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Distracted driving: Prevalence and motivations

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ABSTRACT

This study is a selective review of recent international literature concerning the prevalence of distracted driving and motivations underpinning this behaviour. Distracted driving data from naturalistic observation, roadside observation, self-report studies and crash data were examined. The reviewed studies suggested that any distraction that takes the driver's eyes from the forward roadway significantly increases the risk of having a crash, as do cognitive distractions, including emotional distress. Consequently, many different types of distracted driving behaviours need to be considered in addition to mobile phone use with other distracted driving behaviours shown to be as prevalent, or more prevalent, than mobile phone use. The literature indicated drivers of all ages continue to engage in distracting behaviours despite their self-reported awareness or perceptions of the associated dangers and their increased crash risk, with the immediate benefits of engaging in a distracted driving behaviour viewed as outweighing the risks. Additionally, some distracted drivers attempt to compensate for their distracted driving behaviour or to conceal their behaviour, which increases their level of distraction and may exacerbate the level of risk (e.g. hiding their mobile phone below the window so it cannot be seen by police). This review highlighted the dangers associated with hands-free phone use while driving, and the risk that laws abolishing only hand-held phone may give drivers a false sense of security when engaging in this behaviour. A number of motivational themes underpinning distracted driving were identified, but these were focused mainly on mobile phone use, which included perceived superiority of one's own driving ability, perceived social norms and obligations to respond to social contact, the importance placed on the contact, efficient use of time, sharing information, behaviours being habitual, and perceived low demand traffic conditions. Further research is needed to understand the motivations underlying a wider array of distracted driving behaviours that are not limited to mobile phone use.

KEYWORDS

Distracted driving, motivations, attitudes, prevalence, crash risk, mobile phone use

Summary

This study was a selective review of recent international literature concerning the prevalence of distracted driving and motivations underpinning this behaviour. In this study, distracted driving was considered a type of driver inattention that involves a diversion of attention away from activities critical for safe driving and towards a competing activity. Distracted driving data from naturalistic observation, roadside observation, self-report studies and crash data were examined.

Data from international studies demonstrated that any distraction that takes the driver's eyes from the forward roadway or minds from the driving task (cognitive distraction, including emotional distress) significantly increases the risk of a crash. Recent naturalistic studies revealed distraction was a factor observed in around 52 to 68% of crashes. A small Australian naturalistic driving study also reported that in 98% of all of the journeys analysed, drivers engaged in at least one potentially distracted driving behaviour. These studies also suggested that many types of distracted driving behaviours increased crash risk to the same extent as, and sometimes greater than, mobile phone use. Other distracted driving behaviours were shown to be as prevalent, or more prevalent, than mobile phone use, depending on which data was examined.

There were large discrepancies between self-reported distracted driving rates and rates observed through naturalistic observation and roadside observational methodology. For instance, while self-reported mobile phone use ranged between 28% and 77% in Australian studies, hand-held phone use was observed in only 0.6% to 3.4% of drivers in an Australian roadside survey. Such disparity could be explained by the methodological differences between the various types of data collection.

The literature indicated drivers of all ages continued to engage in distracting behaviours despite their self-reported awareness or perceptions of the associated dangers and their increased crash risk, with the immediate benefits of engaging in a distracted driving behaviour viewed as outweighing the risks. Additionally, some distracted drivers attempted to compensate for their distracted driving behaviour or to conceal their behaviour, which increases their level of distraction and may exacerbate the level of risk (e.g. hiding their mobile phone below the window so it cannot be seen by police). This review also highlighted the dangers associated with hands-free phone use while driving, and the risk that laws abolishing only hand-held phone may give drivers a false sense of security when engaging in this behaviour.

It appears that a large majority of distracted driving behaviours are engaged in voluntarily and are therefore amenable to change. A number of motivational themes underpinning distracted driving were identified, but these were focused mainly on mobile phone or technology use, which included perceived superiority of one's own driving ability, perceived social norms and obligations to respond to social contact, the importance placed on the contact, efficient use of time, sharing information, behaviours being habitual and perceived low demand traffic conditions. Further research is needed to understand the motivations underlying a wider array of distracted driving behaviours that are not limited to mobile phone use.

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1 Introduction and method

1.1 What is distracted driving?

Distracted driving is commonly described as a type of driver inattention which entails "a diversion of attention away from activities critical for safe driving, towards a competing activity" (Lee, Young & Regan, 2009, p.34). It should be noted that driver distraction has been differentially defined within the research literature, resulting in differences in reported prevalence rates and outcome data between studies and countries (World Health Organization: WHO, 2011). For instance, research undertaken by Beanland, Fitzharris, Young and Lenné (2013) distinguished between 'inattention', which they operationalized as giving insufficient or no attention to a driving task (which could include intoxication and fatigue), compared to a subtype of inattention, namely 'distraction', which they defined as a diversion of attention away from driving activities (e.g., talking to passengers, self-grooming etc.).

The scientific literature has largely focused on driver distraction resulting from mobile phone use, with other forms of distracted driving less well understood (WHO, 2011). Nonetheless, mobile phone use while driving, both hands-free and hand-held, places significant demands on one's cognitive resources, with both types of use purported to present a similar four-fold increase in crash risk resulting from the serious distractions they pose cognitively, visually and physically (National Safety Council, 2012; WHO, 2011). Importantly, however, distraction affected driving also encompasses a wide variety of activities unrelated to mobile phone use which are undertaken while driving and similarly divert one's attention away from the activity of driving. The following is a comprehensive list of additional activities which have been classified in the literature as behaviours that distract driving, although there are likely to be many other activities that also distract drivers (Beanland et al., 2013; Braitman & Braitman, 2017; Dingus et al., 2016; Klauer, Guo, Simons-Morton, Ouimet, Lee, & Dingus, 2014; National Centre for Statistics and Analysis, 2017; Pope, Bell, & Stavrinos, 2017; State Farm, 2016):

- consumption of food and beverages
- talking with passengers
- manual activities- adjusting audio/climate/radio/other controls on dashboard/seat belt/rear view mirror/sun visor
- reading social media
- reading/writing
- watching videos
- accessing the internet to read email or Web content
- use of navigation systems (GPS)
- looking at a paper map
- looking through a bag
- extended glance away from forward roadway/looking at roadside object/sign or person
- reaching for objects in the vehicle
- attending to children/pets in car
- distractions posed by animal/insect
- applying make-up/other self-grooming
- smoking

- Cognitive distractions – taking your mind off the road (lost in thought/daydreaming/emotional distress)

Ultimately, research reveals that undertaking any task secondary to driving makes the primary task of safely driving a vehicle very challenging, thus negatively impacting upon driving performance (WHO, 2011). Furthermore, the need to target distracted driving in South Australia is highlighted by the Bureau of Infrastructure, Transport and Regional Economics' (2018) analysis of predicted fatalities on Australian roads which indicated an upward trend in fatalities commencing from 2016, with a forecasted 20% increase in fatalities by 2030 "as fatalities linked to traffic growth and increased mobile phone use outnumber fatality reductions from road safety measures" should these existing measures remain unchanged (p.4).

1.2 Method

This report was not intended to be a systematic literature review, but a selective review of literature concerning the prevalence of distracted driving and motivations underpinning this behaviour. Hence, the report reviews a sample of recent international literature looking at distracted driving in different data sources (observational, naturalistic and self-report), in order to provide understanding of the motivations maintaining distracted driving and an analysis of any demographic differences. To conduct the literature search, the University of Adelaide library search engine was used. This has the capacity to search multiple online journals, ebook collections and databases simultaneously including Web of Science, ScienceDirect, PsychINFO, PubMed, Medline, Informit, EBSCOhost and Scopus. The search was directed at journal articles, conference papers and technical reports that are written in English and were published from 2008 to the present (May 2018), although focussing mainly on literature published in the last five years. Terms used for the search included distracted driving and driver distraction, together with these terms: prevalence, crashes, vehicles, attitudes and motivations.

2 Summary of the literature

2.1 Distracted driving in crashes

While it is difficult to ascertain confidently the exact impairment that distracted driving poses to driving performance and subsequent crash risk, there is growing evidence both nationally and internationally which indicates that crashes resulting from distracted driving pose a significant road safety problem (Beanland et al., 2013; National Centre for Statistics and Analysis, 2017). This has been highlighted in crash data in the USA, and notably the most recent analysis undertaken by the National Centre for Statistics and Analysis (2017) of crashes occurring in 2015. Data is obtained from the National Highway Traffic Safety Administration's Fatality Analysis Reporting System (FARS: a census of fatal crashes from all States in the USA), the National Automotive Sampling System (NASS) and the General Estimates System (GES; the latter two are generated from police reported crashes). Analysis of the 2015 US data revealed that distracted driving resulted in 3,477 fatal injuries (10% of all fatal injuries), consisting of 61% drivers, 23% vehicle passengers, and 16% non-vehicle occupants (pedestrians, for example). While driver distraction was operationalised in the report as including distraction by a moving object in the car, adjusting vehicle controls, reaching for an object, eating or drinking, smoking, being lost in thought, and, more broadly, 'distraction/inattention' and 'distraction/careless', there was no differentiation in prevalence rates between the types of distractions deemed responsible. The exception to this was driver mobile phone use, which reportedly accounted for 14% of the 3,196 fatal distraction crashes (National Centre for Statistics and Analysis, 2017).

Furthermore, the National Centre for Statistics and Analysis (2017) reported that in 2015 young drivers in the USA (aged 15-19 years) represented the largest proportion of drivers who were fatally injured and reportedly distracted at the time of their involvement in a fatal crash (9% of drivers 15-19 years in fatal crashes). Fatally injured drivers aged 20-29 years were overrepresented in distraction related crashes (27%), when compared to the proportion of drivers killed in fatal crashes overall (24%), and 33% of distraction related crashes were attributed to the driver using a mobile phone. While Pope et al. (2017) similarly found that distracted driving behaviours were most prevalent in younger and middle-aged drivers (with no significant differences in frequency between those age groups), they argued the importance of not discounting that distracted driving behaviours are a phenomenon apparent in all age groups, including older drivers, particularly considering that older people are more recently acclimatising to advances in technology.

Regarding injury crashes in the USA in 2015, data analysed from NASS and GES (generated from police reported crashes) revealed that distracted driving resulted in an estimated 391,000 injuries (16% of all injured people) (National Centre for Statistics and Analysis, 2017). Of these distraction related injury crashes, 8% of these people reportedly sustained injuries owing to mobile phone use while driving. This finding was a consistent pattern over the previous three years of data collection, with an increase from 5% of people injured from crashes resulting from distracted driving attributable to mobile phone use in 2011 (National Centre for Statistics and Analysis, 2017).

The prevalence rates of distracted driving resulting in fatal and injury crashes in Australia are less well understood, as are the motivations underlying personal decisions to drive while distracted. Beanland et al. (2013) examined the prevalence of distracted driving in Victoria from in-depth crash data, including interviews of crash involved participants. Of 340 serious casualty crashes that could be coded using their inattention taxonomy, they found that two thirds of these crashes involved some form of 'driver inattention', which included intoxication, fatigue, and falling asleep while driving, and that 16% of crashes were 'distraction' related. The study indicated that the most common type of driver distraction that preceded a casualty crash were those that occurred inside the vehicle and were

unrelated to driving, such as speaking with passengers, arguing, and attending to small children, with only 0.9% relating to mobile phone use. Further, Beanland et al. found that 70% of the distractions drivers engaged in were assessed to have been voluntary, such that the driver had chosen to undertake the behaviour while they were driving. For example, drivers had chosen to interact with passengers, adjust vehicle systems and use a mobile, which were all behaviours that were therefore potentially preventable, compared to involuntary distractions (such as sneezing or intrusive thoughts when feeling stressed).

Given the varying prevalence rates and operationalisations of distracted driving, an overview of research methodologies is warranted to enhance our understanding of the nature and prevalence of distracted driving and the impact this has on road safety.

2.2 Naturalistic driving studies

Naturalistic methodology uses sophisticated recording systems (video and audio systems and sensors) installed in a vehicle to enable unobtrusive, automatic and continuous observation of driver and passenger behaviour, in the real world and in real time (Dingus, Hanowski, & Klauer, 2011; Dingus et al., 2016; Foss & Goodwin, 2014). Essentially, constant unobtrusive monitoring of the driver over an extended period of time provides precise information on usual driving behaviour and performance as well as in the seconds preceding crashes and near-crash events, thus providing a potential wealth of knowledge on observable driver distractions (Dingus et al., 2016). Some technologies only commence recording when there is a pre-defined instance that triggers this, such as heavy braking, which is referred to as triggered sampling (Foss & Goodwin, 2014). Naturalistic driving footage can also be used to measure the amount of time a driver takes their gaze away from the roadway or attends to a secondary task while driving (Foss & Goodwin, 2014). This data can be observed and coded by multiple researchers to enhance the accuracy of the data coding.

On the negative side, such technology cannot detect all types of cognitive distractions (or cognitive overload) such as daydreaming and thinking intensely or obsessively about a stressor (Beanland et al., 2013; Foss & Goodwin, 2014). Further disadvantages of a naturalistic study include the resource intensive nature of this data collection, with often thousands of hours of footage not yielding any crash data (Beanland et al., 2013), and it has been argued that the presence of recording instruments in the vehicle could unintentionally influence the driver's behaviour typically resulting in an underestimation of distracted driving behaviours (Foss & Goodwin, 2014).

At the time of writing, the Australian Naturalistic Driving Study is being undertaken in New South Wales and Victoria. The sample includes 360 drivers being followed for 4 months. Due to the large amount of data collected, data analysis is expected to take some time and results concerning distracted driving have yet to be published.

A small Australian study examined naturalistic data for 19 experienced adult drivers yielding approximately 24 hours of recorded data over a three week period and found that drivers were more distracted by their interactions with children seated in the rear of the vehicle (12% of the total number of potentially distracting activities engaged in by drivers) than they were by interactions with technology, including mobile phones (2% of all potential distracting activities; Rudin-Brown, Koppel, Clark, & Charlton, 2012). Importantly however, they found that driver interactions with technology resulted in a relatively greater proportion of instances in which the drivers' eyes were taken off the road for more than two seconds while the car was in motion, compared with other distractions. For instance, 40% of interactions with technology (2% of distracting behaviours overall) compared to only 10% of interactions with children resulted in the driver keeping their eyes off the road for more than two seconds while in motion. Furthermore, males were significantly more likely to interact with their

child while driving and to keep their eyes off the road for a longer period of time than females. Overall, at least one potentially distracted driving behaviour was detected in 98% of all of the journeys analysed. For all participants combined, the most prevalent distractions were self-grooming (37%), adjustments made within the vehicle (13%), interactions with children (12%) or the front passenger (9%) and eating and drinking (3%), with another 21% of distractions classified as 'unknown'. Rudin-Brown et al. (2012) cautioned that their data was likely to be an underestimate of the true prevalence of distracted driving because participants were instructed to drive 'safely' and 'legally' and thus may have restrained from engaging in illegal behaviour while being monitored. Similarly, the generalisability of the results was limited given the small sample size and possibly due to volunteer bias (i.e., law abiding drivers may be more likely to volunteer for a study). Nonetheless, the high prevalence of distracted driving behaviour observed in this study is concerning, especially in consideration of the results of the following studies, demonstrating a high prevalence of distracted driving behaviour in real time that preceded 'near' crashes and crashes.

Klauer et al. (2014) undertook an analysis of the data obtained from two naturalistic observational studies undertaken in the USA. Klauer et al. (2014) reported that compared to their baseline risk, novice drivers (n=42, mean age = 16.4 years) were eight times more likely to be involved in a crash or 'near crash' event while dialling a mobile phone, while experienced drivers (n=109, mean age = 36.2 years) were only twice as likely. For experienced drivers, there were no other distracting behaviours that were associated with an increased risk, although the authors noted that the data for this group was collected before the widespread use of texting. Novice drivers also significantly increased their crash risk when distracted by reaching for an object (odds ratio OR=8.0, compared to their baseline risk), texting (OR=3.87), looking at a roadside object (OR=3.90) or eating (OR=2.99). Consequently Klauer et al. (2014) argued that fundamentally any of the tasks that required the driver to take their gaze away from the forward road increased their risk of a crash or a 'near' crash, particularly for novice drivers.

Findings from a landmark large-scale investigation of naturalistic driving data (n=3,542) in the USA examining injury or property damage crashes only (no 'near' crashes) in drivers aged 16-98 years, observed that 52% of the time drivers were distracted from their primary task of driving (Dingus et al., 2016). Importantly, distraction was found to be a factor in 68.3% of the 905 crashes recorded, with the risk of having a crash significantly increased by activities that take the driver's gaze from the forward roadway (Dingus et al., 2016). For instance, the odds increased dramatically when the distraction involved reaching for an object (OR=9.1), dialling a hand-held phone (OR=12.2), texting (OR=6.1), reading/writing (OR=9.9), and extending one's glance to an external object (OR=7.1). Additionally, experiencing observable emotionally elevated mood (sadness, anger, agitation etc.) while driving also significantly increased crash risk (OR=9.8). Interestingly, Dingus et al. (2016) found that interacting with child passengers while driving added a significant protective benefit decreasing the chance of a crash, which they speculated was possibly because parents drive safer when they are transporting their children.

Carney, Harland and McGehee (2018) analysed naturalistic crash data for nearly 15,000 drivers in the USA aged 16-19 years who were recruited through a teenage driving program, in which the participants and their families were provided with weekly web-based feedback on their driving performance. The data may represent an underestimate in distracted driving given that participants were participating to learn safer driving practices and were aware that they were being constantly monitored and would receive feedback on their driving performance. Nonetheless, the data indicated that distracted driving preceded crashes. The in-vehicle monitoring videos recorded for the six seconds preceding each crash was analysed in 2,229 cases to ascertain the driving behaviour prior to the crash. Carney et al. (2018) found that the most common distractions engaged in prior to a crash were: attending to passengers (14.6%), mobile phone use (11.9%), and attending to something inside

the vehicle (10.7%). Moreover, drivers were seen to engage in a potentially distracting behaviour prior to a crash on average 58.5% of the time. Over time, for crashes related to mobile phone use, there was a significant decrease in talking or listening on a phone, coupled with a significant increase in the prevalence of operating or looking at a mobile phone. Unfortunately, the authors reported they were unable to calculate a crash risk because uneventful driving data was not recorded.

Collectively, these studies indicate that drivers are distracted at some point in time during most journeys and that distracted driving precedes crashes 52-68% of the time. Importantly, common distractions were not limited to interactions with technology, with other types of distractions, such as interacting with passengers, reaching for an object and emotional distress (a cognitive distraction) all being common distractions that preceded crashes. Ultimately, any task that takes the driver's gaze from the forward roadway significantly increases one's risk of crashing.

2.3 Roadside observational studies

Observational studies require driver behaviour to be directly observed from the roadside at a point in time as the driver and vehicle move past a specified observation point. While this type of methodology enables a larger sample size to be observed in a relatively shorter period of time than naturalistic observations, it is likely to produce an under-estimate of the frequency of distracted driving. Some drivers may conceal their behaviour below the window or modify their behaviour upon noticing the presence of an observer (Sullman, Prat, & Tasci, 2015). Moreover, the subjectivity of the nature of the data collected, such as age, gender and target behaviours (i.e., is the person talking on a hands-free phone, a hand-held phone in their lap, or singing), may impact the validity of the data, and thus observers must use their best judgement in recording these variables (Sullman et al., 2015). Some ways to enhance the validity of data is through inter-observer reliability analyses, which serve as an important way to check its accuracy, yet this employs the use of two observers. On a positive note, Huisingh, Griffin and McGwin (2015) argue that a methodologically sound roadside observational study is able to yield comparable results to a naturalistic study, but with substantially fewer resources.

Only two observational roadside surveys relating to distracted driving undertaken in Australia could be found, although these were restricted to mobile phone use while driving, in 2006 and 2009 (Young, Rudin-Brown & Lenné, 2010; Wundersitz, 2014). Given advances in technology since these investigations were undertaken, these results on mobile phone use in Australia may now be outdated. Nonetheless, the key findings to take from these large scale investigations in Victoria (n=5,813) and South Australia (n=11,524) were that despite laws restricting hand-held mobile phone use, 0.6% (Wunderstiz, 2014) to 3.4% (Young et al., 2010) of drivers were observed using a hand-held mobile phone. Additionally, Young et al. (2010) observed 1.4% of drivers to be using hands-free phones.

More recently, a roadside observation undertaken in Pennsylvania, USA, in 2014 of 1000 drivers who were stationary and 1000 drivers who were in motion discovered that phone use by the driver was more prevalent when stationary than when in motion (note the authors did not report on the legality of mobile phone use while driving at the time of the study; Bernstein & Bernstein, 2015). When stationary at traffic lights, 14.5% of drivers were observed to manipulate their mobile and 6.3% were observed to talk on their hand-held phone, compared to 3% and 5.5% respectively for those who were in motion. This potentially highlights the need to target driver awareness of the associated risks of withdrawing eyes from the road even when stationary, whereby the driver's awareness of the situation around them is depleted and may hinder an appropriate response to the changing environment, such as an ambulance or a pedestrian approaching (Bernstein & Bernstein, 2015). There were no gender differences observed in the drivers of stationary vehicles (gender was not recorded in moving vehicles due to limited time to observe this), but both the presence of a front-seat passenger and the use of a seatbelt were associated with reduced frequency of phone use.

When a study sought to determine a wider array of potentially distracting behaviours in a large sample of drivers (n=16,556) in varying traffic conditions within Virginia, USA in 2014, 23.4% of drivers overall were engaging in some form of behaviour secondary to driving (Kidd, Tison, Chaudhary, McCartt & Casanova-Powell, 2016). At the time of the study, the law prohibited drivers younger than 19 years from using a mobile when driving and all drivers from writing or reading messages on a hand-held phone except in an emergency. Nonetheless, mobile phone use was the most common behaviour with 5% of drivers holding a phone (but not talking on it or manipulating it) and 4.2% talking on a hand-held phone. Mobile phone use, eating and drinking were significantly more likely among drivers who were travelling alone than among those transporting passengers, whereas when passengers were present, drivers were significantly more likely to be engaging with that passenger than using a mobile phone. Consistent with the Bernstein and Bernstein (2015) study, distracting activities were more likely when stationary in traffic than when moving. The next most common behaviours while driving were eating or drinking (3.1%), verbally interacting with a passenger (2.7%), manipulating a hand-held phone (2.3%), smoking (1.6%), wearing headphones or earbuds (1.3%), wearing Bluetooth device (0.6%), manipulating an in-vehicle system (0.4%) and grooming (0.4%). Older drivers over 60 years of age were least likely to be engaging in potentially distracting behaviours, while all other drivers younger than 60 (perceived to be in the age groups <20 years and 20-59 years) were equally as likely, with no significant differences in distracted driving behaviour. Female drivers were significantly more likely than male drivers to be engaged in any distracting behaviour (Kidd et al., 2016).

Similarly to Bernstein and Bernstein (2015), observational data from England also highlighted an age difference in distracted driving behaviours, with 'middle-aged' (30-50 years) and 'older drivers' (>50 years) significantly less likely to engage in such behaviours than younger drivers (<30 years), with the exception of 'adjusting controls in the vehicle' (Sullman et al., 2015). Of the 10,984 drivers observed in England in 2012, 16.8% were engaged in some form of driver distraction, the most common of which was talking to passengers (8.8%) following by smoking (1.9%), talking on hands-free phone (1.7%) and talking on a hand-held phone (1%). It was noted that hand-held mobile phone use was illegal at the time of this study. Fewer drivers were observed reaching for objects (0.9%), eating (0.8%), texting (0.7%), adjusting controls (0.5%), drinking (0.3%) and reading (0.1%). Of all the distracted driving behaviours observed, the only gender differences were related to males being more likely to talk on, or use, a hand-held phone, or to be consuming a drink, whereas they were less likely to talk to passengers than females (although the number of passengers were not recorded and thus perhaps females carried more passengers). However, there were no gender differences for the overall rate of distracted driving (Sullman et al., 2015).

When drivers were observed in Alabama, USA, where at the time of the study (in 2012) no legal bans were in force restricting mobile phone use while driving, a large proportion of the 3,265 drivers were observed to be talking on their mobile phone (31.4%; a higher prevalence observed in females) or texting/dialling a phone (16.6%) (Huisingh et al., 2015). Overall, 32.7% of drivers were observed to be engaged in a distracted driving behaviour. The most frequently observed behaviour was interacting with a passenger (53.2%), while external vehicle distractions accounted for 20.4% of the driver behaviours (and were more common in males). Younger drivers were observed to have a higher prevalence of distraction than those 30 years and older, with younger drivers more likely to text or dial on a phone and older drivers more likely distracted by something external to the vehicle. Other distractions observed were grooming (5.8%), smoking (5.5%), drinking (3.8%), reaching to another seat (3.2%), eating (3%) and manipulating radio controls (2.4%). Less than 1% of the time drivers were observed to be singing, wearing headphones, interacting with pets, manipulating papers, manipulating mirrors, and writing. Drivers in stationary vehicles were more likely to engage in distracted driving behaviours (53%), but drivers tended to text and dial their phone more when travelling at a speed greater than 50mph (25.8%) when compared to drivers whose vehicles were stationary (19.3%) or driving much slower (ranging from 14.2%-17.9%).

In summary, data from recent international roadside observational studies reveal a wide range of mobile phone use (talking/texting/manipulating phone) while driving ranging from 1.7% where this behaviour was illegal to 48% where this behaviour was not illegal. Furthermore, when a range of distracted driving behaviours was included for observation, drivers were seen to be engaged in an activity secondary to driving 16.8% to 32.7% of the time. The most prevalent of these secondary behaviours observed in the studies reviewed was interacting with a passenger, which occurred from 2.7% to 53.2% of the time.

2.4 Self-report studies

While naturalistic and observational studies clearly indicate a high prevalence of distracted driving practices internationally as well as highlighting the impact of these behaviours on increased crash risk, these research methodologies are unable to capture the motivations underpinning drivers' reasons for engaging in distracted driving behaviours. Self-report studies (i.e., online/telephone surveys, face-to-face/telephone interview, questionnaires, focus groups etc.) explicitly seek to investigate and measure these factors. However, there are inherent limitations to the self-report nature of such data, including that individual reports are likely to be an underestimate of one's actual behaviours, due to social desirability biases, memory biases, and individual concerns regarding the legal implications for disclosing illegal driving behaviours. Additionally, a perception of one's distracted driving practice does not necessarily correlate with actual driving behaviour, nor do individuals necessarily have the self-awareness to report on cognitive distractions (Foss & Goodwin, 2014). Beanland et al. (2013) argue, however, that the validity of surveyed responses may be enhanced by the confidentiality and anonymity explicitly offered by such research methodologies, which is not open to scrutiny and litigation as when reporting crash particulars to the police. Nonetheless, despite the subjective nature of survey data, such data provide important insights into the reported prevalence of, and motivations behind, target behaviours, and thus what may be beneficial to target in measures to reduce distracted driving.

Like observational and naturalistic methodologies, self-report methodologies reported in the literature have largely focused on mobile phone use as the predominant distracted driving behaviour. Interestingly, self-report data reveal a much higher prevalence of mobile phone use while driving than observational or naturalistic studies. Despite the inherent limitations to self-report data, and notable difficulties in comparing data between different states in Australia, there remains an extremely large disparity in the literature between what people are directly observed doing compared to what they anonymously self-report doing. Specifically, an observational roadside study in South Australia observed 0.6% of participants to be using a hand-held mobile phone (Wundersitz, 2014) while data from Australian self-report studies outlined below suggests a much larger prevalence of between 28%-77% having used a mobile at some time while driving (Oviedo-Trespalacios, King, Haque, & Washington, 2017; Waddell and Wiener, 2014; White, Hyde, Walsh & Watson, 2010). Additionally, self-report data demonstrate a high prevalence of reading texts while driving (ranging from 27%-57%) and sending texts while driving (18%-28% of drivers; Oviedo-Trespalacios et al., 2017; Waddell & Wiener, 2014; White et al., 2010). The lower rates recorded for observational studies of distracted behaviour are likely due to observations occurring at one specific point in time at specific locations. Self-report surveys of distracted behaviour tend to ask more general questions concerning behaviour over longer time periods such as "have you ever used a mobile phone".

Waddell and Wiener (2014) used an anonymous online survey to measure self-reported hand-held mobile phone use when driving in an Australian sample of 181 adults aged 18-66 years. This data revealed that while driving, 29% of participants had simultaneously initiated a call on their hand-held mobile phone, 44% had answered a phone call, 28% had sent a text message and 57% had read a text message. Feeling social pressure to respond to a text message or to a phone call was a

significant predictor of engaging in these behaviours, while initiating calls and text messages was not (Waddell & Wiener, 2014).

A Queensland study of 796 drivers aged 17-76 years, found that 77% of drivers self-reported on a questionnaire that at 'some time' while driving they had used a mobile phone (both hand-held and hands-free) to talk or text (White et al., 2010). Daily mobile phone use while driving was reported by 40% of participants (or multiple times per day) and, of these, 43% said that they answered calls, 36% made calls, 27% read text messages, and 18% sent text messages (White et al., 2010). While a minority of participants reported owning a hands-free device, half of them did not use this, and 75% reported predominantly hand-held phone use, despite this being an illegal behaviour in Australia.

More recently, an on-line questionnaire in Queensland of 484 drivers aged 17-65 years found that 49% used a mobile phone to talk on while driving, 28% spoke on a hand-held phone and 50% used a mobile for texting or browsing (Oviedo-Trespalacios et al., 2017). Of concern, drivers were unable to demonstrate a comprehensive understanding that using a mobile phone for any purpose while driving was unacceptably risky. For example, 45% of drivers had searched for their ringing mobile to answer while driving, 39% of drivers reportedly looked at a mobile for longer than two seconds while driving (on average 3.9 times per hour) and reported engaging in compensatory behaviours to lessen their risk of a crash when they engaged in mobile phone use while driving. Participants reported engaging in compensatory behaviours while texting or browsing a phone, which included lowering their driving speed (79%) and increasing distance from the vehicle in front (70%). Furthermore, 44% of drivers reported intentional concealment of their mobile phones so as to evade police detection (by holding them below their windows or placing them on the passenger seat).

International research further highlights the disparity of higher prevalence rates reported in self-report data, with a wider array of distracted driving behaviours under investigation. Research conducted by Engelberg, Hill, Rybar and Styer (2015) and Hill, Rybar, Styer, Fram, Merchant and Eastman (2015) using online anonymous surveys in San Diego with 715 older adults (aged 30-64 years) and 4,964 younger students (aged 18-29 years) revealed a consistent pattern of self-reported distracted driving behaviours being prevalent for all ages. Notably, while distracted driving was prevalent across all age groups, there were higher prevalence rates for the younger students compared to the older adults. For example:

- 90% of younger participants reported speaking on the phone while driving (52% claimed to 'sometimes' use a hands-free phone) compared to 56% of older participants reporting speaking on a hand-held phone while driving.
- 87% of younger participants texted while stationary at a red light and 50% texted while driving on the freeway compared to 66% and 30% in the older group, respectively.

Moreover, 27% of the younger group reported using a laptop while driving and 70% used a portable music player. Around 18% of the younger participants reported having been involved in a crash due to their distracted driving behaviour, which they attributed to reaching for an object (24%), talking to a passenger (24%), texting (22%), adjusting the radio (16%), and talking on phone (14%; Hill et al., 2015). Interestingly, this research highlights the importance of considering all distracted driving behaviours, and not just mobile phone use as deleterious driving behaviours to target (Hill et al., 2015).

A recent online attitudinal survey of 962 participants aged 18 years and over in the USA revealed that simply having an awareness of the impact of driving distraction on crash risk was not enough to curb these behaviours (State Farm, 2016). For instance:

- 82% of survey respondents reported that talking on a hand-held mobile phone while driving was distracting, yet 50% of drivers reportedly continued to engage in this behaviour.
- 96% found browsing the internet while driving to be distracting, yet 29% continued to engage in this behaviour.
- 35% of participants reportedly sent a text message while driving, yet 87% of those who engaged in this behaviour perceived this to increase the likelihood of being involved in a crash.

2.4.1 So why do people drive distracted?

Research clearly demonstrates that people of all ages frequently engage in distracted driving activities but what remains to be known is why people choose to do so despite the risk to their safety, and the illegal nature of some behaviours. Interestingly, while researchers argue that distracted drivers require education and ongoing awareness about the risks involved to modify their driving behaviour (Dingus et al., 2011; Dingus et al., 2016; Beanland et al., 2013; Engelberg et al., 2015), self-report data reveals that despite having knowledge and an awareness of the risks associated with distracted driving, there remains a high prevalence of these behaviours (Cazzulino, Burke, Muller, Arbogast, & Upperman, 2014; Li, Gkritza, & Albrecht, 2014; McDonald & Sommers, 2015; Nelson, Atchley & Little, 2009; State Farm, 2016; Terry & Terry, 2016; White et al., 2010).

Self-report methodologies are imperative in gaining an understanding of the underlying motivations people use to justify engaging in these illegal or risky and dangerous distracted driving behaviours. Differing motivations have been reported in the survey literature to account for this discrepancy. Cazzulino et al. (2014) undertook a systematic review of 29 articles regarding drivers' self-reported influences on their mobile phone use while driving (age ranged from 13-82 years). Collectively, the most notable findings were the following:

- Texting and speaking on a mobile phone while driving was more common among individuals with greater self-perceived ability (versus actual ability) to control for any of the potential perceived negative effects resulting from their use of a mobile while driving (an illusion of control), such that those drivers who texted or spoke on the phone while driving tended to perceive these behaviours as less risky than those who did not use a mobile while driving.
- The stronger the personal attachment to one's mobile phone, the less perceived risk and greater the texting or talking on the phone while driving. Such strong personal attachment is known as 'possession attachment': such people feel uncomfortable not having their phone with them and feel distressed when leaving their phone at home.
- Those with a positive attitude to texting or talking on the phone while driving are more likely to do it.
- There is an effect on phone use while driving of social norms/social acceptance (subjective norms from peers and society, and law enforcement norms). For instance, the pressure to respond quickly to a text message, perceived social acceptance of texting or talking on mobile while driving, and the belief that law enforcement does not caution or fine drivers for some mobile phone use behaviours all increase the likelihood that an individual will text or speak on the phone when driving.
- The importance the driver places on the phone call, depending on whom the outgoing or incoming call is from, outweighs the perceived risk of engaging in the call (see more detail below).

Self-report investigations undertaken in Kansas where no laws prohibited the use of mobile phones while driving further highlight reasons why people continue to use phones while driving despite being aware of the risks posed by distracted driving (Atchley, Atwood, & Boulton, 2011; Nelson et al., 2009). Anonymous online surveys of 348 participants aged 18-30 years and 276 participants aged 18-37 years (Atchley et al., 2011; Nelson et al., 2009, respectively) revealed that 100% of drivers at some time speak on their phones while driving and 72.5% reported texting while driving (Nelson et al.) with 75% reporting texting with two hands while driving (Atchley et al., 2011). Together these studies revealed the following motivations underpinning the use of mobile phones while driving even though drivers rated texting and driving as very dangerous (Atchley et al., 2011; Nelson et al., 2009):

- Perception of risk was not a strong predictor of driver behaviour because any risk was outweighed by the importance the driver placed on answering or initiating a call
- The risk of phone use while driving was perceived as lower when traffic conditions were less demanding (stationary or low density for example), rather than when more demanding (heavy traffic, moving vehicle, inclement weather)
- Initiating or responding to texts was perceived as more dangerous than talking on a mobile while driving, but drivers continued to text while driving because of perceived social pressures to respond. Drivers were more likely to read a text message and respond to messages than to initiate them while driving. However, when the driver initiated a text, they effectively justified their behaviour by reclassifying demanding road conditions as less demanding and thus safer.
- Texting while driving was often task oriented and on topics of immediate importance to the driver, such as sending directions and status updates (rather than just 'catching up' or alleviating boredom).

McDonald and Sommers (2015) surveyed 30 teenage drivers in focus groups in Pennsylvania aged between 16-18 years to better understand motivations behind mobile phone use while driving. Mobile phone laws at the time of the study were not reported. The results revealed that drivers recognised that mobile phone use was dangerous and distracting while driving, yet engaged in this behaviour for the following reasons:

- Social pressures and the nature of the relationship with the person initiating a text or telephone call, the purpose of the communication, and the urgency of communication compelled them to respond while driving – for example, they felt compelled to respond if they were contacted by a person that they were driving to meet; the urgency to respond if a parent or significant other called; or if a friend rang who typically texted them.
- External factors like good weather conditions and one's familiarity with the road enhanced mobile use while driving (talking/texting/use of social media applications).
- Texting at red traffic lights was considered safer than while moving and in fact was defined by some participants as not 'texting while driving' because they were stationary.

Additional motivations reported by individuals aged 18 and over in the USA for engaging in specific electronically-based distracted driving behaviours are reported in detail in Table 2.1 below (State Farm, 2016). The main findings included:

- Reasons for speaking on the phone while driving were to use time efficiently (49%), maintaining contact with family (36%) and friends (23%);
- Drivers most frequently cited using social media (35%) and engaging in text messaging while driving (34%) because it was habitual behaviour;

- The most common reason for taking photos or videos while driving was the desire to share the image with others (48%);
- Drivers most frequently accessed the internet while driving to search for answers to questions (44%).

Table 2.1
Percentages for motivations for engaging in different electronically-based distracted driving activities (State Farm, 2016)

Motivation	Talking on phone (n=505)	Using social media (n=148)	Text messaging (n=201)	Taking photos or videos (n=100)	Accessing internet (n=171)
Time efficiency	49	20	27	-	20
Contact family	36	22	33	-	-
Contact friends	23	21	26	-	-
Preventing sleep	17	15	8	14	11
Circumvent boredom	17	27	17	19	22
Habit	14	35	34	17	30
Desire to share an image	-	-	-	48	-
Desire to multitask	-	-	-	17	-
Desire to find answer	-	-	-	-	44
Results of sports game	-	-	-	-	14

2.4.2 Other predictors of distracted driving

A number of investigations have attempted to ascertain factors that predict which drivers will be more likely to drive distracted; many of these have focused exclusively on mobile phone use as the sole distractor. For example, a Queensland study of mobile phone use found that drivers were differentially influenced to use mobile phones when driving depending on their frequency of mobile phone use, and the type of mobile they used (hand-held or hands-free use) (White et al., 2010). Those who frequently used mobile phones when driving were more likely to perceive this as increasing their time efficiency, compared to infrequent users. For frequent hand-held phone users, the receipt of information also increased their mobile use while driving, despite a greater awareness (than low frequency users) of the associated risks of engaging in this behaviour. Notably, unlike hand-held phone use, hands-free use while driving was not perceived by these drivers as a risky driving behaviour, and frequent use of hand-held mobiles while driving was influenced by perceptions of social approval for this behaviour, which is not illegal in Australia. Nonetheless, the WHO (2011) clearly report that both hands-free and hand-held mobile phone use similarly negatively impacts driving performance, and thus highlight the perhaps erroneous message implied by laws banning only hand-held phones, and the potential for laws to foster good social norms.

The White et al. (2010) study also found that infrequent hand-held users reported less social and police approval for this behaviour than frequent hand-held users, and it was suggested that frequent users had developed strategies to avoid being seen while using their phone, such as intentionally concealing the use of their phone while driving. Such strategies only serves to exacerbate the associated dangers with one's eyes diverted from the roadway for significantly longer periods of time (Simons-Morton, Guo, Klauer, Ehsani, & Pradhan, 2014). This finding was consistent with research undertaken by Gauld, Lewis and White (2014) in another Queensland-based investigation, which found that 84% of participants aged 17-25 years (n=171) self-reported intentionally concealing mobile phone use while driving at least once a year (for any purpose), that 61% concealed their phone while driving to read text messages and 51% to send text messages at least once or twice a week. Those who reported high intentions to use and conceal their mobile phones while driving over the following week, compared to those with a low intention to do so, were significantly more likely to perceive that

this benefitted them positively (mostly because they could share information and use their time effectively; Gauld et al., 2014).

One notable aspect of the Gauld et al. (2014) study was that participants were reporting they engaged in illegal behaviour, thus indicating that breaking the law and threat of enforcement was not a sufficient deterrent. A USA study found that, despite reported feelings of confidence in driving and a high prevalence of distracted driving, the majority of participants reported that hefty legal sanctions and increased insurance premiums would act as deterrents to mobile phone use while driving (Engelberg et al., 2015; Hill et al., 2015). Around 89-95% of younger and older participants would reportedly be deterred by a violation resulting in licence suspension and 86-94% by a 30% increase in insurance premiums.

Another Australian questionnaire study, undertaken in New South Wales with 181 adults aged 18-66 years, revealed that participants' perceptions of the amount of control they had over the ease or difficulty of engaging in a behaviour was the strongest predictor of whether they intended to use a mobile phone while driving (Waddell & Wiener, 2014). Hence those with higher perceived control, or 'over confidence' in their driving ability, were more likely to drive distracted. Consistent with previous findings, normalisation of distracted driving behaviours in others significantly influenced one's intention to similarly engage in this behaviour, and there seemed to be a social pressure to respond, given that a higher percentage of participants had typically responded to others' initiation of contact, rather than initiating this contact themselves while driving (see statistics above, Waddell & Wiener, 2014).

The tendency for drivers to report inflated confidence in their own driving ability is consistent with international literature. For example, in a San Diego study a majority of drivers (74% in the older group and 66% in the younger group, study details described above) perceived themselves to have superior driving ability than same aged peers (Engelberg et al., 2015; Hill et al., 2015). Essentially, 46% of younger participants perceived themselves to be capable of driving distracted (behaviour not defined) while for the older participants 53% believed themselves to be capable of driving while talking on a hand-held phone, 89% on a hands-free phone, and 9% capable of driving while texting. These reported feelings of superiority were evident in the older group despite 61% perceiving that hand-held or hands-free talking on the phone was synonymous with driving with a BAC of 0.08, and 34% believing this to be true only for hand-held devices. For the older drivers, higher scores on driving distracted were significantly related to higher confidence levels in one's own capabilities to talk on a hand-held phone or text while driving, and the strongest predictor of distracted driving was an obligation to receive work calls (Engelberg et al., 2015). For the younger group, higher prevalence of distracted driving was strongly predicted by a history of crashes resulting from distracted driving and individuals' self-perceptions of confidence in their own ability to drive distracted, their safety in doing so, and social normalisation of driving distracted (inferred from having viewed others doing this behaviour) (Hill et al., 2015). These findings highlight the vulnerability to distracted driving and misperceptions evident in drivers of all ages.

Terry and Terry (2016) in their survey study of 726 New York college students (aged 18 years and older; mean age 19.2) considered the role that public perceptions had in maintaining distracted driving behaviours. At the time of the study only hands-free mobile use was legal in New York, yet 80% of participants reported reading text messages while driving and 68% reported sending text messages while driving, despite their reported awareness of the associated crash risk. They argued that in their sample, normative public acceptance of talking and texting on a mobile while driving likely increased this behaviour. Furthermore, Terry and Terry (2016) argued that the effectiveness of the risk reduction strategies employed by participants to mitigate any risk from using their phone while driving (such as driving slower, or using the phone while stationary) required further research. Terry and Terry (2016)

argued that a shift in public perception regarding the acceptability of distracted driving may be needed, above and beyond the mere awareness of risk associated with these behaviours.

Sanbonmatsu, Strayer, Behrends, Ward and Watson (2016) similarly found that in a sample of 249 University students aged 18-44 years in Utah that 44% of their sample supported legislation to cease speaking on a phone while driving (this remained legal, yet texting was illegal), yet engaged in this behaviour themselves. They perceived that other drivers were less capable of driving while talking on a phone than they were themselves, and did so because they had a desire to connect with family and friends, alleviate boredom, and to get work done. Participants' use of mobiles while driving was strongly predicted by their misconceptions that they could do so safely, and they did not perceive talking on a phone while driving to be as dangerous as drink driving (Sanbonmatsu et al., 2016), despite research to the contrary (Strayer, Drews & Crouch, 2006).

3 Conclusions

While it is widely recognised in the road safety literature that younger, inexperienced drivers present a greater risk of crashing and at times engage in a higher level of distracted driving, the literature review clearly identifies that distracted driving is not restricted to the young driver population and there is sufficient evidence that it is also prevalent in middle aged and older driving populations. Similarly, while some gender differences were found within studies, these did not indicate the need to preferentially target either gender. Hence, any campaigns ought to include drivers of all ages and gender. Moreover, drivers continue to engage in distracting behaviours despite their self-reported awareness or perceptions of the associated dangers and their increased crash risk.

Data from self-report studies clearly indicates that there are differences in the motivations influencing individuals to undertake distracting behaviours, although many of these investigations focused only on the use of technology while driving (particularly mobile phone use). The general theme was that the perceived and immediate benefits of engaging in a distracted driving behaviour may often outweigh the risks, particularly because ultimately there are many times that distracted driving behaviour does not result in a negative consequence. While the large body of research may contribute to the temptation to focus on driving distraction by mobile phone use, it is imperative to consider the potential danger posed by many types of distracted driving behaviours. Other distracted driving behaviours were shown in the review to be as prevalent, or more prevalent, than mobile phone use, depending on which data is examined. There was a large disparity between self-reported distracted driving rates and rates observed through naturalistic observation and roadside observational methodology. For instance, while self-reported mobile phone use ranges between 28% and 77% in Australian studies, hand-held phone use was observed in only 0.6% to 3.4% of drivers in an Australian roadside survey. Such discrepancies could be explained by the methodological differences between types of data collection, such that observational studies occur at a specific time and location, whereas self-report surveys tend to acquire data representing behaviour over a longer time period.

Data from naturalistic studies internationally has revealed that any distraction that takes the driver's eyes from the forward roadway increases the risk of a crash, with distraction a factor observed in around 52 to 68% of crashes. Thus, the finding that in 98% of all of the journeys analysed in an Australian naturalistic driving study, drivers engaged in at least one potentially distracted driving behaviour, with interactions with children more prevalent than mobile phone use, signifies the importance of considering distracting behaviours simply beyond driver mobile and electronic use. Crucially, international data reveals that, although the odds of having a crash are significantly increased when dialling a handheld phone and texting, this is also true when the driver reaches for an object, extends their glance to an external object, attends to passengers or to something inside the vehicle, or experiences emotional distress.

It appears that a large majority of distracted driving behaviours are engaged in voluntarily and are therefore amenable to change. Many drivers attempt to justify distracted driving behaviours, despite an awareness of the associated risks. A number of motivational themes were identified that appeared to explain this discrepancy. These included:

- perceived confidence in own driving ability,
- perceived social norms and obligations to respond to social contact,
- the importance placed on the contact,
- efficient use of time,
- sharing information,
- behaviours being habitual, and

- perceived less demanding traffic conditions.

Of paramount importance, this review outlined the tendency for some distracted drivers to attempt to compensate for their distracted driving behaviour or to conceal their behaviour, such as to only engage in it while stationary (but still a driver, waiting at traffic lights for example) or to hold their mobile phone out of view, but such behaviours may serve to increase their level of distraction and exacerbate the level of risk. Similarly, this review has highlighted the dangers associated with hands-free phone use while driving, and the significance of laws abolishing only hand-held phone use as potentially misleading and giving drivers a false sense of security when engaging in this behaviour.

Ultimately, a greater understanding of the motivations behind South Australian drivers' distracted driving behaviours for all behaviours, not limited to mobile phone use, would be warranted through future research.

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