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Driving performance while using a mobile phone: A simulation study of Greek professional drivers

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ABSTRACT

Purpose: The current study aims to assess the driving performance of professional drivers while using a mobile phone.
Material and methods: A sample of 50 male professional drivers participated in the study. The sample was drawn conveniently from the professional drivers' registries and the main taxi ranks. The inclusion criteria were: (a) age above 18 years, (b) possession of a driving license, (c) sufficient reading, writing, and communicating skills, (d) informed consent prior to participation. Laboratory tests were conducted using the VS500M driving simulator manufactured by Virage Simulation Inc. The intervention involved different tasks/assignments: (a) driving without using a mobile phone (Control time), (b) driving while having a conversation on the mobile phone, (Task_1), (c) driving while reading out loud text messages (Task_2) and, (d) driving while texting (Task_3). Differences in the driving performance between the control time and the time with assignments, were examined. The participants were evaluated on the followings outcome measures: (a) variation of the steering position per second, (b) following distance per second, (c) variation of the lateral lane position per second, and (d) sum of squared acceleration per second.
Results: The analysis indicated that "variation of the steering position per second" was significantly affected by "text-message reading" [$t(50) = -5.443$; $p < 0.0001$] and "texting" [$t(50) = -5.442$; $p < 0.0001$]. A significant main effect was observed in terms of the "following distance per second" and the "variation of the lateral lane position per second" for all the three mobile phone assignments. Lastly, the "sum of squared acceleration per second" was significantly decreased during conversation on the phone [$t(50) = 2.713$; $p = 0.009$] as well as during texting [$t(50) = 3.428$; $p = 0.001$] as compared with the control time.
Conclusions: The study is among the few existing experimental studies in a country with one of the highest road fatalities in Europe but with limited evidence on road traffic behaviour. This study could guide the design of large-scale simulation studies aiming to explore the impact of mobile phone on driving behaviour.

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1. Introduction

In the last two decades there is a wealth of research on the effect of mobile telephone use on driving performance and crash risk (McEvoy, Stevenson, & Woodward, 2007). This scientific interest in mobile telephone has been led by the increased number of drivers (60–70%) using a mobile phone while driving and by the fact that 1–4% of the drivers use a mobile phone at any given moment during the day (Dragutinovic & Twisk, 2005). Epidemiological studies suggest that over 50 min a month of mobile telephone use during driving is associated with a five-fold increase in accident liability (Violanti & Marshall, 1996), with a risk comparable to intoxication at the legal maximum (Redelmeier & Tibshirani, 1997) and with a higher proportion of rear-end collisions (Wilson, Fang, Wiggins, & Cooper, 2003). A major issue of concern is that drivers do not consider mobile telephone use as risky as other activities a driver may be engaged with simultaneously to driving (e.g. food or liquid consumption, children's care while driving etc.) (Lerner, Singer, & Huey, 2008).

Research has identified a number of behaviours and measures that are affected by the use of a mobile telephone while driving. These include impaired gap judgment (Bowditch, 2001), reduced sensitivity to road conditions (Haigney, Taylor, & Westerman, 2000); poor lane maintenance (Reed & Green, 1999), increased heart rate and subjective workload (Brookhuis, De Vries, & De Waard, 1991; Haigney et al., 2000), and a reduction in headway (Lamble, Kauranen, Laakso, & Summala, 1999). The most reported problem with using mobile telephones, however, is the increase in reaction times to driving-related events (e.g. brake lights, etc.), and an increase in the number of such events missed altogether (Hancock, Lesch, & Simmons, 2003; Irwin, Fitzgerald, & Berg, 2000; McKnight & McKnight, 1993; Patten, Kircher, Ostlund, & Nilsson, 2004; Strayer, Drews, & Johnston, 2003; Strayer & Johston, 2001). This has a great direct influence upon driver safety. Research with simulators has confirmed that increased risk of mobile phone usage is highly linked to the impairment caused to some very crucial aspects of driving performance (Bowditch, 2001; Brookhuis et al., 1991; Goodman, Bents, Tijerina, & Wierwille, 1999; McKnight & McKnight, 1993; Wikman, Nieminen, & Summala, 1998). Dragutinovic and Twisk (2005) acknowledged inattention and physical and cognitive distraction as the major effects of mobile conversation. Physical distraction occurs when drivers undertake multiple tasks while driving such as searching or dialling numbers in their mobile phone, while cognitive distraction occurs when drivers have to divert part of their attention from driving to a telephone conversation. Garcia-Larrea, Perchet, Perrin, and Amenedo (2001) identified a general decrease in attention to sensory inputs, common to both handheld and hands-free telephones. This reflects a general consensus in the literature that though hand-held telephones maybe particularly detrimental to concurrent motor tasks, hands-free telephones can also interfere with driving behaviour (Lamble et al., 1999; Patten et al., 2004; Strayer & Johston, 2001). Although evidence is strong, no consensus has been reached yet on the processes and mechanisms which explain this link between driving performance and mobile telephone use. Taken together the evidence thus far, suggests that conversing via mobile telephones (either hand-held or hands-free) interferes with the processing of visual information during driving. This may seem to contradict many studies that support sensory-specific attentional resources (Wickens, 1980), especially the superior performance of both a visual and auditory task compared to two tasks that share the same modality (Parkes & Coleman, 1990; Treisman & Davies, 1973). However, multiple resource theory (Wickens, 2002), proposes four dimensions on which tasks may overlap, and therefore, draw on the same limited pool of attentional resources. For instance, one dimension distinguishes between processing stages, including perception, cognition and responding. If the conversation requires cognition, or perhaps a verbal response to a question, this may interfere with any aspect of driving that employs those respective processing stages. Thus, multiple resource theory can accommodate the notion that a conversation could draw upon the same attentional resources that are used for critical sub-tasks in driving.

The current study aimed to investigate the effect of mobile phone use on the driving performance of professional drivers and particularly taxi drivers. Mobile phone use is thought to be both a widespread and frequent activity among this group of drivers, constituting their sole or major part of the working day. Mobile phone is also considered to be a communicational device, which offers important advantages in the working routines of this group of drivers. It was hypothesised that the mobile phone use would affect all the outcome measures. It was further expected that texting and text-message reading would manifest a greater effect on drivers' performance than conversation on the phone.

The current study is important for various reasons. In Greece, there is no surveillance system or any registered data on mobile phone related crashes (Greek Ministry of Internal Affairs, 2007, 2008), although prevention of RTCs is one of the first priorities for the Greek government (Greek Ministry of Transport, 2009). Despite the huge number of fatalities under driver causation, this particular area of safety research is still neglected in Greece. Additionally, in Greece there are no records on the number of drivers who use a mobile phone or the number of offenses or traffic collisions due to cell phone use while driving (Home Office, 2007, 2008).

2. Material and methods

2.1. Participants' recruitment

A sample of 50 male professional taxi drivers participated in the study. They were recruited through local adverts, through driver training schools and through taxi ranks. All participants were above 18 years old, held a professional drivers' license, had normal or corrected to normal vision and did not suffer from migraines, epilepsy or motion sickness. Sufficient