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Effect of information sharing and communication on driver's risk taking

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ABSTRACT

This study aims to decrease Chinese drivers' three risk-taking behavior: risky driving, aggressive driving and vehicle–bicycle interaction. The authors proposed an information sharing and communication system (DISC) to send drivers information and communication from neighboring drivers. Three simulation experiments were conducted to test the effectiveness of the DISC system. Thirty-six male drivers aged between 21 and 35 years old with a moderate amount of driving experience took part in this study. For risky driving, the subjective measures of sensation seeking, personal norm and intention to take risk were rated by after-experiment questionnaires. The measures of anonymity, ego-defensiveness, anger and subjective aggression were rated for aggressive driving. The perceived risk during interaction with bicycles was also rated. Cronbach's alpha was used to calculate the internal consistency of each subjective measure. One-way ANOVA was used to compare the mean of each subjective measure and objective measure. Results showed that when having information and communication, sensation seeking, personal norm, intention, anonymity and perceived risk were significantly changed. Drivers had less risky and aggressive behavior and earlier behavior adjustment when interacting with bicycles. The results provide us with a better understanding of the effect of information sharing on risk-taking behavior in automobile driving. Information frequency and driver acceptance of the information system should be investigated in the future.

1. Introduction

With the rapid growth in the economy, more and more Chinese are going to own private cars. At the same time, traffic accident rate and the mortality rate are extremely high. As an example, there are 2,382,351 traffic accidents with 67,759 people killed and 275,125 others injured in 2009 (CRTAS, 2009). In the present study, three risk-taking behavior, voluntary risky driving, aggressive driving and vehicle driver interaction with cyclist were investigated. The reason is that these behavior have caused a large number of traffic accidents and will go on threatening China's road safety during the process of motorization (Wang et al., 2010a).

Many studies have investigated the relationship between risky driving and road traffic crashes (Honkasalo, 1992; Fahrenkrug and Rehm, 1994; Stevenson and Palamara, 2001; Iversen and Rundmo, 2004). It was found that risky driving behavior, however measured, are associated with an increased chance of injury or death (Turner et al., 2004). This has been further proved by the traffic accident statistics in China, that drunk driving, speeding, not yielding as required, close following, illegal overtaking and illegal turning are the primary causes of fatalities in car accidents (CRTAS, 2009).

There is a concept that drivers should be aggressive. Otherwise other drivers will take advantage (Shi et al., 2010). Drivers have to minimize headway and avoid other cars or bicycles cutting in or crossing. These aggressive behavior, such as tailgating, obstructing the paths of others, taking every opportunity to move forward when in congestion resulted in a large number of traffic accidents and an estimate of 10,210 deaths in the year of 2008 (CRTAS, 2008).

As in most developing countries, cyclists are often the victims of traffic accidents (Jacobs et al., 2000). There were 5316 cyclist deaths and 3678 electronic-cyclist deaths, which accounted for 7.85% and 5.43% of the total road traffic deaths in 2009 (CRTAS, 2009). On the one hand, there are not enough bicycle lanes, as a result of fact that they are often occupied by motor vehicle. Sometimes cyclists even have to share sidewalks with pedestrians. On the other hand, cyclists may cross the street anytime and anywhere at their convenience, which creates lots of chaos. In addition, the rapid increase of electrical bicycles has made the situation more complicated.

In the past decade, intelligent transportation systems (ITS) play a significant role in achieving the goals of reducing congestion and

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increasing traffic safety. There are many ITS applications for traffic management and in-vehicle driving support, both in research and practice (Dingus et al., 1997). However, there is no system that was designed to decrease drivers' risk taking. In the present study, the driver information sharing and communication system (DISC) was proposed to send information to drivers when they are voluntarily taking risk, trapped in frustrating situations and interacting with cyclists. The effectiveness of the DISC system on drivers' risk-taking behavior was evaluated.

2. Literatures

2.1. Risky driving

Studies within the realm of traffic psychology have largely focused on attitudes and behavior models since 1985 (Rothengatter, 2002). Fishbein and Ajzen's Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975) and Ajzen's later Theory of Planned Behavior (TPB) (Ajzen, 1991) have been proved to be powerful to identify motivational factors influencing driver behavior. TPB model predicts that intention to perform a certain behavior is determined by attitude, subjective norm and perceived behavioral control. Each construct within TPB has been proved consistently related with risky driving (Parker et al., 1992, 1996; Paris and Broucke, 2008; Wallen Warner and Aberg, 2008).

There are several norms that have been studied. Subjective norm consists of a person's beliefs about whether significant others think he or she should engage in the behavior (Ajzen, 1991). Descriptive norm measures an individual's beliefs about other people's behavior (Forward, 2009). Personal norm relates to an individual's own values involved with a certain behavior (Conner and Armitage, 1998). It is identified as the values that the individual thinks as important and the personal feeling of responsibility to perform or refuse to perform a certain behavior (De Pelsmacker and Janssens, 2007). According to a meta-analytic review (Armitage and Conner, 2001), subjective norm has been shown to be the weakest predictor of intention in both of TRA and TPB.

Besides, a number of additional factors, such as past behavior, sensation seeking and emotional reasons have been suggested as extension of TPB (Conner and Armitage, 1998; Parker et al., 1998; Elliott, 2010). Sensation seeking (SS) has been defined by Zuckerman (1994) and numerous studies have demonstrated that sensation seeking is linked with risky driving and increased accident rates (Arnett, 1996; Heino et al., 1996; Jonah et al., 2001; Rosenbloom, 2003), with correlation from 0.30 to 0.40, depending on gender of the driver, the measure of risky driving and sensation seeking scale (Jonah, 1997).

In order to focus on the determinant factors of Chinese risky driving, a questionnaire survey was implemented prior to this study. The finding is that sensation seeking and norm are the two most important factors relating with Chinese risky driving (Wang et al., 2011). The result of multiple regression analysis showed that the factor of personal norm contributed 17% of the variance of risky driving. Therefore, in the present study sensation seeking (SS) and personal norm (PN) are investigated for reducing risky driving.

2.2. Aggressive driving

The definition of aggressive driving is based on the frustration–aggression model (Shinar, 1998). Driver aggression is manifested as inconsideration towards or annoyance of other drivers. The link between aggression and frustration implies that aggressive behavior could be instigated by a frustrating situation, behavior, or event. Frustration can be caused by environmental factors such as a traffic jam or a difficult road. However, as indicated by Yagil (2001), many frustrations during driving are caused by other drivers' behavior.

Anonymity is a central variable to driver aggression, which has larger effect than other aggressive stimulus (Patricia et al., 2001). Anonymity is the degree to which individuals feel liberated from social evaluation and threats of punishment (Pinsonneault and Heppel, 1997). Drivers become anonymous when they are in the car and cannot be identified by others. Therefore, they cannot be evaluated, criticized, judged, or punished (Patricia et al., 2001). Finally, this anonymity facilitates aggressive behavior. For example, in the study by Ellison et al. (1995), participants displayed significantly shorter horn-honking latencies, longer horn-honking durations, and more frequent horn honks in the anonymous conditions than in the identifiable conditions.

Research has implied that aggression often stems from ego-involved constructs such as perceived threats to self-esteem (Baumeister et al., 2000) and social identity (Branscombe and Wann, 1994). As suggested by Neighbors et al. (2002), driver aggression and aggressive response are more frequently aroused by ego-defensive reactions to other drivers, such as perceiving another driver's actions as being personally directed at the self. However, few research has examined the aggression caused by ego-defensive driving events.

Another important variable for understanding aggressive driving is anger. Driving anger is conceptualized as a situational expression of emotion that represents a significant and dangerous phenomenon in society (Nesbit and Conger, 2011). Studies have shown that driving anger correlates positively with aggressive driving incidents (Lajunen et al., 1998; Underwood et al., 1999). When having higher anger, drivers engage in more aggressive and risky behavior, and more close calls, losses of vehicle control, violations and minor accidents (Deffenbacher et al., 2002). However, the relationship between driving anger, driver aggression and aggressive driving behavior is not clear.

2.3. Vehicle driver and cyclist interaction

This study focuses on driver–cyclist interaction at intersections, as most bicycle accidents occur at intersections (Gårder et al., 1994). Many of the vehicle–bicycle accidents are due to the driver not seeing the cyclists in time to avoid the collision (Wood et al., 2009). From a study of 188 vehicle–bicycle accidents in four cities, neither driver nor cyclist realized the danger or had time to yield in 37% of the collisions. In some serious conflicts the cyclists did not change speed and assumed that the driver would yield (Räsänen and Summala, 1998).

One feature of vehicle–bicycle accidents at intersections is the vehicle direction, as most collisions involved turning movements of motor vehicles. Wang and Nihan (2004) studied the collisions between drivers and cyclists occurred at intersections in Tokyo Metropolitan area. The accidents were classified into three categories: through motor vehicle related collisions, left-turn motor vehicle related collisions, and right-turn motor vehicle related collisions. Cyclists were at fault for most of the reviewed collisions. Most bicycle studies were done in countries where people drive on the right side, like Sweden (Gårder et al., 1994), Denmark (Herslund and Jorgensen, 2003), Finland (Räsänen and Summala, 1998), the USA (Li and Baker, 1996) and China (Wang et al., 2010b). Two studies were done in countries where people drive on the left side, such as Australia (Wood et al., 2009) and Japan (Wang and Nihan, 2004).

Prior to this study, a field observation was conducted to find out the most serious problems of driver–cyclist interaction at intersections in Beijing. The results showed that cyclists always violate and put themselves in dangerous situations. The two most frequently committed violations are driving across the intersection when the traffic light is red and driving in the wrong direction (Wang et al., 2010b).