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Submission to National Transport Commission in Response to Issues Paper

Developing Technology-Neutral Road Rules for Driver Distraction

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Introduction

The National Transport Commission is reviewing Australian road regulations to establish whether there is a better way to regulate general factors that cause driver distraction and the safe use of technology devices and recommend what changes, if any, should be made to the Australian Road Rules.

An Issues Paper (Developing technology – neutral road rules for driver distraction), released by the NTC in December 2018, provides an overview of the problem, current road rules applicable to driver distraction and seeks to identify the key issues to establish the appropriate case for action ahead of developing potential solutions.

The NTC has sought feedback on the Issues Paper to enure that it has identified the relevant regulatory frameworks and captured all of the key issues. In particular, the NTC posed 10 questions for which specific comment was requested from individuals and organisations.

This submission, submitted by the Research Centre for Integrated Transport Innovation (rCITI) at the UNSW, Sydney, is provided to the NTC in response to it's request for feedback on the Issues Paper. It provides feedback on each of the 10 questions listed for comment in the NTC's Issues Paper, along with some additional feedback.

The submission was prepared primarily by Professor Michael (Mike) Regan, who is currently Professor–Human Factors with the Research Centre for Integrated Transport Innovation (rCITI) within the School of Civil Engineering and Environmental Engineering at the UNSW, Sydney. Mike is a recognised world expert on driver distraction and inattention, and brings to the submission the following credentials:

- author/co-author of more than 100 peer-reviewed journal articles, books, book chapters, refereed conference papers and reports on the topic
- senior editor and co-author of two published books on driver distraction and inattention:
    - Regan, Lee and Young, 2009, "Driver Distraction: Theory, Effects and Mitigation" - CRC Press
    - Regan, Lee and Victor, 2013, "Driver Distraction and Inattention: Advances in Research and Countermeasures" - Ashgate
- sits on/has sat on several local and international expert committees on driver distraction and inattention, including:
    - Member - International Organization for Standardisation Technical Committee 22, SC13, which develops among other things standards for the assessment and minimization of driver distraction;
    - Member - US Association for the Advancement of Automotive Medicine Expert Panel on Distracted Driving
    - Member - USA-EU Bilateral Expert Group on Driver Distraction
    - Member - USA-EU Bilateral Expert Group on Cognitive Load
    - Member - NTC Working Group on Driver Distraction
    - Expert Advisor - Australian Road Rules Maintenance Group

- co-creator and co-convenor of the biannual international conference series titled "International Conference on Driver Distraction and Inattention (DDI), which has been

held 6 times in Sweden, France and Australia
- created the driver distraction research program for General Motors Holden
- has written major submissions to two Australian government inquiries into driver distraction (in Victoria and NSW)
- has been an expert witness in several court cases concerning distraction from roadside advertising signage
- has led many distraction-related projects for a wide range of local and international clients

Disclaimer:

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1 Responses to Questions in NTC Issues Paper

1.1 Question 1: Does the proposed definition include all the key functions required to safely perform the driving task.

The list of driving functions proposed by Brown (1986) is preferred. In our opinion, they better encompass, at a functional level, the hundreds of tasks required for driving (identified by McKnight and Adams, 1970).

The list proposed by the NTC is missing two critical driving functions identified by Brown (1986): avoiding collisions and vehicle monitoring. The NTC's list, by excluding the former, excludes the very functional activity most critical for safe driving; and does not, hence, encompass the many skills required to avoid collisions.

Vehicle monitoring is a significant omission. It will become a significantly more important driving function as vehicles become more automated and drivers of partially automated vehicles (especially SAE Level 3, if they are commercially deployed) are required to spend more time monitoring the status of vehicle automation.

The list proposed by the NTC contains some functions additional to Brown's (1986) functions that seem redundant with reference to Brown's (1986) taxonomy: lateral motion control (subsumed by route following); longitudinal motion control (subsumed by velocity control); monitoring the driving environment (subsumed by several of Brown's functions); manoeuvre planning (subsumed by several of Brown's functions); responding to objects and events (subsumed by several of Brown's functions); and making road users aware of the driver's presence (subsumed by avoiding collisions).

1.2 Question 2. Does the proposed definition capture all the behaviours that lead to driver distraction and a reduction in driving performance?

Use of this definition is not supported for this project for 2 main reasons:

a. The NTC points out in the Discussion Paper (p.11) the consequences of having inconsistent definitions for driver distraction; yet, in their document, they propose yet another one.
b. A definition of driver distraction should be parsimonious. It should not seek to capture all the behaviours that lead to driver distraction and a reduction in driving performance. It should define what is meant by the construct itself.

The following two definitions are highly cited in the literature. Both have been endorsed by separate international expert committees convened to agree on a consistent definition of driver distraction.

(1) "Driver distraction is the diversion of attention away from activities critical for safe driving toward a competing activity" (Lee, Young and Regan, 2009) – endorsed by the USA-EU Expert Focus Group on Driver Distraction, in 2010 in Berlin, of which Michael Regan was a member.

(2) "Driver distraction is the diversion of attention away from activities critical for safe driving toward a competing activity, which may result in insufficient or no attention to activities critical for safe driving" (Regan, Hallett and Gordon, 2011) – endorsed by the International Driver Metrics Workshop.

The following definition has been relatively less cited:

(3) "Driver distraction "…refers to situations where the driver allocates resources to a non-safety critical activity while the resources allocated to activities critical for safe driving do not match the demands of these activities." (Engstrom et al, 2013, p. 35) – endorsed by the US-EU Driver Distraction and HMI Working Group, of which Michael Regan was a member.

The second definition is recommended, as it:

(a) has been endorsed by an international group of experts
(b) links distraction with inattention; Regan, Hallett and Gordon (2011) define inattention as " insufficient or no attention to activities critical for safe driving" (p. 1775)
(c) assumes (unlike the NTC definition) that a competing activity that distracts may be driving- or non-driving-related
(d) is a more workable, operational, definition than the third definition

The NTC definition makes reference to visual, manual, auditory and cognitive distraction.

Whilst these terms are often used in the literature, use of them is imprecise. Regan and Hallett (2011) have distinguished between six different "types" of distraction which differ according to the sensory modality via which a diversion of attention toward a competing activity is initiated (p. 279):

- visual distraction – the diversion of attention toward things we see (e.g. advertising signage)
- auditory distraction – the diversion of atttention toward things we hear (e.g. a crying child)
- olfactory distraction – the diversion of attention toward things we smell (e.g. engine fumes)
- gustatory distraction - the diversion of attention toward things we taste (e.g. a rotten apple)
- tactile distraction - the diversion of attention toward things we feel (e.g. a spider crawling on our leg while driving)
- cognitive distraction - the diversion of attention toward things we think about (e.g. the content of advertising signage we just saw).

Each type of distraction can result in a driver taking their eyes off the road, their mind off the road, or one or both hands off the steering wheel; or in all three of these behaviours. It is these behaviours, arising from distraction, which have potential to interfere with the performance of activities critical for safe driving, and degrade driving performance and safety.

We contend that “manual distraction”, as defined on p13 of the NTC document, is not a “type” of distraction. This term is used often to refer to “distraction” that comes about when a driver takes one hand of the wheel to hold, handle or manipulate something within the vehicle (e.g. a cell phone). However, we would regard “manual distraction” as a form of bimanual, or structural, interference (McLeod, 1977) that is a consequence of, not a type of, distraction (Regan & Horrey, 2019).

1.3 Question 3. How could a distinction between manageable and unmanageable levels of driver distraction be used to inform the way distraction is regulated? What evidence-based distinctions could be considered?

There is currently no conensus within the international distraction community about what levels of distraction deriving from the diversion of attention toward a competing activity (driving or non-driving related) are “manageable” or “unmanageable”.

1.3.1 Theory

Generally, the degree of interference with driving generated by drivers engaging in a competing activity will be a function of three factors:

(1) the joint demand of driving and the competing activity

(2) the degree to which both activities compete for access to common mental and physical processing resources and

(3) the manner in which the driver’s attention is distributed between both activities to meet their joint demands (Regan and Horrey, 2019).

Thus, a casual mobile phone conversation (relatively low in demand) that occurs on a quiet stretch of road (relatively low in demand) that is auditory-vocal (and hence competes minimally with the predominantly visual-manual processing resources required by driving) carried out by a driver that is able to distribute their attention between the tasks in a way that allows their joint demands to be met, might be said to be “manageable”. In most so-called “naturalistic driving studies”, it is found that mobile phone conversation in the real world (using a hand-held or hands-free phone) does not significantly increase crash risk (e.g. Klauer et al., 2006). It might be reasonable to assume, therefore, that the level of distraction from this activity is “manageable”, at least for fully licensed drivers; although there is consistent evidence from simulator studies that mobile phone conversation degrades driving performance (Caird et al., 2018) and one recent naturalistic driving study (Dingus et al., 2016) that found a 2.2 times increase in crash risk associated with conversation on a hand-held phone (although this findings directly contradicts findings from earlier NDSs that found no significant increase in crash risk for this activity).

On the other hand, texting on a hand-held mobile (relatively high in demand) that occurs on a busy stretch of road (relatively high in demand) that is visual-manual (and hence competes maximally with the predominantly visual-manual processing resources required by driving) carried out by a driver that is unable to distribute their attention between the tasks in a way that allows their joint demands to be met, might be said to be “unmanageable”. In naturalistic driving studies, it is universally found that texting in the real world (using a hand-held phone) significantly increases crash risk – by around 6 times (Dingus et al., 2016).

1.3.2 Human-machine interface design guidelines

Numerous guidelines have been developed to help engineers and others to design the human-machine interface (HMI) for vehicle information, entertainment, communication, advanced driver assistance and automated vehicle systems to enhance usability and safety. These have been reviewed by Green (2009) and Cunningham, Regan & Imants (2017), and many contain principles for the design of the HMI to minimise distraction.

The Alliance of Automobile Manufacturers (AAM; 2006), for example, has issued voluntary design guidelines that contain one principle, in particular (Principle 2.1), that addresses distraction. It states “Systems with visual displays should be designed such that the driver can complete the desired task with sequential glances that are brief enough not to adversely affect driving”. There are two alternative methods for verifying this principle (Green, 2009): (a) the 85^{th} percentile of single glance durations should not exceed 2 secs, and the total glance time for a task should not exceed 20 secs; and (b) the number of lane departures does not exceed the number of reference task, such as radio tuning (and at the same time, car following headway should not degrade).

There is some debate within the scientific community about what the percentile criteria for these glance time metrics should be, and what the absolute value for total glance time should be (Green, 2009). There is also some debate in the literature about the use of radio tuning as a reference task. Tuning a radio to find a radio station is a secondary task allowed under the current road rules and has been used, as noted, by some vehicle manufacturers and others as a reference task to set an upper bound on the acceptable demand of interactions with secondary tasks. However, there is now converging evidence that tuning a radio to find a radio station increases crash risk by 1.9 times (e.g. Dingus et al, 2016) and results in glance patterns that produce 2.85 - 5.00 times more crashes than baseline driving (Lee et al., 2017)

It is beyond the scope of this submission to review the various criteria contained in the various guidelines, and their validity as criteria. The point made here is that there exist design principles in a variety of guidelines for the design of the HMI through which drivers perform secondary tasks designed to limit levels of distraction to levels considered manageable by industry, often in consultation with governments. These have implications for the regulation of HMI design (to set an upper bound on permissible levels of distraction) and for the regulation of driver interactions with secondary activities in vehicles (e.g., in prohibiting total glance time for completion of a task; which may be enforceable in future with the advent of driver state monitoring technologies; see a later section of this submission).

1.3.3 Data from Naturalistic Driving Studies

As noted elsewhere in this submission, the recent study by Dingus and his colleagues (Dingus et al., 2016), reports odds ratios (indicative of changes in crash risk) for driver engagement in various activities secondary to driving. These include secondary activities involving interaction with technologies, and everyday activities involving no interaction with technology (e.g. grooming). Secondary task interactions that can be considered most risky are those with high odds ratios (indicative of increased risk) and high population risk percentages (PRPs; indicative of a high degree of exposure to those interactions). These are discussed in a separate section of this submission. Naturalistic driving studies provide another source of data that can be used, from a regulatory perspective, to determine which interactions constitute manageable and unmanageable levels of distraction; and, hence, which might be prohibited while driving.

There is converging evidence from naturalistic driving studies (e.g., Klauer et al., 2006) that eye glances away from the forward roadway of more than 2 seconds, or a total of 2 seconds in a 6-second time window, are associated with a 2.2 times increase in crash/near-crash risk compared to normal (baseline) driving. Crash risk increases the longer the drivers’ eyes are off the road. An unmanageable level of visual distraction might be considered, therefore, as that which results from driver eye glances away from the forward roadway that last for 2 seconds or longer.

1.3.4 Driving Simulator Studies

A huge number of simulator studies have been conducted to assess the impact of distraction on driver behaviour and driving performance (see Bruyas, 2013, for a review). These have yielded important information on characteristic changes in vehicle behaviour that occur when drivers are visually distracted, cognitively distracted and use one or both hands to manipulate objects in the vehicle. These characteristic changes in vehicle behaviour may be thought of as providing “distraction signatures” that could be used by Police to detect the presence of distraction in enforcing laws under a performance-based legal regime.

1.4 Question 4. Should conventional and technology-based causes of distraction be treated equally in the Australia Road Rules? Why?

1.4.1 Sources of distraction

To address this question, it is important to understand first the various sources of driver distraction that are known to exist.

There are many different sources of distraction in vehicles, and external to the vehicle, that have been identified in crashes and near-crashes. They include (Regan, Young, Lee and Gordon, 2009):

- "things brought into the vehicle" – defined as "portable objects, devices and living things brought into the vehicle" (p. 256), e.g., mobile phone, animal, document, drink
- "external objects, events or activities" – defined as "objects, events, or activities outside the vehicle that have the potential to distract the driver or the driver is paying attention to" (p. 262), e.g., billboards, crash scene, landmark
- "vehicle systems" – defined as "displays, control, objects and devices already built into the vehicle with which the driver interacts" (p. 258), e.g., CD, radio, heater, sun visor
- "vehicle occupants" – defined as "vehicle occupants other than the driver with whom the driver interacts" (p. 259), e.g. adult, young adult, child, infant
- "moving object or animal in vehicle" – defined as stationary objects or animals that suddenly move in the vehicle due to hard braking, acceleration, or turning because they have been dropped by the driver or other occupant" (p. 260), e.g. insect, animal
- "internalised activity" – defined as driver behaviour that has the potential to distract the driver that involves no overt interaction with an object, event or activity" (p. 261), e.g. coughing, daydreaming or lost in thought, itching, praying, singing.

1.4.2 Sources amenable to regulation

It is also important to consider which of these known sources of distraction might be amenable to regulation and other injury countermeasures. For each of these general sources of distraction, Regan et al (2009) estimated the proportions of sources within each category that might be avoidable:

- Things brought into the vehicle – 92% (e.g. animal, drink)
- Vehicle systems – 67% (e.g. entertainment system)
- Vehicle occupants – 33% (e.g. ban on passenger carriage for young drivers)
- Moving object in vehicle (e.g. animal) – 50%
- Internalised activity (e.g. praying) – 56%
- External objects, events and activities – 31%

Overall, Regan et al (2009) estimated that around 55% of known sources of distraction falling within the general categories above are avoidable, and that it would seem reasonable to focus countermeasure development effort on avoidable sources of distraction deriving from within the vehicle, given the greater difficulties in avoiding sources of distraction external to the vehicle; with the possible exception, perhaps, of advertising signage.

1.4.3 Crash risk associated with driver interaction with different sources of distraction

To address this question, it is also important to consider the degree of risk brought about by driver interaction with these sources of distraction. From a safety perspective, Road Rules should focus on driver interactions with sources of distraction that are known to be most risky, regardless of whether the source of distraction is a piece of technology or some other source.

Risk from distraction is a function of both the degree of interference with driving brought about by driver interaction with a source of distraction, as well as the degree of exposure to the interference. In this respect, naturalistic driving studies provide important data on the relative risks associated with driver interaction with various sources of distraction, although there is some debate in the literature about the manner and consistency with which risk estimates are calculated across these studies (e.g., Young, 2012). The recent paper by Dingus et al (2016), reporting on the findings of the world's largest NDS (the Strategic Highway Research Program [SHRP 2] NDS), involving more than 3,500 drivers and 905 crashes, contains odds ratios for driver interactions deriving from various sources. These findings would seem to provide the most comprehensive guidance yet as to the relative risks associated driver interactions with technology and other sources of distraction.

In this study, as in previous NDSs, there was strong evidence that driver interactions with sources of distraction that take their eyes away from the forward roadway are associated with significant increases in crash risk. The highest increases in risk reported in the study were for dialling a hand-held phone (OR = 12.2), reading/writing (OR = 9.9), reaching for a non-cell phone object (OR= 9.1), extended glance durations to external objects (OR =7.1), texting on a hand-held phone (OR= 6.1), reaching for a hand-held cell phone (OR=4.8) and interacting with in-vehicle devices (OR= 2.5).

Dingus et al (2016) noted that, whilst the increased risk overall of interacting with a hand-held cell phone (3.6 times greater than that for baseline driving) was less than that for some other interactions, the relatively high prevalence of this activity (drivers spent 6.4% of their time interacting with a hand-held phone) "..makes hand-held cell phone use of particular concern" (p. 2640).

Evidence for the role of cognitive distraction in increasing crash risk has been less conclusive. With the exception of the Dingus et al (2016) study, in which it was found that conversing on a hand-held mobile phone increased crash risk by 2.2 times, no other study known to us has reported an increase in crash risk associated with driver engagement in primarily cognitive secondary activities that do not place overt visual-manual demands on the driver. A very recent study, about to be published (Dingus et al., 2019; in press), reports on further analysis of data from a sample of 3,454 drivers collected during the SHRP 2 NDS. The study includes an analysis of the prevalence of drivers' engagement in primarily cognitive activities. Collectively, the findings from this study suggest that primarily cognitive secondary tasks are not associated with an increased odds ratio relative to all driving, but are associated with a significantly increased odds ratio relative to "model driving", in which drivers are apparently alert, attentive and sober. Conversing on a hands-free cell phone was not, in this study, associated with an increased odds ratio. The discrepancy between this finding, and that reported for hand-held mobile phone conversation in the Dingus (2016) study, is not yet clear.

Overall, these findings, and generally convergent findings from other NDSs, suggest that the current emphasis in the Australian Road Rules on visual-manual driver interactions with technology are supported - based on the relatively high ORs associated with these interactions, and the high prevalence of these activities reported in both NDSs and self-report surveys. More generally, there is strong evidence from NDSs that driver interactions with sources of distraction that take their eyes away from the forward roadway are associated with the most significant increases in crash risk.

1.5 Question 5. Can you provide examples of effective non-regulatory approaches to driver distraction that assist drivers to regulate their behaviour in a dynamic driving environment?

There is some evidence that, by self-regulating (i.e. anticipating and compensating for the effects of distraction) some drivers can prevent or minimise distraction; at least for sources of distraction over which they have some control (e.g., Wandtner et al. 2016; Ismaeel, Hibberd & Carsten, 2018).

Ismaeel et al. (2018), for example, analysed naturalistic driving data from the European UDRIVE NDS. They examined the prevalence of secondary task engagement at intersections and how drivers self-regulate to manage such engagements according to the complexity of driving situations. They found that:

- one-third of the total intersection time was allocated to secondary activities and that greater driver engagement with secondary tasks occurred upstream and downstream of intersections
- drivers engaged more frequently in secondary activities when their vehicles were stationary than when the vehicles were moving
- elderly drivers were less likely to engage in secondary activities than younger drivers
- drivers were less likely to engage in secondary tasks when they did not have priority than when they had priority
- drivers were less likely to engage in secondary tasks at intersections managed through traffic signs than in those controlled by traffic signals.

While these and other findings on this topic provide information that could be used to develop driver training/education and awareness programmes on managing distraction (Ismaeel et al, 2018), we are not aware of any education or training programs that have, to date, been developed for this purpose. Nor have we seen any research evidence that proves that failures to self-regulate in response to, or in anticipation of distraction, result in crashes; which is the kind of evidence normally needed by road authorities to justify the need for education and training in self-regulation. The fact that there is evidence that some drivers self-regulate to manage distraction, on the one hand, but converging evidence on the other hand that distraction is a contributing factor in crashes (in 68% of the crashes, for example, in the Dingus et al., 2016 study), suggests that self-regulation, even when it occurs, is not always effective in managing distraction (Young, Regan & Lee, 2009).

1.6 Question 6. Can you provide examples of strategies successfully implemented by other international jurisdictions and industries (for example aviation) that could be applicable to driver distraction?

1.6.1 European Commission

The European Commission funded a comprehensive, evidence-based, review of driver distraction (European Commission, 2015). It concluded that driver distraction is a contributing factor in between 10 to 30 percent of all crashes across Europe, and recommended that a number of "best practice' approaches be used by EU states in their efforts to reduce the road injury burden of distraction. The following were recommended:

1. Adopt a standard definition of distraction, and approach to coding distraction in collisions, for use across jurisdictions, to make it possible to quantify the extent of the problem.

2. Standardise data to be collected on distraction in crash databases across jurisdictions (utilising the definition above as their basis) so that comparisons across State and Territories can be made on the basis of the same underlying factors.

3. Legislation, certification, public awareness campaigns and education during the licensing acquisition process (as well as for professional drivers) were seen as the most effective non-technology-based approaches.

4. The most promising technologies recommended to prevent or minimise distraction were voice recognition, biometry, head-up displays, artificial intelligence, and vehicle automation.

5. Standardised HMI design (for technologies) to minimise distraction should be incentivised, and test protocols developed to assess the distractibility of systems and devices in new vehicles as part of new vehicle testing programs.

6. Stimulate the uptake of technologies that operate far in advance of collisions (distraction prevention measures such as phone blocking systems and distraction mitigation measures such as distraction warning systems)

7. Stimulate the uptake of Collision warning systems (forward collision warning and lane departure warning), as these would prevent or mitigate distraction-related collisions, score highly on safety impact and user acceptance, and are relatively mature technologies.

8. Encourage development of a standard interface for secure mounting and powering of mobile phones and other nomadic devices on a central position of vehicle dashboards to limit distractions caused by sliding and dropping devices and entanglement of power cords.

9. Provide incentives for local developers of automotive apps to develop safer, less distracting apps.

10. Support further research into various aspects of road user distraction, to broaden the scientific evidence base for policies to combat distraction. The following were identified as the top ten research priorities:

- Voice recognition: How should such systems be designed?

- Night vision: Can such systems present extra information to drivers in such a way as to alert the driver to potential risks, but without being too distracting?
- Biometry: Can systems spot inattention quickly enough to permit useful intervention or alerts? Can they be reliably enough to avoid drivers wanting to turn the systems off (e.g. false alarms)?
- Legislation of usage conditions: How should legislation be designed and worded with the pace of technology development (e.g. new input and output modes) being so quick?
- Public information campaigns: What is needed in such campaigns beyond the provision of information? How can behavioural change techniques help?
- Auditory/vocal (cognitive) distraction and how it relates to driver performance and crash risk.
- Sociological aspects of distraction: What makes drivers willing to take part in distraction activities? How do social norms play a role? Does the need for ‘connectedness outweigh risks in the perception of drivers?
- Views of young drivers on driving and distraction: What makes young drivers particularly susceptible to distraction by devices? Which sub-groups of young drivers are particularly at risk?
- Effects of countermeasures: Which countermeasures can be shown to really work? What are the relative benefits of enforcement approaches? Can behaviour change approaches work to reduce exposure to distraction?
- Pedestrian distraction studies: What is the exposure of pedestrians to distraction? What behaviours other than crossing the road are affected? How does the increased risk for pedestrians (per unit of travel) compare with that of other road users?
- Distraction/alertness in the transition to automated driving: How long do people need to move from a distracting task to taking over control of an automated vehicle? What are the best ways of alerting drivers in this situation?
- Self-regulation of road users and good driving behaviour: Does behavioural adaptation (e.g. reduced speed) actually reduce risk for some distracting tasks? What are the distraction tasks that cannot benefit from behavioural adaptation?
- Future trends and challenges in distraction: Does the ageing population represent an increased distraction risk? Will ‘wearable technology’ improve the situation or make things worse?
- New vehicles and distraction: Will new vehicles with different behavioural profiles (e.g. electric bicycles with higher speeds) reduce distraction-related safety margins?
- Business models and eco systems of new distraction-preventing technologies: How can countermeasures be built into the business case? Who will pay for distraction-reducing technologies?

It was concluded in the report that a technology-neutral approach to legislation on road user distraction is desirable, and possible, noting that Sweden had, at the time the report was prepared, technology-neutral legislation on driver distraction – on the basis of research showing that bans on mobile phone use seem to have little effect on crash risk. No information was provided in the report, however, on whether the Swedish approach has been more successful than other approaches in reducing crashes linked to distraction.

1.6.2 Commercial Aviation

The aviation industry has been active in developing countermeasures for preventing and mitigating the impact of interruptions and distraction on commercial flight decks. The Flight Safety Foundation (FSF), for example, has issued a comprehensive Briefing Note for flight crew on Managing Interruptions and Distractions (Flight Safety Foundation, 2018). The Briefing Note identifies factors involved in interruptions and distractions, the effects on flight safety of interruptions or distractions, guidance on reducing interruptions and distractions (general strategies, good rules to follow, specific approaches for each of the major contributing factors), and managing and mitigation interruptions and distractions. The section entitled "Good Rules to Follow", for example, contains the following guidance:

- "Adhere to the Sterile Cockpit Rule (U.S. FAR - Part 121.542) as an integral part of SOPs because it has the potential to reduce interruptions and distractions. The Sterile Cockpit Rule limits unnecessary conversations and communications during taxi, takeoff, landing and below 10,000 feet
- Include the Sterile Cockpit Rule in pre-flight briefings and in Crew Resource Management training with the cabin crew
- Avoid the most frequent causes of interruptions and distractions including:
    - Non-flight-related conversations
    - Distractions by cabin crewmembers
    - Non-flight-related radio calls
    - Non-essential public-address (PA) announcements."

We are unaware of any research, however, that has been undertaken to evaluate the effectiveness of the prevention and mitigation strategies contained in the FSF Briefing Note.

1.7 Question 7. Are there other parties besides the vehicle driver who can influence the risk of driver distraction? If so, are there mechanisms to ensure those parties are doing all that is reasonably practicable to ensure safety.

The management of distraction is a shared responsibility, and there are many parties responsible for the management of road safety, directly and indirectly, who have potential to influence the factors that give rise to distraction and the impact it has on driver performance and safety.

The notion that there are other parties besides the vehicle driver who can influence the risk of driver distraction is not new. The book by Regan, Lee and Young (2009), for example, has 4 chapters devoted to countermeasures for preventing and mitigation distraction (relating to data collection, legislation and enforcement, vehicle fleet management, driver licensing, education and training, vehicle design, technology design and road design) that require for their design and implementation multiple stakeholders, including road authorities, regulatory bodies, Police, company fleet managers, driving instructors, supervising drivers, vehicle designers, technology developers, phone app developers, traffic engineers and policy makers.

More recently, there have emerged in the literature several research papers that have utilised human factors methods to model the road transport system as a sociotechnical system, and identify within the system the parties and entities responsible for managing distraction, their roles, and the critical interactions between the parties that serve to undermine or enhance the management of distraction as a road safety issue (e.g., Young & Salmon, 2015; Parnell et al, 2019).

There are no mechanisms we aware of that currently exist to ensure these various parties are doing, in any coordinated way, all that is reasonably practicable to manage driver distraction as a safety issue. Apart from the normal governance arrangements that exist in Australia for managing road safety, the NTC's Distraction Working Group is the only group we are aware of that currently exists to bring together the various parties responsible for the management of driver distraction in this country. The National Road Partnership Program (NRSPP), led by the Australian Road Research Board (ARRB) is another initiative that brought together multiple stakeholders to produce a well-considered document that provides practical guidance to companies on how to manage the risks of distraction from mobile phones (NRSPP, 2016).

Notable, and of significant relevance to NTC's deliberations, is that no jurisdiction, to our knowledge, has ever evaluated the effectiveness of the existing ARRs on driver distraction. Whilst the NTC is to be commended for reviewing the existing legislation, the review is being undertaken without any supporting research data on the effectiveness or otherwise of the existing legislation. We do not currently know whether the legislation we currently have in place to manage distraction is effective, or not.

1.8 Question 8. Can you provide examples of effective strategies for ensuring that new in-vehicle technology and mobile apps minimise driver distraction?

Evidence-based strategies that are likely to be effective were listed under Question 6 above.

1.9 Question 9. Can you provide examples of strategies to ensure that users of partially automated vehicles are fully informed about their responsibilities, and the limitations of their vehicle's technology?

The UNSW Research Centre for Integrated Transport Innovation (rCITI) has been commissioned by Austroads to undertake Project CAV 6138 - Feasibility of Integrating Advanced Driver Assistance Systems in Driver Education.

New technologies have emerged which perform or augment some or all of the functional activities performed traditionally by human drivers (e.g., route finding, route following, velocity control, crash avoidance, adherence to traffic laws, and vehicle monitoring). These include so-called Advanced Driver Assistance Systems (ADAS; e.g. Adapative Cruise Control) and Automated Driving Features (ADF; e.g., Traffic Jam Assist).

Partially automated vehicles, in which only some of the functional activities performed by human drivers are automated, require drivers to supervise the automation that is in operation, perform the remaining functional activities described above, and be ready and able to take back control of the vehicle if the automation fails or is incapable of operating within the traffic enviornment. In fully automated vehicles, passengers have no control over the vehicle. However, it is possible, in future, that such vehicles may be designed by manufacturers to allow them to be driven manually from time to time.

With increasing automation, the driving functions and tasks performed by drivers will change, as will the repertoire of skills required by drivers to maintain safe driving performance. Drivers will be involved less in controlling the vehicle, and involved more in monitoring the driving environment, supervising the automation, and transitioning to and from control of the vehicle. Education and training may need to be designed to facilitate the development of attitudes, skills (cognitive and behavioural) as well as knowledge needed to perform these functions and tasks.

The objectives of Austroads Project CAV 6138 are to examine what role, if any, registration and licensing authorities in Australia and New Zealand should undertake to ensure that licence applicants are competent in the use of ADAS and emerging automated driving features and whether or not there is a need to review the current driver licensing framework to address gaps (perceived or real) in driver competency when operating a vehicle equipped with ADAS and automated driving features. It will consider also roles that other stakeholders might play in the provision of education and training.

The project involves the following key activities:

1. *A literature review and web searc*h – to identify and review what ADAS and automated driving features exist, the skills and knowledge required to operate them, and who is currently doing what in terms of providing drivers with education, training and testing in the safe use of automated vehicles. This has been completed.
2. *Stakeholder consultations* – to discuss the findings of the literature review, extract any further information available on the above issues, and identify gaps and current strategies within R&L agencies to integrate ADAS in driver education and training. These have commenced, and included a consultation with the NTC.

3. *Training Needs Analysis* - to systematically determine the skill sets required to operate ADAS and automated driving features, identify the extent to which the user population lacks these skill sets and formulate learning and assessment strategies to close the gap
4. Assessment of key issues – to highlight areas where Registration and Licensing Authority actions may be required to improve education about ADAS and automated driving features and operation of conditionally automated vehicles.

The following is a summary of key findings that emerged from the literature review and web search, completed for Austroads by rCITI in January 2019, which are relevant to the question raised by the NTC:

- control of automated vehicles will in future require a different set of driving skills than that needed to operate contemporary vehicles, and those skills that are likely to be required were identified.
- While there exist a wide variety of SAE Level 2 ADAS on the market, only a limited number of automated driving features (Level 3) are currently available.
- Consumers, both nationally and internationally, have high levels of awareness of the existence of various ADAS technologies.
- Knowledge around the limitations of these systems by consumers is limited, however, with education and training required specifically into these limitations in order to avoid a mismatch between expectations and outcomes.
- The most commonly expressed preference by consumers for receiving training is through the dealership, both at point of sale and delivery.
- Research has shown, however, that dealerships often provide limited, inaccurate or incomplete information about ADAS and automated driving features to consumers.
- Whilst there are many modes of information delivery for first vehicle owners, there is no information available online specific to how subsequent vehicle owners acquire information about ADAS or automated driving features.
- High-level written descriptions of ADAS and automated driving features (i.e. what they are, how they function and their intended safety benefits) are available on a variety of registration and licensing, road safety organisation, automotive specialist and vehicle manufacturer websites.
- However, almost no information relating specifically to driver education and/or training in the safe and appropriate use of ADAS and automated driving features was found in the relevant materials of all key road safety organisations, government agencies, motoring clubs, vehicle manufacturers and registration and licensing authorities. This was the case for both light and heavy vehicles.
- There is currently a lack of integration of education and training around ADAS and automated driving features in driver testing programs offered by registration and licensing authorities, both locally and internationally.
- There is however some evidence that, while there may be minimal differences in the impact of different types of training protocols, any type of driver training using these systems prior to driving will improve driving performance and trust compared to no training at all.

1.10 Question 10. What evidence is available in support of a performance-based approach or a prescriptive approach for managing the risks of distraction.

1.10.1 The prescriptive approach

As noted earlier in this submission, the authors are unaware of any attempt that has been made in Australia to evaluate the safety effectiveness of the existing (prescriptive) Australian Road Rules relating to driver distraction. Consequently, we are not aware of any evidence to suggest that Australia's current, prescriptive approach, is effective, or not; and, hence, whether a change to a performance-based approach would even be beneficial from a safety perspective in managing the risks of distraction.

The current emphasis in the Australian Road Rules on preventing driver visual-manual interaction with technology is supported, based on the relatively high odds ratios from naturalistic driving studies associated with these interactions, and the high prevalence of these activities reported in NDSs and self-reported surveys of driver interaction with technology.

Whilst no known studies of the effectiveness of Australia's current prescriptive approach for managing the risks of distraction have been conducted, several studies been undertaken in the US to evaluate the effectiveness of laws there that ban driver use of hand-held cell phones. The findings, however, are equivocal (McCartt, Kidd, & Teoh, 2014).

In some studies, bans on hand-held mobile phone use have resulted in reductions in use immediately after implementation of the laws (e.g., McCartt, Braver & Geary; Johal et al., 2015; Rajalin et al, 2005; McCarrtt & Hellinger, 2007; McCarrtt et al., 2010).

Other studies have found that initial decreases in phone usage have dissipated weeks or months after implementation of the bans (e.g., McCarrtt & Geary, 2004; Hussain et al., 2006).

There is some evidence suggesting that laws prohibiting use of any mobile device by drivers younger than 18 has no effect on subsequent usage rates (Foss et al., 2009; Goodwin et al., 2012).

One study found that bans on phone use had no effect at all on usage rates (eg Goodwin et al., 2012), and another (Burger et al., 2014) found that cell phone bans had no effect in reducing collisions on Californian highways.

Abouk and Adams (2013) found that texting bans were associated with a decrease in fatal crashes initially, but the effect was short lived. Ferdinand et al (2014) found that US states with texting bans had significantly fewer reductions in crash-related fatalities relative to states with no bans. Ferdinand et al (2015) found that texting bans were associated with a 7% decrease in crash-related hopitalisations among drivers aged 22 to 64 years of age, and those aged 65 years and older, with marginal reductions for adolescent drivers.

1.10.2 The performance-based approach

There are some difficulties associated with the current, prescriptive, ARRs relating to driver distraction, which have been raised by the NTC in its Discussion Paper and by others (e.g., King et al., 2017):

- the ARRs do not target all distracted driving behaviours currently known to pose the greatest safety risk
- the ARRs are difficult for Police to enforce
- the distinction in the ARRs between mobile phones and Visual Display Units (VDUs) is artificial, given that modern smart phones may themselves function as VDUs; and VDUs are not, themselves, properly defined in the ARRs
- the ARRs provide exemptions to emergency service and other drivers who may be relatively more vulnerable than the average driver to the effects of distraction in the high speed, high workload, driving situations in which they operate
- driver's aids are not defined in the ARRs and may themselves divert attention away from activities critical for safe driving. There is very little information in the literature on the impact on activities critical for safe driving of driver interaction with drivers' aids
- similarly, workers' aids (e.g. dispatch systems; ticketing machines) are not differentiated from drivers' aids in the ARRs; and nor are they defined. As for drivers' aids, there is very little information in the literature on the impact on activities critical for safe driving of driver interaction with workers' aids
- the ARRs are not very prescriptive with regard to the physical placement in vehicles of cradled mobile phones.

These issues might themselves warrant a shift towards a performance-based approach. However, it is difficult to know at this point in time what the ARRs within such an approach might look like. They might simply take the form of a general road rule for distraction framed in a way that prohibits driver engagement in certain activities. These might relate to specific behaviours known to increase crash risk (e.g. taking ones' eyes off the road for 2 seconds or more), specific secondary activities known from NDS and other research to be associated with the greatest increases in crash risk (e.g. dialing a hand-held phone; reading/writing), specific vehicle behaviours that have been found from simulator research (reviewed by Bruyas, 2013) to be indicative of visual distraction (e.g. lane excursions) or cognitive distraction (e.g. hard braking), and prohibitions relating to specific driver sub-groups (e.g. learner and probationary drivers). Evidence-based exemptions could be granted for certain driving aids (e.g. satellite navigation systems) and working aids (e.g. dispatch systems).

Any future Australian Road Rules for distraction, as for the existing ARRs, should accord with some basic principles (original source unknown):

- **ethical** – improve and not undermine safety
- **data-driven** – discourage the riskiest behaviours based on research evidence
- **appropriate penalties** – should be commensurate with the relative risk associated with the behaviour penalised
- **no loop-holes**
- **justifiable on road safety grounds -** e.g. drivers' and workers' aids?
- **enforceable**
- **in pace with technological developments -** smart phones can be used as a platform for multiple functions

- **evaluated and refined** - what are the safety and other impacts of Australia's current mobile phone laws?
- **recognize that distraction may be involuntary** e.g., when a driver diverts attention involuntarily to an advertising billboard
- **have full support of judges and prosecutors**

A performance-based Road Rule for distraction may be difficult, or impossible, to enforce at this point in time. How would a Police Officer, for example, be able to prove on the spot that a driver had looked away from the forward roadway for 2 seconds or more? The rollout of a performance-based approach to managing the risks of distraction is likely to require the simultaneous rollout of various technologies, existing and under development, that support automated enforcement of the law. So called "driver state monitoring systems", for example, already exist in production vehicles that are capable of detecting for how long and how often a drivers' eyes are off the forward road way. The question, however, is whether the data from these and other vehicle systems could, or should, be used for evidentiary purposes, and how.

2 Closing comments

The current Australian Road Rules focus primarily on prohibiting driver visual-manual interaction with technology; specifically, mobile phones and visual display units. Research evidence suggests that this focus is warranted on safety grounds. The current ARRs do not, however, address the risks posed by some other technologies and by non-driving-related activities known to degrade driving performance and significantly increase crash risk; and nor do they recognise the potential risks that may be posed by interactions with technology that are meant to support drivers and workers to drive/do their work while driving.

The current ARRs are focussed on high risk behaviours brought about by distraction in the vehicle, and not on high risk behaviours emanating from sources of distraction from outside the vehicle – such as digital advertising billboards, which have been shown in several studies to take drivers' eyes off the forward roadway for 2 seconds or longer (Dukic, 2013).

There are some evidence-based criteria available – deriving from naturalistic driving studies, simulator studies and human-machine interface design guidelines - that could be used as the basis for designing performance-based Road Rules. The main difficulty, at present, is determining how any Road Rules that are framed around these criteria might be enforced. The rollout of performance-based Road Rules might have to be contingent, to some extent, on developments in technology that enable automated enforcement of them.

The driving task will continue to evolve as vehicles become increasingly automated. In partially automated vehicles, the frame of reference for distraction will change. In partially automated vehicles, the main activity critical for safe driving will become, with reference to Brown's (1986) taxonomy, *vehicle monitoring* - the requirement to monitor the behaviour of the vehicle and automated subsystems to ensure safe and normal driving is maintained. For drivers who become over-reliant on the technology, and would rather engage in secondary activities whilst the vehicle operates autonomously, the vehicle itself will become a source of distraction.

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