The Role of Mobile Phones in Real World Motor Vehicle Crashes

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INTRODUCTION

In this article, on road epidemiological studies including naturalistic driving studies that have assessed the role of mobile phones in crashes and near crashes will be reviewed, for example, Redelmeier & Tibshirani (1997); McEvoy, Stevenson, McCartt, *et al*. (2005); Klauer, Dingus, Neale, *et al.* (2006); Klauer, Guo, Simons-Morton, *et al.* (2014). The article will summarise the types of on-road studies that have been used to assess the risks of mobile phone use while driving, explain results to date, explore what aspects of the phone task appear to be most risky, and compare this with other common forms of driver distraction including passengers.

Driver distraction has been defined as the diversion of attention away from activities critical for safe driving toward a competing activity (Lee, Young, & Regan, 2009, p. 34). In recent years, driver distraction has emerged as an increasingly important contributor to motor vehicle crashes. Road safety efforts have started to focus on sources of driver distraction, including mobile phone use while driving.

Today's mobile phones feature a range of functions that make them highly useful devices, however under certain settings, it is possible that these same features may cause unintended consequences. Mobile phone use may divert driver attention from the driving task in a number of ways including reaching for the phone, dialling, engaging in conversation, hanging up, sending and receiving text messages, accessing the internet and phone apps, reading maps and emails, and interacting with music functions.

For some years now, researchers have been investigating the distracting effects of mobile phones while driving. These studies have included laboratory testing under simulated driving conditions, testing driving performance on off road circuits, study designs using case-control or case-crossover techniques to examine the association between mobile phone use and crashes and, most recently, naturalistic driving studies in which drivers are filmed during their day-to-day driving to assess the role of distractions in near crash and crash events.

It is possible for driver distraction to affect driving performance in a number of ways: speed variability, following distance (or headway), lane keeping, reaction time and gap acceptance (Young, Regan, Lee, 2009, Ch 7). However, these measures do not tell us the degree to which road safety may be compromised due to degraded driving performance. Accordingly, epidemiological studies have sought to determine the level of risk attributable to various driver distractions.

OVERVIEW

Researchers have used case-control and case-crossover designs to study whether exposure to a distracting activity is associated with a significantly increased risk of a motor vehicle crash. In a case-control study, groups of individuals who have experienced an outcome of interest (in this case, a motor vehicle crash) are compared with respect to their exposure to the distracting factor of interest (such as mobile phone use). The case-crossover study is a variant of the case-control

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design, in which cases act as their own controls. This has the advantage of controlling for driver characteristics that may affect the risk of a motor vehicle crash but do not change over a short period of time, for example, driving experience or a driver's inherent risk-taking propensity. The case-crossover design has particular utility in settings when a brief exposure causes a transient increase in the risk of a rare outcome, such as a motor vehicle crash. As distractions, including mobile phone use, tend to be transient, this design is appropriate to examine the association between distraction and crash risk (McEvoy & Stevenson, 2009, Ch 6).

The pioneers of using the case-crossover design for this purpose were Professor Donald Redelmeier and Professor Robert Tibshirani from the University of Toronto, Canada (Redelmeier & Tibshirani, 1997; the latter now at Stanford University), Dr Suzanne McEvoy and Professor Mark Stevenson, formerly from the George Institute for Global Health, University of Sydney, Australia (the latter now at Monash University), and Dr Anne McCartt, senior vice president of research at the Insurance Institute for Highway Safety, Virginia, United States of America (USA; McEvoy *et al*, 2005).

As discussed earlier, mobile phones have the potential to divert a driver's attention in a range of ways: visually (including eyes off the road while one looks down at the phone screen), manually (including a hand off the steering wheel while one manipulates the phone to write and send a text message) and cognitively (for example, distraction arising from a highly emotive phone conversation). It is possible that these factors either alone or in combination may result in degraded driving performance and an increased risk of a crash. While case-control and case-crossover studies can assess whether an association exists between an exposure of interest (mobile phone use) and an outcome (motor vehicle crash), such studies have been unable to clarify whether certain phone-related tasks are riskier than others during on road driving. To examine this issue, naturalistic driving studies which use a Data Acquisition System (DAS) to monitor driver behaviour in everyday driving have been used.

The team at the Virginia Tech Transportation Institute (VTTI) in the USA are the current leading scholars in this endeavour. Of particular note are Professor Thomas Dingus, who is the Director of VTTI and has been conducting research in transportation safety and human factors since 1984 (Dingus *et al*., 2006), Sheila Klauer (Klauer, Perez, McClafferty, 2011) who was the project manager for the 100-car naturalistic driving study (Klauer *et al*., 2006) and co-principal investigator and project manager for the naturalistic teenage driving study (Klauer *et al*., 2014), and Richard Hanowski who is Director of the Center for Truck and Bus Safety at VTTI (Hickman, Hanowski, Bocanegra, 2010; Olson, Hanowski, Hickman, Bocanegra, 2009).

Characteristically, naturalistic driving studies use a DAS that incorporates multiple sensors (including video cameras, GPS, radar, and accelerometers) to provide a comprehensive representation of driver, vehicle and road user behaviour during driving (Klauer *et al*., 2011). Video cameras record the forward roadway, the driver's face, and driver interactions with pedals and instruments. A separate camera views the area behind the vehicle. Other equipment includes a still camera for a view of the passenger compartment, a microphone, an incident pushbutton, GPS and a sensor to detect unintentional lane deviations, unsafe following distances, imminent collisions and speed limit signs. Forward radar collects data on the relative speed and position of leading traffic. Computer equipment for communication and data storage is located in the vehicle's boot.

One of the major challenges of naturalistic driving studies arises from the sheer amount of data that can be generated. According to Klauer *et al*. (2011), video data typically comprises 80-95% of the total data collection while 5-15% is the vehicle parametric data. The sheer amount of data necessitates a clear strategy for data coding including automated triggering to identify key events based

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