7th Symposium of the European Association for Research in Transportation conference – hEART 2018
5-7 September 2018, Athens, Greece

Mobile phone use and night time driving: impact on driving behaviour

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Keywords: Driving,driver distraction, road safety, driver behavior, reaction time, maximum speed, discrete choice analysis, mobile phone, experiment, driving simulator

1. Introduction

Driver distraction constitutes a particular human factor of road accident causation. Driver distraction is generally defined as "a diversion of attention from driving, because the driver is temporarily focusing on an object, person, task or event not related to driving, which reduces the driver's awareness, decision making ability and/or performance, leading to an increased risk of corrective actions, near-crashes, or crashes" (Regan et al., 2008). More specifically, driver distraction involves a secondary task, distracting driver attention from the primary driving task (Donmez et al., 2006; Sheridan, 2004). Mobile phone use is a source of driver distraction and the cause for a number of traffic accidents. Hence, in most countries mobile phone use while driving is prohibited or only allowed under specific conditions (e.g. use in speaker mode). In particular, in Greece the use of a mobile phone while driving is allowed only in the Bluetooth or speaker mode. At the same time, drivers in Greece tend to use their mobile phone while driving rather frequently, via various modes (handheld, hands-free, speaker). Hence, it is important to estimate the effect of the different modes of mobile phone on driving behaviour to identify whether the existing legislation answers the risks imposed from its use.

There is a substantial number of studies that investigate the impact of mobile phone on driving behaviour (Consiglio *et al*., 2003; Patten *et al.*, 2004; Dragutinovic and Twisk, 2005; Kass S., *et al*. 2007; Benedetto *et al*. 2012; Yiannis *et al*. 2013; Papantoniou *et al*., 2014); however, only a few of them explore the differences between the different possible use modes. At the same time, the vast majority of the existing studies involve daytime driving. This research aims to investigate the impact of mobile phone conversation, considering various modes, on drivers' behaviour at night, along with different drivers' characteristics and road environment parameters.

2. Methodological framework

For the purpose of the study, a driving simulator experiment was designed on the FOERST Driving Simulator FPF, in which 55 participants drove at night-time simulator conditions, in different road environments (urban and rural area) and under different types of distraction (no distraction, hand-held conversation, hands-free conversation and speaker mode conversation). In the framework of the present experiment two routes had been developed in order to estimate the effect of area type on distracted driving performance. More specifically, a divided urban arterial and an undivided two-lane rural road were simulated to represent different road environments – namely, urban and rural road networks. The rural route was a single carriageway (3m width) about 2,5km long, with zero gradient and mild horizontal curves. The urban route was 2,5km long, with its main part being a dual carriageway, separated by guardrails, and the lane width was 3,5m. Moreover, narrow sidewalks, commercial uses and parking were available at the roadsides while two traffic controlled junctions, one stop-controlled junction and one roundabout were located along the route.

The experiment was carried out during late afternoon and evening hours, so as to resemble night- time conditions both in the simulator and the actual environment. Furthermore, to estimate reaction time, a "STOP" sign appeared on the vehicle windscreen at different specific locations along the route, at the sight of which drivers were instructed to decelerate to a complete stop. Each participant drove using all three investigated mobile phone use modes: handheld, hands-free and speaker in both road environments. In each drive the participants drove both with one of the different mobile phone use modes and without distraction, in order to establish a base condition. The order of the design parameters mobile phone use, road environment and location of "STOP" sign appearance varied both within the drives and between the drivers to avoid order effects. The final study sample size was 55 participants, 34 male and 21 female (aged between 19 and 62 years old), who use a mobile phone and obtain a driving license. In addition to the simulator experiment, participants filled-in a questionnaire to obtain information on elements of their driving behaviour, use of mobile phone while driving, socioeconomic characteristics, and so on.

The impact of mobile phone use was captured through several driving behaviour indicators. These were: reaction time, maximum driving speed and speed deviation, acceleration, event deceleration and normal deceleration. First, the aforementioned driving behaviour indicators were classified into three categories according to their measured values – namely, low, "normal" and high. The effect of the different scenario parameters on driving behaviour was established with the design of discrete choice models (ordered probit with random effects). In these models, the aforementioned indicators were the dependent variable, while independent variables varied between the different indicators and included mobile phone use mode, age, gender, mobile phone use familiarity and so on.

3. Results

Results indicate that mobile phone use is significantly affecting driving performance. In particular, reaction time increases both in rural and urban area when driving under distraction, regardless of the manner in which the mobile phone is used and with hand-held conversation causing the greatest increase. The resulting models for driving speed also indicated that participants driving under the influence of mobile phone conversation, generally, tend to reduce their maximum speed. Other contributing parameters involved driver age and gender, attitudes towards driving and frequency of mobile phone use while driving. The latter may pave way to different approaches in driver training in countries where mobile phone use while driving is permitted. It must be emphasized that results indicated that all investigated mobile phone modes impair driving behaviour also during the night. Hence, legislation that allows specific modes of mobile phone use might not be as safe as originally anticipated, and may need to be reconsidered.

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