Validation of the Driver Stress Inventory in China: Relationship with dangerous driving behaviors

Weina Qu [a], Qian Zhang [a,b], Wenguo Zhao [a,b], Kan Zhang [a], Yan Ge [a,*]

[a] *Key Laboratory of Behavioral Science, Institute of Psychology, Chinese Academy of Sciences, Beijing, China*
[b] *University of Chinese Academy of Sciences, Beijing, China*

ARTICLE INFO

ABSTRACT

Perceived stress while driving may affect how critical driving events are handled. The current study validates a Chinese version of the Driver Stress Inventory (DSI) and explores its correlation with dangerous driving behaviors and gender. A sample of 246 drivers completed the Chinese version of the DSI and the Driver Behavior Questionnaire (DBQ). We also evaluated specific sociodemographic variables and traffic violations (including speeding, violating traffic signs or markings, driving while intoxicated, running a red light, and incurring penalty points). A confirmatory factor analysis (CFA) verified the DSI's internal structure. The DSI was also validated using questionnaires related to the DBQ, self-reported traffic accidents and violations, and sociodemographic characteristics. First, all of the DSI dimensions were moderately or weakly correlated with the DBQ subscales. Second, aggression, hazard monitoring and fatigue were weakly correlated with minor accidents. Third, drivers who had sped and violated traffic signs during the previous three years reported higher aggression and thrill seeking, while drivers who had violated traffic signs or markings during the previous three years reported decreased hazard monitoring compared with non-offenders. Finally, there were significant gender differences in driver stress. The Chinese version of the DSI will be useful for classifying and diagnosing drivers who may be at an increased risk for stress reactions.

© 2015 Elsevier Ltd. All rights reserved.

1. Introduction

Driving stress refers to a set of responses associated with the perception and evaluation of driving as demanding or dangerous relative to the individual's driving capabilities (Gulian et al., 1989). Driving requires sustained attention to dynamic tasks and the ability to detect changes in a complex environment and search for potential hazards, all of which can be affected by the driver's stress (Dorn and Brown, 2003). Driving stress may affect how safety-critical events are handled (Matthews et al., 1997). Previous research has shown that an association exists between driving stress and dangerous driving, as evidenced by the associations between several stress indices and involvement in car crashes (Lagarde et al., 2004; Legree et al., 2003; Norris et al., 2000). Thus, investigating the relationship between driving stress and dangerous driving behavior is important.

Several factors may induce driver stress. Driver stress mainly occurs when a driver is unable to manage driving-related dangers, which may induce a dislike of driving and impaired hazard monitoring (Gulian et al., 1989; Matthews, 2002). Other driving behavior can also induce driver stress. For example, being stuck behind a slow vehicle on a winding country road in bad weather may be frustrating and may elicit anxiety about how to safely overtake the vehicle (Rowden et al., 2011). Several studies have proposed that a driver's vulnerability to stress is related to the cognitive processes of appraisal (Lazarus and Folkman, 1984; Wells and Matthews, 1995). Thus, driver stress is a complex concept that can be measured along different dimensions.

Many researchers have explored how to comprehensively measure driver stress. Gulian et al. (1989) developed a scale called the Driving Behavior Inventory (DBI) to measure individuals' general vulnerability to driver stress. However, the DBI does not provide a comprehensive measure of affective reactions to driving (Matthews et al., 1996). Matthews et al. (1997) revised the DBI and developed the Driver Stress Inventory (DSI), which defined five distinct driver stress dimensions: aggression, a dislike of driving, hazard monitoring, proneness to fatigue and thrill seeking. The aggression items (e.g., Does it annoy you to drive behind a slow-moving

* Corresponding author at: 16 Lincui Road, Chaoyang District, Beijing 100101, China.
E-mail address: gey@psych.ac.cn (Y. Ge).

vehicle?) relate to driving reactions that reflect irritation and behavioral aggression, specifically when the driver's progress is impeded by other traffic (Matthews et al., 1998). The dislike-of-driving items (e.g., I feel more anxious than usual when I have a passenger in the car) measure a driver's anxiety, tension, and lack of confidence in complicated driving situations (Matthews et al., 1998). The hazard-monitoring dimension (e.g., I try very hard to look out for hazards even when it's not strictly necessary) primarily reflects a coping style that aims to prevent threats by searching for danger. The proneness-to-fatigue items (e.g., How do you feel when you have to drive for several hours with few or no breaks from driving?) evaluate a driver's reactions to fatigue symptoms when driving for several hours (Matthews et al., 1997). Thrill seeking (e.g., I would enjoy driving a sports car on a road without a speed limit) is measured with items that describe the driver's enjoyment of danger (Matthews, 2002).

Several studies have demonstrated an association between driver stress and driving safety. One study showed that a high number of stress reactions might disrupt the driver's performance and reduce safety (Dorn and Matthews, 1995). Accident report analyses have found that stress significantly elevates the risk of at-fault crashes (Legree et al., 2003). A driver's stress is related to driving safety, which includes accident rates, speeding convictions and errors (Matthews et al., 1997; Westerman and Haigney, 2000). Higher rates of self-reported errors are associated with high aggression, thrill seeking, a dislike of driving, proneness to fatigue, and low hazard monitoring (Dorn and Matthews, 1995). In addition, disliking driving is associated with diminished control skills in simulated driving tasks (Matthews et al., 1998). Aggression and thrill seeking are the strongest predictors of self-reported accidents, speeding and violations, while a dislike of driving is strongly associated with driving errors (Matthews et al., 2005).

Individual differences, such as gender, are important factors that may affect driver stress. Several studies have shown gender differences in drivers' stress reactions. Male drivers reported higher aggression and lower overtaking tension than female drivers did (Matthews et al., 1999). However, no gender differences in aggression have been found in UK and US samples (Matthews et al., 1997). Rowden et al. (2011) found that women were more likely to dislike driving and experience fatigue and aggression and were less likely than men to report hazard monitoring and thrill seeking. From previous studies, the effects of gender on driver stress are mixed and unclear, and we will explore these effects in our study.

Various countries have established the DSI's construct validity (Matthews and Desmond, 2001). The dimensions of driver stress vulnerability appear to be generalizable across cultures (Lajunen and Summala, 1995; Matthews et al., 1999). Kontogiannis (2006) found that driver stress, in the form of aggression, is cross-culturally associated with unsafe behaviors. In addition, the DSI has been translated into many languages (Matthews et al., 1997, 1999; Özkan et al., 2006), and each version has been shown to be reliable and valid. However, because language, culture, traffic regulations and driving habits vary across countries, the psychometric properties of the DSI must be examined to understand stress among Chinese drivers.

The current study has the following aims:

(1) to develop a Chinese version of the DSI by adapting it to Chinese culture and language;
(2) to verify the DSI's validity by examining the relationships among the DSI, dangerous driving behaviors (as measured with the Driving Behavior Questionnaire [DBQ]) and self-reported traffic accidents and violations; and
(3) to investigate the relationship between driving stress and gender.

2. Method

2.1. Participants

The participants possessing a driver's license (only a person older than 18 years is qualified to apply for a driver's license in China) were recruited using a convenience sampling method. A total of 246 out of 309 licensed drivers (79.6% response rate) anonymously completed the questionnaires in the presence of a research assistant and returned the questionnaires. These participants came from train stations ($N = 40$, 16.26%), communities ($N = 55$, 22.36%), the Commodity Wholesale Market Center ($N = 36$, 14.63%) and the Institute of Psychology of Chinese Academy of Sciences ($N = 115$, 46.75%) in Beijing, China. The data from two participants were not included in the analysis because their surveys had missing data or were answered carelessly (e.g., someone circled "1" as the answer for every item on the scale). Therefore, the final sample included 244 participants.

2.2. Measures

The data reported in this paper were collected as part of a large questionnaire survey on the psychological determinants of dangerous driving. Only the parts of the scales analyzed in this paper will be described. Other data from the present survey were used in two other published studies (Ge et al., 2014; Qu et al., 2014).

2.2.1. The Driver Stress Inventory (DSI)

Matthews et al. (1996) developed the DSI, which is an extension of the DBI (Glendon et al., 1993). The DSI assesses drivers' vulnerability to stress reactions while driving and includes 48 items. The total sample consisted of three groups of participants: UK-Workers (339), UK-Students (244) and US-Students (219). The internal consistency of the DSI factors was indicated using Cronbach's alpha coefficient. The original DSI consists of five factors: aggression (12 items; $\alpha = 0.78$–0.80); dislike of driving (12 items; $\alpha = 0.73$–0.82); hazard monitoring (8 items; $\alpha = 0.69$–0.73); proneness to fatigue (8 items; $\alpha = 0.75$–0.84); and thrill seeking (8 items; $\alpha = 0.81$–0.87) (Matthews et al., 1996). All five factors showed good reliability in three different samples. The participants indicated how strongly they agreed with each item on an 11-point Likert scale that ranged from 0 ("not at all") to 10 ("very much").

To develop a Chinese version of the DSI, we followed the translation/back-translation procedure suggested by Brislin (1980) and Regmi et al. (2010). First, two researchers independently translated the original DSI into Chinese. All of the authors then discussed the differences between the two Chinese translations and agreed on a unified version to improve the DSI's accuracy, fluency and adaptation to Chinese driving conditions. Next, a professional translator back-translated the new draft of the DSI into English. After comparing the original and back-translated English versions, some words and expressions that were inaccurately translated in the Chinese version were corrected. The final step involved recruiting four drivers to identify confusing items in the translated Chinese version and revising the draft based on their suggestions. These drivers were also asked to discuss cultural differences to ensure that the items in the final Chinese version of the DSI were consistent with Chinese traffic circumstances and driving situations. For interested researchers, the final Chinese version of the DSI can be made available upon request.

2.2.2. The Driving Behavior Questionnaire (DBQ)

The DBQ has frequently been used in research (Lajunen et al., 2004; Lawton et al., 1997; Parker et al., 1998). The Chinese version of the DBQ (Yang et al., 2013) consists of 28 self-reported items that measure aggressive violations (3 items; $\alpha = 0.75$; e.g., You honk