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Influence of personal mobile phone ringing and usual intention to answer on driver error

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ABSTRACT

Given evidence of effects of mobile phone use on driving, and also legislation, many careful drivers refrain from answering their phones when driving. However, the distracting influence of a call on driving, even in the context of not answering, has not been examined. Furthermore, given that not answering may be contrary to an individual's normal habits, this study examined whether distraction caused by the ignored call varies according to normal intention to answer whilst driving. That is, determining whether the effect is more than a simple matter of noise distraction. Participants were 27 young drivers (18–29 years), all regular mobile users. A Theory of Planned Behaviour questionnaire examined predictors of intention to refrain from answering calls whilst driving. Participants provided their mobile phone number and were instructed not to answer their phone if it were to ring during a driving simulation. The simulation scenario had seven hazards (e.g. car pulling out, pedestrian crossing) with three being immediately preceded by a call. Infractions (e.g. pedestrian collisions, vehicle collisions, speed exceedances) were significantly greater when distracted by call tones than with no distraction. Lower intention to ignore calls whilst driving correlated with a larger effect of distraction, as was feeling unable to control whether one answered whilst driving (Perceived Behavioural Control). The study suggests that even an ignored call can cause significantly increased infractions in simulator driving, with pedestrian collisions and speed exceedances being striking examples. Results are discussed in relation to cognitive demands of inhibiting normal behaviour and to drivers being advised to switch phones off whilst driving.

1. Introduction

It is well-established that inattention when driving and improper lookout are primary causes of driving collisions (e.g. Treat et al., 1979). For example, Hendricks et al. (1999) reported that of 723 crashes, 37.8% were caused by driver inattention or perceptual errors. Drivers have also been shown to be at a higher risk of collisions with stationary vehicles when disrupted by a secondary task (Langham et al., 2002). One such secondary task that has been investigated is the influence of using a mobile phone whilst driving.

An increasing number of consumers own mobile phones, and mobile phone technology has progressed immensely to the extent that individuals are able to send and receive pictures, video files, and e-mail at their convenience. With increasing functionality, "on-the-go" use places a potential risk for those on the road including the driver themselves, passengers and pedestrians (Ferguson, 2003; Peters and Peters, 2002; Lam, 2002). When dialling and receiving mobile phone calls a physical interaction must be made with most units. However, the physical interaction, or amount of time with "hands off the wheel, eyes off the road" is not the only issue. The secondary task of dialling numbers, keying texts or other responses have been shown to be associated with cognitive processing demands resulting in further interference with driving performance (Haigney et al., 2000), underlining the fundamental importance of research into the effects of mobile phone usage on driving.

On road, simulator, and accident report data have all shown a link between mobile phone use and driver errors or collisions. An on road observation study with in-car cameras (Virginia Tech Transportation Institution, 2009) reported that drivers who manually manipulate their mobile phones for calling or text messaging whilst driving were 23 times more likely to crash or be involved in an actual traffic incident. Other evidence has demonstrated that those who engage in mobile phone conversations have a higher risk of failing to notice traffic signals and have slower reaction times when detecting traffic signals compared to those who do not engage in mobile phone conversations (Strayer and Johnston, 2001). This is further supported by Hancock et al. (2003), finding that fewer drivers stopped for red rights in the presence of a mobile phone task than when driving without such a secondary task. Redelmeier and Tibshirani (1997) evaluated 699 mobile phone related motor vehicle collisions. From this analysis the authors reported that 24%

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of these individuals were found to have used their phone during a 10 min period preceding the accident. The authors concluded that drivers using mobile phones are approximately four times more likely to be involved in a car crash than when they do not use it.

The precise effect of this kind of distraction on aspects of driving performance has also been examined. Young et al. (2003) established that mobile phone using drivers have impaired judgments with regards to visual environments, lateral positioning and decision-making skills, particularly in terms of speed of response. Additional evidence reported that drivers' braking reaction times were also shown to increase when they drove with a distraction (i.e. using a hand-held mobile phone) in comparison to driving without this distraction (Consiglio et al., 2003) and Lamble et al. (1999) reported that when following a lead vehicle there was an increased reaction time as well as impaired ability to maintain lane position, with increased variability in steering wheel and speed control (also Reed and Green, 1999). This accumulation of evidence indicates that specific infractions are more likely to occur when drivers use mobile phones.

However, these studies were largely investigating hand-held devices or those that require physical manipulation and diversion of visual gaze. There is also evidence to suggest that hands-free mobile usage, without physical manipulation, and other voice-activated in-car technologies, can have distraction effects on drivers' attention to the driving task or traffic scenarios, with McKnight and McKnight's 1993 simulation study clearly showing the separate effects of conversation on failure to respond to hazards. They found a difference between simple and complex conversations, underlining the influence of cognition. It may be that vehicle control skills (e.g. steering) would be less likely to be affected by distracting secondary tasks that involve a cognitive component only (hands-free distraction) since these are relatively well-learnt, automatic responses, as opposed to cognitively demanding decision-making and response to hazards. Previous studies (e.g. Strayer et al., 2003) have found that hands-free conversation can impair reaction time, especially in high density traffic conditions but have not compared subcomponents of the driving task. Some research has shown little difference in the effects of hands-free versus hand-held (Törnros and Bolling, 2005, 2006; Consiglio et al., 2003), but a meta-analysis of Norwegian data, (Backer-Grøndahl and Sagberg, 2011) found that the relative risk was indeed higher for hand-held phones. One aim of the current study is to compare cognitively demanding components of the driving task with more automatic vehicle control skills.

Despite legislation against drivers' use of mobile hand-held phones in the United States, Australia and United Kingdom amongst others, (Pennay, 2008), evidence shows that bans do not have a long term affect on the drivers' behaviour without sustained reinforcement (Ansari et al., 2000; Royal, 2003), with international evidence demonstrating that many drivers' continue to engage in this behaviour even though bans have been established (e.g. Törnros and Bolling, 2005; Pennay, 2006; McCartt et al., 2006; Svenson and Patten, 2005; Wiesenthal and Singhal, 2005). For example, Pennay (2006) showed that 43% of those who owned a mobile phone used it to answer calls when driving, 24% used their mobile phones for dialling calls, and 23% used their phone for sending and reading text messages, with only a third of these drivers using a hands-free unit.

Nevertheless, given the widely publicised influences of mobile phone use on driving, and the legislation against mobile use in many countries, many people do avoid using their phone to make calls whilst driving or responding to calls they may receive (e.g. compare Goodman's 1999 pre-legislation figure of 85% of people using them whilst driving with Pennay's 2006 post legislation figure of 43%). Studies have examined the factors that may influence intention to use mobile phones in different circumstances. Several studies have used the Theory of Planned Behaviour (TPB) model (Ajzen, 1991) of predicting behavioural intention to examine this issue (e.g. Zhou et al., 2009; Walsh et al., 2008; Rozario et al., 2010). For example, Walsh et al. (2008) indicated that attitudes, subjective norms and Perceived Behavioural Control (PBC) accounted for 32% of the variance in intentions to use a mobile phone whilst driving. A key benefit of such belief-based analysis allows understanding of behavioural influences and aids in identifying predictors of intentions towards a particular behaviour. Thus this information can consequently inform education and campaigns (Fishbein, 1997), and subsequently reduce the incidence of the behaviour.

Zhou et al. found that Perceived Behavioural Control (PBC) was the variable which was indicated in regression analyses as being more important in predicting variance in behavioural intention than age, gender, or the other TPB variables of subjective norm or attitudes. The more favourable attitudes and the greater the perception of control over their ability to use a mobile phone in those situations, the more drivers' willingness to use a mobile phone increased. PBC is defined as the presence of factors that may facilitate or impede performance of the behaviour combined with one's perceived control over these factors (e.g. Ajzen, 1991). However, Zhou et al. (2009) and also Rozario et al. (2010), conceptualised PBC as ability or ease and difficulty of using a mobile phone whilst driving, whereas Walsh et al. (2008), perhaps more accurately, conceptualise it in their questions to participants as control over whether they use it or not whilst driving, with resultant differences in findings, Walsh et al. finding less of a role of PBC in predicting intention to use the phone whilst driving.

However, these studies examined intention to use a phone, not intention to *refrain* from using it whilst driving, and the ability to not do something, such as answering the phone, which may be a well-ingrained habit, needs separate examination. The reason for this is simply that for many people, using, or answering the phone when driving has become a habit. Habits are generally seen as more automatic responses that require less planning. Overcoming a habit, however, such as refraining from answering the phone, is more likely to be demanding of intention and control of intention (e.g. see Holland et al., 2009 for a discussion of this issue), which is in turn likely to be demanding of attentional resources. Thus in this study, the intention to ignore the phone, or refrain from answering it, is the behaviour at issue.

Despite the prior research on the distraction effect of mobile phone use on driving, and on the effect of components of attitudes, subjective norms and perceived control on predicting intentions to perform the behaviour, the relative influence of one's normal intentions on the severity of the distraction effect of incoming mobile phone calls has not been examined. Given that many people do report that they would answer an incoming call whilst driving, the effect of ignoring one's mobile phone ring tone on driving also needs examining in the context of one's normal intentions to ignore or to answer. The research reviewed has been applied to the distraction effects of a mobile phone use (hands-free or hand-held), or to the effect of TPB variables, particularly PBC, on behavioural intentions. The role of TPB variables, particularly behavioural intention and PBC on the level of distraction experienced has not been investigated, with the hypothesis being that those who would normally answer their phone would find hearing their phone ring, in the context of having been instructed not to answer it, more distracting and more demanding of attentional control (inhibiting their normal response) than would people who would normally ignore their phone anyway. Thus, the present research aims to explore the relationships between the TPB components and ability to maintain driving performance in the context of refraining from answering a mobile phone call. The effect of this distraction, in the absence of conversation or physical phone manipulation, is assessed.