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The effects of texting on driving performance in a driving simulator: The influence of driver age

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ABSTRACT

Distracted driving is a significant contributor to motor vehicle accidents and fatalities, and texting is a particularly significant form of driver distraction that continues to be on the rise. The present study examined the influence of driver age (18–59 years old) and other factors on the disruptive effects of texting on simulated driving behavior. While 'driving' the simulator, subjects were engaged in a series of brief text conversations with a member of the research team. The primary dependent variable was the occurrence of Lane Excursions (defined as any time the center of the vehicle moved outside the directed driving lane, e.g., into the lane for oncoming traffic or onto the shoulder of the road), measured as (1) the percent of subjects that exhibited Lane Excursions, (2) the number of Lane Excursions occurring and (3) the percent of the texting time in Lane Excursions. Multiple Regression analyses were used to assess the influence of several factors on driving performance while texting, including text task duration, texting skill level (subject-reported), texting history (#texts/week), driver gender and driver age. Lane Excursions were not observed in the absence of texting, but 66% of subjects overall exhibited Lane Excursions while texting. Multiple Regression analysis for all subjects ($N=50$) revealed that text task duration was significantly correlated with the number of Lane Excursions, and texting skill level and driver age were significantly correlated with the percent of subjects exhibiting Lane Excursions. Driver gender was not significantly correlated with Lane Excursions during texting. Multiple Regression analysis of only highly skilled texters ($N=27$) revealed that driver age was significantly correlated with the number of Lane Excursions, the percent of subjects exhibiting Lane Excursions and the percent of texting time in Lane Excursions. In contrast, Multiple Regression analysis of those drivers who self-identified as not highly skilled texters ($N=23$) revealed that text task duration was significantly correlated with the number of Lane Excursions. The present studies confirm past reports that texting impairs driving simulator performance. Moreover, the present study demonstrates that for highly skilled texters, the effects of texting on driving are actually worse for older drivers. Given the increasing frequency of texting while driving within virtually all age groups, these data suggest that 'no texting while driving' education and public service messages need to be continued, and they should be expanded to target older drivers as well.

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1. Introduction

Distracted driving is a significant and increasing contributor to motor vehicle accidents and distraction-related accident fatalities (Olson et al., 2009; Lee et al., 2013). Lam (2002) estimated that distractions were responsible for approximately 4% of traffic crashes; more recently, Bakiri et al. (2013) suggested that distraction-related factors accounted for 8% of injurious road crashes. The National Safety Council (NSC, 2010) reported that cell phone use of any sort causes 28% of all crashes each year. Hoff et al. (2013) reported that nearly 10% of drivers reported being involved in a motor vehicle accident related to distracted driving. Consistent with these reports, various distractions also impair driving performance in driving simulator studies (Neyens and Boyle, 2008; Lam, 2002; Strayer and Drews, 2004; Beede and Kass, 2006). Indeed, cell phone use while driving has been reported to be more disruptive than ethanol intoxication (Strayer et al., 2006).

Driver age and experience have been demonstrated to affect the extent of distraction-induced driving impairment, with mature drivers typically being found to be less affected by distraction than

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either much younger or much older drivers. Several investigators (Horberry et al., 2006; McPhee et al., 2004; Cooper et al., 2003; Lee et al., 2003) have reported that older drivers (e.g., 60–73 years old) are more affected by distraction when compared to mature drivers (e.g., 31–44 years old). Moreover, Strayer and Drews (2004) have reported that the effects of distraction in older drivers (e.g., 65–74 years old) are comparable to the effects of distraction in younger, less experienced, drivers (18–25 years old). Recently, Klauer et al. (2014) have reported that the odds ratio for a distraction-related motor vehicle crash or near-crash was greater for novice drivers (newly licensed; Mean = 16.4 years old) when compared to experienced drivers (Mean = 36.2 years; data from 100 car study; Klauer et al., 2006). Taken together, these studies suggest that middle-age mature drivers are less affected by distractions than either older or younger drivers.

Texting while driving is a particularly potent yet increasingly likely form of distraction, and incidents of texting while driving and accidents relating to texting while driving continue to be on the rise (O'Malley et al., 2013; Wilson and Stimpson, 2010). In driving simulator studies, texting has been reported to be very disruptive as well (Neyens and Boyle, 2008; Hosking and Young, 2009).

Past studies on the impact of texting on driving have focused primarily on young adults (Neyens and Boyle, 2008; Hosking and Young, 2009), in part because this group represents the 'texting generation' and because these drivers are generally less experienced and therefore are presumably more likely to be affected by distractions while driving (Fofanova and Vollrath, 2011). While texting continues to be more prevalent in young adults, many older individuals now use texting as a frequent form of communication (CTIA, 2012). Furthermore, it is likely that many of these 'older texters' are also texting while driving (Harris Interactive, 2011). At present, there are no studies examining the effects of texting on driving performance across a broad range of driver ages.

The purpose of the present study, therefore, was to examine the effects of texting on driving simulator performance across a broad range of driver ages. One might hypothesize that mature drivers would be less affected by texting because of their maturity and driving experience. Alternatively, one might hypothesize that mature drivers will be more affected by texting while driving because they are not as practiced and efficient as technological multi-taskers, particularly as texters, when compared to younger drivers. In addition to driver age the influence of driver gender, driver texting skill level and text task duration also were evaluated.

2. Materials and methods

2.1. Subjects

All research subjects were unpaid volunteers, over 18 years of age; most subjects were recruited from the population of students, faculty and staff at the Eugene Applebaum College of Pharmacy and Health Sciences (EACPHS) at Wayne State University. Volunteers who did not use texting as a regular form of communication (operationally defined as $\leq$5 text messages/week) were excluded, as were volunteers who did not have a valid drivers license. Volunteers who did not have reliable and fast cell phone service in the driving simulator room (there was a pre-test of cell phone/texting service prior to the experiment; the driving simulator room turned out to be a 'dead zone' for one cell phone service provider) were excluded. Finally, volunteers who experienced 'simulator sickness' (dizziness, queasiness, nausea) during the pre-test drive (see details below) were not tested or included as experimental subjects. Overall, approximately 10% of initial volunteers were excluded from participating as subjects; the reasons for exclusion were either (1) lack of cell phone service in the Driving Simulator Room or (2) simulator sickness after the pre-test drive. This study was approved by the WSU Behavioral IRB (#063413B3X).

2.1.1. Subject demographics

There were 27 female and 23 male subjects, distributed across a range of ages (18–24, $N = 12$; 25–34, $N = 16$; 35–44, $N = 9$; 45–59, $N = 13$; overall, 34.5 ± 11.7 [Mean $\pm$ SD]). The subjects reported 18 ± 12 (Mean $\pm$ SD) years of driving experience, with approximately 246 ± 246 (Mean $\pm$ SD) miles driven per week (range: 10–1000). Texting Skill Level was self-reported by subjects and sorted into one of three categories: (1) limited (hunt and peck; $N = 7$); (2) good (use two hands; $N = 16$); (3) skilled (one-handed texting; $N = 27$). Texting history was self-reported by subjects and sorted into one of four categories: (1) 6–10 texts/week ($N = 6$); (2) 11–50 texts/week ($N = 15$); (3) 51–500 texts/week ($N = 22$); (4) >500 texts/week ($N = 7$).

2.2. The EACPHS driving simulator

Study participants were seated in a fixed base driving simulator (DriveSafety, Inc) that consists of a four-door vehicle (2001 Chevrolet Impala) fully equipped with steering wheel, pedals, ignition switch, gear shift, rear and side view mirrors, headlights, turn signals and a radio. A fully immersed virtual driving experience was created by six networked computers generating the simulated roadway via three forward projection screens (left, center, right) to provide a 150° forward field of view, and one rear projection screen. Driving scenarios were created using HyperDrive software, a tile-based scripting tool.

The 'road' for the present study was created to assess primarily the ability of the drivers/subjects to remain in their intended lane during periods of texting and not texting; it was a two lane 'country' road with several minor turns, no intersections, no stop signs and no stop lights. There was no oncoming traffic.

2.3. Experimental design

The Study consisted of four phases, all conducted within a single 30-min test session. In phase 1, subjects 'drove' the simulator in a brief (3–5 min) drive (50–60 mph) to acclimate to the driving experience. In phase 2, the subjects completed a brief survey asking about demographic information, their texting behavior and some of their driving habits. In phase 3, the subjects again drove the simulator; on this drive the subjects were engaged in series of brief text conversations (three questions requiring brief answers) with a member of the research team. In phase 4, the subjects reflected on their experience in a brief exit survey.

2.4. Data collection and analysis

Data from the simulator computers were collected and sorted into the following categories/bins: (1) 30-s periods before texting, (2) the periods when the subject was texting and (3) the 30-s periods after texting. The Text Task Duration was defined as starting at the time the subject received a text message, and ending at the time the subject sent a text reply. Texting status (i.e., pre-during-post) was judged by a trained 'texting judge' who was watching a projected video image from an in-car camera; the texting judge was 'blind' regarding any other aspects of the drive (car location on the road, etc).

2.5. Statistical analyses

The primary dependent variable monitored during driving was Lane Excursions, which were defined as any time the center of the

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