Transportation Research Part F 14 (2011) 638–648

Contents lists available at SciVerse ScienceDirect

Transportation Research Part F

journal homepage: www.elsevier.com/locate/trf

Distraction while driving: The case of older drivers

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ARTICLE INFO

Article history:
Received 14 July 2010
Received in revised form 19 August 2011
Accepted 28 August 2011

Keywords:
Older drivers
In-vehicle distraction
Secondary task
Driving simulation
Lane Change Task

ABSTRACT

As the impairment of older drivers is especially found in perception and attention, one could assume that they are especially prone to distraction effects of secondary tasks performed while driving. The aim of the study was to examine the effect of age on driving performance as well as the compensation strategies of older drivers under distraction. 10 middle-aged and 10 older drivers drove in a simulator with and without a secondary task. To assess driving performance the Lane Change Task (Mattes, 2003) was used. This method aims at estimating driver demand while a secondary task is being performed, by measuring performance degradation on a primary driving-like task in a standardized manner. The secondary task – a self-developed computer-based version of "d2 Test of Attention" was presented both with and without time pressure. The results show that older participants' overall driving performance (mean deviation from an ideal path) was worse in all conditions as compared to the younger ones. With regard to lane change reaction time both age groups were influenced by distraction in a comparable manner. However, when the lane keeping performance (standard deviation of the lateral position) was examined, the older participants were more affected than the younger ones. This pattern could be explained by compensation strategies of the older drivers. They focused on the most relevant part of the driving task, the lane change manoeuvres and were able to maintain their performance level in a similar way as did younger drivers. The driving performance of the older participants was not additionally impaired when the secondary task imposed time pressure. Overall, subjective rating of driving performance, perceived workload and perceived distraction was found to be similar for both age groups. The observed trends and patterns associated with distraction while driving should contribute to the further research or practical work regarding in-vehicle technologies and older drivers.

1. Introduction

The number of older drivers in the industrialized world is rising steadily. This leads to increasing concern about traffic safety as ageing is commonly associated with psychophysiological changes which can decrease driving ability. Literature reviews indicate that three factors are most relevant for the accidents of older drivers: an impaired visual perception, problems with attention allocation and a general slowing in decision making, planning and execution of actions (Ball, Owsley, Sloane, Roenker, & Bruni, 1993; Owsley, Stalvey, Wells, Sloane, & McGwin, 2001; Oxley, Fildes, Corben, & Langford, 2006; Rubin et al., 2007).

Many older drivers are aware of their limitations in functional capacities and adapt their driving patterns to match these changes by self-regulating when, where, and how to drive (Baldock, Mathias, McLean, & Berndt, 2006; Charlton et al., 2006). Several studies indicate that older drivers are able to compensate for their impairments by not driving in situations that

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doi:10.1016/j.trf.2011.08.005

make them uneasy and by simplifying the driving task, e.g., driving slower, driving less at night, on freeways or during bad weather (Bauer, Adler, Rottunda, & Kuskowski, 2003; Charlton, Oxley, Fildes, Oxley, & Newstead, 2003; Owsley, Stalvey, Wells, & Sloane, 1999). Besides, older drivers may profit from their life-long driving experience and maturity, as well as the flexibility to drive at times and places that they perceive as being safer. The traffic insight they have acquired may give them the ability to anticipate possible problematic situations. Hakamies-Blomqvist, Raitanen, and O'Neill (2002) found that compared to middle-aged drivers, older drivers had no increased crash risk per distance driven, when driving distances were controlled for.

Driver distraction is a significant contributor to road traffic accidents (Horberry, Anderson, Regan, Triggs, & Brown, 2006; McEvoy, Stevenson, & Woodward, 2007). Naturalistic driving studies demonstrate that drivers tend to spend a huge amount of driving time with secondary tasks (Klauer, Dingus, Neale, Sudweeks, & Ramsey, 2006). Laboratory experiments and driving studies show that these secondary tasks can substantially deteriorate driving safety. Up to 23% of all crashes and near-crashes are caused by the secondary task distraction (Klauer et al., 2006). The potential for a non-driving task to distract the driver is determined by the complex interaction of a number of factors including task complexity, current driving demands, driver experience and skill, as well as driver's willingness to engage in the task.

A great deal of research has been conducted on the effect of age on dual task performance, sometimes giving conflicting results (Lindenberger, Marsiske, & Baltes, 2000; McDowd & Shaw, 2000; Riby, Perfect, & Stollery, 2004; Salthouse & Miles, 2002; Verhaeghen, Steitz, Sliwinski, & Cerella, 2003). The reasons for the variable research findings in the literature could lie in the diversity of methods and the numerous task combinations used. The meta-analysis of Riby et al. (2004) conducted on the results of 34 studies found a strong overall effect size ($d = .68$), which indicated a clear age-related dual-tasking impairment. However, this effect size was not representative of all the individual studies reported. Subsequent analysis of study characteristics indicated that task domain was critical in moderating age differences in dual task performance. Notably, tasks with a substantial controlled processing (e.g., episodic memory) or motor component (e.g., tracking) showed greater dual task impairment than tasks that were relatively simple or relied on automatic processing (e.g., perceptual tasks). Lindenberger et al. (2000) suggest that a decline in sensorimotor processing in ageing results in more controlled processing mechanisms and therefore when faced with competing demands older adults are particularly impaired due to a deficit in executive control.

Disproportional impairments in the performance of elderly people are especially obtained with increasing complexity of the tasks (Kliegl, Krampe, & Mayr, 2003; Li et al., 2004). In the present experiment we increased the demands in the secondary task inducing time pressure by means of pacing. Eisdorfer (1968) suggested that pacing induces disproportional anxiety (arousal) in old persons, resulting in a performance decline. Plude and Hoyer (1986) found that the ability to discriminate relevant from irrelevant information is most impaired in elderly people if they have to perform the task under time pressure. Logie, Della Sala, MacPherson, and Cooper (2007) examined dual task demands on encoding and retrieval processes in younger and older adults and found that older people were more sensitive to time pressure in responding under dual task conditions. Based on the ageing and dual-task literature, we expect that as the dual-task demands increase, the driving performance of older drivers will deteriorate more than that of younger drivers.

Most of the research in the area of older drivers and distraction has focused on the use of mobile phones while driving. Several studies have demonstrated that the distracting effect of concurrent mobile phone use on driving performance is greater for older drivers compared with other age groups (Cooper et al., 2003; Hancock, Lesh, & Simmons, 2003; McPhee, Scialfa, Dennis, Ho, & Caird, 2004; Reed & Green, 1999).

In contrast, in a study by Strayer and Drews (2004) no such age differences have been found. They reported that the effects of hands-free phone conversation tasks on reaction time, following distance, and speed recovery after braking did not differ between younger and older drivers. One explanation for this inconsistent finding is that the performance of older drivers (aged 65–74) was compared to that of young, inexperienced drivers aged 18–25 years, rather than older, more experienced drivers, and these younger drivers may also be particularly susceptible to the effects of distraction.

Several studies have reported that older drivers demonstrate difficulty with the dual-task of following a route guidance system while driving (Dingus et al., 1997; Green, 2001). Dingus et al. reported that older drivers (65 years and older) drove more slowly and cautiously, while making more safety-related errors (e.g., increased lane departures) compared with younger drivers (16–18 years) when using an advanced traveller information system.

Despite the observed age-related decrements in dual task performance in many driver distraction studies, research has also shown that older drivers engage in self-regulatory behaviour while driving, in order to compensate for their greater performance decrements. Horberry et al. (2006), for example, examined the effects of distraction on driving performance of young, mid-age and older drivers. Participants were required to perform one of two secondary tasks while driving: operating an entertainment system and conducting a simulated hands-free mobile phone conversation in both simple and complex simulated driving environments. The performance decrements that occurred as a result of in-vehicle distraction were observed in both simple and complex road environments and for drivers in different age groups. The authors reported that older drivers had more difficulty performing the driving task while distracted and compensated by slowing their speed in complex highway environments. Although it appears that older drivers regulate their driving behaviour, they performed as well as younger drivers on the mobile phone task, indicating that they did not trade off mobile phone performance to enable them to drive safely. They slowed down to give themselves an increased margin for error, possibly because they knew they could not respond to hazards as quickly. Whether these compensatory behaviours of older drivers are sufficient to offset the degradation in their driving performance and reduce their crash risk, however, should be the focus of future research.