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How to identify the key factors that affect driver perception of accident risk. A comparison between Italian and Spanish driver behavior

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ABSTRACT

Road crashes can be caused by different factors, including infrastructure, vehicles, and human variables. Many research studies have focused solely on identifying the key factors that cause road crashes. From these studies, it emerged that human factors have the most relevant impact on accident severity. More specifically, accident severity depends on several factors related directly to the driver, i.e., driving experience, driver's socio-economic characteristics, and driving behavior and attitudes. In this paper, we investigate driver behaviors and attitudes while driving and specifically focus on different methods for identifying the factors that most affect the driver's perception of accident risk. To this end, we designed and conducted a survey in two different European contexts: the city of Cosenza, which is located in the south of Italy, and the city of Granada, which is located in the south of Spain. Samples of drivers were contacted for their opinions on certain aspects of driving rules and attitudes while driving, and different types of questions were addressed to the drivers to assess their judgments of these aspects. Consequently, different methods of data analysis were applied to determine the aspects that heavily influence driver perception of accident risk. An experiment based on the stated preferences (SP) was carried out with the drivers, and the SP data were analyzed using an ordered probit (OP) model. Interesting findings emerged from different analyses of the data and from the comparisons among the data collected in the two different territorial contexts. We found that both Italian and Spanish drivers consider driving in an altered psychophysical state and violating the overtaking rules to be the most risky behaviors.

1. Introduction

Road crashes have direct impacts on the social and physical environments. During the past few years in Europe, the annual social cost of road crashes has been estimated at approximately 2% of the GDP (Gross Domestic Product) of the EU countries, corresponding to approximately 180 billion euros. In 2012, a total of 27,700 people in the EU27 died as a consequence of road collisions, approximately 313,000 were recorded as seriously injured, and many more suffered less severe injuries (ETSC, 2013). Specifically, there were 60 fatalities per million inhabitants in Italy, more than in the United Kingdom, Spain (40 fatalities per million inhabitants), Germany, and France (ACI, ISTAT, 2013).

Given the seriousness and relevance of this issue, which constitutes a major public health problem worldwide, many studies have focused on this subject. Two main directions are useful in addressing the problem, i.e., from the point of view of crash frequency or from the point of view of crash injury severity. Lord and Mannering (2010) provided an assessment of the characteristics of crash frequency data and methodological alternatives and limitations for examining such data. Savolainen et al. (2011) and Mujalli and de Oña (2013) provided a similar assessment of data characteristics, methodological alternatives, and limitations for examining crash severity data. The factors that affect the frequency of occurrence and the severity of crashes can be classified into infrastructure, human, and vehicle groups (Wang et al., 2002). The first group includes road and traffic characteristics, i.e., road geometry and surface conditions, traffic flow, vehicle speed, and weather conditions. Human factors encompass driver characteristics, i.e., driving experience and attitude, physiological and psychological state, personal traits, etc. Improvements to the road environment and vehicles have delivered major safety gains, and the importance of behavior in the prevention of

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vehicular crashes has also been extensively documented (e.g., Elander et al., 1993; Parker et al., 1995). However, a gap still exists in the field of understanding human factors as contributors to risky driving and crash causes as well as the behavior of road users, which has been acknowledged as the main contributory factor to crash frequency and injury severity. Data show that 70–80% of road crashes were the fault of the drivers, and this percentage is well known to be similar in most of the developed countries of the world. Sayed et al. (1995) write that even 96% of collisions are attributed at least in part to driver error.

Driver perception of road safety is an important influence on driving behavior and task performance; however, the question arises as to how to measure the perception of safety (Wang et al., 2002). The main objective of this paper is to investigate the factors that primarily affect the driver's perceived accident risk, and specifically factors relating to human behavior, being the main contributory factor to road accidents. Based on the literature and a pilot survey, five behavioral aspects were selected and investigated. We applied different methods for analysis and understanding of the influence of these aspects on driver perception of the risk of road crashes. Specifically, the factors address certain road rules and driver attitudes. An experimental survey was designed and conducted in the city of Cosenza (Italy), and the same survey was subsequently carried out in the city of Granada to identify whether the factors that heavily influence driver perception of accident risk are the same in both contexts. Face-to-face interviews were carried out with samples of drivers. The factors of influence were communicated by the interviewed drivers, who directly expressed a frequency level related to respecting the rules or correct personal behavior, and by indirect opinions gathered in a ranking exercise based on the stated preferences (SP) method. Data collected from the SP experiment were subsequently analyzed via calibration of ordered probit (OP) models, which allow determination of the weight of each attribute relative to the accident risk, and the influence of road rules and driver attitudes on the risk perceived by the users was quantified. We adopted the OP model formulation because it is a suitable methodology that provides satisfactory results if used to analyze ordinal variables, as in this case. Examples of other studies about accident severity where ordered probit model was employed can be found in Duncan et al. (1998), Khattak (2001), Rifaat and Chin (2005). But in these works SP experiments were not adopted. An objective of our work is to show how SP technique can be useful and interesting for analyzing the perception of accident risk.

Interesting results were obtained by applying the above-mentioned different methods for analyzing driver opinions and by collecting data from two different experimental contexts, i.e., Italy and Spain. We retain it as it is very interesting to compare and contrast findings from samples of two different countries for many reasons: to test the methodology in two different contexts, to test the questionnaire in two different languages, to investigate about driving behavior of people living in two different contexts and with different habits.

The findings in the work could be useful in terms of understanding which driving rules or user attitudes are the most important to drivers in terms of affecting perceived road accident risk.

In the following sections, we present a literature review of related works that address the factors that have an impact on the perceived risk of an accident, specifically the human factors. After the literature review, we describe the main assumptions of the proposed work. Next, Section 4 describes the surveys and samples, highlights the main differences between the two experimental contexts, and presents a comparison between different types of drivers. After this characterization of the drivers, the OP models are addressed by briefly describing the theoretical framework and the application of the model to the data collected in the two contexts. The results of the models are discussed in detail, and selected comparisons between the different methods of analysis of the data are carried out. Interesting findings are obtained from these comparisons, and the paper ends with a brief summary section.

2. Literature review

The factors that have an impact on road crashes have been widely investigated in the scientific literature. Traditionally, researchers distinguish among environment, road factors, vehicle characteristics, and human factors.

Many efforts have been carried out to deeply analyze the human factors that affect road crashes and their severity. Researchers have found that accident risk particularly depends on driving experience (in terms of license status, years of driving, accident involvement in the last few years, distance driven in mile/km), driver's socio-economic characteristics (in terms of gender, age, personal or family income, commuter status, educational level, current marital status), and driving behavior (in terms of traffic offences in the last few years, physical condition of the driver, use of alcohol and drugs, use of seatbelt, driving in excess of posted speed limit, failure to remain in the proper lane, passing where prohibited by posted signs, use of cell phone, etc.) (Wang et al., 2002; Dissanayake, 2004; Yannis et al., 2005; Clarke et al., 2006; Lambert-Bélanger et al., 2012; de Oña et al., 2013; Tractinsky et al., 2013).

Additionally, the psychological state of the driver while driving was investigated. As an example, in their investigation, Wang et al. (2002) introduced the respondent's self-description of his/her psychological state in most driving situations. These researchers chose five categories: an aggressive driver, an impatient driver, a hesitant driver, a slow driver, and a highly cautious driver. Clarke et al. (2006) reported on the intentions and behaviors of drivers as interpreted by the attending police officer in terms of the presence or absence of aggressive recklessness. Jamson et al. (2008) focused on driver awareness and distinguished a range of categories from poor (driver is cognitively inattentive) to excellent (driver is fully concentrated on the driving task). Finally, Scott-Parker et al. (2009) introduced a self-reported risky driving behavior assessment expressed via a seven-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree).

Traditionally, risk attitudes of drivers have been investigated using survey data gathered through “self-reported risky driving behavior”. As an example, certain authors analyzed driver psychophysical conditions (Dobson et al., 1999), psychological perspectives (Goldenbeld et al., 2000), or personalities (Iversen and Rundmo, 2002, 2012) as factors that influence driver attitudes and behaviors. Additional studies focused on specific driving attitudes, such as the work of Lahausse et al. (2010), which analyzed attitudes towards speed limits for different road types. Other authors proposed studies of risky driving behavior in young people and analyzed the relationship between personal characteristics and traffic accidents (Fergusson et al., 2003; Clarke et al., 2006; Koushki and Bustan, 2006; Kanaan et al., 2009; Waylen and McKenna, 2008; Eiksund, 2009; Scott-Parker et al., 2009; Daignault and Delhomme, 2011).

To reduce the risks of social desirability bias associated with self-administration, Reason et al. (1990) developed a survey instrument known as the driver behavior questionnaire (DBQ). Certain authors measured the behaviors of the drivers and their attitudes using the DBQ, including items that addressed each driver's frequency of violations, lapses, and errors while driving (Lajunen and Summala, 2003; Lajunen et al., 2004; af Wåhlberg, 2010; Stanojevic et al., 2013).