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Socio-economic and driving experience factors affecting drivers' perceptions of traffic crash risk

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ABSTRACT

Drivers are estimated to contribute an overwhelming proportion to the burden of traffic crashes, as factors that increase crash risk are frequently due to unsafe driving behaviours. The relationship between risk perceptions and people's risky driving behaviours is still not well understood. This paper aims to further analyse the potential effect of risky driving behaviours on drivers' perceptions of crash risk and differences in perceptions among drivers.

Crash risk perceptions in an inter-city, two-way road context of 492 drivers were measured by using a Stated Preference (SP) ranking survey. Rank-ordered logit models were used to evaluate the impact on risk perception of five unsafe driving behaviours and to identify differences in drivers' risk perceptions. The five unsafe driving behaviours considered in the analysis were respectively related to whether or not the driver follows the speed limits, the rules of passing another car and the safe distance, whether or not the driver is distracted, and whether or not she/he is driving under optimal personal conditions.

All risky driving behaviours showed a significant potential effect ($p < 0.001$) on crash risk perceptions, and model's results allowed to differentiate more important from less important unsafe driving behaviours based on their weight on perceived crash risk. Additionally, this paper further analyses the potential differences in risk perception of these traffic violations between drivers of different characteristics, such as driving experience, household size, income and gender.

The SP technique could be applied to further analyse differences in perceptions of risky driving behaviours among drivers. Future research should consider the potential effect of driving skill on perceptions of risky driving behaviours.

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1. Introduction

Road safety is an issue of a huge importance across the world. According to data of the World Health Organization, approximately 1.24 million people die on the world's roads every year, which is estimated to be the 8th main cause of death globally (WHO, 2013). The most frequent causes that lead to traffic crashes are the infrastructure, the environment, the vehicle and human factors (such as excessive speed, driver fatigue and traffic rules violation) (Penden et al., 2004); however, an overwhelmingly proportion of traffic crashes are estimated to be mainly due to the human factor (between 70% and 90%) (Blanco, 2013).

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It has been reported the evidence-based hypothesis that driving behaviour is a central human factor that contributes to road crashes (Sabey & Taylor, 1980). Driver behaviour, also known as driving style, refers to the manner in which people choose to drive or driving habits that have developed over time (Elander, West, & French, 1993). For instance, the most frequent traffic violation is speeding, which is related to increased risk of a crash (Delhomme, Verlhiac, & Martha, 2009; Parker, West, Stradling, & Manstead, 1995; West, Elander, & French, 1992). Similarly, lack of thoroughness in decision making (e.g., making decisions without considering all the implications) has been found to be a driving behaviour associated with crash involvement (Parker et al., 1995; West et al., 1992). Furthermore, several authors have provided grounds for believing that self-reported risky driving behaviours were linked to increased crash involvement for inexperienced drivers (Ivers et al., 2009; Stevenson & Palamara, 2001).

Road users' risk perception is essential in the process of driving because it affects their driving behaviour and how they perform tasks such as receive and process information coming from the driving environment and act based on her/his judgment on predictions about possible actions (Wang, Hensher, & Ton, 2002). In fact, research has shown that risk perception can be a predictor of unsafe driving behaviour (Glendon, McNally, Jarvis, Chalmers, & Salisbury, 2014; Rhodes & Pivik, 2011).

In the decision making literature, two different concepts of risk perception can be differentiated: risk as feelings and risk as analysis (Kinnear et al., 2013). Risk as feelings, or affect, has been defined by Slovic, Finucane, Peters, and MacGregor (2002) as the specific quality of "goodness" or "badness" experienced as a feeling state, implying or not consciousness; and that is related to a positive or negative quality of a stimulus. According to a thorough literature review conducted by Kinnear et al. (2013), dual-process theories of information processing consider that the analytical processing of risk is developed in the analytical system, whereas affect is processed in a different and underlying system, the experiential system. Within the domain of neurological theory, the Somatic Marker Hypothesis (SMH) embeds the position adopted in the literature that these two systems work in parallel (Kinnear et al., 2013). The SMH considers that the feedback from the experiential system allows for decision speed and accuracy when the completely rational analytic system faces complex decisions, which otherwise would be time consuming and incomplete due to working memory limitations (Kinnear et al., 2013). Additionally, the rational decision-making could process options biased by somatic markers that are caused by prior experience (Kinnear et al., 2013). With this regard, there is reported evidence in the literature that there are dissociations between cognitive risk estimates and psycho-physiological measures of hazard awareness such as skin conductance responses, which supports the hypothesis that risk perceptions are processed by two separate systems (Kinnear et al., 2013).

According to the existing literature, drivers' risk perception is believed to be a complex phenomenon and the difference between risk as feelings and risk as analysis has not been frequently introduced in a clear manner. Individual risk perceptions are unique, that is, any two individuals will perceive a given risk differently (Dixit, Harrison, & Rutström, 2014; Iragüen & Ortúzar, 2004). Moreover, risk perception of drivers may depend on several factors, such as transportation mode (Noland, 1995), geometric characteristic of the road and traffic (Wang et al., 2002) and if the person travels with another person (Iragüen & Ortúzar, 2004). Additionally, risk perception of individuals in the driving environment may depend on socio-economic characteristics such as gender and age. There are reported evidences that men tend to have a lower level of perceived risk in the driving environment than women (Deery, 1999; Glendon et al., 2014; Iragüen & Ortúzar, 2004; Ivers et al., 2009; Parker, Manstead, Stradling, & Reason, 1992; Rhodes & Pivik, 2011; Wang et al., 2002). Rhodes and Pivik (2011) found evidence that risk perception was a stronger predictor of risky driving for females and adults than for males and young drivers respectively, when compared to positive affect. In regards to the possible effect of age in risk perception, it is commonly acknowledged that young drivers are more likely to underestimate their risk of crash in a variety of traffic situations (Deery, 1999; Rhodes & Pivik, 2011).

Furthermore, risk perception of road users may be biased by their driving skill, which is concerned with performance limitation on aspects of the driving task (Elander et al., 1993). It has been reported in the literature that optimism is associated with risk perceptions of an accident, and this optimism may be due to people's overestimations of the degree of control that they have over events (DeJoy, 1989). Moreover, Dixit et al. (2014) identified risk attitudes, risk perceptions and driving skills of drivers by using a controlled experimental elicitation method, and they reported differences in subjective risk perceptions between higher skilled drivers and lower skilled drivers. They used a driving simulator to induce a driving context on the decision environment in which respondents were presented risky alternatives and made choices over left-hand turns into incoming traffic at an intersection. They found evidence that higher skilled drivers, when compared to lower skilled drivers, showed a higher subjective probability of turning successfully at shorter gaps (space between incoming cars), and lower subjective probability of success at longer gaps. The concept of calibration may allow explaining the subjective judgment bias in the driving environment. According to Horrey, Lesch, Mitsopoulos-Rubens, and Lee (2015), the concept of calibration has been used to discuss whether or not non-realistic evaluations of our own skills and abilities, and simultaneously, good feelings and self-worth and esteem, could lead us to dangerous situations. Horrey et al. (2015) further developed calibration models by making use of momentary demand regulation, information processing, and lens models for information selection and utilisation. In this model, the way in which the drivers assess the state of the world is described by a lens model, in which the driver uses information cues to make a subjective estimate of "current performance", or any other environmental criterion such as task demands. Similarly, a second lens model explains the calibration of ability as the degree of correspondence between the driver's perceived abilities and actual abilities.

The ability of a driver to detect dangerous situations (i.e., hazards) on the road ahead is the only skill specific to driving that has been found to correlate with crash risk (Wetton, Hill, & Horswill, 2011). In fact, computer-based hazard perception tests are being created for licensing purposes in countries such as the UK, Australia (Wetton et al., 2011) and Spain (Castro

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