The Occupational Environment and Heavy Vehicle Crash Involvement

Empty loads, rigid vehicles, driving more than half the trip between the hours of midnight and 6am, and time since last break have been associated with heavy vehicle crash involvement in WA.

The findings of the C-MARC study, set to be published in a special edition of the journal Accident Analysis and Prevention, support the association between a heavy vehicle driver’s work environment and the risk of heavy vehicle crash involvement in Western Australia (WA).

The case-control study included 100 long-haul heavy vehicle drivers who were involved in a police-reported crash in WA and 100 long-haul heavy vehicle drivers recruited from WA truck stops, who were not involved in a crash in the previous 12 months.

After accounting for potential confounders, driving a heavy vehicle with an empty load was associated with almost a three-fold increased crash risk compared to carrying general freight (adjusted OR: 2.93, 95% CI: 1.17–7.34). Driving a rigid heavy vehicle was associated with a four-fold increased risk of crashing compared to articulated heavy vehicles (adjusted OR: 4.08, 95% CI: 1.13–14.68). The risk of crashing was almost five times higher when driving more than 50% of the trip between midnight and 5.59 am (adjusted OR: 4.86, 95% CI: 1.47–16.07). Furthermore, the risk of crashing significantly increased if the time since the last break on the index trip was greater than 2 h (adjusted OR: 2.18, 95% CI: 1.14–4.17). Drivers with more than 10 years driving experience were 52% less likely to be involved in a crash (adjusted OR: 0.48, 95% CI: 0.23–0.99).

With 14 people killed and 118 hospitalised as a result of crashes involving heavy vehicles in WA during 2013, greater attention needs to be paid to the creation of a safer work environment for long distance heavy vehicle drivers. The results highlight that further training, the minimisation of night-time driving and the enforcement of regular breaks are potential points of interest surrounding the improvement of heavy vehicle safety.
A recent C-MARC investigation found road safety barriers were a successful treatment for reducing run-off-road killed or seriously injured (KSI) crashes in WA.

Loss-of-control and run-off-road crashes constitute close to a third of all serious casualty crashes in WA, and contribute to around 1,000 deaths and serious injuries in the state annually. Inappropriate speed, poor driving conditions, driver impairment, distraction and fatigue are some of the factors that can contribute to such crashes. When a driver loses control of a vehicle and runs off the road, there is the potential for the vehicle to roll over or hit a roadside hazard, which often involves fatal and serious trauma.

Road safety barriers are designed to absorb energy that is released in a collision and prevent a more serious collision with roadside hazards, and as such, are one roadside safety treatment that can be implemented to reduce the severity of road injuries. Road safety barriers can generally be divided into three broad categories, namely rigid (i.e. concrete), semi-rigid (i.e. beams) and flexible (i.e. wire-rope). These barriers are increasingly being used as a counter measure to reduce the injury severity associated with loss-of-control and run-off-road crashes across Western Australia (WA).

Besides studies conducted in America and Europe, there are very few studies on the effectiveness of the road safety barriers on Australian roads with no studies having been conducted in WA to date. Therefore, C-MARC researchers Dr Kyle Chow and Prof Lynn Meuleners conducted a study that aimed to evaluate the effectiveness of three types of road safety barriers that are in active and continuous use on WA roads, namely flexible wire-rope barriers, concrete barriers, and beams, in reducing six types of crashes. The focus of this newsletter will be on run-off-road crashes.

A quasi-experimental “before” and “after” comparison of crashes occurring at the sites treated with road safety barriers between 2000 and 2013 was undertaken in order to assess the effectiveness of the three different types of barriers.

Based on data obtained from the Integrated Road Information System (IRIS) which is maintained by Main Roads WA, it was found that road safety barriers were effective in reducing run-off-road crashes resulting in death or serious injury (KSI crashes) when all sites (metropolitan and rural) were considered. Overall, the 133 metropolitan and rural sites reported a significant 73.9% reduction in run-off-road KSI crashes per million vehicles during the study period. When examining by separate barrier types, flexible wire-rope barriers were successful in reducing run-off-road KSI crashes at the 41 treated sites as evidenced by the 83.4% reduction in run-off-road KSI crashes per million vehicles. At the 27 sites treated with concrete barriers there was a significant 12.9% reduction in run-off-road KSI crashes per million vehicles. At the 57 sites treated with beams there was a significant 74.5% reduction in run-off-road KSI crashes per million vehicles.

Results from the analysis provide WA road authorities with more objective information to guide barrier investment choices. It is recommended that preference be given to the installation of flexible wire-rope barriers, especially at locations likely to experience a higher risk of run-off road crashes, as concrete barriers were less successful in reducing the severity of such crashes.


Reductions in run-off-road KSI crashes per million vehicles at sites treated with road safety barriers in WA

<table>
<thead>
<tr>
<th>Barrier Type</th>
<th>Number of Treated Sites in Sample</th>
<th>Percent Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexible wire-rope barriers</td>
<td>41</td>
<td>83.4%</td>
</tr>
<tr>
<td>only</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beams only</td>
<td>57</td>
<td>74.5%</td>
</tr>
<tr>
<td>Concrete barriers only</td>
<td>27</td>
<td>12.9%</td>
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<tr>
<td>All barriers of interest</td>
<td>133</td>
<td>73.9%</td>
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C-MARC has recently been awarded $80,000 in funding by Main Roads WA to investigate the impact of digital billboards on driving performance.

Previous research suggests that digital billboards have the potential to be distracting to drivers, and therefore, may increase the risk of motor vehicle crash involvement. Electronic billboards have the ability to attract greater visual attention compared to other traffic signs due to their highly conspicuous nature, which can result in more frequent glances. Electronic billboards also have the potential to maintain driver’s attention and curiosity over an extended period of time due to the advertisements changing on a regular basis (Dukic et al 2013).

However, this body of research has not been done with the intention of directly answering questions that translate to inform road safety authority guidelines. A good example of this is that it is unclear how much more distracting a dwell time of 20 seconds is as opposed to a 40 second dwell time. Likewise, the relative impact of the placement of the billboard and the differences in content remain unexplored and are critical questions that need to be taken into account by road authorities.

The proposed study will be an experimental study that will use the new state-of-the-art CMARC-ARRB driving simulator to investigate driver distraction and three specific factors relating to digital billboards, namely dwell times, placement, and content. Each of these factors will be manipulated within a simulated driving freeway environment lasting several kilometres and will result in 18 different conditions being tested. Seventy five participants will be recruited and will complete a maximum of three conditions each. Driving performance under each condition will be objectively measured and will include such factors as speed control, lane keeping and headway. Gaze direction and ‘eyes off the road’ are other variables that will be recorded and analysed.

It is anticipated the results will allow robust conclusions to be drawn about the relative impact of different values of these factors and their interactions. The final report will assist in making informed decisions with respect to electronic billboard approvals and will be used to inform elements of design specification that will be incorporated into the existing Main Roads ‘Policy and Application Guidelines for Advertising Signs’.

Above  This research will be conducted in the new CMARC-ARRB Driving Simulator

C-MARC Team News

Dr Brad Gibson—Research Fellow

Brad completed an Honours degree in aerospace engineering at The University of Adelaide in 2007, and a PhD in mechanical engineering at The University of Adelaide in 2012. Prior to moving to Perth in 2014, Brad worked in the automotive manufacturing industry. As a design engineer, Brad contributed to the design, development, manufacture, and testing of safety critical rear vision mirror and external lighting components incorporating commercialised technology developed in-conjunction with the CRC for Advanced Automotive Technology. Brad is excited to join the multi-disciplinary team at C-MARC and to use his skills, experience, and lifelong interest in transportation to help make road use safer for all.

Publications

Meuleners L, Fraser M, Govorko M, Stevenson M. Determinants of the occupational environment and heavy vehicle crashes in Western Australia: A Case Control Study. Accident Analysis & Prevention 2016. (Epub ahead of print)

C-MARC is a West Australian based independent multi-disciplinary road safety research centre established by the West Australian State Government’s Office of Road Safety in 2009.

The Centre represents a significant partnership between the Office of Road Safety (now the Road Safety Commission), Curtin University and Monash University’s Accident Research Centre (MUARC).

C-MARC’s mission is “to be a Centre of excellence in road and other injury research and the translation of that research into policy and practice that will inform government, industry and the wider community.”