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# Mobile phone use while driving: A hybrid modeling approach

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ABSTRACT

The analysis of the effects that mobile phone use produces while driving is a topic of great interest for the scientific community. There is consensus that using a mobile phone while driving increases the risk of exposure to traffic accidents. The purpose of this research is to evaluate the drivers' behavior when they decide whether or not to use a mobile phone while driving. For that, a hybrid modeling approach that integrates a choice model with the latent variable "risk perception" was used. It was found that workers and individuals with the highest education level are more prone to use a mobile phone while driving than others. Also, "risk perception" is higher among individuals who have been previously fined and people who have been in an accident or almost been in an accident. It was also found that the tendency to use mobile phones while driving increases when the traffic speed reduces, but it decreases when the fine increases. Even though the urgency of the phone call is the most important explanatory variable in the choice model, the cost of the fine is an important attribute in order to control mobile phone use while driving.



## 1. Rationale

Talking on the mobile phone, chatting, sending an e-mail, searching for an address on the GPS, manipulating the sound equipment onboard, watching a pretty woman or a handsome man that passes by on the street, discussing this paper with a passenger, or looking at a crash that has just happened on the road, are activities that, if made while driving, might become distractions that might cause an accident. It would be very difficult to estimate how many distracted drivers drive on a particular section of the road, though there is consensus that distractions are a major cause of accidents because a distracted driver can fail to see a stop sign, not see a red traffic light, violate the speed limit and generally assume attitudes that might put their own safety or that of others at risk.

It has been proven that distraction when talking on the phone reduces the driver's ability to react in relation to other activities which may occur while driving such as using music players (Consiglio et al., 2003). Research based on simulated situations (Drews et al., 2008; Beede and Kass, 2006; Strayer and Drews, 2007) and in real cases (Collet et al., 2010a, 2010b) concluded that using a mobile phone while driving increases the risk of exposure to traffic accidents. However, many drivers seem to be unaware of the risk related to using mobile phones while driving (Horrey et al., 2008; Rosenbloom, 2006) and, therefore, it is estimated that most drivers use their mobile phone while driving. Due to the complexity of the phenomenon related to the activities of talking on the phone while driving, many researchers have tackled this issue from different perspectives, which today is in the best interest of the scientific community.

White et al. (2004) conducted two studies on risk perceptions of mobile phone use while driving. In the first study, they observed that the use of hand-held sets was seen as a higher risk than other activities, such as looking for music to play or eating and drinking. They also observed that people tend to give more importance to physical distractions rather than the cognitive ones, which explains, in part, why people perceive those activities that do not involve the physical handling of devices as less risky. This behavior has been corroborated by other researchers as Backer and Sagberg (2011), who found a significant increase in accident risk for hand-held mobiles and hand-free phones together. Likewise, Reimer et al. (2011) have found that using the headset can be even more dangerous than using the mobile phone without additional devices because drivers try to compensate for the risk in the first case and they forget to do it when using a hands-free phone (Ishigami and Klein, 2008).

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The results of the second study conducted by White et al. (2004) suggested that almost half of the drivers who had a mobile phone had used it while driving. They found that the probability of mobile phone use was higher for young male individuals, and instead of using a hands-free set they used a hand-held device. Regarding young drivers, Neyens and Boyle (2008) indicated that there are a substantial number of crash-related injuries for teenage drivers due to inattention. They suggested that all teenage drivers were more likely to be severely injured when distracted by mobile phones or passengers. This clearly suggests that inattention is a major problem for teenage drivers. Neyens and Boyle (2008) further asserted that as more devices are being installed inside the vehicles, and as mobile phone use continues to increase, the potential for driver distraction is rising, especially for teenage drivers and their passengers.

The study conducted by Wogalter and Mayhorn (2005) suggested that individuals classified as mobile phone non-users have stronger beliefs about the existence of safety problems associated with driving, compared to those individuals they classified as mobile phone users. It is important to highlight how their research found that non-users would be willing to use the phone only in emergencies. This means that despite the condition of an individual user, the decision to use the phone would be clearly determined by the importance or urgency of the call to be made. In this regard, it seems necessary to clarify that the use of mobile phones in vehicles is not harmful per se because the evidence suggests that the mass of mobile phones allows a timely response from the emergency services to the accident site so that it could help to reduce the number of fatalities in traffic accidents (Loeb et al., 2009; Fowles et al., 2010).

Due to the obvious risk, in many countries it is illegal to drive and use a mobile phone simultaneously (Macario et al., 2010). Although using a mobile phone while driving in Colombia is prohibited (the exception is when a hands-free device is used), this is a common practice that tends to escalate, as it has been observed, and results in a concurrent increase in mobile phone coverage and the rate of motorization (Echeverry et al., 2009), while the ability of police control by against continuing violations of traffic rules has been rather stagnant. In Colombia, the level of impunity for traffic violations is very high (Ferrer et al., 2013), yet the country has more than enough budget, gathered from the Compulsory Insurance for Traffic Accidents, which could well be used in advertising for social awareness on this issue.

To this end, it is essential to try to better understand human behavior in the context of the decisions made with compliance or not to traffic rules. To that end, the purpose of this research is to evaluate the drivers' behavior when they must decide whether or not to use their mobile phone. A hybrid modeling approach was used that integrates the choice model with a latent variable model, in which the system of equations is estimated simultaneously. Hybrid models are clearly superior to even highly flexible traditional models that ignore the effect of subjective attitudes and perceptions (Yáñez et al., 2010).

There is sufficient literature addressing risk analysis or the preferences for safety in different contexts of transportation choices. Tsirimpa et al. (2010) developed a latent variable model to address the impact of risk aversion on travelers' switching behavior. They combined choice and latent variable models, in which the individual traveler's risk aversion had been modeled as a latent variable. They found out that specific travel information – such as that regarding an incident or road closure – influences behavioral changes such as departure time change and route change.

Márquez et al. (2014) analyzed the influence that perceptions of safety and comfort of the service have on the choice of river transport by passengers using hybrid choice models incorporating latent variables. The results of the hybrid choice model indicate that older workers attach less importance to the hull condition and safety; in turn, comfort is more valued by young workers and by those users who have a higher educational level.

Daziano (2012) estimated a hybrid choice model to explain consumers' preferences for safety. He found out that hybrid models are superior to include the qualitative and attitudinal nature of safety. Daly et al. (2012) showed the impact that concern with privacy, liberty and security, and distrust of business, technology and authority have on the desire for rail travel in the face of increased security measures, as well as for universal security checks. Unlike many other latent attitude studies, they explicitly recognize the repeated choice nature of the data.

Prato et al. (2012) estimated a hybrid model, which is composed by latent variables linked to measurement indicators and utilities to choice indicators, and structural equations, which link travelers' observable characteristics to latent variables and explanatory variables to utilities. They concluded that considering latent variables (i.e., memory, habit, familiarity, spatial ability, and time saving skills) alongside traditional variables enriches the comprehension of route choice behavior.

According to the proposed approach, measurement variables (i.e., fine, speed, type of conversation and traveling conditions, among others) were included and unmeasurable perceptions and attitudes which were modeled as latent variables. The cost of the fine restricts the driver's behavior (Kowalski and Lundman, 2010) against the possibility of committing an offense. The speed is associated with the risk and severity of the accidents (Kononen et al., 2011). Driver's behavior differs depending on the type of conversation (Dula et al., 2011), and it also affects the risk of accidents both at high or low traffic congestion (Hennessy and Wiesenthal, 1999; Hennessy et al., 2000). Traffic flow is generally taken as a measure of exposure when computing the risk of being involved in a vehicle crash. When exposure increases then the risk increases too (Forkenbrock and Weisbrod, 2001) and affects the use of mobile phones while driving. This framework improves the knowledge about the factors that can lead drivers to take these risks, and it provides useful information for the implementation of policies to reduce crash rates.

The first part of the paper refers to the rationale; the next section describes the methodology; after that the general specification of the model is presented, followed by the relevant results of the modeling process as it was addressed. Finally, the practical conclusion and implications of the research will be presented along with a discussion of possible avenues for further research.

## 2. Methodology

This research studied the factors affecting mobile phone use while driving through integrated choice and latent variable models. Stated preference surveys were collected to represent car drivers in Tunja, which is a medium sized Colombian city, located 150 km northeast of Bogota.

### 2.1. Context of choice

Colombian laws define "using mobile communication systems or installed phones in vehicles when driving, except if they are used with accessories or auxiliary equipment that allow it to keep your hands free" as a traffic violation. Despite the ban, the statistics of human drivers' behavior in Colombia, reflected in the reporting of the offenses punishable by fines, indicate that not using handset devices is in the top 20 most commonly committed offenses in the country, with a share of 3.5% of total national traffic offenses, i.e., around 63,000 offenses per year (Comptroller General of the Republic, 2012).