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What's the law got to do with it? Legislation regarding in-vehicle technology use and its impact on driver distraction

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ABSTRACT

Legislation in the road transport domain aims to control safety on the roads. Despite this, a critical issue affecting road safety is that of driver distraction. Although poorly defined, distraction is a significant road safety issue which, in part, is caused by the prevalence of technology within vehicles. Legislation surrounding the use of in-vehicle technologies are explored in this paper from a socio-technical system perspective. This reveals the wider context of the road transport system operating under the current laws using an Accimap analysis. A distinction in the law between the use of hand-held mobile phones, a device that is typically banned for use by drivers worldwide, and the use of other technological devices that are covered by more general laws against 'careless' and/or 'dangerous' driving was found. Historically, individual drivers' have been blamed for distraction, whereas the systems approach shows how current legislation may have created the conditions necessary for driver distraction.

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1. Introduction

Since the invention of the modern motor car in the late 1800's and its widespread use from the early 1900's, there have been many developments to the road environment, infrastructure, vehicles, in-vehicle technology, licensure and driver training. Legislation must respond to these changes to ensure safety is maintained alongside new developments. Policies titled "Tomorrows Road: safer for everyone" (DfT, 2000) in the UK and 'Vision Zero' (Tingvall and Haworth, 2000) in Sweden infer that legislation is striving to improve road safety in the future.

Road safety is threatened by a number of issues, predominately drink driving, wearing a seatbelt, motorcycle helmets, speeding and driver distraction (WHO, 2016). Driver distraction has become of increasing concern in recent years with the development of technology (Walker et al., 2001; WHO, 2011). Despite being the focus of research for many decades (e.g. Brown et al., 1969), no universal definition or approach to the issue has yet been applied (e.g. Young et al., 2007; Regan et al., 2011). One definition by Lee et al. (2008) has gained support within recent years (e.g. Liang and Lee, 2010; Young and Lennè, 2010; Hosking et al., 2009; Parnell et al., 2016), it states distraction is the "*diversion of attention away from activities critical for safe driving towards a competing activity*" (Lee et al., 2008: 38). Distractions in the form of competing activities are cited to occur from a diverse range of activities inside and outside of the vehicle (e.g. Young et al., 2008; Young et al., 2009). Yet, it is important to note that contemporary approaches to driver distraction have stated that distraction in itself is not an error but that errors occur as result of the distraction (Stanton and Salmon, 2009). In other words, drivers may engage in distracting tasks without adverse outcomes, yet research has shown the risk of incident is greatly enhanced (Redelmeier and Tibshirani, 1997; Violanti, 1998; Laberge-Nadeau et al., 2003).

The adverse impact of driver distraction on road-safety is highlighted in a recent report from the National Highway Traffic Safety Administration (NHTSA) which stated that 3179 people were killed and 431,000 people were injured in motor vehicle crashes involving a distracted driver on American roads in 2014 (NHTSA, 2016). These only include cases where distraction was actually captured in reports, the negative implication related to driver distraction suggest that these figures likely under report the true impact of the issue. NHTSA classified 13% of the distraction related fatalities to be caused by mobile phone use, a growing concern worldwide (WHO, 2016). The developments in technology have facilitated driver to be more connected (Walker et al., 2001), but phone use while driving has a significant impact on road safety (WHO, 2011). Rapid developments in technology are also cited to provide difficulties in capturing the full range of distractions (NHTSA, 2016). In-vehicle systems now provide drivers with an array of information, enter-

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tainment, and comfort features to enhance the driving experience (Harvey et al., 2011). As technology has developed, the variety and complexity of these features has increased (Walker et al., 2001). Although the statistical data related to crash risk is difficult to discern, research has shown that music devices (Lee et al., 2012), satellite navigation systems (Tsimhoni et al., 2004), wearable technologies (e.g. Sawyer et al., 2014), and even hands-free devices (Horrey and Wickens, 2002) impair drivers' attention.

Legislation and regulations must adapt to incorporate technological distractions, yet, there is critique that policy change may be somewhat of an afterthought, playing catch-up only after gaps within existing policy have been found (Leveson, 2011). With developments in technology occurring at a rapid pace it is hard for policy to regulate its use (Leveson, 2011; Redelmeier and Tibshirani, 1997). Mobile phone use in vehicles are a key example of this, their use in vehicles was questioned only after risks to road safety were proven (WHO, 2013). Since the early 2000′s drivers have been banned from using a mobile phone in many countries such as the UK, Australia, New Zealand, China, Japan, India and EU member states. In the USA and Canada, the laws around hand-held mobile phone use varies between states, with 14 states banning their use. Enforcing a ban on specific behaviours aims to target the attitudes of the road users (Chen and Donmez, 2016). Since the mobile phone ban, their use is regarded to have a higher perceived risk than other devices, which is thought to be linked to the increased publicised dangers associated with the ban (Young and Lennè, 2010). Other technological devices that are not banned within legislation are covered under general laws, using sentiments such as "*You must exercise proper control of your vehicle at all times*" (The Highway code, Rule 149), and "*devices may be used as long as it does not detrimentally impact driving behaviour*" (Trafikförordning, 1998; chapter 14.6) are applied. Compared to the definitive ban on hand-held mobile phone use, the legal perspective on the use of other technologies is less conclusive both to those who must follow it and those who must enforce it. (e.g. Young and Lennè, 2010). Therefore, there is a distinction within legislation which permits drivers to have different attitudes towards devices that are not banned to the same degree that mobile phones are. Yet research has found other technologies to be no more safe than mobile phones (e.g. Horrey and Wickens, 2004; Tsimhoni et al., 2004; Sawyer et al., 2014).

To enforce traffic safety laws, drivers are given penalties in the form of fines and points on their license when they are found to be contravening the law. In a bid to clamp down on mobile phone use while driving in the UK the Department for Transport plan to increase the current fine of £100, to £150 and the points on the license from three to four points in a hope to deter drivers (DfT, 2016). However, these techniques descend from a traditional, or 'old view' (Reason, 1990; Dekker, 2002), of accident causation, viewing the driver as unreliable and the main threat to safety (Larsson et al., 2010). Contemporary research favours the 'new' systems approach (Dekker, 2002; Reason, 1990), which considers accident causation to be a consequence of the interrelationships within the socio-technical system (Larsson et al., 2010; Leveson, 2011; Salmon et al., 2012a; Lansdown et al., 2015). Systems thinking, first developed by von Bertalanffy, states that a system should not be studied by looking at the individual elements from which it is composed as this is too simplistic. Instead, the interactions between elements and their environment should be studied to gain a more holistic view (Von Bertalanffy, 1968). The application of systems thinking to the driving domain has been considered a necessary next step in improving road safety (Salmon et al., 2012a; Lansdown et al., 2015; Parnell et al., 2016), including driver distraction (Young and Salmon, 2015).

1.1. Aim

It is evident that there is a distinction within the legislation of many countries between the use of mobile phones in vehicles compared to other technologies available to the driver. This paper aims to evaluate the current legislation surrounding the use of mobile phones and other in-vehicle technologies to gain insight into its efficacy in targeting distraction and maintaining safety with respect to the road-transport system as a whole. Paying particular attention to the systems elements involved in the use of mobile phones and other devices aims to determine what impact the distinction within legislation has on the wider road transport system and their responsibility for the emergence of distraction.

2. Method

To understand how interactions within the road transport system may result in the emergence of accidents caused by distraction, Young and Salmon (2015) applied the risk management framework (RMF, Rasmussen, 1997) to distraction-related events. From this they discerned the utility of current distraction countermeasures and the potential for improved systems-based countermeasures. This paper builds on Young and Salmon (2015), by analysing the laws surrounding in-vehicle technology use by drivers within the context of the whole road transport system. In doing so it will apply the RMF to the system surrounding the use of technologies by drivers and conduct an Accimap analysis. Adaption of the Accimap methodology aims to determine general behaviour of the system under normal functioning as Trotter et al. (2014) and Salmon et al. (In Press) have achieved in other domains. The legal framework of the UK was used for this analysis but comparisons to other countries legislation are made.

2.1. Application of the risk management framework to in-vehicle technology use

Rasmussen's RMF (1997) has been applied across multiple domains that comprise socio-technical systems such as, food safety (Cassano-Piche et al., 2009), public health (Vicente and Christoffersen, 2006), outdoor activities (Salmon et al., 2010) and road transport (Scott-Parker et al., 2015; Newnam and Goode, 2015), including driver distraction (Young and Salmon, 2015; Parnell et al., 2016). This framework typically features six hierarchical, cohesive and interactional levels of a system; the government, regulations, company, management, staff and work. A first step in assessing the impact of legislation on the system was to apply the RMF to driver distraction legislation. This is graphically represented in Fig. 1.

An initial review identified that high-level elements outside of the Government are involved in legislation development. The design and development of in-vehicle information systems is incorporated into international principals (e.g. International Organisation for standardisation, ISO) which sets the standard for all countries conforming to international committees. National bodies coordinate national standardisation, distributing responsibility across the different governmental departments to enact the ISO within national policy. In the UK the British Standards Institute (BSI) sets national standards, collectively developed by a technical committee formed of organisations, consumers, industrial bodies, researchers and other experts within the field. These contributors must come to a consensus on the standards required. The traditional six levels of Rasmussen's sociotechnical system have therefore been expanded in Fig. 1 to include an additional two levels; international and national committees. Government departments outline specific policies in line with the international and

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