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Testing a structural model of young driver willingness to uptake Smartphone Driver Support Systems

Aoife A. Kervick*, Michael J. Hogan, Denis O'Hora, Kiran M. Sarma

School of Psychology, National University of Ireland, Galway, Ireland

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ABSTRACT

There is growing interest in the potential value of using phone applications that can monitor driver behaviour (Smartphone Driver Support Systems, 'SDSSs') in mitigating risky driving by young people. However, their value in this regard will only be realised if young people are willing to use this technology. This paper reports the findings of a study in which a novel structural model of willingness to use SDSSs was tested. Grounded in the driver monitoring and Technology Acceptance (TA) research literature, the model incorporates the perceived risks and gains associated with potential SDSS usage and additional social cognitive factors, including perceived usability and social influences. A total of 333 smartphone users, aged 18–24, with full Irish driving licenses completed an online questionnaire examining willingness or Behavioural Intention (BI) to uptake a SDSS. Following exploratory and confirmatory factor analyses, structural equation modelling indicated that perceived gains and social influence factors had significant direct effects on BI. Perceived risks and social influence also had significant indirect effects on BI, as mediated by perceived gains. Overall, this model accounted for 72.5% of the variance in willingness to uptake SDSSs. Multi-group structural models highlighted invariance of effects across gender, high and low risk drivers, and those likely or unlikely to adopt novel phone app technologies. These findings have implications for our understanding of the willingness of young drivers to adopt and use SDSSs, and highlight potential factors that could be targeted in behavioural change interventions seeking to improve usage rates.

1. Introduction

Road traffic collisions (RTCs) represent a significant global health concern. They have persisted as the leading cause of death for those between the ages of 10–24 for over a decade (World Health Organisation, 2009, 2013), and result in the injury and permanent disability of thousands of young drivers (under the age of 25) and passengers every year (e.g. Elvik, 2010; Keating and Halpern-Felsher, 2008; Lerner et al., 2010). This trend has persisted despite years of research and a multitude of interventions, such as the use of targeted road safety campaigns (see Carey and Sarma, 2011), school educational programs (e.g. Senserrick et al., 2009), or even the implementation of graduated driver licensing (e.g. see Creaser et al., 2009; Fell et al., 2011), all aimed at reducing young driver RTCs. Novel solutions are clearly needed.

Research indicates that the use of 'black box' in-vehicle data recorders (IVDRs) that are hardwired to a vehicle and provide real-time feedback (audio and/or visual) to drivers on unsafe maneouvres can significantly improve young driver behaviour (e.g. Carney et al., 2010; Farmer et al., 2010; McGehee et al., 2007; Musicant and Lampel, 2010). Recently, an alternative form of IVDR monitoring has been developed – which we term the 'Smartphone Driver Support System' (or 'SDSS'). A SDSS is an innovative smartphone application designed to harness the advanced sensors of modern smartphones to monitor and provide feedback support to young drivers (e.g. Creaser et al., 2009, 2011). Typically, such an application is relatively inexpensive and easily downloaded onto a personal phone. The smartphone is then docked onto a vehicle's dashboard or windshield, wherein it provides visual (e.g. a flashing speed limit sign if speeding) and/or audio (e.g. a beep to denote unsafe following distance) feedback to young driver users. Journey records are also typically logged online to a personal webpage. As the smartphone is not physically hardwired to the vehicle, it cannot directly impact on the vehicle performance as an IVDR can (e.g. to limit the maximum speed of the vehicle), and can be activated or deactivated at will.

Given their novelty, there is an almost complete absence of academic publications on SDSSs. To date, a single, small-scale, pilot

* Corresponding author.
E-mail address: aoife.kervick@gmail.com (A.A. Kervick).

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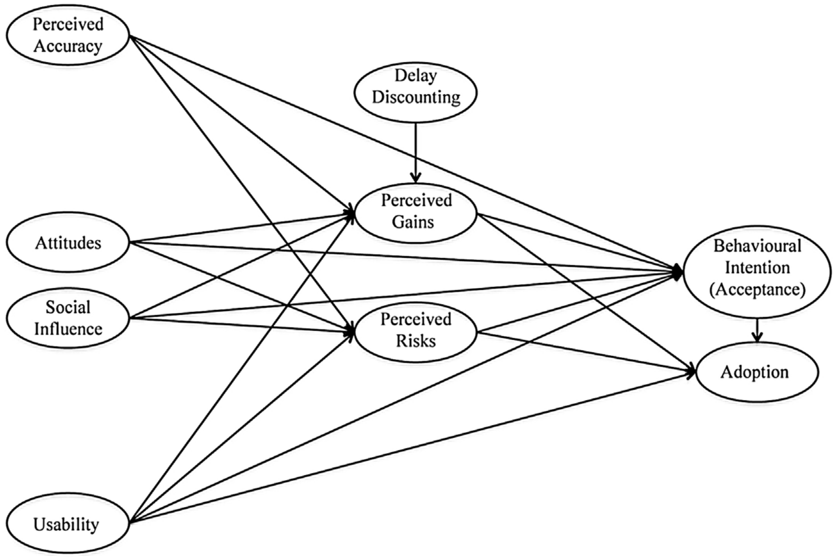

Fig. 1. Eight-factor SDSS adoption model.

study of a smartphone support system has been published (see Creaser et al., 2009). This research reported decreases in speeding from 30.9% to 18.2% of an eight mile track for a sample of sixteen young (18–19 year old) drivers who were asked to drive with and without smartphone based monitoring and feedback present.

Of course, the effectiveness of the SDSS is contingent on the willingness of young driver users to adopt and use them in the first place. Any benefits to this technology will be lost if young people will not drive with it. Thus, the current study tests a model of SDSS adoption. The question is of great relevance as the IVDR literature attests to the reality that young drivers often have an aversion to being monitored (see McCartt et al., 2010; Young et al., 2010).

Before introducing the model of technology adoption tested in the current study, some clarification around terminology is merited. There has been a tendency to use the terms 'acceptability', 'acceptance' and 'willingness to adopt' synonymously (see Regan et al., 2014 for review). Here we differentiate between 'acceptablity' as a reflection of attitudinal judgement, or 'how much a system is liked' (Jamson, 2010, p. 15), and 'acceptance'. When 'the system is not available' as it is in the context of this study, acceptance is a measure of the extent to which the user 'intends to use it' (Adell, 2009, p. 31), that is, Behavioural Intention (BI). The act of uptake and usage itself then, is referred to as technology adoption.

1.1. The proposed structural model

The need for context-specific models of technology acceptance and adoption has been highlighted as critical if they are to have explanatory value (e.g. Kaasinen et al., 2011). Therefore, the current study focused on developing and evaluating a young driver SDSS-specific model of technology adoption (see Fig. 1).

This model is informed by existing models, including the Technology Acceptance Model (TAM; Davis, 1989) and the Unified Theory of Acceptance and Use of Technology (UTAUT; Venkatesh et al., 2003). It is also informed by the findings of a recent systematic review of the factors that are linked to the acceptance and adoption of IVDR monitoring by young drivers (Kervick et al., 2015).

The model focuses on the act of adoption (i.e. whether an individual acts to use the SDSS or not) and BI (i.e. the manifestation of acceptance) as core outcomes. This is because the act of using a phone app is likely to be a planned one, involving controlled cognitive processing of risk/gains as well as other factors. We propose that SDSS adoption can be predicted by BI, perceived gains, perceived risks and the construct of usability (i.e. how easy the app is to use). BI is then both directly and indirectly impacted by four exogenous variables – social influence, usability, attitudes and perceived accuracy. Indirectly, these variables can influence perceptions of associated risks and gains. A key individual difference variable, delay discounting, is also predicted to impact perceptions of gains relating to SDSS usage.

1.1.1. Perceived gains and risks

We anticipate that the perceived gains (e.g. opportunity to earn insurance discounts) and risks (e.g. threats to privacy/security of recorded data) associated with a SDSS will have positive and negative effects, respectively, on intentions to uptake and adoption of a SDSS. 'Perceived gains', as measured in the current study, relates to seminal TA factors such as perceived usefulness and performance expectancy which have emerged as instrumental in past research on driver monitoring and technology acceptance and adoption (e.g. Davis, 1989; Kervick et al., 2015; Venkatesh et al., 2003; Young et al., 2003). In a SDSS use context, perceived gains primarily refer to the potential to improve driver skills and safety, and obtain discounted insurance rates by providing access to safe driving records).

Perceived risks refer to the potential risks associated with SDSS use, such as whether or not engaging with the app could cause distraction while driving (e.g. Young et al., 2003), the risks of private driving data being abused by monitoring parties and the potential for app' errors to cause an increase in insurance premiums (e.g. Lerner et al., 2010). Technology acceptance studies are increasingly incorporating perceived risk variables into proposed theories and models of acceptance (e.g. Martins et al., 2014; Miltgen et al., 2013). In addition, as with perceived gains, concerns over the risks associated with SDSS use emerged strongly in our young driver IVDR systematic review (Kervick et al., 2015).

In line with TA literature, the current study hypothesised that the perceived gains associated with SDSS use would have a positive effect on intention to adopt and adoption of a SDSS, and perceived risks negative effects on these variables.

1.1.2. Delay discounting

The perceived risks and gains concepts implicitly assume that individuals rationally assess costs and benefits to decide upon an action that maximises personal advantage. Such an assumption,