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Journal of the Australasian College of Road Safety

Formerly RoadWise — Australia's First Road Safety Journal

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Peer-reviewed papers Editorial Board

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Editorial Policy

The policy of the publisher is to provide a medium for expression of views and for debate, within the traffic safety community, on a wide range of issues. The journal provides authors of papers with the opportunity to have their work submitted to the Editorial Board for peer review. Encouragement also is given to interested persons and organisations to submit articles, photographs or letters for publication. The publisher reserves the right to reject submissions or, with approval of the author, edit articles. No payment is offered for articles submitted.

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Cover photo: Dynamic energy absorption is the key to reducing injuries in vehicle crashes. In this edition of the Journal Kim Heglund describes progress being made in Europe with sign post design.

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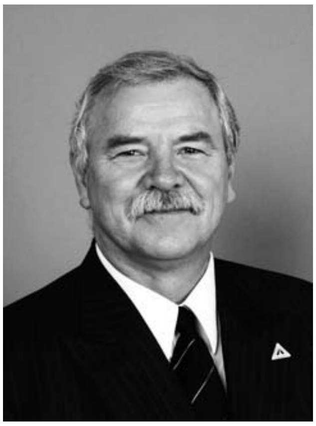
From the President



Dear ACRS Members,

The past year has certainly been one of change for the College in regards to staffing and Executive Committee membership.

The year started with Ken Smith stepping down from the executive. Ken's passion for road safety and assistance with College matters was immediately missed by the Executive committee. A huge knowledge gap opened up. Ken continued to assist tirelessly whenever we asked for his advice. However, we were recently saddened by the news that Ken is again battling with his persistent health problem. Our thoughts are with Ken and his family and we wish him a speedy return to health.

We also saw Robin Anderson, the NRMA - ACT Road Safety Trust 2005 Winston Churchill Fellow, step up to the difficult task of filling Ken's shoes. Robin immediately rolled up his sleeves and began helping by donating his valuable time to the Older Drivers national road safety seminar series that has been presented in most capital cities. He also helped lead the ACRS submission to the NSW RTA's discussion paper on Licensing of Older Drivers. An impressive start and most welcome contribution.

Just after the 2007 AGM the College appointed an Executive Officer (EO) Kevin McLoughlin. Unfortunately Kevin had to resign after a few months for personal reasons much to his and the executive committee's disappointment. He was enjoying the job and welcomed the challenge and contribution he was making to road safety. During his candidature, the office ran particularly smoothly. This then left a period where both Jackie Percival and Geoff Horne had to manage the national office on their own until a new EO was appointed. As usual both Jacki and Geoff were able to maintain stability over this transition period and put their shoulder to the wheel. Without their continued hard work I don't think the college would have survived this transition and have been able to function and support chapter activities. We are most grateful to them both.

ACRS started 2008 by welcoming our new Executive Officer Linda Cooke, a wonderfully efficient and warm person committed to advancing road safety. My, Geoff's and Jacki's load suddenly lightened tenfold when Linda took up the EO position. The three of us, along with the Executive committee, breathed a sigh of relief. Linda was at one time Executive Officer for one of the Australian National University's leading executive academics and is a highly qualified person with a law degree. So she knows how to 'herd us cats' in a nice way. She is particularly suited to dealing with such a diverse voluntary and multi-disciplinary group that exists within the ACRS. The Executive are keeping their fingers crossed that Linda will continue to serve our diverse team and not get too frustrated with us.

The lead up to the election, whilst interesting in regards to the change of Government from Liberal to Labour, was in many aspects disappointing in that road safety did not appear on the radar, either in terms of media questions or in any party's policy statements during the campaign. Nevertheless, it was pleasing to see substantial commitments made in the budget to road upgrades and the recent launch of the 'Keys to Safety' campaign by Minister Albanese. The monies provided for road construction and improvements should assist in reducing the effects of road trauma, so long as we can convince the road design engineers that road safety in terms of a 'Safe Systems' approach needs to be one of the major key design criteria alongside traffic efficiency. Also the black spot program was again supported, and whilst any amount is most welcome, it appears to be continuing at the same level as in previous years at $40 million. It would be nice to see this value increased tenfold at least to have any chance of meeting the ATC's National Road Safety Strategy 2010 target of no more than 5.6 fatalities per 100,000 population. It is very much looking like Australia will fall well short of the target and come in at around 7 to 7.5.

Letters have also been sent to Prime Minister Rudd and Minister Albanese focussing on particular aspects of road safety. The College will continue to do so until such time that positive moves are seen to address this serious health problem. It is interesting to note that the PM's father was killed in a car crash, yet another high profile individual touched by road trauma. Despite road crashes being the largest killer of young people subjected to unintentional injury, and the largest factor in terms of unintentional serious injury, it appears to be receiving little attention at a Federal level. The role of the Road Safety section within the mega Department of Infrastructure, Transport, Regional Development and Local Government and the National Road Safety Strategy Panel previously at the Australian Transport Safety Bureau (ATSB), is also not clear at this stage. The ACRS is prepared to provide some honeymoon time for the new government, but it is becoming more urgent that some clarity be provided as we continue our role into 2008 and ever closer to the 2010 deadline for the current road safety strategy

The New Year also saw ACRS put a submission into the NSW Staysafe Parliamentary committee's inquiry into Young Driver Safety and Education Programs. This was prepared by Dr. Teresa Senserrick with assistance from Dr. Rebecca Ivers from The George Institute for International Health and comments from College members.

The Journal has continued to go from strength to strength, thanks to Geoff Horne for his hard work in improving the quality of this Journal. Thanks also to the members who have contributed to the Journal, either by way of contributed articles or service on the editorial committee.

The College also ran its yearly conference which always focuses on a particular road safety theme. The 2007 topic was 'Infants, Children and Young People and Road Safety'. Opening presentations were provided by the then Liberal Party Commonwealth Minister for Roads and Territories Hon. Jim Lloyd MHR –and the Labour Party Hon. Eric Roozendaal MLC - the current NSW Minister for Roads. This was a wonderful display of bi-partisan support for road safety. Proceedings for the conference will be available soon.

This year's annual conference will be held in Queensland on the topic of High Risk Road Users – Motivating Behaviour Change: What Works and What Doesn't Work? A number of excellent papers have been submitted and a set of proceedings will be published.

2007 also saw the launch of Subaru's impressive vehicle range offered in Australia that are all now ANCAP five (5) star rated and 4 star pedestrian rated with Electronic Stability Control. What is impressive is that the cheapest vehicle comes in at around $27,000. Who said that safety cannot be provided at an economical price! Pressure to Australian manufacturers and designers, who have yet to achieve a five (5) star ANCAP rating in any of their vehicles, has been firmly applied. Hopefully they will respond soon for vehicle occupant's sake.

The College also was proud to present in November a Plaque to Mr Joe Motha, Manager of Road Safety at the then ATSB, in recognition for his help in facilitating and supporting the World Youth Assembly at the inaugural United Nations Global road safety Week, April 2007 in Geneva. We are hoping Joe will continue his strong support of these highly motivated youths and extend their influence in helping young road users survive on Australia's roads.

I would also like to thank the NRMA Road Safety Trust and the Australian Automobile Association (AAA) for their continued sponsorship of the College, the web site and Journal. Without our sponsors we would not be able to function.

My fourth term as President is now coming to an end. I would like to thank all those members, Executive Committee and the Head Office staff who have made my job so much easier. Without them I would have seriously drowned!

Raphael Grzebieta
President

Diary

27 – 30 May 2008 – Australian Trucking Convention, incorporating the 2008 ATA Safety Summit, National Convention Centre, Canberra. For further information see www.atatruck.net.au

31 July – 1 August 2008 – 23rd ARRB Conference: ARRB08 Collaborate – Research – Partnering with Practitioners. For further information see: www.arrb.com.au/conferences

August 2008 – AITPM National Conference, Perth. For further information see; http://www.aitpm.org.au

18 – 19 September 2008 – Joint ACRS-Travelsafe Committee of Queensland Parliament Conference on 'Motivating Behaviour Change Among High Risk Road Users' – for more information contact eo@acrs.org.au

5-8 October 2008 ASPACI Conference , Melbourne – Dynamic Testing of Vehicles Fitted with Electronic Stability Control for Crash Investigation.

10-12 November 2008, Australasian Road Safety Research, Policing and Education Conference, Adelaide. For further information contact: http://www.roadsafetyconference2008.com.au

School Bus Safety – Letter to the Prime Minister

The Honourable Kevin Rudd, MP
Prime Minister of Australia
Parliament of Australia
CANBERRA ACT 2600
26 March 2008

Dear Prime Minister,

I am writing to you in my capacity as President of the Australasian College of Road Safety (ACRS).

The College is an association of people and organisations whose work is related directly or indirectly to road safety. The College has members from a wide range of disciplines including traffic engineers, road trauma specialists, researchers, enforcement agencies, emergency services, policy makers, industry representatives, motoring organisations and insurance companies. The College has a policy on school buses which I attach for your information. As you will see the policy states *(inter alia)* that ACRS will continue to support initiatives and to press for resources to be made available for:

- Buses equipped with seat belts to be used on high speed routes (i.e. rural or semi-rural routes where the speed limit is 80 km/h or above) and for school excursions both urban and rural
- Sufficient buses to be able to eliminate three-for-two seating and standees on routes where the road speed limit is 80 km/h or above

- Replacement of old outdated buses without seat belts used for excursions and rural and semi-rural travel with modern buses that have seat belts and comply with ADR 59, 66 and 68

It may now be timely for the Australian Transport Council (ATC) to review the voluntary nature of the National Guidelines for the Risk Assessment of School Bus Routes. The opportunity for further cooperation between Federal and State and Territory authorities to ensure the best possible outcome for rural school bus safety should be explored fully. It appears that the voluntary nature of the guidelines may be inhibiting progress in NSW and Victoria.

As Prime Minister I hope you will agree that action at both Federal and State Government level should be taken to protect a vulnerable section of our community who travel on Australia's roads but who are currently dependent on voluntary adherence to the Rules and Standards for lap sash seat belts in relation to non urban school buses.This seems inconsistent with the current mandatory requirement that all occupants of cars (adults and children) must wear seat belts. By allowing children to travel on rural and semi rural bus routes without restraint when we know they would be seriously injured in a crash we are putting at risk our youngest community members. As a courtesy to ATC I am copying this letter to its members.

Yours faithfully,
Raphael Grzebieta
President

Letters to the Editor

Dear Editor,

I would like to make readers of the Journal aware of some new road safety initiatives that have been implemented at the IPWEA- NSW Division.

Road Safety Discussion Forum

The IPWEA is now hosting an online discussion forum for road safety professionals. The forum is open to anyone with an interest in road safety. You do not have to be a member of the IPWEA to join the forum. The forum provides the opportunity for people working in road safety to discuss issues and topics on line and share information and resources.

Forums provide a great networking opportunity for people with special interests. We would like you to encourage your members to register and join our discussion forum. To register simply go to the IPWEA (NSW) home page/ Special Interest Areas/Road Safety and follow the registration steps.

Road Safety Auditors Website

In 2001 a register was provided by the Road Safety Auditor website (www.roadsafetyauditors.com) which enabled those seeking the services of qualified auditors to more readily locate them.The importance of this register as a tool for providing information on the skill level of auditors and the type of work they have done is growing steadily.

The original website has outgrown its intended design and, with the upcoming accreditation of the Road Safety Auditor Course through the Vocational Education & Training Sector, the website will soon be redesigned to incorporate such additions as: increased security so auditor details will only be accessible to registered users of the site; automated functions for verifying of audits so that when an audit is added to the website an email will immediately be sent to the contact person nominated for verification (this process alone has taken considerable time in the past); reporting functions which provide detailed information on audits being performed and status of auditors so they will be notified if they will soon require training or to complete additional audits.

The accrediting of the Road Safety Auditor Course also has tremendous potential as this course will be nationally recognised with possibly other courses within the current one being available to help in improving the quality of auditors and audits. The high quality auditing of roads in the various stages of design is seen by almost all traffic engineers as one of the most important avenues which road safety needs to go down at present.

Update of IPWEA Website

We have also recently updated the Road Safety component of the IPWEA website. If you have any questions regarding these please contact the IPWEA Road Safety Program Manager, Mr Paul Riley on 02 8267 3008.

Kind regards
Suzanne Baker
Road Safety
IPWEA – NSW Division

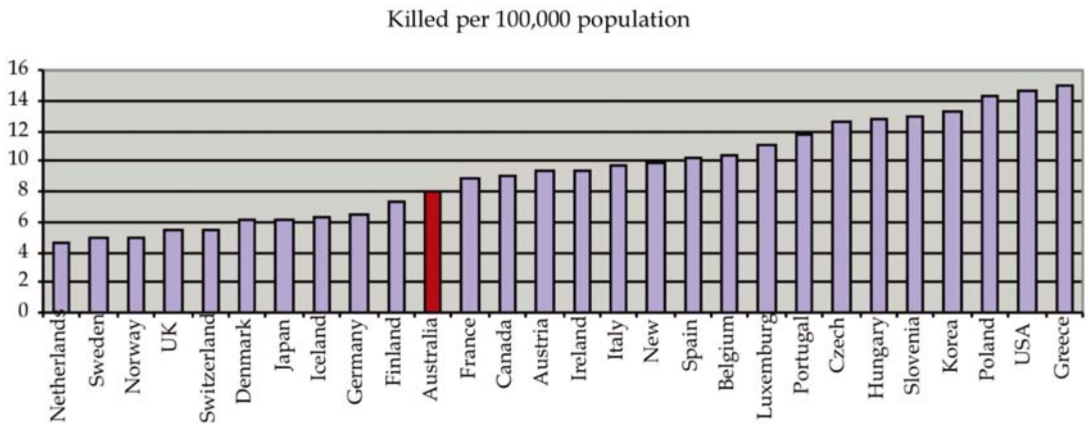
Dear Sir,

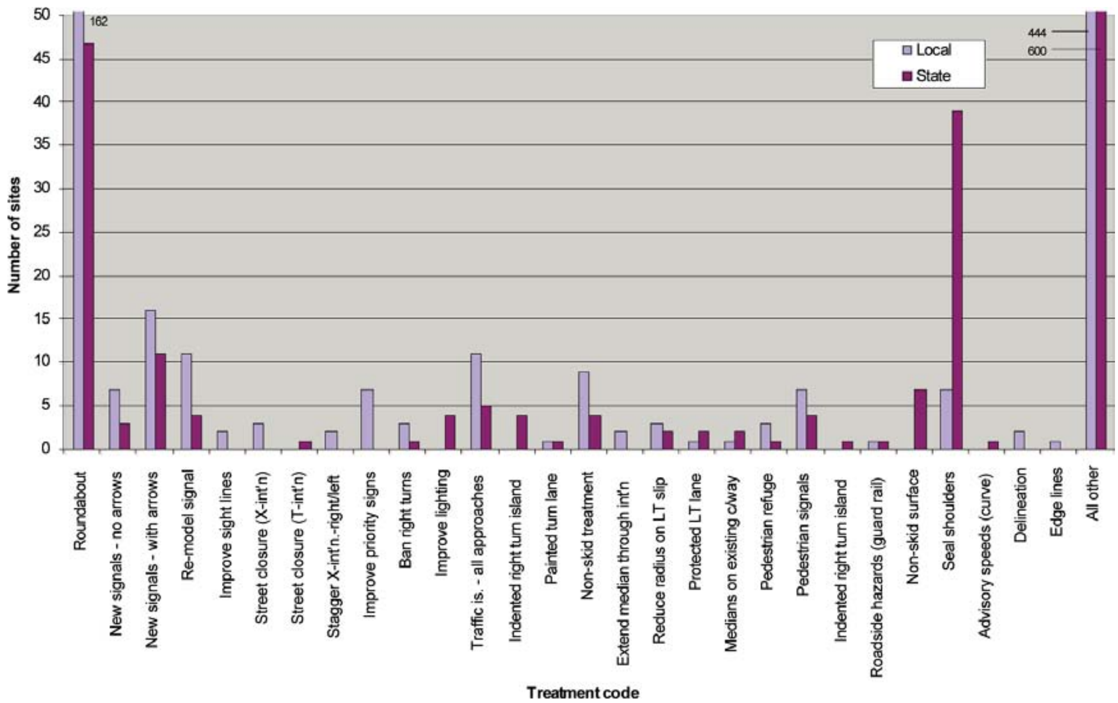
I note the recent Letter to the Editor regarding the Shared Space Concept in Adelaide [February 2008 edition of the Journal]. We are of the view in the College of Surgeons that intuitively pedestrians, cyclists and motor vehicles do not mix, so if they can be separated in any possible manner with urban planning then we would be supportive. If all the traffic is "calm" and steady with due respect for all users then in principle road safety should be enhanced and travel enhanced with some savings for the environment as well. Given driving behaviour in Australia I would encourage a degree of physical separation as the main safety component of "shared space".

Yours sincerely
Robert Atkinson
Chair – RACS Road Trauma Committee
RACS – Representing over 5,900 Surgeons in Australia & New Zealand
Road Safety Initiative at Institute of Public Works Engineering Australia (IPWEA) - NSW Division

Omissions in the February 2008 Journal

Due to an error that occurred during the graphic design stage of production, the February Journal included two block charts that lacked information in the horizontal scale. These were on pages 16 and 32, and are repeated below in their correct format. The Editor apologises for this oversight.





Quarterly News

Chapter News

Australian Capital Territory and Region

The Chapter hosted a 'First Aid in Focus' event, in conjunction with St John Ambulance and the NRMA-ACT Road Safety Trust, on 10 April. This started with the launches of a report 'First Aid and Harm Minimisation for Victims of Road Trauma' by Prof Paul Arbon of Flinders University and also the St John Ambulance 'Crash Course' on-line road crash first aid course. This was followed by a 90 minute seminar on Post-crash Medical Treatment, with presentations by Prof Arbon; Howard Wren, ACT Ambulance Service; and Assoc Prof Drew Richardson, Chair of Road Trauma & Emergency, Canberra Hospital. There was keen interest and questioning with over 30 participants and media coverage by WIN TV and 'The Canberra Times'. The Chapter is now planning a June seminar on on-road cycling, which is a very controversial issue in Canberra at present.

New South Wales (Sydney)

Three seminars are currently being planned. The dates are yet to be confirmed. 1) Public health advertising: learning from professionals in sectors other than road safety. 2) Influencing driver attitudes to speed? What works, what does not work? 3) The role of trauma systems in supporting road safety.

Media activities

Following the Sydney Chapter seminar on motorcycle safety in November 2007, there was an extensive article (9 pages) in the magazine Two Wheels, titled "10 ways not to crash: the danger signs" and based on the data reported by Liz de Rome.

Queensland

The Queensland Chapter held its AGM on Tuesday 4 March 2008. The following members were elected for positions in 2008: Chair - Barry Watson (CARRS-Q); Deputy Chair - Peter Kolesnik (Qld Police Service); Secretary/Treasurer - Maxine Nott (CARRS-Q); Committee Members - Bevan Rowland (CARRS-Q), Lyle Schefe (Roadcraft), Kerry Dunne (Qld Police Service) and Alexia Lennon (CARRS-Q).The Queensland Chapter also held its quarterly seminar on Tueday 4 March 2008. The seminar "Overview of Queensland Red Light and Speed Camera Programs" was presented by Inspector John McCoomb, Traffic Camera Office, Queensland Police Service.

The seminar included an overview of the core responsibilities of the Traffic Camera Office in relation to the:

- operation, coordination, identification, verification and dissemination of speed camera and red light inflingement notices;
- statewide coordination of site-rotated red light cameras;
- statewide coordinatin of speed cameras; and
- training, monitoring and evaluation of the use of red light and speed cameras.

The Queensland Chapter hosted the National ACRS Older Drivers Seminar on Friday 28 March 2008. The seminar featured the following speakers and topics:

- Robin Anderson (New Moves for Older Road Users)
- Dr Mark King (How Population Ageing will Affect Road Crash Patterns)
- David Foster (The RACQ Years Ahead Program)
- Val French (The Older Road User Perspective)
- Professor Joanne Wood (Vision, Ageing and Driving)

The next Queensland Chapter meeting and seminar is scheduled for 3 June 2008.

Victoria

A seminar entitled **'Crash Investigation – Hunting for Clues'** was held 4pm to 5.30pm on 29 April at the Old Kew Post Office. The presenters were Dr David Logan of MUARC, who give an overview of the real-world crash investigation program; and Sergeant Brendan Butland of the Victoria Police's Major Collision Investigation Unit, who described the Unit's role in crash reconstruction and ascribing cause to serious crashes.

The next Chapter meeting will be a half day forum entitled **'Sleepy in Charge! the Challenge of Fatigue on our Roads'.** This will be held between 2pm and 5pm on Thursday, 19 June at Victoria's Parliament House. The presenters will be drawn from academia, the medical profession and government agencies with a view to reviewing the challenges and potential solutions to fatigue-related trauma involving either heavy or light vehicles.

Western Australia

A seminar is being planned for June or July on **'The First 1,000 Weeks of a Child's Life - Seat Belt Wearing".** The WA Chapter Committee continues to hold 'breakfast' meetings monthly. The WA Chapter AGM will be held on 22 May prior to the ACRS AGM.

Australian News

Tougher Penalties for WA

The State Government has announced tougher penalties for hoons, speeding drivers, using hand-held mobile phones, people not wearing seatbelts and reckless driving. On 1st March penalties for speeding, the non-use of seat belts and the use of held-held mobile phones while driving were increased. The higher fines for speeding are targeted at the more extreme infringements, where drivers are exceeding the limit by 19 kph to 40kph. The penalty for using a hand-held phone has increased from $100 to $250. Penalties for the other traffic offences will change later in the year.

Good and Not So Good in Ute Safety

The NRMA recently released some crash ratings for some utes under the Australasian New Car Assessment Program (ANCAP). The tests demonstrated that more could be done to improve occupant protection in utilities sold in Australia, with crash ratings varying from 2, 3 and 4 stars for safety out of a maximum of 5. Top of the list was the Commodore Ute, which achieved a 4-star result and also provided a range of primary safety features - including anti-lock brakes (ABS), Electronic Brake Distribution (EBD) and Electronic Stability Control (ESC) - as standard. The Mazda BT50 gained a 3-star rating, the Nissan Navara (when fitted with optional airbag) was awarded a 3-star rating and the Mahindra Pik-Up rated 2 stars out of 5. The Ford Ranger is based on the same design as the Mazda BT50 and is expected to have similar crashworthiness.

NRMA's Motoring Research Manager, Jack Haley, said the performance of the Commodore Ute was an indication that manufacturers could design and build vehicles to achieve good occupant protection scores. "We are seeing more 4 and 5-star vehicles on the Australian market these days and we would expect that a utility vehicle should earn a 5-star rating in the near future. Manufacturers are building key safety technologies into many of their models as standard features - and while some utes definitely offer more protection than they did five years ago, more needs to be done. Many are lacking in basic occupant protection, which is an occupational health and safety concern for drivers of these vehicles. Increasingly these vehicles are often purchased for family use."

The Mahindra Pik-Up, which only rated 2 stars, has minimal safety features and, despite the dual cab configuration that is popular with families, does not include top tether anchorages for child restraints. Under Australian regulations these are optional on this type of vehicle, which can be classified as commercial. "Mahindra has advised ANCAP it will be providing driver and passenger airbags in 2008 models and the anchorages will be a standard design feature from 2009," Mr Haley said. This is a good example of how publicity of the ANCAP tests encourages manufacturers to improve their vehicles' safety features.
(Source: NRMA Media Release, March '08)

NSW Roads and Traffic Corporate Plan

The Roads and Traffic Authority has released a 2008 to 2012 corporate plan, which outlines priorities and targets for the organisation. It is the key document for organisational planning and performance management. This forward plan is coordinated with the NSW State Plan and other NSW Government priorities and strategies. The plan sets a number of priorities for the organisation, one of which is 'Improving Road Safety'. The document may be downloaded from the RTA website. *(Source: www.rta.nsw.gov.au)*

The Media Reports on Traffic Congestion

A series of recent articles in the *Sydney Morning Herald* on the flight of Sydneysiders to Brisbane and Melbourne prompted some introspection by the media, with road congestion and lack of public transport cited as among the major reasons behind the exodus. At least one expert, who was quoted in the Herald, cited the need for consideration of a congestion tax, alongside calls for the completion of key missing roads links and greater investment in public transport, particularly new rail lines to car-dependent suburbs in the northwest of the city.

The *Daily Telegraph* reported that higher petrol prices were prompting Sydney commuters to abandon their cars in favour of public transport. The quoted figures were 700,000 additional morning peak passenger trips on government buses in January, compared to the same time last year.

In Melbourne, the *Herald Sun* reported on a Monash University study that foreshadowed three million plus private vehicles on the city's roads within 30 years, up from the current 1.97 million. The article described this as a recipe for a traffic congestion nightmare.

The *Australian Financial Review* reported last week that the National Transport Commission was calling on the Federal Government to phase out its Fringe Benefit Tax concession for company cars as a means of addressing urban congestion. And the road user pricing model, advocated by the Australian Automobile Association in its Federal Budget submission, has received widespread media coverage. The Australian Automobile Association is calling for the replacement of existing State and Federal road taxes with a road user charge.

Federal Government Unveils Road Safety and Productivity Package for Heavy Vehicles

New 'black box' technology that makes it more difficult for truckies to drive for too long or at high speeds are among the measures contained in the Federal Government's $70 million plan to tackle the ongoing loss of life on Australian roads. The four-year Heavy Vehicle Safety and Productivity Plan was announced by Infrastructure and Transport Minister Anthony Albanese at the conclusion of the meeting of state and federal transport ministers held in Canberra on February 29. The meeting also reached agreement on overhauling heavy vehicle charging.

The Heavy Vehicle Safety and Productivity Plan will fund:

- trials of technologies that electronically monitor a truck driver's work hours and vehicle speed - one using an onboard 'black box' or electronic log, and one which makes use of the Global Positioning System (GPS);
- the construction of more heavy vehicle rest stops and parking areas along our highways and on the outskirts of our major cities; and
- upgrades to freight routes so they can carry bigger loads.

"It is our intention to directly involve the trucking industry in the process of putting the available funds to the best possible use," Mr Albanese said. "At the same time we will work with the states and territories to investigate the introduction of mandatory, periodic health checks for heavy vehicle drivers as well as undertake further work on new national standards for random drug and alcohol testing. As well as improving road safety, our Plan will help lift national productivity by funding upgrades to the road network such as the strengthening of bridges. This targeted investment in the road network will open more roads to heavy vehicles, freeing up the movement of freight across the country and easing congestion."Mr Albanese said the much greater investment in road safety and transport productivity had been made possible by the decision to overhaul heavy vehicle charges.

SA's First Road/Rail Transport Corridor to be Mapped

The South Australian Government has announced early planning for a new billion-dollar 14km road and rail freight corridor in Adelaide's north – the first dual-use project in the State's history. Transport Minister Patrick Conlon said that a planning study would determine the preferred alignment and feasibility of a proposed joint road/rail route to be built in a new corridor to the west of Port Wakefield Road. The Northern Connector project – which is estimated to cost $1 billion dependent on construction timing – would secure the long-term freight needs in Adelaide's north and take freight trains out of the suburbs around Salisbury and Parafield. While the State Government is funding the planning study, a future Northern Connector would be a joint Federal and State undertaking funded under the Auslink program - reflecting the project's status as a transport link of national importance. The planning study and associated environmental impact assessments are expected to be finished by the end of 2009, and a completed project could be operational by 2017.

Construction Gets Moving on Ipswich Motorway

Work has been undertaken on what Federal Infrastructure and Transport Minister Anthony Albanese calls the most important roads project in south-east Queensland - the Ipswich Motorway upgrade. The Federal Government has provided $700 million for the Stage 1 of the Wacol to Darra project, which will initially upgrade three kilometres of the Motorway, starting with the interchange at Centenary Highway. Leighton Contractors has been appointed as the principal contractor by Queensland Main Roads to deliver Stage 1 as a key member of the SAFElkink Alliance. Leighton Contractors will join Main Roads, BMD Constructions, Arup and Maunsell Australia in the SAFElink Alliance to design and construct the road upgrade.

Once completed, the upgraded motorway from Wacol to Darra is expected to:

- improve the Ipswich Motorway to six lanes;
- clear congestion by eliminating the Centenary Highway roundabout and replacing it with a new high-standard interchange, including on-and off-ramps;
- take around 20 per cent of vehicles off the motorway by building new service roads that can cater for local or cross-suburb trips;
- provide a safer motorway, with wider lanes and road shoulders, and a straighter, flatter road that meets modern standards; and
- create bicycle lanes and pedestrian paths along the Motorway to encourage alternative transport.

Truck Research Proposal to Governments

A funding proposal for a major new Australian research program on the safety, efficiency and performance of heavy road transport vehicles has now been formally put to the Federal and State governments.

The proposed program involves pursuit of research-based improvement in heavy vehicle design, operations and impacts, with a new Australian Truck & Bus Research & Information Centre [ATBRIC] as its focal point. The proposal was presented to new Federal Infrastructure and Transport Minister, Anthony Albanese, and his state counterparts by ARRB Group in January.

ATBRIC will require multi-year funding mainly from government sources, as the research priorities during the first five-year period of its existence will be predominantly 'public interest' matters. The ATBRIC concept along with the proposed research program have flowed from a comprehensive Scoping Study on heavy vehicle safety and efficiency research needs in Australia, undertaken by ARRB in 2006-07.

The study, which enlisted the financial assistance and/or support of governments, transport authorities, industry and research institutions, identified the major challenges ahead in infrastructure adequacy, heavy vehicle performance, congestion, safety, shortage of skilled drivers, overall driver performance, other workplace factors and road transport's environmental and social impacts. Further improvement in the safety, efficiency and productivity of heavy vehicle operations in Australia is both critical and achievable, the study concluded, and recommended new strategically targeted heavy vehicle research, aimed specifically at Australian purposes and conditions.

As well as using state-of-the-art technology for heavy vehicle research activities that cannot be safely conducted 'live' in open road conditions, the ATBRIC will ensure more comprehensive data collection and analysis on all major aspects of HV operations and issues and be a hub for research networking and collaboration, within Australia and internationally. If government funding for ATBRIC is achieved soon, ARRB is confident the program and the Centre can still be made operational within 2008.

New Initiatives in Victoria

New road safety initiatives in Victoria are featured on the Transport Accident Commission's website: http://www.tac.vic.gov.au/jsp/corporate/homepage/home.jsp

One item is the new Road Safety Strategy – Arrive Alive 2008-2017. This strategy announced tougher drink driving laws; more driver education; passenger restrictions for P plate drivers; and mandatory car safety technology.

Another component of the site is the advertising campaign *Pictures of You*. This initiative is also described in the quarterly newsletter *Shoulder-to-Shoulder*, issued by the Road Trauma Support Team Victoria Inc. (RTSTV). The latter organisation was consulted by the Commission to assist with identifying participants who had lost family members in crashes involving speed. Apart from the exposure of this campaign through the Victorian media, it can also be viewed on the website: www.picturesof you.com.au

"Safer Roads Sooner"

Queensland Main Roads Minister Warren Pitt has announced that $31 million derived from red light and traffic camera fines, boosted by another $23 million from Main Roads, would be invested in vital road improvements under the "Safer Roads Sooner" program.

The $54 will be allocated to 90 new high priority projects across Queensland, approved by the Safer Roads Sooner Advisory Committee. The Committee includes representatives from major road safety groups. The plan gives priority to locations with a serious crash history or assessed as having a potential problem.

New Zealand News

Study Shows Car Ads Ignore Safety

A recent study at the University of Otago, Wellington, led by Dr Nick Wilson, has shown that car safety information is rarely featured in car advertisements. The research, published in the *Injury Prevention* international journal, analysed 514 car advertisements in *Metro* and *North and South* magazines over a five-year period. Only 27% of the ads mentioned one or more of nine key safety features and, even in that 27%, on average less than two safety features were mentioned. Manufacturers' websites were, however, found to include more safety information. In contrast to the lack of safety information, the researchers found that 39% of the car ads included potentially hazardous information that breached the spirit, if not the letter, of the voluntary NZ code for motor vehicle advertising. Hazardous speed imagery features in 29% of ads and power references in 14%. The researchers expressed the view that the public needed more detailed information about safety and safety features, which the automotive industry was failing to supply through its advertising. The researchers concluded that there was a case for government regulation of vehicle advertising to ensure a greater emphasis on vehicle safety features and to remove potentially hazardous content, such as speed imagery. *(Source: University of Otago Magazine February 2008)*

Testing for Drink-Drivers Gets a Boost

NZ Police recently took delivery of two new 'super-sized' booze buses, now in operation on the streets of Auckland. Built in Australia, the buses are intended to supplement existing stock. They provide state-of-the-art technology, safer and more spacious work areas and an eye-catching new livery. The new livery – funded by ACC as part of its ongoing campaign to reduce the amount of injury caused by drink drivers – will leave drivers in no doubt about the purpose of the buses.

"New Zealanders are currently spending around $50 million every year on alcohol-related crashes. People are getting hurt needlessly and it's costing them, and the country dearly," says ACC Injury Prevention Programme Manager, Phil Wright. "By supporting Police, and the booze buses, we're working to reduce the number of people hurt by drunk drivers."

For the first time in New Zealand, the buses will also provide an opportunity for Police to test and process drugged drivers. The new buses are considerably bigger (1.9 metres longer than the 11 smaller buses deployed in 2005), and provide more room for operational staff to work in. They feature two extra processing desks, reducing waiting times for alleged offenders, enabling staff to be back out on the streets without unnecessary delay. *(Source: NZ Police Ten-One Community Edition: 306, March 2008)*

Amnesty Results in $70,000 Road Sign Savings

A chance conversation with a fellow rugby player has seen Hastings Detective Sergeant Darren Pritchard lead two unique operations, recovering $70,000 worth of stolen property. After a game, a roads contractor team mate was lamenting the theft of road signs and road cones around Hastings, resulting in $60,000 annual replacement costs for his firm. With road cones costing around $40 each and simple directional arrow signs up to $300 each, these costs are, in turn, passed on to the tax payer. There's also associated safety issues for road users and

pedestrians when cones and signs are stolen. So Darren decided to do something about the problem. In 2004, he ran Operation Lollipop, a "no questions asked" week-long amnesty for the return of stolen road signs. Publicised via local media, the operation resulted in the return of $30,000 of goods. Between 3 - 16 December last year, Darren ran the operation again for two weeks. This time he widened the amnesty into Napier and Hastings, resulting in the return of $40,000 of stolen signage –including speed camera, railway crossing and liquor ban signs. "We had a grandmother pulling up in front of the Police station and getting out of the car with a stop sign under her arm, and hauling out her nine-year-old grandson to hand it over," says Darren. "It was a great success, and cost nothing to run. The offenders come to us, we collect it and a local roads contractor returns the property to the complainants. "There are some pretty happy contractors around getting that gear back."
(Source: NZ Police Ten-One Community Edition: 306, March 2008)

European News

EU Seeks Improved Cross-Border Traffic Law Enforcement

At present, in the European Union (EU), effective and efficient follow up of traffic offenders from other EU States (cross-border offenders) hardly exists. A further complication is the trend where an increasing number of countries employ automatic enforcement systems (e.g. Austria, France and the Netherlands). Although a number of bi-lateral agreements exist, there has been no common EU approach so far for cross border traffic offences. To deal with this problem, the European Commission is now moving to introduce legislation that will set up a system for exchanging information (e.g. owner data) and procedures for the proper notification of offenders, so that road safety enforcement measures can be applied to non-resident traffic offenders. In a recent press release the European Transport Safety Council (ETSC) stated that it welcomed this new proposal as it would certainly contribute to reducing road deaths on Europe's roads. The ETSC believes that under the current ineffective cross-border enforcement arrangements non-resident drivers are more likely to take risks and break the law due to their feeling of impunity. According to available data, non-residents represent around 5% of road traffic in the EU, whereas the share of non-resident drivers in speeding offences is around 15% on average.
(Source: ETSC New Release 19 March 2008)

Note: The European Transport Safety Council (ETSC) is a Brussels-based independent non-profit making organisation dedicated to the reduction of the number and severity of transport crashes in Europe. The ETSC seeks to identify and promote research-based measures with a high safety potential. It brings together 39 national and international organisations concerned with transport safety from across Europe. www.etsc.be

Sweden and France Tackle Drink Driving

For many years in Europe the most active country in the fight against drink driving has undoubtedly been Sweden. The problem of drink driving was exacerbated in 1995, when Sweden joined the European Union and was obliged to conform to the more liberalised EU alcohol sales laws.

Levels of drink driving checks are exceptionally high. A total of 2.5 million tests were undertaken in 2007. In its 2006 Road Safety Policy the Swedish Police chose drink driving as one of the four priority areas for accident prevention measures with a target of at least 2 million breath tests a year. A more targeted breath testing approach focussing on times and places where drink driving takes place is now proceeding. Every driver who is stopped for whatever reason is automatically breath tested. The aim is to reduce the number of drink drivers and to give people with drink and drug problems an opportunity to deal with their problem. Key actors alongside the Police include the Parole and Probation Department of the Swedish Prison and the County Administrative Board. Drivers stopped and charged by the Police under the influence are immediately offered a consultation which should take place within 24 hours. This is the time when alcohol dependent drivers have a high motivation to do something about their problem. In the introductory talk with the client, individual needs and requirements for rehabilitation are discussed such as counselling or medical treatment.

In the field of rehabilitation, Sweden has been running an alcolock pilot program for convicted drink drivers since 1999. In the commercial area the government strategy recommends that alcolocks should be fitted to all new commercial busses and lorries. However, this is not yet a legal requirement. Alcolocks were first introduced to the commercial fleet in 2000 and there are now an estimated 30,000 alcolocks fitted to commercial vehicles.

This is out of a total fleet in Sweden of some 200 000 commercial vehicles (heavy goods vehicles, buses, taxis and some light trucks and company cars). The major campaign in Sweden is the "Don't drink and drive" program, which raises awareness among youths on the risks with alcohol and drink driving. The activities within "Don't drink and drive" rely upon collaboration between a number of stakeholders – the law enforcement, schools and sports organisations among others. The problems of drink driving are brought to light through films, exhibitions and lectures. In spite of these campaigns, drink driving remains a very serious problem in Sweden.

Now France, with strong leadership from President Sarkozy, is planning to follow Sweden's lead in the battle against drink driving. Measures recently proposed by the French Government are ground breaking. If implemented, they would include alcolock rehabilitation programs for all recidivists and alcolocks in school buses and possibly amongst other target groups. Another possible sanction is car confiscation for those found to be much over the limit. The government has also proposed that night clubs would have to install 'alcotests' so that drivers have the opportunity to test their BAC level before driving. Lastly the sale of alcohol would be prohibited in all petrol stations 24 hours a day. *(Source: ETSC Drink Driving Monitor, March '08)*

How Risky is Travel on Europe's Motorways?

A recent report by the European Transport Safety Council reveals that there is a considerable difference in the safety levels on Europe's motorways. Motorways are defined in the report as *"Roads with dual carriageways, at least two lanes each way; entrance and exit signposted; grade separated interchanges; central barrier or central reservation; no crossing movements at the same level; no stopping permitted unless in an emergency. Use of motorways on foot and by some types of vehicle is restricted in various ways in different countries"*.

The four safest countries for motorway travel are Switzerland, the Netherlands, Denmark and Great Britain. In these four countries, less than two people are killed on average for every billion vehicle kilometres. In Sweden, France, Ireland, Germany, Finland and Israel the risk of death is below the EU average of 4 deaths per billion vehicle-km. In Austria, Norway, Belgium, the Czech Republic, Italy, Portugal and Spain, death rates are above the EU average of 4 but below 7 deaths per billion vehicle-km. On Slovene and Hungarian motorways, more than 8 people are killed for every billion vehicle-km. The difference between the worst and the best performing countries is a factor of 6. For example, the level of risk that a person travelling on motorways from London to Budapest experiences in Belgium is more than double what they experienced in Britain.

Then in Germany it is between the two, but in Austria it is again twice what it was in Britain, and in Hungary it is twice as high again, that is more than 4 times the level in Britain! The following countries could not be assessed for motorway risk due to lack of data: Cyprus, Greece, Luxembourg, Poland or Slovakia. The number of deaths on motorways was not available in Bulgaria, Lithuania or Romania. There are no motorways in Estonia, Latvia and Malta. *(Source: ETSC Road Safety Performance Index Flash 8 – February 2008)*

Vulnerable Road User Report by ETSC

The European Transport Safety Council (ETSC) has published a full and final report on its 2005-2007 campaign in support of vulnerable road users (VRUs), known as the VOICE Campaign. This report may be seen at http://www.etsc.be/documents/1-VOICE_Final_Report.pdf.

The aim of the VOICE campaign was to raise awareness among EU and national policy makers of the needs of vulnerable road users. It was hoped that the campaign would encourage them to accept responsibility for the implementation of the measures necessary for the protection of pedestrians and cyclists.

The ETSC cooperated with key European non-government organisations (NGOs) that shared ETSC's concern for the safety of vulnerable road users. In the framework of the VOICE campaign, periodic meetings and e-mail discussions were held regarding EU legislation relevant to vulnerable road users; issues were publicised in the media; and VRU reports were issued for 12 countries. An example of VOICE network activity was monitoring and commenting on EU legislation on bull bars and safer car fronts. The positions and press releases were widely disseminated reaching policy makers at EU and national level. *(Source: ETSC Final Report on VOICE Campaign – April 2008)*

North American News

Passenger Fatalities Higher with Teenage Drivers

Research led by Dr. Flaura K Winston of the Children's Hospital of Philadelphia has shown that more than half of the children killed in car crashes over a six-year period were riding with a teenage driver. The researchers examined national data on serious car crashes including those resulting in death between 2000 and 2005.

The research focused on 9,807children passengers aged 8 to 17 who were killed in car crashes, out of 2.5 million children who were involved in crashes. 54 percent of those killed were found to have been riding with a teen driver. Also, more than three-quarters of the fatal crashes occurred on roads with speed limits higher than 45 mph (72 kph), and nearly two-thirds of the young passengers were not wearing seat belts. The researchers concluded that the risk of death for children riding with drivers aged 16 to 19 was at least double that of those riding with drivers aged 25 and older.
(Source: The Providence Journal March 4, 2008)

New Academic-Based Journal on Transport Safety

A new journal, 'Transportation Safety & Security (TS&S)', will be published quarterly by the Center for Transportation Research in the College of Engineering at the University of Tennessee. The journal will cover multimodal transportation safety arenas, including the highway, transit, ridesharing, pedestrian and bicycle modes, as well as rail, water and aviation safety issues. The aims and scope of TS&S are broad and multidisciplinary and include

- safety aspects of infrastructure design;
- driver behavior and human factors;
- traffic control and traffic operations;
- crash data collection and analyses;
- safety information and communication systems;
- advanced and emerging vehicle and network technologies;
- safety policy and planning;
- security issues of transportation systems and networks; and
- emergency and incident planning and response.

TS&S will publish original, full-length articles, reviews, short communications and a news section. All papers are subject to rigorous peer review prior to publication. For further details contact

Editor-in-Chief Dr. Stephen H. Richards, University of Tennessee, USA, email: stever@utk.edu

International News

Australian Expertise Contributes to World Road Safety Manual

An international good practice guide on 'Speed Management', a road safety manual for decision-makers and practitioners, was recently released by the Global Road Safety Partnership* (GRSP). Australian research company, ARRB Group, made a major contribution to the manual, including leading inputs from a number of different research agencies, contracted to GRSP. The manual consists of 'how to' modules, assessment, design and planning techniques as well as how to implement a program to address traffic speed issues. One area highlighted in managing speed is the application of 'expert' speed setting tools developed by ARRB to assist practitioners to undertake speed zoning assessments.

The key objective of the computer based tools, generically known as XLIMITS, is to ensure that speed limit policies and practices are consistently applied across the road network. The 'expert' systems consider a range of factors such as the safety and operational performance of a road or the road network, the condition of a road and its geometry, and the road's environment. ARRB has developed such systems for all Australian states, New Zealand and the United States. ARRB believes that the development of this best practice manual will provide a valuable worldwide resource that can be used by organisations to reduce the trauma caused by road crashes through more effective management of speed.

The manual, jointly produced by leading members of the United Nations Road Safety Collaboration, which includes the World Health Organization (WHO), the World Bank, the FIA Foundation and GRSP will be circulated to hundreds of countries worldwide. It is also available to download from the GRSP website (www.grsproadsafety.org). (Source: ARRB media release 10 April 2008)

* The Global Road Safety Partnership (GRSP) brings together governments and governmental agencies, the private sector and civil society organisations to address road safety issues in low and middle income countries. GRSP is a hosted programme of the International Federation of Red Cross and Red Crescent Societies (IFRC), based in Geneva.

Valuable Resource for Road Safety Research Papers

ACRS member Dr Ric Bouvier has asked us to inform Journal readers of a valuable source of research papers on road safety (and other areas of injury). This is the Safetylit website to be found at www.safetylit.org. This website describes its functions as follows: "The primary purpose of SafetyLit is to provide information about articles from scholarly peer reviewed journals and selected reports from government agencies, university-based research centers, and professional organizations. We recognize that other types of information about injury prevention and safety promotion may be useful. Thus, we maintain a series of links pages to facilitate your connection to the Web sites of several thousand agencies and not-for-profit organizations". Safetylit is a service provided in collaboration with the World Health Organisation.

Contributed Articles

State Roads Now Star Rated for Safety

by John Wikman, Executive Manager Traffic and Safety, Royal Automobile Club of Queensland

This article was contributed by the SaferRoads Program

SaferRoads
www.aaa.asn.au/saferroads

Australia's motoring clubs are drilling further down into Australia's road networks in the development of its star rating road safety program, the Australian Road Assessment Program (AusRAP).

The role that roads play in road safety is more important than most people think. The National Road Safety Strategy, agreed to by the Commonwealth and all State and Territory governments in 2000, shows that nearly half (332) of the targeted reduction in Australia's road toll by 2010 – 700 per annum – could be achieved by improving the safety of roads. This is equal to the combined contribution that improvements to vehicle safety and driver behaviour could deliver (333).

The Australian Automobile Association and motoring clubs have released star ratings of the AusLink national network over the past two years – some 60% the national highway network is rated three stars or less, which is not acceptable according to the motoring clubs.

These AusRAP star ratings provide a snapshot of the state of Australia's major highway network – now the motoring clubs are working with State and Territory road agencies to look at the safety of state roads.

To assist with identification of roads and sections in need of improvement, AusRAP uses two methods to assess their safety:

- risk mapping, based on a road's history of casualty crashes and traffic flow; and
- star ratings, based on an inspection of a road's design elements.

Risk maps highlight road sections where crashes occur. Star ratings highlight poor road sections where engineering treatments have the potential to save lives – together they provide a compelling argument where roads should be upgraded.

RACQ Risk Map Report

In December 2007, RACQ published risk-maps to provide a measure of the safety performance of Queensland's rural road network comprising of AusLink National Network and selected State highways in Queensland. In this report a number of road sections were identified as being particularly high risk. These included:

- Bruce Highway – Cooroy to Gympie
- Warrego Highway – Helidon to Toowoomba
- Brisbane Valley Highway - Ipswich to Fernvale
- Captain Cook Highway – Cairns to Port Douglas
- D'Aguilar Highway – Caboolture to Kilcoy, Harlin to Kingaroy
- Gillies Highway – Gordonvale to Atherton (see photo)
- Kennedy Highway - Captain Cook Highway to Mareeba
- Maryborough to Hervey Bay Road
- Mount Lindesay Highway – Park Ridge to Beaudesert

2-star, Gillies Highway
Undivided, poor alignment, unsafe roadsides, narrow sealed shoulder width, wide lanes

This report now provides star ratings for 7,917km of rural highways in Queensland zoned at speed limits 90km/h or higher, comprising 5,206km of the AusLink National Network (previously reported on in October 2006) and 2,710km of State highways, similar to those selected for the 2007 risk maps report (mentioned above).

Of the selected State highways assessed, 17% rated 2 stars, 82%

rated 3 stars and 0.4% rated 4 stars (there were no 1 or 5 star roads). This compares to 1% 2 stars, 59% 3 stars and 40% 4 stars for the AusLink network. It is expected that the standard of the AusLink network would be higher than the State Highways, but there is much room for improvement on both levels. Two and three star ratings are unacceptable on important heavily trafficked AusLink network roads.

The RACQ has urged the Federal government to fund upgrades to bring them up to at least 4 stars. Two star ratings are completely unacceptable for the selected State Highways covered in the report. Therefore RACQ urges the State government to focus on upgrades to bring them up to at least 3 stars.

Methodology

There are three crash types which account for almost 75% of all crashes on rural highways. These are run-off road crashes, head-on crashes and crashes at intersections. In Queensland the Department of Main Roads has identified that of all killed and serious injury crashes that occurred on state controlled roads (AusLink and state highways) 36% were intersection crashes, 33% were run-off road crashes and 7% were head-on crashes.

The incidence of these types of crashes and their severity can be greatly reduced by engineering improvements to roads and roadside environments.

The risk scores for road design elements such as lane and shoulder width, road alignment, whether or not the road is divided, and the presence of safety barriers (all of which are known to have an impact on the likelihood of a crash and its severity) were combined to calculate the road protection score (RPS).

Sections of road were awarded a rating between 1 (least safe) and 5 (safest) stars based on this score. These star ratings are displayed on colour-coded maps to show how the level of safety 'built-in' to the road, and the risk it poses to drivers, can change along its length.

The AusRAP report provides an insight into which design elements should best be targeted to improve a road's star rating and thus reduce the risk to road users. There's a particular connection between the condition of roadsides on highways and their overall star ratings.

Safer Roadsides

For instance a major contributing factor towards 76% of the Bruce Highway (AusLink network) between Cooroy and Gympie rating 2 stars was due to it having only 13% safe roadsides. For State highways, 72% of Mt Lindesay Highway rated 2 stars due to it having only 4% safe roadsides.

Similarly, 3% of safe roadsides influenced the proportion of 2 star sections for each of the Brisbane Valley Highway (47%), D'Aguilar Highway (37%) and Maryborough- Hervey Bay Rd (28%). Thirty three percent of the Rockhampton – Yeppoon Road rated 2 stars and only 1% of it had safe roadsides.

Making roadsides safer through removal or protection of hazards such as trees, poles and steep embankments on these roads would provide major benefits in reducing crash costs. Further, RACQ believes the safety of all key highways will benefit from improved sealed shoulders, road alignment upgrades, regular overtaking opportunities, and safer intersections.

The RACQ has compiled the following list of roads urgently requiring attention.

- Bruce Highway – Cooroy to Gympie
- Brisbane Valley Highway – Ipswich to Esk
- Captain Cook Highway – the 28km section south of Mossman
- D'Aguilar Highway – Caboolture to Woodford and sections to Yarraman
- Gillies Highway - Gordonvale to Yungaburra
- Kennedy Highway – Captain Cook Highway to Kuranda and a 13km section south of Atherton
- Mt Lindesay Highway - Park Ridge to Beaudesert
- New England Highway - Crows Nest to Toowoomba
- Proserpine – Shute Harbour Road

The RACQ welcomes the opportunity to work with the respective governments to progress these upgrades. The bottom line is that safe drivers in safe vehicles should not die as a consequence of unsafe roads.

This philosophy underpins the activities of Australia's motoring clubs in developing and refining AusRAP

A Funny Thing Happened on the Way from the Seminar

By Graham Smith, Senior Educator, Roadcraft Gympie, Queensland.

Incident Report

On returning from an Australian College of Road Safety, Aged Drivers Seminar held at Carseldine Campus of the Queensland University of Technology, I was involved in a traffic incident near the entrance to the Drummond Industrial Estate. This event took place at approx. 6.30pm on the evening of 28th March, 2008. Light rain was falling and mist rising from the surface of the road. It was dark and a combination of wet surface, rising mist and reflected light made road markings very difficult to see.

There is no street lighting in the area and there are no lights marking the intersection. There are however many security lights on the surrounding industrial buildings which were the cause of the reflections. I turned right into what I thought was the entrance to the Industrial Estate to find that my car was perhaps some 30/40 metres south of the entrance. In order to clear the South bound lane I continued into the water table drain with the front wheels of the car. We were now stuck fast with the front wheels of the vehicle spinning freely in the water and the underbody resting firmly on the bank.

The car was then towed out of this situation by my colleagues Chris Grivell , Geoff Clive and a passing tow-truck driver. I thank these people for their timely assistance. No injury or vehicle damage resulted from this event.

Lessons We Might Learn from this Misadventure

1. We drive where we look. I incorrectly perceived the position of the entrance to the Industrial Estate. I drove to where I thought it was.
2. At my age, 68 years, eyesight checks should be regular. I will be bringing forward my regular due visit to the optometrist.
3. Having always disliked night driving I will be planning fewer night drives.
4. This is my first on road incident in over 50 years of driving on road. Beware of complacency!!!!!!!!!!
5. It would be timely to bring to the attention of the Main Roads Dep't the situation regarding this intersection. The delineation of the intersection is primarily confined to road markings. The conditions prevailing on the evening of the 28th March, 2008 made these markings very difficult to see.
6. A subject highlighted at the ACRS seminar was the lack of visual contrast in road markings and signage. The combination of lights, reflections and misty rain made the whole scene very difficult to interpret. By contrast the raised kerb or traffic islands and better lighting at the intersection just a kilometer north, at the junction of the Bruce Highway and Brisbane Road was easily identified and negotiated.
7. Research carried out by Blair Turner and Micheal Tzoitis and presented in a paper at the Australian Road Safety Research, Policing and Education Conference at Surfers Paradise 25/27th October 2006 found that the establishment of Splitter islands at intersections reduced crashes by 35% to 45%
8. It is my intention to use this event as first hand experience in our overall attempt to create a safer road environment.

Further Comments

The ACRS Seminar was very interesting, with the speakers presenting some very salient points. I think that the relevance of several of these was proven to me by my little misadventure on the way home.

Now after almost a quarter of a century presenting driver education and training I would like to share some points that have guided the philosophy of our presentations.

1. Vision – Perception- Response.— The inherent human vision, perception, response system is based on a top speed of about 25 kph. We now travel our roads at rates several orders of magnitude above that speed.
2. Most police crash reports contain the concept of 'I didn't see it officer, I didn't see it until it was too late'. Many thousands of our participants have included this concept when talking to us about their crash experiences.
3. In a difficult or a threatening situation we are going to drive to where we are looking. It is best that we look to and correctly identify where we want to go.

The relevance of these concepts was well and truly brought home to me, first hand, on the evening of the 28th March.

Ten Years with Passive Safety – a Manufacturer's View

by Kim H. Heglund CEO Lattix Ltd.

Kim H. Heglund has been involved with the designing, developing, testing and producing passively safe traffic masts since early 1990. He is based in Norway outside Oslo. Since the Scandinavian countries were forerunners in passive safety, Kim H. Heglund had the advantage of early involvement in the development of Scandinavian and more recently European standards. He was a member of the so called "Nordic Working group" in the late 1990's, the first working group to start looking at how to implement the (European) EN 12767 approved masts into the road network. He has later participated in several national and international working groups connected to passive safety. He gave the (British) Highways Agency advice when TA89/04 was originally drawn up and more recently provided advice for the forthcoming British guidelines in their National Annex to BS EN 12767. The following article will be published in the United Kingdom on 21 May 2008 in the book 'Safer Roadsides – A Handbook for Engineers' edited by David Milne and published by The Highway magazine TEC. The ACRS thanks Kim Heglund for making his article available to the Journal.

Initial thoughts and reflections

Over the last 10 years I have worked to develop and promote the use of passively safe traffic masts (used as signposts and to support roadside equipment). Over this period the understanding of passive safety, the national application guidelines and the products themselves have all greatly evolved. In the early days before EN 12767 "Passive Safety of Support Structures for Road Equipment – Requirements and Test Methods" first published in 2000, there was a growing appreciation in Scandinavia that positioning hard and heavy objects alongside roads created an intolerable risk.

In those days one did not seek to redesign such objects by making them lighter in weight and/or softer, but rather to either shield them from impact with a crash barrier or to use a "slip base" system so the post or mast sheared at its base on impact. There are still heavy steel masts with slip bases on highways in Scandinavia, next to modern lightweight and softer traffic masts. In my opinion the use of heavy steel masts for signposts or lighting columns with a slip based system is a sort of Russian roulette. Either it functions and shears or if you are unlucky, it locks and fails to shear. When a heavy steel mast shears off in an impact it bounces off the vehicle at speed with a real risk of a secondary accident. If it fails to shear the consequences are usually serious.

In England there was little or no historical use of slip based products and the Highways Agency there wisely adopted the light weight BS EN 12767 approved masts for signposts from the start on trunk roads

In Norway we have extensively used Lattix lightweight yielding NE masts to EN 12767 for signposts and similar applications and these are permitted at all locations. Norway also still has slip based products, which are typically heavier steel posts that break away or slip off the base on impact. The posts do not readily deform or absorb energy on impact and so tend to bounce off the vehicle in an impact (always provided the base slips). They are not allowed to be used on slopes because if they are hit at a high level they lock up and fail to yield and soften the impact. These products can be a danger in urban areas due to the risk of secondary accidents.

I will explore how passively safe masts (typically signposts, lighting columns and traffic light posts) are being used differently in England and Norway and conclude with my views on what advice national guidelines should provide in this area.

The Ideal "Forgiving Roadside" a Dream or the Future?

Modern safe road design should where possible include wide open verges with gentle slopes so errant cars can lose speed without hitting anything. The RISER project report, (a European 5 year road safety study involving several countries) *"designing and keeping roadsides safe"* strongly agrees with this principle. Safety is best achieved through the design of forgiving roadsides and the use of *forgiving traffic signs/signals/street lightning*. The report draws on input from 8 countries and 5 years of statistics. It actually shows that barriers are a serious danger on motorways and roads and should only be used where it is impossible due to lack of space (or any other reason) to provide a *forgiving roadside*. Often cars hitting barriers are thrown back into the traffic.

It is proven that barriers do save lives and at many locations there are no alternatives. There are energy absorbing terminals and crash cushions now on the market that provide a far safer alternative to the older ramped end terminals to safety fences which caused so many severe accidents.

E18 Motorway showing widened centre reserve with no barrier, passively safe sign posts, passively safe lighting columns and gentle side slopes to retain traffic

However my view is that modern safe roads should be provided with wide verges with gentle slopes, wherever possible, to gradually redirect the errant vehicles gently back towards the carriageway. I am convinced, even where land is expensive, that providing wide central reserves and verges (with suitable attention to slopes and banks to guide errant vehicles) will be significantly safer, more cost effective and more aesthetically pleasing than providing and maintaining expensive barrier to a minimum width highway when the ongoing cost of accidents and injuries is properly accounted for. Barriers should of course be used where they are essential and there are no alternatives.

In Scandinavia, as the picture shows, on some new motorways like the E 18 and E 6 south of Oslo, even the normal central reserve crash barriers to stop cross-over accidents are not always installed. This is because the motorway itself was actually designed and built as two separate roads with a significant wide centre reserve and a gentle depression aimed to avoid cross-over accidents. Since opening of the new part of E 18 south of Oslo in 2002 only one fatal accident has been recorded. Before 2002 between 5 and 10 people died each year.

E 18 in construction

The road minimises the use of barriers where possible, all signs are light in weight and sign support masts and lighting columns are passively safe (light in weight and yielding energy absorbing products and not slip based products)

Forgiving Roadsides, not only the future, but already here in the UK

The use of lightweight passively safe structures without barrier is not only safer but also more economical and faster to install (and to replace after an accident). Speedy installation and replacement of signs and street furniture is becoming ever more important on congested motorways where traffic management is disruptive and expensive

The NE, LE and HE classifications and the choices to be made.

Differing road and traffic conditions will lead to a choice of different types of mast. BS EN 12767 is a protocol that describes how to carry out a very specific crash test and then how to measure and categorise the results. The results are used to divide masts into various categories. It does not advise on how the resulting classifications should be used when selecting or specifying masts and lighting columns for use on the highway.

The standard categories are Non Energy (NE), Low Energy (LE) and High Energy (HE). The category a mast falls within is derived from the exit speed of the vehicle after impact in the high speed test and is thus related to the loss of velocity of the vehicle (and thus its kinetic energy) in that test.

The kinetic energy that is lost in the test from the vehicle is largely absorbed by:

a) the deformation of the car structure mainly at the front - if this goes too far this can obviously threaten the integrity of the passenger compartment and it is obviously desirable if the energy can be lost elsewhere

b) absorbed by deformation or for fibreglass reinforced plastic structures degrading of the structure of the mast (the post or lighting column). This is the best place for the energy to be absorbed as it does not threaten the integrity of the vehicle.

c) transferred as kinetic energy to the mast or the equipment on the mast. If the post does not yield or deform or degrade in the impact it can bounce off like a billiard ball and thus take kinetic energy with it. This again is undesirable as there is a risk of the mast causing a secondary accident. This is a characteristic of rigid steel slip based posts on impact

What happens to the energy can be as important as how much velocity is lost in the test. In my view, solely relying on the energy classification can be misleading, especially for the NE class. The name "Non Energy" indicates a class where the mast does not absorb energy. Some energy will always be lost in an impact.

A "hard" heavy steel mast on a slip base can cause deformation to the front of the vehicle and fly off at some speed with transferred kinetic energy and yet still attain a NE classification. This is very wrong in my opinion.

For a "soft" deformable energy absorbing NE post the energy will be lost in the plastic deformation or degrading of the post material. The post will not acquire significant kinetic energy or bounce off the vehicle at speed but will be comparably inert in an impact and not move a significant distance from the point of impact. This is a safer failure mode especially in an urban situation with pedestrians.

Then there are true energy absorbing poles and masts which progressively deform in an impact. They are usually formed from thin walled aluminium tubes or tubes formed from rolling thin steel plates. Lighting columns are typical examples. The tubes deform or flatten on impact and thus absorb energy whether categorised as NE, LE or HE.

Obligatory EN 12767 low speed 4425 NE test (35 km/h = 21.0 miles/h).

The photographs above show our deformable energy absorbing NE product deforming on impact in a successful low speed EN 12767 test. The light strong structure is deforming and crushing before it breaks away from its base. Because of the deformation of the mast it is inert and does not bounce away from the impact and will fall to the ground very close to its original position. It can be seen the product absorbs energy even if it's classified non energy or NE.

In my opinion, lightweight energy absorbing masts are suitable for use in urban areas regardless of their classification. Thin walled aluminium tubes or even roll form steel tube masts also have energy absorbing qualities.

Conclusion: Some measure of the energy absorbing abilities of the mast itself should be part of the EN 12767 testing regime, especially in the NE class to reflect the need for a product to absorb energy in an impact and prevent "bounce"

3 fundamental questions have to be asked before producing/deciding a National Annex :

Question 1:

Should passively safe masts be used extensively in urban areas and where speed limits are less than 50 mph

Relatively low speed accidents with standard (i.e. not passively safe) signposts, lighting columns and utility poles are dangerous since a car will often stop more abruptly than in a higher speed accident because the post or mast is more likely to bend or shear or the ground fail allowing post rotation. A speed of 50 km/h (about 30 miles/h) is fast enough to cause serious injury. Passively safe masts which are truly "light", "soft" and "deformable" and "energy absorbing" are safer at all speeds.Where speeds are limited to 20 mph (which also significantly increases the safety for pedestrians in accidents with vehicles) and the limits are abided by it is probably not necessary to use passively safe street furniture as the speeds are probably slow enough to avoid serious injury.

Question 2:

Should only HE and LE masts (and not NE Masts) be used in urban areas or areas with regular pedestrian or bicycle users?

My answer is no. Lightweight energy absorbing NE masts are suitable (In Norway there are no government approved LE signposts)

I will try to explain why I believe passively safe posts are necessary for speeds above 20 mph and why NE masts are suitable where there are pedestrians and cyclists:

1. Confusingly a modern yielding energy absorbing deformable lightweight mast can be categorised NE, LE or HE depending on length, the equipment or sign carried and the base fixing details. Therefore one can actually question if the categories HE, LE and NE are a good guide to safety and performance or even necessary?
2. In my opinion the most important traffic safety parameters for a post especially in an urban area are:
   a) Low weight
   b) The ability to readily yield and deform and thus absorb energy in any impact
3. Energy absorbing deformable lightweight masts and columns will always give the lowest risk. It is also easier to have lower decelerations (and thus lower Theoretical Head Impact Velocity (THIV) if the mast is allowed to break away at its base. NE posts are typically designed to break away and this lessens impact decelerations.
4. If the aim of using passively safe masts is not only to reduce risk in the collision itself but also to slow or stop the car to achieve a LE or HE classification the base of the post cannot be permitted to break away and the decelerations (and THIV) will need to be higher to achieve the required speed change. As a result LE and HE classes impacts will be **more severe** and as a result it has been necessary to accept higher THIV ASI values in EN 12767 for HE products. (ASI = Accident Severity Index).

5. We have found as a manufacturer after expensive crash tests and computer simulations that it is very difficult to develop LE and HE products for signposts, that it is extremely difficult if not impossible especially for medium sized signs with a single mast.

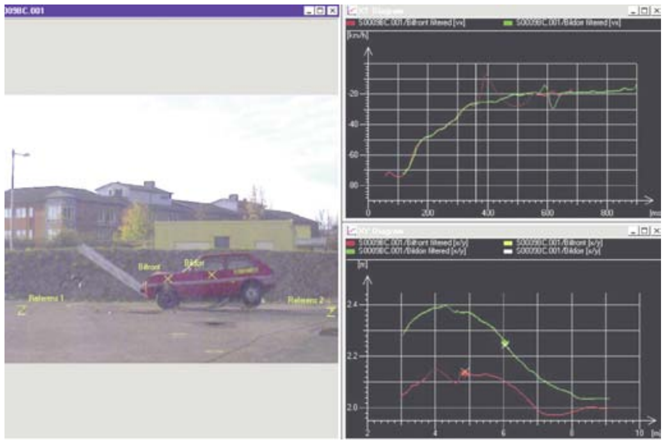
I will try and explain why achieving an LE classification for a sign with a single post is so difficult:

- The length of signpost between the underside of the sign and the ground is effectively the length available to distort and so absorb energy and thus slow or stop the vehicle. It is difficult for a sign mast to slow up a vehicle in such a short distance without causing such high decelerations that THIV and ASI limits are exceeded (lighting columns have a longer length to slow the vehicle allowing a gentler deceleration and so find it much easier to comply). So this actually rules out the HE class and leaves us with the LE class where the car speed is only to be reduced by approx 50%.
- The weight (and resultant inertia) of the sign itself on top of such a short mast makes the top of the mast (with the sign) readily bend over the front of the car when hit.
- The sign, if large, will not readily pass under the car even if the mast and the sign bend forward on impact
- The problem in achieving a LE or HE rating will be common to all lightweight energy absorbing passively safe signposts.

We currently believe the only way to achieve a LE approved signpost, is to use at least two posts to support a sign. When then a LE post is hit, it would need to disengage or instantly break away from the sign and so permit the post to pass underneath the car while being flattened and distorted and thus absorbing energy to reduce the car speed.

From the above tests we learnt that when designing for safety it is important to consider what object a signpost will carry. A heavy Variable Message Sign (VMS) will be a great danger to a vehicle hitting the sign and whether the posts were NE or LE will be irrelevant provided they are lightweight passively safe and yield or fail in the impact as designed. Height is also most important and a heavy object can penetrate a vehicle windscreen if the object is low or the vehicle windscreen high.

Picture shows a LE Sign Post trial in Sweden where the Sign wants to go above the car while the mast underneath………. Note This is not a standard Lattix mast, but one we attached permanently to the foundation so it does break free on impact



Picture above including the diagrams showing the car speed reduction from 80 down to 20 km/h combined with low level of G-momentum on the driver during the collision (only 2.4g) shows a successful LE test of a standard Lattix 3325 short post which again was fixed permanently to the foundation (not standard). Actually the same mast, length and car speed as shown was used on the previous unsuccessful LE, but this time with no sign and weight fixed on top. Here we prove that the same Lattix mast can be NE, LE or HE depending how you fix it to the foundation and what you install on top.

Personally I would be terrified hitting something like this (a heavy VMS sign on rigid steel posts either of which represent an unacceptable risk)

Why not reduce the topside weight as absolutely much as possible and go underneath like this.

Question No 3

Are NE masts tested and approved at 100kph (including the 35 kph lower speed test) to EN 12767 suitable for use in urban areas and areas of lower speed limits or are further tests at 70 kph and 50 kph needed?

The answer is no. In my opinion an NE post tested at 100kph is suitable for use for all traffic speeds. The Scandinavian countries followed Table 7 – Hierarchy of Performance Types in EN 12767:2000. The table states a 100,NE,3 product includes approval to performance type 70,NE,3 and similarly a 100,NE,2 product includes approval to performance type 70,NE,2. Table 7was drawn up to limit unnecessary testing. Table 7 may I understand be omitted from the forthcoming update to EN 12767. but in my view testing at 70 kph or 50 kph is still unnecessary and will not add to safety where an NE product is tested at 100kph and 35 kph. In Norway 100 NE approved masts, regardless of safety class, are used on all types of road in urban and country areas (although there are limitations on slip base products in urban areas).

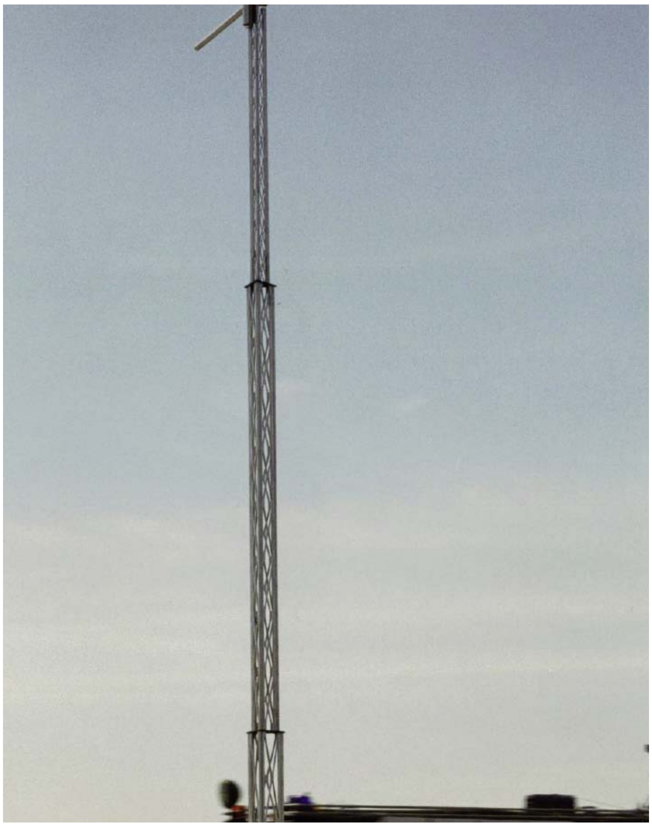
Lattix mast after 120 kph impact with aeroplane wing section

A 100 kph NE mast to EN 12767 will be tested at a low speed 35 km/h and 100 km/h. Our experience for Lattix (with more than 100 injury free accidents with our masts in Norway and over 30 in the UK) shows that a "soft" NE Mast is safe at all speeds. Used as a 14 metre Aviation Light column, we have successfully tested Lattix at speeds of 120 km/h with a thin walled sport airplane wing hit at a height of 4 metres with very little damage to the wing as shown in the photographs below.

For an NE product the low speed test (35 km/h) is the most difficult to satisfy and a product which satisfies this element of the test will probably pass a 100kph (and a 70 kph or 50 kph) test.

For the lower 35 kph speed test the car must not abruptly halt or bounce back or the THIV (Theoretical Impact Velocity) will exceed 27 kph. i.e. unless the car is not still moving forwards at least at 8kph when the theoretical head makes contact with the inside of the vehicle the test is a fail.

The high speed tests are easier to pass in this respect because higher THIV's are permitted and with the higher energies possessed by the vehicle the posts shear and fail with much less of a reduction to vehicle speed.



14 metre Lattix aviation mast before 120 kph impact with lightweight aeroplane wing section

In real life, accidents will occur at a variety of speeds with different cars, sometimes with posts on slopes where impact level may be very much different the EN 12767 test. The all round crash safety needed to cope with these varied impact conditions is achieved not only by meeting the EN 12767 test requirements but by having a product which is light in weight and soft or yielding when struck at any level. You are better off kicking an empty milk carton than you are kicking a brick with your bare foot.

It is important to ensure that any apparatus such as a VMS sign or traffic light head mounted on a mast or masts is light and readily deformable in a crash. This is much more relevant for safety than whether a mast is classified as NE, LE or HE. There is a need for guidelines on this so industry can develop suitable products for VMS signs and other roadside equipment.

Some final reflections

I think the important attributes of a mast are that it must be lightweight and yield readily in any accident. This is more important than NE LE and HE classifications or additional expensive crash tests at 50 and 70 kph speeds for 100 NE products. After more than 10 years of working with these issues, I wonder why road authorities in so many countries currently advocate HE, LE or NE masts depending on the various road types, locations and whether if it is rural or not.

Damage to light aircraft wing after 120 kph impact

For example the use of HE and LE masts is often recommended:

a) where it is desirable to prevent an uncontrolled vehicle from continuing on to other hazardous obstacles such as trees, bridge supports, and rock faces (this is really asking the mast to do the task only a safety fence can reliably do).

b) in built-up areas and other places with regular cyclists and/or pedestrian use; (this is prompted by fear of secondary accidents where a mast, sign or lighting column can hit vulnerable road users).

c) on central reserves that are wide enough so a mast when hit (but anchored at its base) cannot fall across the path of oncoming vehicles in the other carriageway; (prompted by fear of secondary accidents).

Differences in the use of passively safe masts in Scandinavia and in the United Kingdom

EN 12767 gives guidelines, accepted throughout Europe, as to the testing and approval of energy absorbing equipment. Carrying out the tests, completing the test reports and seeking approval is time consuming and expensive. It is thus desirable to limit the number of crash tests to an acceptable minimum. With this in mind Norway took the initiative in the autumn of 1998 of establishing a Nordic group which was to cooperate in the testing and approval of energy absorbing passively safe street furniture.

On 29th January 1999 representatives from road authorities and testing laboratories from all the Nordic countries met in Oslo. There it was decided to establish a Nordic committee designed to cooperate in further work in testing and approving energy absorbing road equipment in accordance with EN 12767. When discussing where to use energy absorbing masts, the Nordic Group concluded the following:

A steel slip based mast which has been hit at a high level. The heavy mast failed to shear off and it can be see the mast has not bent or distorted significantly. This will have been a very hard impact.

It is recommended that energy absorbing sign masts and energy absorbing lighting masts are used on all important roads where there is a lot of traffic and where the speed limit is 50 kph. or greater. This will, of course, include all roads leading to and through towns, villages and other built-up areas. Boroughs should be encouraged to introduce these demands on local roads.

Energy absorbing masts should be employed in the following situations:

- *the building of new roads*
- *wherever new masts are being erected along existing roads*
- *a systematic renewing of equipment along existing roads*

These demands are not relevant where the masts are protected behind crash barriers or are otherwise situated that they do not constitute a hazard. The demands would still apply in those cases where a mast is situated behind a crash barrier but within the working width of the barrier.

Soft masts behind Barriers within its working width works.

We note that in Great Britain the use of passive safe masts is typically restricted to roads with speed limits over 50 mph (80 km/h).*

Why?

Our test experience shows that it's often the low speed tests that results the largest retardation on the driver (almost a sudden stop). From 35 km/h (23 Miles/h) and above a sudden stop can become fatal and indeed a large proportion of serious injury and fatal accidents from collisions with street furniture (and the resultant casualties) occur in urban areas in the UK.

* Editorial note: The 50mph UK practice was generated in 2004 in TA89/04 for UK trunk roads where the existing policy was to typically protect dangerous roadside obstacles with safety fences only where speed limits exceeded 50 mph. However any study of UK accident statistics will show urban areas have most injury with street furniture.

Safety levels, ASI and THIV

Safety levels are a very complicated matter even for specialists. Being a generalist I will therefore be careful and brief on this subject. Having looked into the NE, LE and HE classification System though, the safety levels should be addressed. The very simplified safety levels give us an idea of the retardation (the G forces) the driver suffers in the initial period when hitting a traffic mast.

Two theories are used which are derived from barrier testing in Europe and the USA.

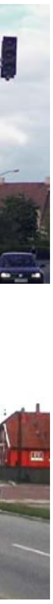
In Europe we usually say that a driver can suffer a maximum of approx 12 g before the risk of suffering personal injury is overwhelming. In the United States a higher g force is allowed for a very short period of time.

EN 12767 uses both theories. THIV measures the speed an unrestrained body will impact the inside of the vehicle and this will limit how much a vehicle can be slowed in the short time before the body hits the inside of the vehicle. The ASI relates to the deceleration forces the driver suffers.

The test to EN 12767 typically uses older Ford Fiesta and sometimes Suzuki Swift cars. They are light and represent the smaller vehicles (but not smallest) on the road. It is probably fair to say it modern equivalent cars will tend to be heavier, stronger and will safely absorb more energy in an impact so the test may be severe. Lattix products to EN 12767 have an unblemished safety record and I understand some competitors may also perform well. The test does have a good record in developing safe products (with the possible exception of slip based products)

Paradoxically a car with a rigid bumper encouraging a post to shear on impact may fair better than a car with a soft bumper in a NE crash test as there is no requirement to reduce vehicle speed in the NE classification. If a car was soft at the front so it did not readily shear a post, it might fair better in a LE or HE test where the post must not shear off as it is needed to deform over its length and thus absorb energy and slow the vehicle.

In my view some energy absorption is essential even in a NE product if only because the mast must not bounce when struck and this should be part of the test. One should in my opinion, at this early stage, be careful complicating matters, introducing safety levels as a classification system in National Annexes. They can, in some cases, be very misleading. In Norway safety levels are not introduced in the exiting handbook 062 which regulates the use of EN 12767 approved masts.



How Norwegians apply passive safety

In Norway most passively safe masts are installed on ordinary single carriageway roads often where speed limits are 80 kph or less and in urban areas. Of course they are still used on our motorways but most roads in Norway are not 4 lane motorways or dual carriageways.

The Handbook 062 (National Guidelines for the use of EN 12767 Masts) states that passively safe masts should always be used in a safety zone next to the carriageway regardless of type of road. The safety zone width depends on the speed limit and is:

- 3 metres where speed limits are 50 kph or less
- 4 metres where speed limits are 60 kph
- 6 metres for speed limits of 70km/h and 80 km/h
- 7 metres for higher speeds than 80 kph

Road designers, Contractors, County Councils have tended to standardize on selected passively safe products for logistical reasons.

Perhaps as much as 60 – 70% of passively safe masts are used on single carriageway roads including roads in urban areas. In Norway all passively safe signposts are NE (including two NE slip based masts which are subject to extra limitations and not permitted in urban areas). Only NE masts have been used as Signal masts, but still traditional "not approved" signal poles are mostly used, especially on smaller installations. NE and HE classes are used for lighting columns. Here both traditional steel posts with slip base and modern thin walled roll form steel tube and thin walled aluminium tube columns are in use.

In Oslo and other Scandinavian urban areas more than one thousand lightweight yielding NE posts have been installed without any reports of primary or indeed secondary fatal accidents in the last 10 years. Many of the posts are in the centre of Oslo where there are numerous pedestrians.

Pictures of passively safe NE masts in use in urban areas


Sign and mast falling close to its original position after impact

Secondary accidents or their absence

I can only answer for Lattix but we have had no report of any fatalities or serious casualties in secondary accidents (or indeed primary accidents) with our product in over 10 years of use.

About 30,000 Lattix masts are installed in Norway and 20% are probably in urban areas. Typically these Lattix masts support signs, traffic light heads or similar street equipment. All the Lattix masts are lightweight yielding NE products. Lattix masts are widely used on country roads where Norwegian speed limits are generally 80 kph as well as higher speed motorways.

The risk of "lightweight yielding" NE products causing secondary to pedestrians or cyclists as identified in national application documents is in my view much overstated and counterproductive in safety terms. Secondary accidents are so rare that nobody has reported one to our product.

I believe this is because:

- Lattix posts are lightweight and yielding (these characteristics are I believe more important than whether they are of NE or LE classification)
- Signs and signal head mounted on top are normally lightweight
- The construction itself being light and yielding so posts usually fall close to the point of collision (this can be seen in the Lattix EN 12767 crash tests)
- Signs and signal masts are normally on the roadside so the risk of a sign falling into the roadside and being hit by a following car is low

It is argued that because HE and LE products can stop or slow a car they will prevent a vehicle hitting vulnerable pedestrians. This may happen if the vehicle is not too heavy but in the case of a glancing blow or heavy vehicle it makes little difference. Relying on isolated posts to safeguard pedestrians by slowing or catching vehicles is at best a highly uncertain safety fence.

Different considerations apply to HE and LE lighting columns where a long HE or LE lighting columns wrapping round the vehicle in an impact rather than falling across a crowded footpath or busy road may be a welcome virtue.

Conclusions

- To demand in national annexes that LE posts are used for signs in built up or low speed areas is probably not the best way forward. To make this physically achievable it is probably necessary to provide two LE posts to each sign.
- However, lightweight deformable energy absorbing NE posts are inherently safer for the errant vehicle than a steel post (or a HE or LE post).
- Because lightweight deformable energy absorbing NE posts fall close to the point of impact the chance of a secondary accident is very low indeed (and as the masts are comparatively light and deformable such an accident may well not be serious).
- Designing a LE mast for mounting traffic signals is more easily achievable than for signs. We concur the LE class is suitable for mounting traffic signals in urban areas.
- We would also agree it is reasonable to use HE masts for lighting columns in built-up areas where the speed limit is normally 50 k.p.h. or 60 k.p.h. and to use LE and NE for lighting columns and NE masts for signs outside built-up areas where the speed limit is 70 k.p.h. or more.
- We advise that NE classified Products be divided in two categories lightweight energy absorbing products which should be judged suitable for urban areas and slip based products which in Norway would not be used in urban areas (or on a slope).
- The problem in achieving a LE or HE rating will be common to all lightweight energy absorbing passively safe signposts.
- Those specifying passively safe masts as signposts or traffic signal posts should be careful to ensure signs or signals attached to them are lightweight and yield on impact. This is probably more important than whether the masts are LE or NE. In particular VMS signs can be heavy and a real danger if they are at windscreen height of any vehicle.

Suggested Restrictions for Australian Slip Base Sign Posts

by Kim H. Heglund CEO Lattix Ltd

There is a considerable amount of evidence that slip base posts don't work as designed in certain applications. These include on filled slopes and where a post may be hit by a vehicle at an angle outside the design parameters of the post. Road Safety Barriers are assessed and limitations are placed on their installations. Some restraints placed on barrier installations include the batter must be less than 1:10 and the barrier must be at least 200mm behind the face of a kerb. A similar process should be used for sign supports.

Most slip base posts seem to be derived from the AASHTO Roadside Design Guide criteria. The Austroads report AP-R200 "Frangible Sign Supports Part 2: State of the Art Review" Section 3: International Practice and Literature Review 3.1.1 AASHTO Roadside Design Guide states "The guide discusses location of signs to minimise the risk of the support being struck. The mechanism of failure is dependent to some extent on what height the vehicle strikes the support.

For this reason the likely impact position may be affected when locating supports on slopes. Where possible the supports should be located on level terrain."

AP-R200 section 2.9 also reported discussions with representatives from each state. Responses included "Concern that if a sign is not struck at the normal height (eg flat approach) that the sign will not fail properly. This may be as a result of a vehicle striking a kerb, or travelling out of control down an embankment". There are two problems here. One is that hitting the sign high means uncertainty whether the slip base will function. The other problem is if the slip base does function and if the hinge point functions there is still a heavy steel post behind the sign. There is a chance of the steel post penetrating the windscreen and entering the cabin of the vehicle. This would apply particularly for high vehicles like trucks. Anywhere that a car is likely to become airborne is a location that slip base posts should not be used.

AP-R200 section 2.9 reported another concern; "Frangible signs at intersections are difficult to cater for, with the possibility of the sign being struck from almost any direction". This is a problem with slip base posts. They have been designed to be hit from the front or back, but not from the side. Truly frangible supports will absorb the energy of the impact no matter where they are hit.

Austroads publication AP-T47 06 Revision of Guide to Engineering Practice - Part 8 - Traffic Control Devices 5.2.3 Large Supports when describing slip base posts warns "However they are designed for impact up to a limited angle and may not perform as intended if struck from the side."

AP-T47 06 5.5 Installation and maintenance issues for frangible supports states "The following aspects are critical to the successful behaviour of a frangible sign support:

- Base bolts must be installed and maintained at the tension specified on drawings or in specifications
- The frangible mechanism must be installed at the correct height above the ground surface. If it is too low the surrounding surface may impede the correct operation of the slip base, and if it is too high an impacting vehicle will snag on that part of the base that remains in place
- The ground level around the base plate must be compacted and finished so that it remains at the correct level relative to the slip base, debris will not build up around the base, and the soil will not erode from around the base
- Hinges should be installed strictly in accordance with drawings and should not be modified (e.g. by welding) for any purpose as part of maintenance operations.

AP-T47 06 5.2.2 Small Supports states "... it is important that the spacing between posts is such that an errant vehicle is likely to only collide with one of the posts. Opinion varies on the spacing, a value in the range 1.5m to 2.4m being adopted."

AP-T47 06 5.6 Frangible post selection guidelines states "In selecting post numbers and sizes the:

- Smallest possible number of posts should be used
- Distance between posts should not be less than 1.6 metres to avoid the risk of an errant car simultaneously striking more than one post

We submit to you that although steel slip base posts are infinitely safer than rigid posts, they do have limitations in their applications. We believe the following limitations should be applied to the use of slip base posts immediately.

1. Slip base posts be banned from filled batters of 1:3 or greater or where the base plate will be more than 400mm below the road level. This is a Danish regulation, Norwegian Road Authority specifies batters steeper than 1:4. The Norwegian specification should be adopted by January 1, 2012
2. Slip base posts be banned from gore areas as the GE2-3 exit signs are (a) likely to be hit, (b) likely to be hit at an angle greater than the design parameter of the slip base post, (c) the post is likely to finish up on a roadway, and (d) a vehicle is likely to hit more than one post simultaneously as the signs are 1.8m wide giving a standard post spacing of 1.08m (1.8 x 0.6).
3. Height of stubs above ground of existing installations should be checked and any rectification works to be completed within 12 months.
4. Torque settings of bolts on existing installations should be checked every 3 months for at least one year, until it is evident that the torque is not changing.
5. Installers are to be liable for checking and maintaining torque settings for 5 years from installation. This is to be introduced after an Approved Sign Installer program is initiated. The price of this checking is to be included in the initial installation price. Records of torque settings to be presented to the Approved Installer Program administrator.
6. Slip base posts to be banned where it is likely that a vehicle will hit the sign from an angle other than the design angle. This includes within 60m of an intersection.
7. Slip base posts to be banned where the is kerbing.

Points 1 to 6 can be avoided by using an approved energy absorbent post. A post may be considered energy absorbent if it meets the requirements of NCHRP 350 or EN 12767 and has a failure mechanism which does not rely on a slip base. It must function when struck from any direction. Full crash test reports to either standard must be supplied to Queensland Main Roads. The full scale crash test must use a vehicle as specified in the standard. Computer simulations will not be accepted unless the largest and smallest posts in a "family" of posts have been sucessfully full scale crash tested. The structural requirements must be satisfied by showing compliance with AS1170.2 2002 - Structural Design Actions - Wind Actions and a relevant

Australian Standard. This compliance must be from an independent Australian certified Structural Engineer. Foundation sizes are the responsibility of the manufacturer / supplier. It is suggested that these are designed an independent Australian certified Structural Engineer.

Also the following restrictions should be placed on all posts.

Unless protected by a barrier which is there for another purpose, no posts may be installed with less than 1.5m between the posts. Note: Minimum centre to centre of posts is 1.5m plus one post diameter. Hitting 2 x 50NB posts is the same as hitting 1 x 100NB post.

Peer Reviewed Papers

Rollover Crashworthiness: The Final Frontier for Vehicle Passive Safety

by Grzebieta R.H.*, Young D.+, McIntosh A.**, Bambach M.+, Fréchède B.**, Tan G.+, Achilles T+

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This is an edited version of the paper presented at the Research, Policing and Education Conference held in Melbourne 17th-19th October 2007 and published in the Conference Proceedings.

Abstract

Fatalities and injuries to seat belted occupants resulting from rollover crashes is of considerable concern to road safety advocates around the world. Rollover crashes in Australia account for around 1 in every 6 road fatalities, in Europe approximately 1 in every 10, while in the USA it is an alarming 1 in every 4. Recent detailed analysis of the Australian National Coronial Information System fatalities for the year 2005 has revealed that almost 1 in every three vehicle (excluding motorcycle, bicycle and pedestrian fatalities) occupant fatalities (29%) can be attributed to a rollover crash and that of those crashes 16% occur in urban environments whereas 84% are rural crashes. Moreover, vehicle roll-overs are among the most common cause of spinal cord paralysis injury in Australia. Yet there still is no government mandated or consumer dynamic rollover test that protects occupants in such crashes. The main reason for this is considered to be two fold. Firstly, vehicle manufacturers continue to contend that there is no causal link between roof crush and occupant injuries and in particular neck injuries. Secondly, government and consumer groups are presently focussed on prevention of rollover via assessment and ranking of a vehicle's stability characteristics and promotion of electronic stability control.

This paper provides a brief summary of research work carried out and findings to date of an Australian Research Council (ARC) project "Protecting Occupants in Vehicle Rollover Crashes". It includes: the mechanisms that lead to neck injury and fatalities in rollover crashes; the causal link between serious head and neck injuries and excessive roof crush for seat belted occupants; and a proposed rollover crashworthiness testing device called a Jordan Rollover System (JRS) test rig; some preliminary results of a number of vehicles tested using the JRS test rig and a proposal of how vehicle rollover crashworthiness could be rated using the JRS test rig.

Australian Rollover Crashes For 2005

Approximately 1268 of a total of 1627 road fatalities recorded for year 2005 were investigated using the Australian National Coroners Information System (NCIS). The remaining 359 fatalities were still associated with open files and hence could not be accessed. This meant that a total of around 77% of all road fatalities in 2005 were accessible. **Table 1** shows the breakdown in percentage of all fatality cases accessible via NCIS in each state.

Out of this total (accessible) of 1268 road fatalities in 2005, 742 were vehicle occupants. This excludes motorcyclists, cyclists and pedestrians. Of the 742 occupant fatalities, 216 were in a vehicle involved in a rollover crash where around 63% were in cars, 30% in 4WD vehicles, 6% in trucks and the remainder were non-typical road vehicles such as tractors, etc. From a another perspective, nationally, around 29% of vehicle occupants killed were in a vehicle that was in a rollover crash, i.e. a little less than 1/3rd of vehicle occupants (excluding motorcyclists and cyclists). This figure is not dissimilar to the proportion of vehicle fatalities in the USA that are rollover crash related. Around 11,519 fatalities from a total of around 33,041 vehicle occupant fatalities (excluding motorcyclists and cyclists) occurred in the USA in 2005 that were rollover related, i.e. 1 in every three vehicle occupant deaths can be attributed to a rollover crash mode [1].

Of the 29% of vehicle occupants involved in a rollover crash around 42% were in a vehicle that is involved in a secondary collision, and 58% were in a single vehicle crash. The secondary collision vehicles were either vehicles struck by another vehicle prior to or after rolling over, or the vehicle hit a fixed object such as a tree, pole, road side barrier, etc, prior to or after rolling over. **Table 2** shows the percentage breakdown of vehicle occupant fatalities involving a rollover crash occurring in each state. It is worth noting that rollover

	% data accessible
ACT	100%
NSW	62%
NT	93%
QLD	76%
SA	92%
TAS	98%
VIC	82%
WA	68%
Total	**77%**

Table 1: Percentage of all road fatalities for each state accessible using NCIS.

	% rollovers (vehicles only)	Rollover % rural divide
ACT	27%	0%
NSW	13%	89%
NT	74%	79%
QLD	29%	89%
SA	32%	96%
TAS	22%	63%
VIC	26%	76%
WA	45%	95%
Total	29%	84%

Table 2: Percentage of vehicle only crashes where it was identified the vehicle rolled over and percentage of the rollover related crashes that were rural.

related crash fatalities are over represented in Western Australia and the Northern Territory.

The rollover occupant fatalities were also analysed and segregated into rural and urban associated fatalities. The division of rural versus urban was based on assessing postal codes and using maps and assessing whether the crash occurred in an urban built up environment or not. **Table 2** again shows the percentage rural rollover occupant fatalities for each state. **Table 2** also shows that rollover associated fatalities predominantly occur in the rural divide at around 84% nationally but varies greatly and clearly percentage of rollovers in each state is at least partially related to the amount of rural areas.

Occupants who were killed in a vehicle that rolled over were further investigated for seat belt usage and ejection. This data is summarised in **Table 3**. It is interesting to note that 49% of the fatalities that occurred were either fully or partially ejected during rollover and around 35% of occupants killed were found to be not using a seat belt. Unfortunately, little can be said

Ejection		**Seatbelt Usage**	
Yes	43%	Yes	19%
No	32%	No	35%
Partial	6%	Unknown	46%
Unknown	20%		

Table 3: Categorisation of rollover crashes where a fatality occurred.

about the 46% of occupants killed involving a rollover crash where seatbelt usage is unknown. However, the authors suspect a large proportion of these occupants may not have been wearing seat belts. Thus significant gains in terms of injury reduction could be made by ensuring occupants wear seat belts and that systems are developed to ensure the occupants are contained within the vehicle during the rollover event.

Rollover Crash Mechanism

The different ways in which a single vehicle rollover crash occurs has recently been described by Young et al [2], Gugler et al [3] and Viano and Parenteau [4]. As mentioned above, vehicles can also become involved in a rollover crash as a secondary event after it has been struck by another vehicle [5]. Of those rollover crashes described for single vehicle rollover crashes, one of the most common ways a rollover crash occurs involves a vehicle loosing steering control, yawing sideways, and eventually "tripping" because of excessive tyre resistance to yaw sliding. Analyses of crash scenarios have revealed to date that this can either occur:

- because of excessive speed during a cornering manoeuvre inducing the yaw;
- as a result of the driver falling asleep at the wheel allowing the vehicle to drift onto the soft gravel shoulder, suddenly waking and then oversteering the vehicle in an attempt to guide it back onto the bitumen;
- from an excessive swerving steering manoeuvre to avoid a collision into another vehicle or object;
- or from an impact with a roadside concrete barrier or dirt mound.

Regardless of how vehicle tripping was induced, once the vehicle begins its rollover sequence, the safety of the occupants depends on the structural integrity of the roof, the seatbelt restraint and side air-curtain system. The majority of rollovers usually occur on flat terrain where there is little rise or fall of the vehicle during the rollover event [6]. Newton's first law of physics governs that any objects within the vehicle are usually thrown to the outside away from the centre of rotation of the vehicle unless they are restrained in some manner. The restrained occupant is held within the seat area by forces applied primarily by the seatbelt. If the occupants are not restrained, there is no air curtain and the vehicle's side windows are compromised and fractured as a result of roof crush, ejection of the occupants is most likely. If the roof structure is weak and readily collapses, then the internal survival space is compromised to a point where both the occupant's head and neck cannot fit under the roof structure unless the neck is broken as is obvious for the vehicle shown in Figure 1.

The vehicle shown in **Figure 1** underwent two rollovers (two complete revolutions). Friedman et al [7, 8] have shown that around 90% of rollover crash related fatalities occur within 2 complete 360 degree rolls, i.e. 8 one quarter (90 degree) turns.

In other words, the authors believe that the vehicle's roof structure should be built to withstand at least 2 rollovers without intrusion into the occupant compartment. A strong roof also helps significantly reduce breakage of side and/or front glazing which in turn mitigates ejection (which constitutes a large proportion of rollover fatalities and serious injuries).

Injury Mechanism

This paper focuses on injuries to seat belted occupants. A large number of papers have been published analysing how such occupants are injured during a tripping rollover event. It has been established that a seat belted person suffers serious, potentially fatal neck injuries, as a result of loading to the head which in turn loads the neck. Hence the large number of spinal injuries resulting from vehicle rollover crashes [9]. In other words, the head appears to be driven into the torso of the occupant.

Figure 1: Tenting roof crush and pillar deformation leaves little room for survival

Effectively there appear to be two different hypotheses in regards to how occupants are injured in this way. One proposes that the occupant "dives" into the roof during the rollover when the roof strikes the ground. This view was introduced by Moffat in 1975 [10], but continues to this day to be strenuously defended by vehicle manufacturers [11]

The basis on which the "diving" hypothesis is defended dates back to a series of FMVSS 208 dolly rollover tests carried out in 1987 by General Motors of their 1983 Chevrolet Malibu vehicle, with seat belted Hybrid III 50th percentile crash test dummies (ATD). The series is referred to as the Malibu II rollover crash tests. Eight vehicles were tested. Four vehicles had roofs strengthened with a 'roll cage' and four 'production' vehicles had no strengthening. The ATD's were restrained with the vehicle's seatbelt systems. The belts were fitted to the ATD's with slack equivalent to the static inversion of a human surrogate in the vehicle. ATD neck loads were measured. Any neck load above 2000 N was identified as a Potentially Injurious Impact (PII). There were forty (40) such PII's recorded from the test series.

An alternate view, mostly promulgated by Friedman et al [6, 7, 8, 9, 12, 13] and other crashworthiness experts [14, 15 and 16], states that roof crush is causally linked to fatal and serious head and neck injuries resulting from rollover crashes.

In an attempt to resolve the argument and hence fill a knowledge gap, the authors have analysed in detail the principles on which the "diving" hypothesis is based. A discussion of this can be found in two papers by Young et al [17] and Grzebieta et al [18]. Essentially the authors have developed equations based on a single degree of freedom dynamic model of an occupant that directly relates the magnitude of neck load to either the intrusion velocity of a roof and/or the velocity of the occupant "diving" into the roof. Further analysis of General Motors (GM) Malibu II vehicle rollover crash tests [11] was also presented in these papers illustrating how high neck loads in production (non-reinforced) vehicles cannot be attributed to "diving" alone. It was concluded that these significant forces must be resulting from roof crush and in particular the velocity at which the roof intrudes

Figure 2 shows the model used [18]. The following equations

$$F_{neck} = V_R\sqrt{km} \quad (1)$$

and

$$F_{neck} = V_d\sqrt{km} \quad (2)$$

relates the velocity of roof intrusion V_R and the "diving" velocity V_d to the neck loading where k is the ATD's neck stiffness, x the neck compression, xm the displacement of the torso, m the mass of the torso, and $\ddot{x}_m$ the acceleration of the torso.

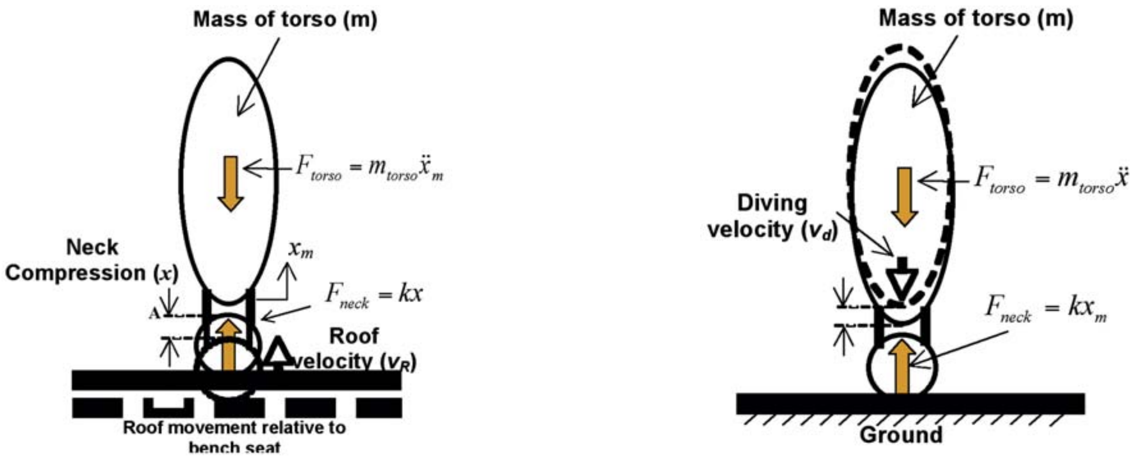


Figure 2: Single degree of freedom dynamic model representing Hybrid III dummy

Consider the silhouette of a vehicle that is rolling over as shown in **Figure 3.** It rotates at a roll speed of ϖ degrees per second and its Centre Of Gravity (COG) is travelling sideways at a velocity of VCOG. The rollover can be thought of as a smooth cylindrical barrel roll. Friedman and Nash [10] on analysing the GM rollover Malibu II test data found that the COG of the vehicle does not rise or fall more than 4 to 5 centimetres such that the vehicle's COG vertical velocity at roof impact is never more than 2.5 m/sec. Thus each complete rollover can also be considered as being made up of four quarter turns where a small portion of the vehicle's kinetic energy is dissipated during each quarter turn [3 and19]. During each quarter turn the corners of the roof, points B & C, and the tyres interact (touches down) with the road surface. Between each touchdown the vehicle can be assumed to be airborne.

We now assume that the roof and pillars are weak and will distort typically as an unbraced frame with weak joints at positions A, B, C & D. In other words, we assume the pillar AB sways sideways. The pillar on the non-struck side can also sway in a mechanism commonly referred to as 'match-boxing' or 'side sway' if pillar CD is weak in rotation **(Figure 3(a))**. In the case of the vehicle shown in **Figure 1**, the roof 'tented' rather than deform the opposite pillar as depicted by line DC in **Figure 3(b)**. Note that the force in the opposite non-struck side pillar resolves in a direction that provides maximum resistance to any loading from the struck side impact. Hence, the roof 'header rail' at the front windscreen tends to deform instead because it provides a weaker resistance to movement than the far side pillar. **Figure 3 (b)** shows how the deformation mechanism and weak roof can result in an extra hinge point G forming in the header rail.

Regardless of how the opposite side pillar distorts, the occupants head is close to the struck pillar when contact occurs as shown in **Figure 4**. This occurs as a result of plastic deformation hinges forming at points A, B, C & D as shown in **Figure 3(a)** or at A, B, C, G & D as shown in Figure 3(b). Position A represents a hinge formation at the intersection of the 'a'-pillar and side roof rail and/or at the 'b'-pillar and side and header roof rails. We also assume this occurs when the trailing side at point B strikes the ground. That the trailing side usually distorts as a result of adverse load paths generated by rollover forces, as opposed to the leading side that better resist the forces, has been confirmed by a number of investigators [6, 11, 14, 20, 21].

Consider now in isolation pillar AB, e.g. the 'b-pillar', manufactured at an inclined angle α. If the pillar roof connection is very weak in bending then as a result of striking the ground the pillar will distort sideways as it moves horizontally by an amount Δ. This deformation occurs at the speed at which the vehicle is moving laterally, i.e. at a velocity VCOG. Geometry and kinematics then dictates that the roof rail drops down a distance of δ at a velocity directly related to the horizontal velocity. Bahling et al [3] found in their rollover crash tests of the Malibu vehicle where the occupants were seat belted that: *"As a result of this rotational velocity, dummies moved upwards and outward to the extent which the lapbelt and vehicle side interior would allow. They tended to remain with their heads adjacent to the outboard roof siderail while constrained by the lapbelt and door and moved away from that point only by vehicle-to-ground impacts."*

This means that the head when in contact with the siderail near point B would undergo a vertical displacement of δ when the line AB ('b-pillar' and/or 'a-pillar' together) rotates sideways. Thus by calculating δ it is possibly to determine the vertical intrusion velocity of the roof onto the occupant head that causes both a vertical and lateral displacement of the head.

Weak Roof

The relevant dimensions for length AB in isolation are shown in **Figure 5** where the length of the 'b-pillar' is adopted as L. From this sketch when element AB is rotated the following relationship is obtained

$$\delta_T = \delta_0 + \delta = L - \sqrt{L^2 - (\Delta_0 + \Delta)^2} \qquad (3)$$

This expression can be rearranged to

$$\delta = L - \sqrt{L^2 - (\Delta_0 + \Delta)^2} - \delta_0$$

and

$$\delta = L - \sqrt{L^2 - (\Delta_0 + \Delta)^2} - \left(L - \sqrt{L^2 - \Delta_0^2}\right)$$

and thus

$$\delta = \sqrt{L^2 - \Delta_0^2} - \sqrt{L^2 - (\Delta_0 + \Delta)^2} \qquad (4)$$

or in trigonometric form

$$\delta = L(\cos\beta - \cos\alpha) \qquad (5)$$

At point B touchdown if the roof is a weak structure, the 'b-pillar' can potentially reach the vehicle's COG horizontal velocity minus the velocity due to vehicle rotation at point B. Thus

$$V_R = \frac{\delta}{\Delta} \times (V_{COG} - V_{\varpi}) \qquad (6)$$

Substituting Equation (1) for the neck force from roof crush, the expression for the neck loading resulting for a vehicle with a weak roof is

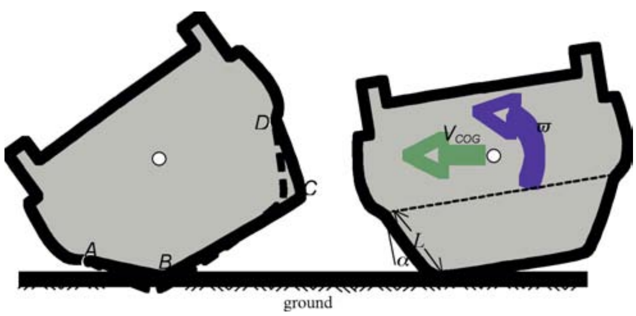
$$F_{neck} = \frac{\delta}{\Delta} \times (V_{COG} - V_{\varpi})\sqrt{km} \qquad (7)$$

or in expanded form

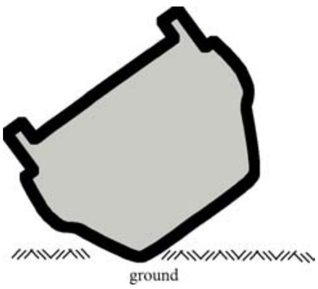
$$F_{neck} = \frac{\left(\sqrt{L^2 - \Delta_0^2} - \sqrt{L^2 - (\Delta + \Delta_0)^2}\right)}{\Delta} \times (V_{COG} - V_{\varpi})\sqrt{km} \qquad (8)$$

or in trigonometric form

$$F_{neck} = \frac{L(\cos\beta - \cos\alpha)}{\Delta} \times (V_{COG} - V_{\varpi})\sqrt{km} \qquad (9)$$



(a) Sway mode



(b) Tenting mode

Figure 3: Sedan vehicle rolling over striking the ground on the trailing side of the roof

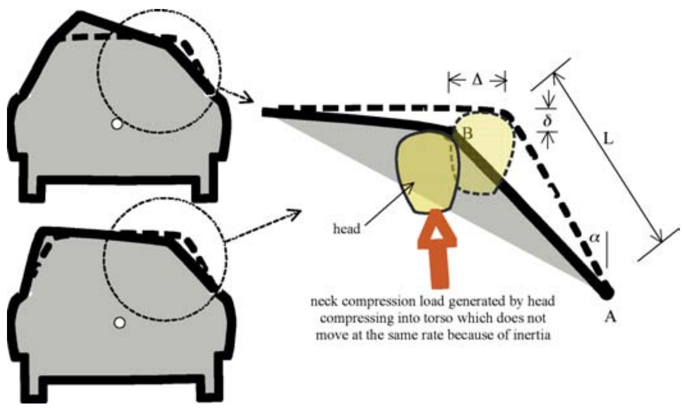


Figure 4: Deformed 'weak roof' vehicle with head placed at intersection of side pillar and roof

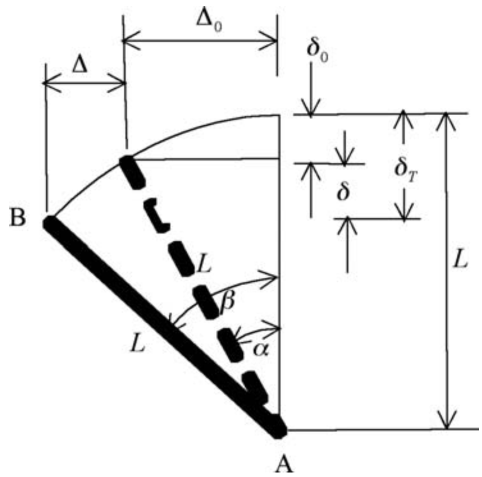


Figure 5: Displacement of pillars sideways

Strong Roof

It is now assumed that the vehicle is subjected to an FMVSS 208 dolly rollover crash test on a bitumen surface and the roof is very strong. In general, for an FMVSS 208 dolly rollover crash test, the height of a vehicle's COG does not change significantly. If the roof is now so strong that it does not deform during contact with the ground, the vehicle effectively skids along the road surface each time contact is made in quarter turn. In other words, the steel-bitumen and tyre-bitumen contact surfaces slide against each other as shown in **Figure 4** and a certain amount of energy is dissipated. It is for this reason scratch or gouge marks left in the road or gravel surface are often noted by crash investigators and reconstructionists, as points of contact and sliding, identifying how the vehicle rolled. It should be noted that rollover energy is also dissipated by the raising and lowering of the vehicles COG [19] albeit the COG height change is small as indicated by Friedman and Nash [6].

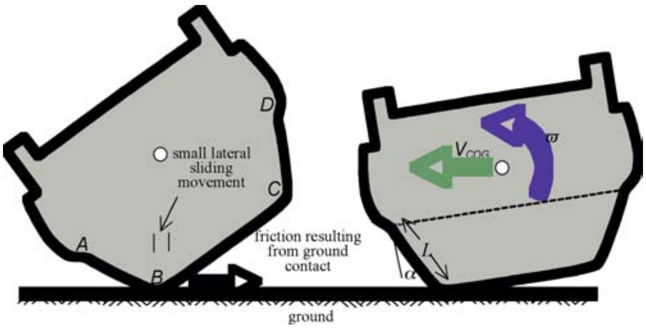


Figure 5: 'Strong roof' vehicle contacts ground.

The car body can be considered as a rotating shell surrounding the occupant, slowing down each time it makes contact and the steel roof corner or tyres skid on the bitumen surface. To determine how much the vehicle decelerates each time touchdown occurs, the following equation based on Newtonian laws of physics governing the deceleration or acceleration of a body can be used

$$V^2 = 2fgd \qquad (10)$$

where 'f' is the deceleration drag factor, 'g' is 9.81 m/sec2 being the earth's gravitational constant and 'd' is the distance over which a body decelerates, can be used. Equation (10) has been used by crash reconstructionists for over twenty years [22]. The key variable is the drag factor 'f'. Coefficients of friction for steel against bitumen and for tyres against bitumen range from 0.55 to 0.7. In this instance a value of around 0.6 will be adopted.

The "diving" velocity of an occupant inside the vehicle can be calculated, knowing the rate of angular roll ϖ, the distance Ro from the occupants COG to the vehicle's COG and the vertical drop height 'h' through which the vehicle's COG drops as it rolls along. Thus

$$V_d = \varpi R_0 + \sqrt{2gh} \qquad (11)$$

However the rate of angular roll can be directly related to the change in velocity of the vehicle structure in each quarter turn as it strikes the bitumen, i.e.

$$V_d = \frac{R_0}{R_{COG}}\sqrt{2fgd} + \sqrt{2gh} \qquad (12)$$

Again Equation (2) for "diving" velocity can be adopted in place of the roof crush velocity to be used to estimate the neck load. Thus

$$F_{neck} = \left[\frac{R_0}{R_{COG}}\sqrt{2fgd} + \sqrt{2gh}\right]\sqrt{km} \qquad (13)$$

Equation (13) shows that the main factor that influences the severity of a rollover crash and the velocity at which an occupant will dive into a strong roof during each quarter turn is the height of vertical fall 'h'. However, the authors and others [6, 2, 17 and 18] have shown that the vertical drop height is small for a rollover on level ground in the case of a rollover FMVSS 208 crash test.

What is interesting to note about Equation (13) is it is independent of the velocity at which rollover commences. Thus it should be irrelevant of the vehicle starts to rollover at 100 km/h freeway speed or 52 km/h as in the case of a dolly rollover crash test, so long as the vertical drop height 'h' is not large and consistent between the two events. The outcome will be that the occupant "diving" velocity will always reach a threshold value that is directly related to the coefficient of friction between the vehicle's steel body and tyres and the road surface. It also means that if the coefficient of friction becomes higher, i.e. ploughed earth, or the drop height becomes larger, the neck load will increase unless the occupant is firmly secured in a seat belt with adequate clearance between the head and the roof. The research work to confirm this finding is currently under way.

Jordan Rollover Test Rig and Rollover Crash Testing

To confirm the validity of Equation (1), the authors requested results of measured neck loads from Hybrid III dummies placed into vehicles that were subjected to a repeatable, dynamic rollover test using the Jordan Rollover System (JRS) test rig as shown in **Figure 6**. Details of the test rig are provided by Jordan & Bish [23] and Friedman et al [7 & 8]. The test vehicle or occupant compartment only buck is supported by two drop towers along its longitudinal roll axis at the vehicle's COG. The vehicle can be positioned at any pitch or yaw angle. A mobile roadbed segment moves under the vehicle and is synchronised with the vehicle's roll so as to simulate the rate at which the vehicle's COG is moving as it rolls. When the test starts the vehicle is rotated and allowed to free fall to the roadway. The vehicle moving freely, strikes the near side and far side of the roof on the road bed. The vehicle is then caught by the towers as the road bed progresses through and beyond the towers so that the vehicle does not suffer any further damage. The vehicle, roadbed and Hybrid III Crash Test Dummy (ATD) are instrumented to record: vertical and lateral vehicle impact loads; roof displacement and roof intrusion velocity during roof impacts at several roof locations inside the vehicle; and dummy neck loads. High speed and real-time cameras record movement of the vehicle and ATD.

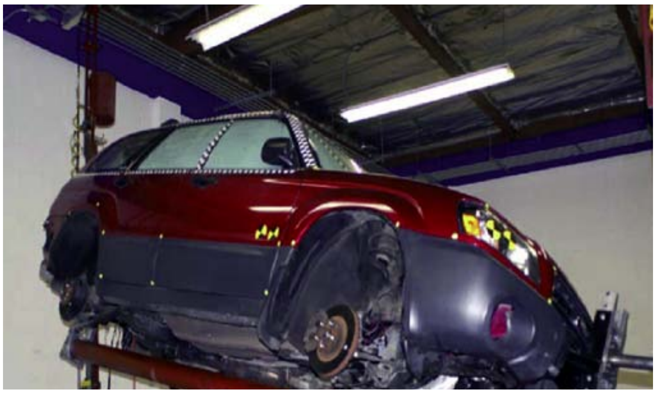


Figure 6: Photograph of the JRS Test Rig [8]

Real world crash analysis by Friedman et al [7 & 8] indicates that the most appropriate set up for the vehicle in the JRS is: a pitch angle of 5°; a yaw angle of 10°; a rotation speed of around 190 degrees per second; a free fall of 10 cm; and a roadbed speed of 24.1 km/h (15 mph). Under these conditions the vehicle strikes the near side of the roof at a roll angle of 135°.

A selection of US vehicles have been tested in the JRS under the initial test conditions outline above by Friedman et al [7 & 8]. The neck loads measured in the ATD are plotted against the speed of roof intrusion relative to the ATD and is shown in **Figure 7**. Theoretical values calculated using Equation (1) are also plotted using values of neck stiffness and mass as detailed by Young et al [17] and Grzebieta et al [18]. Correlation between theory and test is considered reasonable, indicating that peak neck loads appear to be linked to the speed of roof intrusion. The values at the far right of the plot in **Figure 7** are instances where the vehicle roof was known to be weak, whereas the point on the far left of the plot where the load was around 2000 Newtons was a vehicle that was known to have a strong roof. In the instance of the two 'weak roof' vehicles, the ATD head was found to be to one side of the point in the vehicle roof where the intrusion and its velocity was a maximum, accounting for the underestimate in peak neck load for these tests. Suffice to say that many more tests need to be carried out to assess the validity of the above equations. This is one of the current tasks of the Australian Research Council (ARC) Discovery Project rollover grant research team.

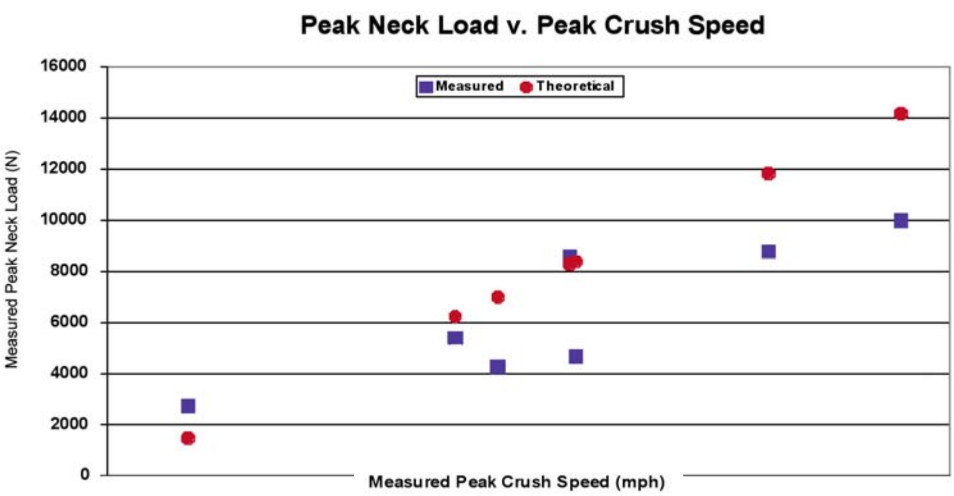


Figure 7: Peak Neck Load VS. Peak Crush Speed

Considerable biomechanical research has been carried out in regards to identifying what magnitudes of axial loading need to be applied to a vehicle occupant's neck to cause serious injury, and how ATD measurements relate to these injury levels. The impact velocity was shown by Alem et al [24] and Myers et al [25] to influence both the risk and severity of neck injuries in experimental crown impacts to the head. In parallel, Sakurai et al [26] and Sances et al [27] showed that measured Hybrid III peak neck loads also correlated with the impact velocity for a given impact scenario (see also **Figure 7** for the present study). In particular, Hybrid III reconstructions of injurious events presented by Mertz et al [28] or Pintar et al [29] showed that severe injuries to the neck start to occur at compressive loads between 4000 to 6000 Newtons (N) measured on this ATD. However, as raised by Friedman et al [6, 7, 8 and 13], and based on recent results by Viano and Pellman [30], the current 4000 N Injury Assessment Reference Value may be underestimated for the Hybrid III. Therefore, it is considered more work is needed in order to precisely define the peak load/impact velocity combination that may be associated with a given injury level.

The above raises the issue of using the JRS rollover rig to assess the crashworthiness of vehicles and rate them in terms of protection for seat belted occupants. The JRS test rig is also capable of assessing the on-board safety restraint systems such as an aircurtains, pretensioners and seat belts. For example, a possible five star rated vehicle could be one where the neck load is less than its Injury Assessment Reference Value (IARV), the vehicle is installed with pretensioners and curtain airbag, and the roof deformation is such that no window rupture occurs.

Conclusions

The following conclusions have been drawn so far from the research work carried out to date:

1 Statistical data clearly indicates that rollover crashes are dangerous events and should be a priority in terms of mitigating injuries occurring to occupants;

2 Occupant protection in rollover crashes are not currently being addressed by design rules. There is an urgent need to introduce a system that will ensure seat belted occupants are adequately protected in a rollover crash;

3 It appears that the vertical load imparted to the neck of a seat belted occupant inside a vehicle that is rolling over, where the roof strength is weak, is directly related to the amount of lateral roof "match boxing" distortion a vehicle undergoes at the moment of touchdown;

4 In the case of a weak roof that can readily deform, the vertical intrusion velocity is directly related to the velocity of the lateral displacement of the roof and/or roof pillars. This deformation is in turn directly related to the velocity at which roof touchdown occurs with the ground surface which is directly related to the speed at which the vehicle's COG is moving laterally;

5 If the vehicle roof is weak, the higher the lateral travelling velocity of the vehicle's COG, the higher the speed of vertical intrusion and hence the greater the severity of injury to the occupants;

6 If the roof is strong enough to resist lateral and vertical movement during each quarter turn touchdown, the maximum "diving" velocity an occupant will be subjected to will be limited to the resistance to rollover afforded by friction between the vehicle's roof structure, its tyres and the road surface (around 0.6 drag factor) and the height of drop the vehicle's COG undergoes from one quarter turn to the next.

7 If the roof is strong, each quarter turn touchdown will slow the rotating vehicle approximately 4 km/h being a consequence directly related to the roof to ground friction coefficient of around 0.6 and the movement of the COG vertically – this movement is a non-injurious change in roll rate for a seat belted occupant;

8 If the roof is strong enough to resist lateral and vertical movement during each quarter turn touchdown, theoretically there should not be any difference in crash severity to a seat belted occupant between a vehicle being tripped at 100 km/h and 52 km/hr so long as the vehicle's COG remains within 3-5 centimetres or so of vertical displacement and the occupant is adequately restrained. This fact has been proven time and again in racing cars that rollover where the roof has been substantially strengthened and the occupant is held in a full harness seat belt. Again the coefficient of friction between the vehicle's body and the road surface is the main factor governing this outcome.

9 The Jordan Rollover System (JRS) test rig can adequately assess the rollover crashworthiness of a vehicle. A JRS test rig should be built in Australia for research and crashworthiness rating purposes.

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Road Crashes Involving Stolen Motor Vehicles in South Australia

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Abstract

This study examined the incidence of road crashes involving motor vehicle theft in South Australia over a 12-year period. The study found that 3,774 crashes involved a stolen vehicle, equating to an average of almost one crash per day. These crashes resulted in 835 casualties including 24 fatalities. The estimated cost of damage to property in crashes involving vehicle theft in 2006 was $2 million with an average cost of $7,330 per crash. When the additional human, vehicle and general costs are considered, the true price of collisions involving vehicle crime is estimated at around $17 million per year (based on crashes in 2004). Data on offenders' age, sex and license status was missing. Further research which captures the demographics of the offenders involved in road crashes in South Australia would provide additional insight and better inform policies developed to tackle the issue.

Notation

ADR	Australian Design Rule
CARS	Comprehensive Auto-theft Research System
DTEI	South Australian Department for Transport Energy and Infrastructure
NMVTRC	National Motor Vehicle Theft Reduction Council

Acknowledgement

The National Comprehensive Auto-theft Research System (CARS) is funded by the National Motor Vehicle Theft Reduction Council (NMVTRC) to provide comprehensive and timely data upon which effective crime prevention strategies can be developed and evaluated. The views expressed in this paper are those of the authors and do not necessarily reflect the views of the NMVTRC.

Special thanks to Steve Lippett and Terrie Baker from the Department for Transport, Energy and Infrastructure (DTEI) for their assistance and providing the crash data for this study.

Introduction

Motor vehicle theft is not a victimless crime. The impact is felt by not only the vehicle owner but also the insurance industry, criminal justice system and the community, who bear the costs of this crime. Considerable effort and resources are directed into combating both profit-motivated and short term theft including developing strategies to prevent vehicles from being stolen in the first place. The successes that such strategies have had are measured in theft numbers, recovery rates and insurance premiums and yet these figures cannot possibly capture the most significant costs associated with vehicle theft - that of injury and loss of life.

A number of overseas studies have looked at the issue of road crashes involving stolen vehicles including a Canadian study [1] which examined newspaper articles from 1999 to 2001 on fatalities and injuries incurred through motor vehicle theft. They found that during the 3-year period, 81 people died as a result of vehicle theft. Around 40% of those who died were in the third party vehicle while 54% were offenders or occupants in the stolen vehicle. Where the collision resulted in a fatality, 71% of occupants in the stolen vehicle were under the age of 25. The study also found that 29% of all injuries sustained were serious, ranging from life threatening to paralysis, with the medical costs alone of treating persons with sustained head trauma, paraplegia and quadriplegia at well over CAD$1 million per year, per person injured.

A United States study [2], used inpatient records to determine the medical and economic impact of caring for patients injured after crashes involving stolen cars. The study examined inpatients treated at a university trauma centre in New Jersey over a 2-year period and found that crashes involving stolen vehicles accounted for 8% of motor vehicle crash admissions. Over half (57%) were occupants of the stolen vehicle with offenders significantly more likely to be young and male than victims. The study found that both speeding and police pursuits were related to the severity of the crashes and that the average cost of treatment was over US$34,000 per patient.

Marshall, Boyd and Moran [3] also used hospital records in their study of the 'joy-riding epidemic' and the associated injuries that have occurred through vehicle crime. The study was based on an investigation of patients admitted to the Newcastle General Hospital in the United Kingdom over a 9-month period as a result of a road crash involving a stolen car. Patients' injuries and any treatment were recorded and estimates were made of cost using hospital figures (based on bed occupancy, expenditure on investigations and treatment). The study found that around 13% of hospital admissions for a road traffic accident were the result of a stolen vehicle with 40% of these crashes resulting in severe injury or death. The majority of those injured were innocent members of the public with 20% of in-hospital road traffic accident deaths attributable to vehicle crime. The average cost to the hospital was £5,200 per patient with the study concluding that the associated costs were likely to be underestimated as it did not account for those treated through out-patient services or cases where the victim was declared dead at the scene.

Despite newspaper headlines regularly featuring crashes involving stolen vehicles, no research has been carried out in Australia on the incidence of road crashes involving motor vehicle theft. In South Australia during 2007, two road crashes each resulted in a fatality following a police pursuit, although in both instances the pursuits were abandoned by police over safety concerns before the crashes occurred. In one incident [4] a 17-year old was reported responsible for the death of his 18-year old female passenger, and serious injury of a second passenger when the stolen Holden he was driving slammed into another car, seriously injuring the second driver. In the second crash a 30-year old man was killed after his vehicle was hit by a 23-year old driver of a stolen Holden while waiting to turn right at an intersection [5].

These examples indicate the tragic consequences of motor vehicle theft and the dangers that stolen vehicles present on our roads. With this in mind the objectives of the current study are to:

- Examine the relationship between motor vehicle crashes and vehicle theft in South Australia.
- Report on the number of fatalities and injuries for all crashes involving motor vehicle theft
- Assess the economic and social costs of motor vehicle crashes which involve stolen vehicles.

Methodology

The study was based on data provided by the South Australian Department for Transport Energy and Infrastructure (DTEI) on vehicle crashes that occurred between 1995 and 2006. This data comprised all casualty crashes, all tow-away crashes and property only crashes where the aggregated damage value was greater than or equal to $3,000. For the purpose of this study, crashes which did not involve at least one motorised vehicle were removed from the data. The data was matched with CARS data on motor vehicle thefts in South Australia based on the following conditions:

- A match on registration plate, and
- a recorded crash date/time between the earliest possible theft incident date/time (minus 10 minutes to allow for differences in time estimates) and theft recovery date/time (plus 10 minutes), **or**
- a recorded crash date/time on or after the earliest possible theft incident date/time (minus 10 minutes) where the stolen vehicle remained unrecovered.

DTEI also provides CARS with data on all motorised vehicles currently registered in South Australia bi-yearly. This study is based on the June 2006 registration snapshot.

Approximately 4.3% of the motor vehicles in the crash data did not have a valid registration plate to allow a join with the CARS vehicle theft data. This means that the number of stolen vehicles involved in road crashes may be slightly under-represented in this study. Manual checks of the crash data were also carried out. Any crashes in the crash data which involved a duplicate registration plate and the same date/time details were excluded as they were considered likely to be duplicate records, but which of the two was the correct record could not be established. These accounted for 0.1% of records. Likewise, for crashes involving stolen vehicles, crashes with duplicate registration plates were removed where the date/time details were exactly the same or contained conflicting information (e.g. where the crashed vehicle was reportedly towed away following the first of two crashes). These accounted for 0.5% of records.

Findings

Crashes involving stolen vehicles

Since 1995, the number of road crashes in South Australia has risen by approximately 4.5%, however, as Figure 1 shows, there has been a gradual decline in the number of crashes since 2001. The proportion of crashes which involved a stolen vehicle follows a similar, if somewhat exaggerated, pattern to that of crashes overall. In 1995, approximately 1.7% of road crashes involved a stolen vehicle with the proportion falling slightly, to 1.4% by 2006. Over the 12-year period, 1.5% of crashes involved a stolen vehicle. These resulted in a total of 835 casualties including 24 fatalities.

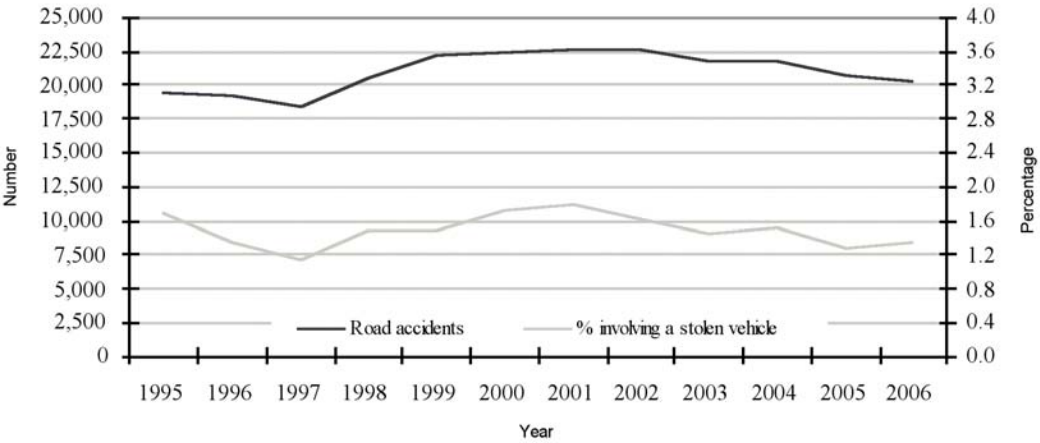

Figure 1. Number of road crashes and percentage involving a stolen vehicle, 1995 – 2006

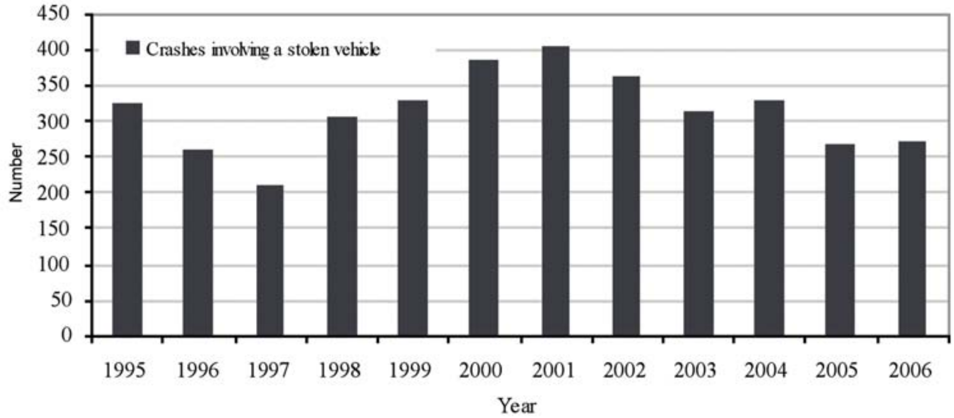

Figure 2. Number of crashes involving a stolen vehicle, 1995 – 2006

Figure 2 shows the number of crashes involving stolen vehicles per year since 1995. Over the past 12 years an average of 315 crashes per year have involved stolen vehicles. In 2006 there were 272 such crashes. In terms of the proportion of stolen vehicles which were involved in a road crash, in 2006, one in every 28 vehicles stolen, crashed.

Severity of crashes

A severity rating of either property damage, injury or fatal is applied to all recorded crashes and they are defined as follows:

- Property damage refers to a crash resulting in property damage in excess of the prescribed amount ($3,000) in which no person is injured or dies within 30 days of the crash.
- Injury involves a non-fatal crash in which at least one person sustains either minor or serious injuries, and does not die from those injuries within 30 days of the crash. The person may be admitted to hospital or require medical or surgical treatment, either by a doctor or in a hospital.
- Fatal refers to a crash for which there is at least one fatality (based on death within 30 days of a crash as a result of injuries sustained in that crash).

The majority of all road crashes result in property damage. Over the 12-year period, 84.3% of crashes involving stolen vehicles involved property damage only compared with 67.1% for crashes which did not involve a stolen vehicle. These crashes recorded a larger proportion of injuries (32.2% compared to 15.1% for stolen vehicle crashes) and in both crash types, fatality crashes made up less than 1% of crashes. While less casualties are noted in stolen vehicle crashes it should be noted that in some cases an offender may have been injured but not remained at the scene of the crash for assistance or did seek medical help but did not admit that it related to a road crash.

Figure 4 shows the number of fatalities in crashes involving stolen vehicles over the 12-year period. During the peak of 2001 there were 5 deaths associated with crashes involving stolen vehicles. No fatalities were recorded in 2006 however, in 2007, 2 fatalities have already been recorded in the first six months [4,5]. The findings of this study do not include these 2 fatalities.

Historically, fatality rates for crashes involving stolen vehicles have varied widely due to the small numbers involved. In the 12-year period to 2006, the fatality rate was 6.4 deaths per 1,000 crashes involving stolen vehicles. In comparison, road crashes which did not involve a stolen vehicle had a rate of 7.4 fatalities over the 12-year period and showed a reduction over time, from 9.4 fatalities per 1,000 crashes in 1995 to 5.9 in 2006.

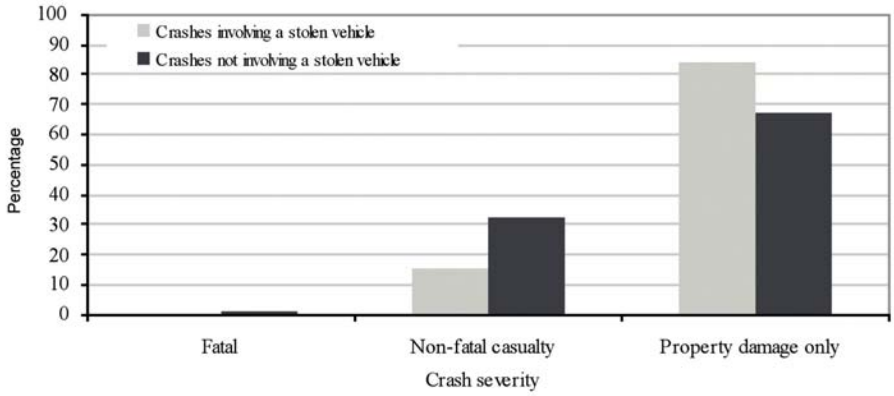

Figure 3. Crash severity rating of road crashes over the 12-year period, 1995 – 2006

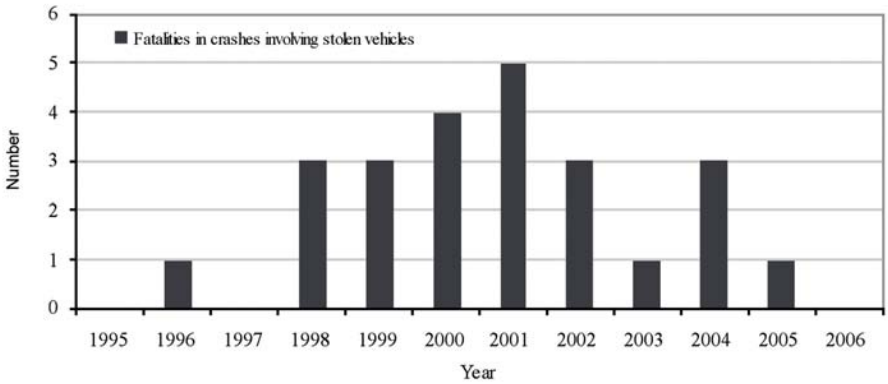

Figure 4. Number of fatalities in crashes involving a stolen vehicle, 1995 – 2006

Casualties refer to crashes in which either an injury or a fatality were recorded. The pattern of casualties resulting from crashes involving a stolen vehicle shows a similar trend to that of road crashes overall, with over 100 casualties recorded in 2000 and 2001 after which the graph shows a gradual decline in the number of casualties (see Figure 5). In 2006 there were 53 casualties associated with stolen vehicle crashes.

The rate of casualties per crash type shows a very different pattern to that of fatalities with stolen vehicle crashes recording a small rise in casualty rates from 186.5 casualties per 1,000 crashes in 1995, to 194.9 in 2006. Casualty rates for crashes not involving vehicle theft are much higher but show a downward trend, falling from a rate of 430.8 per 1,000 in 1995, to 391.3 in 2006. Once again, it is not clear whether these differences are true or are possibly the result of a reporting bias.

In most crashes involving stolen vehicles over the 12-year period, the greatest number of casualties was incurred by the occupants of the stolen vehicle (59.6%). Of those casualties outside the stolen vehicle, on average, 85.2% were occupants in another vehicle, 13.4% were pedestrians and 1.5% were cyclists.

Property damaged

Table 1 outlines the types of property damaged (in addition to the vehicle at fault) in crashes in 2006 where a motor vehicle was considered to be at fault. Crashes involving a stolen vehicle

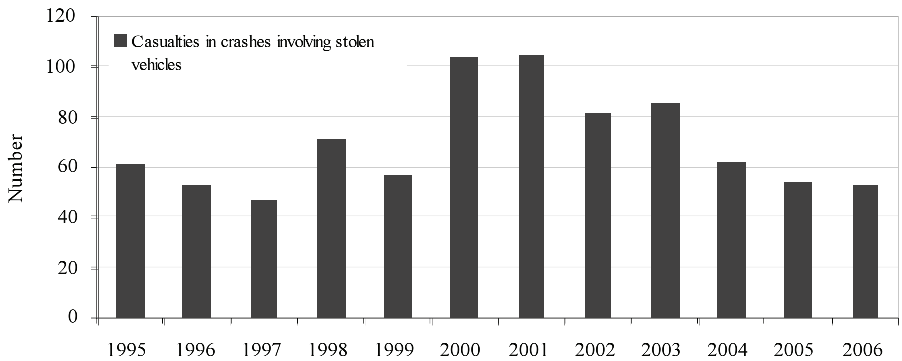

Figure 5. Number of casualties in crashes involving a stolen vehicle, 1995 – 2006

Property	Stolen motor vehicle at fault Number	%	Motor vehicle at fault Number	%
Motor Vehicle	102	32.4	16,614	77.7
Property - Other	91	28.9	1,888	8.8
Property - Pole/Sign Post	63	20.0	976	4.6
Tree	49	15.6	1,143	5.3
Property - Bridge/Guard	6	1.9	173	0.8
Pedestrian	3	1.0	215	1.0
Animal	1	0.3	16	0.1
Cycle	0	0.0	335	1.6
Railway Vehicle	0	0.0	9	0.0
Total	**315**	**100.0**	**21,369**	**100.0**

Table 1. Types of property damaged in road crashes involving a motor vehicle at fault, 2006

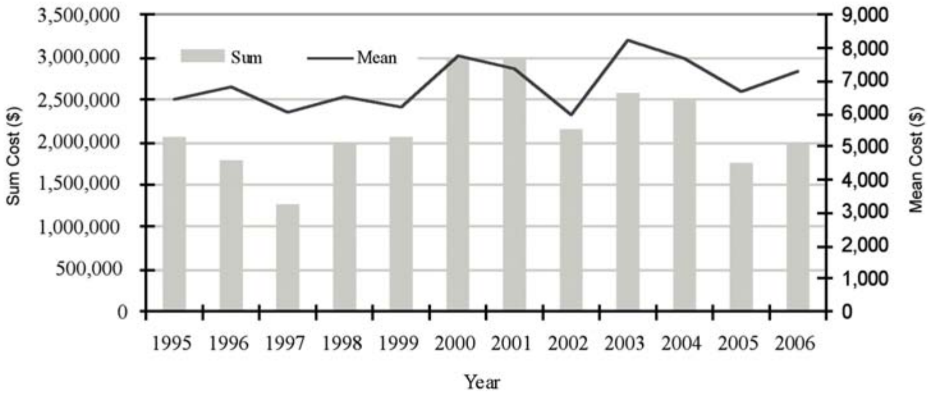

Figure 6. Total estimated property damage cost of crashes involving stolen vehicles, 1995 – 2006

at fault were more likely to result in damage to poles and sign posts (20.0%), trees (15.6%) and other fixed obstructions (28.9%) than crashes not involving vehicle theft (4.6%, 5.3% and 8.8% respectively). These differences were partly explained by the timing of stolen vehicle crashes, which were more likely to occur at night, as outlined in a later section. The most common form of damage in crashes where a motor vehicle was at fault was damage to another motor vehicle (77.7% compared with 32.4% in crashes involving a stolen vehicle at fault).

Costs of crashes

Road crash data includes an estimate of the damage value of property involved in a road crash. The total cost of road crashes involving stolen vehicles showed some fluctuation over the 12-year period. In 2006, the total property damage cost of crashes involving stolen vehicles was around $2 million with an average cost of $7,330 per crash. On average, costs have increased by 14.1% since 1995 despite the total number of stolen vehicle crashes falling during this period (down 16.8%).

To provide a more holistic picture of the cost, the Centre for Automotive Research produced a paper on the estimated costs of road crashes in South Australia [6]. The paper, adapted from a report by the Bureau of Transport Economics [7], included an estimate of the 'human costs' (e.g., lost labour, ambulance, coroner), 'vehicle costs' (e.g., repairs, towing) and 'general costs' (e.g., police, non-vehicle property damage) associated with road crashes based on 2002 crash data. Using prices as at March 2004, they estimated the costs to be nearly $1.18 billion or an average of $52,000 per crash. If we relate this cost to crashes involving stolen vehicles, in 2004, there were 330 such crashes which at an average of $52,000 per crash would roughly amount to a cost of $17 million. While this is merely a very crude calculation[1], it does highlight the enormous cost of crashes involving stolen vehicles.

Individuals involved in crashes

Analysis of the sex of individuals involved in crashes (either as drivers, riders or pedestrians) which did not involve vehicle theft revealed that 60.8% of individuals involved in road crashes in 2006 were male. Around one-quarter (26.2%) of the individuals were aged 25 and under and a further 18.3% were aged 26 to 35. Individuals aged over 65 made up 7.3% of crashes not involving vehicle theft.

Age data on individuals in crashes involving stolen vehicles is not summarised due to a high proportion of missing data (54.4%). Nearly three-quarters (72.2%) of the missing age data related to the drivers of the stolen vehicles which may not have been possible to collect due to the offender fleeing the scene of the crash. South Australian data on apprehensions for vehicle theft in 2006 [8] revealed that a number of apprehensions involved juveniles, some of whom would not be old enough to

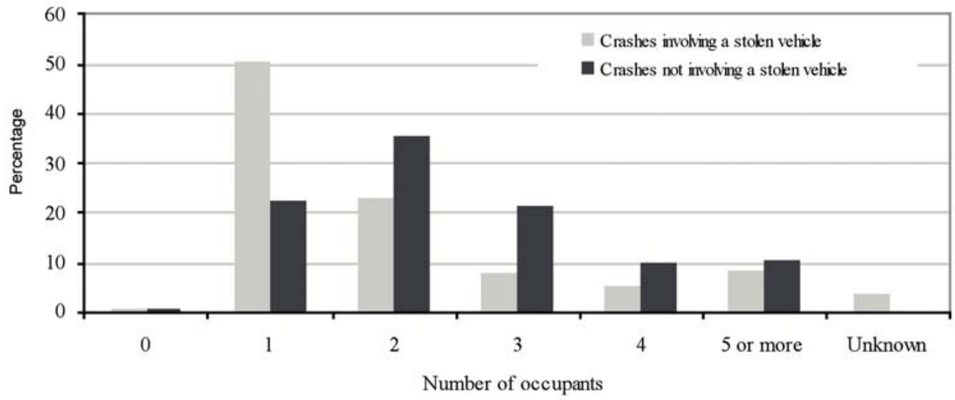

Figure 7. Number of occupants involved in road crashes, 2006

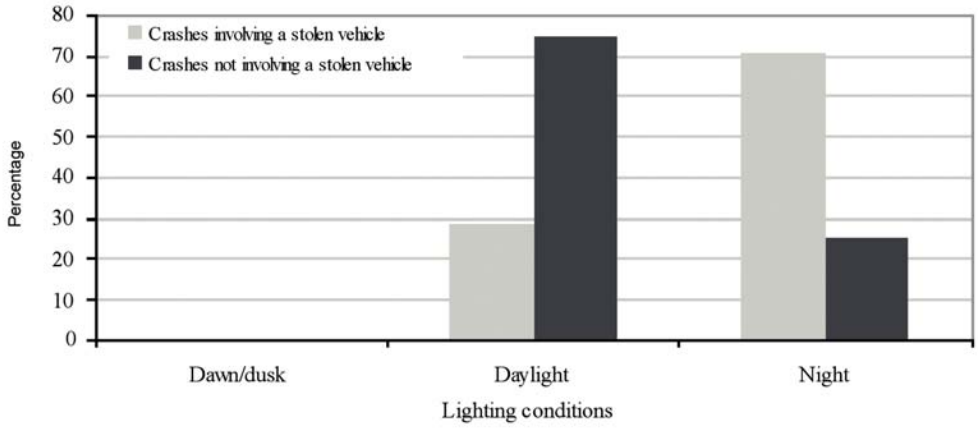

Figure 8. Lighting conditions for road crashes, 2006

even have their learner's permit. Likewise, recent police statistics from Western Australia [9] indicated that juveniles as young as 10 and 11 were charged with driving stolen cars in the past financial year and that the number of vehicle theft charges for children aged 16 or less had doubled in the past two financial years. It should be noted that while offence statistics are useful in providing information about vehicle theft offenders, they do not represent all offenders, only those who have been caught.

A large proportion of data on the sex of individuals in crashes involving stolen vehicles was also missing. In one-third of crashes involving stolen vehicles the sex of the driver was unknown with 43.3% of the unknown data on sex relating to the driver of the stolen vehicle.

Figure 7 shows that in 2006, half (50.7%) of crashes involving stolen vehicles involved only one occupant in the motor vehicle and a further 22.8% involved two occupants. In comparison, crashes not involving a stolen vehicle were more likely to involve multiple occupants. Approximately 35.2% of crashes involved two occupants, 21.2% involved three occupants and a further 20.6% involved four or more occupants. Whilst there is some discrepancy between the two crash groups, it is possible that in some incidents one or more passengers in the stolen vehicle fled the scene, reducing the number of occupants reported in the crash.

When crashes occur

Crashes involving stolen vehicles were most likely to occur on Saturdays (22.3%) and Sundays (17.9%) with stolen vehicles most commonly taken on Fridays (16.5%) and Saturdays (22.7%).

Figure 8 shows that seven out of every ten (71.0%) crashes involving a stolen vehicle occurred at night. This is almost the complete opposite pattern to crashes not involving vehicle theft in which three-quarters (74.7%) of these crashes took place during daylight hours. With presumably less cars and general traffic on the road at night it makes sense that stolen vehicles which crash at this time are less likely to hit other vehicles or pedestrians and more likely to hit some form of property.

In 18.7% of crashes involving stolen vehicles, the vehicle crashed within one hour of being stolen and nearly half (48.7%) crashed less than 5 hours after the vehicle was taken. This suggests that the potential risk to road users is apparent from the minute the vehicle is stolen.

Where crashes occur

Around half (50.9%) of the stolen vehicles involved in crashes were taken from the street with a further one-fifth taken from the driveway of a home.

The figure below shows the distance between the theft and crash suburbs for stolen vehicles involved in crashes in 2006.

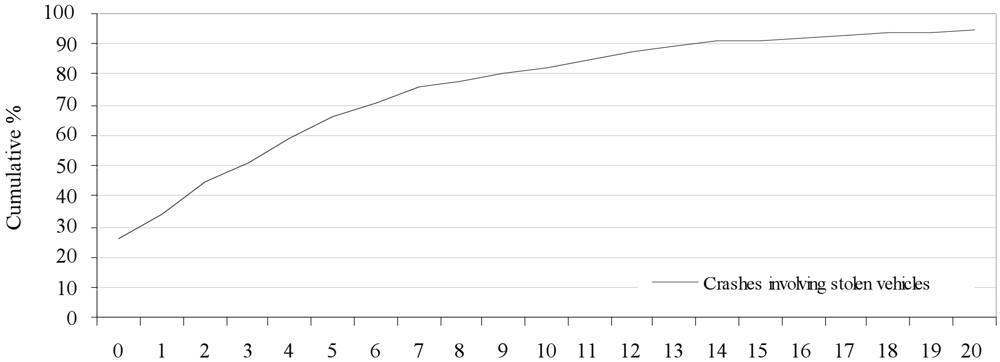

Figure 9. Distance between centroids of theft and crash suburbs, 2006

	Stolen vehicle at fault		Motor vehicle at fault (in crashes not involving vehicle	
Local Government Area	Number	%	Number	%
Inattention*	169	64.0	8,429	44.6
Dangerous Driving*	24	9.1	80	0.4
Excessive Speed*	23	8.7	176	0.9
Disobey - Traffic Lights	6	2.3	422	2.2
Fail to Give Way*	6	2.3	2,364	12.5
Reverse Without Due Care	6	2.3	908	4.8
Follow Too Closely*	5	1.9	1,560	8.2
Driving Under the	4	1.5	456	2.4
Change Lanes to Endanger	3	1.1	747	3.9
Fail to Stand	2	0.8	1,285	6.8
Disobey - Give Way Sign	1	0.4	497	2.6

Table 2. Top causes of crashes for motor vehicles at fault, 2006

* Indicates where chi-square tests revealed statistically significant differences between crash groups (p <0.001).

The analysis is based on the Euclidean (or 'straight-line') distance between the centroid of the theft and crash location suburbs. Therefore a vehicle that is stolen and crashes within the same suburb will be recorded as having crashed 0 kilometres from the theft location. This gives a rough indication of the distance between the two locations, but it does not take into account any driving that occurred between the vehicle being stolen and the crash. **Figure 9** shows that the vehicles were most likely to crash a short distance from the suburb from which they were stolen with 59.3% crashing less than 5 kilometres from the theft suburb.

Why crashes occur

In crashes involving stolen vehicles, the stolen vehicle was considered at fault in 97.1% of cases. The cause of the crash for these cases is compared with crashes not involving stolen vehicles in which a motor vehicle was considered at fault. In both crash groups the most common cause of the crash was inattention accounting for a greater proportion of stolen vehicle crashes than those not involving vehicle theft (64.0% compared with 44.6%). Dangerous driving and excessive speed were the next most common cause of crashes involving stolen vehicles, accounting for 9.1% and 8.7% of crashes respectively. This proportion was far greater than for crashes not involving stolen vehicles in which less than 1% involved these factors. The involvement of police pursuits in crashes is not recorded in the data (and not publicly available from South Australian Police) so it is not possible to establish whether high-speed chases were associated with findings on excessive speed and dangerous driving amongst stolen vehicles.

Vehicles involved in crashes

Of the 20,217 road crashes in 2006, 272 involved a stolen vehicle with one crash involving two stolen vehicles. The characteristics of the 273 stolen vehicles are outlined below and where appropriate, comparisons are made to stolen vehicles not involved in road crashes and the registered vehicle fleet in South Australia.

Figure 10 shows that compared to the registered fleet, stolen vehicles involved in crashes were most likely to be manufactured in the 1980s. This decade accounted for nearly half (46.9%) of crashes involving stolen vehicles and yet made up less than one-fifth (18.7%) of the registered fleet. The over-representation of this age group of vehicles is cause for concern. These ageing vehicles are far less likely to have associated safety features than more recently manufactured vehicles which meet more stringent safety standards. With a high proportion of these older, less safe vehicles being involved in these types of collisions, there is the potential for even greater casualties.

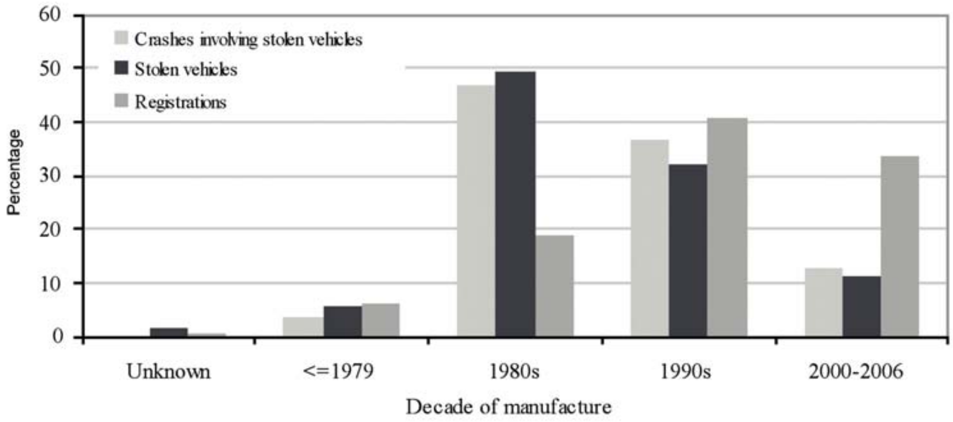

Figure 10. Motor vehicles by decade of manufacture, 2006

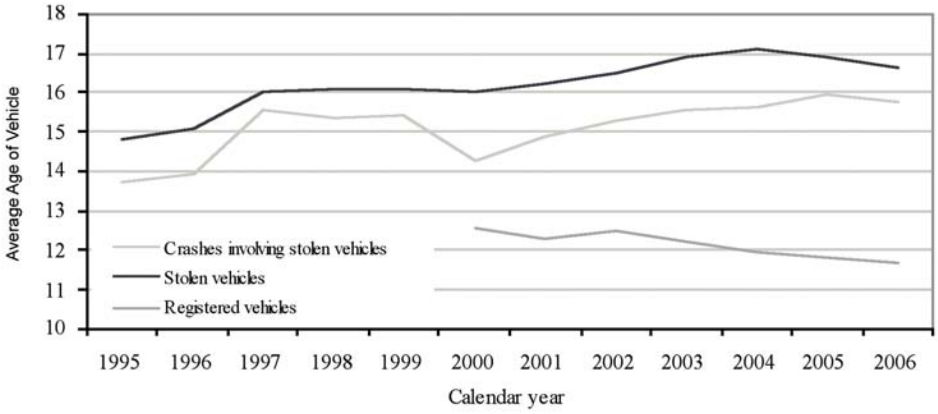

Figure 11. Average vehicle age, 1995-2006

Security is another issue with vehicles manufactured in the 1980s. Very few of these models are likely to have any form of immobilisation to prevent a would-be thief from stealing the vehicle. In 2006 nearly three-quarters (73.5%) of the stolen passenger/light commercial vehicles involved in crashes did not have a factory-fitted immobiliser. This proportion was below that of the passenger/light commercial vehicles stolen in 2006 in which 83.5% were non-immobilised, most likely due to these vehicles being slightly older. Up until the early 1990s very few vehicles were fitted with immobilisers until high theft rates prompted Holden and Ford to begin fitting the devices in their passenger vehicles. Gradually, over time the proportion of immobilised vehicles in the registered fleet has increased and since July 2001 all new cars sold in Australia are required to be fitted with an Australian standard immobiliser under the Australian Design Rule (ADR). In 2006, half (49.5%) of the registered fleet did not have an immobiliser which is much lower than the proportion noted amongst stolen vehicles involved in crashes (73.5%).

Figure 11 shows the age profile of stolen vehicles involved in road crashes over time. The age of these vehicles shows a steady increase from an average of 13.7 years in 1995, to 15.7 in 2006. Interestingly, the registration data (from 2000 onwards) shows the opposite trend with the fleet becoming younger with each year. The average age of the registered fleet was 12.6 in 2000 and 11.7 by 2006.

Registration data is based on the June snapshot for each year. Data only available from 2000 onwards.

An analysis of vehicle characteristics revealed that passenger/light commercial vehicles made up the bulk of both stolen vehicles overall and of those stolen and involved in crashes, with sedans being the most common body type (70.1% and 78.0% respectively). Holden Commodores proved the most popular in 2006 with the VN series accounting for 7.3% of the vehicles stolen in 2006 and 11.4% of crashes involving vehicle theft. Motorcycles made up a greater proportion of stolen vehicles overall (6.8%) than of those involved in a crash (1.5%) in 2006. This may be because stolen motorcycles are more likely to be transported away than ridden and are less likely to be stolen for short-term gain.

Analysis of the number of cylinders in both stolen vehicle groups was also carried out to determine whether the passenger/light commercial vehicles that crashed were more likely to be larger, more powerful ones (categorised as those with 6 or more cylinders). Where the number of cylinders was recorded, a significantly higher proportion of the stolen passenger/light commercial vehicles that crashed had six or more cylinders (69.2%) compared to stolen vehicles which did not crash (54.7%, $\chi 2 = 19.26$, $p<0.001$). This proportion was also far greater than that found in the registered fleet in which 44.0% of passenger/light commercials had six or more cylinders.

Conclusion

The findings of this paper indicate that stolen vehicles play a small but by no means insignificant role in the number of crashes on our roads each year. Over the 12-year period in the study 1.5% of road crashes involved a stolen vehicle resulting in 835 casualties, of which, 24 were fatal. While the proportion of stolen vehicles involved in road crashes is small it is worth noting that the problem remains despite the significant decline in vehicle theft that has occurred since 2000. One in every 28 vehicles stolen in 2006, crashed.

There were a number of characteristics which distinguished stolen vehicle crashes from road crashes generally. Stolen vehicles were more likely to involve property only damage, in part because of the time of day in which the crashes occurred. Seven-in-ten crashes involving stolen vehicles occurred at night in complete contrast to road crashes not involving stolen vehicles. Lighter traffic and fewer pedestrians on the road at night along with fewer occupants in the stolen vehicle may partly explain the lower casualty rate found in crashes involving vehicle theft. A possible reporting bias may also be a factor with offenders less likely to remain at the scene of a crash for assistance due to the criminal component of the crash.

In nearly all cases, the stolen vehicle was considered at fault in the crash. Where this was the case, inattention was the most common cause of the crash (64.0%). Of concern is the finding that stolen vehicle crashes were significantly more likely to be caused by excessive speed and dangerous driving (each accounting for approximately 9% of crashes) than crashes not involving stolen vehicles (accounting for <1%).

Stolen vehicles involved in crashes were most likely to be manufactured during the 1980s with this decade accounting for nearly half of crashes despite making up less than one-fifth of the registered fleet. The over-representation of this age group of vehicles raises questions about safety. These aging vehicles are less likely to be as robust as newer vehicles that must comply with increasingly strict safety standards and many of which now feature crumple zones, anti-lock brakes and airbags. With a significant proportion of these older vehicles being involved in collisions the potential for injury is considerable.

Related to vehicle age is the finding that three-quarters of the stolen passenger/light commercial vehicles which crashed did not have an immobiliser, making it very easy for thieves to steal these vehicles. As with stolen vehicles generally, older non-immobilised vehicles are most popular among joy-riders because of the lack of security features in the vehicles.

The estimated cost of property damage in crashes involving vehicle theft in 2006 was $2 million with an average cost of $7,330 per crash. A rough approximation of the additional costs associated with stolen vehicle crashes was calculated based on a cost estimate of road crashes in 2004 [6] and the proportion of crashes that involved a stolen vehicle. Taking into account the human, vehicle and general costs, crashes involving stolen vehicles equate to roughly $17 million per year.

With regard to future research, it would be useful to identify the characteristics of occupants of stolen vehicles to provide additional insight and better inform policies developed to tackle the issue. In the current study, age and sex indicators were not available for the majority of these records and it is assumed that this is because the offender(s) fled the scene of a crash. Similar studies on stolen vehicle crashes have revealed that the majority of the offenders are young males [1,2] and apprehensions data from South Australia on motor vehicle theft support these findings [8]. While these statistics do not represent all car thieves (only the ones who were caught) they do contribute to our understanding of this group of offenders, and suggest that targeting young males may be helpful in preventing stolen vehicle crashes. There are many risks associated with vehicle crime, particularly with young, inexperienced drivers behind the wheel of powerful vehicles, so it would be very useful to know if this inexperience is a factor in crashes involving stolen vehicles.

Finally, although police pursuits are at times mentioned by the media in association with stolen vehicle crashes, it was not possible in the current study to determine how many of the crashes involving stolen vehicles were related to high-speed pursuits by police. Two crashes from the first six months of 2007 each involved a fatality that occurred moments after a police pursuit was terminated and between 1995 and 2005, 9 people died in South Australia as a result of a motor vehicle pursuit [10]. While there can be no doubt that some police pursuits involve stolen vehicles, without data relating to stolen vehicle crashes in particular, it is not possible to determine whether or not such pursuits are in fact an issue of concern in this context.

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Profiling Drink Driving Offenders in Queensland

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Keywords

Drink driving; offender profiling; recidivism

Abstract

The major objective of this research was to characterise drink drivers in Queensland and generate profiles of drink drivers within the general driving population, convicted drink drivers, recidivist drink drivers, and crash-involved drink drivers. This profile was part of Phase 1 of the work program of the Impaired Driving Legislation Review Research Sub-Group convened by Queensland Transport, and was conducted to provide background information that could inform other components of the review. Variables of interest included: gender; age; Indigenous status; licence status; frequency of drink driving; BAC at time of drink driving offence; previous convictions; location of drink driving offence; socio-economic status (income and education); employment; purpose of trip; passengers; and vehicle type. While profiles of the drink driving offender were generated for each of the four "sub-groups" of drink drivers, this paper will present the general profile of the drink driver in Queensland.

Introduction

Due to the significant social and road safety concerns associated with recidivist offending, a substantial body of profiling drink driving offender research has focused upon defining the sub-group of drink drivers that can be considered recidivist offenders. This research has established a number of demographic and lifestyle characteristics which can be used to distinguish high risk, "hard-core" recidivist offenders from the general driving population. These factors may also be useful for distinguishing between sub-groups of drink driving offenders [1, 2]. Several studies have identified distinct and clinically relevant sub-groups of recidivist drink driving offenders [3-5]. Whilst these characteristics may assist in creating a descriptive profile of recidivist offenders, a plethora of studies have attested to the heterogeneity of this group of offenders [2, 6].

Broadly speaking, the following characteristics have been associated with drink driving recidivism: offenders tend to be male; are more likely to be single, separated, or divorced relative to members of the general population; are likely to possess low levels of literacy and low self-esteem; tend to have a history of other general traffic as well as criminal offences; are from a low socio-economic background; and tend to be employed in a blue-collar occupation [1, 2, 6-10].

However, as noted previously, repeat offenders do not represent a homogeneous group and therefore, considerable demographic variation may occur within this sub-group of offenders [6]. This review, similar to other international and national research, is underpinned by a notion highlighted by Harrison (1998, p. 120), who posited that "…drivers who continue to offend are unlikely to form a single homogenous group….[however] smaller groups of drivers may share some of the characteristics that might be useful for the development and targeting of new countermeasures". Further, it is acknowledged that recidivist offenders are one part of the whole drink driving problem, and the majority of drink driving offenders are not recidivists. It is therefore important to profile not only recidivist drink driving offenders, but all groups of drink drivers, to determine what, if any, differences between groups exist.

The major objective of this research was to characterise drink drivers in Queensland using existing data sources. Drink drivers were divided into a number of groups: drink drivers in the general driving population; convicted drink drivers; recidivist drink drivers; and crash-involved drink drivers. For the purposes of this research, the index period for convicted and crash-involved drink drivers was the 2004 calendar year. In order to identify factors which may be associated with increased risk of drink driving and predictors of recidivism as found in existing literature [6, 7, 11-13], this paper examines available statistics regarding drink driving in Queensland. The research on profiling drink driving offenders is underpinned by the notion that in order to more effectively target drink driving behaviours, a greater understanding of the characteristics of drink driving offenders is needed [1, 14]. Data will be reviewed in an attempt to profile the characteristics of drink driving offenders in Queensland, and this profile will be compared to those available in the literature.

Data Sources

A number of variables of interest were identified, including: gender; age; Indigenous status; licence status; frequency of drink driving; BAC at time of offence; previous convictions;

location of offence; socio-economic status (income and education level); employment; purpose of trip; passengers; and vehicle type. A number of possible data sources were identified. Those available for use within research timeframes included: Queensland Police Service Random Breath Testing (RBT) statistics [15]; household surveys, such as the 2004 National Drug Strategy Household Survey [16] and Queensland Road Safety Tracking Research [17]; Queensland Transport licensing and offence data [18, 19]; "Under the Limit" drink driving rehabilitation program evaluations conducted by CARRS-Q [1, 20-22]; Alcohol Ignition Interlock Trial data [23]; and Queensland Transport crash data [24]. Although the index year for the research was 2004, the "Under the Limit" program evaluations relate to information collected 10 years earlier.

Data sources relating to drink drivers in the general population

The Queensland Police Service RBT data [15] was collected by requesting breathalyzer instruments from all police stations in Queensland, and downloading any data held on the instrument into a single data file. The data set outlined the results of 21599 breath tests conducted between March 7, 2003 and June 1, 2005. All Queensland Police Districts provided at least one instrument, and there did not appear to be any biases in the data that would limit representativeness. The National Drug Strategy Household Survey 2004 [16] was identified as a source of information regarding drink drivers in the general population as one item asked respondents if they had a driven a motor vehicle while under the influence of alcohol in the last 12 months. A computer file of data for all Queensland respondents was made available to the researchers through the Australian Social Sciences Data Archives. Since 1997, Queensland Transport has regularly conducted surveys for the Queensland Road Safety Tracking Research study [17]. This survey is designed to monitor the effectiveness and outcomes of road safety advertising and other public relations initiatives. Drink driving behaviours are typically assessed by one question only, e.g., respondents are asked to indicate the extent to which they drive when they think that they may be over the legal alcohol limit.

Data sources relating to convicted drink drivers

Queensland Transport provided licensing and offence history information for all drivers with a drink driving breach that occurred on Queensland roads in the 2004 calendar year [18]. The Queensland Police Service RBT statistics [15] described previously were also analysed to provide information about BAC levels. The "Under the Limit" drink driving rehabilitation program for convicted drink drivers is a 12 week program aimed at helping drink driving offenders separate future episodes of drinking from driving. It is a behaviour change intervention that aims to reduce recidivism through modification of relevant lifestyle factors. Information about offenders participating in the "Under the Limit" program has been derived from a number of evaluation reports prepared by CARRS-Q [1, 20-22]. Offering offenders the option of participating in the program is at the discretion of magistrates, and individual offenders ultimately decide whether to undertake the program, which limits the representativeness of the samples due to a self-selection bias.

Data sources relating to recidivist drink drivers

As described above, Queensland Transport provided licensing and offence information for all drivers with a drink driving breach that occurred on Queensland roads in the 2004 calendar year [18]. Recidivist drink drivers were defined as those with more than one breach in 2004, or a previous drink driving breach in the calendar years 2003 and / or 2002. Under current Queensland legislation, a person is considered to be a recidivist offender if they have had a previous drink driving offence within five years. However, the extraction method used was only able to go back as far as 2002 within project timeframes, thus only the full calendar years of 2003 and 2002 were included for this research. Therefore, the proportion of recidivist drink drivers identified in this research is an underestimate of the true proportion of recidivist drink drivers in Queensland. The Queensland Alcohol Ignition Interlock Trial represented the first randomised trial of court-ordered alcohol ignition interlocks in Queensland [23]. Eleven courts from Brisbane and surrounding areas were involved in the trial, each of which was assigned the classification of either a control or experimental court. During the two year data collection period, 472 recidivist offenders were convicted of drink driving across the 11 courts and, of these, 166 volunteered to participate in the trial. As a large proportion of offenders declined to participate in the trial, a self-selection bias may limit the representativeness of results.

Data sources relating to crash-involved drink drivers

Queensland Transport provided data for drivers involved in crashes during the calendar year 2004 where the driver's BAC was over the legally prescribed concentration of alcohol [24]. It was possible to extract offence histories for these drivers for the 2002, 2003 and 2004 calendar years.

Overall Findings

The prevalence of drink driving observed in this research varied. For example, drink driving in the general population ranged from 1.6 percent in the Queensland Police Service RBT statistics to 11.0 or 12.4 percent in self-report data sources in which participants reported if they had ever engaged in drink driving. It is not possible to compare figures, however, as the nature of each measure differed.

There were 25,836 drink driving offences recorded in Queensland in 2004, committed by 24,661 drivers. This equates to one percent of Queensland licensed drivers. This proportion assumes that these convictions were attributable only to Queensland drivers and that the number of licences on record is an accurate reflection of the true number of drivers on the road. The true figure would probably differ, although one percent is a reasonable estimate.

Of the 24,661 drivers convicted of a drink driving breach in 2004, 3,679 (or 14.9%) were classified as recidivist offenders, as they had more than one breach in 2004, or at least one drink driving breach in 2003 and / or 2002. However, this is an underestimate of the true proportion of recidivist offenders due to the limited time period compared to the legislative definition of recidivism in Queensland.

Finally, of the 39,473 drivers involved in crashes on Queensland public roads during 2004, 1,581 (or 4.0%) crashed with a BAC that was over the prescribed concentration of alcohol. For serious crashes (fatal and hospitalisation), this proportion rose to 6.1 percent. However, this is likely to be an underestimate as not all drivers and riders involved in crashes are breath tested. Of these crash-involved drink drivers, 219 (or 13.9%) were classified as recidivist offenders using the definition described above, which is also likely to be an underestimate.

Drink Driver Variables of Interest

This section summarises the key findings for each of the variables of interest in this research. Additional information relating to variables that were not in the variables of interest list, but were available for analysis in the data sets, is discussed as "Other variables".

Gender

The gender of the driver was available in all data sets analysed for this research. Analysis revealed that males are consistently over-represented in drink driver samples. Males accounted for 68.1 to 94.7 percent of drink drivers, compared to baseline (all driver) proportions of 49.5 to 86.8 percent (maximum figures are from the Queensland Police Service RBT data set, and may overestimate the proportion of male drivers due to the default [male] instrument setting). Such a large gender discrepancy leads to the question of whether an overall profile of drink drivers would be skewed towards males. For this reason, data sets were analysed separately for females where possible.

There was no difference in the mean BAC of drink drivers (i.e., those with a BAC of 0.05 and over) in the Queensland Police Service RBT statistics sample as a function of gender. However, these analyses should be interpreted with caution, as a number of females are likely to be included in the data set as males due to the default settings on the instruments. Compared to male self-reported drink drivers in the National Drug Strategy Household Survey sample, female drink drivers were: more likely to report being of Aboriginal origin; less likely to be employed; more likely to be a student or engaged in home duties; less likely to hold a qualification above secondary school; and likely to have lower annual incomes.

There were no significant differences as a function of gender in the convicted drink driver sample [18]. However, female recidivist drink drivers were slightly older than male recidivist drink drivers and less likely to have had a drink driving breach in all three calendar years. When female crash-involved drink drivers were considered separately, they were slightly older than male crash-involved drink drivers and less likely to be novice drivers. They had received less traffic tickets, and were more likely to crash in a car or station wagon. Their crashes were less likely to be considered speed-related by the attending Police Officer, but were more likely to have involved an illegal manoeuvre.

Age

The age of the driver was available in all but one (Queensland Police Service RBT statistics) of the seven data sets analysed for this research. Analysis revealed that drink drivers are generally young (i.e., under 30 years of age). However, analysis of some data sets (e.g., National Drug Strategy Household Survey; Queensland Alcohol Ignition Interlock Trial) indicates that drink drivers are aged under 35 or 37 years. Interestingly, Queensland Road Safety Tracking Research suggests that there is no difference in self-reported drink driving behaviour between respondents aged under and over 30. Analysis of offence description in Queensland Transport data files revealed that drivers charged with driving under the influence of liquor (under 0.15%) were younger ($M = 30.5$, $SD = 10.7$) than drivers charged with driving under the influence of liquor (over 0.15%) ($M = 35.4$, $SD = 11.2$).

Indigenous status

The Indigenous status of the driver was available in four of the seven data sets analysed for this research. This involved the driver self-reporting their Indigenous status (National Drug Strategy Household Survey; "Under the Limit" program evaluations; Queensland Alcohol Ignition Interlock Trial), although "Racial Appearance" was also a field in the Queensland Transport crash data. The proportion of drink drivers who identified as Indigenous ranged from 1.8 percent to 10.8 percent; however 10.8 percent may be an over-estimate given that this was obtained in a Central Queensland sample for the "Under the Limit" program evaluation. Police described the racial appearance of 3.6 percent of crash-involved drink drivers as "Aboriginal and Islander". It is important to note that self-report data is reliant upon a respondent's willingness to identify as Indigenous, and that racial appearance in crash data may be unreliable given the difficulties assessing Indigenous status by appearance alone.

Licence status

Licence status of drink drivers was available in three of the seven data sets analysed for this research. Two of these data sets were based on official records from Queensland Transport, while respondents to the "Under the Limit" program evaluations self-reported their current licence status. It was difficult to draw any conclusions about the licence status of drink drivers in Queensland, as some data sets included current licence status [18], while others considered licence status at the time of the offence [1, 20-24]. Further, some data sets included unlicensed or unknown categories, while others were simply Learner, Provisional or Open (full licence).

Novice drivers were over-represented, as the proportion of drink drivers with Learner or Provisional licences was much greater than that for all drivers. Between 6.1 percent and 11.7 percent of drink drivers had Learner licences (versus 3.7% of all drivers), 20.6 percent to 59.6 percent held Provisional licences (versus 6.3%) and 31.7 percent to 56.8 percent held an Open licence (versus 90.1%). Although a higher proportion of novice drivers may be expected, given that drink drivers tended to be younger, proportions as high as those observed here were unexpected. It is possible that the date of data extraction may have inflated the proportion of novice drivers, as current licence status was provided. Thus drink drivers who held an Open licence at the time of their drink driving offence may hold a Provisional licence at the time the data was extracted due to a sanction imposed. "Under the Limit" program evaluation data and crash data also revealed that 12.8 percent and 20.5 percent of drink drivers, respectively, were unlicensed (or disqualified) from driving at the time of their offence or crash.

Frequency of drink driving

Frequency of drink driving was only available in two of the seven data sets analysed for this research. Almost half of the drink drivers in the "Under the Limit" sample (48.0%) reported drink driving once in the previous six months, while 39.1 percent admitted doing so more than once. Among recidivist drink drivers in the Interlock sample, 60.2 percent admitted drink driving at least once in the six months prior to commencing the trial, with 18.0 percent admitting doing so more than 10 times. Thus self-reported drink driving indicates that drink driving is far more common than official recidivism statistics suggest.

Self-reported frequency of drink driving has a number of limitations. Firstly, it assumes that individuals can not only accurately judge when they were drink driving (or were over the legal limit), but keep an accurate count of how often they engage in the behaviour. They need to be able to remember the event, which may be difficult given that they must be under the influence of alcohol in order to drink drive, and thus may not recall it due to the impairment associated with alcohol consumption. There is also the problem of honesty in responses (social desirability bias). For example, three recidivist drink drivers in the Interlock sample (1.8%) indicated that they had not driven while drunk in their lifetime, yet they had at least two drink driving convictions.

BAC at time of drink driving offence

The driver's BAC at the time of their drink driving offence was available in five of the seven data sets analysed in this research. Queensland Police Service RBT statistics revealed that the mean BAC of drivers with a BAC of 0.05 and over was 0.10 (SD = 0.05). However, as not all drivers who could have been charged with drink driving are included in this sample (that is, those for whom the legal BAC limit is zero), this result should be interpreted with caution as it is likely to be an over-estimate of the true mean BAC. This result is consistent with that observed in Queensland Transport data, where most convicted drink drivers (68.5%) for whom an offence description was available (N = 12,599) were charged with an offence that involved a BAC of less than 0.15. Some data sets reported higher average BACs, for example, "Under the Limit" program evaluations report that most drink drivers have "high BACs" [1, 20-22], and the mean BAC of drivers in the Interlock and crash samples were 0.155 [23] and 0.14 (SD = 0.06), respectively.

Drivers with BACs of 0.15 and over were analysed separately (where possible). In the Queensland Police Service RBT data set, these drivers were more likely to be male. Among convicted drink drivers in Queensland Transport data sets, drivers with a high-range BAC were slightly older than drink drivers generally and were more likely to hold an Open licence. Crash-involved drink drivers with BACs of 0.15 and over were involved in crashes that were more severe (in terms of injury) than those involving drink drivers generally. These drivers were older and less likely to be novice drivers (a higher proportion held Open licences).

Previous convictions

Information about previous convictions was available in four of the seven data sets analysed for this research. Almost 15 percent of convicted drink drivers in the Queensland Transport data set were classified as recidivist drink drivers, as they either had more than one drink driving breach in 2004, or one breach in 2004 and at least one breach in 2003 and / or 2002. Similarly, 13.9 percent of crash-involved drink drivers could be classified as recidivist drink drivers. As the period prior to the index drink driving offence ranged between two and three years, this is an underestimate of the true number of recidivist drink drivers in the sample. It is also inconsistent with Queensland legislation and other data sets in this research, where recidivist drink drivers are those with more than one breach in five years. For crash-involved drink drivers, this is also likely to be an underestimate given some of the drivers were from interstate or overseas, and it was only possible to extract Queensland convictions.

Consideration of the proportion of crash-involved drink drivers with a previous drink driving offence is important, as had these drink drivers been constrained or deterred after their initial drink driving offence, the proportion of alcohol-related crashes in 2004 might be reduced. Further, it is possible that some of these crashes may even have been avoided, reducing harm to the driver and other involved road users, and social cost to the community.

Of the drivers in the "Under the Limit" program evaluation samples, 30.2 percent had a previous drink driving conviction. All drivers in the Interlock sample had a previous drink driving offence, with the number of convictions ranging from two to seven. The proportion of these drink drivers with a previous traffic offence ranged from 40.4 percent to 48.2 percent. The most common traffic offence was unlicensed or disqualified driving. The proportion of drink drivers with a criminal record ranged from 32.1 percent to 47.6 percent

Compared to all drink drivers, drink drivers classified as recidivists in this research were older, more likely to hold an Open licence, and had higher BACs. Compared to all crash-involved drink drivers, recidivist drink drivers were: less likely to be involved in fatal crashes but more likely to be involved in property damage only crashes; more likely to hold a Provisional licence or be unlicensed (e.g., due to cancellation / disqualification); and to be driving a car / station wagon, utility / panel van, four wheel drive or riding a motorbike when they crashed while over the prescribed concentration of alcohol.

Location of "over prescribed concentration of alcohol" crashes

The only data set analysed for this research that included location of offence was Queensland Transport crash data. Most drink driver crashes (80.2%) occurred on urban roads (that is, roads in Brisbane City, Rest of Brisbane Statistical Division and Provincial Cities). However, as this is lower than the proportion of all crashes that occurred in urban areas (86.1%), drink driver crashes appear to be more likely to occur in rural areas of Queensland. Improved knowledge regarding the location of drink driving offences could provide valuable information for intelligence and enforcement purposes.

Socio-economic status (income and education level)

Variables relating to the socio-economic status of the drink driver were available in three of the seven data sets analysed in this research. Compared to all Queensland respondents, self-reported drink drivers in the National Drug Strategy Household Survey sample were more likely to report an annual personal income in the four highest brackets: $20,000 to $39,999 (30.2% versus 22.5%); $40,000 to $59,999 (23.5% versus 14.4%); $60,000 to $99,999 (9.9% versus 7.8%); and $100,000 or more (5.2% versus 2.9%). However, in other data sources, drink drivers reported lower annual incomes. For example, most drink drivers in the "Under the Limit" program evaluations (63.5%) reported earning less than $20,000 per year, while 65.6 percent of recidivist drink drivers in the Interlock sample reported earning between $12,000 and $35,000 per year.

Data from the National Drug Strategy Household Survey indicated that self-reported drink drivers in the general population are more likely to have completed Year 12 than all drivers in the sample (57.3% versus 44.1%). Similarly, self-reported drink drivers were more likely to have obtained a tertiary qualification (57.9% versus 46.3%). However, in other data sources, drink drivers reported less education. For example, 51.0 percent of drink drivers in the "Under the Limit" program evaluations reported completing up to Year 10, and 66.3 percent of the Interlock sample had completed Year 10 or less.

However, the reader is reminded that these data sources differed in methodology, sampling, and importantly the year in which the research was conducted. The "Under the Limit" program evaluations were conducted approximately 10 years before the National Drug Strategy Household Survey. The samples of drink drivers differ in that those in the National Drug Strategy Household Survey may not have been convicted of drink driving, while those in the "Under the Limit" and Interlock samples have at least one conviction. Further, it was not possible to compare the samples in terms of driving exposure and frequency of drink driving to determine whether they were comparable in these aspects. The differences may also be indicative of the type of person who is likely to take the time to respond to a lengthy questionnaire such as the National Drug Strategy Household Survey.

Employment

As per socio-economic status, information relating to the employment status of drink drivers was available in three of the seven data sets analysed for this research. Self-reported drink drivers in the National Drug Strategy Household Survey sample were more likely to be employed or self-employed than all drivers in the sample (77.1% versus 53.5%). Self-reported drink drivers were less likely than all drivers in the sample to be a student, engaged in home duties or retired. Of the 66.3 percent of recidivist drink drivers in the Interlock sample who were employed, most were employed full-time in blue-collar occupations. In contrast, 42.2 percent of drink drivers in the "Under the Limit" program evaluation samples were unemployed, while only 40.1 percent were employed full-time.

Purpose of trip

The purpose of the trip when the offence was committed (e.g., leaving licensed venue, leaving party at private premises, collecting children from school) was not available in any of the seven data sets analysed for this research. The inclusion of trip purpose in drink driver data sets may be useful in terms of informing enforcement practices and intervention programs.

Passengers

Information about passengers of drink drivers was only available in Queensland Transport crash data. The number of occupants in the vehicle with a drink driver when they crashed ranged from one to nine (including the driver). Most drink drivers crashed alone (64.6%) or with one passenger (21.6%). These statistics were similar to those observed for drivers in all crashes. Improved knowledge regarding passengers of drink drivers may have important policy implications, particularly with the recent announcement of passenger restrictions for young drivers in Queensland, and in other jurisdictions.

Vehicle type

Information about the vehicle type of drink drivers was only available in one of the seven data sets analysed for this research: Queensland Transport crash data. Most drink driver crashes occurred in cars / station wagons (73.8%) and utilities / panel vans (14.9%), with some occurring in four wheel drives (6.5%) or motorcycles (3.8%). Very few drink driver crashes occurred in larger vehicles (1.2%).

Other variables

Information relating to additional variables was also available in some of the seven data sets analysed for this research, including marital status, crash severity and other factors and contributing circumstances for crashes. More than half of the drink drivers in the National Drug Strategy Household Survey sample (56.3%) were married, however they were more likely than all respondents to be single (42.4% versus 38.6%). Most drink drivers in the "Under the Limit" program evaluation samples were single (60.8%). Similarly, 60.2 percent of recidivist drink drivers in the Interlock sample were single, divorced or separated. Most drink driver crashes (44.3%) are property damage only crashes. However, compared to all crashes, drink driver crashes are more severe as they are more likely to be fatal (3.9% versus 1.0%) or involve hospitalisation (27.8% versus 19.8%). Drink driver crashes also involve inexperience (19.9%), inattention (15.0%) or speed (12.3%). Compared to all crashes, drink driver crashes are more likely to involve inexperience (19.9% versus 10.9%) or speed (12.3% versus 3.0%). However, these results should be interpreted with caution, as they are based on the subjective judgment of the attending Police Officer, and may be influenced by a number of other factors, such as previous experience with crashes or perceptions (e.g., crashes involving young drivers are due to their inexperience).

Profile of the Drink Driver in Queensland

According to the data analysed for this research, general characteristics of drink drivers (i.e., across the four drink driver groups) include:

- Far more likely to be male than female
- Aged under 30 or under 35 years
- 1.8 – 3.6% identify as Indigenous (or 10.8% in a Central Queensland sample)
- Hold a Provisional or Open licence, although novice drivers are over-represented compared to all licensed drivers (perhaps due to sanctions previously imposed or the method of data extraction in this research)
- Report drink driving at least once in last six months, or more than 10 times in lifetime
- Likely to be caught with a mean BAC of 0.10 (or 0.14 or 0.155 for crash-involved drink drivers and recidivist drink drivers respectively)
- 13.9 – 14.9% are recidivist drink driving offenders, although this is an under-estimate, given that it was only possible to check the previous two to three years for this research
- Likely to have committed traffic and / or criminal offences previously
- While most drink driver crashes occur in urban areas of Queensland (80.2%), although crashes in rural areas are over-represented compared to all crashes (19.8% versus 13.9%).
- Annual income was varied: $20,000 – $60,000 for self-reported drink drivers in the general driving population; but generally lower for convicted drink drivers (less than $20,000) and recidivist drink drivers ($12,000 – $35,000)
- Self-reported drink drivers in the general driving population had completed Year 12 and obtained some form of tertiary qualification, while convicted drink drivers and recidivist drink drivers had completed Year 10 or less at secondary school
- Most self-reported drink drivers in the general driving population were employed, while employment was much less common among convicted and recidivist drink drivers, where those who were employed were generally employed full-time in blue-collar occupations
- Drink drivers tend to crash alone or with one passenger in a car, wagon, ute or panel van

Implications for Policy, Enforcement and Future Research

This research has a number of implications for road safety policy, enforcement practices and future research. Most findings were consistent with those in the recidivist drink driver literature. However, interesting differences between the drink driver groups considered in this research were observed. For example, the finding that there were socio-economic (i.e., income and education) differences between self-reported drink drivers and convicted and recidivist offenders was interesting (although unexpected) and warrants further clarification or consideration, as differences in the definition of drink driving and methodology makes direct comparisons between these groups difficult.

Knowledge of the location of the drink driving offence would provide valuable information for intelligence and enforcement purposes. However, law enforcement agencies must acknowledge the limitation of the possibility of creating their own biased intelligence by conducting enforcement at a limited number of times and at a limited number of locations, as the only drink driving offences that will be detected using this methodology are those occurring at those times and at those locations. A better understanding of the socio-economic background and employment status of drink drivers may have policy implications in terms of sanctions. That is, setting fines of appropriate punitive value, and gathering information that may be relevant to the allocation of work licences to drink driving offenders.

Profiling drink driving offenders in Queensland on a regular basis would be useful in providing up to date information on the problem of drink driving in Queensland. Comprehensive profiling may also assist in evaluating the effectiveness of current interventions and enforcement practices. A review of the nature of data required to develop a comprehensive profile of drink drivers involving collaboration between relevant agencies is recommended. Establishing a better and more time and cost efficient method of data collection and storage relating to drink drivers will assist in streamlining the profiling process and improve government capacity to gather the information required to inform policy, enforcement practices and intervention development and implementation.

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Road Safety Literature

New to the College Library

First Aid and Harm Minimisation for Victims of Road Trauma – a Population Study – Final Report June 2007, published by Flinders University, Adelaide and the NRMA-ACT Road Safety Trust..

Recent Publications

Centre for Automotive Safety Research (CASR)

The University of Adelaide

CASR has released the following reports, which are available in full text online:

CASR039 - **Pedestrian collisions in South Australia**

http://casr.adelaide.edu.au/publications/researchreports/CASR039.pdf

CASR013: **Best practice criteria in practical driving tests of medically referred drivers**

http://casr.adelaide.edu.au/publications/researchreports/CASR013.pdf

You can access the entire CASR report series and subscribe to RSS feed from the CASR website: http://casr.adelaide.edu.au/publications/researchreports/

Monash University Accident Research Centre

Report No. 274: Clarke, B. & Bobevski, I. (2008) **Disqualified drivers in Victoria: Literature review and focus group study,**

http://www.monash.edu.au/muarc/reports/muarc274.html

Australian Transport Safety Bureau

Level Crossing Crash

The ATSB Transport Safety Investigation Report 2006/015 into the level crossing collision between The Ghan Passenger Train (1AD8) and a road-train truck at Ban Ban Springs, Northern Territory on 12 December 2006, may be read at:

http://www.atsb.gov.au/publications/investigation_reports/2006/RAIR/rair20060015.aspx

Statistics on Road Deaths

Road Deaths Australia, Monthly Bulletin; February 2008 may be accessed at:

http://www.atsb.gov.au/publications/2008/mrf0208.aspx

Note: Release of Road Deaths Australia - Monthly Bulletin, February 2008 is the last to be published by the ATSB. Although the content of future issues will remain the same, publication will be managed by the Infrastructure and Surface Transport Policy Division. Links will be provided from the ATSB website to the new webpages.

Recent Publications in Australia and New Zealand

Biggs SN, Smith A, Dorrian J, Reid K, Dawson D, van den Heuvel C, Baulk S. J, 2007, "Perception of simulated driving performance after sleep restriction and caffeine", pp. 573-577, Journal of Psychosomatic Research, Vol. 63, No. 6, Elsevier Publishing.

(School of Psychology, Centre for Sleep Research, University of South Australia).

There have been reports of a high correlation between feelings of alertness with performance perception. The objective of this study was to determine whether caffeine, a common countermeasure to driver sleepiness, affected a sleepy driver's ability to monitor his or her simulated driving performance.

Healthy young adults, six males and six females, participated in three counterbalanced, blinded, daytime conditions:

(a) control with 9 hr. time in bed;

(b) 100 mg caffeine and 4 hr. time in bed; and

(c) placebo and 4hr. time in bed.

Driving performance was measured through lane drift on a series of simulated driving sessions of 30-minute duration. Subjective sleepiness and perception of driving performance were measured at five-minute intervals during driving sessions using the Karolinska Sleepiness Scale and a corresponding perception scale.

Sleep restriction had a significant adverse effect on driving performance and subjective measures. Caffeine resulted in significant improvements across all measures. There was significant correlation between subjective measures after sleep restriction and prior to caffeine. Correlations between actual and perceived performance were not significant across all conditions.

It was concluded that the strong correlation between subjective measures supports the postulation that sleepiness is used as a cue for performance prediction when sleep restricted. The relationship between perceived and actual performance after fatigue countermeasures remains inconclusive. Further research, addressing limitations, is needed.

Bilston LE, Brown J, 2008, "Accuracy of medical and ambulance record restraint and crash data information for child occupants", pp. 46-50, Injury Prevention, Vol. 14, No. 1, BMJ Publishing Group.

(Prince of Wales Medical Research Institute, University of NSW)

Restraint usage and crash information contained in medical and ambulance records is often available, but information on the accuracy of this data is limited. The objective of this study was to examine the correlation between information in these records on children's restraint usage, on the one hand, and crash characteristics recorded with medical data using in-depth crash investigation, on the other hand.

A comparison of data from both sources, was made for a case series of child occupants aged 2-8 years involved in motor vehicle crashes.

When data for restraint type, seating position, impact severity, and impact direction were recorded in either the medical record or ambulance records, it tended to be at least partially correct. However, incompleteness or absence of specifics of restraint use and crash information in the medical record (7-17%) was common. Ambulance records were often not available (39%), but this data was more often complete (78-100%) and accurate (52-89%), when available, possibly due to the use of a standardized pro-forma.

It was concluded that data in ambulance and hospital records can provide information on restraint type and usage for child occupants in motor vehicle crashes, as well as crash information. The use of a standardized pro-forma may encourage more complete and accurate reporting of data.

Delaney AK, Newstead SV, Watson LM, 2007, "The influence of trends in heavy vehicle travel on road trauma in the light vehicle fleet",

(http://www.monash.edu.au/muarc/reports/muarc259.pdf)

Monash University Accident Research Centre.

An increase of road usage by heavy vehicles (rigid trucks, articulated trucks and buses) has been identified as one of the key components of projected total growth in vehicle travel to 2010. This study examines the effect of anticipated growth in heavy vehicle travel on road trauma in the light passenger vehicle fleet.

A measure of road trauma is the number of light vehicle driver fatalities and serious injuries resulting from light passenger vehicle collisions with heavy vehicles.

Using exposure data sourced primarily from the Bureau of Transport and Regional Economics and the Australian Bureau of Statistics in conjunction with NSW Police reported crash database, a model to project relevant future trends in road trauma has been developed to reflect three key elements of the road trauma chain: exposure, crash risk and injury outcome given crash involvement.

In addition to the results of this study, the model developed may be used to assess the likely impact of proposed policy changes on heavy vehicle related road trauma. Future heavy vehicle related road trauma trends are projected based on two scenarios of future crash risk.

It is concluded that (a) the study demonstrates the sensitivity of heavy vehicle related road trauma to crash risk and (b) the study highlights the importance of continuing to reduce heavy vehicle crash rates to offset projected growth in heavy vehicle travel in order to deliver reductions in heavy vehicle related road trauma. A potential remedy to predicted increases in heavy vehicle related trauma is explored and demonstrates the application of the model as a policy evaluation tool.

Fildes B, Charlton J, Muir C, Koppel S, 2007, "Driving responses of older and younger drivers in a driving simulator", pp. 559-572, Annual Proceedings of the Association for the Advancement of Automotive Medicine, Vol. 51, Association for the Advancement of Automotive Medicine.

(Monash University Accident Research Centre)

A study was designed to examine the behaviour of younger and older drivers to hazardous traffic manoeuvres in a driving simulator. Hazardous situations, on both highway and residential streets, were studied and data on drivers' vision and vehicle performance were collected.

The finding was that all drivers were able to avoid crashes. However, older drivers were consistently slower to fixate hazardous stimuli in the driving environment and were slower to respond. This presents a potentially serious road safety concern.

Further research is warranted, especially under conditions of increasing traffic complexity.

Hatfield J, Chamberlain T, 2008, "The Effect of Audio Materials From a Rear-Seat Audiovisual Entertainment System or From Radio on Simulated Driving", pp. 52-60, Transportation Research Part F: Traffic Psychology and Behaviour, Vol. 11, No. 1, Elsevier Publishing.

(NSW Injury Risk Management Research Centre, The University of NSW)

Although there is an increasing use of in-car audiovisual entertainment systems, there is a lack of research as the basis of appropriate legislation controlling their use. Current legislation seeks to prevent drivers from observing the audiovisual display within their own vehicle. However, research suggests that the auditory materials alone may result in cognitive and auditory distraction that impairs driving.

In an experiment using a driving simulator, 27 participants completed drives under each of three conditions:

- without audio materials,
- with audio materials from a movie, and
- with audio materials from radio.

Performance was measured in terms of lateral control, speed control, and response to hazards. Participants provided self-reports of distraction and driving impairment.

Results showed minimal effects on driving of audio materials. Perhaps this is because listening while driving is fairly well practised and easily modulated, and does not involve speech production. There appears to be no need for regulations relating to such auditory entertainment materials. Nonetheless, further research is required regarding the effects of multiple concurrent distracters on actual driving performance in traffic.

Hoareau E, Newstead S, Oxley P, Cameron M, 2007, "An evaluation of 50-km/h speed limits in South East Queensland", Monash University Accident Research Centre.

The full document is available online (Copyright):

http://www.monash.edu.au/muarc/reports/muarc264.pdf

In March 1999, a default speed limit of 50-km/hr, in built-up areas, was introduced in South East Queensland, with the primary aim of reducing the incidence and severity of casualty crashes. An evaluation of this initiative by Queensland Transport, using a control chart style of statistical analysis, revealed significant reductions in the number of both serious and fatal crashes. This translates into substantial social cost savings on projected outcomes.

Queensland Transport adopted a recommendation by the Parliamentary Travelsafe Committee to obtain independent external evaluations of its major road safety countermeasures. Hence, it commissioned Monash University Accident Research Centre to analyse the program effectiveness and assess its own internal evaluation. This report details the results of this analysis, performed using Poisson log-linear regression, and compares the outcomes of the two evaluations.

The Monash University Accident Research Centre evaluation found that the implementation was associated with statistically significant average yearly reductions of 88% (for fatal crashes), 23% (for all casualty crashes) and 22% (for all reported crashes). It appears that there has been a reduction in crashes with time, after program implementation, for each crash severity level considered. Data analysis indicated that reduction in crashes stemmed largely from a reduction in excessive speeding in 50km/hr zones rather than large reductions in mean speeds at the affected sites.

These results showed that Queensland Transport internal evaluation underestimated the impact of the implementation of 50 km/hr in built up areas. This resulted from a poorly specified treatment area that consisted of roads other than those that had changed to 50 km/hr. This study also affirmed that the assumptions underlying the control chart method used by Queensland Transport did not meet the theoretical properties of the crash data and formal statistical evaluation of program effects was better undertaken using Poisson regression techniques. However, the control chart method was endorsed as a satisfactory method for internal monitoring of program performance.

Hosking S, Newstead S, Hoareau E, Delaney A, 2007, "An evaluation of the 50km/h default speed limit in regional Queensland", Monash University Accident Research Centre.

The full document is available online
http://www.monash.edu.au/muarc/reports/muarc265.pdf)

The 50km/h default speed limit was introduced on local roads in regional Queensland in February 2003, with a three-month amnesty period. Full enforcement of this regulation commenced in May 2003. The objectives of this study were to evaluate the effect of the 50km/h default speed limit on crash frequencies and vehicle speeds.

Evidence of significant crash reductions associated with implementation of the 50km/h default speed limit in regional Queensland was found. Crash reductions were estimated (a) in the amnesty period immediately after implementation and (b) in the subsequent period, until the end of May 2004, during which the new speed limit was fully enforced. In the period of full enforcement, the analyses found statistically significant crash reductions of 13.5% for all crashes reported to police. Greater reductions were estimated in higher severity crashes with a reduction of 24.9% estimated for serious casualty crashes (crashes involving death or hospitalisation) and 19.3% for fatal, hospitalisation and medical attention severity crashes combined. Estimated percentage crash reductions in the full enforcement period translated to an estimated saving of 9 casualty crashes, 5 serious casualty crashes and 14 crashes of all severity levels per month.

The analyses also found that the 50km/h default speed limit was associated with significant reductions in crashes that involved younger drivers during both periods. It also estimated statistically significant reductions in speed related crashes that occurred primarily during the amnesty period. Analysis of speed survey data associated with the program implementation indicates that the reported crash reductions were associated with a reduction in vehicle speeds above 60km/h on roads that became 50km/h subsequent to the default limit introduction.

It was concluded that the 50km/h default speed limit was an effective program in reducing crashes in regional Queensland.

Keall M, Newstead S, 2007, "Four-wheel drive vehicle crash involvement risk, rollover risk and injury rate in comparison to other passenger vehicles: estimates based on Australian and New Zealand crash data and on New Zealand motor vehicle register data", Monash University Accident Research Centre.

The full document is available online (Copyright):

http://www.monash.edu.au/muarc/reports/muarc262.pdf)

Recent analyses have established that four-wheel drive vehicles are forceful in crashes:

(a) causing comparatively more harm than other passenger vehicles when in collision with other road users, and

(b) having a high risk of rollover crashes.

To assess the safety of these vehicles more completely, this study produced two analyses of risk:

- firstly, estimates of crash risk and injury rates using New Zealand data; and,
- secondly, induced exposure estimates of rollover risk using Australian and New Zealand crash data.

Crash risk and injury rates were estimated using New Zealand data, with control for the number of relevant owner and vehicle characteristics. Nevertheless, within given locations, age bands and gender groups, drivers wanting to drive in a particular manner may choose types of vehicles to suit their driving style, leading to differences in risk between vehicle types. This is an explanation why sports cars, which often have highly developed braking and handling systems, were found to have a high risk of crash involvement and a high rate of resultant injury. It is likely to be the manner in which these vehicles are driven that leads to these elevated rates.

Similarly, despite previously estimated high rollover rates and high aggressiveness for four-wheel drive vehicles, crash involvement risks estimated for four-wheel drive vehicles were generally low, probably because of the manner in which they are driven. This estimated low crash involvement risk, in combination with established generally good overall protection four-wheel drive vehicles provide their own occupants in a crash, meant that four-wheel drive vehicles were estimated to impose relatively low injury risk on their own occupants, to other roads users and occupants of other vehicles per registered year adjusted for distance driven, despite their established high aggressiveness. The one situation identified with unusually high risk for four-wheel drive vehicles compared to other passenger vehicle types was that of large four-wheel drive vehicles owned by teenagers.

The estimation of induced exposure risk involved two steps:

(1) identifying the most appropriate crash type to represent exposure (in terms of amount of driving, driving environment, and driver characteristics) using existing data on distance travelled in New Zealand;

(2) fitting a model to crash data from Australia and New Zealand to estimate risk.

The best set of comparison crashes was found to be multi-vehicle crashes in which the vehicle type analysed was damaged in the rear. Estimates of risk consistent with previous studies were generally obtained, showing higher rollover risk for those vehicles with a high centre of gravity compared to the width of the wheel track (four-wheel drive vehicles and People Movers). As found in a previous study, higher rollover risk was found for young drivers. Higher rollover risk was also found for older vehicles: a 2% higher rollover risk (95% CI 1% to 3%) for a vehicle that is a year older than another vehicle. Female drivers were found to have a 35% lower rollover risk than male drivers (with 95% confidence interval 42% to 27%). The results overall warn that parents who are owners of four-wheel drive vehicles - and, to a lesser extent, owners of People MoversÂ -- need to be wary of allowing their novice family members to use such vehicles (keeping in mind that for young drivers, regular cars present significantly less rollover risk than 4WDs and people movers), and reinforce the importance of electronic stability technology as a highly desirable risk-reducing feature for these relatively unstable vehicles.

Koppel S, Charlton JL, Fitzharris M, Congiu M, Fildes B, 2008, "Factors associated with the premature graduation of children into seatbelts", pp. 657-666, Accident Analysis and Prevention, Vol. 40, No. 2, Elsevier Publishing.

(Monash University Accident Research Centre)This study investigated the factors associated with the premature graduation into seatbelts for Australian children aged 4-11 years. In questionnaires from 699 child restraint users, 195 children were identified as meeting the booster seat height-weight criteria (height: 100-145cm and weight: 14-26kg). Of these children, 44% were correctly traveling in a booster seat, while 56% had been moved prematurely into a seatbelt. A multivariable logistic regression model showed that there were a number of key predictors associated with the premature graduation to seatbelts. For example, children who were moved prematurely into a seatbelt were more likely to be older, have other children travelling in the vehicle and have younger parents compared to children appropriately restrained in a booster seat. In addition, there was a significant interaction between vehicle type and parent's household income. Based on the findings of this study, a number of recommendations are made for strategies to enhance appropriate restraint use for this age group, as well as for future research.

Lenne MG, Triggs TJ, Mulvihill CM, Regan MA, Corben BF, 2008, "Detection of emergency vehicles: driver responses to advance warning in a driving simulator", pp. 135-44, Human Factors, Vol. 50, No.1, Human Factors and Ergonomics Society. (Monash University Accident Research Centre)

This research evaluated the effects of an advance-warning device on the safety of drivers when interacting with emergency vehicles. The advance-warning device was intended to provide drivers with advance warning of an approaching on-call emergency vehicle via visual and auditory warnings when the emergency vehicle was within a 300- to 400-m radius.

Research suggests that drivers can experience difficulty in accurately detecting the distance and direction of approaching on-call emergency vehicles. In-vehicle technology has not previously been explored as a means of overcoming the limitations of existing emergency vehicle lights and sirens and improving driver detection of emergency vehicles. With use of an advanced driving simulator, this study examined the effects of the advanced-warning device on driving performance in a range of circumstances in which real-world emergency vehicle crashes and near-misses commonly occur. Each event contained a combination of scenario type (adjacent lane, turning across, car following) and warning condition (control, standard, advance). Data from 22 participants were collected, including measures of speed, braking, and visual scanning. For adjacent-lane and turning-across events, the advance-warning device was associated primarily with reductions in mean speed. The advance-warning device resulted in an earlier lane change to clear a path for the emergency vehicle in the car-following event. The reduction in speed observed was a positive finding, given the relationship between impact speed and injury severity. Response priming emerged as the mechanism underpinning these effects. An application of response priming may result in safety benefits in other settings when an advisory warning is presented before the threat can be perceived.

Lennon A, Siskind V, Haworth N, 2008, "Rear seat safer: Seating position, restraint use and injuries in children in traffic crashes in Victoria", pp. 829-834, Accident Analysis and Prevention, Vol. 40, No. 2, Elsevier Publishing.

(Centre for Accident Research and Road Safety, Queensland University of Technology).

Car crashes are a major cause of death and serious injury to children. Most analyses of risk for children passengers are based on data from USA. The Australian context is different in at least three ways:

(a) the proportion of passenger-side airbags, a potential risk to children in front seats, is much lower;

(b) unlike in America, Australian airbags are designed to work with restrained passengers;

(c) restraint use for children 0-12 years is high (>90%).

Official data drawn from Victorian crash records (n=30,631) were used to calculate relative risks of death or serious injury for children (0-3 years, 4-7 years; 8-12 years) traveling in passenger cars during 1993-1998 and 1999-2004. Over 90% were reportedly wearing a restraint, and 20% were traveling in the front seat. For children under 4 years traveling in the front seat, the relative risk of death was twice as great as when traveling in the rear, and that of serious injury was 60% greater. The relative risk of death whilst traveling in the front seat was almost four times greater for children aged under 1 year. We suggest that serious consideration should be given to mandating rear seating for children, particularly those aged 4 and under.

Newstead S, D'Elia A, 2007, "An investigation into the relationship between vehicle colour and crash risk", Monash University Accident Research Centre.

The full document is available online (Copyright):

http://www.monash.edu.au/muarc/reports/muarc263.pdf

This study has assessed the relationship between vehicle colour and crash risk through the analysis of real crash outcomes described in mass crash data reported to police in two Australian states. A stratified induced exposure study design was employed identifying:

- vehicle to vehicle crashes; and
- crashes involving unprotected road users

as those having a risk dependent on vehicle colour whilst exposure was induced from single vehicle crash involvement.

Analysis was stratified by vehicle type, light conditions and jurisdiction of crash. Results of the analysis identified a clear statistically significant relationship between vehicle colour and crash risk. Compared to white vehicles, a number of colours were associated with higher crash risk. These colours are generally those lower on the visibility index and include black, blue, grey, green, red and silver. No colour was statistically significantly safer than white although a number of other colours could not be distinguished from white statistically in terms of relative crash risk. The association between vehicle colour and crash risk was strongest during daylight hours where relative crash risks were higher for the colours listed compared to white by up to around 10%. Comparison of analysis results between the two states of Australia analysed suggested that vehicle colour also has an association with crash severity with lower visibility colours having higher risks of more severe crashes. Furthermore, the results also suggested that environmental factors can also modify the relationship between vehicle colour and crash risk although further work is required to quantify this.

Robb G, Sultana S, Ameratunga S, Jackson R, 2008, "A systematic review of epidemiological studies investigating risk factors for work-related road traffic crashes and injuries", pp. 51-58, Injury Prevention, Vol. 14, No. 1, 51-8, BMJ Publishing Group.

(Section of Epidemiology and Biostatistics, School of Population Health, University of Auckland, New Zealand)

The authors, using systematic review, aimed to critically appraise the published evidence for risk factors linked with work-related road traffic crashes and contributing to injuries and deaths.

A search was made using electronic databases including Medline, EMBASE, PsycINFO, Transport database, and the Australian Transport and Road Index (ATRI) database. Additional searches included websites of relevant organisations, reference lists of included studies, and issues of major injury journals published within the past 5 years. Studies were included if they met the following criteria:

- they investigated work-related traffic crashes or related injuries or deaths as the outcome;
- they measured any potential risk factor for work-related road traffic crash as an exposure;
- they included a relevant comparison group, and
- they were written in English.

The studies included in the review were critically appraised, using the GATE-lite critical appraisal form (www.epiq.co.nz). Meta-analysis was not attempted because of the heterogeneity of the included studies.

Twenty-five studies were identified. There were four robust (case-control and case-crossover) studies. Three of these found an increased injury risk

- among workers after extended shifts,
- for tractor-trailers with brake and steering defects, and
- for"double configuration"trucks.

The fourth study showed that alcohol and drug use were not risk factors in an industry with a random testing policy.

The best cross-sectional studies showed associations between injury and sleepiness, time spent driving, occupational stress, non-insulin-dependent uncomplicated diabetes, and use of narcotics and antihistamines.

It was concluded that modifiable behavioral and vehicle-related risk factors are likely to contribute to work related traffic injury. The most commonly researched topics are fatigue and sleepiness and these were consistently associated with increased risk.

Thornley SJ, Woodward A, Langley JD, Ameratunga SN, Rodgers A, 2008, "Conspicuity and bicycle crashes: preliminary findings of the Taupo Bicycle Study", pp. 11-18, Injury Prevention,Vol. 14, No.1, BMJ Publishing Group.

(School of Population Health, University of Auckland, New Zealand. (sithor@woosh.co.nz)

A web-based survey was designed to establish a cohort of cyclists. This is a report on the preliminary findings of a longitudinal study of cyclists that aimed to describe the methods and characteristics of participants. These participants were the 2469 riders who enrolled online in the largest mass-participation bicycle event in New Zealand, the Wattyl Lake Taupo Cycle Challenge.

The measurement was based on self-reported crashes in the preceding 12 months. The average number of kilometers cycled per week in the preceding 12 months was 130. Of the 5653 riders in the event, 2469 (44%) completed the study questionnaire. Mean age was 44 years, 73% were male.

The annual incidence of crashes leading to injury that disrupted usual daily activities for at least 24 hrs was 0.5 per cyclist/year. About one-third of these crashes resulted in consultation with a health professional. The mean number of days absent from work attributable to bicycle crashes was 0.39 per cyclist/year. After adjustment for potential confounders and exposure (kilometers cycled per year), the rate of days off work from bicycle crash injury was substantially lower among riders who reported always wearing fluorescent colors (multivariate incidence rate ratio 0.23, 95% CI 0.09 to 0.59).

It can be concluded that low conspicuity of cyclists may increase the risk of crash-related injury and subsequent loss of work time. Increased use of high-visibility clothing is a simple intervention that may have a large impact on the safety of cycling.

Vassallo S, Smart D, Sanson A, Cockfield S, Harris A, McIntyre A, Harrison W, 2008, "Risky driving among young Australian drivers II: Co-occurrence with other problem behaviours", pp. 376-386, Accident Analysis and Prevention, Vol. 40, No.1, Elsevier Publishing.

(Australian Institute of Family Studies)

This study examined the relationship of risky driving with a range of externalising and internalising problems among 1055 young Australian drivers participating in an ongoing, 23-year longitudinal study.

The methodology involved:

(1) investigating the relationship of risky driving and other problem outcomes at 19-20 years;

(2) exploring the rate of single and multiple problems among high, moderate and low young risky drivers; and

(3) investigating connections between risky driving in early adulthood and adolescent problem behaviours.

The study identified concurrent and longitudinal associations between risky driving and both (a) substance use (alcohol, cigarette and marijuana use, binge drinking) and (b) antisocial behaviour. However, risky driving generally appeared unrelated to internalising problems (depression, anxiety) and early sexual activity. Overall, young risky drivers varied considerably in the number and types of problem behaviours exhibited, although the great majority (70%) had displayed at least one other type of problem behaviour.

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Staff: Ms Linda Cooke, Executive Officer
Mr Geoff Horne, Manager, ACRS Journal and Professional Register
Mrs Jacki Percival, Executive Assistant

Office hours:	Monday	9.30am - 5.00pm
	Tuesday	9.30am - 5.00pm
	Wednesday	9.30am - 2.30pm
	Thursday	9.30-5.30
	Friday	Closed

Messages can be left on Voice Mail when the office is unattended.

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