



## Older driver distraction: A naturalistic study of behaviour at intersections

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### ARTICLE INFO

#### Article history:

Received 28 October 2011  
Received in revised form 5 November 2012  
Accepted 20 December 2012

#### Keywords:

Older drivers  
Naturalistic driving  
Intersections  
Driver distraction  
Self-regulation

### ABSTRACT

This study examined older driver engagement in distracting behaviours (secondary activities) at intersections using naturalistic driving data from a larger study based in Melbourne, Australia. Of interest was whether engagement in secondary activities at intersections was influenced by factors such as driver gender and situational variables, in particular, those relating to the complexity of the driving environment. Specifically we expected that when making left/right turns, older drivers would reduce the proportion of time engaged in secondary behaviours at intersections which required gap judgements (partly controlled or uncontrolled) compared with intersections that were fully controlled by traffic signals. Consideration was given to engagement in secondary activity with hands off the wheel and when the vehicle was moving versus stationary. Older drivers aged between 65 and 83 years drove an instrumented vehicle (IV) on their regular trips for approximately two weeks. The IV was equipped with a video camera system, enabling recording of the road environment and driver and a data acquisition unit, enabling recording of trip distance, vehicle speed, braking, accelerating, steering and indicator use. Driving experience and demographics were collected and functional abilities were assessed using the Useful Field of View (UFOV), Trail Making Test B, Mini Mental Status Examination (MMSE), visual acuity and contrast sensitivity. The study yielded a total of 371 trips with 4493 km (99.8 h) of naturalistic driving data including 1396 left and right turns. Trips were randomly selected from the dataset and in-depth analysis was conducted on 200 intersection manoeuvres (approximately 50% left turns, 50% right turns). The most frequently observed secondary activities were scratching/grooming (42.5%), talking/singing (30.2%) and manipulating the vehicle control panel (12.2%). Glances "off road" 2 s or longer were associated with reading, reaching and manipulation of the vehicle control panel. Hands off the wheel was associated with reading. Key parameters associated with the percent of intersection time that drivers engaged in secondary activities were intersection complexity, vehicle status (moving vs. stationary) and traffic density. In conclusion, older drivers appeared to engage selectively in secondary activities according to roadway/driving situations, supporting the notion that drivers self-regulate by engaging in secondary tasks less frequently when the driving task is more challenging compared with less challenging manoeuvres.

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### 1. Introduction

Intersections feature prominently in the crash statistics for older drivers. Specific problem areas include failure-to-yield, looked-but-fail-to-see, and inaccurate gap selection (Benekohal et al., 1994; Stamatiadis et al., 1991; Staplin et al., 2001; Mayhew et al., 2006). Despite this widely acknowledged problem, there is limited understanding about the real-world driving behaviours of older drivers. In particular, relatively little is known about the role of inattention and the propensity for older drivers to engage in distracting behaviours whilst undertaking turning manoeuvres at intersections.

Previous research suggests that older drivers are more likely to be involved in crashes when turning across traffic (Griffin, 2004; Staplin et al., 1998; Chandraratna et al., 2002; Chandraratna and Stamatiadis, 2003; Mayhew et al., 2006) or when evaluating the gaps between their vehicles and other vehicles (Chandraratna and Stamatiadis, 2003; Oxley et al., 2006) compared to younger age groups. Recent literature has also demonstrated that a greater percentage of older drivers' intersection crashes occur at stop sign-controlled intersections than at signalised intersections (Oxley et al., 2006; Braitman et al., 2007; Preusser et al., 1998; Viano and Ridella, 1996).

Given the differences in older and younger driver crash types, researchers have speculated that the behaviours that lead to older driver crashes may be more related to inattention or slowed perception and responses than to deliberate unsafe actions that are more common in younger drivers (for a review, see Koppel et al., 2009). For example, Stutts et al. (2001) conducted an analysis of the

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1995–1999 Crashworthiness Data System (CDS) data to determine the role of driver distraction in police reported crashes in the United States (where at least one vehicle was towed away) and the specific sources of this distraction. Younger drivers (less than 20 years) were more likely than drivers 65 years and older to be identified as distracted at the time of their crash: 11.7% of younger drivers were found to be distracted, compared to 7.9% of older drivers. In contrast, older drivers were more than three times more likely to have “looked but didn’t see” (16.5%) listed as a contributing factor in crashes compared to younger drivers (5.4%). However, [Stutts et al. \(2001\)](#) reported that these differences were not statistically significant.

The findings of [Stutts et al. \(2001\)](#) are consistent with the findings of European research by [Hakamies-Blomqvist \(1994\)](#) who found that older drivers (65 years and older) were significantly less likely to be distracted by a non-driving activity (such as eating, drinking, smoking, listening to the radio, and conversing.) immediately preceding a crash (42%) than younger drivers (aged 26–40 years; 57%). Similar findings were reported in an Australian-based study. [McEvoy et al. \(2007\)](#) examined the prevalence and type of distracting activities involved in serious injury crashes. Interviews were conducted with hospitalised drivers within hours of their crash. Crashes involving a distracting activity were more likely to be reported by younger drivers (17–29 years) compared with drivers aged 50 years and older (39.1% vs. 21.9%).

In a recent study focusing on intersection crashes, [Braitman et al. \(2007\)](#) confirmed that failure-to-yield the right-of-way crashes increased with age and noted that the reasons for failure-to-yield crashes tended to vary by age. Using information from police reports and follow-up telephone interviews with drivers, the authors found that compared with drivers aged 35–54 years and 80 years and older, drivers aged 70–79 years made more evaluation errors – seeing another vehicle but misjudging whether there was adequate time to proceed. In contrast, drivers aged 80 years and older predominantly failed to see or detect the other vehicle. Drivers aged 35–54 years also tended to make search errors which were more often attributed to distraction.

A study of older driver ‘blackspot’ crash sites in Australasia noted that the principal problem for older drivers at intersections was selecting safe gaps ([Fildes et al., 2000](#)). The authors noted that the difficulty in gap selection was often exacerbated by factors such as high task complexity and the presence of other road users. It is also widely acknowledged that the increased complexity of intersections could produce very high momentary cognitive overload which would result in driving errors of the kind discussed above ([Hakamies-Blomqvist et al., 1999](#); [Hancock et al., 1990](#)).

While the over-involvement of older drivers in intersection crashes is well documented, it is possible that some older drivers modify this risk at least in part, through self-regulatory behaviour ([Charlton et al., 2006](#)). A number of older drivers reportedly use an extensive range of adaptive strategies including driving at slower speeds, avoiding adverse weather conditions, avoiding busy traffic, limiting driving to the daytime and travelling shorter distances ([Baldock et al., 2006](#); [Charlton et al., 2003, 2006](#); [Smiley, 2004](#)).

Despite the successful use of self-regulation in a range of contexts, it is less well known whether older drivers modify their driving at intersections and in particular, whether their self-regulation is associated with reducing secondary (non-driving related) activity at times of high cognitive load. A small number of published studies have surveyed drivers’ self-reported engagement in or intention to engage in secondary activities, albeit predominantly with younger and middle-aged drivers. Findings suggest that older drivers are also less likely to report eating or drinking in the car compared to other age groups. Further, approximately 40% of older drivers reported using stops in traffic to engage in

secondary activities ([Young and Lenne, 2010](#)). Similarly, surveys conducted by [Lansdown \(2012\)](#) have found that age was negatively predictive of engagement in distracting behaviours. [Lerner et al. \(2008\)](#) also reported age group differences in drivers’ propensity for distraction, including use of mobile telephone or navigational system and eating, when driving. A consistent finding was that older drivers were less willing to engage in these behaviours than younger drivers and perceived the risk of engaging in secondary activities to be higher than the younger drivers.

While the findings reviewed above suggest that older drivers may self-regulate distracting behaviours, they are derived from drivers’ self-report data, which may or may not differ from real-world driving behaviours. With developments of covert in-vehicle technologies and naturalistic driving methods for monitoring driver behaviour, there is a growing body of evidence on drivers’ frequency of engagement in distracting activities and their role in crash causation ([Dingus et al., 2006](#); [Klauer et al., 2005](#); [Sayer et al., 2005](#); [Stutts et al., 2003](#)). Research from the 100-Car Study showed that almost 80% of all crashes and 65% of near crashes involved the driver looking away from the road prior to the conflict ([Dingus et al., 2006](#)). U.S. naturalistic data also shows that the most common distracting behaviours are manipulating audio controls, conversing, eating or drinking, grooming, reading or writing and using a mobile ([Sayer et al., 2005](#); [Stutts et al., 2003](#)).

Observational studies using naturalistic methods have also identified some negative consequences of distraction on driver performance. For example, [Stutts et al. \(2003\)](#) reported that reading, mobile telephone use and reaching for an object were associated with an increased likelihood of the driver taking both hands off the steering wheel. Intuitively, this action can result in the vehicle wandering within the lane or crossing into adjacent lanes. Furthermore, the secondary activities of reaching, reading and using a mobile telephone were associated with the diversion of drivers’ eyes off the roadway. What remains unclear is whether these findings generalise to the older driver population. The sample sizes were small and unrepresentative and no specific figures were given for older drivers as a group.

An advantage of using naturalistic methods to study driving behaviour is that this affords the opportunity to investigate driving patterns across a range of driving situations and conditions. For instance, [Sayer et al. \(2005\)](#) found that drivers of all ages were less likely to engage in some distracting behaviours when braking, on wet roads, travelling around bends, or during night driving. This study suggested that drivers choose to perform secondary activities at what might be perceived as safer times. [Stutts et al. \(2003\)](#) also found that drivers tended to engage in distractions more frequently when they were stationary than when they were moving. To date, this approach has not been applied in the study of older driver distraction.

This study examined older driver engagement in distracting behaviours (secondary activities) at intersections using naturalistic driving data from a larger study based in Melbourne, Australia. Of interest was whether engagement in secondary activities at intersections was influenced by driver characteristics and situational variables, in particular, those relating to the complexity of the driving environment. The primary hypothesis was that older drivers would exercise a greater level of self-regulation by reducing potential distractions during complex driving manoeuvres. Specifically we expected that when making left/right turns, older drivers would reduce the proportion of time engaged in secondary activities at intersections which required gap judgements (partly controlled or uncontrolled) compared with intersections that were fully controlled by traffic signals. In addition, consideration was also given to level of engagement in secondary activities when the vehicle was moving versus stationary. It was expected that the driver might perceive that driving task is more demanding when the vehicle

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