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Distraction and Older Drivers: An Emerging Problem?

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Key Findings

- Distracted driving is predicted to increase in future generations of older drivers;
- Age-related declines make older drivers vulnerable to the risks of distracted driving;
- Australian data shows that older drivers spent 37% of driving time engaged in secondary tasks;
- Evidence suggests older drivers self-regulate the type and timing of secondary task engagement.

Abstract

Distracted driving is widely recognised as a significant threat to the safety of all road users. Age-related declines in a range of sensory, cognitive and physical processes can, however, make older drivers particularly vulnerable to risks associated with distraction. While traditionally viewed as a younger driver issue, distracted driving among the older driver cohort is predicted to increase as future generations of older drivers drive more often, and for longer, and embrace technology in increasing numbers. This paper discusses current knowledge regarding why older drivers are particularly vulnerable to the effects of distracted driving and reviews recent research on older driver distraction engagement and its impact on their driving performance. Also presented, is an Australian case study of older driver secondary task engagement using data from the recently completed Australian Naturalistic Driving Study (ANDS). This case study examined patterns of secondary task engagement during everyday trips among 48 older (60+), middle-aged (43-49 years) and young (22-31 years) drivers. The findings suggest that Australian older drivers do engage in a large number of secondary tasks when driving; however, there is evidence that they self-regulate the type and timing of these tasks.

Keywords

Distracted driving; Older drivers; Ageing; Road safety

Introduction

Older drivers constitute the fastest growing segment of the driving population (FHWA, 2016). Increases in population growth, longevity, licensing rates, and travel frequency and distance will all combine to yield a marked growth in older drivers on the road (Koppel & Berecki-Gisolf, 2015; Koppel & Charlton, 2013). There is strong support for people to maintain independent vehicular mobility as they age to combat issues such as social isolation and depression; however, the safety of older drivers remains a serious public concern (Langford & Koppel, 2006). Current data show that while older drivers have lower crash rates overall than young novice drivers, they represent one of the highest risk groups for fatal and serious injury crashes per number of drivers and distance travelled (Koppel et al., 2011; Langford & Koppel, 2006).

Older drivers' elevated risk for serious injury and fatal crashes can largely be explained by older driver frailty, or their susceptibility to injury in a crash (Li, Braver, & Chen, 2003). Older peoples' biomechanical tolerances to injury are lower than those of younger people (Mackay, 1988; Viano et al., 1990), mainly due to reductions in bone and muscle strength and fracture tolerance (Dejeammes & Ramet, 1996; Padmanaban, 2001).

Declines in a range of sensory, cognitive and physical processes can also place older drivers at an increased risk of crash-related injury and death. Age-related impairments commonly include visual field loss; deteriorated visual acuity and/or contrast sensitivity; reduced dark adaptation and glare recovery; loss of auditory capacity; reduced perceptual performance; diminishing attentional and/or cognitive processing ability; reduced memory function; musculoskeletal declines, strength loss, and slowed reaction time (Janke, 1994; Stelmach & Nahom, 1992). It is these age-related declines that make older drivers particularly vulnerable to any increases in driving complexity, such as occurs with distracted driving. Indeed, a number of studies have shown that older people have a reduced ability to share attention effectively between two concurrent tasks due to declines in vision and cognitive processing (Mourant, 2001; Verhaeghen et al., 2003; Ward et al., 2018) and, thus, may be more susceptible to the distracting effects of engaging in secondary tasks while driving than their younger counterparts.

Distracted driving is defined as "a diversion of attention away from activities critical for safe driving towards a competing activity" (Lee, Young, & Regan, 2009, p. 34) and is acknowledged as a significant threat to road safety (WHO, 2011). While it is difficult to quantify the exact role of distraction in road crashes given a lack of systematic reporting, a growing body of evidence indicates that is an important contributor to both fatal and serious injury crashes. Indeed, distracted driving has been identified as the main contributing factor in approximately 16 percent of serious casualty crashes resulting in hospital attendance in Australia (Beanland et al., 2013) and in 15 percent of injury and 10 percent of fatal crashes in the United States (NHTSA, 2017).

Distracted driving is often thought of as a problem for young novice drivers. While past research has certainly shown that older drivers engage in distracted driving to a lesser extent that their younger counterparts (Sullman, 2012; Young & Lenné, 2010), it is not clear if this will be the case for the upcoming cohort of older drivers – the baby boomers. The baby boomer generation has a number of distinct characteristics that differ from previous generations. In relation to driving, it is predicted that the baby boomers will have higher licensing rates, travel more frequently, travel greater distances, and be more likely to maintain their private vehicle as their primary mode of transport compared to earlier generations (Koppel & Berecki-Gisolf, 2015; OECD, 2001). This increase in motor vehicle use means that the baby boomer generation will be at greater risk of crash involvement and crash-related trauma than previous cohorts (Langford & Koppel, 2006). Furthermore, it is predicted that baby boomers will have higher rates of technology use than previous generations. Despite persistent stereotypes, research has shown that a significant proportion of older adults now utilise mobile technology to send and receive SMS, access the internet and entertainment media and to do on-line shopping (Kuoppamäki, Taipale, & Wilska, 2017; Niemelä-Nyrhinen, 2007). Taken together, these findings suggest that not only will the current and future generations of older drivers drive more, their growing use of mobile technology, coupled with the increasing number and sophistication of on-board technologies, may mean that their engagement in distracted driving may also escalate.

This paper discusses why older drivers are particularly vulnerable to the effects of distracted driving and reviews current knowledge on older driver distraction engagement and its impact on driving performance. The paper also presents an Australian case study of older driver secondary task engagement using data from the recently completed Australian Naturalistic Driving Study (ANDS).

What makes older drivers vulnerable to distracted driving?

Even healthy older adults are likely to experience some level of age-related decline in physical, sensory and cognitive functions. A number of these declines have implications for distracted driving because they increase older drivers' susceptibility to interference from secondary tasks.

Vision

Vision is critical for safe diving. As we age, visual ability declines and older people can experience a range of issues with vision that can impact driving, including a decline in field of view, visual acuity and contrast sensitivity and reduced dark adaptation and glare recovery (Eby & Molnar, 2012). Such declines have implications for safe driving, such as being able to read street and traffic information signs, seeing pedestrians, cyclists and adjacent vehicles, judging gaps in traffic and driving safely at night. Indeed, a range of age-related declines in vision, including those related to poor visual acuity, visual field loss, glare sensitivity and reduced contrast sensitivity have been associated with increased crash risk (Ball et al., 1993; Owsley, 1994; Rubin et al., 2007).

With respect to distracted driving, vision problems can cause older drivers to experience a number of issues with the use of in-vehicle devices, including difficulty seeing small text and discriminating colours, and problems with display glare, particularly at night. This, in turn, could increase the amount of time older drivers have to spend with their eyes off the roadway in order to extract the required information from devices and displays, placing them at greater risk of a distraction-related crash. Research from the 100-car study has shown that glances away from the forward roadway of more than two seconds increases crash and near-crash risk by at least two times that of normal, undistracted driving in a sample of largely young and middle-aged drivers (Klauer et al., 2006). It is not known if older drivers might have an even lower off-road glance threshold before their crash risk is elevated.

Physical ability

Older people often experience a range of physical or psychomotor impairments that can impact their driving.

Physical issues experienced with aging typically include decreased flexibility, strength and endurance, coordination issues, muscle/hand weakness, increased difficulty in moving limbs and extremities, and increased discomfort, pain and fatigue (Anstey et al., 2005). In terms of driver distraction, these physical limitations can affect the ability of older drivers to easily reach device controls and make it difficult for them to manipulate certain control types such as small buttons, turn dials, or steering wheel controls. This can, in turn, result in longer times to complete secondary tasks, increasing older drivers' exposure to the risks associated with distraction engagement. Moreover, difficulty with manipulating buttons and controls could potentially increase the number of errors made, such as selecting the wrong item or under- or over-shooting items in a list. Errors can further increase completion times and result in confusion or frustration, exacerbating the impact of secondary task on driving performance.

Research has shown that older adults have slower and more variable reaction times, particularly when performing complex tasks such as driving (Kaber et al., 2012; Svetina, 2016). While an increase in reaction time is primarily related to age-related changes in cognition, physical limitations resulting from joint stiffness and muscle weakness can also play a role (Godefroy et al., 2010; Klavora & Heslegrave, 2002).

Cognition

The adverse effects of distracted driving reflects a discrepancy between the amount of resources required for the driving task and the amount of resources the driver is devoting to it. Those drivers with lower cognitive capacity, such as older drivers, are particularly susceptible to the risks posed by distracted driving because they have less spare capacity to devote to secondary tasks (Cuenen et al., 2015). As people age, they often experience a range of cognitive declines and a general slowing of processing speed (Eby & Molnar, 2012; Salthouse, 2010; Yang & Coughlin, 2014). Of particular relevance to distracted driving is research showing that ageing leads to declines in divided attention, selective attention and attention switching. Divided attention, or the ability to focus on, or perform, two or more tasks simultaneously diminishes with age (Ponds, Brouwer, & Van Wolffelaar, 1988; Salthouse, Rogan, & Prill, 1984). Therefore, the ability of older drivers to perform even a relatively short and simple secondary task without it impacting driving performance in some way is often limited. Likewise, the ability of older drivers to ignore incoming information from portable or on-board devices, or to select appropriate times to engage in a secondary task may also be diminished.

Age-related declines in information processing speed can also lead to issues in older people processing large amounts of information provided by on-board or portable devices or responding quickly to information or traffic warnings, particularly if these occur simultaneously (West, Crook, & Barron, 1992). Indeed, older drivers have been shown to have a diminished ability to respond to hazardous situations in a timely manner, primarily due to age-related declines in perception and cognition (Ball et al., 1993; Svetina, 2016). Typically, reaction times become longer and are more variable with increasing age, particularly during times of high complexity (Dickerson et al., 2014; Leversen, Hopkins, & Sigmundsson, 2013; Stinchcombe & Gagnon, 2013; Zhang et al., 2007).

Taken together, the observed decline in cognitive abilities with age can place older drivers at particular risk of the dangers of distracted driving because they have less capacity to cope with the added complexity of engaging in secondary tasks and also have less ability to react to hazardous roadway events should these occur while distracted.

A review of distracted driving in the older driver population

Despite the fact that older drivers represent the fastest growing driver population, and they are particularly vulnerable to the negative impacts of distraction, there has been relatively little research specifically focussed on studying distracted driving in this population compared to their younger counterparts. The current literature on older driver engagement in distracted driving and its impact on behaviour and crash risk is reviewed in this section.

Older driver engagement in distracted driving

Research shows that drivers spend a vast amount of driving time engaging in secondary tasks (Dingus et al., 2016). However, willingness to engage in distracted driving varies greatly across different age groups. In general, older drivers have been found to engage less in distracting activities than younger and middle-aged drivers (Gao & Davis, 2017; Huisingh et al., 2018; Lansdown, 2012; Pope, Bell, & Stavrinos, 2017; Young & Lenné, 2010). In a German sample of older (65-83 years) and middle-age drivers (26-61 years), Fofanova and Vollrath (2012) found that the older drivers were significantly less likely than middle-aged drivers to report engaging in certain distracting activities including using in-car devices, self-initiated internal tasks and eating or drinking. Older drivers also rated most of the distracting activities as significantly more dangerous than the middle-aged drivers. Chen and colleagues (2016) also found that, compared to younger drivers, drivers aged 60 years and over reported marginally lower levels of engagement in distracting activities, were less confident about their driving performance while engaging in distractions, and generally held a more negative view of distractions. It is generally concluded that older drivers' reluctance to engage in distracting activities while driving is indicative of a process of self-regulation (e.g., Fofanova & Vollrath, 2012; Lerner, Singer, & Huey, 2008).

It is well acknowledged that older drivers change their driving patterns to avoid complex or high demand driving situations such as driving at night, during bad weather, peak traffic times and on high speed roads (Eby & Molnar, 2012). While some of these changes to driving patterns reflect lifestyle changes, they can also be an adaptive response to a decline in driving ability, termed driver self-regulation. There is also evidence, albeit limited that older drivers self-regulate their behaviour in relation to distracted driving. This self-regulation is not only evident in the relative unwillingness of older drivers to engage in distracting activities overall, but also in the fact that older drivers have been shown to restrict their engagement in certain tasks when driving demands are increased. Charlton and colleagues (2013), for example, examined older driver engagement in distracting activities at intersections using a naturalistic driving study (NDS) method. They found that the most frequently observed secondary activities at intersections were scratching/grooming (42%), talking/singing (30%) and manipulating the control panel (12%). Interestingly, high-risk tasks commonly associated with taking hands off the wheel and eyes off the road, such as reading, phone use and reaching for objects, were all restricted to times when the vehicle was stationary. Older drivers also engaged less in secondary tasks at uncontrolled intersections where the complexity of gap judgements was highest. Such findings are indicative of self-regulation, whereby older drivers chose to perform more demanding secondary tasks when driving demands were lower. While the results from the Charlton et al. (2013) and other studies are encouraging in that they indicate that older drivers attempt to minimise their risk in relation to distracted driving, self-regulation does have its limitations, namely that it relies on drivers being aware of and accurately assess their limitations and risk. In relation to distracted driving, research has shown that drivers have poor awareness of their performance decrements when engaging in secondary tasks and even tend to underestimate both the demands of dual-task engagement the detrimental impact of distraction on their driving performance (Horrey, Lesch, & Garabet, 2008; 2009; Lesch & Hancock, 2004). Further research is needed to examine the nature of older driver self-regulation in relation to distracted driving and how successful these adaptive strategies are likely to be in reducing crash risk.

Research examining the association between driver age and distraction-related crashes confirms the findings of older driver engagement studies by showing that older drivers are significantly less likely to engage in distracting activities at the time of the crash compared to younger age groups. In an analysis of the 1995–1999 Crashworthiness Data System (CDS) data to determine the role of driver distraction in police reported crashes in the United States, Stutts et al. (2001) found that younger drivers aged under 20 years were more likely to be identified as distracted at the time of their crash (11.7%) than drivers aged 65 years and older (7.9%). A later Australian-based study by McEvoy et al. (2007) examining the prevalence and type of distracting activities involved in serious injury crashes showed similar findings. Interviews with hospitalised drivers revealed that younger drivers (17–29 years) were more likely to report being involved in a distraction-related crash (39.1%) than drivers aged 50 years and older (21.9%). With respect to the risks associated with individual secondary tasks, Donmez and Liu (2015) found that dialling or texting on a mobile phone, in-vehicle sources, and talking on a mobile phone were all associated with an increased likelihood of older drivers (65+ years) sustaining a severe injury in a two-vehicle crash.

More recently, Guo et al. (2017) used data from the Second Strategic Highway Research Program Naturalistic Driving Study (SHRP2) to examine the risk of a severe crash associated with distracted driving for four age groups including older drivers (aged 65-98 years). They found that secondary task engagement posed a consistently higher crash risk for drivers aged 30 years and younger and drivers aged 65 years and older when compared to middle-aged drivers, although the older drivers engaged in secondary tasks less frequently than their younger counterparts. One critical finding was that visual-manual phone tasks, texting and phone dialling increased the odds of a crash by 24.5 to 81.5 times for older drivers aged 65 years and older, far exceeding the odds for the same tasks for teenage drivers. Huisingh and colleagues (2018) also used SHRP2 data to examine the association between secondary task involvement and risk of crash and near-crash involvement for older drivers (70+ years). Older drivers engaged in secondary tasks in 40 percent of the driving trips sampled; however, engagement in any secondary task as a combined category was not associated with an increase in crash or near-crash risk. Use of a mobile phone was associated with 3.8 greater odds of being involved in a crash event, while glances to the interior of the vehicle was associated with 2.6 greater odds of near-crash involvement. Interestingly, interacting with passengers and talking/singing were not associated with an increase in crash or near-crash risk. The discrepancy in the crash risk found across the two SHRP2 studies has been attributed to differences in the reference groups used. Specifically, Guo et al. used sober, alert and attentive driving as a reference to compare secondary task involvement, whereas the reference group used by Huisingh et al., while not engaged in secondary tasks, may have had other impairments. The higher odds ratio found by Guo et al. may therefore be attributable to their reference group having a lower risk of crash involvement compared to the reference group used in the Huisingh et al. study.

Overall, the results of research examining older driver distraction engagement and crash risk suggests that older drivers do engage in distracted driving, albeit to a much lesser extent than younger or middle-aged drivers, and that this behaviour can increase their crash risk, particularly if it involves complex visual-manual tasks such as texting or dialling a phone.

Impact of distracted driving on older driver performance and crashes

A review of early research (pre 2008) into the impact of distraction on the driving performance of older drivers has been conducted by Koppel et al. (2009). Since then, there has been an increase in the number of studies examining how distracted driving affects older drivers' performance, although research on this population still lags well behind the number conducted with younger and middle-aged driver cohorts.

Of particular relevance to the topic of distracted driving is how the ability to divide attention and multitask is affected by the aging process. Research has shown that age-related changes in various aspects of cognition can impact older peoples' ability to divide attention across multiple tasks, particularly when the tasks are complex or they require the use of different modalities (Zanto & Gazzaley, 2014). These findings are typically explained in terms of a decline in processing resources that is associated with healthy ageing and not declines specific to attentional resources (Glisky, 2007). Research examining older peoples' divided attention and multitasking ability when driving confirms these general findings. Using a divided-attention task, Mourant et al. (2001) found that older drivers' (aged 58+ years) were less accurate at extracting information from an in-vehicle display and exhibited diminished lane keeping performance during the divided-attention task compared to younger driver group. Comparable results were found by Ward et al. (Ward et al., 2018) using a gaze-contingent useful field of view paradigm, with older drivers exhibiting poorer lateral control and greater following distance variability when multitasking, which declined further with the increased workload and the introduction of wind. Interestingly, they found that visual discrimination performance suffered regardless of eccentricity, supporting a general interference account of multitasking in older drivers rather than multitasking leading to tunnel vision.

Recent research examining the impact of distracted driving on older driver performance has utilised different criteria for defining the 'older driver'. While many studies classify older drivers as 60 or 65 years and older, the starting age for the older driver samples ranged from 55 to 70 years across the studies reviewed. There is also considerable overlap across studies in the age range used for the older and middle-aged driver groups, with some middle-aged samples containing drivers aged up to 65 years. The different age ranges used can make it difficult to elucidate the role of age as a factor moderating the impact of distraction on driving performance. Despite these difficulties, the evidence is fairly compelling that the impact of distracted driving on driving performance is greater for older drivers than it is for other age groups. More specifically, when compared to their younger counterparts, distracted older drivers display a greater level of impairment in longitudinal and lateral control, increased reaction time to expected and unexpected events, a poorer ability to extract information from the driving scene and a higher involvement in crashes (Aksan et al., 2013; Cuenen et al., 2015; Fofanova & Vollrath, 2011; Gao & Davis, 2017; Ortiz et al., 2018; Svetina, 2016; Thompson et al., 2012). For example, in a recent simulator study by Ortiz et al. (2018), texting WhatsApp messages using a smartphone impaired lane keeping performance across all age groups, but particularly among older drivers (55+ years). Notably, crash risk increased by 135 percent for older drivers when sending WhatsApp messages, compared to an 8 percent increase for young drivers.

Despite the age-related declines in driving performance observed in many distraction studies, research has indicated that older drivers may engage in self-regulatory behaviour while engaged in distracted driving. On-road studies by Thompson et al. (2012) and Aksan et al. (2013) demonstrated that older drivers tended to reduce their speed when engaged in a secondary task. Fofanova and Vollrath (2011) also found evidence for task shedding by older drivers under dual-task conditions, whereby they focused on the most relevant part of the driving task, the lane change manoeuvres, and shed lane keeping. All authors explain their results as evidence that older drivers engage in compensatory strategies when distracted. That is, they slow down to increase their margin for error to account for their reduced reaction times, or they shed less relevant driving tasks to reduce the amount of information they have to process. This explanation, however, suggests that these behaviours reflect, at least in part, a conscious decision made by the drivers to mitigate the risks of being distracted and assumes that older drivers are aware of both their cognitive and physical limitations, as well as the risks posed by the distraction task. It is not clear if this is indeed the case, or if the observed changes in drivers' behaviour simply reflect a degradation in driving performance. Further research is required to determine if such behaviour by older drivers is a form of self-regulation and, if it is, whether it is sufficient to off-set the risks posed by engaging in secondary tasks.

While chronological age is used as a common indicator of possible performance deficits, it is not always an accurate reflection of the level of physical, sensory or functional impairment experienced by older people (Koppel et al., 2009). Indeed, some older drivers can perform as well as younger drivers under dual-task conditions (Svetina, 2016). Thus, an older person's functional status, or their level of functional impairment, may be more relevant in understanding the impact of how distracted driving in older drivers. A number of studies have examined how cognitive capacity can moderate the impact of distracted driving on older driver performance. In an on-road study examining the role of visual, motor and cognitive functioning in the distracted driving performance of older and middle-aged drivers, Aksan et al. (2013) found that older drivers (65+ years) identified fewer landmarks and made a higher number of safety errors than middle-aged drivers. Interestingly, for older drivers, functioning in visual cognition predicted both traffic sign identification and safety errors, and executive function predicted variability in traffic sign identification. However, familiarity with the test area and greater exposure to roadway hazards did not benefit the performance for older drivers.

More recently, Cuenen and colleagues (2015) investigated if cognitive capacity has a moderating effect on older drivers' (70+ years) driving performance during visual and cognitive distraction. They found that cognitive capacity moderated the impact of visual and cognitive distraction on lane keeping ability, whereby higher cognitive capacity was associated with better lane keeping performance. Attention capacity was also found to be negatively related to the number of crashes experienced by the older drivers when visually and cognitively distracted. Taken together, the results of these two studies demonstrate that the functional status of older drivers, not just their chronological age, is an important indicator in understanding the extent to which their driving performance may be impacted by distraction.

Case study of older driver engagement in distracted driving from the Australian Naturalistic Driving Study

A large proportion of our knowledge of older drivers' engagement in distracted driving has been informed by self-report surveys (Chen et al., 2016; Fofanova & Vollrath, 2012; Young & Lenné, 2010) and crash data (Donmez & Liu, 2015; Gao & Davis, 2017), both of which are subject to reporting bias. A small number of studies have utilised NDS data to examine older driver engagement in secondary tasks that are unrelated to driving under specific driving conditions, such as when negotiating intersections (Charlton et al., 2013). The recently completed Australian Naturalistic Driving Study (ANDS) offers a unique opportunity to examine older driver engagement in secondary tasks under a wide range of every day, real-world driving conditions in an Australian context.

Using data from the ANDS (Williamson et al., 2015), this case study examined patterns of secondary task engagement during everyday trips among older (60+ years), middle-aged (43-49 years) and younger (22-31 years) drivers. The selection of the age groups examined was constrained by the demographics of the wider ANDS sample (containing drivers aged 20 -70 years) and the small sub-set of coded available at present. The focus of the data analysis was to examine if there are differences across the three age groups in terms of the type and duration of secondary task engagement and the contextual factors that influence drivers' decisions to engage in secondary tasks while driving.

Method

The ANDS comprised 346 privately owned vehicles (n = 185 from New South Wales; n = 161 from Victoria) that were equipped with a data collection system and driven by primary drivers and members of their household for a period of 4 months in real-world, everyday driving. All drivers resided in metropolitan Sydney and Melbourne or in regional areas of New South and Victoria.

The Data Acquisition System (DAS) equipped to each vehicle was supplied by the Virginia Tech Transportation Institute (VTTI) and comprised sensors and data-loggers, allowing the continuous recording of vehicle data and video while the vehicle ignition was on. Variables captured included: acceleration in multiple axes, gyroscopic motion, indicator status, speed and GPS position. A continuous multi–camera video recording system captured the driver's face, forward and rear views, and a view of the dashboard, each at a rate of 15 Hz.

Approximately 1.95 million km of driving was collected during the study from 377 participating drivers. At the time of writing, 185 trips (2,592 minutes of driving) from 117 drivers had been manually coded for secondary task engagement. The data used for this case study comprised 78 trips that were completed by 48 drivers. The 48 drivers were split into three age groups: 16 older (M = 63.4 years, SD = 3.3 years, 68.8% male), 16 middle-aged (M = 46.2 years, SD = 1.7 years, 43.8% males) and 16 younger (M = 27.6 years, SD = 3.1 years, 31.3% males) drivers. For each age group, 16 drivers were randomly selected that fit within each age range and all of their available trip data was used. For a number of drivers, this meant that data was included for multiple trips.

To code the data, two analysts viewed entire driving trips and coded sections where drivers were observed engaging in at least one secondary task. Using a modified version of the coding protocol developed for the SHRP2 project (VTTI, 2015), a range of categorical variables were coded for each secondary task event identified using the video data. These included secondary task type, passenger presence, driving context, self-regulatory behaviour and safety-related incidents occurring while engaged in secondary tasks.

A secondary task was defined as a discretionary task, performed concurrently with driving, but that is not critical to the primary driving task. Secondary tasks therefore did not include interaction with driving related vehicle controls (i.e., gears, indicators), checking the speedometer or mirrors (unless drivers were clearly using the mirrors to perform a non-driving task), or looking out the windows to check traffic or perform head checks. A range of non-critical vehicle tasks are included, however, such as adjusting mirrors, windows, seatbelt and sun visor because these tasks are not directly related to the primary tasks of vehicle control and safe travel. If drivers engaged in additional secondary tasks while already performing a secondary task (e.g., press centre stack button while talking on a hands-free phone), the number and type of additional secondary tasks engaged in were recorded. All variables, apart from self-regulation and incidents, were coded once for each secondary task event, at the point of the secondary task initiation.

Results & Conclusions

A total of 78 trips were analysed, equating to 1,185 minutes of driving time. Across the three age groups, 761 secondary task events were identified, with drivers engaging in a secondary task every 90 seconds, on average. Table 1 displays an overview of secondary task engagement for the older, middle-aged and young drivers. The younger drivers engaged in the highest total number of secondary tasks, followed by older and the middle-aged drivers. However, once total driving duration was taken into account, it was the middle-aged drivers who engaged most frequently in secondary tasks (1 task every 75 seconds), followed by older drivers (1 task every 84 seconds) and, lastly, younger drivers (1 task every 106 seconds).

In terms of the percentage of driving time spent engaged in secondary tasks, older drivers spent less time (23.5%) engaged in secondary tasks than both the younger (38.4%) and middle-aged drivers (32.2%). However, results of a negative binomial regression revealed that these differences were not statistically significant (all p's < .05), most likely due to the large variance in percentage of time engaged within age groups and the small sample size.

The average duration of each of the secondary tasks engaged in when driving was also examined across age groups. The average duration of individual secondary tasks for the younger drivers was 44.5 seconds (SD = 153.0), 35.9 seconds (SD = 91.2) for middle-aged drivers and 30.6 seconds (SD = 129.2) for older drivers. Results of a one-way ANOVA revealed, however, that these differences were not significantly different ($F(2,47) = 0.524$, $p = .596$). The large variance in mean task duration within age groups and across task types and the small sample size is, again, likely to account for this non-significant finding.Taken together, these results suggest that while older drivers' frequency of engagement in secondary tasks was similar to middle-aged drivers and more frequent than younger drivers, the older drivers' secondary task engagement tended to be shorter in duration, meaning that they spent relatively less driving time overall engaged in secondary tasks. There was, however, large variability within all of the age groups in terms of the total driving time spent engaged in secondary tasks and the duration of individual tasks. For the 16 older drivers examined here, for example, the percentage of total driving time spent engaged in secondary tasks by each driver ranged from zero to 99.4 percent. Similar variability was found for

Table 1. Number and mean (SD) total task duration (secs) of secondary tasks in each category

Secondary Task	Older		Middle-age		Younger	
	N	Duration	N	Duration	N	Duration
All secondary tasks	*214*	*30.6 (129.2)*	*176*	*35.9 (91.2)*	*371*	*44.5 (153.0)*
Adjusting steering wheel buttons	2	1.3 (0.4)	4	4.2 (3.6)	37	2.0 (2.5)
Adjusting centre stack controls (e.g. radio, HVAC)	18	1.7 (1.2)	27	4.9 (8.0)	71	2.4 (4.3)
Adjusting non-critical vehicle devices (e.g. seatbelt)	95	1.5 (2.2)	29	2.6 (3.0)	41	7.4 (30.7)
Drinking	1	12.1	1	91.1	7	16.8 (9.0)
Eating	-	-	2	197.5 (261.1)	4	607.0 (343.0)
Holding object (other than phone)	-	-	3	38.6 (51.1)	7	72.8 (80.2)
Looking at object/event OUTSIDE vehicle	22	7.0 (12.0)	39	11.2 (14.6)	19	8.9 (13.7)
Looking at object INSIDE vehicle (not reaching/touching it)	9	1.6 (1.1)	6	2.8 (1.9)	18	4.5 (7.2)
Manipulating object (other than phone)	-	-	5	27.7 (29.8)	11	123.1 (208.1)
Mobile phone, holding	2	32.6 (32.5)	1	40.0	5	243.8 (324.3)
Manipulating phone (hand-held)	2	5.7 (0.8)	1	11.7	18	18.6 (15.4)
Manipulating phone (hands-free)	-	-	-	-	4	6.3 (8.9)
Mobile phone, talking/listening (hand-held)	-	-	-	-	5	164.7 (118.1)
Mobile phone, talking/listening (hands-free)	-	-	2	69.3 (50.9)	6	543.0 (346.5)
Personal hygiene	2	10.2 (1.3)	22	14.0 (13.6)	30	12.3 (14.1)
Reaching for object/phone (includes moving)	10	4.4 (2.5)	9	5.9 (7.1)	40	5.1 (7.8)
Reading	-	-	-	-	1	9.0
Talking to front passenger	42	142.8 (265.5)	17	170.0 (210.3)	8	484.4 (470.2)
Talking to rear passenger	-	-	2	536.4 (149.4)	-	-
Talking/Singing to self	8	5.3 (4.7)	4	91.9 (135.6)	30	33.7 (59.0)
Other	1	22.8	2	12.7 (14.6)	9	15.7 (17.0)

Note: older = 60+ years, middle-aged = 43-49 years, younger = 22-31 years.

younger and middle-aged drivers. This massive variability likely led to the non-significant findings despite there being large absolute differences across groups in the mean percentage of time engaged. Future work with the ANDS data set will include a larger sample of drivers and also breakdown the secondary tasks into categories, rather than looking at all secondary tasks as a whole.

Older drivers were also found to engage in a smaller range of secondary tasks compared to younger and middle-aged drivers and the types of tasks they engage in most frequently also differed. Almost half (44.4%) of all the secondary tasks engaged in by older drivers involved adjusting/monitoring devices integral to the vehicle, such as their seat belt, window and sun visor. Adjusting/monitoring non-critical vehicle devices made up much smaller percentage of the overall secondary tasks engaged in by middle-aged and younger drivers (22.4% and 11.1%, respectively). Older drivers also interacted with passengers (i.e., talking, touching or giving or receiving objects) more frequently than the middle-aged and younger drivers. Finally, older drivers engaged less in tasks involving holding or using mobile phones than the younger drivers. Indeed, older drivers were only observed on two occasions manipulating a hand-held phone, compared with 18 occasions for younger drivers.

Interestingly, approximately one fifth (20.5%) of all secondary task events identified for the older drivers involved engagement in multiple secondary tasks. This level of engagement in multiple tasks was similar to that found for both middle-aged (20.4%) and younger (18.1%) drivers ($F(2,47) = .473$, $p = .626$). A large majority of multiple task engagement involved drivers talking to passengers while also performing another secondary task.

We also examined if the driving conditions under which drivers chose to engage in secondary tasks differed across age groups (see Table 2). As displayed, compared to the middle-aged and younger driver groups, older drivers engaged in a greater number of secondary tasks when passengers were present in the vehicle. Results of a two-way mixed ANOVA revealed a significant two way interaction ($F(2,45) = 5.85$, $p = .005$), whereby the older drivers engaged in more secondary tasks with passengers present, but the younger and middle-aged drivers engaged in less secondary tasks with passengers present. Given that interacting with passengers made up almost 20 percent of the secondary tasks engaged in by older drivers, the fact that they engaged more in secondary tasks with passengers present is not surprising. Indeed, the older drivers spent more time driving with passengers than the middle-age and younger drivers. It is important to note here that passenger presence has been found to be beneficial for older drivers in terms of reducing their involvement in unsafe driving actions (Michel & Meyers, 2004) and crash risk (Padlo, Aultman-Hall & Stamatiadis, 2005). Rather than being a 'distraction' from safe driving, passenger based secondary tasks could, therefore, have a protective effect for older drivers, at least in some situations. Further research is required to determine the circumstances in which passenger interaction may be beneficial for older drivers.

Older drivers, like both the younger and middle-aged drivers, were also significantly more likely to engage in secondary tasks while maintaining their current speed ($F(4,180) = 7.335$, $p < .001$) and when the traffic was light or there was no other traffic ($F(1,45) = 4.896$, $p = .032$).

Table 2. Percentage of all secondary task engagement as a function of age group, passenger presence and driving context

Driving Context	% Older	% Middle-age	% Younger
Front passengers			
Yes	56.1	41.4	16.7
No	43.9	58.6	83.3
Speed			
Maintaining current speed	73.8	40.3	54.2
Increasing speed	2.3	6.1	7.3
Slowing down to stop	7.9	12.2	15.6
Slowing down to turn	0.5	1.1	1.6
Stationary	15.4	40.3	21.3
Traffic density			
Heavy	2.3	4.9	10.5
Medium	17.3	33.1	24.5
Light	53.7	41.4	45.3
No traffic	26.6	20.4	19.7

Note: older = 60+ years, middle-aged = 43-49 years, younger = 22-31 years.

The fact that the older drivers tended to engage in shorter secondary tasks and at times when the traffic was light or no traffic was present suggests that they do self-regulate their engagement with secondary tasks to some extent. However, almost three quarters of the secondary tasks engaged in by the older drivers were initiated when they were maintaining their current speed. Only 15.4 percent of the secondary tasks engaged in by older drivers were initiated while they were stationary, compared to 40.3 percent of tasks for middle-age drivers and 21.3 percent for younger drivers. This result likely reflects the nature of the secondary tasks most commonly engaged in by older drivers, which were short, discrete tasks involving adjusting vehicle controls or devices or interacting with passengers. However, it is important to note that the older drivers also engaged in a small number of high-risk secondary tasks while travelling at speed, including reaching for objects and holding and manipulating a mobile phone, suggesting that older driver self-regulation of distracted driving behaviours is not always present or sound.

One of the key strengths of the ANDS is the use of naturalistic driving data which allows the examination of the prevalence of drivers' secondary tasks engagement in a natural, real-world driving setting, free from the constraints of traditional experiments. The enormous amount of data collected, however, meant that only a fraction of the available data set was coded and available for analysis in this paper. Future work with NDS data should examine ways to at least partially automate the coding of secondary task events to ensure that larger amounts of data can be analysed. Second, the random selection process used to select trips for coding meant that there was variability in the number of trips analysed for each driver; the number of trips coded for individual drivers ranged from 1 to 12. Thus, individual differences in the propensity to engage in secondary tasks may have had more of an influence on the data for those drivers with a greater number of trips coded. Future analysis of the ANDS data will include a greater number of trips with an even distribution of trips across drivers.

Discussion

This paper has highlighted a number of important issues related to distracted driving among older drivers. The first is that the older driver cohort is growing rapidly and the demographic characteristics of older drivers are changing, most notably in terms of licensing rates, travel patterns and technology use. In recent years, older adults have reported more positive and accepting attitudes towards technology (Mitzner et al., 2010) and this may change the norms in relation to older driver distracted driving behaviour. An increase in the acceptance and use of technology by older people, coupled with the increasing pervasiveness of technology in vehicles, means that the safety risks associated with distracted driving may be further compounded for the upcoming baby boomer cohort of older drivers.

Recent NDS research from the United States and our own case study of Australian older drivers from the ANDS, indicates that the current cohort of older drivers do engage in distracted driving. Indeed, data from the SHRP2 study showed that older drivers engaged in secondary tasks in 40 percent of the driving trips sampled (Huisingh et al., 2018). A small subset of data from the ANDS also showed that older drivers in Australia spent 36.5 percent of their driving time engaged in secondary tasks, a percentage comparable to the younger and middle-aged drivers sampled; however, the nature of the tasks that older drivers engaged in tended to differ. Based on the limited data available in the literature, it is difficult to draw definitive conclusions as to whether engagement in distracted driving is increasing in older drivers. However, given the upward trend in older adult technology uptake and the proliferation of technology into vehicles, older driver engagement in distracted driving should be carefully monitored into the future.

The age-related functional declines discussed in this paper make older drivers particularly susceptible to the risks of distracted driving. Any increase in older driver engagement in distracted driving is therefore likely to have a disproportionally high effect on the crash risks associated with distraction for this population. This is particularly likely to be the case if older drivers increase their engagement with certain technologies such as mobile phones, which has been found to increase the odds of a crash for older drivers by almost four times (Huisingh et al., 2018).

On a more positive note, there is evidence that older drivers engage in self-regulatory behaviour in relation to distracted driving. When engaged in secondary tasks, older drivers have been shown to reduce their speed and shed less relevant driving tasks (Aksan et al., 2013; Fofanova & Vollrath, 2011; Thompson et al., 2012). Data from the ANDS case study also demonstrated that older drivers self-regulate the types of tasks they engage in when driving, as well as the conditions under which they engage. More specifically, the older drivers in the ANDS tended to engage in secondary tasks of relatively short duration and at times when the surrounding traffic was light or no traffic was present, compared to younger and middle-aged drivers. The older drivers in this study did, however, initiate engagement in the majority of the secondary tasks, including some high-risk tasks, while they were maintaining their current speed. These findings suggest that while older drivers do self-regulate their distracted driving behaviours, these self-regulation strategies are not always implemented, nor are they perfect. More research is needed to investigate the self-regulation of distraction behaviours and to determine if the strategies adopted are sufficient to offset the functional limitations of older drivers and the increased risks they face from distracted driving.

As discussed, distracted driving has traditionally been thought of as a younger driver issue and, thus, limited effort has been made to manage driver distraction in older drivers. There are, however, a range of strategies that could be implemented to manage distracted driving in the older population. Koppel et al (2009) provide a review of several potential countermeasures including legislation, licensing, education and training, and vehicle, technology and road design. Those countermeasures that specifically address the functional declines experienced by older drivers that make them more susceptible to the risks of distraction are likely to have the greatest impact. For example, research that has demonstrated that attention capacity training in older adults can have long lasting benefits for road safety (Ball, Edwards, & Ross, 2007; Ball et al., 2010), suggests that this may be one potentially promising countermeasure for older drivers. Given the limited research in this area, however, it is difficult to draw conclusions about the efficacy of any one distraction countermeasure for older drivers; however, as with other driver populations, a systems approach to managing older driver distraction, that contains multiple complementary countermeasures, is likely to yield the highest safety impacts.

Conclusions

Overall, far from being a younger driver problem, this review and the ANDS case study demonstrates that older drivers do indeed engage in distracted driving and that this negatively impacts their driving performance, more so than younger drivers. However, there is evidence that older drivers regulate the type and timing of the tasks they engage in. More specifically, older drivers engage in secondary tasks for shorter durations than younger drivers, engage more often when surrounding traffic is light or not present, and they avoid tasks that have been found in previous research to be high-risk, such as holding or manipulating a mobile phone. Distraction countermeasures should capitalise on the natural self-regulatory tendencies of older drivers by increasing their awareness of dangers of certain secondary tasks and the driving conditions under which they should avoid engagement.

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