process:

<http://mylicence.sa.gov.au/my-car-licence/pre-learners-stage>
My Licence - My car licence - Pre learners stage - Getting ...
mylicence.sa.gov.au

Yes, getting your driver’s licence is exciting, but learning to drive needs time and practice so you can become a safe driver. You can start learning, now.

Page 19, Table 2, Conditions and Restrictions, Minimum age for full licence (years) – the minimum age for a provisional licence in South Australia is 20 years and not 19 years as stated. A longer provisional licence period (3 years) was introduced at the same time as the passenger and night driving restrictions for P1 drivers in July 2014. Age 20 was specified on our website in July 2014 (<http://mylicence.sa.gov.au/gls/home>).

We note that the search to elucidate the graduated driver licensing conditions and restrictions in Australasia was conducted in June and July 2014 – this is a time-consuming exercise, therefore it was unable to be executed in one day. As such, it seems the age-related changes that occurred in July 2014 were missed simply due to the time period in which the SA information was sourced. Unfortunately this may occur with whatever date we choose as the ‘cut-off’ date, as it is simply impossible for every relevant website in

Australasia to be searched and data gleaned on the same day. We note that the online Table PDFs will provide the most recent minimum age for a provisional licence.

Page 20, GDL changes according to Australasian jurisdiction – the passenger restrictions introduced in South Australia apply at all times of the day and not only between midnight and 5am.

This comment pertains to the following sentence:

“Further, for the first stage of the provisional licence, recent restrictions were applied to night time driving between midnight and 5am, unless for work purposes; no more than one passenger aged 16-20, unless immediate family members, between midnight and 5am; and all mobile (including handheld, loudspeaker, Bluetooth) phone use.”

We agree that a reading of this sentence may not make it clear that the passenger restrictions extend beyond midnight and 5am - our primary focus at the time was to emphasise the night-time restrictions, and this may have obscured the passenger restrictions, which certainly was not our intent. The PDF table will be amended to make this clearer for the reader.

The journal article presents a snapshot of the GLS in each jurisdiction as at August 2014. However, some GLS enhancements implemented in South Australia prior to this date have not been captured.

As noted above, information was gleaned directly from the relevant SA websites. Changes that were missed, or conditions that were obscure, will be updated in the online PDF, as noted above.

Table 1 (page 17) shows that South Australia is the only jurisdiction not requiring an eyesight test before a learner’s permit may be issued. While this is true, it is worthy of note that in SA all health professionals (including doctors and opticians), and drivers themselves are legally required to report any medical condition that could affect a person’s ability to drive safely, such as poor eyesight, to the Registrar of Motor Vehicles. Research on the connection between road crashes and vision problems shows this may only become a significant road safety issue when drivers become elderly. The SWOV Fact Sheet, ‘Visual impairments and their influence on road safety’ (2010) states the effects of visual impairments on crash rate are limited, most likely because people with visual impairments often compensate by avoiding driving in busy situations or in the dark, and by using other visual strategies. Moreover, visual impairment generally develops gradually over time (hence the need for GPs and ophthalmologists to report visually impaired drivers). After considering introducing a compulsory visual acuity test for drivers (e.g. Snellen chart), the Netherlands discounted the proposal because visual acuity is not an accurate indication of fitness to drive and would not on its own detect problems such as poor Useful Field of View, glare

sensitivity and contrast sensitivity, which are linked to crash rate. Similarly, the Austroads Assessing Fitness to Drive Guidelines 2016 state that the evidence is incomplete regarding visual fields, visual acuity and crash risk. In light of this research, not requiring an eyesight test before a learner’s permit may be issued is not seen as detrimental in South Australia given our existing mandatory reporting regime.

Our intention was to summarise the characteristics of novice driver licensing in Australasia. Licensing websites for Australasia were reviewed, and mandatory eye sight testing was reported by nearly every jurisdiction, as you note. While we agree that, as you note, eye sight testing may not be a reliable predictor of crash likelihood, it was not our intention to critique every condition and/or restriction of novice driver licensing programs in Australasia. Rather the focus was upon reviewing the safety-critical changes to GDL, such as related to age, practice conditions, night-time and passenger limits, as operationalised in the IIHS GDL safety rating.

Table 2 (page 19) has a footnote for SA under the Hazard Perception Test (HPT) on page 20, reporting that the HPT has to be passed before a probationary licence (P1) can be issued. SA has a provisional licence phase, not probationary. In South Australia, a probationary licence refers to a licence issued to a full licence holder following a drink or drug driving disqualification.

We agree that there is an error in this footnote, such that ‘probationary’ should be ‘provisional’. The Table will be updated before the PDF is available on the ARRU website.

On page 20, South Australia is discussed as being the only jurisdiction not to have automatic only licences if the CBT/VORT was done in an automatic vehicle. The reason for this is that the research and crash data does not support it. Rogerson (1989, Accident Risk of First Year Drivers: Automatic v Manual Transmission, Road Traffic Authority, Victoria) found weak evidence of a higher crash risk for drivers who took the driving test in an automatic car and subsequently drove a manual, but that any extra crashes were too few in number to change the overall proportion of first year drivers involved in crashes. Haworth (1994, Young Driver Research Program: Evaluation of Australian Graduated Licensing Schemes, Federal Office of Road Safety, Canberra) found that ‘automatic only’ licences discouraged some drivers from obtaining their licence in an automatic vehicle, while preventing drivers subject to the requirement from driving manual vehicles with no clear road safety benefits. Also, while important in the early stages of learning to drive, vehicle control skills (including changing gear) are not as important as accumulating substantial amounts of supervised driving experience and development of higher order cognitive and perceptual skills such as scanning the road ahead, hazard perception and speed control as the novice driver approaches assessment for a first licence (RACV, 2016, The Effectiveness of Driver Training/Education as a Road Safety Measure, RACV, Melbourne).

As noted above, our intention was to provide a snapshot of the characteristics of novice driver licensing in Australasia, with the discussion focussed upon reviewing the safety-critical changes to GDL, such as related to age, practice conditions, night-time and passenger limits, as operationalised in the IIHS GDL safety rating.

These issues may have led to an inaccurate conclusion regarding South Australia's "GDL strength rating".

In light of the concurrent changes to the minimum driver age, the overall rating for the SA GDL program would have been the same as for NSW, QLD, and Vic. We note that this section of the manuscript is unable to be changed at this time. We note also that the manuscript asserts that *all* of the reviewed GDL programs have room for improvement. Finally, we note that the Table PDFs to be provided on the ARRU website will be augmented by a third summary table which calculates the overall rating for the GDL program.

Commentary on Road Safety

A collaborative road safety survivor mission: the sacred work of sorrow

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Key findings

- Working together, three friends influenced the allocation of Federal Black Spot funding to repair a dangerous rural road where a loved one had died;
- A "survivor mission" is a healthy way for a survivor to express and channel grief for wider community benefit;
- Wider understanding of the concept of "survivor mission" among road safety specialists and road authorities can raise public awareness, as well as contributing to the healing of survivor grief;
- Emotional numbness can characterise institutional responses to road fatalities; and
- Local road authorities need specific, targeted educational programs to help them better put a "human face" to road fatality statistics, understand grief, and deal more compassionately with survivors and grieving family and friends.

Abstract

Mooren (2017) undertook a systemic analysis of the road safety factors that she believed contributed to the 2016 death of her friend, Karl Langheinrich. In this article, Karl's wife, Dr Wendy Sarkissian, a prominent community planner, explains how collaborative road safety activism (her "survivor mission") helped to heal her grief following Karl's death. I propose that survivors consider making a "Victim Impact Statement" to the responsible road authority to help their staff put a human face to statistics. This article also challenges road safety and traffic specialists (especially those in local councils) to attend to their own literacy about grief and healing and to pay greater attention to the emotional consequences of road crashes and fatalities. New policies and approaches are necessary to encourage better education of road safety staff and management (about emotional intelligence, emotional literacy, mindfulness, and compassion) in road authorities, such as local councils in Australia.

Keywords

road safety, survivor mission, grief, advocacy, activism, road authority

Introduction

This article builds on an earlier article by Dr Lori Mooren (2017). She argued that:

- Globally, road and traffic systems are providing the conditions to allow some 1.25 million people to die every year;

- The application of root cause analysis methods can identify systemic factors in road injury;
- Some road authorities are not embracing a safe system approach to road safety;
- People are generally complacent about the continuing road trauma crisis; and
- A louder community voice is the key missing element in the struggle to eliminate road deaths and injuries.

On 6 February 2016, my husband, Karl Langheinrich, drowned in the Tweed River near Uki, NSW, after our car plunged forty metres off the narrow, winding, two-lane Kyogle Road. In a period of eighteen months, Karl was one of four people to die on that notorious stretch of road, which has also seen numerous other non-fatal crashes. I am recovering from my injuries and have lobbied strongly at all levels to have the road repaired. The Lost River Shire Council (not their real name) has received Federal Black Spot funding but repairs have been delayed, apparently because of massive flooding in northern NSW in March 2017.

This article discusses the concept of “survivor mission” (Jozefowski, 1999 and <http://www.survivorguidelines.org/articles/jozef01.html>) and its relevance to road safety and road safety advocacy and activism. It is my personal story.

Why do road crash survivors need to take our grief out into the community?

Following a tragedy, such as a sudden death in a road crash, the grieving survivor may eventually seek to move from predominantly inner (or self-focused) grief work to “outer” work. We may find ourselves eager, as I was, to complement self-care with a wider ethic of caring. As we begin to turn our thoughts towards others, we may find ourselves asking, as I did, “What was his dream? What has he taught me?” Or even: “How would he take this healing into the wider community?” Many agree that a part of human adaptation to loss is to construct a way to move forward. Bereaved people who cope best find comfort in ongoing connections. So we may see an opportunity to transform broken dreams, ambitions, opportunities, or future life events that vanished with the death of our loved one. In my case, I found myself asking, “What would Karl do here?”

A survivor mission

At some point, as survivors begin to loosen our hold on our departed one, we may be able to make our pain a gift to others and redeem our traumas through what is now termed a *survivor mission*. Survivor missions exist in many forms, from concrete engagement with a particular individual, to more abstract, intellectual pursuits, to dramatic social and political action and movements (Jozefowski, 1999; <http://www.survivorguidelines.org/articles/jozef01.html>). All are evidence of the recognition that others have died and we may have suffered greatly, but we are alive and able to bring about changes in our world.

Examples of road safety survivor missions

Shortly after our 2016 crash, I found myself, as a planner, focussing on the dangerous rural road where Karl died. As my interest in road safety grew (supported by my close friend, Lori Mooren, a road safety specialist), I discovered the excellent road safety activism work of the European Federation of Road Traffic Victims (FEVR: <https://fevr.org/>). FEVR and London-based RoadPeace (www.roadpeace.org) focus on improving the justice system’s post-crash responses. FEVR member organisations (24 at present) support the importance of sharing grief and anger about lenient treatment or injustice, and the value of learning from people who have suffered. Advocacy to support the rights of crash victims is also a focus of FEVR, which acknowledges that “the bereaved and injured need assistance and information to help them cope with the crash ... but support services for victims of crime do not always extend to road crash victims.”

Roadpeace

RoadPeace helps bereaved families cope and build resilience through peer support, local group networks, and trauma support programs. They also provide information guides on navigating the justice system and help with seeking fair compensation for bereaved families and seriously injured victims.

SARAH

Also in Australia, the Sarah Group (now **Safer Australian Roads and Highways: SARAH**) was established to honor Sarah Frazer and campaign for changes to planning, policy and legislation to ensure that lives are not lost in preventable situations like the one that took her life (<http://www.sarahgroup.org/sarabs-story>). In 2012, Sarah was a victim of a tragic crash that could easily have been prevented with more intelligent and safer road planning and design. When her car broke down, she organized for a tow-truck driver to assist her. However, while he was hooking up the car, a truck side-swiped Sarah’s car and collided with the pair, killing both instantly. SARAH’s call to action is: “Road Safety Champions! Commit to Drive So Others Survive!”

Mothers Against Drunk Driving (MADD)

MADD is a non-profit organization in the United States and Canada that seeks to stop drunk driving, support those affected by drunk driving, prevent underage drinking, and strive for stricter impaired driving policy. There is at least one MADD office in every state of the United States and each province of Canada. MADD claims that drunk driving has been reduced by half since its founding (<https://www.madd.org/>).

Reflecting on these initiatives, we might ask ourselves, “Do I have such a project in my heart and mind that would honor my loved one?” Or: “Could I invent or build on such a project?”

My re-entry into activism

As I reflected on Karl's distinctive approaches to activism, I realized that he would want me to use the power of my grief to fuel action. I had spent a long career planning, managing, speaking, and teaching about community engagement. But that life ended abruptly when Karl died. My concussion and witnessing Karl's death severely impaired my cognitive abilities for many months and brought about some serious bouts of PTSD. So I was astonished when I found myself even considering *engagement* to heal my grief. However, action can be strong medicine in times of trouble. While action cannot undo the trauma we have suffered, making people accountable for the wrong that caused our loss can offer a sense of well-being. Engagement in the wider community literally allows us to step outside our grief. It can steer us away from isolation and any negative tendency toward self-absorption that can accompany grief. My attention was drawn away from my sorrow and directed into the unfamiliar realm of road safety activism.

Contributing to a community project or action builds our confidence by reminding us that we can make a difference. The well-known "helper principle" in psychology applies here: when we help others, we often help ourselves, as we begin to see the power of our own resilience and resourcefulness. Following the crash, I was astonished by my first sense of "pleasurable mastery" (being able to do things competently that I could not do for many months) and "personal agency" (a sense of control and awareness of initiating and carrying out my actions in the world).

My first act of road safety activism — delivering my Victim Impact Statement to the Council — was a revelation. I hold that authority completely responsible for Karl's death. Until that moment in September 2016 (over seven months after Karl's death), I felt completely washed-up professionally and intellectually, certain I would never again chair a meeting, speak publicly, or write professionally. As the road safety campaign expanded and my friends and I started to see results, I imagined that I might flourish again. I had not survived to be untouched. So how could I move forward in my life when I had a cognitive impairment, which made me feel hopeless, directionless, and incompetent? Now, to my surprise, I sensed a power that drew on my own initiative, energy and resourcefulness that I feared I had lost forever.

Because I was undertaking my new advocacy work with two close friends (Lori Mooren and Kev Cracknell) and "in community", I experienced an alliance based on cooperation and a shared purpose. I gained a sense of connection with my friends that was deeper than what we had before; it brought out the best in all three of us. And I was getting my hands dirty with the emotions that frightened me.

The fearsome threesome

My two friends and I worked together to raise awareness about the state of the winding stretch of Kyogle Road where Karl died, to lobby for better road planning and funding to repair it. Initially, as we considered our "activist" options,

our collective emotions were a bewildering mix of guilt, despair, confusion, anger, frustration, powerlessness, sadness, and a desire for justice: an outcome that would help others and save lives. Although we did not know it when we began our organic process, we were well equipped to do this work (with a history of community activism and advocacy, knowledge of road design and safety, community engagement and empowerment, and municipal governance and planning). We had complementary skills: a balance of professional, on-the-ground experience, and academic knowledge. We were naturally a good team. The experience was most powerful for me, as it was easier for me to speak out in the company of friends than in my lonely, mourning voice. Delivering my Victim Impact Statement to the Council helped build my competence and confidence. Soon our "small wins" buoyed us up. Often we found ourselves laughing through our tears. Now we feel empowered and emboldened. The quality I missed the most — my courage — slowly began to return.

How we did it: our road safety activism

Three days after the crash, Kev drove down from Brisbane to the crash site to look for water pooling, to inspect the condition of the edge of the road at the fog line, skid marks and debris and to take photographs. He noticed a new "Danger: oil on road" signage and wondered why it was there, as there was no oil on the road. Local police told me on three occasions after our crash about their years of lobbying for a guardrail on that stretch of road.

I received a polite and compassionate response from the Council's General Manager when I first wrote to him. However, when I asked to make a Victim Impact Statement to their road traffic staff and a junior manager (an engineer) took over communication, our relationship rapidly deteriorated. What had begun as an "information session" to raise staff awareness flourished into full-blown activism after I received this email from him:

... whilst the proposed victim impact statements are very important, I am concerned this part of the meeting might cause distress to yourself and Council staff. As you would appreciate, Council has an obligation to ensure the workplace health and safety of its officers.... Council's preference is that you provide written statements beforehand and these can be considered outside of the meeting.

Later emails demanded that I restrict my remarks to "the circumstances of the crash" and not to any impacts I had experienced. "What's a Victim Impact Statement without impacts?" I cried. I delivered my Victim Impact Statement minus the impacts, while Lori (who had promised nothing to anyone) detailed the impacts I had experienced.

My Victim Impact Statement

Our meeting at the Council, while empowering for me, was highly disappointing from an activist standpoint. Not only did we encounter resistance, denial, falsehood, evasiveness, and outright hostility, we also identified professional

incompetence. My conversations with senior planning colleagues in other government agencies confirmed our perceptions that in this small, backwater municipality, professional traffic management and road safety design skills were a long way from “best practice”. These folks were woefully out-of-date. Further, they seemed determined to ignore the fact that two people had died in a crash in the same spot only a year before. (Astonishingly, only six days after our meeting, another car plummeted from Kyogle Road into the Tweed River. That driver survived because the water was shallow at that time. And only weeks later, in early October 2016, a crash between a car and a motorcycle on Kyogle Road near that spot claimed the motorcyclist’s life.)

We were appalled that no Council staff member had even visited our crash site (only twelve kilometres from their office). When they convened the Council’s Traffic Committee to discuss our crash a week after it occurred, no police attended (although several were at the crash site). The Council officers had no photographs, yet steadfastly refused to countenance any explanation other than “driver error and speed”. They were willing to defend their shabby, dangerous rural road to the death (i.e., someone else’s death and another potential tragedy). We were appalled.

Nevertheless, the first activity of my survivor mission empowered all of us. Although I felt insulted, angry and wronged, I also felt “alive” for the first time in seven months. I imagined that these six municipal employees, hearing the words of a grieving elderly widow, might soften their hard hearts and actually listen. I felt that we were speaking truth to power. We were willing to show up and be seen, even when we knew we could not control the outcomes of the meeting. We persisted.

In November 2017, we prepared our second annual submission to the World Day of Remembrance for Road Traffic Victims (<https://worlddayofremembrance.org/>). I am nominating two local residents (who tried to save Karl) for federal bravery awards. The Council “lawyered” up early on, demanding all communication be through their solicitor. Now they refuse to engage in any communication. I feel discounted and dismissed, as though they are blaming the victim. Raph and John, our two academic road safety advisors (both senior professors) described the Council’s lawyer’s latest email as “appalling” and “very disrespectful and brutal”. It went like this:

Council has been more than reasonable in responding to your requests for information and passing on your submissions to the Councillors and the Local Traffic Committee. However, correspondence cannot continue indefinitely in relation to this matter. In light of the State Coroner’s office no longer having an interest in the matter, Council and [our] lawyers will not be entering into any further correspondence with you on this matter.

In all, our road safety activism in Karl’s name included: analysis of the road conditions and numerous communications to the Council and the press; a detailed request to the State Coroner for an inquest (which was fully

investigated but ultimately refused); my Victim Impact Statement; and three academic articles about the effects of my experience (See: Mooren, L. & Sarkissian, W., 2017, “We need a louder road safety voice.” *World Transport Policy and Practice*, 22(4): 83-95). I was also responsible for three hard-hitting articles in the local press about safety problems with Kyogle Road (*Gold Coast Bulletin*, 2016; Grant, 2017a; Grant, 2017b). In December 2016, my televised interview in program about the national road toll was aired in South Australia and Perth to a very strong response (<https://www.todaytonightadelaide.com.au/stories/road-toll>).

World Day of Remembrance for Road Traffic Victims

Probably our most powerful activism involved our contribution to the 2016 World Day of Remembrance for Road Traffic Victims (17 November 2016). Lori and I held a media conference at the Mt Warning Hotel in Uki, near the crash site, to raise awareness that three people had died there and still no repairs had been made to the road. Sitting quietly in our meeting was a local woman who was driving the second vehicle involved in the previous fatal crash. She told us how five Aboriginal children were injured and nearly killed there. After our speeches, we drove down Kyogle Road and attached a huge poster of Karl to a tree near the crash site. It read, “My name is Karl. I died here. Please slow down.” (Figure 1). The idea came from reading about roadside memorials (also called wayside shrines) in France and other countries. (We asked permission to erect a permanent sign with a photo of Karl on it but the Council refused to allow anything other than a white wooden cross because it might distract drivers. They also refused to specify the permitted sign size. Our poster was promptly removed.) That blatant ethnocentrism offended me greatly. In a multicultural community such as the Tweed, how could anyone assume that a Christian cross should be the only acceptable memorial? Karl had deep spiritual beliefs but a Christian cross would have been anathema to him.

I made another impassioned speech to camera by the roadside, begging the municipality to use more sophisticated road planning approaches. (A video by Nicholas Curthoys of our November 2016 media event at Uki, our speeches and erecting our poster on the tree, is at <https://www.youtube.com/watch?v=FyI5jNqqYdE>.)

Lots of tears and laughter, in a long afternoon celebrating with local friends on the verandah of the Mt Warning Hotel, honored Karl in a manner that would have met his approval.

Would we undertake these actions again?

All three of us strongly believe that our road safety activism was the right thing to do. We received very positive support from the print and TV media. I found that collaborative activism greatly helps to reduce the isolation of the grieving person. While we have had many victories, I am sure that Lori and Kev would agree that the greatest was getting Wendy out of the house. And I learned that survivor mission



Figure 1. A poster of Karl Langheinrich at the crash site

activism gives loving friends something valuable and visible to do.

Our work called us to draw on our most mature and adaptive coping skills, a sophisticated level of teamwork, applied research and networking, and qualities of patience, anticipation, and altruism. More than anything, it summoned up our sense of humor (which we were desperately missing). During the most dramatic aspects of our campaign, we would find ourselves howling with laughter, questioning the apparent futility of our task and the idiocy of the people we were encountering.

We were out to make amends, to repair a dangerous road and protect future road users. We argued that those responsible for dangerous roads must be held accountable for their actions. The road must be fixed. Broken road safety systems and processes must be mended. More than my mental health was at stake. We were holding the perpetrators responsible for their actions. That was important for the health and safety of the wider society. We were after justice. And we achieved it.

After our September 2016 meeting at the Council, I did not recognize myself. I read my statement without crying. I was able to “read” the meeting dynamics and put an insensitive bureaucrat in his place. I felt confident and empowered. I was also beginning to understand Lori’s lessons about road safety. It was not that complicated. The road safety system in the Shire was broken. Just plain broken. The meeting was a completely unexpected breakthrough moment for me. I never really looked back.

What does this mean for road safety education for road authorities?

I believe that the next step must be tailored, high-quality educational programs for road authority staff, management and their legal advisors. Emotional intelligence must feature in this training. Rather than aiming to humiliate and “blame the victim”, road authorities could be encouraged to understand and address the massive personal and community consequences of tragedies that result from inexpert road planning and maintenance. Topics such as empathy, compassion, kindness, and emotional literacy could be part of curriculum. We need a new protocol here: a new education policy, program, curriculum, and a whole-of-community response to this critical community issue. Staff need training in basic communication skills. Corporate cultural issues will probably also need to be addressed, if victims are to be protected and supported.

It has recently been claimed that the Council is experiencing serious bullying and harassment issues among some staff in environmental and public health, building and planning, a claim that Council management strongly refutes (<https://www.tweeddailynews.com.au/news/union-claims-tweed-the-most-hazardous-place-to-work/3297590/>). Reading the union report did cause me to ask, “Were they simply treating me the way staff are treated within that Council?”

As within, so without? How they handled an aggrieved *outsider* like me may well reflect how they handle their *internal* affairs. How I was treated certainly does not align with the Council’s mission statement: “We have conversations where everyone can contribute and we are willing to have a go.”

One of my senior expert road safety advisors had this response to the final email I received from the Council’s lawyer:

This is a very disrespectful and brutal reply from the Council. The Council may well feel they have reached “the end of the road” but you do not agree, and I do not agree. The intelligent, respectful and ethical response should be “let’s meet and discuss what you think we (the Council) could and should do to resolve this matter... We will invite an independent chair to guide us in this meeting.”

Conclusions

What the road safety managers at the Council appear to misunderstand about my “annoying” advocacy is that the force of the grief that Kev, Lori and I feel for Karl is much more powerful than their road, their evasive, “risk-management” strategies, or their budgets. In speaking out for Karl, we are expressing our grief as deep activism.

My loving friends encouraged me to engage passionately with my survivor mission. They brought me back to life by helping me transform my private grief into public grief.

And that stretch of Kyogle Road: it *will* be repaired. With a guardrail.

I escaped from the Tweed River with my life. I’m betting my life on that!

Appreciations

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May 2018 Issue: We are soliciting contributions for the May 2018 Issue on all topics of road safety. Sample topics may include, but are not limited to: evaluation of Safe System interventions; system designs protecting vulnerable road users; research related to child road safety and older driver safety; in-depth analyses of the rising or plateauing road deaths especially in New Zealand and Australian jurisdictions; policy and practice on sustainable transport and road traffic exposure reduction; research related to autonomous vehicles; case studies of road safety activities in low and middle income countries; commentary on road safety communications and advocacy leading to government actions.

SUBMISSION DEADLINE for May 2018 Issue:

Peer-review papers: Wednesday, 21st February 2018

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For more details on article types, the scope and requirements see the **Instructions to Authors** available from the ACRS website: <http://acrs.org.au/contact-us/em-journal-conference-contacts/> (scroll down). Please submit your manuscript online via the Editorial Manager: <http://www.editorialmanager.com/jacrs/default.aspx>. Authors wishing to contribute papers and discuss their ideas with the Managing Editor in advance of submission or to ask any questions, please contact Dr Chika Sakashita: journaleditor@acrs.org.au

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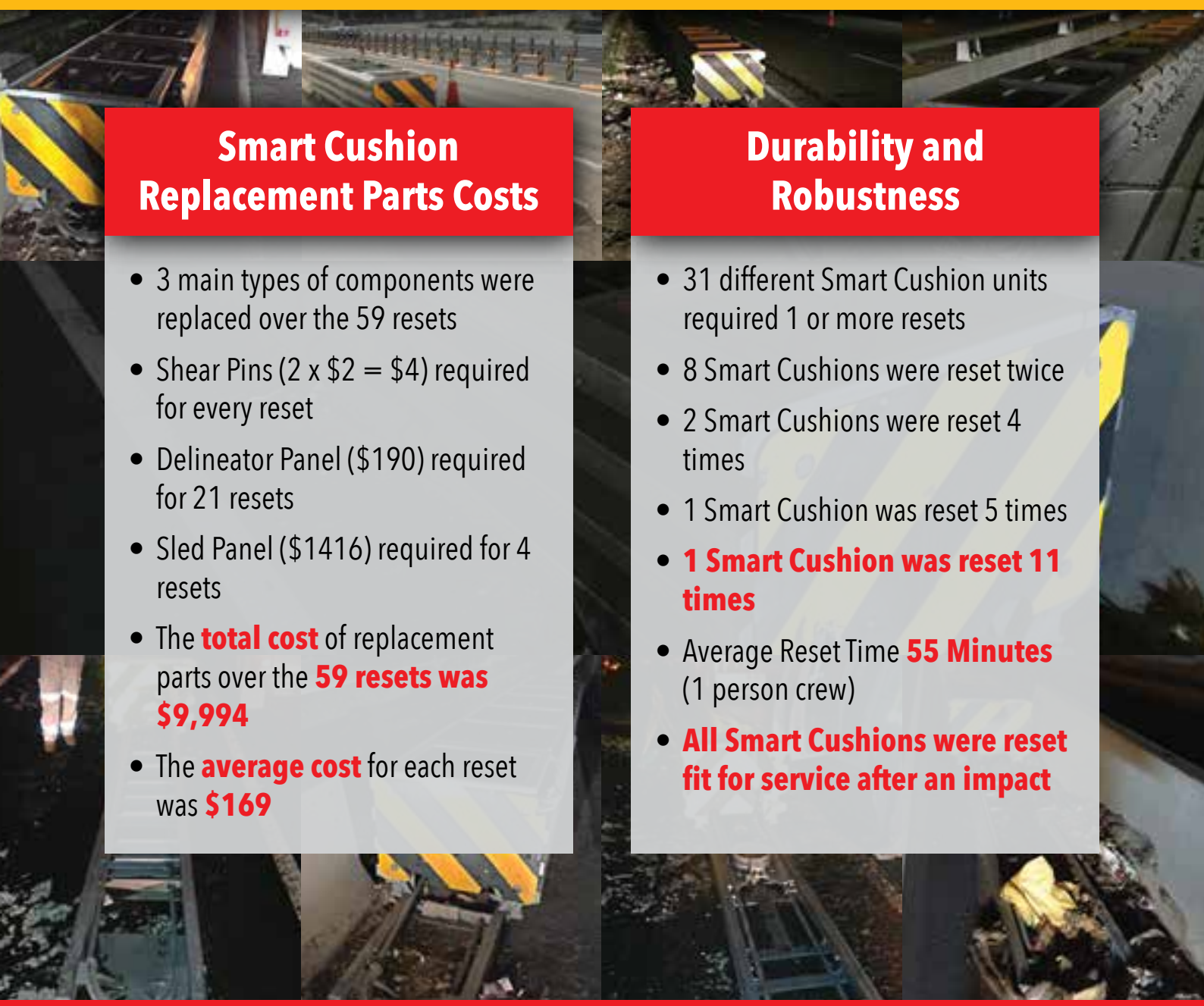
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