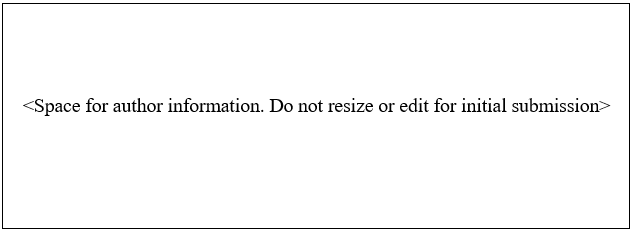
**The Impact of Mobile App Usage on Individual Performance Improvement: An Experimental Study of Driving Behavior**

*Research-in-Progress*

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**Abstract**

*Information technology is playing an increasingly essential role in reducing driving risk by helping individuals to improve their safety driving behavior. The purpose of this research is to empirically examine the effects of IT (mobile app usage) on* *individua’s driving behavior changing. Based on motivational theory, this study investigates how the driving-assistant app usage (as well as OBD device usage) influences driver’s behavior changing and further influence their driving performance. A natural experiment is designed to collect the individual App usage and behavioral data from 60 drivers. The research results will benefit both IT designer and drivers theoretically and practically.*

**Keywords:** App usage, behavior changing, driving performance, motivational theory

# Introduction

With the development of Internet of vehicles (IOV), more and more organizations including government agents and IT companies are paying attention to leverage information technology to improve driving behaviors. It is acknowledged that the diffusion and deepening of the IT revolution is a hallmark of the emerging ‘information age’ (Castells 1997). And the rapid development of IT brings many gadgets with it, such as mobile apps (Joorabchi et al. 2013; Mahmood et al. 2001; Nishad and Rana 2016). People use these IT products and applications for different purposes. And not surprisingly, as people use IT more frequently, researchers are studying the effects with growing interest (Greengard 2011).

Prior studies have put more emphasis on IT positive effects, including promoting the development of health care, education, business, communication, entertainment and global connectivity (Chen 2020; Cole-Lewis and Kershaw 2010; Green and Bavelier 2008; Hitt and Brynjolfsson 1996). Parts of researchers started to exploring how to use IT to influence human behavior (Årsand et al. 2010; Hebden et al. 2012; Hughes et al. 2010; Mattila et al. 2009; Sundaram et al. 2007; Varnfield et al. 2011). However, there is still a lack of its application on the purpose of driving safety. Thus, this study plans to leverage a natural experiment to investigate the change in individual driving behavior and to assess the value of IT usage.

# Literature Review

## IT Usage and Behavior Changing

A typical objective of most prior IT research is to explain the factors influencing the IT usage and acceptance. Researchers have built and tested several theorical models of IT usage, such as *theory of planned behavior* (TPB), and the *technology acceptance model* (TAM) (Taylor and Todd 1995; Venkatesh et al. 2003). Another major objective of IT research is to assess the value of IT in terms of organizational performance. Studies show that IT usage is a key driver of good organizational performance and can effectively improve productivity (Devaraj and Kohli 2003; Hitt and Brynjolfsson 1996). Recently, IT has been used for the purpose of environmental protection. Prior researchers defined Green IT as the systematic application of practices that enable the minimization of the environmental impact of IT and allow for company-wide emission reductions based on technological innovations (Pablos 2012). Green IT is put forward because of the urgent need for sustainable development (Lubin and Esty 2010). We will definitely benefit a lot from Green IT such as saving our money, improving energy efficiency, lowering greenhouse gas emissions and so on (Erek et al. 2011; Loeser et al. 2011; Murugesan 2008).

However, only a few researchers have reported on the use of IT products and applications for individual behavior changing. Research is usually seen in certain fields such as public health and business. In the field of public health, Mattila et al. tried to record self-management of weight-related behaviors (Mattila et al. 2009), Hughes et al. developed an app for monitoring energy balance (Hughes et al. 2010), and others have monitored diet or physical activity as part of a program for diabetes (Årsand et al. 2010) or cardiac rehabilitation (Varnfield et al. 2011). When it comes to commercial field, Sundaram et al. suggested that the effective and efficient use of technology enhances salesperson performance (Sundaram et al. 2007).

## Driving Risks

Prior studies have assessed various contributing factors in driving risks. Researchers summarized as drivers’ driving behaviors, traits, the road condition, environment state and vehicle failures (Cai et al. 2016; Donovan and Marlatt 1982; Donovan et al. 1988; McMillen et al. 1992; Rolison et al. 2018). From the perspective of drivers themselves, research often distinguishes between driving skills and driving style (Rolison et al. 2018). The skills component includes practice, exposure to the diversity of traffic situations and reaction time (Boyce and Geller 2002; Groeger and Brown 1989; Lajunen and Summala 1995; Li et al. 2016; McMillen et al. 1992; Özkan and Lajunen 2006). Driving style means the ways an individual chooses to drive (Rolison et al. 2018). Driving characteristics a complex interaction of diving skills and styles are explained in prior studies. For example, driving experience was confirmed to be a significant predictor of safety and skill-oriented driving (Lajunen and Summala 1995), for which researchers explains that practice and increased exposure to the diversity of traffic situations could be expected to improve skills, but also increase subjective control over driving and reduce concerns about safety (Näätänen and Summala 1976; Spolander 1983). And of course, age may be related to driving experience, thus many of the younger drivers tend to have higher risk of driving than older drivers (Sharkin 2004).

Efforts have been taken to improve the driving risk assessment. However, traditional ways to reduce the driving risks are not taking full advantage of technology. Given that mobile apps are a novel technology that can be used to deliver behavior change interventions directly to individuals and have the potential to make a difference (Hebden et al. 2012), and little research explores the IT in terms of human driving behaviors, this study will investigate the relationship between individual level driving behavior changing and App usage behavior of the drivers.

# Theoretical Foundations

Although research on the impact of mobile Apps on individual behavior is still relatively young, theory on factors for arousing and directing a person’s behavior has already existed (Halepota 2005; Iso-Ahola 1980), and the theory is emerging as an appropriate lens for its examination (Chang et al. 2013; Lee et al. 2005). Motivational theories are such a group of theories. Motivational theory is tasked with discovering what drives individuals to work towards a goal or outcome, most of which differentiate between intrinsic and extrinsic factors: the former are concerned with the performance of an activity for no apparent reinforcement other than the activity per se. Extrinsic motivations focus on the outcome of the activity i.e. individuals are driven by the outcome rather than the activity itself (Deci and Ryan 2010; Moon and Kim 2001; Ramayah et al. 2003). In the past decades, people’s intrinsic and extrinsic drives have been utilized to account for individual behavior. For example, researchers put perceived enjoyment, perceived ease of use as intrinsic motivation while perceived usefulness as extrinsic motivation of Internet usage (Lee et al. 2005; Moon and Kim 2001; Ramayah et al. 2003; Teo et al. 1999; Zhang et al. 2008). And referring to Steg and Vlek (Steg and Vlek 2009), behaviors can be motivated by informational strategies aiming to influence perceptions and knowledge, and by structural strategies aiming to change external factors such as policy and technology.

Thus, since the goal of our work is to explore the impact of mobile app usage on individual behavior changing, after understanding humans’ behavioral motivation, we plan to design our experiment and explain the results based on the prior theories. In our research, the participants will have access to an App which will send alert to them when it detects risky driving behaviors and provide a performance ranking at the end of the day. Considering that the App has feedback and reminder function, we will take the app as a prime extrinsic motivator for individual behavior changing. Besides, the willingness of using our app and improving their driving behavior reflects drivers’ intrinsic motivation.

In short, as our participants’ different behavior of app usage, attitude towards improving driving performance and actual changes of driving behavior can be clearly observed, the experiment is definitely feasible and reasonable.

# Research Model and Hypotheses Development

Based on motivational theory, this research investigates the effects of App usage and desire for improving individual driving performance, and how the influences will differ across different groups of personal driving habits. Our research model is illustrated in Figure 1.

## 

**Figure 1. Research Model**

Drivers’ higher desire for correct guidance reflects their greater concern about driving safety and brings with it greater intrinsic motivation to improve driving skills. According to the motivational theory, such intrinsic drives account for individual behavior, and will lead to better driving performance in the context of our experiment. Thus, we hypothesize:

**H1:** Users with higher desire to improve their driving skills will have a better driving performance.

The App could help improve individual driving performance as a form of extrinsic motivation. By informing drivers of their driving behaviors every day, the App gives feedback and provides a means of mutual supervision between users, driving them to perform better. Thus, we hypothesize:

**H2:** The App usage is positively correlated with better driving performance.

According to research on driving risks, individual road users differ in their personal balance between perceived safety and physically or statistically determined safety for various reasons, cognitive, motivational, as well as physiological (Klebelsberg 1977; Michon 1985). Specifically, increasing driving experience and exposure to traffic enhance the sense of subjective control and decreases the concern for safety aspects (Näätänen and Summala 1976; Spolander 1983). Once such driving habit has been developed, it’ll be difficult to change. Hence, experienced drivers tend to develop such a fixed driving habit and are more skilled at driving but need every effort to change their driving styles. Young novice drivers, on the contrary, will tend to have a lower-level sense of control on their driving skills while they can change their driving styles more easily. Thus, although their intrinsic motivation and extrinsic help of App may drive people to change behaviors, the positive effects are affected differently by drivers’ driving habits. In other words, it will be easier for drivers with a fixed driving habit to control their behavior as the way they want because of their rich driving experience, while it is less likely to have them influenced by external factors (App) because they have formed fixed behavior patterns. Thus,

**H3a:** A more fixed driving habit will enhance the relationship between user’s desire and driving performance.

**H3b:** A more fixed driving habit will weaken the relationship between App usage and driving performance.

# Methodology

## Natural Experiment Design and Data Collection

The hypotheses will be tested by means of a natural experiment with the use of a 2 x 2 between-subject design. The treatments will be app usage (yes versus no), and desire to improve driving skills (high motivation group versus low motivation group). And we will randomly assign the drivers based on their driving habits (measured by driving experience) to the 4 different groups.

60 different drivers will be observed by using a driving-assistant App named “hujiabao” in 3 months. Meanwhile, their driving behavior will be collected with the on-board devices. The control variables such as the participants’ age, gender, type of car will be obtained through the App. We will first distinguish novice drivers from experienced drivers bounded by the median of all drivers’ driving experience (Brown and Groeger 1988; Underwood et al. 2003), and in the following experiment, drivers will be randomly assigned to each group based on their driving experience. According to the data from the App, drivers will be automatically divided into Group1 (high motivation group) and Group2 (low motivation group) based on the self-perceived willingness to improve driving skills.

Then participants will be provided with a mobile App that we designed for the experiment and be asked to check in if using the App. In Group1 and Group2, different behaviors of app usage (whether have used or not) in a given day will be observed. And then within drivers using or not using App, changes of individual driving behavior will be measured and recorded respectively.

In the experiment, we’ll mainly test two instruments. One is the drivers’ intrinsic motivation for driving in a better manner. Another is the extrinsic factor (App usage) to encourage drivers to driving better. Then participants will be provided with a mobile App that we designed for the experiment and be asked to check in if using the App. In Group1 and Group2, different behaviors of app usage (whether have used or not) in a given day will be observed. And then within drivers using or not using App, changes of individual driving behavior will be measured and recorded respectively.

## Measures

Drivers’ driving performance will be measured by driving score in a given day as the dependent variable. And when calculating a driving score, we will take the abnormal operation including the rush for driving speed, nasty brake, etc. into account. The App usage behavior of drivers will be the key independent variable of interest in our estimation. It will be used to identify whether a driver has used the App, measured by the driver's check-in status in the App in a given day. Another contributing factor, desire (high/low), will be measured by the degree of drivers’ desire to improve their driving performance and be directly collected through the App. In addition, driving habits will be seen as a moderate variable measured by driving experience, which indicates the driving months of a driver.

Several control variables are considered to ensure the model robustness, such as hours of tired driving, average driving speed and the total range per day. The demographic variables including age and gender are viewed as control variables as well.

# Preliminary Contributions

This paper contributes to contemporary knowledge about the impact of IT on individual behavior changing. We believe the findings of our research will (1) Extend the motivational theory by applying it into driving behavior changing area; (2) Provide insights of the positive impact of IT on individual behavior; (3) offer suggestions to drivers for choosing their appropriate function settings and to relevant IT developer to make a useful App function design for driving performance improvement practically.

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