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Simulation of texting impact on young drivers' behavior and safety on motorways

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ABSTRACT

Texting while driving seems to be a widespread behavior, which has been associated with a non-negligible proportion of road accidents, especially among younger drivers. The impairment of the driver's behavior and the related risks may be increasing on motorways, taken into consideration the fact that there are high vehicle speeds and the necessary reaction time is decreased. This research aims at investigating the impact of texting on young drivers' behavior and safety on motorways. For this reason, a driving simulator experiment was carried out, in which 34 young participants drove in different driving scenarios (moderate/high traffic, good/rainy weather). Lognormal regression methods were used to investigate the influence of text messaging as well as various other parameters on the mean speed and the mean headway. Moreover, binary logistic methods were used to investigate the influence of texting and other parameters on the probability of an accident. Results suggest that texting leads to statistically significant decrease of the mean speed and to increased headway in normal and in specific traffic and weather conditions on motorways, as drivers appear to produce compensatory behavior while texting. Furthermore, texting leads to increased accident probability, probably due to longer reaction time of the driver at unexpected incidents. Analyzing the driving performance of those who text while driving may lead to the identification of measures for improving their driving performance such as restrictive measures, training and licensing, and information campaigns.

1. Introduction

While driver distraction is estimated to be an important cause of vehicle accidents, the use of mobile phones is considered as a major factor that distracts driver attention. The rapid growth of the possession and use of mobile phones in recent years, has generated a wide interest and a range of studies have shown that the use of cell phones has adverse consequences on driver's behavior and the probability of being involved in an accident. Early research results showed that cell phone communication is a quite demanding cognitive and operational task, which may compromise decision making while driving

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(McKnight & McKnight, 1993). Recent studies confirm that mobile phone use while driving may significantly affect driver's behavior and safety (Caird, Willness, Steel, & Scialfa, 2008; Horberry, Anderson, Regan, Triggs, & Brown, 2006; McEvoy et al., 2005; Patel, Ball, & Jones, 2008; Strayer, Drews, & Johnston, 2003).

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

Percentages of drivers receiving, reading or replying to messages on their mobiles while driving reach 70%, 81% and 92% respectively (Atchley, Atwood, & Boulton, 2011; Nelson, Atchley, & Little, 2009). Texting while driving remains a common behavior even in countries where law prohibits it. In Australia, 27% of drivers admit texting while driving and in the United States of America (USA) the respective percentage among young drivers reaches 60% (Vlingo Corporation, 2009; White, Walsh, Hyde, & Watson, 2010). Using the keyboard of the mobile is considered even more dangerous than talking on the mobile while driving, as accident probability increases by 23.24, 5.93 and 1.04 times respectively for commercial driver texting, dialing, and talking, compared to free driving (i.e. without talking or texting) (Olson, Hanowski, Hickman, & Bocanegra, 2009). This is probably because texting or dialing requires frequent and long observation of the phone. Looking away from the road for more than 3 s increases the accident probability (Klauer, Dingus, Neale, Sudweeks, & Ramsey, 2006).

In addition, texting entails a motor act (typing) which requires additional resources. In this framework, Hosking et al. (2009) asked 20 participants to drive a computer simulated roadway that contained a number of emerging threat events, a car following episode, and a lane-change task. Results indicated that drivers were particularly impaired when sending text messages and less so when receiving. In particular, they found that drivers' ability to maintain their lateral position, their ability to detect and respond to traffic signs, the amount of time spent looking at the road, and their following distance, were all impaired when sending and receiving text messages.

Texting causes difficulty in retaining a stable position within traffic lanes (Crisler et al., 2008), doubles reaction time (Cooper, Yager, & Crysler, 2011). When texting, drivers react more slowly to information in the peripheral field of vision, drive more slowly, sway more and watch the road less often compared to when using the call function (SWOV, 2010).

In a driving simulator research (Drews, Yazdani, Godfrey, Cooper, & Strayer, 2009) 20 participants drove a simulated roadway while sending and receiving text messages using their mobiles. Additionally, the text messages sent and received in this study were shared between actual friends, thus the actual communication was likely more representative of every-day text messages. The driving tasks consisted of following a periodically braking lead vehicle down a 65 mph two–three lane roadway. Results indicated that when texting, participants expressed greater following variability, greater lateral variability, reduced response time to the lead vehicle, and an increase in collision frequency. Brake response times associated with reading were reported to be higher than those associated with writing. However, because the reading and writing portions of this research were not balanced, the actual amount of driving time associated with reading was likely very low.

Furthermore, Cheung (2010) found that due to texting while driving, the lateral deviation increased by 280% compared to free driving. The vast majority of the respondents to a survey in the USA (95%) admitted texting while driving despite recognizing the increased associated risk (Atchley et al., 2011). The risk associated with texting while driving is estimated 5 times higher than that associated to driving under alcohol influence (Klauer et al., 2006). Sometimes, distracted drivers adopt behaviors to compensate for their delayed responses (Horrey & Simons, 2007). However, few young drivers alter their driving behavior to make up for the recognized increased risk of texting while driving (Atchley et al., 2011; Nelson et al., 2009).

The combination of all the aforementioned findings with a research based on motorways – where the vast majority of the accidents are considered serious – can provide further insight on the impact of texting on drivers' behavior and safety. Examining specifically the case of young drivers, one of the most vulnerable groups of drivers and very keen mobile users, may also contribute to the better understanding of texting as a driving distraction and its consequences.

Within this context, driving simulators have become a widely used tool for examining the impact of driver distraction, with respect to individual driver differences and/or roadway design, as examining distraction causes and impacts in a controlled environment helps provide insights into situations that are difficult to measure in a naturalistic driving environment.

This research aims to investigate the interrelation between texting while driving, speed, headways and accident probability of young drivers on motorways, through a driving simulator experiment. Particularly, mean speed, mean distance from the vehicle ahead and the possibility of an accident are the independent variables that examined in order to render the impact of texting on drivers' safety and behavior on motorways. Likewise, the effect of texting in combination with road type (motorway), traffic characteristics (moderate/heavy traffic), environmental conditions (good weather, rain) and driver characteristics (gender, annual mileage, driving habits) is further explored (Table A1).

2. Methodology

Within this research, a driving simulator experiment was implemented in order to investigate the impact of texting on driving in combination with specific driver and road environment characteristics. The driving simulator experiment took place at the Department of Transportation Planning and Engineering of the National Technical University of Athens where a motion based quarter-cab driving simulator is placed (Gkartzonikas, 2012).