Accident Analysis and Prevention 111 (2018) 222–237

Contents lists available at ScienceDirect

Accident Analysis and Prevention

journal homepage: www.elsevier.com/locate/aap

What technologies do people engage with while driving and why?

Katie J. Parnell*, Neville A. Stanton, Katherine L. Plant

Transportation Research Group, Faculty of Engineering and the Environment, Boldrewood Innovation Campus, University of Southampton, Burgess Road, Southampton, SO16 7QF, United Kingdom

ARTICLE INFO

Keywords:
In-vehicle technology
Driver distraction
Qualitative methods
Willingness to engage

ABSTRACT

This paper presents the findings of a semi-structured interview study that was conducted to identify drivers' self-reported likelihood of engaging with technologies that are now commonly found in modern automobiles. Previous research has focused on the effect these technological tasks have on driving performance, but there has been less focus on how, why and when drivers choose to engage with them. As distraction remains a significant contributor to road accidents, an understanding of why it occurs will give important insights into how it can be prevented. A semi-structured interview schedule was developed to allow drivers to discuss the factors that influence their decision to engage with a variety of different technologies. The methodology facilitated both quantitative ratings of the drivers' likelihood of engaging in a variety of tasks and qualitative insights into why. Age and gender had some influence on the propensity to engage, in line with other findings in the literature, as did road type and task type. The reasons drivers gave for why they engage with potentially distracting tasks inform recommendations for preventing distraction related accidents from the increasingly prevalent sources of technologies available to drivers.

1. Introduction

The popularity of mobiles phones has notoriously had a negative effect on road safety (see McCartt et al., 2006 for a review). The coupling of a high willingness to engage (Young and Lenné, 2010) and the adverse effects they have on the drivers' visual monitoring of the road (Reimer, 2009), vehicle control (Törnros and Bolling, 2005), and speed (Alm and Nilsson, 1995) have encouraged the decision to ban drivers from using hand-held telephone devices across many countries globally. Yet, technological advancements have facilitated a host of other devices for drivers to interact with. This includes those that aid the driving task, e.g. sat-navs and eco-displays, in addition to those that provide alternative functionalities e.g. music players and hands-free telephones, that are proposed as 'safer' alternatives to hand-held devices, although this is not always the case (Strayer and Johnston, 2001; Horrey and Wickens, 2006). A movement towards wearable technologies is also likely to impact road safety (e.g. Sawyer et al., 2014), as technology develops faster than legislation is able to control its appropriate use (Leveson, 2011). Compared to research into mobile phone use, research into other technological devices is more limited, although the distractive potential and their relationship to accidents is becoming evident (e.g. Tsimhoni et al., 2004; Rouzikhah et al, 2013; Lee et al., 2012). This has led to the current laws that focus specifically on hand-held phones to be questioned (Parnell et al., 2017).

Age is reported to be a significant factor contributing to the drivers' engagement with technological devices (e.g. Lamble et al., 2002; Lerner and Boyd, 2005; McEvoy et al., 2006; Chen et al., 2016; Pope et al., 2017). This is thought to relate to the relationship between age and access to technology, for example younger drivers have been found to have a higher ownership of mobile phones that has been linked to their increased use while driving in this demographic (Lamble et al., 2002). Although, this effect seems to have decreased in recent years with older adults becoming more accepting of technologies (Mitzner et al., 2010). Yet, older drivers have been found to show more disapproving attitudes towards mobile phone use when driving (Mizenko et al., 2015) and are more in favour of increased restrictions on their use (Lamble et al., 2002). There is also evidence to suggest that older drivers are more adversely effected by the increased demand of managing secondary tasks while driving (Alm and Nilsson, 1995; Reed and Green, 1999). Furthermore, Strayer and Drews (2004) found that, while the impact of performing a phone based secondary task on driving performance was equivalent in younger and older drivers, the younger drivers' performance when on the phone was the same as the older drivers when they were not engaging with the phone secondary task. Yet, younger drivers are also more likely to underestimate the effect that mobile phones have on their driving behaviour (Tison et al., 2011) and are also more likely to self-report engaging in the use of devices while driving (McEvoy et al., 2006). Although, caution should be heeded when discussing and

* Corresponding author.
E-mail addresses: kp4g13@soton.ac.uk (K.J. Parnell), N.stanton@soton.ac.uk (N.A. Stanton), K.plant@soton.ac.uk (K.L. Plant).

https://doi.org/10.1016/j.aap.2017.12.004
Received 17 August 2017; Received in revised form 16 October 2017; Accepted 4 December 2017

selecting age categories as recent findings suggest that a middle age category (those between young and old adults) may be similar to the younger drivers in their acceptance and inclination to use technology while driving (Engelberg et al., 2015; Pope et al., 2017). As a generation of drivers who are accustomed to the use of technologies grow older, the interaction between their cognitive ageing which is also linked to reduced driving performance e.g. Strayer and Drews, 2004, and their potential to engage with distractions needs to be considered for future road safety (Pope et al., 2017). The effect of gender and age have also been evidenced with the suggestion that older females are the least likely demographic to engage with mobile phones and younger males the most likely (Pöysti et al., 2005; Lamble et al., 2002).

The impact of distracting tasks has also been linked to environmental conditions and circumstances such the complexity of the roadway environment (Horberry et al., 2006), manoeuvring different road segments (Lerner and Boyd, 2005), and the curvature of the roadway (Kountouriotis and Merat, 2016). These factors have been found to effect the compensatory mechanisms that drivers employ when engaging with secondary tasks, e.g. slowing down (Rakauskas et al., 2004; Cnossen et al., 2004), an effect that has been found to be exaggerated with age (Horberry et al., 2006). Road type has also been linked to the structure and content of drivers' situational awareness, with different road environments altering driver perceptions and behaviour (Walker et al., 2013). Engagement with distractions is deemed by some to be largely voluntary, with as estimated 70% of distractions being actively engaged by the driver (Beanland et al., 2013). There is, however, evidence to suggest that becoming distracted may not always be directly related to the choices of the driver, but is instead influenced by the choices of manufacturers, regulators and policy developers (Young and Salmon, 2015; Parnell et al., 2017). The PARRC (Prioritise, Adapt, Resource, Regulate, Conflict) model of distraction, which focuses on technological sources of distraction (Parnell et al., 2016), takes a systemic view of the phenomenon and proposes that other elements may have a top-down influence in providing conflicting goals to the driver and illustrates how they may be responsible for distraction related accidents. The factors that impact on the decision to engage with potentially distracting tasks is therefore of interest to future accident analysis research, to determine why distraction may be emerging from the system and how it can be managed.

A variety of methods have been applied to the study of driver distraction (Young, 2008), from the objective study of what happens when drivers become distracted (e.g. Harbluk et al., 2007) to measures seeking to determine the scale of the problem (e.g. McEvoy et al., 2006). To assess the factors that are impacting on the drivers' decision to engage with technologies, self-report methods can be used to capture the drivers view of their behaviour (West et al., 1993). Pope et al (2017) explored the drivers self-reported engagement with technologies and contrasted this with a subjective measure of executive functioning in a novel exploration the relation between the two measures. This suggested that increased difficulty in executive functions related to an increased engagement in distractions while driving that could be linked to a lack of ability to inhibit activities. Yet, they noted the need to test the reliability of the self-report methods (Pope et al., 2017).

Online surveys have been used in recent years to understand what distractions drivers engage with as they allow for large scale data collection (e.g. McEvoy et al., 2006; Young and Lenné, 2010; Lansdown, 2012). Such studies have cited the distractions sourced from technologies such as mobile phones, hands-free phones, sat-nav's and in-vehicle infotainment systems (IVIS) (e.g. Young and Lenné, 2010; Dingus et al., 2006; McEvoy et al., 2006). They have provided insights into individual differences (e.g. McEvoy et al., 2006), the perceived risk of drivers when engaging in different tasks and their views on 'getting caught' (e.g. Young and Lenné, 2010). The anonymity provided by accessing surveys remotely online may encourage honesty when asking questions that may reveal illegal behaviours characteristic of distraction based research, (e.g. using a mobile phone while driving). Yet, surveys are restrictive in their reliance on closed questions which can facilitate the imposition of the researchers own agenda through their choice of survey questions (O'Cathain and Thomas, 2004). Closed-ended questions, which have been favoured in the literature, limit the driver from detailing the influences they perceive to determine their decision to engage with technologies while driving. To understand *why* drivers become distraction requires the application of the more open-ended methods of qualitative data collection, the use of which have been limited in past research.

Huemer and Vollrath (2011) conducted short interviews with drivers at service stations which probed into their engagement with secondary tasks in their most recent drive. While face-to-face communication of this format allowed drivers to dictate their behaviour in an open manner, the large sample (289 drivers) meant that interviews only lasted 5 min and only sought to determine the prevalence of secondary task activity in the drivers' most recent trip. The only other research to the authors knowledge that has attempted to probe further into decisions to engage, using in-depth qualitative measures, was a focus group study by Lerner and Boyd (2005). They conducted focus groups with drivers from different age groups (teen 16–18yrs, young 18–24yrs, middle 25–59yrs and older 60 +) to discuss their willingness to engage with a variety of technologies including a sat-nav, mobile phone and a personal digital assistant. They found drivers were primarily concerned with their motivation to perform the task (Lerner and Boyd, 2005). Interestingly, it was found that drivers stated hand-held mobile phone use to be safe to perform under most driving conditions and that they were motivated by social factors such as the use of their personal time. This is in contrast to more recent reports that have identified that drivers rate mobile phone tasks to be high risk and dangerous (e.g. Young and Lenné, 2010). This may be explained by the fact that Lerner and Boyd (2005) conducted their focus groups with participants from Washington D.C in the USA in 2002, where hand-held mobile phone use while driving was not restricted until 2004. Furthermore, the use of focus groups may have facilitated social biases in what participants reveal with normative, cultural and dominance bias playing a role (Smithson, 2000). A more up to date in-depth qualitative analysis is therefore required to understand the decision-making processes of drivers when faced with modern technologies in the current socio-technical climate and why they may, or may not, be motivated to engage with distractions.

This paper presents findings from a semi-structured interview study with drivers on their engagement with different technological tasks. It is the first interview based study used to determine the drivers' views and general usage behaviours relating to a variety of technological distractions, not just mobile phones or the most recent journey. It aimed to understand both *what* technological tasks drivers engage with and *why*. The use of semi-structured interviews has been neglected in the study of driver distraction, yet the interviews conducted within this research enabled drivers to detail their decision-making processes when faced with different technological tasks while driving. To help mitigate the limitations of a smaller sample size, the interview data is supplemented with data from an online survey to assess the representation of the drivers sampled in the interview study to a larger population of drivers. The role of age, gender and roadway environment were explored due to evidence in the literature that suggests these to be prominent factors implicating driver distraction and technology engagement (e.g. Pöysti et al., 2005; Horberry et al., 2006; McEvoy et al., 2006; Pope et al., 2017).

2. Method

A trade off between the in-depth data analysis of complex open-ended qualitative methods and the sample size had to be made, with lengthy interview data unable to be collected and analysed in great detail from the large samples that may attributed to online surveys. The use of a smaller sample size allows for an in-depth understanding of a