Driving anger in China: A case study on professional drivers

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\textbf{A B S T R A C T}

This paper investigated the types of situations that caused drivers to become angry when driving in China by examining the characteristics of a sample of professional drivers. The revised Chinese version of a 19-item driving anger scale (DAS) was used to examine driving anger amongst a sample of 132 professional drivers. The resultant data were analyzed by conducting principal components analysis, reliability and validity tests, producing four categories of anger provoking situations: discourtesy, traffic obstructions, illegal driving and slow driving. Compared with studies conducted in USA and Malaysia, the present study showed that Chinese professional drivers experienced lower levels of driving anger. Regarding demographics and descriptive variables, age, driving experience, and mileage were weakly correlated with driving anger, whereas preferred speed was positively significantly related to driving anger. In addition, personality differences in driving anger also existed as drivers with Type A personality and those in the middle of this continuum reported higher levels of anger than those with Type B personality. When facing certain traffic scenarios, drivers in the anger-out and the anger-in group were found to have higher anger scores than those in the anger-control group. Importantly, for professional drivers, preferred speed and anger expression were found to be important variables in predicting driving anger. Based on the survey and the comprehensive data analyses, this study provides a valuable contribution to developing the Chinese version of the DAS as a reliable and valid tool to measure driving anger among Chinese professional drivers and demonstrates the possible need for interventions among certain personality types to minimize the safety consequences of driver anger.

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1. Introduction

Road rage refers to the emotion of anger caused by pressure and frustration involved in driving. Arnold and Plutchik (1964) put forward that anger is a hostile emotion, the intensity of which increases from weak to strong. There are two forms of anger expression, namely, internal and external, thus anger not only has a negative influence on the individuals who are experiencing the emotion, such as interfering with people’s attention, affecting their capabilities of risk perception and information processing, but also other road users (Funkenstein, King, & Drolette, 1954). Previous studies found that anger was closely related to drivers’ aggressive and risky behaviors while driving, such as speeding, honking loudly, overtaking and threatening verbally, which might result in traffic accidents (Deffenbacher, Deffenbacher, Lynch, & Richards, 2003;
Deffenbacher, Lynch, Filetti, Dahlen, & Oetting, 2003; Deffenbacher, Lynch, Oetting, & Yingling, 2001). Another study has found that the number of traffic accidents related to road rage may account for between 3% and 8% of all accidents (NHTSA, 2007). That said, driving anger is likely more common than believed and is likely experienced by normal drivers regularly. For example, a diary approach to study driving anger revealed that during a two-week period, 85% of the 100 drivers studied experienced anger while driving (Underwood, Chapman, Wright, & Crundall, 1999). According to a survey conducted in 2008, more than 60% of the drivers in China experienced driving anger (Sohu., 2008). Thus, overall, road rage, as a typical negative emotion, has become a common problem worldwide.

Studies on road rage have focused primarily on the development and application of the driving anger scale (DAS). Because drivers' emotion is largely affected by the immediate environment they are experiencing, the DAS, as a self-reported questionnaire, can be used to evaluate the levels of driver anger in different traffic scenarios. The investigators ask the drivers to imagine some situations in traffic and to rate their anger levels in each situation. The original DAS, which comprised a long form and a short form, was developed in the United States by Deffenbacher, Oetting, and Lynch (1994). The short scale is a unidimensional scale with 14 items, while the long scale contains 33 items which produced six subscales, namely: police presence, illegal driving, slow driving, traffic obstructions, hostile gestures and discourtesy. However, because the original DAS was restricted to US driving conditions, some studies calibrated the results for conditions in other countries (Nesbit, Conger, & Conger, 2007; Yasak & Esiyok, 2009); thus, there were variations in the underlying structures of the scale. The original six-factor model was modified for the UK because a number of the original items evoked only slight anger among native drivers. Thus, researchers obtained a 21-item version of the DAS and total scale contained three dimensions, which were labeled: “impeded progress”, “reckless driving” and “direct hostility” (Lajunen, Parker, & Stradling, 1998). In France, researchers adopted a 22-item version of DAS and indicated that a five-factor model was satisfactory in the French context (Villieux & Delhomme, 2010). O'Brien, Tay and Watson (2002) argued that the original DAS items might lack situational or contextual cues among Australian drivers. Recently, the original DAS was used to investigate differences in the levels of driving anger between Chinese and German drivers. It was found that Chinese drivers’ perception of driving anger was quite different from that indicated by the original six-factor model, while German drivers’ perception was similar to that described by the model (Liu, Zhou, & Oeh, 2013). The inconsistencies in factor structure and representative items of the DAS in different countries may be explained by some factors such as driver groups, traffic characteristics and dissimilar analytical methods; and cultural differences between countries may also have some contribution (Lajunen et al., 1998; Liu et al., 2013; O’Brien et al., 2002; Sullman, Gras, Cunill, Planes, & Font-Mayolas, 2007; Villieux & Delhomme, 2010). As Yasak and Esiyok (2009) noted although anger is universal, the situations causing anger vary across culture. The findings from these studies raised some doubts as to whether all the original 33 situations or the factor structure of the DAS would adequately capture anger among drivers in a Chinese context. Compared with studies on European countries and the United States, studies in China on driving anger and the resultant safety problems are neither timely nor sufficient. Thus, the primary purposes of this study were to examine whether situations in the original DAS would cause Chinese drivers to experience anger.

Using the DAS, detailed investigations were conducted by many researchers to determine the relationships between driving anger and various demographic variables, such as driver age, gender, driving experience, and mileage. For example, some results indicated that the probability of getting enraged in the younger drivers' group was much higher than that in the older drivers' group, and experienced drivers had lower levels of anger than novice drivers (Bjorklund, 2008; Maxwell, Grant, & Lipkin, 2005; Parker, Lajunen, & Summala, 2002; Sullman, 2006; Sullman et al., 2007). Based on these findings, it can be concluded that demographic factors exert effects on driving anger.

Some researchers associated involvement with personality because of the correlations between personality traits and driving behaviors (Benfield, Szlemko, & Bell, 2007; Elander, West, & French, 1993). One personality trait often examined in relation to various medical and safety concerns is Type A behavior pattern. Type A behavior pattern was first discovered by cardiologists Friedman and Rosenman (1959) in patients with coronary heart disease. The typical behavioral characteristics of Type A personality are described as intense ambition, aggressiveness, a competitive drive, a constant preoccupation with occupational deadlines, and a sense of time urgency. The relative absence of these characteristics is defined as the converse, i.e., Type B behavior pattern. Following its discovery, a 14-item Type A scale was designed by Bortner (1969), and this scale, which uses a semantic differential-type procedure, has been determined to be a valid measurement tool. Initially, the scale was used to conduct research on factors related to coronary heart disease. However, Perry (1986) attempted to link the behaviors of Type A people with their driving behaviors and found that Type A individuals tended to be more impatient, involved in more accidents, and received more tickets. Furthermore, Evans, Palsane, and Carrere (1987) found that in the United States, Type A bus drivers had more accidents and self-reported occupational stress than Type B bus drivers, whereas in India, Type A drivers braked, overtook other vehicles, and blew their horns more often than Type B drivers. Other studies (Magnavita et al., 1997; Perry & Baldwin, 2000) have also concluded that Type A drivers were more aggressive on the road and were involved in many more accidents. In China, bus drivers with Type A personalities had been found to commit more errors and violations while driving than non-Type A individuals (Sun, 2009). Accordingly, it is concluded that Type A behavior pattern as a typical aggressive personality factor which threatens the safety of traffic and other drivers on the road. It is critical and logical to capture the effects of Type A behavior pattern on anger behind the wheel.

Driving anger has been defined as a situation-specific form of trait anger (Deffenbacher et al., 1994). In fact, some studies have found a positive correlation between state anger, trait anger, and driving anger (Deffenbacher, Richards, Filetti, & Lynch, 2005; Deffenbacher et al., 2001; Sullman, Stephens, & Yong, 2014). However, to date, no research has explored the levels of driving anger among people who express anger in different ways. The State-Trait Anger Expression Inventory-2 (STAXI-2)
divides people into three anger expression groups, namely, the anger-out, anger-in and anger-control group (Spielberger, 1999). Anger-out individuals vent their anger to others, whereas anger-in individuals hide or repress their anger. By contrast, the anger-control individuals control their anger well. Some studies (Funkenstein et al., 1954; Tao, 2009; Zhang, Tao, Qiao, & Zhang, 2011) concluded that the anger-out and anger-in group acted differently from each other as well as differently from the anger-control group in the face of difficulties and setbacks. An investigation of whether people who have different ways of expressing anger exhibit different levels of anger on the road would contribute to the literature on driving anger.

To test the methodologies discussed herein, the research team selected professional drivers as the sample population. As a special group, professional drivers are those who work as drivers in transport companies, such as bus drivers and taxi drivers. Because of their high road traffic exposure, professional drivers significantly contributed to road traffic accident statistics and were at a greater risk of an accident than other drivers (Broughton, Baughan, Pearce, Smith, & Buckle, 2003). Generally, professional drivers carried out most of their driving in relation to tight time schedules and this might affect their risk levels when driving (Dorn, Stephen, Wahlberg, & Gandolfi, 2010). Another study found that minibus drivers were more aggressive in traffic than non-professional drivers (Öz, Özkan, & Lajunen, 2010). For these reasons, professional drivers were selected as the sample for this study to examine the levels of driving anger they experienced, and as such, the findings have some exploratory meaning for research in this area.

The aim of this study was to use a sample population of professional drivers to investigate driving anger in China. This investigation involved the revision of the DAS, the verification of its reliability and validity, the identification of typical traffic scenarios that were rated as the most anger provoking by professional drivers in China, the exploration of differences in driving anger among different driver personality types, and the examination of driving anger in relation to demographic factors. All of the factors related to driving anger were considered to determine whether it was possible to predict driving anger significantly among professional drivers.

2. Method

2.1. Materials

2.1.1. Driving anger scale

All items on each subscale in the original 33-item DAS were translated into Chinese following the translation/backtranslation procedure conducted by a professional translator proficient in English–Chinese translation. Collective discussions of the Chinese version of DAS were then conducted by a focus group of researchers, who were also drivers, to ensure that the translations of the original 33 items were accurate. Interviews were conducted with professional drivers to determine whether any additional items should be included in the DAS. This process resulted in the addition of six new items, specifically, “someone changes lane without turning on signal lights”, “someone changes lanes while crossing the solid white line at an intersection”, “some people park their cars illegally on the road”, “non-motor vehicles occupy lanes designed for motor vehicles”, “some people park their cars illegally at intersection entrances or exits”, and “novice drivers drive too slowly on road”.

The initial 39-item driving anger questionnaire was carried out in a survey of 10 experienced school-bus drivers, all of whom had more than ten years driving experience. This representative sample of ten school-bus drivers then participated in a final calibration of the questionnaire. The sample identified ambiguous questions and those that were irrelevant to the Chinese driving experience, namely, “someone makes an obscene gesture towards you”, “someone beeps at you” and “the police drive close by.” Based on this calibration, the “hostile gestures” factor from the original DAS was eliminated, and the remaining 36 questions were sorted into five categories, namely, discourtesy, traffic obstructions, traffic management and control (formerly police presence), illegal driving, and slow driving. The participants were asked to rate how angry they would be when encountering each situation listed in the scale. Ratings are made upon a five-point Likert scale (1 = not angry, 5 = very angry).

2.1.2. Type A behavior pattern scale

Zhang’s (1985) Type A behavior scale, revised from the Jenkins Aetirity Survey (Jenkins, Rosenman, & Friedman, 1967), was used to assess whether an individual has a Type A personality, a Type B personality, or was somewhere in between. Under repeated testing, the correlation coefficient of the total scale score on two tests exceeded 0.5. Thus, the revised TABP exhibited high test-retest reliability. The questionnaire comprised 60 items which produced three subscales, specifically, a 25-item time hurry (TH) set that emphasizes urgency; a 25-item competition hostility (CH) set that emphasizes competitiveness; and a 10-item lie (L) set used to detect deception. The respondents were asked to mark each item with a tick mark for “Accept” and a cross for “Refuse”. After the questionnaire was completed, any responses with an L score greater than seven were eliminated owing to unlikely authenticity. The total TH and CH scores were then added to match each respondent to a personality type. Type A respondents had combined scores of between 37 and 50; Type A-respondents had combined scores of between 30 and 36; middle-type respondents had combined scores of between 27 and 29; Type B-respondents had scores of between 20 and 26; and Type B respondents had combined scores of between 1 and 19.
2.1.3. State-trait anger expression inventory-2

The STAXI-2 (Spielberger, 1999) was revised by Spielberger based on the original STAXI (Spielberger, 1988). In this study, we used the 57-item Chinese STAXI-2 which was derived from the original English version by Tao (2009). The STAXI-2 exhibits good internal consistency, with Cronbach Alpha values ranging from 0.63 to 0.93. The anger expression-out scale (AX-O) ($\alpha = 0.66$) and the anger expression-in scale (AX-I) ($\alpha = 0.75$) were used as the subscales of the STAXI-2 to measure trait propensities for anger. The AX-O measures whether anger and aggression are expressed outwardly, and the AX-I measures whether anger is mentally suppressed. These two scales were used to screen the anger-in, anger-out, and anger-control group. Ratings are made upon a four-point scale (1 = almost never; 4 = almost always). The participants whose scores were higher than 16 in the anger-out scale were classified as the anger-out group, and whose scores were higher than 21 in the anger-in scale made up anger-in group. All other drivers composed the anger-control group.

2.1.4. Driving behavior

Drivers were asked to report the total penalty points marked on their driving records as well as any accidents, both minor and major, in which they had been involved in the last year. They were also asked their preferred driving speeds on three types of speed-limit roads (expressways with a speed limit of 120 km/h, highways with a speed limit of 80 km/h, and urban roads with a speed limit of 60 km/h).

All the above scales were included in a comprehensive questionnaire that also contained demographic characteristics, such as gender, age and driving information, such as driving experience and mileage in the last year.

2.2. Participants

The study included 150 drivers (all males) from the Hefei Passenger Transportation Co., Ltd. in China, and all were inter-city bus drivers. Some of the drivers drove medium distances between the cities within Anhui Province, whereas others drove long-distance inter-province routes. These drivers drove, on average, 8–11 h every work day. All drivers drove at least 150 km one-way when on duty. In total, 150 questionnaires were distributed and 132 responses were valid, giving a validity rate of 88%.

2.3. Procedure

The 150 professional drivers represented different bus lines and were randomly sampled and then convened in a conference room to complete the survey. The methods for filling out the three scales were explicitly explained by the researchers before the participants began the survey. All results were anonymously self-reported. Incomplete survey sheets were discarded. No remuneration was provided for participation because the questionnaire was considered a part of the performance appraisal for each professional driver who participated.

3. Results

3.1. Demographics and descriptive variables

Table 1 presents the basic information of the professional drivers who participated in the survey, such as age, driving experience, and mileage in the last year. All participants were male drivers aged from 32 to 56 years old ($Mean = 43.01$, $SD = 5.12$). They had between 5 and 39 years of experience driving cars, with an average of 20 years. As the drivers were from the same company, all the participants’ ages, driving experience, and mileage in the last year were relatively concentrated with a standard deviation ranging from 5 to 7.

The participants were also asked to report their preferred driving speeds on three different types of roads, namely, expressways, highways and urban roads (Table 1). The preferred speed of professional drivers on expressways was often within the speed limit, with an average speed of 99.96 km/h ($SD = 8.48$), which was far lower than the maximum speed limit of 120 km/h. However, the participants tended to drive closer to the actual speed limits on highways and urban roads, with
speed limits of 80 km/h and 60 km/h, respectively. Though some drivers were found to exceed the speed limit, the number was relatively small.

Table 1 also summarizes the average number of traffic accidents in which the participants were involved during the past year and the total penalty points received for violations. In summary, the participants reported being involved in only a small number of traffic accidents (M = 0.36; SD = 0.60), and only approximately 25% of the drivers received penalty points (M = 1.11; SD = 2.16).

3.2. Reliability and validity test of the driving anger scale

The researchers used SPSS19.0 to assess item-total correlations, perform a PCA, and validate the reliability of the metrics used. Internal reliability, which is concerned with the homogeneity of the items within a scale, is typically measured by using Cronbach’s Alpha, a proven reliability measure. To have good validity, an item or scale is required to have only an empirical association with a specific criterion or gold standard (Devellis, 1991).

For items to be considered correlated to the total scale, a correlation coefficient (r) of greater than 0.4 is required. Furthermore, the significance level, i.e., the p-value, for each correlation should be less than 0.05. Therefore, two items, 16 and 26, were removed because they failed to meet these thresholds; the remaining 34 were retained, as presented in Table 2.

To determine whether the remaining 34 items were reliable and valid with respect to Chinese professional drivers, the data obtained were subjected to an exploratory factor analysis. Because several items had changed wording or were removed as inappropriate for the target demographics, an exploratory analysis, rather than a confirmatory analysis, was considered more appropriate. Thus, principal component analysis was conducted to determine the factor structure, and the items were exposed to factor analysis using varimax rotations. The analysis revealed that the KMO = 0.85, and the Bartlett test of sphericity produced a significant level of p < 0.01. Considering commonality, the eigenvalues and factor loadings, which exceeded 0.40 after repeated comparisons were further removed, thus items 4, 5, 8, 9, 10, 13, 14, 15, 19, 21, 27, 28, 29, 34 and 35 were eliminated. When these items were removed, special attention was given to ensure that the factor loading of each item was greater than 0.45 and each dimension contained at least three items.

After these tests to eliminate nonsignificant results, the remaining 19 items were subjected to PCA. The KMO = 0.78, and the result of the Bartlett test of sphericity produced a significance level of p < 0.01. The eigenvalues of four factors were greater than 1, and the cumulative variance contribution rate was 60.42%. The four factors: discourtesy, traffic obstructions, illegal driving and slow driving explained 17.21%, 15.39%, 15.38% and 12.43% of the variation, respectively. The loading of each item under each factor is presented in Table 3.

A reliability analysis of the revised 19-item scale was conducted, and the Cronbach Alpha value of internal consistency of the total scale was 0.88. Furthermore, the internal consistencies of the four dimensions were 0.85 (discourtesy), 0.74 (traffic obstructions), 0.78 (illegal driving) and 0.72 (slow driving). The Cronbach Alpha value was greater than 0.7 for the total scale and for each factor, thus indicating acceptable reliability (Nunnally, 1978). These results demonstrated that the modified scale exhibited good internal reliability.

An additional validity analysis of the revised 19-item scale was performed. The results of the correlation tests between each factor and the total score in the revised DAS are shown in Table 4. As evidenced by the results, the correlation among various factors was low to low-medium, which indicated that the scale exhibited good differential validity. There was also a high degree of consistency between the content tested in the total scale and that in each factor, which indicated that the revised scale had good criterion-related validity.

3.3. The induction of driving anger

The means and standard deviations of the revised 19-item DAS are presented in Table 5. The results indicated that in the group of professional drivers, traffic obstructions, as an inducing factor of driving anger, had the highest score among the

<table>
<thead>
<tr>
<th>Item</th>
<th>Item-to-total score</th>
<th>Item</th>
<th>Item-to-total score</th>
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<th>Item-to-total score</th>
<th>Item</th>
<th>Item-to-total score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.44**</td>
<td>10</td>
<td>0.46**</td>
<td>19</td>
<td>0.58**</td>
<td>28</td>
<td>0.54**</td>
</tr>
<tr>
<td>2</td>
<td>0.42**</td>
<td>11</td>
<td>0.68**</td>
<td>20</td>
<td>0.54**</td>
<td>29</td>
<td>0.52**</td>
</tr>
<tr>
<td>3</td>
<td>0.51**</td>
<td>12</td>
<td>0.47**</td>
<td>21</td>
<td>0.44**</td>
<td>30</td>
<td>0.61**</td>
</tr>
<tr>
<td>4</td>
<td>0.44**</td>
<td>13</td>
<td>0.74**</td>
<td>22</td>
<td>0.53**</td>
<td>31</td>
<td>0.52**</td>
</tr>
<tr>
<td>5</td>
<td>0.59**</td>
<td>14</td>
<td>0.74**</td>
<td>23</td>
<td>0.60**</td>
<td>32</td>
<td>0.65**</td>
</tr>
<tr>
<td>6</td>
<td>0.59**</td>
<td>15</td>
<td>0.56**</td>
<td>24</td>
<td>0.63**</td>
<td>33</td>
<td>0.48**</td>
</tr>
<tr>
<td>7</td>
<td>0.65**</td>
<td>16</td>
<td>0.38**</td>
<td>25</td>
<td>0.47**</td>
<td>34</td>
<td>0.33**</td>
</tr>
<tr>
<td>8</td>
<td>0.66**</td>
<td>17</td>
<td>0.53**</td>
<td>26</td>
<td>0.38**</td>
<td>35</td>
<td>0.51**</td>
</tr>
<tr>
<td>9</td>
<td>0.59**</td>
<td>18</td>
<td>0.53**</td>
<td>27</td>
<td>0.54**</td>
<td>36</td>
<td>0.53**</td>
</tr>
</tbody>
</table>

*p < 0.05.
**p < 0.01.
four factors, with a subscale score of 2.78 (SD = 0.89). In addition, on this subscale, item 33 “the road works sign is not set when the road is under reconstruction” had a score of 3.23 (SD = 1.35), the highest score of all 19 items, meaning that this situation induced the highest level of anger. Illegal driving was the second greatest factor in inducing anger, in which item 12 “other vehicles run a red light” was the second most anger-inducing scenario (M = 3.18; SD = 1.55). Interestingly, the least anger inducing situation was “a pedestrian walks slowly across the middle of the street, forcing you to slow down” (M = 1.56; SD = 0.80) and this belonged to the slow driving subscale, which had the lowest average anger-ratings (M = 1.89; SD = 0.67) of the four subscales.

Overall, compared with the findings of the USA (Deffenbacher et al., 1994) and Malaysia (Sullman et al., 2014), our findings showed that Chinese professional drivers reported lower levels of anger than samples in the USA and Malaysia on similar subscales, though the number of subscales and items varied. For example, regarding the discourtesy, traffic obstructions

<table>
<thead>
<tr>
<th>Item no.</th>
<th>Item</th>
<th>M(SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>33</td>
<td>The road works sign is not set when the road is under reconstruction</td>
<td>2.78(0.89)</td>
</tr>
<tr>
<td>22</td>
<td>You hit an unmarked deep pothole when driving</td>
<td>2.94(1.31)</td>
</tr>
<tr>
<td>18</td>
<td>Other cars block traffic during the parking process</td>
<td>2.69(1.19)</td>
</tr>
<tr>
<td>32</td>
<td>You drive behind a large truck that occupies the lane</td>
<td>2.59(1.19)</td>
</tr>
<tr>
<td>30</td>
<td>You drive behind a badly smoking vehicle and the smoke blocks your sight</td>
<td>2.48(1.27)</td>
</tr>
<tr>
<td>12</td>
<td>Other vehicles run a red light</td>
<td>2.64(0.93)</td>
</tr>
<tr>
<td>31</td>
<td>Some people park their cars illegally on the road</td>
<td>3.18(1.55)</td>
</tr>
<tr>
<td>23</td>
<td>Someone changes lanes without turning on signal lights</td>
<td>2.64(1.16)</td>
</tr>
<tr>
<td>25</td>
<td>Someone drives well on above the speed limit</td>
<td>2.34(1.22)</td>
</tr>
<tr>
<td>36</td>
<td>Someone changes lane while crossing the white line in an intersection</td>
<td>2.25(1.14)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item no.</th>
<th>Item</th>
<th>M(SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Someone backs out in front of you without looking</td>
<td>2.02(0.89)</td>
</tr>
<tr>
<td>7</td>
<td>Someone cuts in and takes the parking spot you have been waiting for</td>
<td>2.44(1.41)</td>
</tr>
<tr>
<td>20</td>
<td>Someone changes lanes in front of you when there is no one behind you</td>
<td>2.30(1.30)</td>
</tr>
<tr>
<td>24</td>
<td>When you drive normally, someone honks at you</td>
<td>2.08(1.09)</td>
</tr>
<tr>
<td>6</td>
<td>Someone cuts in right in front of you on the freeway</td>
<td>1.89(1.12)</td>
</tr>
<tr>
<td>17</td>
<td>Someone speeds up when you try to pass them</td>
<td>1.79(1.17)</td>
</tr>
<tr>
<td>3</td>
<td>Someone is driving too slowly in the passing lane</td>
<td>1.85(0.92)</td>
</tr>
<tr>
<td>1</td>
<td>Someone in front of you does not move straight away when the light turns green</td>
<td>1.89(0.67)</td>
</tr>
<tr>
<td>2</td>
<td>A pedestrian walks slowly across the middle of the street, forcing you to slow down</td>
<td>2.34(1.06)</td>
</tr>
<tr>
<td></td>
<td>Total driving anger (z = 0.87)</td>
<td>2.36(0.67)</td>
</tr>
</tbody>
</table>
and slow driving subscale, the anger scores in the USA and Malaysia exceeded 3.06, whereas for Chinese professional drivers, the levels of anger for the three subscales were all less than 2.78. Furthermore, the highest mean score for the USA and Malaysia samples was the discourtesy subscale. This was not the case for Chinese professional drivers.

3.4. Anger by age, driving experience, mileage and preferred speeds on different roadway types

To examine the relationships between the driving anger subscales and total anger with the demographic factors, such as age, driving experience and mileage in the last year, Pearson’s correlation coefficients were calculated. As demonstrated in Table 6, though weak, age, driving experience, and mileage were found to be positively correlated with the total driving anger, which was inconsistent with previous studies of non-professional driver group in which older, more experienced drivers seemed to generally be less provoked (Jovanović, Lipovac, Stanojević, & Stanojević, 2011; Li, Li, & Zhan, 2003).

The analysis of the relationships between anger propensities and the drivers’ preferred driving speeds choices on three different roads is presented in Table 6. As was to be expected, speed preferences were significantly correlated with anger. Specifically, the drivers who preferred higher speed on expressways and urban roads were more easily irritated by the following three traffic scenes: other drivers’ discourtesy, traffic obstructions and slow driving. However, the drivers who preferred higher speeds on highways were easily irritated by only two factors: discourtesy and slow driving. This is a critical finding that drivers who have higher speed preferences on the three examined roadways have a greater propensity to become angry.

3.5. Driving anger by penalty points and accidents

Mean scores and standard deviations on the driving anger subscales and the total scale were compared between those drivers who had either been involved in traffic accidents (both minor and major) or received penalty points in the last year and those that had not. The results are presented in Table 7. Independent t-tests indicated that on the total DAS, as well as the subscale of traffic obstructions and slow driving, there were no differences between the group with penalty points (N = 33) and the group without penalty points (N = 99). However, on the discourtesy and illegal driving subscales, obvious differences existed between the two groups, as the drivers who had no penalty points reported higher propensities for anger than those who did have penalty points.

Independent t-tests were conducted to analyze the differences between those drivers who had been involved in traffic accidents (N = 40) in the last year and those that had not (N = 92). The results revealed a significant difference between the two groups on the discourtesy subscale. Specifically, the drivers who had not experienced traffic accidents in the last year reported higher levels of anger than those who had been involved in such accidents. On other subscales and total driving anger, no differences between the two groups were revealed.

3.6. Driving anger and the Type A behavior pattern

To avoid deviations in the results owing to the small samples in each group, the 132 participants were divided into three categories. To explore the differences among the three types of personalities in the driving anger subscales and the total score, an ANOVA was performed. The ANOVA revealed significant personality differences in overall levels of anger (F(2, 129) = 4.52, p < 0.05). Furthermore, there were significant personality differences on the discourtesy, traffic obstructions and slow driving subscale (F(2, 129) = 3.68, p < 0.05; F(2, 129) = 3.21, p < 0.05; F(2, 129) = 4.99, p < 0.01). Thus, the least significant difference (LSD) method for multiple comparisons was performed to conduct pairwise comparisons, and the results are shown in Table 8.

Post hoc tests revealed that on the total scale, the discourtesy, traffic obstructions and slow driving subscale, drivers in the middle of this continuum reported significantly (p < 0.05) higher levels of anger than Type B personality individuals but not Type A personality individuals. Interestingly, there were significant differences in anger between the drivers with Type A

| Table 6 |
The correlation coefficients between driving anger and demographics and preferred speeds.

<table>
<thead>
<tr>
<th></th>
<th>Discourtesy</th>
<th>Traffic obstructions</th>
<th>Illegal driving</th>
<th>Slow driving</th>
<th>Total DAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (N = 124)</td>
<td>0.106</td>
<td>0.002</td>
<td>0.053</td>
<td>0.030</td>
<td>0.070</td>
</tr>
<tr>
<td>Driving experience (N = 126)</td>
<td>0.119</td>
<td>0.053</td>
<td>0.047</td>
<td>-0.004</td>
<td>0.085</td>
</tr>
<tr>
<td>Mileage in the last year (10⁴ km, N = 90)</td>
<td>0.073</td>
<td>0.014</td>
<td>0.184</td>
<td>0.014</td>
<td>0.097</td>
</tr>
<tr>
<td>Preferred speed on express ways (120 km/h, N = 123)</td>
<td>0.582**</td>
<td>0.248**</td>
<td>0.101</td>
<td>0.481**</td>
<td>0.445**</td>
</tr>
<tr>
<td>Preferred speed on highways (80 km/h, N = 123)</td>
<td>0.269**</td>
<td>0.151</td>
<td>-0.007</td>
<td>0.287**</td>
<td>0.210**</td>
</tr>
<tr>
<td>Preferred speed on urban roads (60 km/h, N = 122)</td>
<td>0.307**</td>
<td>0.220</td>
<td>0.026</td>
<td>0.334**</td>
<td>0.268**</td>
</tr>
</tbody>
</table>

**, **p < 0.05.

**, **p < 0.01.
personality and those with Type B personality over slow driving. When facing slow driving on the road, professional drivers with Type A personality experienced significantly higher levels of anger than drivers with Type B personality.

3.7. Driving anger and anger-out, anger-in groups

Based on the revised STAXI-2, there were 43 drivers in the anger-out group and 9 drivers in the anger-in group. All others belonged to the anger-control group. An ANOVA was used to determine whether the differences among the groups were significant, and the results are shown in Table 9.

An ANOVA revealed significant anger differences among the three groups on total DAS ($F(2, 129) = 21.93, p < 0.001$) and on the four subscales: discourtesy, traffic obstructions, illegal driving and slow driving ($F(2, 129) = 27.30, p < 0.001$; $F(2, 129) = 11.65, p < 0.001$; $F(2, 129) = 4.74, p < 0.01$; $F(2, 129) = 9.88, p < 0.001$). The LSD method of multiple comparisons was again used to conduct pairwise comparisons, and the results indicated that on the discourtesy subscale, the professional drivers in the anger-out group exhibited higher levels of anger than those in the anger-in group and the anger-control group. On the other subscales and on total DAS, there were no obvious differences between the anger-out group and the anger-in group, but significant differences were noted between the anger-out group and the anger-control group, i.e., drivers in the anger-out group had higher anger scores than those in the anger-control group. Only on the traffic obstructions subscale and on the total scale did the anger-in group reported significantly higher levels of anger than those in the anger-control group. Based on these results, the anger-control group exhibited the lowest levels of anger on the road.

3.8. Predictors of the driving anger factors

Multiple regressions were used to explore the influence of certain variables on the four types of driving anger represented by the four subscales of the DAS. Because age, driving experience and mileage showed weak correlations with driving anger, these factors were excluded from the regression. Thus, in each regression, the preferred speeds on expressways, highways and urban roads as well as TABP personality types and anger expression were entered into the model by using the stepwise
This paper presented a comprehensive examination of driving anger in China based on a case study amongst professional drivers. To measure professional drivers’ anger, the revised 19-item DAS containing the most representative items on each subscale in the original questionnaire was obtained on the basis of rational metrics (such as significance and suitability) and empirical criteria (such as item-total correlation, principal components analysis and reliability and validity tests). This revised scale comprised four factors, namely, discourtesy, traffic obstructions, illegal driving and slow driving, and was considerably different from the factor structures found in the USA (Deffenbacher et al., 1994), the UK (Lajunen et al., 1998), New Zealand (Sullman, 2006) research. In many Chinese cities, traffic is characterized by a strong mixed mode with motor vehicles, non-motor vehicles and pedestrians all competing with each other on the road. Our study revealed that Chinese drivers under mixed traffic patterns behaved quite differently from drivers in other nations, particularly those in the USA and in Malaysia, as Chinese drivers experienced lower levels of anger, especially in response to the discourteous behaviors of other drivers. As an example of this difference, in the original DAS the situation “someone makes an obscene gesture towards you” rarely occurs on Chinese roads and evoked slight anger. Based on these results, studies conducted in Western countries may not be applicable to Chinese situations. Thus, there were variations in the underlying structure of the DAS used in this study in comparison with that used in other studies when cultural differences were taken into consideration. However, another explanation of these differences may be the fact that research has found professional drivers are not necessarily the same as private vehicle drivers with regards to driving anger (Sullman, Stephens, & Kuzu, 2013).

This study further revealed which traffic scenarios evoked greater driving anger among a sample of professional drivers in China. Using the revised DAS, the study showed that traffic obstructions was rated as the most anger provoking of the four driving anger subscales, which differed from previous studies conducted in other countries where drivers reported the highest anger propensities for the discourtesy subscale in the U.S. (Deffenbacher et al., 1994), New Zealand (Sullman, 2006), France (Villieux & Delhomme, 2010), Turkey (Yasak & Esiyok, 2009), and the UK (Lajunen et al., 1998). On the traffic obstructions subscale, the item “the road works sign is not set when the road is under construction” was the highest score item inducing driving anger among all items. Because the sample used in this study consisted of professional drivers who worked as drivers in transport companies and were accustomed to maintaining tight time schedules, annoyance at delays caused by road construction may account for this result. Interestingly, the least anger provoking situation was “a pedestrian walks slowly across the middle of the street, forcing you to slow down,” which belonged to the slow driving subscale. This finding might imply that the professional drivers tended to give a socially acceptable response rather express their true opinion. However, there was also an inconsistency with previous findings in which the lowest levels of anger was evoked by “police presence” among a sample of drivers from Malaysia (Sullman et al., 2014), New Zealand (Sullman, 2006), Spain (Sullman et al., 2007) and France (Villieux & Delhomme, 2010), demonstrating again that driving anger provocations varied among nations. However, in this case the items from the police presence subscale were not included in this version of the DAS, accounting for this difference. Importantly, the levels of driving anger on all subscales for Chinese professional drivers were less than three. Moreover, on each subscale as well as the total DAS, Chinese professional drivers experienced less anger than drivers in the US (Deffenbacher et al., 1994) and Malaysia (Sullman et al., 2014). These findings are similar to those of Liu et al. (2013) who found that Chinese drivers’ driving anger levels were significantly lower than those of German drivers.

### 4. Discussion

Table 10 shows that anger induced by discourtesy was predicted by the preferred speed on expressways and anger expression. Anger expression predicted anger evoked by traffic obstructions and illegal driving. Anger caused by slow driving was predicted by the preferred speed on expressways. Accordingly, the preferred speed on expressways and anger expression were the two most critical variables that could be used to predict anger among professional drivers.

#### Table 10
Prediction of the driving anger factors.

<table>
<thead>
<tr>
<th>Step</th>
<th>Variable</th>
<th>$R^2$</th>
<th>$\Delta R^2$</th>
<th>$F$</th>
<th>Beta</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Discourtesy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Preferred speed on expressways</td>
<td>.350</td>
<td>.350</td>
<td>64.65***</td>
<td>.417***</td>
</tr>
<tr>
<td>2</td>
<td>Anger expression (control = 1; in = 2; out = 3)</td>
<td>.406</td>
<td>.056</td>
<td>40.69***</td>
<td>.294***</td>
</tr>
<tr>
<td><strong>Traffic obstructions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Anger expression</td>
<td>.100</td>
<td>.100</td>
<td>13.31***</td>
<td>.316***</td>
</tr>
<tr>
<td><strong>Illegal driving</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Anger expression</td>
<td>.063</td>
<td>.063</td>
<td>8.11**</td>
<td>.252**</td>
</tr>
<tr>
<td><strong>Slow driving</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Preferred speed on expressways</td>
<td>.228</td>
<td>.228</td>
<td>35.47***</td>
<td>.478***</td>
</tr>
</tbody>
</table>

*p < 0.05.
*** p < 0.001.
**** p < 0.0005.
***** p < 0.0001.
and that the levels of driving anger was greater than 3 on only one item. Therefore, our study verifies the assumption that Chinese drivers experience lower levels of anger than some drivers in some Western countries.

Unfortunately, this study did not reveal any significant correlations between demographics such as age, driving experience as well as mileage and driving anger. The finding was inconsistent with results obtained from a sample of non-professional drivers group that older, more experienced drivers tended to be less provoked to anger in general (Lajunen et al., 1998; Sullman, 2006; Sullman et al., 2007). However, Parkinson (2001), Yasak and Esiyok (2009) found that age was not correlated with the DAS, and Li et al. (2003) found there was no significant relationship between driving anger and age or driving experience. This study shows great agreement with this literature, thus demonstrating the viability of using professional drivers as a case study group. It also reflects that geographical area and sample types may be the primary causes for these differences in correlations between demographics and driving anger.

An important finding produced by this study is that professional drivers who preferred higher speeds were more likely to become angry than people driving at slow speeds. This finding was in accordance with previous research conducted in New Zealand (Sullman, 2006), Spain (Sullman et al., 2007) and Malaysia (Sullman et al., 2014). Accordingly, it indicates that driving anger is more common for drivers who prefer driving faster and that this phenomenon is not restricted to professional or non-professional drivers.

Another important contribution of this study to the literature is the finding that personality types (A, B, or middle) exert an effect on driving anger. Surprisingly, among the whole sample, approximately 50% of the professional drivers had Type A personality. A possible explanation could be that tight time schedules contribute to professional drivers’ Type A disposition. Interestingly, professional drivers with Type B personalities reported the lowest levels of anger on the road. However, the difference between Type A drivers and Type B drivers was significant only over slow driving. This phenomenon may result from a common Type A personality predisposition toward timeliness and promptness. Therefore, professional drivers with Type A personality should be cautious so as not to become dangerously angry when encountering slow driving situations.

The analysis of driving anger among the anger-out, anger-in and anger-control group showed that the anger-control group reported the lowest levels of driving anger among the groups. Though the anger-in group hid their anger rather than expressing it outwardly, they still reported higher levels of anger than the anger-control group, and surprisingly, on some subscales, the anger-in group even reported higher levels of anger than the anger-out group. Thus, the anger-in group and the anger-out group should be paid equal attention to in the implementation of driving anger interventions. In other words, controlling anger is more conducive to safe driving behavior than expressing anger either outwardly or inwardly.

In previous studies (González-Iglesias, Gómez-Fraguela, & Luengo-Martín, 2012; Sullman et al., 2007), driving anger was treated as a variable that could predict aggressive driving, traffic accidents and traffic violations. The present study identified certain factors that could predict driving anger, including anger expression personality types and preferred speed on expressways. This finding was similar to the research conducted by Sullman (2006) who concluded that speed significantly predicted driving anger among New Zealand drivers. However, the results in this study were inconsistent with those of Lajunen et al. (1998), who found that self-evaluated safety skills, perceptual-motor skills, age and mileage were important predictors of driving anger. In this study, given the nonsignificant correlations between demographics and driving anger, these demographic variables were excluded from multiple regressions. Based on all of the results, this study verifies the contention that high speed is significantly associated with driving anger, and it also reveals that individuals who lack anger control may be more prone to dangerous driving behaviors due to anger. Therefore, with regard to the selection of professional drivers, people who prefer to drive fast and those who belong to either anger-out or anger-in groups should be considered with caution.

5. Conclusion

Road rage is known to be a common psychological condition that affects traffic safety throughout the world. However, the levels of driving anger among different groups are likely to be dependent on a driver’s unique home culture. For this reason, measurements of driver anger, namely the DAS, must be calibrated for an individual setting to understand the role of road rage within a specific geographic context. In China, only cursory attempts to understand driving anger have been made. Therefore, this paper examined and analyzed driving anger in China by using a number of different scales.

This paper conducted a research on the problem of road rage in China by using several different methodologies, including the calibration of the DAS, the consideration of different personality types, and various statistical models such as regression to determine significant variables. Because of wide ranges in potential demographics and driving behaviors, an initial population sample comprising professional drivers was used. These drivers displayed characteristics that were both predicted based on past research and unique to China.

This paper offers a number of contributions to the literature, the most important of which is a model validation that indicates that the DAS should be calibrated to the Chinese driving climate. Noteworthy results also concluded that Chinese drivers might report less driving anger than drivers in other countries and that drivers of different personality types likely processed anger differently, which in turn affected the expression of anger. For example, Type A drivers tend to more angered by slow driving, and drivers who express anger inwardly are equally prone to driving anger as drivers who express anger outwardly. Connected to these findings are results that driving anger among professional drivers in China is correlated with being forced to drive slowly and encountering traffic obstructions.
5.1. Limitations

The present study has certain limitations that must be considered when the results are interpreted. As the present study is based upon drivers’ self-reported data, it suffers from social desirability bias. Though participants were all assured of total confidentiality and anonymity and were geographically separated from the researchers even in the process of testing, the usual weaknesses of self-reported questionnaires could not be avoided. In further work, an improved surveying technique is important. Thus, access to individual driving records may provide objective outcomes that confirming self-reported information and thus reduce concerns about potential response bias.

Additionally, the sample group itself may be perceived as a limitation of the present study. First, though a larger number of professional drivers would provide greater validation of the results, recruiting more professional drivers may be difficult. Second, because professional drivers may behave differently from non-professional drivers when facing similar or identical traffic scenarios, the findings may be limited in their generality. Therefore, a more comprehensive survey with a focus on general drivers is also needed. However, as revealed in this paper, the professional driver group verified findings with respect to other nationalities in the literature; thus, using this set of drivers as a case study is reasonable.

Finally, owing to the limited age range of Chinese drivers, and even for professional drivers, the ranges of professional drivers’ age, driving experience and mileage are narrower than those of samples in other studies (Sullman et al., 2014). In further work, it is important to enlarge the field of drivers’ demographic backgrounds when selecting the sample, as a larger group would provide a greater distribution of demographic properties for analysis.

5.2. Practical implications and directions for further research

Because professional drivers are an important group in China, they exert direct effects on numerous industries. Accordingly, the results of this study may be beneficial to transportation groups, freight groups, and those who use the services of professional drivers. This research developed a localized version of the DAS, and it illuminates certain unique characteristics of driving anger among professional drivers in China. The findings of this research may assist the corresponding agencies in developing more effective traffic control and management policies and thereby enhance existing driver education programs to improve safety. For instance, “the road works sign is not set when the road is under construction” and running red lights were identified as the most anger provoking situations among professional drivers, which implies the urgency of enforcing work zone management and the necessity of revisiting the enforcement policies against running red lights. For professional drivers as a special group, conducting tentative and targeted interventions to reduce driving anger and aggressive driving is critical, and as such, this research will aid in improving selection and training strategies for professional drivers in that it revealed that personality factors and preferred speed are significant criteria that affect safety and performance.

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