



Journal of the Australasian College of Road Safety

Formerly RoadWise – Australia's First Road Safety Journal

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Special Issue: Speed Management in support of the 4th UN Global Road Safety Week 8-14 May 2017

Peer-reviewed papers

Original Road Safety Research

- Infrastructure treatments for managing speeds on rural and urban arterial roads
- Safety of raised platforms on urban roads
- Speeding in urban South East Asia: Results from a multi-site observational study

Road Safety Policy & Practice

- Not all roads are created equal: Technical analysis and engagement frameworks developed for New Zealand's new Speed Management Guide

Contributed articles

Road Safety Policy & Practice

- Understanding low level speeders to increase speed compliance via road safety campaigns

Road Safety Case Studies

- Speed limits: Getting the limit right – the first step in effective Speed Management

Perspective on Road Safety

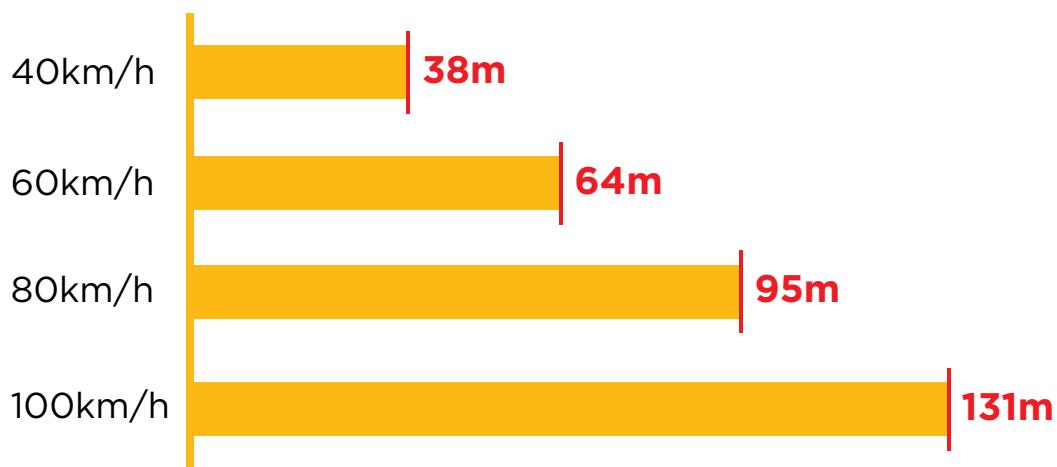
- Posted speed limits:
When is the maximum posted limit not the recommended?



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*Average stopping distances for a car on a reasonable road surface, Centre for Road Safety 2014

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With a theme of "**Expanding our horizons**", ARSC2017 will showcase the regions' outstanding researchers, practitioners, policy-makers and industry spanning the plethora of road safety issues identified in the United Nations Decade of Action for Road Safety: Road Safety Management, Infrastructure, Safe Vehicles, User Behaviour, and Post-Crash Care. ARSC2017 will bring with it a special focus on **engaging all levels of government and community, from the city to the bush, to move Towards Zero**. The comprehensive 3-day scientific program will showcase the latest research; education and policing programs; policies and management strategies; and technological developments in the field, together with national and international keynote speakers, oral and poster presentations, workshops and interactive symposia.

WHO SHOULD ATTEND?

ARSC2017 is **expected to attract over 500 delegates** including researchers, policing and enforcement agencies, practitioners, policymakers, industry representatives, educators, and students working in the fields of behavioural science, education and training, emergency services, engineering and technology, health and rehabilitation, policing, justice and law enforcement, local, state and federal government, traffic management, and vehicle safety.

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Entries open 1st March 2017 and close 5pm (EST), 31st July 2017



3M-ACRS Diamond
Road Safety Award 2017



Contents

| | |
|---|----|
| From the President | 3 |
| From the Minister for Infrastructure and Transport Australia..... | 3 |
| From the WHO Regional Director for the Western Pacific..... | 4 |
| The 4th UN Global Road Safety on Speed Management: Show your support and get involved | 5 |
| ACRS Chapter reports..... | 7 |
| ACRS News | 9 |
| Diary | 12 |

Peer-reviewed papers

Original Road Safety Research

| | |
|---|----|
| Infrastructure treatments for managing speeds on rural and urban arterial roads -Blair Turner, Tariro Makwasha and Paul Hillier | 13 |
| Safety of raised platforms on urban roads - Tariro Makwasha and Blair Turner..... | 20 |
| Speeding in urban South East Asia: Results from a multi-site observational study - Abdulgafoor M. Bachani, Nukhba Zia, Yuen W. Hung, Rantimi Adetunji, Pham Viet Cuong, Ahmad Faried, Piyapong Jiwattanakulpaisarn, and Adnan A. Hyder | 27 |

Road Safety Policy & Practice

| | |
|--|----|
| Not all roads are created equal: Technical analysis and engagement frameworks developed for New Zealand's new Speed Management Guide - Glenn Bunting, Paul Durdin, Diane Gamble, Iain McAuley, Tracey Bridges and Matt Benson | 36 |
|--|----|

Contributed articles

Road Safety Policy & Practice

| | |
|--|----|
| Understanding low level speeders to increase speed compliance via road safety campaigns - Richard Blackwell, Sarah Zanker and Joanne Davidson | 47 |
|--|----|

Road Safety Case Studies

| | |
|--|----|
| Speed limits: Getting the limit right – the first step in effective Speed Management - Michael de Roos and Fabian Marsh | 55 |
|--|----|

Perspective/Commentary on Road Safety

| | |
|--|----|
| Posted speed limits: When is the maximum posted limit not the recommended? - Doug Fryer | 59 |
|--|----|



Cover image

Speed limits – what do they mean to you? How do we improve compliance? The photos show speed limit signs in Vietnam, Switzerland, Australia and Brazil (clockwise from top left). As part of the *UN Global Road Safety Week 8-14 May 2017 on Speed Management*, this May 2017 Special Issue on Speed Management features a *Road Safety Case Studies* article (de Roos, M. and Marsh, F. (2017). Speed limits: Getting the limit right – the first step in effective Speed Management. *Journal of the Australasian College of Road Safety*, 28(2), 55-59) and a *Commentary on Road Safety* article (Fryer, D. (2017). Posted speed limits: When is the maximum posted limit not the recommended? *Journal of the Australasian College of Road Safety*, 28(2), 59-60), helping us rethink speed limits.

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All papers submitted for publication undergo a peer-review process, unless the paper is submitted as a *Perspective/Commentary on Road Safety* or *Correspondence* or the authors specifically request the paper not to be peer-reviewed at the time of original submission. Submissions under the peer-review stream are refereed on the basis of quality and importance for advancing road safety, and decisions on the publication of the paper are based on the value of the contribution the paper makes in road safety. Papers that pass the initial screening process by the Managing Editor and Peer-Review Editor will be sent out to peer reviewers selected on the basis of expertise and prior work in the area. The names of the reviewers are not disclosed to the authors. Based on the recommendations from the reviewers, authors are informed of the decision on the suitability of the manuscript for publication.

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From the President



Dear ACRS members,

This is a special issue on Speed Management; in support of the UN Global Road Safety Week (8-14 May 2017) which will also focus on speed management.

One of the key papers in this edition has the phrase in the title “Not all roads are created equal”. That phrase and another “the speed limit is not a target” are two that we need to encourage road users to recognise and understand their implications.

Road vehicles generally have the capacity to exceed the speed limits set by road owners, but we rarely encourage drivers/riders to understand the differences in the road networks. “Roads that cars can read” is another phrase that we should encourage drivers to recognise. It is interesting that many of the new autonomous vehicles have relatively low pre-set speeds as the computing power is not able to keep up with the complexities of traffic.

Every increase in vehicle speed increases the complexity and the risks of safe travel. The road system, the vehicles, the environmental conditions, the traffic are not always synchronised for the same level of safe travel at the same speed.

We do know how to build and operate safer road systems and we must rely on drivers (or the automated vehicle even) in understanding and recognising the interaction of all the factors, all the time. We must encourage road designers, road builders, vehicle manufacturers to work together to demonstrate the inequalities in the system and commit to reducing risks.

The UN is seeking your support in creating a more informed view of the impacts of speed as one of the key factors in reducing road trauma.

The College has recently been formally accepted as a member of the UN Road Safety Collaboration, which will increase our contacts and conversations with like-minded road safety people across the globe.

Creating awareness of the potential to reduce road trauma across the whole community is essential. The College Submission to Australian Federal Parliamentarians in March 2017 sets out specifically the impacts of road trauma not only in the transport sector, but in health, welfare, workplaces, communities and in the economy in productivity, finance and insurance to name the key areas.

*Lauchlan McIntosh AM FACRS FAICD
ACRS President*

From the Minister for Infrastructure and Transport Australia



I don't accept that another 1,300 people have to die on Australia's roads this year.

All Australians have been touched by road trauma – we all know someone who has been killed or seriously injured in a crash and we have to accept responsibility to do our bit to reduce road trauma.

By working together with organisations such as yours, as well as communities, police and governments, I'm confident we can improve safety on our roads throughout Australia.

This edition of your Journal coincides with the Fourth UN Global Road Safety Week, and the Australian Government is proud to be hosting the Asia-Pacific regional launch (7 May). This year's focus on speed and road safety is a great opportunity to centre the conversation around what we are prepared to do to make our road transport system safe.

Australia's immediate goal under the National Road Safety Strategy 2011-20 (NRSS) is to reduce the annual number of deaths and serious injuries by at least 30 per cent by 2020. More importantly, the strategy outlines a vision that no person should be killed or seriously injured on Australia's roads. These targets are designed to be met in the face of increasing numbers of vehicles on our road. This means all levels of government must work together with communities and continue to implement measures and take actions that will secure future improvements.

Addressing speed is a critical issue across our vast road network.

Australia has relatively high speed limits across much of its road network compared with similar roads in most OECD countries. We have many rural, undivided roads where the speed limit is 100km/h and a crash is simply not survivable. We also have a higher fatal crash rate overall in regional and rural areas. Often these roads have a lower standard of design and the default speed limits may not be appropriate to the road standard.

Speed is a critical element of the safe system approach, both in terms of ensuring speed limits are appropriate for the roads and environment, and that road users comply with speed limits. The safe system approach, embedded in the NRSS, includes an acceptance that humans will always make mistakes, and the system must be designed around avoiding death or serious injury. It gives us a methodology to move closer to our vision through safer roads, safer vehicles, safer people and importantly safer speeds. The safe system approach acknowledges the complexity of the problem and offers some solutions.

In Australia, the safe system and the role of speed are not widely understood or accepted by the community. Although surveys show that people know higher speeds increase the risk of crashing and make crashes more severe, there remains considerable community resistance to reducing speed limits because of the impacts on time and efficiency. That is why we need to engage the community in our discussion on how to achieve safer speeds.

When we met last year, state and territory Ministers agreed to be part of a conversation with the Australian community about speed and speed limits, one that looks honestly at both community concerns and the available evidence. While we understand the research, we must lift our game when it comes to discussing the evidence about speed and the various safe system options with the community. Engaging with some of our expert researchers and communicators will help with this task.

When setting speed limits under the safe systems approach, consideration must be given to what is survivable on different road conditions. The human body is fragile and survival is a matter of physics. The Victorian Transport Accident Commission's 'Graham' campaign highlighted this

very fact extremely well. The campaign cleverly combined the skills of artist Patricia Piccinini, with those of a trauma surgeon and a crash investigation expert, to reimagine the human body as it might look if it had evolved to withstand the forces involved in crashes. The result was not pretty, but the campaign made its point – that everything we do in regards to road safety must be to protect us from our own vulnerabilities.

When we start to think about human vulnerability in different types of collisions, we can see why speed limits should be much lower in built-up areas, where there are more pedestrians and cyclists mixing with other traffic. There is also a strong case for limits to be lower on highways and undivided main roads. Some of the speed limits posted on our roads do not match the quality of the road and do not provide the necessary guidance to drivers on the speed that is safe for a particular road.

But we can't enforce our way out of the problem – the community needs to genuinely accept speed limits as a public benefit.

Too often, discussions on speed are met with knee jerk reactions and entrenched positions from each side of the argument. We are smarter than that, both as a community of road users, and a community of road safety experts. Of course, improving safety is not just about slowing people down. Introducing safer speeds is only one pillar of the safe system approach. Together, I am sure we will keep working to achieve better roads, better vehicles and better drivers.

*The Hon Darren Chester MP
Minister for Infrastructure and Transport Australia*

From the WHO Regional Director for the Western Pacific



The High Road to Safety

In United Nations Road Safety Week, we pause to reflect on the fact that too many people die and are seriously injured on the world's roads.

Approximately every one and a half minutes, someone is killed on a road in the WHO Western Pacific Region, which includes 37 countries and areas, stretching from China all the way to remote Pacific islands.

Globally, more than 1.2 million people die from road traffic injuries every year. Many of the tragedies are young people: road deaths are the number one killer of people

aged 15 to 49. Low- and middle-income countries bear a disproportionate share of the burden.

Tens of millions more are seriously injured – often resulting in lifelong disability. Many are left unable to work, unable to care for themselves or their loved ones. The poor suffer the most with the catastrophic health-care costs of road crash injuries.

The toll on families, health systems and the economy is enormous. Road traffic injuries cost some countries as much as 5% of their annual gross national product. The social and economic costs will only increase in low and middle-income countries in the future — unless comprehensive action is taken.

Up to now, the response to road dangers has not matched the magnitude of the problem. Some policy-makers contend

that increases in crashes and injuries are an inevitable consequence of motorization, urbanization and economic development. They say nothing can be done. They are wrong.

Economic growth and development should lead to enhanced safety, not increased danger for citizens. Australia, Japan, New Zealand and many others have increased road safety as they have prospered. Now a mountain of evidence worldwide shows that cost-effective interventions exist to manage risk factors and improve infrastructure to reduce death and serious injury.

But the gulf between what is known to work and what is put into effect — especially in low- and middle-income countries — continues to be wide.

The theme of this year's United Nations Global Road Safety — which runs from 8 to 14 May — is managing speed. Speed is a causal factor in up to half of all road traffic injuries and deaths. Even a slight decrease in speed can greatly lessen the likelihood of death or serious injury. And lowering motorists speeds will make an enormous contribution to lowering the Region's unacceptably high pedestrian fatality rates.

But managing speed is more than putting up speed limit signs. In addition to enforcement, speed limits must be adjusted based on conditions and surroundings, factoring in everything from visibility and quality of the roadway to motorbike, bicycle and pedestrian traffic. Speed management should also be integrated into the design and construction of roadways, and the design of vehicles.

We are headed in the right direction. Road safety has become a priority at the highest levels of global politics and development. Sustainable Development Goal 3 calls for a 50% reduction in road traffic deaths and serious injuries by 2020.

Yet up until now, the pace of change has been too slow. Between 2010 and 2013, global road traffic mortality rates dropped by just 4%. We will need to expand and accelerate the implementation of tried and tested policies to improve

road safety if we are to meet the ambitious development targets.

In this part of the world, the WHO Western Pacific Region in 2015 adopted the first-ever Regional Action Plan on Violence and Injury Prevention in the Western Pacific for 2016-2020. The action plan includes road safety, spelling out the scale of the problem and fostering the political commitment and evidence-based action needed to address it.

WHO advocates the Safe Systems approach, which features a set of complementary interventions to create safer roads, safer vehicles, safer speeds, and safer behaviour by road users. All parts of the system work together so that if one part fails, the others still protect people in a crash.

Australia and New Zealand have formally adopted these principles. The results are convincing: from 1970 to 2016, Australia reduced road traffic fatalities by two thirds, even though road traffic injuries are still the second leading cause of death among Australians aged 15 to 34.

However, the Towards Zero strategies adopted by Australian state and territory governments continue to inspire other countries. WHO shares the Towards Zero hope for all road users globally. We look to Australia and New Zealand to continue to provide leadership and guidance for other countries in the Region. Contrary to some perceptions, this approach is not specific to high income countries alone and is also entirely feasible for low and middle income countries.

The Sustainable Development Agenda sets a vision for a safer, greener, more prosperous, equitable and healthier world by 2030. A global road crash death toll of 1.2 million people is at odds with this vision.

We know what we need to do to prevent death and serious injury from road crashes. Now is the time to put into effect what has worked in high-income countries in all countries. So many lives depend on it.

*Dr Shin Young-soo
World Health Organization Regional Director for the Western Pacific*

The 4th UN Global Road Safety on Speed Management: Show your support and get involved

The Fourth United Nations (UN) Global Road Safety Week (UNGRSW) is taking place from 8-14 May 2017. The theme for the Week is speed management with the strapline Save Lives: #SlowDown.

The Global Road Safety Week was established in 2006 by the UN General Assembly. The Week's objective is to contribute to the *Decade of Action 2011-2020* as well as the Global Goal 'to halve all deaths by road traffic crashes by 2020' (Goal 3.6, Sustainable Development Goals 2015-2030).

Risk factor: Speed

Speed is a major global risk factor for road safety. Speed impacts negatively on road safety, affecting both the likelihood of a road traffic crash and the severity of crash consequences. Speed also has adverse effects on levels of environmental and noise pollution, and the "livability" of urban areas.

Over the last decade, along with greater global attention to reducing travel speeds as part of efforts to reduce road traffic deaths and injuries, there has been a growing

movement, often instigated at local levels, concerned with strategies to manage speed in communities, and the potential benefits.

Research shows that a 5% cut in average speed can result in a 30% reduction in the number of fatal road traffic crashes. Higher speeds also put vulnerable road users such as pedestrians and cyclists at high risks of deaths and serious injuries.

Solutions

The Week promotes key solutions, which can be implemented to better manage speed and make the roads safer for all road users. These solutions include Safe People, Safe Roads and Safe Vehicles.

Safe People: Speed management campaigns serve many functions. They not only help people learn about the dangers of speeding, but also about the penalties they may face if they break speed limit laws. Enforcement is also critical. Such campaigns offer practical reasons to #SlowDown.

Safe Roads: Speed management must be a part of every road design and every review of existing roads. This can be done through the provision of safe design features needed to ensure safety at higher speeds or through the active management of vehicle speeds that account for the limitations of road design. Setting appropriate speed limits is also important. 30 km/h in pedestrian zones, 50 km/h at crossroad intersections and 70 km/h on undivided roads are just some examples of safer speeds that minimize the risk of fatality.

Safe Vehicles: Not all cars are created equal and some are safer than others. How safe your car is can mean the difference between life or death in the event of a crash. Certain vehicle safety technologies can also help you

manage your speed (e.g. intelligent speed assistance) and avoid a crash in the first place (e.g. autonomous emergency braking).

UNGRSW website: Get involved

Under the patronage of the World Health Organization, a new online hub has been set up to host current and previous Weeks. The website www.unroadsafetyweek.org currently hosts information about the Fourth UN Week with detailed information about the speed risk factor, solutions, ways to get involved, inspirational stories and key resources. Through the website, road safety campaigners and advocates from all around the world are able to find out more about the issue and take active steps to be safer on the road and call for the implementation of solutions.

Firstly, supporters can **pledge** to #SlowDown by adding their name on the website as well as tell their friends and family that their loved one is slowing down for them. This is done via social media where a campaigner can **tag** their friends and family to encourage them to #SlowDown too.

Campaigners and advocates can also take pictures with pre-written **signboards**, which can be downloaded from the website and share them on social media with the #SlowDown hashtag.

Additionally, campaigners and advocates all around the world can **register** their events for the Week for concerted global action for speed management. One key events being promoted is a #SlowDown day. By working with local authorities, campaigners can reclaim and #SlowDown their streets so they are safer for all road users, as well as pushing for lower speed limits on streets and roads frequented by pedestrians.

A toolkit is available to download, written in collaboration with the UK based 20's Plenty Campaign about how you can slow down the streets in your community.

Readers are encouraged to log onto www.unroadsafetyweek.org and get involved with the UN Global Road Safety Week. You can also connect with the Week's activities on social media: @UNGRSW on Twitter and www.facebook.com/UNGRSW.

*Floor Lieshout and Manpreet Darroch
Youth for Road Safety (YOURS)*





ACRS Chapter reports

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

Australian Capital Territory (ACT) and Region

Drug driving

The Chapter continues to participate in the ACT review of drug driving. Following receipt and consideration of the report prepared as a result of the forum managed by the Chapter last year, 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). The first, education and communications, is due for completion in the near future.

Reducing the risks - Cyclists, Pedestrians and Buses/Heavy Vehicles

Concerns have existed among ACT bus and heavy vehicle drivers, cyclists and pedestrians about situations in which they believe the risks to vulnerable road users are inadvertently but unnecessarily increased. All parties had expressed a desire to identify these situations and work harmoniously to address and agree on meaningful ways to eliminate or reduce the risks.

A Workshop was designed to bring representatives together to identify specific areas of risk and to propose solutions that might reduce the risks. A wide range of interested parties

was invited to participate. They included representatives and spokespersons for the various bodies directly involved but also transport planners, traffic engineers from ACT government responsible for short and long term provision of infrastructure, legal practices with interests in transport law, transport associations and surrounding local government road safety officers with similar interests and issues.

It was held on 21 February 2017 at the Transport Industries Skills Centre at Sutton Road ACT. Around 50 people attended. ACRS National Vice President, David Healy, facilitated the workshop. The day was structured around a limited number of presentations, but focused more on practical demonstrations and sessions for inclusive discussion where the participants could personally and collectively attempt to find common ground.

Overall the objectives were achieved and significant goodwill was engendered. A high degree of agreement was reached on the areas of risk and the solutions which might best reduce these risks. All parties were able to outline their areas of concern and express their views on actions aimed at addressing them. The main issues discussed were:

- education and training should form the central element of a program aimed at changing attitudes and behaviours of commercial and private drivers, pedestrians and cyclists. It would include changes to licensing requirements to include in all licence testing theoretical and practical modules relating to vulnerable road users. Bus and heavy vehicle driver training and WHS programs could include updates on these issues and use the latest education tools available.
- Ongoing education of cyclists and pedestrians and road users as a whole should re-emphasise the rights

and obligations of the different categories. A concern existed among workshop participants that important road rules relating to cyclists and pedestrians were not front of mind for many road users.

- The means of transmitting messages to various sections of the community differs and a “one approach fits all” does not apply these days. Messages can be transmitted to wide targeted audiences through existing structures.
- Areas where safety can be improved by means of voluntary rather than mandatory action should be openly discussed and where they are found to have merit, they should be publicly supported. Voluntary programs such as ANCAP have made significant advances in the safety of the Australian car fleet. The voluntary use of daytime running lights has also safety advantages for motor cyclists.
- All effort should be made to ensure the future design and construction of infrastructure meets best international practice in terms of the safety of vulnerable road users and value for money. In vehicle technology and vehicle design will continue to assist in minimising the risks of crashes involving heavy vehicles and vulnerable road users.

The Demonstrations were very helpful and provided a practical means of articulating some of the real on road difficulties faced by cyclists and drivers alike. They allowed participants to appreciate each other’s concerns and to discuss them frankly. A number of buses and articulated vehicles were provided for the day by operators, and attendees were able to participate actively in the demonstrations. Some had their first drive of a bus under supervision. Others sat on bikes as buses drove past at varying speeds and distances from the bikes (1 or 1.5 metres). People climbed into the buses and articulated vehicles to get a better appreciation of what drivers can and cannot see from their driving positions.

UN Global Road Safety Week May 2017

The ACT & Region Chapter will support initiatives being considered by the ACT Government for 2017 UN Global Road Safety Week. The program is currently being finalised and will be announced and publicised soon.

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

Queensland (QLD)

Seminar and Chapter meeting

The Queensland Chapter held a seminar and Chapter meeting on 7th March 2017. Brett Simpson, Operations Manager – Brisbane Motorway Services presented and the title of the presentation was “*Unique road safety challenges applicable to a tunnel environment*”. The session was very well attended and illustrated both the efficiency with which safety and traffic movement on a controlled section of road can be managed, and the ongoing challenge of planning for

unusual or low probability contingencies. The next seminar is scheduled for 6th June 2017. Queensland Chapter will also hold their AGM following the seminar.

UN Global Road Safety Week May 2017

The Chapter is also supporting CARRS-Q in its UN Global Road Safety Week (and Yellow Ribbon National Road Safety Week) launch of a Queensland-wide initiative “*Watch your Pace when Sharing Space*” on Friday 12 May 2017. The event will take place in Samford Village, a semi-rural town on the outskirts of Brisbane. Samford has demonstrated its interest in the need for safer roads over the years, and has a mix of road users, both locals and visitors, particularly at peak times, who need to share space safely. RACQ and Kidsafe QLD have partnered with CARRS-Q for this event, and guest speakers will include Peter Frazer, President of Safer Australian Roads and Highways (SARAH) who will be participating as part of Yellow Ribbon Road Safety Week.

The campaign aims to educate people about the vulnerability of pedestrians and cyclists in collisions with cars at relatively low speeds, in the context of a shift in lifestyles towards urban areas where different road users are more likely to be sharing space, and where conflicts between VRUs and vehicles will become more common. It addresses similar themes to the presentation *Is 40 the New 50?*” which was promoted at the Australasian Road Safety Conference in 2016.

*QLD Chapter Chair
Dr Mark King*

Victoria (VIC)

The first quarter of 2017 has been focused on preparation for two forthcoming seminars. The first is to be held in late April and will focus on the issues of Distraction and Fatigue - areas of special interest relate to the most recent research findings regarding distraction and their implications for the use of mobile phones, together with progress in development a roadside fatigue monitor. Presenters from practitioner agencies as well as academia are being sourced.

The second seminar planned for June aims to give PhD students in the field of road safety drawn from a number of academic institutions the opportunity to present on their research themes and progress to date. Short presentations will be encouraged to enable six or seven PhD students with research in different fields of road safety to present. The aim is to continue the practice of videoing the presentations to enable a much broader College audience to view them via the medium of the College youtube site.

*VIC Chapter Chair
Mr David Healy*

Western Australia (WA)

The Road Safety Commission in Western Australia will be hosting a Road Safety Week Forum on Thursday 11 May at the Perth Convention and Exhibition Centre (PCEC), with key expert speakers presenting on topics including Challenges Facing Road Safety and Innovation and Technologies in this field.

ACRS President, Lauchlan McIntosh and WA ACRS Chapter Chair, Paul Roberts have been selected to speak at the forum. The Road Safety Week Forum will open at 9am and close at 4pm and will be followed by a Networking Event which will also take place at the PCEC from 5pm to 8pm.

*WA Chapter Chair
Dr Paul Roberts*

ACRS News

2017 ACRS submission to federal parliamentarians: The way forward to reverse the current increase in road deaths and injuries

ACRS President, Lauchlan McIntosh, recently released the “2017 ACRS Submission to Federal Parliamentarians - The way forward to reduce road trauma” (<http://acrs.org.au/wp-content/uploads/2017-ACRS-Submission-to-Federal-Parliamentarians-FINAL.pdf>). This Submission outlines Australia’s stalled progress against National Road Safety Strategy 2011-2020 targets for death and injury reduction, the multi-portfolio impacts of road trauma across the spectrum of federal departments, and presents comprehensive recommendations on the way forward to reduce road trauma.

“In combination, our supporting organisations represent around 10 million Australians - that’s 10 million of our citizens urging our elected federal representatives to unanimously reject the current increasing rate of road death and injury,” said Mr McIntosh.

“Road trauma has insidiously pervaded our society to such an extent that there now seems so to be an acceptance that this huge and growing burden of 25 deaths and 700 hospitalised injuries every week is the price we must pay for our mobility. This is just not the case.”

“The College brings together global and national expertise across the full spectrum of road safety, and our best minds have come together to develop and support our Submission where we outline recommendations to expedite trauma reductions.”

The Submission outlines 4 key recommendations underpinning future road trauma reductions, and calls for unanimous support across the political spectrum to reject the rise in deaths and hospitalised injuries.

The Royal Australasian College of Surgeons President, Dr Philip Truskett AM, strongly supports a concerted effort towards reductions in road trauma: *“Each week there are 25 deaths and 700 serious injuries on our roads (that’s 1,300 deaths and 37,000 hospitalised injuries per year). Seen first-hand by our surgeons, this has an enormous impact on Australia’s health system as a whole. The College supports all evidence-based initiatives that assist in the prevention of road trauma and the reduction of the devastating effects of injury”.*

Carers Australia CEO, Ms Ara Cresswell, strongly supports The Australasian College of Road Safety in its aim to reduce the level of deaths and serious injuries from road trauma in Australia through evidence-based strategies: *“Families experience firsthand the tragedy of these deaths and the impact of the serious injuries sustained in these accidents. Every day too many ordinary Australian families will become a caring family – this means that one or more family members will need to change their own way of life to provide support (including emotional, personal, clinical and financial) to the injured person. Australian and international research indicates that these carers are likely to have significantly lower health and wellbeing (including social and financial) than non-carers and that this impact increases with the duration of their caring responsibility”.*

The Australian Automobile Association CEO, Mr Michael Bradley, reaffirms that making roads safer is central to the work of the AAA along with the College: *“In 2011 all Australian governments agreed to the National Road Safety Strategy to reduce road deaths and trauma by 30% by 2020. But with 1,300 killed on Australia’s roads in 2016, a 7.9% increase, AAA analysis shows that almost no progress has been made in reducing deaths since the Strategy was agreed. At a time when new vehicles and roads have never been safer, we need to understand why 40 years of improvement is being reversed. With 1,300 dead and tens of thousands more now dealing with life-changing injury as a result of crashes in 2016, the human cost is*

immense. Additionally, the annual cost to our economy is around \$34 billion. This level of death, injury, and cost cannot be accepted and we must continue to work to uncover the causes of the rising levels of road trauma and reverse this trend.”

Submission Key Points:

- **Key Point 1** The Australasian College of Road Safety calls 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.
- **Key Point 2** The Australasian College of Road Safety calls on 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.
- **Key Point 3** The Australasian College of Road Safety calls on the Federal Government to:
 - 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; and
 - Ensure all new vehicles (cars, vans, motorcycles, buses and trucks) are equipped with world best practice safety technology and meet world best practice crash-worthiness.
- **Key Point 4** The Australasian College of Road Safety calls 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 to review progress in road safety at a national level, and discuss key initiatives for significantly improving results.

ACRS elected as a member of the United Nations Road Safety Collaboration

At the most recent United Nations Road Safety Collaboration (UNRSC) meeting held 16-17 March 2017 at the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) office in Bangkok, the ACRS was officially elected as a member of the UNRSC.

The UNRSC aims to promote and strengthen international collaboration to reduce road traffic injuries. UNRSC members meet biannually to facilitate international cooperation and to strengthen global and regional coordination among UN agencies and other international

3 April 2017

Dear Mr McIntosh,

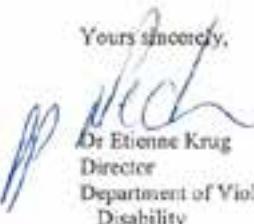
I refer to your letter of 6 February 2017 in which you request membership of the Australasian College of Road Safety to the United Nations Road Safety Collaboration (UNRSC) and to the presentation which Dr Chika Sakashita gave at the UNRSC meeting on 17 March 2017, in Bangkok, Thailand.

On behalf of the World Health Organization, I have the pleasure of congratulating you and welcoming the Australasian College of Road Safety as a member of the United Nations Road Safety Collaboration, effective as of 17 March 2017. Your membership will be reflected on the UNRSC webpage in the coming weeks, see <http://www.who.int/roadsafety/about/partners/en/>

In view of the major role of the Australasian College of Road Safety in disseminating and advocating for road safety good practices through workshops, conferences and a dedicated journal, we believe that you will have a key role to play in supporting global efforts towards the objectives of the Decade of Action and the attainment of target 3.6 of the Sustainable Development Goals.

We look forward to seeing you at the next meeting.

Yours sincerely,


Dr Etienne Krug
Director
Department of Violence and Injury Prevention &
Disability

partners. The aim of these meetings is to implement UN General Assembly resolutions and the recommendations of the World Report on Road Traffic Injury prevention, thereby supporting country programmes.

Our Journal Managing Editor and ACRS member, Dr Chika Sakashita, presented a case on behalf of the ACRS to the UNRSC members. This presentation detailed ACRS activities and how these are very much aligned with UNRSC activities. Chika also highlighted that the ACRS will be a valuable contributing member to the UNRSC. The UNRSC recognised that ACRS and its members as a whole offer broad, deep and credible road safety experience and expertise with which we can assist other countries and organisations to implement practical and evidence-based best practice in road safety. This was recognised by all delegates, confirmed with our successful election as an official member of the UNRSC.

The current May 2017 Issue of the *Journal of the Australasian College of Road Safety* is a Special Issue on Speed Management in support of the UN Global Road Safety Week 8-14 May 2017, one of the major initiatives of the UNRSC. This year the Week's focus is on promoting speed management as part of continued efforts to reduce road trauma globally. The May 2017 Special Issue on Speed Management provides a balance of research and practical evidence to support speed management actions in Australasia and globally. Some ACRS Chapters are also organising events in support of local speed management as part of the Week.

UNRSC members are required to self-fund to the biannual meetings. Chika, as our ACRS representative, self-funded her attendance at the March 2017 UNRSC meeting, and will continue to be the focal person for the UNRSC meetings without any travel expenses incurred by the ACRS.

Chika plans to attend the November 2017 meeting and make a partner report to the UNRSC. We believe ACRS Chapters and ACRS member organisations will be able to make significant contributions to the UNRSC. Please contact Chika (journaleditor@acrs.org.au) so that the ACRS can share at the next UNRSC meeting the important road safety activities we are undertaking in our continued efforts to reduce road trauma.

Need up-to-date road trauma statistics for Australia, New Zealand or internationally?

You may occasionally have a requirement for up-to-date road toll statistics across Australia, New Zealand or internationally. Go to <http://acrs.org.au/statistics/> to access the following sites:

Australian state-by-state statistics:

1. Australian Capital Territory (ACT Policing)
2. New South Wales (NSW Centre for Road Safety)
3. Northern Territory (NT Department of Transport)
4. Queensland (QLD Department of Transport and Main Roads)

5. South Australia (SA Department of Planning, Transport and Infrastructure)
6. Tasmania (TAS Department of Infrastructure, Energy and Resources)
7. Victoria (VIC Road Safety Partners)
8. Western Australia (WA Road Safety Commission)

Country-wide statistics:

1. Australia
 - Road Deaths Australia Monthly Bulletin (Department of Infrastructure and Regional Development, BITRE)
 - Fatal Heavy Vehicle Crashes Quarterly Bulletin (Department of Infrastructure and Regional Development, BITRE)
2. New Zealand (New Zealand Transport Agency)

Australia and New Zealand Holiday Road Toll statistics:

1. Easter & Christmas periods – (ANZPAA – historical data only, to 2014/2015 Christmas period)
2. New Zealand - Christmas/New Year holiday period statistics (New Zealand Ministry of Transport)

International statistics:

1. International Road Safety Comparisons Reports (Department of Infrastructure and Regional Development, BITRE)
2. International Road Traffic and Accident Database (OECD)
3. European Road Safety Observatory
4. OECD Country Reports on Road Safety Performance
5. IRF World Road Statistics

Injury publications:

Australian Institute of Health and Welfare reports, including:

- Trends in hospitalised injury, Australia: 1999-00 to 2010-11
- Injury of Aboriginal and Torres Strait Islander people due to transport: 2005-06 to 2009-10
- Trends in hospitalised childhood injury in Australia 1999-07
- Serious injury due to land transport accidents, Australia 2007-08
- Trends in serious injury due to land transport accidents, Australia 2000-01 to 2008-09

ARSC2017 partnership invitation: over 70% of booths sold -> join us now to maximise your exposure and avoid disappointment

We are delighted to announce that we have sold over 70% of our exhibition space for ARSC2017 and continue to be inundated with sponsorship and exhibition enquiries. Before we sell out, now is the time to showcase your support for road trauma reductions by exhibiting or sponsoring at the

largest road safety-dedicated conference in the southern hemisphere. The WA road safety commission is proud to be our platinum partner for the event.

With an anticipated attendance of 500+ delegates, ARSC2017 is an excellent opportunity to promote your organisation and its role in reducing road trauma, and maintain a high profile within the industry before, during and after the event. It is a perfect space to showcase your leadership, commitment to the decade of action, and to be represented as a key supporter in the field.

As per previous years, *ARSC2017: expanding our horizons* will include international and national keynotes speakers, interactive and engaging panels, workshops, symposia, concurrent sessions and dedicated poster sessions. The gala dinner is the highlight social event for the ARSC2017 conference and also includes the prestigious ACRS awards. Delegates will dine on a sumptuous 3 course dinner with quality entertainment.

Remaining exclusive sponsorship opportunities

- *Gala dinner sponsorship - \$17,000*
- *Satchel sponsor - \$10,000*
- *Ice cream cart sponsor - \$8,000*
- *Soft drink sponsor - \$8,000*
- *Water bottle sponsor - \$8,000*

Download the sponsorship prospectus (<http://acrs.org.au/wp-content/uploads/ARSC2017-Sponsorship-Prospectus-FINAL.pdf>) which outlines the valuable entitlements you will receive if you choose to partner with ARSC2017. We would be delighted to hear your ideas and work with you to ensure this valuable partnership achieves your marketing goals, and look forward to working with you in the lead up to the ARSC 2017. Please contact Lynne Greenaway on +61 8 9389 1488 or e: lynne.greenaway@encanta.com.au.

Diary

March 9

RoSPA Road Safety Conference 2017
Birmingham, UK
<http://www.rospa.com/events/road/>

March 20-23

10th International Conference on Managing Fatigue
San Diego, USA
<http://fatigueconference2017.com/>

April 6-7

Traffic Management Association of Australia Annual Conference 2017
Gold Coast, Australia
<http://www.tmaaconference.com.au/>

May 7

Asia-Pacific regional launch of the Fourth UN Global Road Safety Week 2017
Sydney, Australia

May 8-14

The Fourth UN Global Road Safety Week 2017
#SlowDown
<https://www.unroadsafetyweek.org/>

May 11

National Road Safety Week Forum
Perth Convention and Exhibition Centre, Australia
<https://www.rsc.wa.gov.au/NRSW-Register>

May 21-24

5th International SaferRoads Conference
Auckland, New Zealand
<http://saferroadsconference.com/>

June 5-8

25th International Technical Conference on the Enhanced Safety of Vehicles (ESV)
Detroit, USA
<https://www-esv.nhtsa.dot.gov/About%20ESV.htm>

June 12-15

1st International Roadside Safety Conference
San Francisco, USA
http://onlinepubs.trb.org/onlinepubs/conferences/trb_irsc_call_for_abstracts.pdf

June 14-15

Vision Zero Conference 2017
Stockholm, Sweden
<http://www.trafikverket.se/en/visionzero/>

June 18-21

CARSP Conference 2017
Toronto, Canada
<http://www.carsp.ca/carsp-conference/carsp-conference-2017/>

September 12

Euro NCAP's 20th Anniversary Celebration
Antwerp, Belgium

October 10-12

Australasian Road Safety Conference 2017
Crown Perth, Australia
www.australasianroadsafetyconference.com.au

October 17-19

Road Safety & Simulation International Conference 2017
The Hague, Netherlands
<http://rss2017.org/>

Peer-reviewed papers

Original Road Safety Research

Infrastructure treatments for managing speeds on rural and urban arterial roads

Blair Turner¹, Tariro Makwasha¹ and Paul Hillier¹

¹Australian Road Research Board, Melbourne, Australia

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Key Findings

- Infrastructure treatments, many of them low cost, are available to better manage vehicle speeds on rural and urban arterial roads
- The reductions in speed from these treatments are associated with improvements in safety outcomes
- When combined with other safety approaches, management of speed through infrastructure measures has the potential to provide significant safety improvements with the potential of achieving Safe System outcomes
- Gaps in knowledge remain about the speed reducing impact and safety benefits for infrastructure measures.

Abstract

Core to the Safe System approach is management of vehicle speeds to reduce the likelihood of crashes occurring, and to ensure that those crashes that do occur, happen at survivable impact speeds. Although there is substantial guidance on infrastructure measures that can assist in the management of speed on the local road network (often under the heading of local area traffic management or traffic calming), there is little information on how to manage speeds on rural and urban arterial roads, locations where the majority of fatal and serious injury crashes occur. Austroads has funded research that was aimed at identifying infrastructure solutions for managing speeds in these environments. Results are presented indicating the effectiveness of infrastructure-based solutions for managing speeds.

Keywords

Speed, speed management, urban, rural, arterial, infrastructure, treatments.

Introduction

Excessive speed has been identified as a major factor in the occurrence and severity of road crashes (e.g. Turner & Makwasha, 2014; OECD, 2006; Elvik et al. 2004; Kloeden et al. 2002). While the management of speeds on urban local roads (typically residential streets or collector roads) using different types of infrastructure treatments is well established (e.g. Austroads 2008), less guidance is available for managing speeds on rural roads and higher volume urban arterial roads.

This paper presents the findings from two separate Austroads studies on effective speed management. The key objective of this Austroads funded research was to provide information on effective techniques to manage speed and reduce speed related crashes on roads in rural areas (Turner & Makwasha, 2014) and on urban arterial roads (Hillier, Makwasha & Turner, 2016). In order to achieve this objective, the projects

aimed to identify existing treatments, and quantify the benefits of these. In addition, there was also an objective to identify less well known or innovative approaches to speed management; to trial the most promising of these; and to identify the benefits of these.

Although the research concentrated on engineering based approaches to managing speed, it is recognised that non-engineering approaches also have a significant role to play in the management of speed on rural roads, either as a standalone or complementing the engineering treatments. The Austroads study also examined the role of in-vehicle technology, enforcement, and training, publicity and education programs in improving safety. A coordinated response using all of these approaches is essential to maximise the safety benefits for roads.

The Austroads research was set within the context of the Safe System approach (e.g. ITF, 2016). The approach accepts that humans will make errors while driving, and so crashes will continue to occur. In addition, humans are physically vulnerable, and are only able to withstand limited change in kinetic energy (e.g. during the rapid deceleration associated with a crash) before injury or death occurs. As well as measures to reduce the likelihood of crashes, there is also a requirement for infrastructure that takes account of these errors so that road users are able to avoid serious injury or death in the event of a crash. Within this context speeds need to be appropriate to the type of road and levels of risk present. This includes taking account of the function of a road and the road users present.

The purpose of this paper is to present a brief synthesis of the research conducted and to alert safety professionals to the engineering based countermeasures that have been identified for the management of speed on rural and urban arterial roads. In the context of this paper excessive speed (or ‘speed’) relates to any road user who is travelling above the posted speed limit, or who is driving at a speed that is dangerous for the conditions (whether that be above or below the posted speed limit). Although the focus of this paper is on speed-related solutions, it is also recognised that there are other measures to help improve safety in these environments. Practitioners are encouraged to explore the full range of options when seeking to improve safety outcomes.

Method

Each of the two Austroads studies used a similar methodology. Details are provided in Turner & Makwasha (2014) and Hillier et al. (2016), but in each case included:

- literature reviews assessing the scale of the rural and urban arterial speed problem and possible speed based solutions
- contact with key international agencies and individuals to determine measures currently in use or under development to manage speeds
- data analysis of crashes on rural and urban arterial roads, highlighting situations where speed has been identified as a specific crash contributor
- site investigations at a sample of locations where high severity crashes have occurred in order to determine ways that speed may have contributed to crash outcomes, as well as potential ways that speed may be reduced at such locations
- workshops across Australia and New Zealand to discuss potential treatments, and issues with using such treatments
- trials of promising treatments where there are currently gaps in knowledge on effectiveness
- provision of guidance on good practice in managing speeds.

This current paper presents findings relating to effective infrastructure treatments, based primarily on the literature review task and trials of promising treatments. Readers

are directed to the source documents for information on limitations of different treatments, and issues such as cost and implementation issues.

In order to identify relevant research, a literature review was conducted using the resources of ARRB Group’s MG Lay Library. The Australian Transport Index (ATRI) was used in identifying literature, as was TRID, an integrated database that combines the records from the US Transportation Research Board’s Transportation Research Information Services (TRIS) Database and the OECD’s International Transport Research Documentation (ITRD) Database. This information was supplemented with searches using Google Scholar.

As indicated above, literature was also supplemented with several retrospective before and after evaluations using comparison sites to minimise the impact of changes beyond the infrastructure improvements. The methodology adopted for each is available in Makwasha & Turner (*under review*).

Results

This results section provides information on the engineering-based treatments that have been identified from these two Austroads studies. Reference is made to well-established treatments, but greater attention is given to emerging treatments and those that have been found to be highly effective. Some of the key rural treatments are presented first, with a review of speed management approaches at rural curves, intersections, transition zones (from high speed to low speed environments and for routes. This is followed by treatments that can be used to address speed on urban arterial roads, including at intersections and for routes. Of particular interest is information on the speed and crash reduction potential of these treatments. Although information was sought on the fatal and serious injury reduction from each treatment (in line with Safe System objectives to eliminate these more severe crashes) research typically provides information on the casualty reduction (i.e. fatal, serious and minor crash reductions combined) and so it is typically these results that are provided. In some cases there is substantial information on these factors, while for many there is evidence base is less robust.

Rural bends

Traditional infrastructure improvements at bends have included advanced warning signs, chevron alignment markers, and speed advisory signs. Each of these treatments were seen to provide safety improvements ranging from 25 to 40% casualty crash reduction (Turner & Makwasha, 2014.), although less is known about the speed reducing potential of each. Other delineation devices (e.g. line markings, guideposts etc.) were found to have lesser safety benefits (5 to 20%; Turner & Makwasha, 2014) and typically operated through provision of better advanced warning rather than speed reduction. Indeed in some cases the introduction of this improved delineation resulted in slight increases in speed (presumably offset by the benefits to road users through clear guidance on the road direction (Elvik & Vaa, 2004)).

There has been an increase in the use of Vehicle Activated Signs (VAS) at rural curves in recent years. These signs are usually activated for a short time (around 4 seconds) when an approaching vehicle exceeds a threshold speed limit (normally set at the 50th percentile speed as measured prior to the introduction of the signs). Once triggered, the sign displays the hazard, and may include a message to slow down. These signs have had wide application in the United Kingdom for many years, with demonstrated benefit. Winnett and Wheeler (2002) found mean speed reductions of between 3.4 km/h and 11.3 km/h at rural curves. A study in Queensland found similar reductions; between 5 km/h and 10 km/h (Burbridge et al. 2010) while a New Zealand study reported more modest speed reductions of up to 5 km/h (Gardener & Kortegast 2010). Makwasha and Turner (2014), as part of the Austroads rural speed management project, found an average mean speed reduction of 2 km/h and a 4 km/h reduction in 85th percentile speed for 16 sites across Australia. The crash evaluation showed a reduction of around 35% in casualties across these sites.

Although many existing treatments provide benefit in reducing speeds at curves and improving safety, it is apparent that these are often installed in an ad hoc manner, often in response to high crash locations. A key finding of the rural research (Turner & Makwasha, 2014) was the need for a consistent approach, whereby whole routes (or better still, whole networks) are assessed to determine the severity of curves, and a consistent signing regime used based on this severity. The approaches documented by Cardoso (2005) and Herrstedt & Greibe (2001) were recommended by Turner & Makwasha (2014). These involve the assessment, and then categorisation of curve risk into ‘bands’. Each band is then treated in a consistent way with the same package of treatments. As an example, low risk curves (typically identified through risk factors such as the requirement for speed reduction on approach and through the curve) are treated with more modest infrastructure solutions (e.g. guide posts) while more severe curves receive more significant treatment (e.g. guideposts, advance warning and curve advisory speed signs, chevron alignment markers, and enhanced line marking). Each curve type is treated in a consistent way, assisting road users to determine the curve severity and appropriate response for safely negotiating the curve. Based on the findings of Turner & Makwasha (2014), this approach has now been adopted by some jurisdiction in Australia (Jurewicz et al., 2014), while a similar approach has also been used in New Zealand (Durdin & Harris, 2015).

Rural intersections

Several engineering treatments were identified as being potentially useful for moderating vehicle speeds on the approach to rural intersections. The most substantial safety benefit was from the installation of well-designed roundabouts (defined here as providing adequate deflection on approach and through the roundabout), with this treatment reducing fatal and serious injury crashes by around 70% (Turner & Makwasha, 2014). Benefits are derived by the reduction in speeds on approach and through roundabouts, as well as by fewer conflict points and lower

impact angles when crashes do occur compared to the alternative intersections.

VAS at intersections were also identified as providing substantial benefits (also up towards 70%; Turner & Makwasha, 2014; Makwasha & Turner, 2014). It is interesting to note that the speed reduction using VAS at intersections was similar to that at curves, although the safety benefits were substantially greater. One possible reason is that other safety benefits are derived from VAS at intersections besides the speed reduction (for example greater alertness of drivers to the potential risk of vehicles entering).

One variety of VAS identified in Turner et al. involved the use of vehicle activated speed limits at intersections. These are triggered by vehicles approaching the intersection from the side road. Trials indicated quite substantial benefits in speed reduction (up to 17 km/h) from this treatment overseas (Tempo, 2006), although at the time of the review, less was known about the actual crash reduction. A recent trial in New Zealand has identified sustained reductions in speed at sites where rural intersection active warning systems were introduced as well as substantial safety improvements (from 0.34 fatal and serious injury crashes per month before installation to 0.04 in the after period; Mackie et al., 2016). Further trials of vehicle activated speed limits signs are now planned for several Australian states.

Several other treatments showed promise at intersections, including the use of advanced warning signs, perceptual countermeasures, lane narrowing, and increasing the prominence of the intersection. Each of these, along with other possible treatments are described in Turner & Makwasha, 2014).

Transitions from high speed to low speed environments

A number of techniques were assessed at locations where there is a requirement to transition from high speed roads to low speed environments (e.g. on the entry to a rural town). Treatments included the use of static signage alone (e.g. advanced warning signs, buffer zones and count-down signs), although each of these were assessed as having a limited impact on speed reduction and safety improvement.

More promising was the use of rural threshold or gateway treatments. These typically use a combination of signs and road markings to indicate a significant change in the characteristics and usage of the road environment ahead. Such treatments appear to produce reductions in speed of up to 15 km/h at the transition point (LTSA, 2002). Research highlights the need to sustain speed reductions by implementing further measures within a town or village (Kennedy, 2005). These are used widely in New Zealand and the UK, but until recently have had limited use in Australia.

As part of the Austroads research, Makwasha & Turner (2013) reported on an analysis of gateways in New Zealand. The study indicated a 26% reduction in overall crashes, with higher reductions (35% reduction in casualty crashes, and a

41% reduction in serious injury crashes) at locations where pinch points were used to restrict lane width. Substantial speed reductions were also identified (up to 25 km/h). These threshold treatments are now being assessed for their potential use in the urban arterial environment by several road agencies.

Rural routes and networks

Fewer options were identified that can be used to slow speeds on a rural route or network-wide basis. Speed limits are the most widely applied approach for addressing speeds on rural routes. The research by Turner & Makwasha (2014) identified a number of studies that examined the topic of an appropriate rural speed limit. To summarise this work, it appears that rural limits in Australia and New Zealand are generally higher than the safest countries in the world. It is very likely that there would be large safety benefits from a reduction in the default rural speed limit, particularly for undivided roads. Speed limits less than the default rural limit (i.e. for specific sections of road, rather than for the rural network as a whole) have traditionally been applied when there is an increase in roadside development and activity (e.g. a small township). More recently, lower speed limits have been applied in locations where there is no, or very little roadside development, but rather due to other types of risk (for instance, adverse horizontal alignment). Evaluations were undertaken as part of the Austroads research (Turner & Makwasha, 2014). Despite some promising evidence for safety improvements and speed reduction (around 4 km/h), there are still gaps in the knowledge base regarding the most effective way to implement lower speeds for different rural environments.

Road narrowing has been used for rural roads in a number of countries. Perhaps most widely reported is the ‘2 – 1’ (two minus one) system used in some European countries. This system involves the removal of the road centreline, and installation of a broken edgeline. The road is effectively narrowed to one lane in total (e.g. Herrstedt; 2006). To date there has been little in the way of evaluation of this approach.

More recently, wide centreline treatments have been applied (Beck, 2016; Bobbermen, 2016). There are positive indications regarding the safety benefits of such treatments (up to 60% reductions), and this is in part due to the speed reduction. Combining the wide centreline with a lower speed limit has been identified as a particularly promising treatment in some higher risk rural road environments.

Urban intersections

As indicated for rural environments, roundabouts are a very effective treatment in the management of speed at intersections. They also reduce the number of conflict points and the angle of impact when collisions do occur. Hyden and Varhelyi (2000) found that roundabouts reduced vehicles speeds considerably at intersections and on links between roundabouts. Roundabouts are especially effective at reducing fatal and serious injury crashes (up to 75% reductions), and also have a net benefit in terms of minor crashes.

Concerns have been raised in a number of studies about the safety of pedestrians at roundabouts. However, several studies have addressed this issue and it appears that roundabouts, in general, do have the potential for improving pedestrian safety with reduction of up to 75% in pedestrian casualties (Brilon et al. in Retting, Ferguson & McCartt 2003; Schoon & van Minnen in Retting, Ferguson & McCartt 2003; Midson 2009). However, roundabouts have a mixed record in relation to the safety of cyclists. Recent efforts have attempted to address this issue of cyclist safety, for example through a reduction in speed (e.g. Campbell et al. 2006; Asmus et al. 2012). Current research by Austroads is also addressing this issue.

The Austroads project on urban arterial speed (Hillier et al., 2016) also reviewed the benefits of signalised roundabouts, turbo roundabouts (which typically operate by reducing lane changes within the roundabout) and mini roundabouts. All of these designs appear to have benefits in terms of speed reduction and safety improvement. Signalised roundabouts were seen as a viable option for many urban arterial intersections, with the potential for maintaining higher traffic volumes than traditional roundabouts while providing even greater benefits (an estimated 30% reduction in casualty crashes compared with standard roundabouts; Hillier et al., 2016).

Raised intersections (also known as platform intersections, raised junctions or plateaus) are a speed management and safety device generally used on local roads, although there are increasing examples on arterials, particularly through activity centres. The entire intersection acts as a type of extended speed hump, with the aim of reducing speed.

Much of the research on raised intersections comes from the Netherlands. For example, Van der Dussen (2002) studied 82 intersections studied, of which 10 were treated with raised plateaus. The raised plateaus reduced injury crashes reduced by 80%.

The safety performance of raised intersections on urban roads, evaluated as part of the Austroads urban arterial speed project was reported in Makwasha & Turner (under review). There was an indicative casualty crash reduction of 55%. This reduction was not statistically significant, most likely due to the small sample size. On the other hand, the study found a statistically significant reduction of 7.5 km/h in 85th percentile speeds.

Several traffic signal based options were assessed as part of the Austroads research (Hillier et al., 2016), including ‘rest on red’ or ‘dwell on red’ signals. This involves including an additional phase so that a red traffic signal is displayed to all vehicle and pedestrian directions. This treatment has typically been applied on roads passing through entertainment precincts where there are likely to be high volumes of potentially distracted (often alcohol-affected) pedestrians, and is only activated late at night and into the early morning. The overall aim of rest-on-red signals is to reduce vehicle speeds and bring down the proportion of vehicles travelling at a speed that threatens severe pedestrian injury.

Lenné et al. (2007) installed a dwell-on-red treatment at an intersection in Ballarat, Victoria, on a section of road that reported a high number of pedestrian casualty crashes during high alcohol hours. The treatment was associated with mean speed reductions of 3.9 km/h at the 30 m detector point and 11.0 km/h at the stop line detector. Archer et al. (2008) trialled a similar treatment at an intersection in metropolitan Melbourne and also found significant reductions in average speed. Combining these results with more recent data from eight sites in Victoria indicated that casualty crash reductions of 45% and 85th percentile speed reductions of up to 11 km/h could be expected this treatment.

Other treatments with speed reducing potential at intersections reviewed as part of the Austroads study included road narrowing and deflection; other traffic signal treatments; and urban vehicle activated signs. Each of these treatments appear to have some speed reduction benefit, although in some cases this is quite limited.

Urban arterial midblock treatments

A variety of midblock treatments were identified, including vertical deflection treatments (humps and platforms) and raised pedestrian ('Wombat') crossings. There is relatively limited data on the effectiveness of these on urban arterial roads, with most studies focussing on local and collector roads. Several international studies identify potential benefits. For example Elvik et al. (2009) reported that installing a raised crosswalk instead of an ordinary marked crosswalk decreased pedestrian-related injury crashes by 42%, and in cases with no existing crosswalk the reduction in all injury crashes was 65%.

As part of the Austroads research, Makwasha & Turner (under review) assessed the safety performance of raised platforms at midblock and wombat crossings. The study found significant casualty crash reductions of 47% and 63%, respectively. There were reductions in 85th percentile speeds of 5 km/h and 6 km/h, respectively.

Speed limits are a widely applied speed management method on urban arterial roads. Elvik et al. (2004) conducted a meta-analysis of speed limit changes in order to identify the actual change in speed and crashes. The findings show that it is rare for the mean speed to change by the same amount as the speed limit, although it almost always moves in the same direction. On average, the change in speed is around 25% of the change in speed limit. Therefore, a 10 km/h reduction in speed limit could be expected to bring about a 2.5 km/h reduction in mean speed. Given the link between speed reduction and positive safety outcomes, especially for higher severity crashes, it is likely that reduction in speed limits that bring about subsequent changes in speed will have a positive safety benefit. It should be noted that the influence of speed limit change on safety is often a complex issue. The eventual change in speed is dependent on a number of factors, and not just the posted speed limit. Therefore, changes in speed limit may need to be supported with other measures.

Variable speed limits (VSL) are dynamic road signs displaying variable statutory speed limits depending on

prevailing traffic, weather and road conditions. Austroads (2009a) provided a detailed review on the implementation of VSL across Australia and New Zealand, showing a wide variety of uses for this treatment. Several states across Australia are trialling VSL systems on urban arterial roads in high pedestrian activity centres (Scully et al. 2008; Main Roads Western Australia 2013; Austroads 2009b). The aim of the trials is to improve pedestrian safety during peak pedestrian activity periods.

A wide-scale international and domestic practice literature review on the application of VSL was undertaken by Han et al. (2008). The study outlined the application, effectiveness and operation of different VSL signs in Australia, New Zealand and internationally. The applications included school zones, shopping precincts, tunnels, bridges, motorways/highways/freeways and roadworks.

Scully et al. (2008) assessed the implementation of VSL treatments at 18 strip shopping centres across metropolitan Melbourne. The aim of the study was to evaluate the effectiveness of VSL in terms of overall crash reductions and reductions in crashes involving pedestrians. The study included control sites from the same local government areas as the treated sites. The data indicated reductions of 8% in all casualty crashes and 17% in casualty crashes involving pedestrians. Overall crash impacts ranged from an increase of 4.5% to a 19% reduction while crashes involving pedestrians ranged from an increase of 8% to a 36% reduction. The reductions in all crashes and pedestrian-related crashes were not statistically significant.

Several methods of managing speeds on urban arterial roads through road narrowing were identified. Perhaps most effective on urban arterial roads was the use of 'road diets'. This treatment involves converting a four-lane road (two each way) into a road with only one lane in each direction, and a two-way left turn lane (TWLTL, two-way *right* turn lane in Australia/NZ) in the centre. A road diet can also provide enough space to install a bicycle lane or on-street parking.

Several overseas studies have identified significant safety benefits from the use of these road diets. Stout et al. (2006) analysed the effect of 15 road diet projects in the United States. They found an overall 25% reduction in crash frequency per mile and a 19% reduction in crash rate.

Another study of multiple road diets in the United States found a more modest but statistically significant 6% crash reduction in the after period compared to the after period at control sites (Huang et al. 2002).

There is also evidence of speed reduction from the use of this treatment. An evaluation of a version of a road diet in New Zealand revealed that there were reduced speeds after the project was completed, although precise data on changes in mean and 85th percentile speed were not provided. Before the road diet, 21.1% of vehicles exceeded 60 km/h. After completion, this rate dropped to 5.1%. The rate of crashes dropped from approximately 8 to 7 per year (Rosales 2006).

Makwasha and Turner (2016) analysed the safety performance of 11 road diet sites across New South Wales and Victoria. Combining data from the 11 sites and results from leading international literature, the study suggested a reduction of 35% in casualty crashes could be achieved, and that average speed reductions of 4 km/h in 85th percentile speed and a 5 km/h reduction in mean speed could be expected. The results also showed improvements in traffic flow and reduced crossing distances for pedestrians.

Other treatments reviewed through the Austroads research (Hillier et al., 2016) for use on urban arterial road midblocks include other forms of road narrowing, including reduced lane width, pedestrian refuge islands, median treatments; use of deflection; vehicle activated signs; road surface and tactile treatments; transverse rumble strips; and shared spaces/naked roads. Many of these treatments have shown positive but modest reductions in speed and safety improvement as reported in Turner & Makwasha.

Conclusion

Road users travelling above the speed limit, or too fast for the prevailing conditions are a significant safety problem on rural and urban arterial roads. In order to deliver Safe System outcomes on roads, there is a requirement to either improve the quality of road infrastructure in order to support current speeds, or to reduce speeds to a level where death or serious injury is minimised. Where this is not possible in the short to medium term, incremental safety improvements can be made through more moderate reductions in speed and/or through less substantial infrastructure improvements. These changes can be low cost and very cost effective.

Table 1. Summary of treatment effectiveness

| Location | Treatment | Crash modification factor (CMF) | Speed reduction |
|---------------------------|--|---------------------------------|-----------------|
| Rural bends | Advance warning signs, chevrons and speed advisory signs | 0.60-0.75 | - |
| | Other delineation | 0.80-0.95 | - |
| | Vehicle activated signs | 0.65 | 6 km/h |
| Rural intersections | Roundabouts | 0.30 | 4 km/h |
| | Vehicle activated signs | 0.30 | 5 km/h |
| Transition zones | Gateways | 0.65 | 25 km/h |
| Rural routes and networks | Speed limit | - | 4 km/h |
| | Wide centrelines | 0.40 | - |
| Urban intersections | Roundabouts | 0.25 | 10 km/h |
| | Raised intersections | 0.60 | 8 km/h |
| | Dwell-on-red signals | 0.55 | 11 km/h |
| Urban arterial midblock | Humps/platforms | 0.50 | 5 km/h |
| | Wombat crossing | 0.40 | 6 km/h |
| | Speed limit | 0.75 | 6 km/h |
| | Variable speed limits | 0.92 | - |
| | Road diet | 0.65 | 5 km/h |

Source: Adapted from Hillier, Makwasha & Turner (2016), Makwasha & Turner (under review) and Turner & Makwasha (2014).

The objective of this paper has been to highlight infrastructure-related treatments that can be used to reduce speeds where required. Table 1 summarises the effectiveness of the rural and urban speed management treatments discussed in this paper. Crash modification factors (CMFs) are provided for each. When multiplied by the number of crashes in the before period, these indicate the expected number of crashes in the after period (i.e. a CMF of 0.6 indicates a 40% reduction).

It is likely that combinations of treatments will have the greatest impact on safety. This may include combinations of different engineering solutions, as well as combination of engineering treatments along with non-engineering based solutions (e.g. education, enforcement and vehicle-based solutions). Suitability of these treatments will depend on the road environment, with more research required on treatments (including some widely used treatments) to determine how to maximise the safety benefits.

It is clear from the evidence presented in this paper that substantial safety benefits can be obtained using infrastructure treatments, in some cases up to around 70% reductions in casualty crashes. All of the treatments presented here operate (at least in part) through reductions in speed. One interesting conclusion to be drawn is that these findings provide further support for the relationship between speed and safety outcomes. In situations where speed reduction is obtained (especially many of the high-risk situations described above), substantial safety benefits are also observed.

During the research it has been a challenge in many situations to identify robust data relating to likely speed and crash reduction. This related both to emerging treatments as well as some established ones. On-going evaluation of measures is crucial. There is also the need for a repository of information on effective treatments (including speed and non-speed related) to inform expenditure on infrastructure improvements. This repository needs to be dynamic and regularly updated so that new or emerging measures are captured and disseminated to practitioners.

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Safety of raised platforms on urban roads

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Key Findings

- raised platforms at pedestrian crossings (wombat crossings) lead to a casualty crash reductions of 63%;
- platforms at midblocks reduce casualty crashes by 47%;
- raised priority controlled intersections reduce casualty crashes by 55% ($p = 0.1$),
- raised platforms also lead to speed reductions; 85th percentile speed reductions ranged between 5 km/h and 8 km/h for all platform types.

Abstract

A recently concluded Austroads study identified effective and innovative countermeasures for improving safety outcomes on urban arterial roads. Included in the study were raised platforms at priority controlled intersections (raised intersections), midblock and pedestrian crossings (wombat crossings). While these treatments have been widely applied overseas and, to an extent, across Australia and New Zealand (especially wombat crossings and at midblock sections on local and collector roads), a measure of effectiveness in mixed use and high volume environments in an Australian context was required. Using available speed and crash data from across Australia, this paper applied Poisson regression analysis in a retrospective quasiexperimental study to determine the effect of raised platforms on crash occurrence and severity. The results showed that

overall, raised platforms are effective in improving road safety on urban roads. The effectiveness differed by platform type; platforms were most effective in reducing casualty crashes at wombat crossings. Casualty crashes fell by 63% at wombat crossings, 47% at midblock platforms and an indicative 55% reduction at priority controlled intersections. Furthermore, 85th percentile speed reductions of between 5 km/h and 8 km/h were observed at the different platforms. While this study provides an effectiveness measure for raised platforms on urban roads in Australia, most sites were high order collector roads. Further work is required to determine when and where on the urban arterial network platforms are most and/or least effective, the effect of design and implementation considerations on effectiveness and overall effectiveness in different conditions and different road users.

Keywords

Wombat, Platforms, Crashes, Speed, Intersection, Traffic calming

Introduction

Background

This paper presents the findings of a recent Austroads study aimed at identifying Safe System treatments for managing urban arterial speeds, including those that help to achieve Safe System levels. As part of this project, raised platforms were identified as a potential measure for managing speeds and reducing severe crashes on urban roads of different functions, speed and use, while maintaining traffic flow.

A literature review indicated safety benefits from raised platforms at intersections (raised intersections), midblock locations (traffic calming devices) and at pedestrian crossings (wombat crossings). These findings were from applications in the UK (Gordon 2008, 2011), the Netherlands (Schermers 1999 and Van der Dussen 2002) and the US (PEDSAFE 2004, Watkins 2000). Research from Australia and New Zealand evaluated trial applications of wombat crossings in New South Wales and the Australian Capital Territory (ACT) and raised intersection in New Zealand (Austroads 2008, Department of Territory and Municipal Services 2006, Hawley et al. 1993).

Raised Intersection

Raised intersections are an innovative speed management and safety device generally used on local roads, with some examples on arterials through activity centres. The entire intersection acts as a form of speed hump aimed at



Surf Coast Shire, Victoria

**Figure 1. Raised platform at intersection
(source: VicRoads)**

reducing vehicle speeds to 50 km/h or less (Austroads 2010). Alternatively, raised stop lines can be used in advance of the intersection. The height of the intersection is often equal to that of the surrounding pavement, which can facilitate pedestrian crossing movement. They can be painted or paved to raise driver awareness of the intersection as illustrated in Figure 1. An extensive review of existing literature indicated that raised intersections are most common in Europe, especially the Netherlands. Trials have also been completed in the United States and on local and collector roads in Australia and New Zealand.

Austroads (2011) assessed raised intersections as a part of a review of trials in Australia and New Zealand. The study found a 1.1 km/h reduction in 85th percentile speeds at an intersection on Mahoe Street in Hamilton, New Zealand. In addition to a raised intersection, median islands and a chicane were also installed.

Watkins (2000) assessed raised intersections at two sites near schools and activity centres in Cambridge, Massachusetts (USA). The raised intersections were implemented in an attempt to make intersections safer for pedestrians. The study found reductions in 85th percentile speeds of 8 km/h (5 mph) and 6.4 km/h (4 mph) respectively, with the percentage of drivers exceeding the 40 km/h (25 mph) limit dropping from 57% to 17% at one site, and from 39% to 14% at the other. The raised intersections tripled the number of drivers yielding to pedestrians at crossings.

Van der Dussen (2002) studied the effectiveness of raised platforms at 10 intersections in Gelderland (the Netherlands) with traffic volumes of 3000–6000 per day. The study concluded that raised platforms reduced the number of crashes by 70%. The platforms were especially effective at reducing the severity of crashes, with casualty crashes reduced by 80%, while property damage only crashes were 60% lower. Schermers (1999) outlined the Sustainable Safety program in the Netherlands and the role that raised intersections could play. The study recommended the use of raised platforms where arterial roads intersected with dedicated cycle paths, in order to alert drivers to the presence of other road users.



Wombat crossing



Raised platform at midblock

Figure 2. Wombat crossing and raised platform at midblock (source: Austroads, 2016a).

Raised Platforms at Midblock and Wombat Crossings

Raised platforms at midblock sections are typically used to maintain lower speeds along a route. In high pedestrian activity areas, raised platforms at midblock generally include pedestrian crossing facilities. The raised pedestrian crossings, typically termed wombat crossings in Australia, have a similar profile and speed reduction effect as flat top speed humps but they differ in that they give priority to pedestrians rather than motorists (Austroads 2016a). When designed with appropriate signs, markings and lighting, this adds a pedestrian mobility and safety element to the speed management objectives. Figure 2 shows both a wombat crossing (left) and a raised platform at midblock (right).

Hawley et al. (1993) analysed the speed reduction associated with installations of platforms in Australia. Across the seven study sites, the initial average 85th percentile speed between platforms was 66 km/h. After the platforms were installed, the speed dropped to 49 km/h, a 26% reduction. The study also found that the speed across the platform was lower with higher ramp gradients and with shorter platform lengths.

The UK Mixed Priority Routes Demonstration Project included raised intersections in several of their study sites. These sites were located in areas with high traffic volumes but relatively low speeds due to the mixed-use nature of the area. Across the four sites that included either a speed table or speed hump, there were casualty reductions ranging from 0%–41%. Mean speeds were reduced by between 5% and 19% and 85th percentile speeds by between 5% and 17% (Gordon 2011).

A series of wombat crossings were trialled in NSW from 1991 to 1992. At the five study sites, the 85th percentile speed was 34%–43% lower at the device after the installation of wombat crossings compared to a 10%–12% reduction at the control sites (Hawley et al. 1993).

Three wombat crossings, along with two chicanes and a speed platform, were installed on two collector roads in the ACT (Department of Territory and Municipal Services 2006). The aim of the scheme was to reduce the speed and volume of vehicles using these collector roads. The study found that mean speeds between devices fell by between 3 km/h and 11 km/h. Eightyfifth percentile speeds fell by between 5 km/h and 9 km/h; however, they remained above the 50 km/h posted speed limit on both roads. Traffic volumes were around 12% lower on one road while remaining unchanged on the other road. In addition, there was an increase in crashes at one intersection in the study area; however this was not directly adjacent to any of the wombat crossings.

Aim of Study

While the literature review identified safety benefits of raised platforms at intersections, midblock and at pedestrian crossings, there were concerns regarding the transferability of these benefits to an Australian and New Zealand context. The concerns included differences in design standards, operating environments (e.g. traffic and road user mix, speed limit, surrounding land use, etc.), and the expected magnitude of benefits; some of the research did not account for underlying trends nor the presence of other treatments. Furthermore, most of the raised platforms in Australia and New Zealand were on local or low volume collector roads (Austroads 2011, Department of Territory and Municipal Services 2006 and Hawley et al. 1993). To obtain a comprehensive measure of the safety effectiveness of raised platforms on high volume and high order roads in Australia and New Zealand, evaluations of applications at intersections, midblock locations and at wombat crossings across jurisdictions were undertaken. The evaluation aimed to provide insight into the speed management effectiveness of the different platform types and to determine whether they have an effect on crashes (frequency and severity) and traffic volumes.

Data was obtained on raised platform applications across Australia and New Zealand. Only sites with sufficient after periods were included in the crash analysis. The excluded sites were reserved for future evaluations and monitoring. This paper outlines the evaluation process and findings.

Method

A quasiexperimental retrospective matched comparison approach was used in this evaluation. To determine whether reductions or increases in crashes at treatment sites were statistically significant, Poisson regression with a log-link function was applied. The assumption was that crashes follow a Poisson distribution (1):

$$\Pr(y|\lambda) = \frac{e^{-\lambda}\lambda^y}{y!} \quad (1)$$

where = conditional probability function of y given λ , y = the number of crashes and λ = the average and variance of the distribution.

To control for mild violations in distribution assumptions, robust standard errors were estimated. Tests for the most appropriate distribution were also conducted. These involved fitting both Poisson and Negative Binomial distributed models and comparing the Akaike Information Criterion (AIC), the Bayesian Information Criterion (BIC) and the loglikelihood to determine the most parsimonious distribution.

Each treatment site was matched to similar untreated sites (comparison), on criteria outlined below. The comparison sites accounted for the effect of the underlying traffic, socioeconomic conditions and other road safety initiatives, excluding any effects from raised platforms. The treatment effects were therefore measured by comparing crashes before and after the implementation of raised platforms at treatment sites, while accounting for the underlying trends. The study was retrospective as there was limited time within the project to identify locations, install raised platforms and collect post-completion data.

Data

Site data

While the key gap in knowledge and the focus of this study was on urban arterial roads, it was evident that raised platforms were not widely applied on arterial roads. The site selection involved identifying treatments on higher volume collector roads with a traffic mix and function approaching that on arterial roads (high order collector roads). The selection of all sites depended on the surrounding land use, the traffic volumes prior to installation and road function.

Given the differing definitions of an urban arterial road, the definition used for this research was set broadly. Urban arterial roads were defined as higher volume roads, some of which may be designated as collector roads with typical speed limits of 60 km/h and above (for Australia) and 50 km/h and above for New Zealand.

The sites were classified into three treatment categories, depending on location and function; raised intersections (sites in this study were raised intersections only, and did not include raised approaches or stop lines at intersections), wombat crossings (i.e. platforms with pedestrian crossing facilities); and raised platforms at midblock locations. Overall, there were 10 raised intersections, 26 raised midblock sites and 14 wombat crossings (see Table 1).

Table 1. Treatment sites by jurisdiction

| Treatment type | New South Wales | Victoria | Queensland | Total sites |
|------------------------|-----------------|----------|------------|-------------|
| Intersection | 1 | 8 | 1 | 10 |
| Midblock | 5 | 19 | 2 | 26 |
| Wombat crossing | - | 14 | - | 14 |
| Total sites | 6 | 41 | 3 | 50 |

Traffic volumes ranged between 5,000 and 10,000 annual average daily traffic (AADT) for the raised intersections, between 2,000 and 10,000 AADT for raised platforms at midblock and between 4,000 and 9,000 AADT for wombat crossing sites. All sites installed from 2013 onwards were excluded from the evaluation as the after period was not long enough for an informative crash analysis. However, these sites were reserved for future evaluations.

For each of the treatment sites, three sites were selected as the comparison group. The comparison group included sites with similar attributes to the treatment sites in terms of speed limit, surrounding land use and geometric design. Where similar sites were not available in the same local government area (LGA), comparison sites were obtained from a neighbouring one. Care was taken to ensure that comparison sites had not received any interventions during the evaluation period.

The selection of the comparison groups ensured that:

- crash distributions in the before period were similar at both treatment and comparison groups
- the speed limit at the treatment and comparison groups was similar
- road geometry at the treatment and comparison sites was similar
- where possible, the traffic volumes at the treatment and comparison sites were matched as closely as possible, however, where traffic volumes were not available, the match was based on road function and the surrounding land use
- intersection layout was similar to the treatment site (for raised intersections)
- similar traffic control to match downstream and upstream of platforms (mainly for midblock and wombat crossings)
- comparable section length considered where platforms were a route treatment

Table 2. Crash data

| Treatment type | Crash severity | Treatment sites | | Comparison group | |
|----------------|----------------|-----------------|-------|------------------|-------|
| | | Before | After | Before | After |
| Intersection | FSI | 1 | 1 | 28 | 29 |
| | Non-FSI | 12 | 6 | 35 | 47 |
| | Total | 13 | 7 | 63 | 76 |
| Midblock | FSI | 23 | 14 | 182 | 179 |
| | Non-FSI | 68 | 35 | 394 | 405 |
| | Total | 91 | 49 | 576 | 584 |
| Wombat | FSI | 16 | 5 | 62 | 58 |
| | Non-FSI | 26 | 13 | 94 | 121 |
| | Total | 42 | 18 | 156 | 179 |
| Overall | FSI | 40 | 20 | 272 | 266 |
| | Non-FSI | 106 | 54 | 523 | 573 |
| | Total | 146 | 74 | 795 | 839 |

- the evaluation period for the treatment and comparison groups was the same in order to avoid temporal bias.

Crash data

Crash data for the treatment and comparison sites was obtained from the respective jurisdictions. For Victorian sites, crash data was obtained from the Road Crash Information System (RCIS) while data for Queensland and New South Wales was obtained from the Austroads crash dataset and the respective LGAs.

Crash data for intersections covered a 100 m radius from the centre of the intersection. For wombat crossings, crash data was obtained for 50 m upstream and downstream of the crossing. The data for midblock platforms depended on the length of each treated section of road.

Crash data covered five years before and after the treatments were installed. The data was grouped by severity, i.e. fatal and serious injury (FSI) crashes and non-FSI crashes (see Table 2). The five year period was selected as it was long enough to account for regression to the mean while being short enough to ensure any technological advances, traffic mix and other socio-economic trends remained as similar as possible in the before and after periods. To ensure both treatment and comparison groups had similar evaluation periods, crashes at the comparison sites were classified using the installation dates at the treatment sites.

One of the key issues in crash analyses is regression to the mean. Regression to the mean is a selection bias resulting from the selection of sites with high crash numbers in a short period of time. There is a probability that crash reductions may not only be due to the treatment installed but also due to chance or measurement error.

The effect of regression to the mean was minimised by using an evaluation period of five years before the raised platforms were installed. Preliminary analyses of crashes before the evaluation period at the treatment and comparison sites

showed no significant jumps in the crash trends, and similar crash distributions, reducing the risk of regression to the mean. Regression to the mean will also be reduced for most of the sites as it was evident that most of the treatments had been installed as part of a systemic approach to addressing crash risk rather than prior safety performance.

Evaluation period

The before period was defined as five years prior to the installation start date, up to the calendar month before the installation start date, and the after period was defined as the period one calendar month after the installation end date onwards. The implementation period covered a month before and after the installation start and end dates (rounded to calendar months). The implementation period was designed to account for changed traffic conditions before, during and after installation, allowing for an adjustment period following the implementation.

Speed data

Eightyfifth percentile speed data before and after raised platforms were installed was obtained. Eightyfifth percentile speed is defined as the speed at or below which 85% of all vehicles are travelling. The evaluation focused on 85th percentile speeds as more detailed data was not available. The 85th percentile speed was used as a proxy for high end speeding and an indicator of driver behaviour. Due to the retrospective nature of the evaluation, complete data was not available for all sites, therefore the evaluation was restricted to those sites with available data in both the before and after periods. The data was obtained from different LGAs and where the treatments were on arterial roads, from the state road authorities. The analysed data was collected using pneumatic tubes and in some cases, radar. Speed data for neighbouring similar roads or sections of road for use as comparisons was also collected. The use of comparison sites accounted for the underlying trends outside of the treatment effect.

Speed data was available for 21 sites, eight raised intersections, eight platforms at midblock and five wombat crossing sites (see Table 3).

Table 3. Treatment sites with speed data by speed zone

| Treatment type | 40 km/h zone | 50 km/h zone | 60 km/h zone | Total ^a |
|------------------------|--------------|--------------|--------------|--------------------|
| Intersection | - | 2 | 6 | 8 |
| Midblock | - | 2 | 6 | 8 |
| Wombat crossing | 1 | 4 | - | 5 |
| Total | 1 | 8 | 12 | 21 |

^a table outlines sites with complete data only.

Statistical Analyses

The Poisson loglinear analysis was conducted to assess the significance of differences in casualty and FSI crash changes as well as pedestrian crash changes. The model for each individual treatment type was specified as outlined in (2):

$$\ln(y_{pgs}) = \alpha + \beta_{ps} + \gamma_{pg} + \delta_{pgs} + \varepsilon_{pgs} \quad (2)$$

where y = cell crash count (casualty or FSI crash count), $\alpha, \beta, \gamma, \delta$ = model parameters to be estimated, ε = error term, p = evaluation period index, g = treatment or comparison group index, s = site index.

The interaction term was modified to estimate the average crash effects across all sites within the treatment and comparison groups and to estimate the crash effects within each site, time period and treatment group combination.

The overall crash effectiveness, accounting for comparison site crashes, was defined as (3):

$$\text{Percentage change} = 100 \times (1 - \exp(\delta_{111})) \quad (3)$$

where δ_{111} = the parameter for the after installation period at treatment site 1.

The student's t-test was conducted to determine the statistical significance of differences in 85th percentile speeds before and after the platforms were installed.

Table 5. Estimated crash changes by severity

| Treatment type | Severity | Estimated casualty crash reduction (%) | Significance | Lower 95% confidence level (%) | Upper 95% Confidence limit (%) |
|---------------------|----------------|--|--------------|--------------------------------|--------------------------------|
| Intersection | FSI | - | - | - | - |
| | Non-FSI | 62.8 | 0.0712 | -8.9 | 87.3 |
| Midblock | FSI | 38.1 | 0.1764 | -24.1 | 69.1 |
| | Non-FSI | 49.9 | 0.0016 | 23.0 | 67.4 |
| Wombat | FSI | 66.6 | 0.0438 | 3.0 | 88.5 |
| | Non-FSI | 61.2 | 0.0099 | 20.3 | 81.1 |
| Overall | FSI | 48.9 | 0.0195 | 10.2 | 70.9 |
| | Non-FSI | 53.5 | <0.0001 | 34.1 | 67.2 |

Results

Overall Crash Effect

The evaluation showed a statistically significant casualty crash reduction of 53% for all sites regardless of platform type. However, given the differences in conditions, design and expected impacts, this value was used for indicative purposes only. There was a reduction of 47% in casualty crashes at raised platforms at midblock and 63% at wombat crossings as shown in Table 4. These reductions were statistically significant. At the same time, there was no statistically significant change in casualty crashes at raised intersections. This may be attributable to the small sample size and the number of crashes at both treatment and comparison sites.

Table 4. Estimated casualty crash changes

| Treatment type | Estimated casualty crash reduction (%) | Significance | Lower 95% Confidence level (%) | Upper 95% Confidence limit (%) |
|---------------------|--|--------------|--------------------------------|--------------------------------|
| Intersection | 55.4 | 0.1059 | -18.7 | 83.2 |
| Midblock | 46.9 | 0.0011 | 22.1 | 63.8 |
| Wombat | 62.6 | 0.0012 | 32.5 | 79.3 |
| Overall | 52.6 | <0.0001 | 35.7 | 65.1 |

There were statistically significant reductions of 49% and 54% in FSI and nonFSI crashes for all platform types, respectively. FSI crashes at wombat crossings fell by 67% and nonFSI crashes by 61%. At the same time, there was a reduction of 50% in nonFSI crashes at midblock platforms as shown in Table 5.

Speed Changes

The speed analyses were based on 85th percentile speed data for 60 km/h speed zones at raised intersections and midblock platforms and 50 km/h speed zone for wombat crossings. There were statistically significant reductions of 7.5 km/h and 5.4 km/h at raised intersections and midblock platforms, respectively. Wombat crossings led to a 6.5 km/h

reduction in 85th percentile speeds as shown in Table 6.

Table 6. Estimated 85th percentile speed changes

| Treatment type | Speed reduction (km/h) | Significance | Lower 95% confidence level | Upper 95% Confidence limit |
|------------------|------------------------|--------------|----------------------------|----------------------------|
| Intersection | 7.5 | <0.0001 | 5.9 | 9.0 |
| Midblock | 5.4 | 0.0012 | 2.6 | 8.1 |
| Wombat crossings | 6.5 | 0.0048 | 2.7 | 10.3 |

Discussion

The evaluation of raised platforms at intersections, midblock and pedestrian crossings on urban roads across Australia showed overall crash and speed reductions. The crash reductions varied by treatment type and severity. The study identified a significant casualty crash reduction of 63% for wombat crossings. This finding was consistent with the 65% reduction in injury crashes in Elvik et al. (2009). However, other international research provides a more conservative estimate of 40% to 60% casualty crash reduction (Harms & Turner, 2013; Vaa, 2006). The evaluation also showed a significant 47% reduction in casualty crashes for raised platforms at midblock. There is limited research on the effectiveness of raised platforms at midblock, with one study showing a 60% reduction in serious and minor injury crashes (Elvik et al. 2009). The indicative reduction at raised intersections highlighted the need for further trials of this treatment in order to obtain the effectiveness measure in an Australian and New Zealand perspective.

Raised intersections and raised platforms at midblock in 60 km/h speed zones and wombat crossings in 50 km/h speed zones were associated with reductions in 85th percentile speeds ranging from 5 km/h to 8 km/h. Raised intersections lowered 85th percentile speeds by 8 km/h. The speed reduction is consistent with Watkins (2000). Watkins (2000) assessed the effectiveness of raised intersections at two locations in Cambridge, Massachusetts (USA). The results showed a 5 mph (8 km/h) and 4 mph (6.4 km/h) reduction in 85th percentile speeds at the two sites. The 7 km/h reduction in 85th percentile speed was consistent with Hawley et al. (1993), PEDSAFE (2004) and Department of Territory and Municipal Services (2006). These studies reported 85th percentile speed reductions between 6 km/h and 8 km/h at wombat crossings. On the other hand, the 5 km/h reduction at midblock platforms was at the lower end of changes identified in research (Hawley et al. 1993).

While the study provided evidence on the effectiveness of raised platforms at different locations across Australia, it highlighted the need for further research into the following:

- Trials on arterial roads – there is a need for widespread trials and effectiveness evaluations of platforms on urban arterial roads across Australia and New Zealand.

The trials will provide information on implementation issues e.g. when and where to install platforms, the ideal dimensions for different locations and traffic mix, ideal traffic volumes and speed and environmental impacts. Austroads (2016b) outlines implementation issues and considerations for different platform types.

- Monitor and assess raised platforms in different speed zones – there is limited evidence on the effectiveness of raised platforms in different speed zones. Evaluating trials in different speed zones will improve the information on where different platform types are most effective.
- The effect of raised intersections on crashes – more widespread applications of raised intersections are required in order to identify the safety effect. At the time of the evaluation, further trials of raised intersections were underway. An evaluation of these trials will add to the evidence base.
- Traffic migration – there is a need to assess the impact of raised platforms on traffic volumes on adjacent routes. Traffic volume data was available for some of the treatment and comparison sites before and after the implementation of raised platforms. However, this was limited and generally excluded data from adjacent routes. This information could be obtained from further onroad trials.

Conclusions

The use of raised platforms at intersections, midblock and pedestrian crossings across Australia led to associated reductions in crashes (both casualty and FSI crashes) and 85th percentile speeds. There was a 63% reduction in casualty crashes at wombat crossings, 47% reduction at midblock platforms and an indicative 55% reduction at priority controlled intersections. These reductions were consistent with international research. Further, raised intersections lowered 85th percentile speeds by 8 km/h, 7 km/h at wombat crossings and 5 km/h at midblock platforms. While the evaluation provided a measure of effectiveness for raised platforms in an Australian context, the effectiveness of each application depend on the design (e.g. platform height and length), the speed environment and road function. The study also highlighted the need for further onroad trials on urban arterial roads and the subsequent monitoring and evaluation. These will add to the existing evidence base and used to support the widespread use of raised platforms as a measure for achieving Safe System outcomes on urban arterial roads.

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Speeding in urban South East Asia: Results from a multi-site observational study

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Key findings

- There is a high prevalence of speeding in three large cities in Southeast Asia
- Motorcycles were speeding at >50 km/hr over posted speed limits in Bandung
- Speed prevalence was highest during the weekends in all three cities.

Abstract

Speed is an important risk factor for road traffic crashes. We studied the prevalence of speeding in three major cities in Southeast Asia (Bandung, Bangkok and Ho Chi Minh City-HCMC), and factors associated with it. The study was conducted between July 2015-September 2016 using a standardized protocol and data collection tool. Observation locations were selected through systematic sampling. Speed was measured using a microwave radar gun on weekdays and weekends, and 5 times during each day. Descriptive and logistic regression analysis was done separately for each city. 623,744 vehicles were observed (Bangkok:61.8%; Bandung:36.0% and HCMC:2.2%). 21.8% vehicles were found to be speeding across the three cities. The prevalence of speeding was 7.8% in Bandung, 30.7% in Bangkok, and 1.9% in HCMC. When adjusted for other variables, compared to motorcycles, SUVs were more likely to be speeding in Bandung (aOR:1.97); large trucks (aOR:7.69) in Bangkok; and light trucks in HCMC (aOR:2.39). In Bandung, speeding was mostly observed in the peri-urban parts of the city (94.5%). Speed was likely to be highest during non-peak hours of the day in HCMC (aOR:3.08). High prevalence of speeding was observed in the three cities, making this an important risk factor for road safety in urban Southeast Asia. Findings, especially with regards to variations by vehicle type, times of day, days of week, and types of roads would be useful for city governments and traffic police to better plan strategies to improve road safety in these cities.

Key words

Speeding, Asia, developing countries, multi-site analysis

Introduction

In 2015, more than 1.3 million people were estimated to have died around the world as a result of road traffic crashes (“Global Burden of Disease 2015,” 2017; “Global status report on road safety 2015,” 2015). Many more are injured and suffer from short-term and long-term disability. Estimates show that road traffic injuries contribute to 67,270,399 disability-adjusted life years (DALYs) lost annually, making them the number one cause of the burden of injuries globally (“Global Burden of Disease 2015,” 2017). Low- and middle-income countries (LMICs) are disproportionately affected, with 90 % of this burden (“Global status report on road safety 2015,” 2015). Poor infrastructure, rapid urbanization and motorization, poor enforcement, and post-crash care systems have all shown to contribute to this burden in LMICs (“Global status report on road safety 2015,” 2015).

Speeding is an important risk factor for road traffic injuries (“Global status report on road safety 2015,” 2015). Several studies have demonstrated the increased risk of serious injury and fatality with speed (Elvik et al., 2009; “Global status report on road safety 2015,” 2015; Rosen et al., 2011). The Global Status Report on Road Safety identifies speed as one of the leading risk factors for road traffic crashes, serious injuries, and fatalities (“Global status report on road safety 2015,” 2015). A comparative analysis conducted by Center for Disease Control USA found that in 2013 speeding was responsible for 15% – 42% deaths in 19 countries of Organization for Economic Co-operation and Development (Sauber-Schatz et al., 2016). In the United States, for example, slightly over a quarter of crash fatalities in 2015 were related to speeding according to the National Highway Traffic Safety Administration (“Quick facts,” 2015). Recent studies from LMICs also show that the proportion of road crash fatalities due to speeding tends to vary in LMICs, it is reported to be 14.0% in China, 19.3% in Iran, 32.0% in DR Congo (Nangana et al., 2016; Rad et al., 2016; Zhang et al., 2013).

The prevalence of speeding also varies within a country or city depending on the types of roads, traffic volume, and presence or absence of speed calming measures and police enforcement (“Global status report on road safety 2015,” 2015). An observational study done in two Kenyan districts found that in one of the districts, 69.5% of vehicles were found to be speeding compared to less than half of that (34.3%) in another district. The same study shows that the most common type of vehicles speeding in both districts were light trucks, large trucks and minibuses. Despite the differences in proportion of speeding vehicles, the enforcement in both the districts was low (Bachani, Hung, et al., 2013; Bachani et al., 2012). While there is consensus that speed is a significant risk factor for road traffic crashes, especially in LMICs, where the infrastructural development has not been able to keep up with rapid motorization, empirical data from these settings are scant.

The Bloomberg Initiative for Global Road Safety (BIGRS) aims to promote the implementation of evidence-based interventions for road safety in ten large cities around the world (“Road Safety,” 2017). Three major cities in Asia - Bandung in Indonesia, Bangkok in Thailand, and Ho Chi Minh City (HCMC) in Vietnam, are part of this program and focus on addressing speed as one of the risk factors for road safety (Table 1). As part of this project evaluation, observational studies are being conducted in each of the cities to track the prevalence of road safety risk factors over time. This represents a unique opportunity to understand the distribution and changes of risk factors over time in urban areas of LMICs.

In this paper, we aim to assess speed in three Asian cities – Bandung, Bangkok, and HCMC, in a rapidly developing part of the world. We present data on the average prevalence of speeding in each of the cities, and explore factors associated with speeding in these cities. This information would be valuable for cross-city learning to understand what may or may not work in terms of addressing this major risk factor for road safety.

Table 1. City description and basic road safety data

| City | Population (million) | Registered vehicles (number) | Vehicle per 100,000 population | Road traffic (rate per 100,000 population) | | | Reference year |
|--------------------------------|-------------------------|------------------------------------|--------------------------------------|---|----------|------------|-------------------|
| | | | | Crashes | Injuries | Fatalities | |
| Bandung (Indonesia) | 2.4 | 1,617,022 | 65840 | 38.1 | 42.9 | 4.9 | 2012 |
| Bangkok (Thailand) | 5.7 | 9,018,594 | 158321 | 468.8 | 98.3 | 3.5 | 2015 |
| HCMC (Vietnam) | 7.4 | 6,849,285 | 92608 | - | - | - | 2013 |

Source: Indonesian Police (“Indonesian National Police,” 2017), Ministry of Interior and Department of Land Transport, Thailand (“Bangkok Statistics,” 2015), Statistical Office of Ho Chi Minh City (“HCMC statistics”, 2013)

Methods

Speed observations were conducted in three Asian cities: Bandung, Bangkok and HCMC. Three rounds of speed observational studies were implemented between July 2015 and September 2016: Round 1 was conducted in July-August 2015, Round 2 in March-April 2016 and Round 3 in August-September 2016. Observation sites were randomly selected from a list of all eligible sites within the city, and included the different road types present in the city based on a standardized protocol to systematically survey a representative proportion of the local traffic; detailed methodology has been previously published (Bachani, Branching, et al., 2013; Bachani et al., 2012; Slyunkina et al., 2013; Vecino-Ortiz et al., 2014). In summary, the objective of this study was to understand average, city-wide prevalence of speed in the three cities by conducting observations on different days of the week and at different times of each day. Therefore, speed was recorded for all vehicles systematically observed during each observation time period at each selected location in each city. To avoid the risk of bias, observation locations excluded areas where vehicles may generally slow down, such as junctions or intersections, construction sites or parts of the road with speed bumps, entrance of parking lots, gas stations, malls, or shopping centres. Locations where tourists rather than location populations were likely to be observed were also excluded, and so were locations that were considered unsafe for observations to be conducted. Observations were conducted at 10 out of 39 eligible locations in Bandung, 6 out of 46 in Bangkok and 5 out of 20 in HCMC. Each round of observations consisted of 3 randomly selected full days, including both weekdays and weekends. Observations were conducted in 90-minute intervals with a 15 minute traffic volume assessment before the beginning of each observation interval. A full-day observation schedule included five 90-minute periods throughout the day, from early morning to evening. Peak time was between 07:00 – 09: 00 and 17:30 – 19:00.

All the different road types represented within the official city limits were included. Roads were categorized into arterial and collector/distributor roads. (“Highway Functional

Classification Concepts, Criteria and Procedures,” 2013). Roads were grouped into urban, peri-urban and rural locations. Vehicle types constituted cars, light trucks, SUVs, taxis, minibus/vans, large trucks, motorcycles and buses. Weather on day of observation was also recorded.

In all three cities standardized data collection methodology was followed for systematic observations to obtain reliable estimates for speed measurements with the exception of HCMC where weather and vehicle ownership data was collected in round 3 only. Observations were done inconspicuously; vehicles were observed traveling in one-direction only to minimize counting the same vehicles twice during the observation period; observations at each location were conducted by two trained observers, with one observer taking the speed measurement using a microwave radar gun, while the other observer recorded the observed speed and vehicle type. If more than one vehicle crossed the observer, then the observer measured the speed of the one nearest to them.

This paper presents pooled analysis for each city. To estimate the prevalence of vehicles traveling above the speed limit in each city, we calculated the proportion of vehicles traveling above the speed limit for each observation round. Speeding above the posted speed limit was categorized into 5 groups: <10 km/hr, 11-20 km/hr, 21-30 km/hr, 31-50 km/hr and >50 km/hr. Speed limits in the cities varied based on road type and vehicle type based on local laws; this was accounted for during the analysis. For the sites selected for this study, the speed limit in Bandung was 50 km/hr for all vehicle types within the city, in Bangkok speed limit was 60km/hr for trucks and buses, and 80km/hr for all other types of vehicles while the speed limit for all vehicles in HCMC varied between 40 – 60 km/hr based on observation site.

We conducted bivariate logistic regression analyses to explore the association between speeding and independent variables which included data collection round, road type, road location (urban,peri-urban and rural), vehicle type, day of week, weather and observation time. Subsequently, we performed multivariate logistic regression to estimate independent association with these variables. Data

management and analysis was done using MS Excel and STATA 12 (StataCorp 2011), respectively.

The speed observation study protocols were reviewed and approved by the Institutional Review Boards at Johns Hopkins University Bloomberg School of Public Health (JHSPH) and at the ethical review board at each of the implementing local institutions: Universitas Padjadjaran in Bandung, Indonesia, ThaiRoad Foundation in Bangkok, and Hanoi School of Public Health in HCMC. The study is led by the Johns Hopkins International Injury Research Unit (JH-IIRU) hosted by the Department of International Health at JHSPH.

Results

A total of 623,734 vehicles were observed for speeding across the three cities, Bandung: 224,588 (36.0%); Bangkok: 385,546 (61.8%); and HCMC: 13,600 (2.2%) during three rounds of data collection (Table 2). The number of observations conducted varied from 2,455 to 134,276 vehicles across the three rounds. Overall, 21.8% (n=135,869, 95% CI 21.7-21.9) vehicles were found to be above the speed limit across the three cities: 7.8% (n=17,464, 95% CI 7.7-7.9) in Bandung, 30.7% (n=118,180, 95% CI 30.5-30.8) in Bangkok, and 1.7% (n=225, 95% CI 1.5-1.9) in HCMC. The prevalence of speeding in each city varied over the 18 months covered by the three rounds of observations with the highest prevalence seen in the first round and the lowest in the latest round (Bangkok: 37.9% in round 1 to 21.7% in round 3; Bandung: 12.6% in round 1 to 6.0% in round 3 and HCMC: 3.7% in round 1 to 0.7% in round 3).

Exploratory data analysis showed that speeding prevalence varied by type of vehicle and this differed across the three cities. In Bandung, it was mostly suburban utility vehicles (SUVs) (32.1%, n=5,610), cars in Bangkok (42.8%, n=50,531) and motorcycles in HCMC (76.9%, n=173). This could reflect the vehicle mix in these cities (Table 2). Speeding also varied by time of day and day of week, with highest prevalence in Bandung observed between 12:30 – 14:00 hours (21.4%, n=3,730), in Bangkok between 7:30 – 9:00 (21.8%, n=25,703) and in HCMC 17:30 – 19:00 (32.9%, n=74) and during weekdays (Bandung: 63.1%, Bangkok: 64.2%, and HCMC: 57.8%). In Bandung, weather was recorded to be dry on most (88.9%) observation days with only 8.2% observations conducted during rain. However, weather was dry for all the observations conducted in Bangkok and HCMC. (Table 2). In Bandung, speeding was more of an issue in the peri-urban parts of the city (94.5%, n=16,497). However, in Bangkok and HCMC, speeding was mostly observed to be highest in urban parts of the city (Bangkok: 100.0%, n=118,180; HCMC: 76.9%, n=173).

An analysis looking at the extent over the speed limit revealed that on average, speeding vehicles were traveling at between 5-12km/hr over the posted speed limits in the three cities (Bandung: 8.9 ± 8.0 km/hr; Bangkok: 11.6 ± 9.1 km/hr; HCMC: 5.0 ± 4.2 km/hr). Majority of speeding vehicles (>50%) were traveling at ≤ 10 km/hr over the posted speed limits (Bandung: 54.5%, Bangkok: 55.0%, and HCMC:

90.7%). The proportion of vehicles traveling between 11-20 km/hr was 24.7% Bandung, 30.1% in Bangkok and 8.0% in HCMC (Table 2). Among the vehicles found to be speeding at >50 km/hr above the local speed limit, motorcycles were the commonest in Bandung (31.5%) and cars in Bangkok (38.8%) (Figure 1).

Results from logistic regression analyses showed that after controlling for data collection round, road type, road location, day of week, weather and observation time, the adjusted odds ratio of speeding were highest for SUVs compared to motorcycles in Bandung (aOR: 1.97, 95% CI: 1.86-2.08) followed by cars (aOR: 1.94, 95% CI: 1.86-2.06) and large trucks (aOR: 1.35, 95% CI: 1.26-1.46). In Bangkok, large trucks were 7.69 times (95% CI: 7.08-8.35) more likely to speed compared to motorcycles, followed by buses (aOR: 3.17, 95% CI: 2.81-3.56) and light trucks/pick-ups (aOR: 3.14, 95% CI: 2.95-3.34) (Table 3). In HCMC, light trucks/pick-ups were two times more likely to speed (aOR: 2.39, 95% CI: 0.68 – 8.43) compared to motorcycles, but this was not statistically significant.

The odds of speeding on collector/distributor roads were quite low as compared to arterial roads in both Bandung (aOR: 0.13, 95% CI: 0.12-0.14) and Bangkok (aOR: 0.23, 95% CI: 0.22-0.23). While all speeding in Bangkok was in urban areas of the city, this was not the case in Bandung, where the adjusted odds of speeding were almost 24 times higher in peri-urban areas of the city as compared to urban areas (aOR: 23.6; 95% CI 22.05-25.23) after controlling for data collection round, road type, road location, vehicle type, day of week, weather and observation time. In HCMC, speeding was more likely on roads in areas of the city classified as rural (aOR: 2.68; 95% CI: 1.90-3.79) as compared to urban roads when controlled for other factors. The adjusted odds of speeding were also lower during the weekdays compared to weekends (Bandung: aOR 0.70, 95% CI 0.68-0.73; Bangkok: aOR 0.68, 0.67-0.70 and HCMC: aOR 0.96, 95% CI 0.72-1.29). Interestingly, however, the adjusted odds of speeding were lower for all observation times compared to the morning peak time (7:30-9:00) in Bandung and Bangkok, but the opposite was the case for HCMC, where the adjusted odds for speeding were 3.08 times higher between 12:30 – 14:00 compared to morning peak hour (95% CI 1.18- 8.05) in HCMC (Table 3).

Discussion

This study shows that there is significant prevalence of speeding in Bandung, Bangkok and HCMC. To our knowledge this is one of the first attempts to empirically document the prevalence of speeding using standardized approaches in these cities, and presents an opportunity to understand factors associated with speeding in these three large metropolitan cities in Southeast Asia. The BIGRS initiative is city-led and involves collaboration with city mayors and city governments (“Road Safety,” 2017). This has thus created an opportunity for cross-city learning to improve road safety, and our study is the first step in the process to understand the prevalence of speed and factors underlying it.

Table 2. Prevalence of speeding and distribution in three Asian cities (n=135,905)

| | Bandung | Bangkok | HCMC^c |
|--|----------------|-----------------|-------------------------|
| Total observations^a | 224,588 | 385,546 | 13,600 |
| Vehicles speeding, n(%)^a | 17,464 (7.8) | 118,180 (30.7) | 225 (1.7) |
| Vehicle related factors | | | |
| Vehicle type | | | |
| Car | 2,300 (13.2) | 50,531 (42.8) | 29 (12.9) |
| Light truck | 1,115 (6.4) | 38,321 (32.4) | 3 (1.3) |
| SUV | 5,610 (32.1) | 11,655 (9.9) | - |
| Taxi | 206 (1.2) | 8,410 (7.1) | - |
| Minibus/van | 2,382 (13.6) | 4,471 (3.8) | 12 (5.3) |
| Large truck | 1,202 (6.9) | 2,836 (2.4) | 3 (1.3) |
| Motorcycle | 4,515 (25.9) | 1,303 (1.1) | 173 (76.9) |
| Bus | 132 (0.8) | 637 (0.5) | 5 (2.2) |
| Vehicle ownership | | | |
| Private | 10,217 (85.1) | 89,527 (75.8) | 18 (7.0) |
| Commercial | 898 (7.5) | 16,060 (13.6) | - |
| Government | 195 (1.6) | 288 (0.2) | - |
| Taxi | 688 (5.7) | 12,158 (10.3) | - |
| Tourist | 6 (0.1) | 121 (0.1) | - |
| Environment related factors | | | |
| Day of week | | | |
| Weekday | 11,015 (63.1) | 75,893 (64.2) | 130 (57.8) |
| Weekend | 6,449 (36.9) | 42,287 (35.8) | 95 (42.2) |
| Weather^b | | | |
| Dry | 15,533 (88.9) | 118,180 (100.0) | 18 (7.0) |
| Drizzle | 485 (2.8) | - | - |
| Rain | 1,428 (8.2) | - | - |
| Observation timing | | | |
| 7:30-9:00 | 3,542 (20.3) | 25,703 (21.8) | 56 (24.9) |
| 10:00-11:30 | 3,421 (19.6) | 23,565 (19.9) | 45 (20.0) |
| 12:30-14:00 | 3,730 (21.4) | 21,884 (18.5) | 9 (4.0) |
| 15:00-16:30 | 3,631 (20.8) | 24,392 (20.6) | 41 (18.2) |
| 17:30-19:00 | 3,140 (18.0) | 22,636 (19.2) | 74 (32.9) |
| Road related factors | | | |
| Road type | | | |
| Arterial | 16,490 (94.4) | 99,077 (83.84) | 225 (100.0) |
| Collector/ Distributor | 974 (5.6) | 19,103 (16.16) | - |
| Road location | | | |
| Urban | 967 (5.5) | 118,180 (100.0) | 173 (76.9) |
| Peri-urban | 16,497 (94.5) | - | - |
| Rural | - | - | 52 (23.1) |
| Extent of speeding | | | |
| ≤10 km/hr | 9,521 (54.5) | 64,991 (55.0) | 204 (90.7) |
| 11-20 km/hr | 4,321 (24.7) | 35,544 (30.1) | 18 (8.0) |
| 21-30 km/hr | 1,517 (8.7) | 12,287 (10.4) | 3 (1.3) |
| 31-50 km/hr | 259 (1.5) | 5,061 (4.3) | - |
| >50 km/hr | 1,846 (10.6) | 294 (0.3) | - |

^a All subsequent percentages are calculated based on speeding vehicles

^b Weather was recorded to be dry in Bangkok and HCMC (round 3) for all days on which observations were conducted

^c Vehicle ownership and weather data for HCMC was available for round 3 only

SUV - suburban utility vehicle

Speeding puts lives of every road user at risk. Therefore, even a seemingly small prevalence is problematic as it has far reaching implications which not only include death and disability, but also economic consequences due to property loss and lost productivity (“Global status report on road safety 2015,” 2015). Studies have demonstrated that the risk of death increases with increase in speed: 10% if vehicle is driving at 30 km/hr, 20% at <50 km/hr and 60% at 80 km/

hr (“Global status report on road safety 2015,” 2015; Rosen et al., 2011; “Speed management : A road safety manual for decision-makers and practitioners,” 2008). Another study, by Finch et al, found that for every 1 km/hr increase in speed, the risk of injury due to a crash goes up by 3% (Finch et al., 1994). Our data showed that a significant proportion of speeding vehicles were traveling at speeds of >20 km/h over the posted limits. This is especially important in light of the infrastructural challenges that many LMICs face in keeping up with rapid motorization, the wide variation in traffic mix, and little or no separation between motorized traffic and pedestrians or even larger vehicles from smaller ones such as two-wheelers. Speeding exacerbates the vulnerabilities of these vulnerable road users (“Global status report on road safety 2015,” 2015; Hazen et al., 2006).

Our study also found higher prevalence of speeding on arterial roads. Our data showed that it was mainly large vehicles that were found to be speeding on these roads. This is a significant issue for metropolitan cities like Bandung, Bangkok and HCMC; these roads are often also shared by pedestrians, motorcyclists and cyclists, increasing their vulnerability. Furthermore, the posted speed limits across the three cities vary—ranging from 40 km/hr for large vehicles to 80 km/hr for cars and motorcycles. These limits are above the recommended limit of 30 km/hr for roads that have diverse vehicle mix as well as a combination of motorized and non-motorized road users (“Global status report on road safety 2015,” 2015; “Speed management : A road safety manual for decision-makers and practitioners,” 2008).

Additionally, speeding was more of a problem during morning peak hours, especially in Bandung and Bangkok. This was also observed in a study from Kenya where speed observations were made in two districts. The authors found that speeding was common during morning peak hours in one of the districts in Kenya (Bachani, Hung, et al., 2013). This has implications for road traffic crashes as shown in a modelling study from China. According to the study, speeding during peak hours increases risk of road traffic crashes compared to off-peak hours (Wang et al., 2015). This could be because many people are trying to reach their workplace at that time, but this is also a time when drivers of large vehicles who tend to drive long distances overnight are reaching urban centres, often fatigued. This mix could potentially exacerbate the risk posed by speeding (Ellison et al., 2015; “Speed management : A road safety manual for decision-makers and practitioners,” 2008). However, further work is needed to understand such driver related factors associated with speeding. In HCMC, majority of the speeding occurred during non-peak hours, and this may be a result of congestion during peak hours in the morning and the evening.

Appropriate laws and regular and visible enforcement of the laws has been shown to be key in addressing behavioural risk factors for road safety such as speeding (Bachani et al., 2017; “Global status report on road safety 2015,” 2015; “Speed management : A road safety manual for decision-makers and practitioners,” 2008). Previous studies have found that among other factors associated with speeding, lack of police enforcement changes drivers’ behaviour and

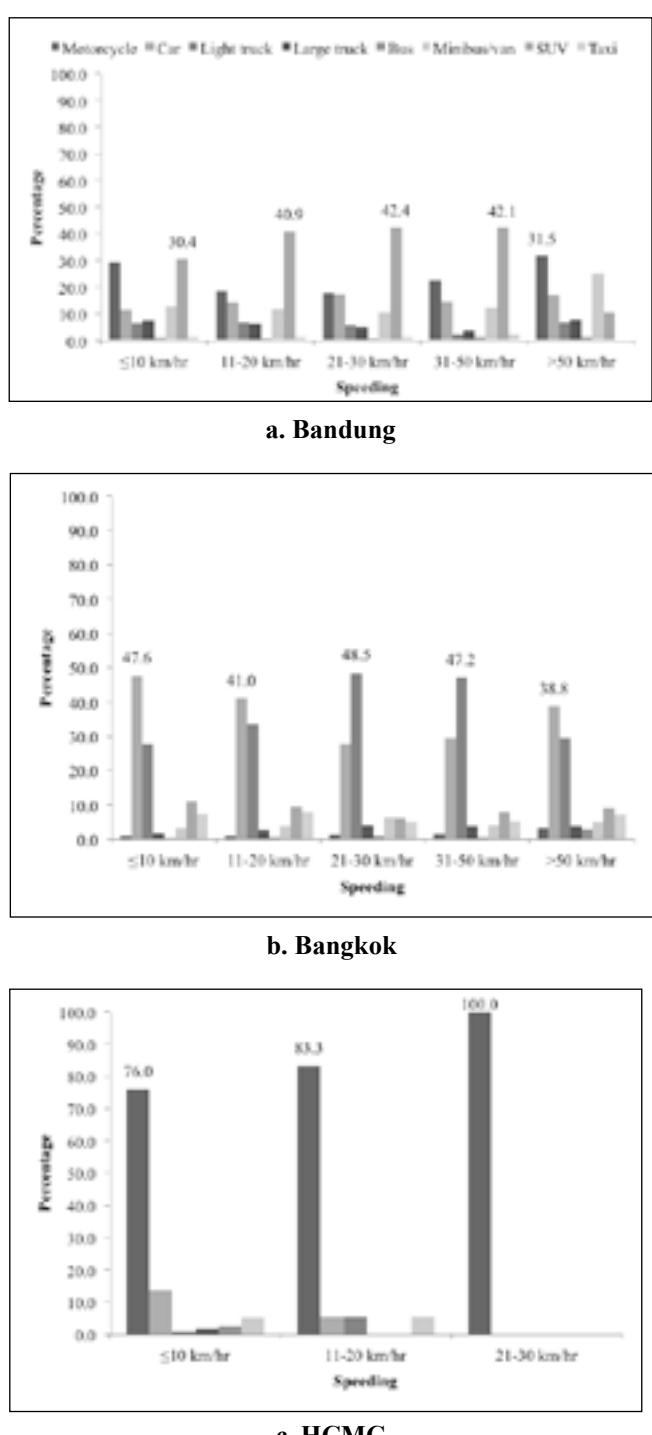


Figure 1. Extent of speeding for vehicles over the posted speed limit (n=135,905)

Table 3. Logistic regression of factors associated with over-speeding ^{a,b}

| | Bandung | Bangkok | HCMC |
|------------------------------------|---------------------------|-------------------------|-------------------------|
| Data collection round | | | |
| Round 1 | Reference | Reference | Reference |
| Round 2 | 0.75 (0.71-0.78) | 0.82 (0.81-0.84) | 0.11 (0.07-0.17) |
| Round 3 | 0.92 (0.87-0.97) | 0.42 (0.41-0.43) | 0.08 (0.04-0.16) |
| Road type ^c | | | |
| Arterial Road | Reference | Reference | - |
| Collector/ Distributor Road | 0.13 (0.12-0.14) | 0.23 (0.22-0.23) | - |
| Road location ^d | | | |
| Urban | Reference | - | Reference |
| Peri urban | 23.6 (22.05-25.23) | - | - |
| Rural | - | - | 2.68 (1.90-3.79) |
| Vehicle type | | | |
| Motorcycle | Reference | Reference | Reference |
| Car | 1.94 (1.83-2.06) | 1.59 (1.49-1.69) | 0.81 (0.54-1.21) |
| Light truck | 1.06 (0.98-1.14) | 3.14 (2.95-3.34) | 2.39 (0.68-8.43) |
| Large truck | 1.35 (1.26-1.46) | 7.69 (7.08-8.35) | 0.42 (0.13-1.34) |
| Bus | 1.10 (0.90-1.34) | 3.17 (2.81-3.56) | 0.68 (0.27-1.67) |
| Minibus/van | 1.18 (1.11-1.24) | 2.58 (2.40-2.78) | 0.78 (0.43-1.43) |
| SUV | 1.97 (1.86-2.08) | 1.69 (1.58-1.80) | - |
| Taxi | 0.66 (0.57-0.77) | 1.26 (1.18-1.34) | - |
| Day of week | | | |
| Weekend | Reference | Reference | Reference |
| Weekday | 0.70 (0.68-0.73) | 0.68 (0.67-0.70) | 0.96 (0.72-1.29) |
| Weather ^e | | | |
| Dry | Ref | - | - |
| Drizzle | 1.04 (0.93-1.16) | - | - |
| Rain | 3.09 (2.87-3.33) | - | - |
| Observation time | | | |
| 7:30-9:00 | Reference | Reference | Reference |
| 10:00-11:30 | 0.91 (0.86-0.96) | 0.86 (0.84-0.88) | 1.22 (0.82-1.83) |
| 12:30-14:00 | 0.99 (0.94-1.04) | 0.71 (0.70-0.73) | 3.08 (1.18-8.05) |
| 15:00-16:30 | 0.84 (0.79-0.89) | 0.81 (0.80-0.83) | 0.89 (0.59-1.34) |
| 17:30-19:00 | 0.67 (0.63-0.70) | 0.71 (0.69-0.73) | 1.19 (0.8531.69) |

^a Independent variables for speeding included data collection round, road type, road location, vehicle type, day of week and observation time

^b Odd ratios are statistically significant

^c Road type was not included in logistic regression analysis of HCMC because all roads were arterial roads

^d Road location was not included in logistic regression analysis of Bangkok because all the roads were urban

^e Weather was included in logistic regression for Bandung only. Weather was recorded to be dry in all rounds in Bangkok and HCMC (round 3) for all days on which observations were conducted. Weather data in HCMC was available for round 3 only

they tend to speed (Hassan et al., 2017; Stanojevic et al., 2013). There is lack of data on speed law enforcement in the three cities, however, there are national speed control laws in the three countries but the degree of enforcement (self-enforcement) is low as reported in Global Road Safety report 2015 (Table 4) (“Global status report on road safety 2015,” 2015). These countries need to revise speed laws to bring them in line with acceptable standards such as lower speed limits within the cities (Bachani et al., 2017; “Global status report on road safety 2015,” 2015). Additionally, in resource limited settings such as these three cities, data collected through this study presents an opportunity to improve efficiency through more targeted enforcement. Given the observed variations in speeding prevalence at different times of the day, different days of the week, and by vehicle type, police could plan additional targeted enforcement activities to reduce speeding rates (Hyder et al., 2013). These cities are among the most populous cities in their countries, and data from the three cities can facilitate discussions with local and national level government for improving legislation and enforcement (“Global status report on road safety 2015,” 2015).

Table 4. National speed control laws

| Speed indicators | Indonesia | Thailand | Vietnam |
|--|-----------|----------|---------|
| National speed limit law | Yes | Yes | Yes |
| Max urban speed limit (km/hr) | 70 | 80 | 50 |
| Max rural speed limit (km/hr) | 100 | 90 | 80 |
| Max motorway speed limit | No | 120 | No |
| Local authorities can modify limits | Yes | No | No |
| Country reported enforcement ^a | 5 | 3 | 6 |

Source: (“Global status report on road safety 2015,” 2015)

^aOn scale of 0 to 10 with 0 being no enforcement and 10 being maximum enforcement; ‘good’ enforcement was defined by the GSRRS 2015 as 8 or above (“Global status report on road safety 2015,” 2015)

One limitation of this study is that this was an observational study which, while yielding important empirical evidence on the prevalence and distribution of speeding in the three cities, was not designed to understand underlying factors that could be responsible for the observed rates. The study also focused on assessing city wide prevalence of speed on different road types on different days of the week and times of the day. As such, it did not focus on factors associated with individual drivers’ selection of speed. The three cities differ considerably in terms of their population, number

of registered vehicles, vehicle per 100,000 population and rate of road traffic crashes, injuries and fatalities. Bandung’s population and number of vehicles is lower compared to Bangkok and HCMC but has the highest road traffic fatalities as reported by their police data (“Bangkok Statistics,” 2015; Hazen et al., 2006; “HCMC statistics”, 2013; “Indonesian National Police,” 2017). On the other hand, HCMC has the largest population among the three cities with over 90,000 vehicles per 100,000 population on the road with a very small proportion of vehicles speeding on the road. Effective speed control law enforcement could be one among other reasons, but this needs further exploration in future work (“HCMC statistics”, 2013). Additionally, further studies looking into knowledge, attitudes, and practices around speed, such as knowledge of existing legislation, knowledge of speed limits, and perceptions about the risks of speeding, and reasons why people choose whether or not to speed, would be invaluable when combined with our data to support the development of comprehensive programs to address speeding.

In conclusion, speeding is a major road safety issue in Bandung, Bangkok and HCMC. Evidence from this empirical work can help to drive future work on speed control and speed control enforcement in these cities. Information from this study, especially with regards to distribution of the prevalence of speeding by vehicle type, times of day, days of week, and types of roads would be useful for city governments and traffic police to better plan strategies to improve road safety in these cities. Further studies that examine factors underlying the differences observed in these cities are warranted to facilitate cross-city learning of what works and doesn’t work to address this important risk factor. We recommend further studies of this nature at city level to be a new agenda for road safety in LMICs.

Conflict of interest

None declared

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Author contribution

Abdulgafoor M. Bachani and Adnan A. Hyder conceptualized the idea for the paper, coordinated the planning and implementation of BIGRS project in the three cities and provided extensive feedback during development of manuscript. Nukhba Zia was involved in analysis and draft development. Yuen W. Hung and Rantimi Adetunji were involved in draft development and helped with analysis. Pham Viet Cuong, Ahmad Faried and Piyapong Jiwattanakulpaisarn coordinated field work and were involved in local implementation of the observation protocols, facilitated training of data collectors, managed data collection and entry and reviewed the draft manuscript. All authors approved the final version of the manuscript.

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Road Safety Policy & Practice

Not all Roads are Created Equal: Technical Analysis and Engagement Frameworks developed for New Zealand's new Speed Management Guide

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This peer-reviewed paper is an extension of the peer-review paper that was first presented at the 2016 Australasian Road Safety Conference (ARSC2016) held in Canberra, ACT, Australia and that was published in the ARSC2016 Proceedings as a 'Full Paper'. Both papers underwent the full peer-review process by independent experts in the field. The present extended paper is only available in this edition of the JACRS.

Abstract

New Zealand Transport Agency's new Speed Management Guide introduces two innovative frameworks which together are critical to support local authorities in their efforts to put in place positive and lasting speed management measures. The technical framework provides a single assessment method for determining safe and appropriate speeds at a network level. The technical framework aims to better align travelling speeds with road function, design, safety and use, while linking into

wider planning and investment programmes. Implementing speed management interventions is as important as, and much more difficult, than the technical analysis. The new engagement framework builds better conversations on road risk, based on engagement principles that are designed to empower road controlling authorities to improve their engagement, and to encourage communities to participate positively in decision making. This paper presents the application of the technical framework to the Waikato region, including analysis of the assignment and prioritisation of intervention strategies to road sections where speed management interventions have high benefit safety and efficiency opportunities. This paper also details fresh national research focused on understanding community attitudes to speed, used to inform engagement strategies and collateral. This paper will be of interest to all those involved in network management and community engagement, and those interested in prioritising the potential safety benefits of speed management.

Keywords

Speed, engagement, strategy

Introduction

In November 2016, the New Zealand Transport Agency (the Transport Agency) published the final Speed Management Guide, which is an agency responsibility under the second Safer Journeys Action Plan (2013-15). "Managing speed on the road network is crucial to reducing deaths and serious injuries because the consequences of all crashes are strongly influenced by impact speed. New Zealand's Safe System goal is to reduce the number of speed related crashes and the severity of all crashes if they do occur. Safer travel speeds that also support economic productivity will help achieve that goal. This leads to three long term objectives:

1. People will increasingly understand what travelling at safe speeds means;
2. Speed limits will better reflect the use, function and safety of the network; and
3. Travel speeds will support both safety and economic productivity."

Specifically the Action Plan called for development of a speed management programme "to deliver agreed positions on appropriate speed given the use, function, risk, and level of safety provided by the road, and the communication approach required to achieve this".

The Speed Management Guide includes two key frameworks, a technical framework, which aims to better align travelling speeds with road function, design, safety and use, while linking into wider planning and investment programmes, and an engagement framework to build better conversations on road risk. The Guide is clear that implementing both frameworks are critical if local authorities wish to put in place positive and lasting speed management measures.

Speed Management Guide

The stated objectives of the Speed Management Guide are to:

- Ensure a consistent sector-wide approach is adopted to manage speeds so they are appropriate for road function, design, safety, use and the surrounding environment (land use); and

- Help Road Controlling Authorities (RCAs) and other system designers identify and prioritise the parts of their networks where better speed management will contribute most to reducing deaths and serious injuries, while supporting overall economic productivity.
- Support a new conversation on speed by demonstrating that not all roads are equal

The Speed Management Guide helps RCAs plan, invest in and operate their networks to achieve both safety and efficiency, and to effectively engage with their communities to build support for an evidence-based, network-wide strategic approach to achieve these twin outcomes.). A Safe System approach (fundamentally that people make mistakes and the human body is fragile, requiring a system approach addressing safer speed, safer roads and roadsides, safer user behaviour and safer vehicles) is integral to this framework. Applying the technical framework results in the identification of safe and appropriate travel speeds (travel speeds that are appropriate for the road function, design, safety and use) for every road in New Zealand.

Speed Management Technical Framework

The Speed Management technical framework is primarily governed by the One Network Road Classification (ONRC). The ONRC involves categorising roads based on the functions they perform as part of an integrated national network. The classification helps RCAs and the Transport Agency to plan, invest in, maintain and operate the road network in a more strategic, consistent and efficient way throughout the country.

The safe and appropriate speed matrix shown in Figure 1 is based on the ONRC, horizontal alignment, and generalised land use category. The matrix is the fundamental building block upon which the Speed Management technical framework has been developed. The table details travel speed ranges (not speed limits) for different road classifications. The technical framework detailed in the Guide translates these broad travel speed ranges onto the network to identify if speed management is required.

| Classification | Straight open road /urban motorways | Curved open road | Winding open road | Urban (not motorway) |
|--|---|------------------|-------------------|---|
| Class 1 High volume national | 100–110km/h⁷ Depends on design and safety risk (e.g. divided 4-5 star, grade separated intersections, safety barriers) and factoring in enforcement thresholds | | | |
| Class 2 National, Regional, Arterial | 80–100km/h Depends on safety risk and whether volumes justify investment to bring the road up to 3 star equivalent, also enforcement thresholds | | 60–80km/h | 50km/h 60–80km/h where safety risk allows, e.g. fewer intersections, mode separation for active users |
| Class 3 Primary and secondary collector | | | | 30–50km/h 30km/h if high volumes of cyclists/pedestrians Recognise access and place |
| Class 4 Access and low-volume access All winding/tortuous | 60–80km/h Depending on roadside development, pedestrian and cyclist volumes, whether sealed or not | | | 10km/h for Shared Spaces |

Figure 1. Recommended Safe and Appropriate Speed Ranges for Road Classes (NZTA, 2015)

The Speed Management technical framework sets criteria for a range of safe and appropriate speeds in urban and rural environments. The Speed Management Guide defines safe and appropriate speeds as travel speeds that are appropriate for the road function, design, safety and use.

The key factors in the Speed Management technical framework that are used to derive the safe and appropriate speed for any given section of road are:

- ONRC, which represents the function of the road within the whole network. The ONRC factor provides the overarching basis for aligning travelling speeds with road function, design, safety and use, as it takes traffic volumes, freight networks and place functions into account. The ONRC factor provides the essential network efficiency component into the analysis, ensuring the results are both safe and appropriate for the network function.
- Road safety risk metrics, primarily Personal Risk, represents the crash exposure for individual road users on a road (Brodie et al; 2015), and is derived from 5 year crash data. Incorporating a safety performance metric of the road into the safe and appropriate speed assessment acknowledges the intrinsic link between travel speeds and safety outcomes. It aligns travel speeds with the safety performance of the road.

- Infrastructure Risk Rating (IRR), which is a road assessment methodology designed to assess road safety risk based on eight design features, operational characteristics and interactions with adjacent land use, independent of crash history. IRR is designed to proactively assess safety risk and is incorporated into the process to assess risk on roads where crash data is an unreliable indicator of safety risk, such as lower volume roads. Full details of the IRR assessment methodology, application and results are presented in 'An Automated Process of Identifying High-Risk Roads for Speed Management Intervention' (Zia et al; 2016.).

The criteria associated with all safe and appropriate speed outcomes for urban roads is shown in Table 1. A road section needs to satisfy the criteria in each of the 'Function / Feature', 'Road Safety Performance' and 'Infrastructure Risk Rating' assessment categories to justify the safe and appropriate speed.

The safe and appropriate speed for each road section is then compared to the posted speed limit. If the safe and appropriate speed and speed limit are the same, the road section is deemed to be 'in alignment' with the Speed Management Framework. Equally, where the safe and appropriate speed and speed limit are different, the road section is deemed to be 'not in alignment'.

Table 1. Proposed Safe and Appropriate Speed Criteria – Urban Roads

| Function / Feature | Personal Risk | Infrastructure Risk Rating | Safe and Appropriate Speed (km/h) |
|---|---|-----------------------------------|--|
| <ul style="list-style-type: none"> ONRC is Class 1 or 2 Identified as a Freight Priority Route in a Network Operating Framework Limited Access Road controls Median Divided | ≤ Low-Medium | Low or Low-Medium | 80 |
| <ul style="list-style-type: none"> ONRC is Class 1 or 2 Non-commercial adjacent land use | ≤ Medium | Low or Low-Medium' | 60 |
| <ul style="list-style-type: none"> ONRC is Class 1 or 2 Non-commercial adjacent land use | <i>No road safety metric used in the assessment</i> | Any IRR | 50 |
| <ul style="list-style-type: none"> ONRC is Primary Collector Residential adjacent land use | ≤ Medium High | Low to Medium | 50 |
| <ul style="list-style-type: none"> Any ONRC Non-commercial and non-residential adjacent land use | ≤ Medium-High | Low to Medium | 50 |
| <ul style="list-style-type: none"> Any ONRC CBD/town centre Residential neighbourhoods | <i>No road safety metric used in the assessment</i> | Low to Medium-High | 40 |
| <ul style="list-style-type: none"> Any ONRC CBDs or town centres with high place function and concentration of active road users | <i>No road safety metric used in the assessment</i> | High | 30 |

A key purpose of the comparison between the safe and appropriate speed and the speed limit is as an initial filter to reduce the number of road sections taken through for subsequent assessment, classification and prioritisation. It is not a confirmation that a lower or higher speed limit is justified. The overarching aim of the framework is to achieve regionally and nationally consistent outcomes and enable road controlling authorities to prioritise speed management efforts and available resources to risk.

Intervention Strategies and Prioritisation

Road sections not in alignment with the Speed Management Framework are assessed in further detail to identify speed management intervention strategies and to assign implementation priorities. This secondary assessment process incorporates the following additional factors:

- Travel speeds – both current operating speeds and estimated operating speeds.
- Collective Risk, which is a measure of the overall safety performance of a road.

Analysis of Speed on the Network

For the Waikato Speed Demonstration Project, current operating speeds for high-speed roads were calculated for 9,629 km of roads using an automation of the Austroads Operating Speed Model (Austroads, 2009; Harris et al, 2015). The model is based on maximum desired speeds

established from the speed limit, horizontal geometry and vertical terrain, and typical driver acceleration and deceleration behaviours approaching, travelling through and exiting curves. The use of a speed model is necessary where incomplete or unreliable actual speed data exists across a network.

As the Austroads Operating Speed Model is only applicable to high-speed roads, operating speeds for urban road sections needed to be estimated. Based on the analysis of some speed data in Hamilton, the following coarse assumptions were used in the estimation of existing operating speeds:

- All road sections with ‘Winding’ or alignment or worse, Operating Speed = Speed Limit – 5 km/h
- If ONRC is Class 3 or 4, Operating Speed = Speed Limit
- Otherwise, Operating Speed = Speed Limit + 5 km/h

Understanding the current operating speed for a road section and how this compares with the existing speed limit and calculated safe and appropriate speed, is a critical component of the speed management process for assigning intervention strategies and priorities. Equally important is an awareness of the likely change in operating speed if changes are made to the posted speed limit. For rural parts of the network, the future operating speed is normally calculated by simulating the automated operating speed model with the speed limit set to the safe and appropriate speed. However, given the scale of the Waikato region,

a different method was used to estimate future operating speeds. The method involved the detailed analysis of similar modelling previously completed on the high speed part of the network around the top of New Zealand's South Island. The analysis correlated current operating speeds with future operating speeds for different speed limit and safe and appropriate speed combinations.

The relationship between the change in operating speed as a result of a speed limit change was found to best fit a polynomial function. The following equation was derived for resulting operating speed of corridors with a posted speed limit of 100 km/h and safe and appropriate speed of 80 km/h:

Final Operating Speed

$$\begin{aligned} & - 8.824 \times 10^{-5} \text{ Existing Operating Speed}^3 \\ & + 0.011 \text{ Existing Operating Speed}^2 + 5.819 \\ & = 0.553 \text{ Existing Operating Speed} \end{aligned}$$

The simplified predictive relationship was then applied retrospectively and found to deliver a R² value of 0.99 for 3,262 km of rural roads assessed in the top of the South Island. This provided sufficient confidence that the simplified predictive approach for future operating speeds could be applied to the Waikato region.

Once all four speed values (existing speed limit, safe and appropriate speed, current operating speed and future operating speed) are known, the applicability of different speed management implementation strategies can then be evaluated and prioritised. All roads not in alignment with the technical framework are evaluated against the following four speed management intervention categories:

- Engineer Up – a road section that satisfies criteria to justify investment to bring the road section up to standard to maintain the existing speed limit or to support a higher speed limit.
- Challenging Conversations – a road section where the calculated safe and appropriate speed is below the existing speed limit and the current operating speed (i.e. road users are not understanding the inherent road risk). The criteria for Engineer Up is not satisfied but safety performance justifies intervention (reduce speed limit supported by low cost interventions to manage travel speeds down – involves robust engagement and challenging conversations).
- Self-Explaining – a road section where the current operating speed is comparable to or lower than the calculated safe and appropriate speed, both of which are lower than the existing speed limit (i.e. road users are understanding the inherent road risk and are driving accordingly – the speed limit should be reduced to reflect that behaviour).

- Potential Speed Limit Increase – a road section where the calculated safe and appropriate speed is greater than the existing speed limit and criteria is satisfied for a potential speed limit increase.

Attached to each intervention strategy are a series of factors. All road sections are evaluated against each factor under all intervention strategies to determine the intervention strategy that each road section is most closely aligned with. The factors assigned to each intervention strategies are:

- Engineer Up and Challenging Conversations – based on ONRC, Collective Risk, estimated Deaths and Serious injuries (DSi) saved and estimated DSi saved per km. Road sections with higher order ONRC, moderate to high Collective Risk and moderate to high estimated DSi savings are well-aligned with this intervention strategy.
- Self-Explaining – based on existing operating speed, operating speed change as a result of speed limit change, IRR and estimated DSi per km. Road sections with current operating speeds below the existing speed limit that exhibit little change in operating speed under a lower speed limit, have a moderate to high (poor) IRR and some existing crash history are well-aligned with this intervention strategy.
- Potential Speed Limit Increase – based on ONRC, Collective Risk, IRR and estimated DSi per km. Road sections with higher order ONRC, low to moderate Collective Risk and low to moderate crash history are well-aligned with this intervention strategy.

The 'Speed Increase' priority is only evaluated on those road sections where the calculated safe and appropriate speed is higher than the existing speed limit.

Calculating Deaths and Serious Injuries Savings

The estimation of death and serious injuries (DSi) that can be saved as a result of speed management interventions is based on a form of Nilsson's Power Model. Recent studies undertaken by Elvik (2009) and Cameron et al. (2010) confirm that speed environment is an important moderator of Nilsson's Power Model. Elvik concluded that in general, changes in speed have a smaller effect at low speeds than at high speeds. Furthermore, the analyses show that the exponents proposed by Nilsson based on speed limit changes in Sweden during 1967-1972 overestimate the expected DSi reductions due to various safety improvements in the last 40 years. However, both authors acknowledge that the Power Model remains a valid model of the relationship between speed and road safety if the exponents are adjusted according to speed environment.

Elvik's study presents separate exponents that are considered to be the best estimate to calculate DSi reductions for rural and urban speed environment. The generic form of Power Model equation for calculating future DSi is:

$$\text{Estimated Future DSi} = \text{Estimated DSi} \times \left(\frac{\text{Speed after}}{\text{Speed before}} \right)^{\text{Exponent}}$$

Where the exponent is set to 2.0 for urban environments (speed limit $\leq 70\text{km/h}$) and 3.5 for rural environments (speed limit $\geq 80\text{km/h}$). 'Speed after' values derived from the operating speed modelling have been moderated to ensure that potential DSi savings are not overestimated. This has been achieved by limiting the difference between current operating speed and future operating speed to a maximum rate of change of 5km/h for every 10km/h change in speed limit. This reflects national and international experience where the change in operating speed is rarely found to exceed 5km/h per 10km/h change in speed limit without supporting measures.

Based on experience, the change in operating speed rarely exceeds 5km/h per 10 km/h change in speed limit without supporting measures. This ratio is the upper limit in terms of the operating speed change. The technical analysis showed that, in most cases, the operating speed change per 10 km/h speed limit change is lower than this limit. Based on this experience and using Nilsson's Power Model, this translates to an average DSi reduction of 27% for 100km/h road subject to a proposed 80km/h speed limit, and 9% for a 50km/h road changing to 40km/h.

Road sections where the current operating speed is less than the existing speed limit will attract a lesser percentage reduction in DSi than road sections where the current operating speed is higher. Likewise, road sections where the current operating speed is lower than both the existing speed limit and safe and appropriate speed will generate few DSi savings, as the future operating speed will only reduce by a marginal amount, if at all. Road sections that fall into the latter scenario are most likely to be categorised as 'Self-Explaining' whereas those with a greater difference between current and future operating speeds are more likely to be categorised as 'Challenging Conversations', especially where the road section has an established safety issue. Despite the lack of direct safety benefits that are associated with the 'Self-Explaining' intervention strategy, the classification is important for helping to change the conversation and behaviours with the public around what safe speeds mean. The alignment of speed limits with operating speeds is expected to drive safer travelling speeds on other similar roads and deliver safety benefits across a wider area.

Prioritising High Benefit Opportunities

The highest benefit opportunities for speed management interventions are developed from the intervention strategy evaluation process.

'Speed Management Maps' (SMM) depicting the top 5% and 10% of high benefit opportunities by length have been prepared for every region in New Zealand, and are mapped geospatially on a tool accessible by all RCAs.. The SMM are 50% 'Engineer Up' and 'Challenging Conversations' and 50% 'Self Explaining'. The purpose of the 50/50 split is to ensure there is a twofold focus on both potential for DSi reduction from speed management intervention and improving the public acceptability of speed limit reductions.

If all the speed management interventions prioritised in the top 10 % high benefit opportunities for the network were implemented, it is estimated (using the analysis as detailed above) that approximately 189 deaths and serious injuries will be saved annually on New Zealand roads.

Finally, the process prioritises those road sections where the calculated safe and appropriate speed is greater than the existing speed limit based on thresholds set to rank each of these road sections. Road sections that have a 'High' or 'Medium High' Speed Increase priority are included in the SMM as potential speed limit increase segments. These road sections equate to approximately 0.15% of the total road network in terms of length.

A flexible and pragmatic approach

The Transport Agency is acutely aware that implementation of speed management on a regional and national scale to achieve desired safety outcomes whilst supporting economic activity requires extremely careful planning and consideration. To help realise this, the Transport Agency has invested significant time and energy in building confidence and support in the technical analysis by actively working with key stakeholders, such as the Automobile Association, Police and RCAs, in developing the process.

Although the technical analysis provides the platform for speed management decisions, it does not replace sound professional judgement. For the Waikato Speed Demonstration Project, safe and appropriate speeds, intervention strategies and priorities have been reviewed for numerous road sections of interest. Where there is a mismatch between the technical analysis and professional judgement, the technical processes were reviewed, and where necessary modified to reduce the number of anomalous outputs generated from the process. .

A key part of the process used in the Waikato Demonstration process was a local 'sense check', where the high benefit maps were critically reviewed by the road controlling authority engineering staff. Even at this stage, further refinements were able to be achieved to further improve the acceptability of the process outputs.

The engagement and willingness to modify the technical processes has resulted in an upswell of confidence and support for the speed management process in Waikato. This confidence is reflected by the technical outputs of the analytical process now being used by RCAs in Waikato to develop Speed Management Plans for local consultation.

The process refinement developed in the Waikato Speed Demonstration Project was then applied in the analysis for all of the regions across New Zealand. Notwithstanding this refinement, openness to 'sense-check' the technical outputs continues to be a critical element to ensuring local engagement, confidence and support for the new Speed Management Guide.

Implementation and engagement

Implementation is as important as and much more difficult than the technical analysis. This is especially true of many aspects of transport where public and political interest is high. Speed is a particularly sensitive topic.

An essential element of the Speed Management Guide is a new engagement framework that sets out to build better conversations on road risk, in order to support local authorities in their efforts to put in place positive and lasting speed management measures.

A principles-based approach

The engagement framework is grounded in conversation, holistic communication and social movement theory, and is based on engagement principles that are designed to empower local authorities to improve their engagement, and to encourage communities to participate positively in decision making.

Holistic communication theory (Zaharna et al; 2013) suggests that in order to influence people, it is necessary to allow oneself to be influenced, and this concept is central to the programme's design and implementation, and apparent in the communication and engagement principles that sit at the heart of the framework:

The engagement principles are an integral part of the Speed Management Guide, and accompanied by detailed guidance to help RCAs engage more deeply and meaningfully, and in a more sustained manner, with their communities.

The conversation principles have been designed to show RCAs the power of personal engagement to contribute to real, long term social change (Bridges; 2010) and have been presented to RCAs through online tools and face to face training modules.



Figure 2 Engagement Principles

Combined, these engagement and conversation principles encourage local authorities to involve as many parties as possible in their community engagement, to engage consistently (not just when they need to consult on changes) and to listen to a wide range of views, and potentially adapt their approach as they go based on that input, consistent with the theory of holistic communication logics.

Audience research

In preparing to implement the new approach to speed management, national market research was commissioned to ensure communities' beliefs, values and behaviours about speed, driving and road safety were understood.

The research had four elements:

1. Stakeholder Interviews (Comprising 20 in-depth interviews): Feedback from local government, transport industry and community groups revealed a range of views. Some believed that attitudes to speed could be changed through more strongly linking speed with risk, while others questioned the focus on speed altogether, believing that driver behaviour was the core issue. Others believed speed reduction needed to be 'better sold' or that it was more relevant to reckless drivers that should be more specifically targeted. Others acknowledged that the conversation needed to extend beyond speed to include road risk and that it needed to be better informed by locals with local knowledge.
2. Community Focus Groups (Comprising 4 group discussions in each of Cambridge and Taupo): Feedback from the community sample was that speed is a personal choice and one that many felt confident in making. They tended to trust speed limits as being indicators of safe speeds and felt comfortable exceeding these limits when they felt safe to do so. They resisted the idea that slowing down would save lives and tended to blame 'other' drivers for road safety issues.
3. National Survey (Comprising a national on-line survey of n=2,134 using the Research Now on-line research panel. Data was weighted to be representative of age, gender and region): This study revealed differences



Figure 3 Conversation Principles

by both region and the types of roads most frequently driven on. It also revealed four distinct segments that highlighted the range of different attitudes and behaviours in relation to speed, perceptions of road risk and support for changes. Drivers tended to agree that they were safer than others and that speed limits should reflect the risk on the road.

4. Waikato Community Survey (Comprising a telephone survey of n=1,328 residents drawn from random dialing from publicly available phone numbers selected based on meshblocks): This research explored local community perceptions and revealed differences in attitudes to both local road safety and awareness of local road safety conversations to support the Waikato Speed Demonstration project.

The National Survey research (on-line survey of n=2,134 using the Research Now New Zealand General Public Research Panel) revealed that:

- People are more likely to blame driver behaviour for crashes on their roads. They blame poor decisions (54%), driver distraction (50%), exceeding the speed limit (49%) and driving too fast for the road (45%).
- People are less likely to blame speed limits as being too high (19%) although they do acknowledge the role higher speeds play in injuries (84%). However they are less sure that slowing driver speed will save lives (55%) and they tend to be divided on speed limit reduction (31% support versus 33% oppose).
- In keeping with the above, people tend to believe the better solutions are to improve warnings to drivers of

changing conditions (66%) and to improve road design rather than reduce limits (62%). Where people live plays a key role in attitudes with those living outside small towns more likely to believe that some roads are not safe at their current limit (58% versus 41% nationally) and that it can be difficult to tell what a safe speed is. (42% versus 22% nationally).

The research findings have been invaluable in helping RCAs shape their approach to engagement, and also in adapting and evolving the engagement framework over time.

Attitudinal Segments

Through the research analysis, four segments of drivers were identified. Several attitudinal variables (including perceptions of road safety, speed and a desire to change limits) were run through the latent effects clustering algorithm and segment solutions were chosen in 2 ways:

- A manual run similar to K-means of 3,4,5,6,7 and 8 group solutions
- Automatic selection using the Bayesian Information Criterion (BIC). This chooses the best model / group solution with the smallest BIC from a 1 group to a 10 group solution.)

A four segment model was chosen and displayed significant demographic differences (such as by age, gender, driving patterns and by proximity to towns and cities.) as well as attitudinal differences (such as being concerned with road safety, being willing to advocate for safer driving etc.).



Figure 4 Four attitudinal segments related to speed management

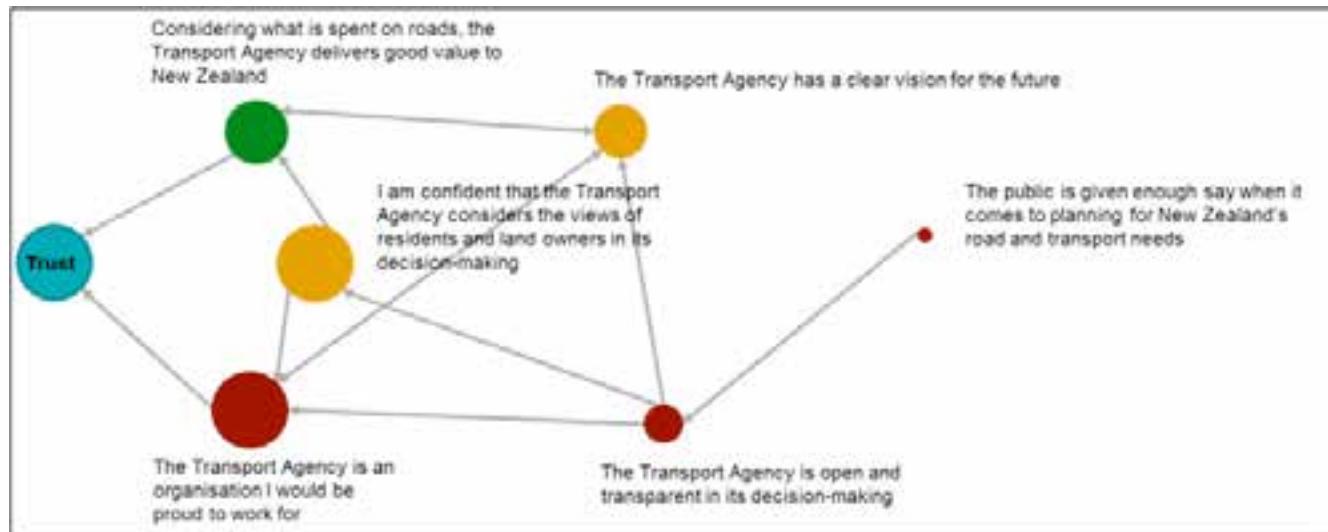


Figure 5 Taking local views into consideration is important to New Zealanders and leads to trust in decision-making

It's important to note here that they are not, however, about age or gender. For example, the 'Fast is Good' does not only represent young male drivers. It's simply that young male drivers are over-represented in this segment.

The segments are much more about the attitudes they represent, than about fitting a certain set of characteristics. The programme uses these segments to help people understand how different people think, and talk, about road safety.

Research Influence on Activities

The segmentation has helped narrow the scope and content of future engagement activity to address speed management's unique challenges. The research showed that more than half of New Zealanders had low engagement in speed issues (comprised of the 'Concerned but disengaged' and 'Care free' segments). The rest of the population was divided into polarised engagement (comprised of the 'Fast is good' and 'Safe speed advocate' segments).

Past research and experience with engagement around road changes gave us confidence to assume that when New Zealanders believe they have an opportunity to engage and that their opinions will be taken into consideration, roading changes are more likely to be supported through the formal consultation process. Figure 5 summarises the output of a bayesian network analysis conducted with NZTA survey data that identifies 'Confidence in the Transport Agencies consideration of the views of residents and landowners' as being an important driver of trust in the organisation.

Given that more than half of the population is dis-engaged from conversations around speed management, it is considered that in order to have a better conversation, first people need to notice that there is a conversation taking place. It has been decided to set the polarised segments aside and focus activity on:

1. Ensuring that people know that a conversation is happening
2. Ensuring that people know that they are invited to participate

It is acknowledged that most people in these segments will not participate. However, the working theory is that as long as they recall being invited to participate and made the conscious choice not to, they will be more likely to accept the final outcome, particularly if reports from those who did participate demonstrate a willingness on the part of the Transport Agency and local government partners to openly accept ideas and feedback.

In order to get participation from at least some within these segments, further focus will be on the "Concerned but disengaged" segment. This segment professes concern so is at least one step closer to engagement. The engagement tools, therefore are centred on making it easy for 'Concerned but disengaged' individuals to participate.

The research helped identify a productive space for engagement, not around speed and speed limits, but around the unique nature of New Zealand roads, as the image below indicates:

The research and accompanying news media audits (which analysed tone and content of media articles over three month periods in two regions of New Zealand) indicated that the current conversation, which tends to be around extreme road safety incidents and blame for other drivers, is not a helpful initiator for engaging in productive discussion about speed management.

Another important insight from both the Stakeholder and General Public Focus Group research is the extremely local nature of people's knowledge of and interest in roads. People know their roads. And their roads are different from other people's roads. And they believe they understand the changes their roads need, and the speeds that should be

posted on their roads better than people who do not live or drive in their region.

Working with and through stakeholders

Implementing the Speed Management Guide, and putting forward the new engagement framework, has involved working closely with stakeholders in the regions, to help them understand the framework and its implications and jointly find solutions to local problems or challenges.

Regions have been encouraged to introduce engagement at a much earlier stage, before any formal consultations. In this way the strategic objectives for an RCA's network have been explained early to gradually build public understanding and support for speed management interventions.

Communication and technical staff in partner organisations have been supported by providing engagement tools and templates, training on conversation theory, and support for developing communication strategies and implementing tactics.

The pace of change has also been important. The speed management framework supports the long term objective that travel speeds should reflect the function, use and safety of the network, but this will not happen overnight. Change should be at a pace that the public can accept and support.

Conclusion

Safe speed is one of the four pillars of the Safe System approach to road safety. The New Zealand Transport Agency's Speed Management Guide has introduced a single technical assessment framework that takes the road function, design, safety and use into account, to determine safe and appropriate speeds at a network level.

Where the safe and appropriate speed is different from the speed limit, a road section is said to be not in alignment with the framework. These road sections are assessed in further detail to identify speed management intervention strategies and to assign implementation priorities. A key aspect of this process is the understanding of current and estimated future operating speeds. The change in operating speed that may be realised from speed limit changes is used to estimate DSi that can be saved as a result of speed management interventions is based on a form of Nilsson's Power Model.

High benefit opportunities for speed management are developed so that 50% of the sections are within the ‘Engineer Up’ and ‘Challenging Conversations’ categories, and 50% are within the ‘Self Explaining’ category. The purpose of the 50/50 split is to ensure there is a twofold focus on both potential for DSi reduction from speed management intervention, and improving the public acceptability of speed limit reductions.

Whilst the technical analysis provides the platform for speed management decisions, implementation is much more difficult and important than the technical analysis. The Transport Agency is acutely aware that implementation of speed management on a regional and national scale to achieve desired safety outcomes whilst supporting economic activity requires extremely careful planning and consideration.

The second essential element of the Speed Management Guide is a new framework for engagement. The engagement framework sets out to build better conversations on road risk, in order to support local authorities in their efforts to put in place positive and lasting speed management measures. Early engagement with key stakeholders and openness to sense testing the outputs of the technical processes to reflect stakeholder views are key themes that

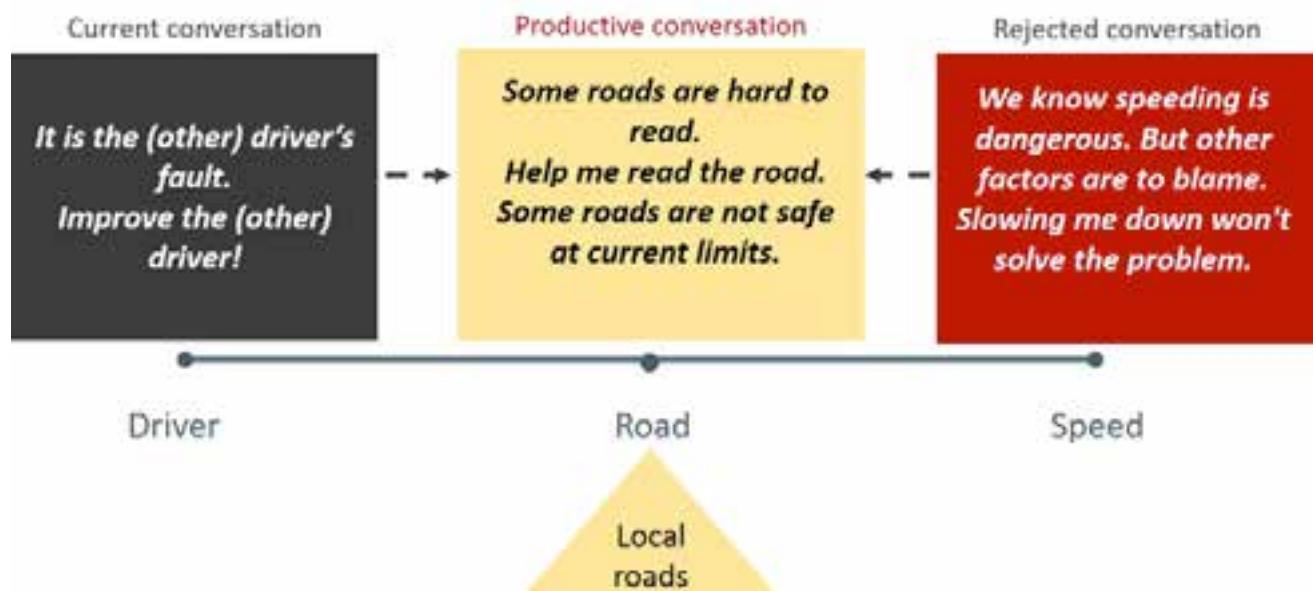


Figure 6 Productive conversations on speed management focus on the road

are contributing to the building of public understanding and support for speed management.

The ultimate success measure for road safety programmes in New Zealand is reduction and deaths and serious injuries. The Speed Management Guide contributes to this measure by aligning travel speed to the use, function and design of New Zealand roads, together with encouraging effective engagement through better conversations on road risk. Using both the technical and the engagement frameworks in the Guide is critical to achieving positive and lasting speed management measures, and when success is measured by reduction in risk, more options are open for consideration for reducing deaths and serious injuries.

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Contributed Articles

Road Safety Policy & Practice

Understanding low-level speeders to increase speed compliance via road safety campaigns

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Key Findings

- Greatest reductions in road trauma can be yielded by targeting the greater volumes of low-level speeders.
- Low-level speeders are disengaged from the notion that their behaviour can have consequences.
- Research has quantified and measured four distinct groups of low-level speeders, characterised by shared perceptions of ‘speeding’.
- Tactical messaging has addressed specific resistances and resulted in greater speed compliance over time.

Abstract

Reductions in speed and speeding will have an immediate impact on reductions in road trauma, yet persuading road users to adhere to speed limits remains a persistent communications challenge. Why is it that the risks of speed and adherence to speed limits remain a contentious issue amongst otherwise law-abiding road users? This paper explores some of the attitudinal and research insights that have been mined from extensive interviews with low-level speeders, the resulting campaign messaging and effects over the longer term.

Keywords

Speed; speeding; road safety advertising; campaigns; campaign effects; attitudes; behaviours

Introduction

The Motor Accident Commission (MAC) is responsible for road safety education campaigns and communication activities in South Australia on behalf of the Government of South Australia. MAC have engaged in investigative behavioural and attitudinal research amongst drivers across a variety of audiences, developing a body of knowledge of driver behaviour and attitudes since 2007. This includes the issue of speed and speeding.

Encouraging drivers to drive within speed limits is a key activity in MAC’s behavioural change program in recognition that reductions in speed and speeding is one of the cornerstones of the Safe Systems approach to reducing fatalities and serious injuries on our roads as documented in Towards Zero Together: South Australia’s Road Safety Strategy (Government of South Australia, 2011). At the same time voluntary compliance with speed limits, or

travelling within speed limits, is one of the most challenging behavioural issues facing road safety with considerable sections of the public viewing small increases over the speed limit as inconsequential and speed limits as arbitrary, inhibiting mobility and a source of opportunistic revenue raising.

In order to better understand the motivations for and attitudes toward low-level speeding MAC undertook investigative research to understand the psychology of low-level speeding to determine how best to craft tactical messages that may challenge those perceptions. Research was undertaken with Colmar Brunton Adelaide. Colmar Brunton are a market research agency specialising in both qualitative and quantitative research across a broad range of social issues and public education campaigns for Government and Not For Profit organisations.

Why low-level speeding?

Analysis by the Centre of Automotive Safety Research (CASR) of where injury and fatal crashes occur indicates that while speed reductions of any type would be expected to reduce injuries and fatalities, the greatest potential gains for reducing injuries appears to be in targeting low-level speeding, between 0-10km/h over the legally signed speed limit, on Adelaide low speed (50km and 60km) roads. For fatalities this would be extended to include low-level speeding on high speed rural roads (Doecke, Kloeden and McLean, 2011).

For this reason, MAC's speed related programs target those drivers that 'low-level speed'. At very high speeds the risk of crash becomes severe and when a crash occurs the results are dramatic. These types of crashes generally garner the most media attention and are of the style that is generally referenced when community speaks to speed, speeding and speeders. However, the sheer number of low-level speeders contribute to a large proportion of the risk associated with speeding. (Gavin, A., Walker, E., Murdoch, C., Graham, A., Fernandes, R., and Job, R.F.S, 2010)

Attitudes to Speeds

Numerous research projects undertaken by Colmar Brunton over seven years have unearthed many attitudes and behaviours toward speeding. There are many stated rationalisations for when people speed, such as running late or keeping up with the flow of traffic, however whatever 'excuse' is given there appears to be consistent themes.

Commonality of speeding

Speeding is considered to be extremely common among both regional and metropolitan speeders. Respondents do appear to feel overall that traffic was slowing down but some attribute this to speed limit reductions and roadworks, rather than greater compliance. Regional respondents indicate they are trying to slow down more and speed less. Some (especially regional females) indicated that they are now more aware of their speed than they had been previously. Metropolitan respondents indicate some effort at reducing speeding, largely motivated by the size of fines and the perceived increase of enforcement from cameras and police.

Ease of speeding

Among regional males, the design of modern cars was cited as encouraging speeding. Among regional females overtaking was the key thing that justified speeding. For the metropolitan participants, other drivers speeding and being familiar with the route (and the locations of fixed cameras) made it easier for people to drive over the speed limit.

Perceived consequences of speeding

While those who do not speed think speeding is not acceptable and feel like they are in the minority, those who speed think driving under the speed limit is unacceptable and dangerous. Most speeders feel that low-level speeding is

something very different from excessive speeding and that the "problem" is not low-level speeding but all excessive behaviours, including drink and drug driving. Low-level speeding is not seen as a big issue and acceptable to most speeders. Regional respondents considered negative consequences of low-level speeding to be "unlikely" other than enforcement which was considered relatively easy to avoid. Most metropolitan participants also felt negative consequences of low-level speeding were unlikely, however was of greater concern than amongst regional drivers. The concern however, was more related to 'other drivers' rather than potential risks they were creating themselves.

There is a group of persistent speeders, most likely to be metro males, who feel there is nothing wrong with the behaviour. In summary, persistent speeders expressed the following attitudes:

- Negative consequences are not applicable to them.
- Other drivers are to blame for dangerous situations and crashes.
- Extensive arsenal of excuses, with some irrational or contradictory (e.g. running late but at the same time acknowledging lack of time saved by speeding, keeping up with the flow of traffic, above average driving skill mitigating risks, its dangerous to drive under the legally signed speed limit.)

When they would not speed

Driving over the speed limit is accepted in 50, 60, 80,100 zones. Respondents said they would not speed in 40 zones and especially not when there are people around. This suggests when people can see a justification for the speed limit they will obey it.

Non-speeders and perceived consequences of non-speeding

Non-speeders feel pressured by speeding traffic. Non-speeders indicated that they intentionally slow down if someone behind is pressuring them to drive faster but get frustrated that that speeders appear to suffer no negative consequences. Non-speeders essentially receive constant negative reinforcement from obeying the law. This suggests there is opportunity to reinforce and reward non-speeders' positive behaviour.

"Hooning"

Most low-level speeders were disparaging of high level speeders (even if they used to be guilty of this themselves). There is an opportunity to leverage this attitude by persisting with encouraging people to think of any speed over the limit as speeding.

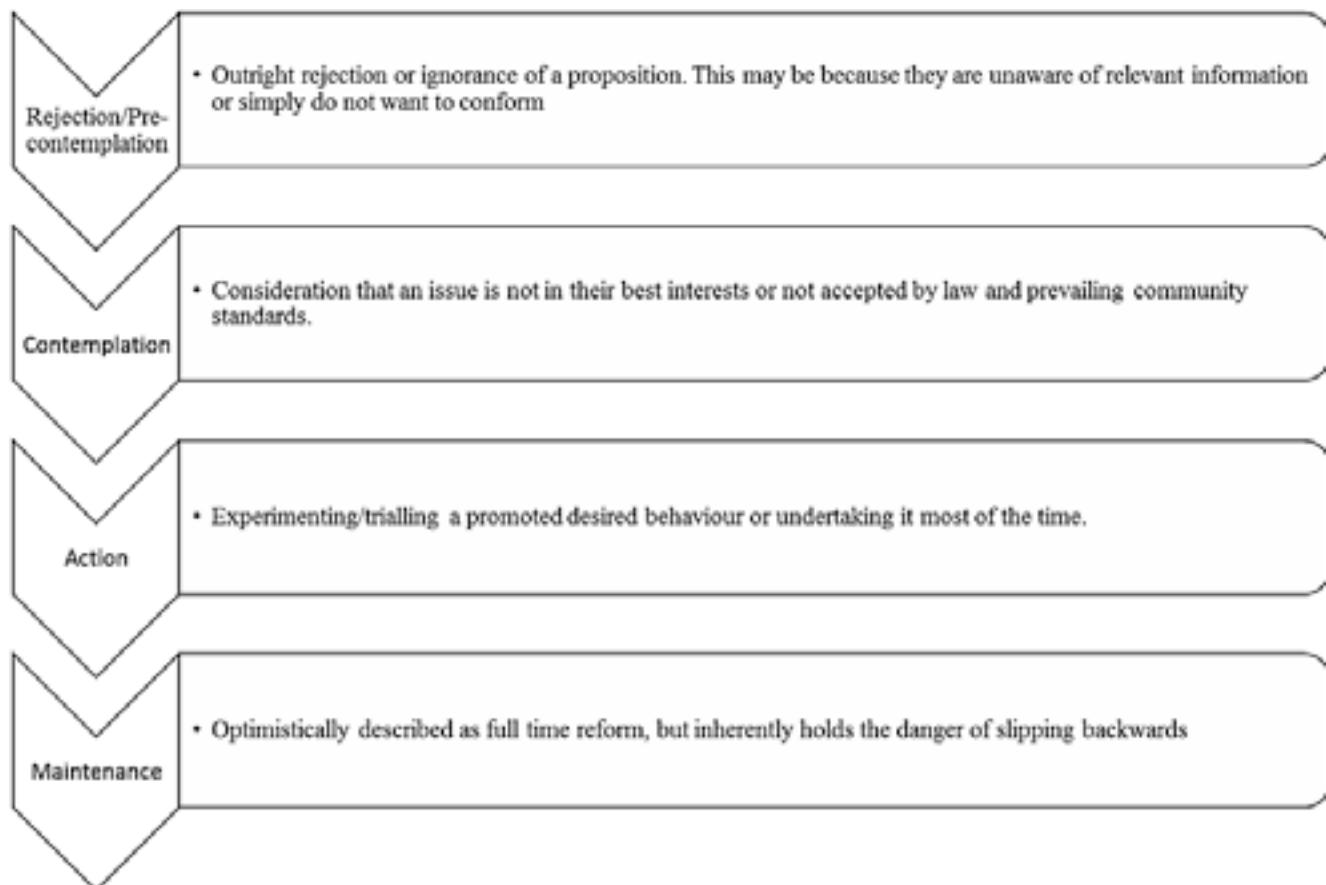


Figure 1. An adaption of the Prochaska and DiClemente behaviour change model – Stages of Behaviour Change

The Communications Challenge

'It's not an issue'

Those interviewed regarding their low-level speeding behaviour indicated that they disapproved of extreme behaviours such as 'hooning' and drink driving. Low-level speeding does not carry the same level of social stigma as other issues and is not seen as an overtly dangerous act likely to increase the immediate danger of a crash. It is also engaged in by a greater number of road users (as opposed to issues such as drink/drug driving) who would likely view themselves as law abiding citizens.

So why do they 'low-level speed'? A consistent theme to emerge from feedback to MAC speed campaigns, and focus groups conducted in their development, is a pronounced cynicism that low-level speeding has a meaningful contribution to road trauma.

Traditional depictions of road trauma in low-level speeding advertising are seen as exaggerated outcomes reinforced by drivers' own experiences in not having crashed over many years of regular speeding. The absence of any crash, let alone a serious crash, after an individuals many years of low-level speeding is often cited as absence of evidence that their speeding could be contributing to crash risk. It is this that sits at the heart of the problem of low-level speeding and

the challenge of expressing the problem to the public. Low-level speeding, unlike other road safety and social marketing issues, does not have an intuitive or obvious cause and effect relationship.

Broad Audience

Compounding the problem is the fact that the low-level speeding issue is relevant to such a broad section of the community. As such, there is greater diversity in the 'target audience' making messages that resonate with all of them more challenging than with some more tightly defined audiences.

Unengaging Subject Matter

A key problem identified in focus group testing is that the subject matter regarding speeding is not compelling to the target audience. While it is easier to find the drama in more obvious cause and effect relationships, such as drink driving or not wearing a seatbelt, the communication of the facts of low-level speeding are difficult to make interesting.

While often challenged, audiences can also be accepting of some data presented however its ability to engage and motivate is limited. For this reason, the delivery of messages in this issue needs to be engaging in order to cut through and hold attention.

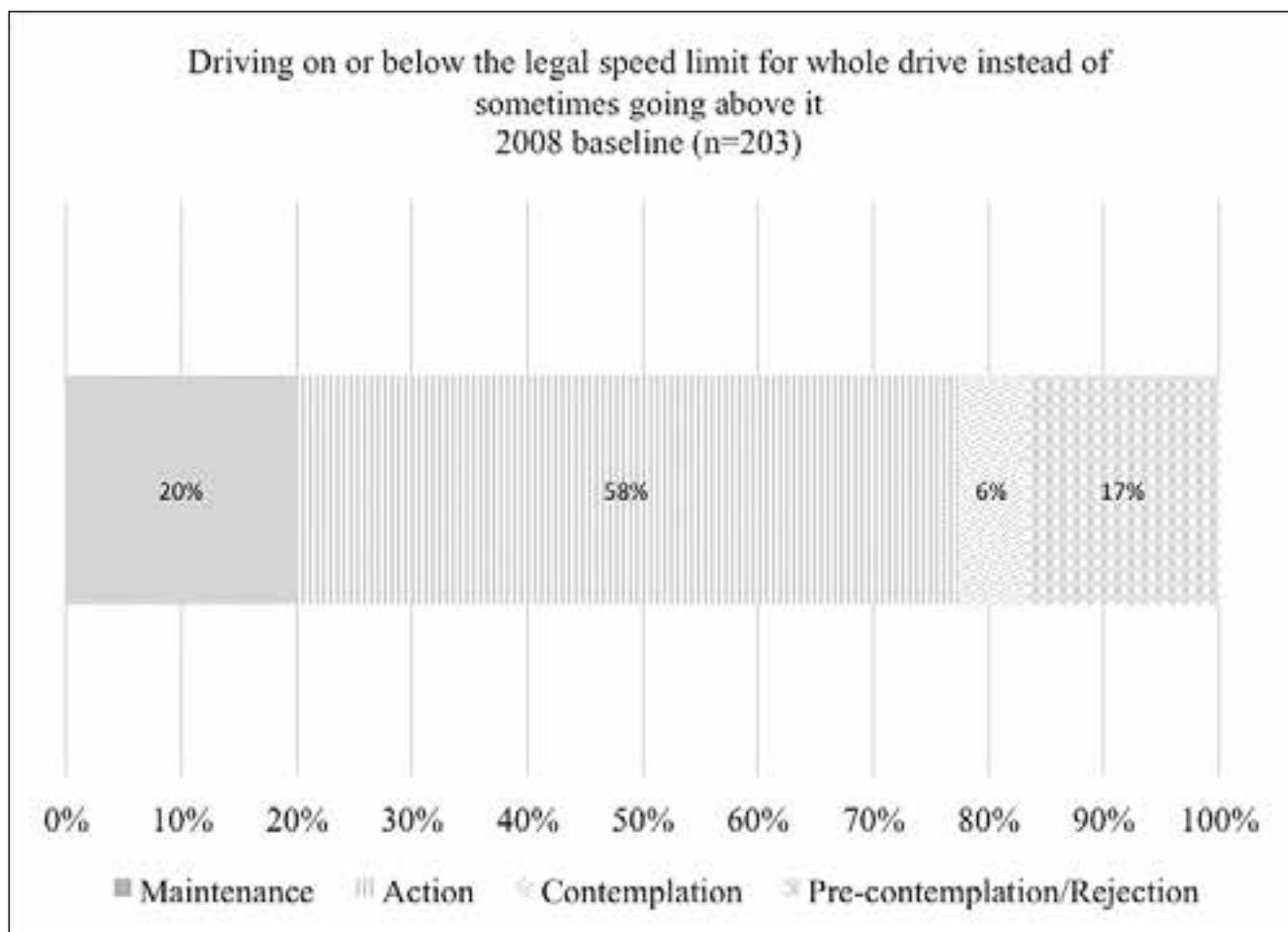


Figure 2. Stages of Speeding of South Australian Road Users, 2008

Behaviour Change

In applying road safety messaging to audiences MAC and Colmar Brunton use an adaption of the Prochaska and DiClemente behaviour change model (Figure 1), to analyse and quantify where audiences sit on the path toward desirable road user behaviour. In the case of adhering to or below the legally signed speed limit, in 2008 a quantitative survey of South Australian Road Users (Figure 2) showed that only a minority of drivers adhered to the speed limits all the time with similar proportions rejecting the notion of adhering to speed limits.

Re-positioning Low-level Speeding

In 2008, a survey of South Australian drivers, exploring attitudes toward the issue of speeding, identified a problem with the language road safety communicators were using around speed. The words ‘speed’, ‘speeding’ and ‘speeders’ were intrinsically linked to high level speeding. Most speeders felt that low-level speeding was something very different from excessive speeding (more than 10kms over the limit) and that the “problem” is not the low-level speeding but in fact the excessive behaviours (including excessive speeding, drink and drug driving). To ask someone not to ‘speed’ was to ask someone not to grossly exceed

the speed limit in an obvious display of dangerous driving. Therefore, campaigns targeting low-level speeders were deemed irrelevant to the specific behaviour of driving between 1-10km/h over the legally signed speed limit and went unnoticed.

“Creepers 2008-2012”

Based on the 2008 research, the term ‘creeping’ was coined to refer to the road safety issue of low-level speeding, distinguishing it from the extreme behaviour that disconnected low-level speeders from their negative actions. The “Creepers” campaign was developed to re-frame the low-level speeding argument so that it was relatable to the routine behaviour of daily low-level speeders. An education campaign was launched to impress upon ‘everyday drivers’ that ‘creeping’ had a cumulative impact that resulted in a high level of casualty crashes. “Creepers” ran from October 2008 to 2011 with two evolutions to ‘refresh’ the creative.

Key learnings:

The term “Creeper” evidently became part of the vernacular and imbued with meaning. It is clearly distinguishing for drivers between driving “just a little bit” over the speed limit as opposed to driving at excessive speeds. However, as the term “Creeper” became strongly associated with a particular

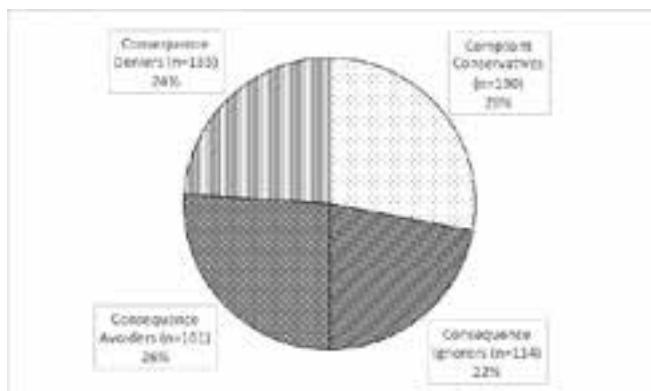


Figure 3. Segmentation of low-level speeders (n=600)

type of speeding, the visuals used in the Creepers ads now stand out strongly as not being related to “creeping” but rather to “high level speeding” and the ads consequently lost credibility.

While there was value in the continued use of the term “Creeper” to denote low-level speeders, campaign visuals and tactical messaging needed refreshing.

Characterising and Grouping Low-level Speeders

Having established low-level speeding as a relevant issue and relatable behaviour, in 2011/12, quantitative research was undertaken amongst South Australian low-level speeders to segment them on the basis of attitudes toward speeding and willingness to change, recognising that the motivators for all speeders would not necessarily be the same. The following segments were identified and were found to be fairly evenly distributed in the population, as illustrated in Figure 3 below.

Consequence Deniers (24%) – Do not believe speed is an issue. Hardest to shift.

This group tends to span the age and gender distribution of drivers with no skew towards a particular demographic, household type or level of education. 56% are male and 59% are aged over 40 years of age including 42% who are aged between 40 and 64 years. 80% of this group live in metropolitan Adelaide although 38% drive on regional roads at least weekly. They drive often with 99% driving at least 3 times per week and do not consider low-level speeding to be speeding. Speeding is defined as 10km/h + over the legally signed limit.

For this group there is little consequence to low-level speeding and it is likely that they believe an enforcement focus on low-level speeding is motivated by factors other than safety (such as revenue raising or political motivations). They deny that there are any meaningful consequences to low-level speeding. This can be seen in their relatively high levels of agreement that “driving up to 5kms over the limit is fine in 50 and 60 zones” and that “low-level speeding doesn’t cause accidents”. They show a lack of respect for

the law and perceive low risk of being caught speeding at low-levels. They are less likely than other groups to agree that “you should never drive 1 to 5 kms over the speed limit because it is the law” and “I risk getting caught and fined if I drive between 1 to 5 kms over the speed limit”.

Potential messages/approach

This group is the hardest to shift with communications in isolation and will most likely respond to interventions that significantly increase penalties and opportunity for detection.

Consequence Ignorers (21%) - Do not believe speed is an issue. May respond to new information or penalties, or changes in overall traffic speeds.

This group skews to young male drivers that drive frequently. 61% are males and 38% are aged between 16 and 35 years. 71% live in metropolitan Adelaide and 29% in regional South Australia. They have a high frequency of driving (92% everyday) and half drive at least weekly on regional roads. They acknowledge that they sometimes creep over the limit, particularly in response to the speed of the traffic flow. Despite their speeding behaviour, they do acknowledge the risk of low-level speeding. While they have a high incidence of being fined for speeding their focus tends to be on avoiding the potential consequences of low-level speeding while still indulging in the behaviour – they ignore the consequences.

Most try to not speed most of the time but 9% deliberately drive over the speed limit. If they realise they are creeping they are more likely than other groups to maintain the higher speed rather than slowing down - one third of this group would not slow down to the speed limit if they realised they were speeding. They have the highest incidence of having been fined for speeding (80%).

This group agrees that they risk being caught and fined at low speeding levels and agree that small reductions in speed can positively influence crash chances and outcomes. They also have a higher level of agreement, compared to Consequence Deniers that people should not drive over the speed limit simply because it is the law. They are also more likely to worry about a crash if low-level speeding in a 60 zone and less likely to agree that low-level speeding is fine in 50 and 60 zones. This group is also likely to go along with changes among most drivers.

Potential messages/approach

They tend to keep up with the flow of traffic and see speeding as “normal”, a shift in other people’s driving is likely to have a flow on effect to this group.

Consequence Avoiders (26%) - Acknowledge speed as a potential issue. Need encouragement.

These are drivers that try to not speed but find themselves doing so to keep up with traffic or without realising it. When they realise they are speeding they tend to slow down to the speed limit. They not only acknowledge that their driving choices contribute to overall levels of trauma but are also motivated by fear of being caught and punished. They avoid the consequences of speeding.

There is a skew towards females in this group (62%). A significantly high 16% are on a provisional licence, however, there is no general skew among this group towards younger drivers – the age profile is similar to the overall driving population with 62% aged over 40 years. 75% live in metropolitan Adelaide.

They are moderately frequent drivers with 77% driving every day; 40% drive less often than monthly on regional roads. 98% try to not drive over the legal speed limit. Only 2% indicated that they sometimes knowingly speed. This approach is reinforced by the 64% who would immediately slow down to the speed limit if they realised they were low-level speeding.

This group considers personal contribution to the road toll to be credible with the highest average agreement of all the segments that they are personally reducing the road toll by driving on the speed limit. They are motivated to try to stay on the speed limit because they might get caught or simply because it is the law. They are equally worried about having a crash (more so in a 110 zone than in a 60 zone) and getting caught and fined when speeding.

As they have a willingness to do the right thing, and an acceptance that there are consequences to the unsafe behaviour, the critical element might actually be around increasing encouragement to reduce overall speeding, such as deliberately slowing down when realising they are driving over the limit.

Potential messages/approach

These people need to be instructed to decide if they want to be part of the problem or part of the solution. Their willingness to accept the consequences of low-level speeding would make them amenable to messages about being part of the solution. Encouragement to slow down when one becomes aware they are speeding, or resisting the temptation to speed from surrounding traffic.

Compliant Conservatives (28%) - Need reinforcement of behaviour

This is the group of drivers that actively chooses to not speed at low-levels. These drivers acknowledge and actively avoid the risks of low-level speeding. While they agree that one should not drive over the speed limit because it is the law, they are more focussed on the potential consequences of low-level speeding.

This tends to be an older group with 24% aged 74 and older. There is a skew towards females in this group (58%). 71% of this group live in metropolitan Adelaide. They are less frequent drivers being more likely to drive 2-3 times a week rather than daily compared to other segments. A significant 17% of this group never drives on regional roads. These people never deliberately drive over the speed limit on either metropolitan or regional roads. They are significantly more likely to drive less often than monthly on regional roads (57%). Their incidence of having ever been fined for speeding is also relatively low at 49%.

This group is sensitive to the definition of speeding with a significantly high incidence of defining speeding as 1-2 kms over the speed limit. This definition applies in both metropolitan and regional speed zones. When this group realises they are driving above the legal speed limit they immediately slow down – and have a significantly high incidence of slowing down to below the legal speed limit (38% for metro roads; 46% for regional roads). They have a relatively lower level of agreement that they sometimes speed to keep up with the flow of traffic, or that speed limits are generally too slow. They are equally worried about having a crash (more so in a 110 zone than in a 60 zone) and getting fined when speeding.

Potential messages/approach

Positive reinforcement of doing the right thing and putting up with pressure from other drivers, would reinforce this group's decision to not speed.

Evolution of Speed Campaign Messaging

"Crash Puzzle 2012-2014"

The prevailing view that low-level speeding does not make any difference is likely because many people low-level speed very often and have never suffered a negative consequence. Because so many people think this way, we have very high volumes of cars exceeding the speed limits by a small amount. The aggregated impact of this in traffic is a higher number of avoidable crashes.

If everyone slowed down and stuck to the legally signed speed limit, the aggregated impact on traffic would be a reduction in crashes. Because the actual impact on an individual and their individual trips may be negligible, 'Crash Puzzle' approached the low-level speeding issue as a broader community issue as one might with a water-saving campaign or an environmental campaign. That is, the small contributions of many people will have a big impact on society.

Pre-campaign research identified that when the low-level speeding argument was framed in this fashion it resonated and had the potential to change behaviour. That is, it encouraged people to slow down and stick to the legal speed limit, not out of fear of having a crash or getting a speeding ticket, but out of a desire to play their small part in reducing road trauma on our roads.



It is from this insight that campaign line and underlying strategic thought was drawn. The concept of Body Crash sought to demonstrate in an engaging way, that the low-level speeding issue is a community one, that when cars crash it is really people who crash, and that most importantly, we all play a part in the solution.

Key learning:

Awareness of this campaign was lower than previous campaigns suggesting the softer approach impacted cut-through. While the cumulative impact of volumes of low-level speeding traffic on the crash rate has merit, the challenges of articulating this concept to drivers is embodied in the abstract nature of this campaign compared with driver's daily experiences.

"Mistakes 2014- 2016"

This campaign aimed to reframe the way that people look at their speed when they are driving. Rather than challenge the driver's own behaviour it challenges the behaviour of 'other people'. The speed a person chooses to travel at needs to leave room for any potential error, whether it is theirs or someone else's. At speed, there is less opportunity for a driver to react to a mistake and recover. This campaign was developed by the New Zealand Transport Agency who kindly granted permission for its use in South Australia.



Key learning:

The impactful nature and talk ability of this TVC increased awareness of the speed issue considerably after launch. It has been broadly shared on social media and responded to positively.

Post campaign research also indicated that sections of the community viewed the creative as a cautionary message and promotion of safe driving generally.

"Hairy Fairy 2016-present"

This campaign aimed to normalise driving within speed limits by challenging some of the entrenched misconceptions around low-level speeding by;

- demonstrating that 'most people don't speed'
- educating the increased crash risk from small increments in speed
- encouraging compliant drivers not to succumb to speeding traffic
- encouraging speeders to correct their behaviour when they notice they are speeding

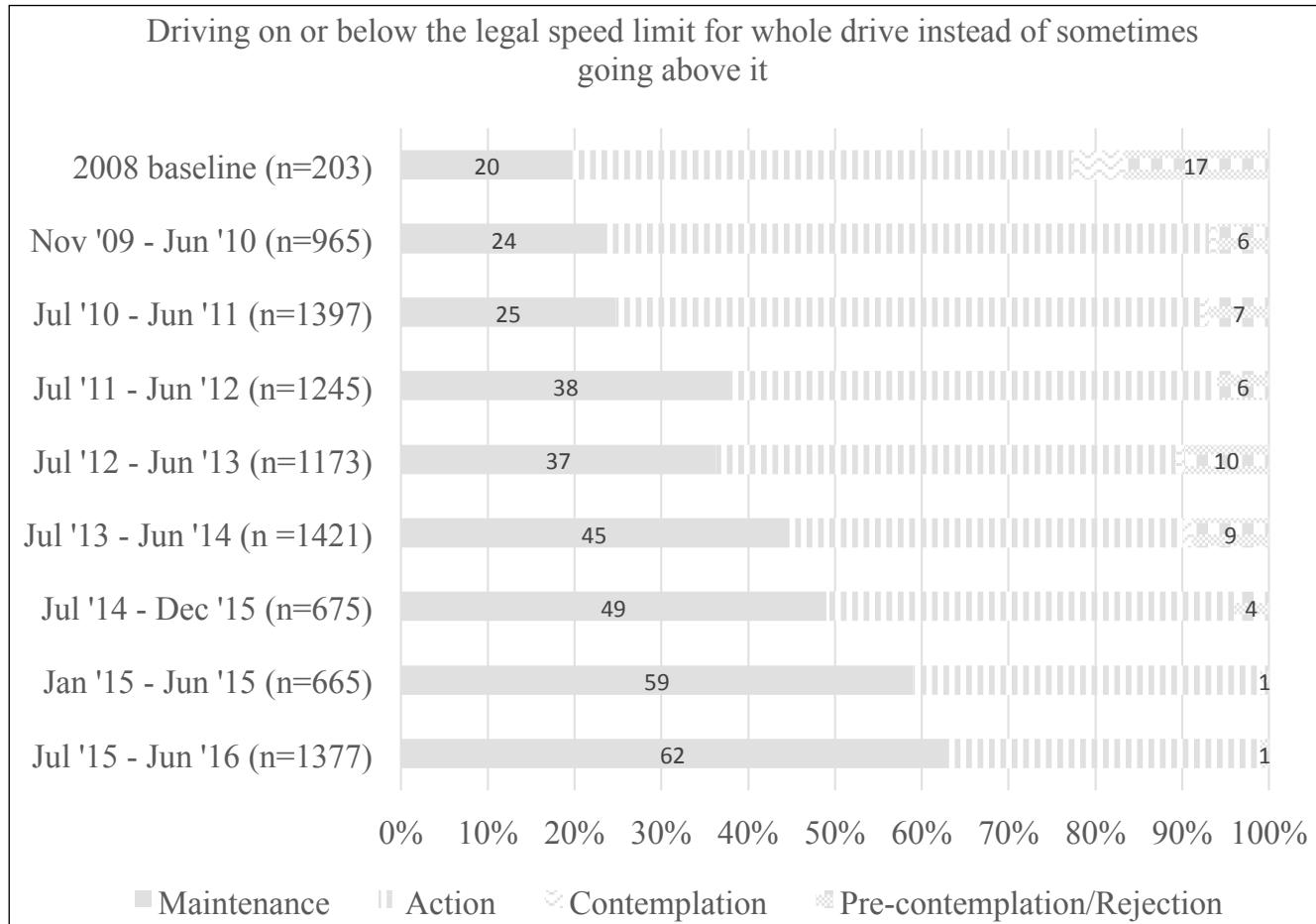


Figure 4. Stages of Speeding of South Australian Road Users, 2008 – June 2016

The presentation was in humorous style in order to cut through and engage audiences with a subject matter that carries the risk of being un-engaging. Launched in November 2016 and having had one month in market, sufficient data to assess campaign effectiveness is not yet available. However, initial feedback suggests cut-through, engagement and talk ability has been achieved.

Key Learnings and Campaign Effects

Reasonable expectations need to be set against what can be achieved through delivery of persuasive messages seeking attitudinal and behavioural change over time. The research has made clear that against the group of Consequence Deniers, the entrenched cynicism will make persuasive arguments difficult and interventions such as increased enforcement and penalties are heavier motivators.

Against other groups, a pre-disposition toward recognising the issues of low-level speeding give greater potential leverage, although best practice of delivery of these messages concurrent with enforcement activity is still relevant.

Campaign results are best tempered by isolating those variables that we can be confident our campaigns directly

influence and can be measured. In this instance the self-reported attitudes and behaviours have been measured via quantitative market research tracking.

Since 2008, the number of drivers who drive on or below the legal speed limit has grown significantly from 20% to 62% while at the same time, those who reject the notion have decreased significantly from 17% to 1% (see Figure 4 below).

Pleasingly, the behavioural results reflect the crash results, strengthening the argument that our combined efforts are pushing the regional road safety issue in the right direction. The implication of speed in South Australian road crashes in 2008 was 36%, decreasing to 30% in 2015.

Conclusions

Research on perceptions and motivations for speeding has highlighted the need and guided message development to reposition speeding as a relevant issue. The development of an attitudinal and behavioural segmentation of drivers in reference to speeding enabled the tailoring of messages to specific segments. Research has also identified perceptions that can be leveraged to improve desirable road behaviour as well as one segment that is unlikely to be influenced (i.e.

Consequence Deniers). These research findings guided communications, resulting in greater compliance with speed limit over time.

Tracking of campaign effects have shown that message effects of specific campaign executions appear to diminish quickly, necessitating continuous re-invigoration of messages and approaches to the problem. Memorable and impactful messages that provide cut-through are necessary to overcome perceived dryness and relevance of the issue. Tracking research also suggest that emotive messages, rather than rational, appear more salient.

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Road Safety Case Studies

Speed Limits: Getting the limit right – the first step in effective Speed Management

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Key Findings

- This paper illustrates and challenges some of the orthodoxy surrounding the setting of speed limits using a case study:
 - Focus on the safe speed limit without compromising on the assumption it may be unacceptable to drivers.
 - The correct safe speed limit is essential to deliver further speed management initiatives.
 - The 85th percentile method for setting speed limits does not deliver a safe speed limit.
 - Proposes that there may be an ideal range when reducing a speed limit.

Abstract

The safety benefits of reducing speed limits and managing travelling speeds is well proven. However, practitioners involved in reviewing and setting speed limits continue to include practices that are based on assumptions. This paper uses a case study to apply established road safety models while challenging established practices that limit the potential for safety benefits. The next step is to better understand, through research, the range of effects on driver behaviour when speed limits are reduced and to develop physical devices suitable to safely moderate travelling speeds on higher-speed roads.

Key Words

Speed limits, speed limit increments, driver compliance, speed calming, speed management on high-speed roads

Introduction

It is still often stated that drivers will choose to travel at a speed they feel most comfortable, regardless of the posted speed limit. However, research suggests this simplistic statement underestimates the factors that influence driver behaviour. Research in developed countries has demonstrated that the speed limit affects speeding behaviour (Nilsson 2004, Elvik 2009). It could also be argued that this is in an environment with high-profile police enforcement.

Experience in the Middle East suggests that, like the developed nations, speed limits are regularly exceeded (Al Ghamsi 2006) but that they too can have an influence on driver behaviour. The results of a recently evaluated case study demonstrate that posted speed limits affect driver behaviour and that, based on reduced travelling speed, a positive road safety benefit can be expected.

Furthermore, while setting a safe speed limit is an important first step to maximising road safety, the benefit would be greater if additional speed management measures were introduced. The temptation to compromise when setting a speed limit based on anticipated driver preference is to compromise on the potential safety benefit.

Case study

Following a number of complaints from members-of-the-public and Police it was decided to reduce the speed limit on a 40 km length of desert road from 120 km/h to 80 km/h. The road is a major collector road connecting the capital city to an important regional centre. It is a two lane undivided road with a high percentage of heavy vehicles.

The road is largely straight with mostly unencumbered clear zones. However, there is a history of vehicles rolling over in the clear zones due largely to speed and the softer surface (sand). There are a number of intersections along the road

with basic T-junction layouts and some channelling for deceleration and acceleration. It is noted that these junction types allow for vehicles to turn across high speed oncoming traffic, which can be an unsafe manoeuvre. The road was in fair condition throughout the evaluation, with extensive heavy patching in places.

Intervention: speed limit reduction

The decision to reduce the speed limit to 80 km/h was based on sound Safe System principles (Marsh and de Roos 2016) and the likelihood for a vehicle occupant to survive a head-on crash at an impact speed of 70 km/h or less (RTA 2011). Due to budget constraints and noting that the road is scheduled to be upgraded to a dual lane road in the near future it was possible to install speed limit signs only. No additional works were undertaken to support the reduced speed limit and no additional speed enforcement was undertaken.

The speed limit was reduced in December 2015 and 7 day 24 hour speed surveys were undertaken before and after the speed limit change to monitor the effect on driver behaviour. The before speed survey results suggest that while vehicles were not travelling at 120 km/h they were still travelling in excess of 110 km/h, which should be considered unacceptable for an undivided road (with potential for head-on crashes and right-against crashes at junctions). The speed survey results obtained after the speed limit change show that 85th percentile vehicle speeds reduced by 8 to 17 km/h (Table 1) and mean speeds by 6 to 8 km/h (Table 2).

Fatal and injury crash reductions

Unfortunately, reliable crash data is not available to directly measure the effect of the reduced speed limit on road related trauma. However, by using the Power Model it is possible

Table 1. Before and After 85th percentile speed results

| 85th percentile | Before | After | Difference | % change |
|------------------------|------------|------------|------------|----------|
| Westbound | 112.7 km/h | 104.6 km/h | -8.1 km/h | -7.2% |
| Eastbound | 110.9 km/h | 93.5 km/h | -17.4 km/h | -15.7% |
| Both Directions | 111.8 km/h | 99.1 km/h | -12.7 km/h | -11.4% |

Table 2. Before and After mean speed results

| Mean | Before | After | Difference | % change |
|------------------------|-----------|-----------|------------|----------|
| Westbound | 90.6 km/h | 84.6 km/h | -6.0 km/h | -6.6% |
| Eastbound | 85.5 km/h | 77.5 km/h | -8.0 km/h | -9.4% |
| Both Directions | 88.4 km/h | 81.1 km/h | -7.3 km/h | -8.3% |

to predict the road safety benefits and casualty savings as a result of the reduced speed limit. The model was originally developed by Nilsson (2004), later validated by Elvik (2005 and 2009) and subsequently tested by numerous case studies including Bhatnagar (2010). The Model enables a simulation of the relationship between measured speeds and level of trauma and, by inference, the effect of changing the speed limit.

The Power Model predicts that a 1% reduction in mean speeds results in: a 2% reduction in all injury crashes, a 3% reduction in fatal and serious injury crashes; and a 4% reduction in fatal crashes. When applying the same principles to this road, which experienced an 8.3% reduction in mean speed (two-way), it is anticipated that there will be a 16.6% reduction in injury crashes, 24.9% reduction in serious injury crashes and 33.2% reduction in fatal crashes.

Impact on driver behaviour

In this case, the original speed limit of 120 km/h was too high. Allowing (or endorsing) opposing vehicles that are travelling at 120 km/h to pass each other on a road while separated only by a thin white line is unacceptable and serious head-on crashes will be inevitable. Based on Safe System principles and associated survivability curves (Marsh and de Roos 2016, RTA 2011) the speed limit should be no more than 80 km/h.

It is interesting to note that when considering the before speed survey results the majority of drivers also felt uncomfortable traveling at 120 km/h, with 85 percent not exceeding 112 km/h. The after speed survey results indicate that drivers felt more comfortable travelling at about 100 km/h.

The results suggest that:

- Setting the speed limit too high acts as a target value that drivers will attempt to drive to;
- The old style 85th percentile method for setting speed limits would have suggested a speed limit of 100 km/h which would have been too fast for these road conditions (Al Ghamsi 2006, Austroads 2008).

In time this road will be upgraded to a dual lane road designed and constructed to high engineering standards. When the potential for head-on crashes is eliminated by the introduction of median barriers the speed limit will be further reviewed and increased to 100 or 120 km/h depending on the junction treatments (either at-grade or grade separated).

Further initiatives

While the reduction in traveling speed will deliver pleasing road safety benefits there is more that could be done to make this a safe road. The road is through an open desert environment with three junctions and large sweeping curves (with radius greater than 800m). The two most obvious remedial safety measures that could be applied here are enforcement and engineering.

Enforcement

There is little opportunity for high-profile face-to-face police speed enforcement on this remote desert road which thus relies on unattended or automated enforcement. Fixed speed cameras operate best as blackspot type treatments (ARRB 2005). However, it is not possible to identify specific blackspots due to lack of crash data. Anecdotally, serious crashes occur anywhere along the road with some increased risk at the junctions due to turning vehicles.

The optimum speed enforcement method in this environment is point-to-point (or average speed) speed cameras. It has been shown that point-to-point speed cameras can: 1) reduce serious casualties by up to 65% (Soole et al 2013); 2) improve compliance with speed limits by an average of 5 km/h; 3) reduce the percentage of vehicles exceeding the speed limit by, on average, 72% (de Pauw et al (2014)).

Engineering

Experience on similar rural desert roads (Marsh and de Roos 2016) suggests that large rural roundabouts can be used to reduce travelling speed and change the angle of potential impacts to survivable levels. Should there be concerns about the speed of vehicles on approach to the large rural roundabouts it is possible to install carefully designed vertical deflection devices to slow vehicles. Vertical deflection devices (or speed humps/tables) can be designed with a lower profile or longer approach ramp to allow vehicles to pass over at a speed of approximately 70 km/h to match the safe approach speed to the roundabout.

While not common practice in Australia, the installation of physical speed management devices is common elsewhere. There is scope to further research and develop standards for speed calming devices in higher-speed rural road environments, noting the objective is to reduce speeds to a range of 60 to 80 km/h rather than 20 to 40 km/h as would be the case in a low-speed urban environment.

Setting the speed limit at the correct level, so as to reflect the level of safety (or risk) of the road, is critical if supporting measures such as enforcement or engineering are to be used effectively.

Local conditions

Local conditions may partially explain why the reduction in travelling speed was so large. It is common for rapidly developing Middle East nations to have large expatriate populations of poorly educated workers who are entirely dependent on their income to support an extended family in their home country. As the greatest penalty for these workers is to lose their job and be sent home, they are, on the whole, law abiding. It is possible that drivers under these conditions will be more likely to comply with the speed limit.

While further research is required to test this hypothesis and to quantify the impact, this effect illustrates that a strong incentive to abide by the law creates an environment of increased compliance. Notwithstanding, the results suggest

that reduced speed limits can be used to great effect in developing nations.

Traditional speed zoning guidelines and practice

Traditional speed zoning has developed as a traffic engineering practice rather than a road safety discipline and adopts accepted practices such as:

- a. *Avoid speed limits that are too low.* If speed limits are set at levels substantially less than what is suggested as appropriate by the road environment, say 50 km/h on a wide and level rural road, the speed limit can be perceived as an error and drivers will largely ignore it.

The problem with this approach is that often safe speed limits are discounted as being unrealistic or too difficult to manage. In Australian jurisdictions it is often argued that 80 km/h on rural undivided roads is too low (notwithstanding that 50 mph used to be the rural default speed limit in NSW). However, the experience outlined in this case study suggests that 80 km/h on a rural undivided road can be effective. This is similar to the experience of Scandinavian countries which have a practice of setting lower speed limits on undivided rural roads and higher speed limits when a median barrier is installed.

- b. *Substantial increments.* While speed zoning guidelines generally allow for speed limits to be changed in increments of 10 km/h, it is typically accepted as good speed zoning practice to change speed limits in increments of at least 20 km/h so that drivers perceive it as a substantial difference (and to reduce the number of changes of speed limit along a route) (NSW Centre for Road Safety 2011).

In contrast to point (a) above, if a speed limit is reduced by only a small amount, i.e. by just 10 km/h, it could be perceived as a minor change not requiring much attention: but if it is reduced by 20 km/h then clearly it is a more serious matter.

It can then be hypothesised that there is an ideal range when reducing a speed limit. More research would be required to quantify the effect but it appears there is a ‘sweet spot’ when reducing speed limits that maximises driver acceptance and as a result delivers increasing levels of compliance. For example, on an undivided rural road reducing the speed limit by between 20 km/h and 40 km/h may have the greatest impact on driver perceptions and show greater levels of compliance.

Conclusions

The case study results show that reducing the speed limit has had a positive effect; (1) Vehicle speeds have reduced and (2) even if not all vehicles comply with the speed limit there is an overall improvement in road safety.

In addition, this experience suggests that:

- a. The speed limit should be chosen on sound road safety principles;
- b. Compromising and setting speed limits based on what is assumed to be acceptable to the driver will limit the potential road safety benefits;
- c. A safe speed limit is critical for implementing additional speed management initiatives;
- d. Further research is required to develop physical speed calming devices suitable for higher-speed rural road environments;
- e. There may be an ideal range (or sweet spot) when reducing the speed limit. Research could be conducted to identify ideal ranges when reducing the speed limit as well as the ideal increment when changing the speed limit.

Experience suggests that there is a need for further research to quantify the true effects of changing speed limits. As a result, speed zoning guidelines and practices may need to be revised to reflect these results and to maximise road safety outcomes.

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Commentary on Road Safety

Posted Speed Limits: When is the maximum posted limit not the recommended?

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Key Findings

- Excessive speed continues to be a causal factor in road trauma.
- Country road users are three times more likely to be killed than city drivers.
- Speed reduction on country roads in lieu of road treatment options is essential to reducing trauma.
- The posted speed limit may not be suitable for the road and prevailing conditions.

Towards Zero and Enhancing Community Safety

Towards Zero 2016//2020 Victoria's Road Safety Strategy sets a long term vision of zero deaths and serious injuries on our roads and a target of less than 200 deaths by 2020. Research tells us that country road users are three times more likely to be killed and 40 % more likely to be seriously injured than drivers in metropolitan Melbourne (Victoria Police, 2014). That 3 out of 4 country fatalities involve older model cars speaks volumes about modern-day “safer cars”. Accordingly, our aim is to reduce road trauma and create safer roads by working closely with our road safety partners and the community to embed the Safe Systems approach; Safer roads, Safer speeds, Safer road users and Safer vehicles.

In 2013, Victoria achieved a record low Lives Lost of 243. This is in direct contrast to 1970 when 1061 lives were lost. The introduction of the mandatory wearing of seat belts, random alcohol / drug testing, fixed / mobile safety cameras and reduced speed limits in built up areas, central Melbourne, shopping strips and school zones combined with improved road infrastructure and vehicle safety have contributed to road trauma reductions.

In 2012, Victoria Police piloted and subsequently implemented the Speed Tolerance Enforcement Program

(STEP). STEP aims to shift community attitudes and beliefs around speeding; to have the community see the posted speed limit as essentially the limit, thereby enhancing compliance and removing the concept of de-facto speed limits. During the initial pilot, low level speed enforcement increased by 144% and overall speed enforcement by 27%, equating to an additional 4442 motorists being penalised for speeding (Victoria Police 2016).

The Adaptive Challenge

Notwithstanding progress in reducing road trauma, the recurrence of speed, impairment, and road conditions continue to be causal factors in road trauma. In 2016, there were 291 fatalities. Frustratingly, 150 of these fatalities occurred in rural locations, representing an increase of 9% compared to 2015. More than half of these were single vehicle crashes. The majority involved loss of control prior to running off the road. 72% of rural crashes occurred in 100 kph speed zones or higher (Victoria Police, 2017).

The design of our major highways and freeways prevent head on crashes through engineering such as a solid divide or concrete bollards or wire rope barriers in the event of a run off road situation. There are no trees to hit and any

light post or gantry pole is embedded in a concrete bollard. However, the only treatment stopping these types of crashes on a country road is a painted white line, yet both have a speed limit of 100 kph. It is little wonder that statistically people are three times more likely to die on country roads.

It is acknowledged that humans make mistakes which are often seemingly minor mistakes or lapses of judgment, but often with fatal consequences. Victoria continues to invest significantly in safer roads through engineering and road treatment options which are designed to accommodate error and minimise impact forces to humans. That said, many sections of Victoria's vast road system remain without engineering, design and treatments within the context of a Safe System. Physical treatments simply cannot be applied to every Victorian road as the network is too vast. The absence in many rural areas of safety features such as roadside and central median barriers or other traffic separation often expose road users to an unforgiving environment. Increasing this risk is the fact that many such roads have posted speed limits of 100 kph. The case for a review of speed limit settings in such areas in lieu of applying engineering treatments is very compelling.

There are many in the community that see a posted speed of 100 kph on rural roads and believe this to be the safe and recommended speed. However, it is not. It is the maximum speed (and the default speed on rural country roads in Victoria) and we implore everyone to understand this. It is up to the driver to assess the application of the maximum speed limit depending on the circumstances. We simply ask that everyone drive to the conditions, not necessarily to the posted speed limit.

The Need for Discussion around Speed Settings

There is a well-established body of evidence that confirms the probability of crashing increases with higher travel speeds. Crashes at higher speeds clearly result in more severe impacts and poor road safety outcomes. Equally dangerous is travelling at an inappropriate speed, 'Driving too fast for the circumstantial road conditions, despite being within speed limits' (Oxley & Corben, 2002).

Also well-established is that crash incidence and injury severity decline with speed reduction (Oxley, Corben & Diamantopoulou, 2001) and that safety outcomes can be improved by lowering speed limits as well as investing in road infrastructure (Risbey, 2015, p.39). Therefore, while the importance of continued investment in road infrastructure cannot be overstated, so too are discussions with rural communities around speed limit settings that are suitable for the prevailing conditions and challenging attitudes that may regard mobility as being a higher priority than safety. There is some irony that many rural communities oppose the reduction of speed limits as a treatment option and yet two thirds of those who die on country roads are country people!

Conclusion

While progress in road trauma reduction has been achieved, every day across Australia we see more than 3 people being remembered by grieving family and friends who are left to say goodbye to those whose life need not have been lost. In 2016, we lost more than 1300 people on Australian roads. Further road trauma reductions are achievable through safer speeds, where timely road engineering treatments may not be possible. "There is no one that someone won't miss".

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Calls for submissions to the *Journal of Australasian College of Road Safety*

August & November 2017 Issues: We are soliciting contributions for the August & November 2017 Issues on all topics of road safety. Sample topics may include, but are not limited to: in-depth analyses of the rising road deaths in Australia with practical implications on actions to address them; evaluation of Safe System interventions; drug-driving related research, technology, and countermeasures; research related to autonomous vehicles; research/evaluation of road safety activities in low and middle income countries; case studies of best practice evidence-based enforcement.

SUBMISSION DEADLINE for August 2017 Issue:

Peer-review papers: Wednesday, 3rd May 2017

Contributed (non peer-review) articles: Wednesday, 31st May 2017

SUBMISSION DEADLINE for November 2017 Issue:

Peer-review papers: Wednesday, 2nd August 2017

Contributed (non peer-review) articles: Wednesday, 30th August 2017

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 You can also search for current and past papers here:

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The Australasian College of Road Safety (ACRS) is the peak membership association focussed on saving lives and injuries on our roads.

What membership benefits do we provide?

- **Communication** – weekly e-newsletters, quarterly peer-reviewed journal, social platforms (LinkedIn and Facebook), media releases... **We keep you up to date!**
- **Professionalism** – Awards, Code of Professional Conduct.... **We reward innovations to save lives and injuries!**
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Who can be members?

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A range of **businesses** bring expertise and innovations which contribute to road safety.

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The College promotes **government programs and initiatives**, coordinating activities between agencies and across communities. This collaboration builds strong road safety messages and achieves greater results by sharing resources.

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How can you support the College and our work to reduce road trauma?

There are a variety of ways to showcase your support in reducing road trauma, including:

- **Membership**

All people and organisations are responsible for road safety and we encourage an inclusive environment via our diverse membership.

- **Sponsorship (e.g. events and awards)**

Showcase your support to combat road trauma and be associated with a prestigious organisation endorsed by the Governor-General of Australia.

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A myriad of events are linked in the weekly e-newsletter - take your pick!

- **Registering as a Road Safety Professional**

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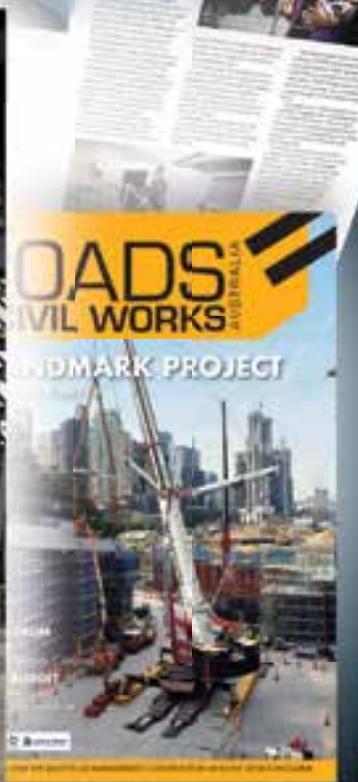
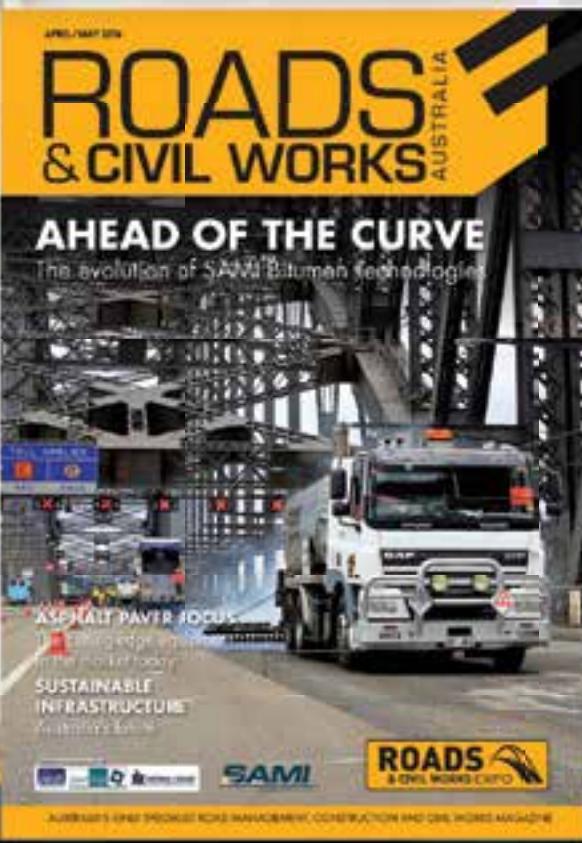
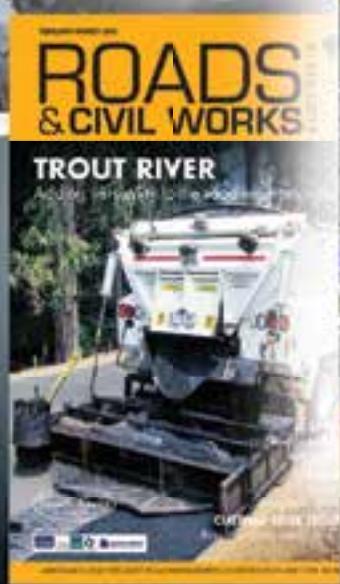
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| | | | | | | |
|--------------|--------------|--------------|--------------|--------------|--------------|---------------|
| sci-01 07/15 | sci-02 07/15 | sci-03 09/15 | sci-04 10/15 | sci-05 10/15 | sci-06 11/15 | sci-07 11/15 |
| 1st SP |
| sci-08 11/15 | sci-09 11/15 | sci-10 12/15 | sci-11 04/16 | sci-12 05/16 | sci-13 05/16 | sci-14 06/16 |
| 1st SP+DP | 1st SP | 1st SP | 1st SP | 1st SP | 1st SP+DP | 1st SP+DP |
| sci-15 07/16 | sci-16 07/16 | sci-17 10/16 | sci-18 10/16 | sci-19 11/16 | sci-20 11/16 | sci-21 11/16 |
| 1st SP+DP | 1st SP+DP | 1st SP | 1st SP+DP | 1st SP | 1st SP | 1st SP+DP |
| sci-22 11/16 | sci-23 02/17 | sci-24 02/17 | sci-25 02/17 | sci-26 02/17 | sci-01 09/15 | sci-02 02/17 |
| 1st SP | 1st SP | 1st SP | 1st SP+Sd | 1st SP+Sd | 2nd SP+DP | 2nd SP |
| sci-06 11/15 | sci-07 07/16 | sci-08 12/15 | sci-09 12/15 | sci-14 07/16 | sci-25 11/16 | sci-01 11/15 |
| 2nd SP+DP | 2nd SP+DP | 2nd SP | 2nd SP+DP | 2nd SP | 2nd SP+DP | 3rd SP |
| sci-06 11/15 | sci-09 05/16 | sci-01 12/15 | sci-06 09/16 | sci-09 12/16 | | |
| 3rd SP | 3rd SP | 4th SP | 4th SP+DP | 4th SP | | |
| sci-01 12/15 | sci-01 01/16 | sci-01 01/16 | sci-01 05/16 | sci-01 06/16 | sci-01 06/16 | sci-01a 08/16 |
| 5th SP+DP | 6th SP | 7th SP | 8th SP+Sd | 9th SP+DP | 10th SP | 11th SP |

Code for Unit number / date / sequence

| | |
|-----------|-----------------------------|
| sci-XX | unique Smart Cushion number |
| MM/YY | Month reset/repaired |
| 1st / etc | Reset sequence per unit |

Reset/Repair required

| | |
|-------|---------------------------------|
| SP | only Shear Pins were required |
| SP+DP | Delinimator panel also replaced |
| SP+Sd | Sled panel also replaced |

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