



# What drives technology-based distractions? A structural equation model on social-psychological factors of technology-based driver distraction engagement

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## ABSTRACT

**Background:** With the proliferation of new mobile and in-vehicle technologies, understanding the motivations behind a driver's voluntary engagement with such technologies is crucial from a safety perspective, yet is complex. Previous literature either surveyed a large number of distractions that may be diverse, or too focuses on one particular activity, such as cell phone use. Further, earlier studies about social-psychological factors underlying driver distraction tend to focus on one or two factors in-depth, and those that examine a more comprehensive set of factors are often limited in their analyses methods.

**Objective:** The present work considers a wide array of social-psychological factors within a structural equation model to predict their influence on a focused set of technology-based distractions. A better understanding of these facilitators can enhance the design of distraction mitigation strategies.

**Method:** We analysed survey responses about three technology-based driver distractions: holding phone conversations, manually interacting with cell phones, and adjusting the settings of in-vehicle technology, as well as responses on five social-psychological factors: attitude, descriptive norm, injunctive norm, technology inclination, and a risk/sensation seeking personality. Using data collected from 525 drivers (ages: 18–80), a structural equation model was built to analyse these social-psychological factors as latent variables influencing self-reported engagement in these three technology-based distractions.

**Results:** Self-reported engagement in technology-based distractions was found to be largely influenced by attitudes about the distractions. Personality and social norms also played a significant role, but technology inclination did not. A closer look at two age groups (18–30 and 30+) showed that the effect of social norms, especially of injunctive norm (i.e., perceived approvals), was less prominent in the 30+ age group, while personality remained a significant predictor for the 30+ age group but marginally significant for the younger group.

**Conclusion:** Findings from this work provide insights into the social-psychological factors behind intentional engagement in technology-based distractions and in particular suggesting that these factors may be sensitive to demographic differences.

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## 1. Introduction

Distracted driving has become a major safety concern on today's roadways. It contributes to roughly 10% of all fatal crashes and 18% of all crash-related injuries in the United States (National Highway Traffic Safety Administration, 2014). A large portion of distractions that lead to crashes are initiated by the driver and thereby are potentially preventable (Beanland et al., 2013). One prominent

example of driver-initiated distractions is when drivers willingly engage in cell phone conversations or text messaging; the detrimental effects of both on driving performance are well established (Caird et al., 2008).

Yet, cell phone use while driving remains a prevalent issue around the world. In a 2012 national survey in the United States, 48% of drivers surveyed reported to answering their cell phones at least sometimes when driving (Schroeder et al., 2013). This study also found 14% of drivers reporting to read text messages or e-mails, which was a slight increase from 12% of the drivers surveyed in 2010. A nationwide survey in New Zealand found 60% of their respondents reporting to hold cell phone conversations while driving on a weekly basis (Hallett et al., 2011). In a French survey, 33%

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of drivers who owned cell phones reported talking on the phone while driving; further, 6% of this 33% reported five calls a day or more (Brusque and Alauzet, 2008). Finally, an Australian study estimated 57% of drivers to have used a cell phone while driving and 12% to have engaged in texting at least once (McEvoy et al., 2006).

In contrast with cell phone use, manual interaction with in-vehicle technologies, such as adjusting audio controls or manipulating air conditioning controls, has received much less attention in driving safety research; nonetheless, it is ranked among the most frequently observed distractions in naturalistic driving studies (Metz et al., 2014; Stutts et al., 2005; Tison et al., 2011) and in crash data analyses (McEvoy et al., 2006; Stutts et al., 2001). Generalising the effect of manual interaction with in-vehicle technologies is difficult as it depends largely on the specific system (considering modality, control interface design, etc.) and the task (e.g., entering destination into or following instructions from a navigational system). Indeed, studies have been conducted on these factors or features alone, and much effort has been geared towards establishing guidelines for designing safer interfaces (Green, 2008).

Whether the goal is to design safer interfaces or, more generally, a safer driving environment, our understanding would not be complete without considering motivations behind voluntary engagement in technology-based driver distractions. Given the increasing number and growing complexity of technologies that can be found in a vehicle's cab today, there is a need to understand not only how, but why drivers engage in technology-based distractions. The current paper aims to help address this need by investigating a number of social-psychological factors as potential facilitators behind three technology-based distractions: cell phone conversations, manual phone interactions, and in-vehicle system adjustments.

Research on social and psychological aspects of driver distraction is limited compared to other unsafe driving behaviours, such as speeding (Paris and Broucke, 2008), drinking and driving (Åberg, 1993), and traffic violations in general (Parker et al., 1992). A number of large-scale surveys about driver distraction, including some of the earlier citations, have also collected data on perceptions and attitudes about distracted driving (McEvoy et al., 2006; Schroeder et al., 2013; Singh, 2010). These studies contributed significantly to our understanding of both the prevalence of driver distraction and drivers' perception about distractions. However, results are often descriptive in nature and do not quantify the relationship between distracted driving and different social-psychological factors.

Social-psychological factors of driver distraction have been explored more explicitly in a few recent studies. Li et al. (2014) analysed survey responses from 1088 Iowa drivers. The list of distractions surveyed ranged from listening to the radio, to having passengers in the vehicle, to making cell phone calls, and to texting or e-mailing. The study found self-reported distraction behaviours, attitudes, and perceived distractibility from the items surveyed to be highly correlated with each other. Demographic factors, primarily age and household income, were also found to influence distracted driving behaviours and perceived distractibility from the items surveyed. Horrey and Lesch (2008) also found a relation between attitudes and self-reported willingness to engage in distractions (use cell phone, CD player, and paper map). Further, they found willingness to engage in distractions to correlate with tendencies towards sensation seeking. Another measure of personality, extraversion, was also found to be a factor of engagement in a wide range of distractions (e.g., cell phone use, conversation with passengers, and eating and drinking) among UK drivers (Lansdown, 2012).

Another recent study targeting novice adolescent drivers examined the normative influence parents and peers have on adolescent distracted driving (Carter et al., 2014). Eight distraction items (e.g., "eating or drinking something" and "talking on a cell phone")

were assessed in this study. The adolescents' distracted driving behaviour was predicted by their parents' self-reported distracted driving, and the adolescents' perceptions of their parents' and peers' distracted driving behaviours.

The studies mentioned thus far all selected a wide range of activities representative of different distractions. Consequently, their assessment of social-psychological factors may be hindered by the fact that sources of and motivations behind distraction engagement likely vary considerably across different distractions. For example, chatting with passengers and interacting with a navigation system are motivated by distinct needs. Focusing on a more narrow range of distractions may deepen our understanding. In this light, previous research has focused on the use of cell phones while driving. Walsh and colleagues found attitudes and pressure from significant others about calling and texting while driving to be significant predictors of a driver's intention to use a cell phone while driving (Walsh et al., 2008; White et al., 2010). A survey of 276 young drivers, who reportedly use cell phones while driving, delved further into the various dimensions of attitude towards initiating and receiving calls (Nelson et al., 2009). This survey found that even when people consider talking on a cell phone while driving to be dangerous, they will still tend to initiate a phone conversation if they believe that the call is important.

Overall, research so far evaluated whether one or more of attitudes, social norms, and personality influence distracted driving. To our knowledge, no study has examined all three factors together with respect to their influence on driver distraction. The present study endeavours to examine all three factors in one analysis using 525 responses collected through an online driver distraction survey conducted in the United States and Canada. Each respondent answered questions on risk/sensation seeking, attitudes and social norms about technology-based driver distractions, as well as technology inclination, a psychological factor that may potentially relate to technology-based distraction engagement. Using structural equation modelling (SEM), we treated these social-psychological factors as latent, i.e., cannot be directly observed, and assessed the strength of survey items in a separate measurement model before analysing the relationships among the latent factors in a structural model. Findings presented in this paper can shed light on how these factors influence technology-based distraction engagement, and thus provide insights for developing more targeted strategies to help mitigate the risks associated with technology-related distractions.

## 2. Methods

### 2.1. Data

Survey data collected as part of a larger study on driver distraction gave us the opportunity to study the social-psychological factors that may underlie intentional engagement in technology-based distractions. These data were collected via an online survey administered between May 2013 and January 2014. Survey respondents were recruited using online advertisements, electronic mailing lists, and posts at local communities. Additional senior respondents (60+) were recruited from the Adult Volunteer Pool from the Department of Psychology at the University of Toronto. Respondents were encouraged to complete the entire online survey to become eligible for a draw to win one of three iPads. Only those who filled out the entire survey, were from either Canada or the U.S., and reported to holding a valid driver's license were included in the analysis. Overall, the sample used in the current analysis included 525 respondents (315 males and 210 females) between the ages of 18 and 80 years old (median = 30.0, mean = 34.5, standard deviation, SD = 14.2).

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