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Does Emotionality and Private self-consciousness influence drivers' cognitive appraisal in anger-provoking situations?—An explorative study in Chinese drivers

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ABSTRACT

In recent decades, most studies have investigated the role of drivers' demographic background, dispositional traits, and cognitive appraisal in driving anger in an independent manner. However, it is possible that driver's dispositions and their cognitive appraisal could impact driving anger concurrently. The present study aims to investigate how the individual's characteristics (e.g., age, gender, and dispositions) influence state driving anger when considering the role of cognitive appraisal undertaken in anger-provoking situations. 17 anger-provoking scenarios using the Measure for Angry Drivers (MAD) were employed to probe the cognitive appraisal of Chinese drivers. The participants completed the Private self-consciousness scale (Prsc), the Brief HEXACO Inventory, and questions related to cognitive appraisal and state driving anger. Several ANCOVAs were performed to evaluate age and gender differences in state driving anger, Emotionality and Prsc. Results indicated that younger drivers reported higher state driving anger and Emotionality. While males and females exhibited similar levels of state driving anger, they significantly differed in Emotionality, instead of the Prsc. Moreover, a Partial Least Squared Structural Equation Modelling (PLS-SEM) found that age showed no direct impact on cognitive appraisal, but gender did. Importantly, Emotionality was found to be directly and positively related to state driving anger rather than the cognitive appraisal, while Prsc was indirectly associated with state driving anger if considering the driver's cognitive appraisal. The study provided the theoretical basis and insights to develop targeted driving anger countermeasures in China.

1. Introduction

Driving anger in China is prevalent and has been positively associated with aggressive driving, risky driving, and crash risk (Fei et al., 2019; Zhang et al., 2019; Zhai & Xi, 2023). For instance, in 2015, there were 17.33 million traffic violation records associated with driving anger in China (Suo et al., 2017). According to Deffenbacher et al. (1996), driving anger covers trait driving anger (i.e., the tendency to become angry) and state driving anger (i.e., the transitory emotional state in response to anger-provoking events). Using the State-Trait theory, Deffenbacher et al. (2001) revealed a positive association between trait driving anger and state driving anger, indicating the higher the level of trait driving anger, the more frequent and severe state anger is experienced.

Sharkin (2004) asserted that there are three types of underlying causes of driving anger, including a) driver's demographic characteristics, e.g., age, gender, etc. b) personality/dispositional traits, e.g., Neuroticism, and c) situational/contextual conditions, e.g., different types of anger-eliciting situations. However, previous studies mainly investigated trait driving anger and research into situational factors is relatively rare in comparison to demographic and personality factors (Deffenbacher et al., 2016).

1.1. The relationship between individual characteristics and driving anger

Sümer (2003) and Demir et al. (2016) suggest that an individual's characteristics can influence driving outcomes (e.g., aggressive driving) directly or indirectly

through proximal context, such as trait driving anger. The relationship between drivers' demographic characteristics and driving anger has been probed, but the findings are inconsistent. For instance, some studies found that younger drivers more easily become angry while driving than older drivers (Lajunen & Parker, 2001; Sullman, 2006), but certain researchers argued that age is not significantly correlated with trait driving anger (Bachoo et al., 2013; Feng et al., 2016). Similarly, several scholars indicated that males showed a higher level of trait driving anger than females (Wu et al., 2018), whereas, females are found more likely to experience anger when driving (Jovanović et al., 2011; Albentosa et al., 2018), or there were no gender differences in trait driving anger (Li et al., 2014).

Additionally, the association between an individual's dispositions and driving anger have also been widely investigated. Neuroticism, a personality dimension in the Five Factor Model, reflects an inclination to experience negative emotion (Mccrae & Costa, 2003), which has gained traffic safety/psychology researchers' attention and interest. Several studies suggested that individuals who rated higher on Neuroticism are prone to become anxious and angry while driving (Jovanović et al., 2011; Taubman-Ben-Ari & Yehiel, 2012).

An alternative personality model, HEXACO, has been developed from cross-cultural lexical studies (Lee & Ashton, 2004; 2008). This model could provide a more comprehensive understanding of personality variations, because it captures important variances not described in the Five Factor Model (Ashton et al., 2014). Emotionality as one of the personality dimensions of the HEXACO, shares some conceptual contents with Neuroticism, but they are not identical. For example, Emotionality does not involve anger-related content as Neuroticism, but contains sentimentality, fearfulness, dependence and anxiety aspects (Ashton et al., 2014). It has been suggested that the occurrence of these facets within Emotionality could provide stronger predictive power when investigating emotions (Rolison et al., 2013; Ashton et al., 2014). More recent studies apply the HEXACO model to explore the relationship between personality and driving anger (Burtăverde et al., 2017; Ābele et al., 2020; Zhai et al., 2023), providing some empirical evidence of HEXACO's predictive power in explaining unsafe driving and driving anger. For example, Burtăverde et al. (2017) indicated that Emotionality is a positive and significant predictor of anxious driving, whilst Ābele et al. (2020) and Zhai et al. (2023) found that Emotionality

positively predicted state driving anger and trait driving anger.

Moreover, another dispositional trait that might influence driving anger is Private self-consciousness (Prsc), which reflects the tendency to be self-aware, and concentrate attention on reflecting inner thoughts, motivations, feelings and physical sensations (Fenigstein et al., 1975; Adam & Bak, 2016). Earlier studies showed that individuals with higher levels of Prsc are more prone to experience emotional responses and display a lower inclination to suppress anger (Ohira, 1989). This statement was partly supported by Zhai et al. (2023) that Prsc positively moderates the relationship between trait driving anger and driving anger expression (i.e., how drivers express their anger when driving).

1.2. The role of cognitive appraisal in driving anger

Despite previous studies demonstrating the utility of certain theoretical frameworks (e.g., State-Trait theory) in explaining driving anger, understanding the mechanisms underlying anger evoked while driving (i.e., state anger) might still be insufficient, because of the inadequate description of the interplay between driver and traffic situations (Emo et al., 2016).

Emotion and appraisal theorists suggest that the generation of emotion is a result of cognitive appraisal of what significantly happens related to an individual's well-being (Lazarus, 1991a). In other words, emotion cannot happen without individuals evaluating what has happened related to the personal well-being. It should be noted that the "significance of well-being" mentioned here can be conceptualized as the obstruction or achievement of an individual's concerns (Frijda, 1986). Correspondingly, "concerns" include individuals' values, attachments, beliefs, desires, goals, and everything they care about (Lazarus, 1991b; Frankfurt, 1995; Scherer, 2004).

Cognitive appraisal theories are componential oriented, suggesting the number of components determines the specific emotion (Moors et al., 2013). Theoretically, two appraisals and six components are used to assess different aspects of an individual's evaluation of stress-inducing situations (Smith & Lazarus, 1993). Primary appraisal concerns whether the external context is relevant to a person's well-being, which contains evaluating goal relevance (e.g., the extent to which the external context relates to an individual's well-being) and goal incongruence (e.g., the extent to which the external context is consistent or inconsistent with one's well-being). The

secondary appraisal reflects whether there is a target that should be blamed for causing the event, and an assessment of the individual's coping ability/potential to handle the trigger, which involves appraising self/other responsibility (e.g., the degree to which is oneself or someone/something else receives the credit), coping potential (e.g., to what extent individuals are able to adopt coping strategies to alter the situation [problem-focused coping] or emotionally adjust their psychological prospects [emotion-focused coping]) and future expectancy (e.g., the prospects that individuals believe (for any reason) the stressors could be improved/solved, either in actual or psychological aspects). It should be noted that both appraisals are important for emotions and happen simultaneously (Smith & Lazarus, 1993).

Previous studies have shown that anger is associated with high goal relevance, goal incongruence, other responsibility and high coping potential (Berkowitz & Harmon-Jones, 2004). By way of illustration (see Figure 1), driver A might become angry if their right of way (goal relevance) is restricted (goal incongruence) by an aggressive driver B (other responsibility) who cuts in, and driver A firmly believes that honking (problem-focused coping potential) to notify the trigger driver B will prevent them from merging (future expectancy). Severe anger could be experienced by Driver A if Driver B continues to cut in.

It has also been demonstrated that drivers' cognitive appraisal of the driving context might be more important than dispositional traits when determining driving behaviors across anger-provoking situations (Stephens & Groeger, 2009). As illustrated by Stephens et al. (2016) and Albentosa et al. (2018), the way drivers evaluate driving situations significantly predicts the intensity of state driving anger. Importantly, Stephens et al. (2016) observed that there is no direct association between trait driving anger and state driving anger when considering drivers'

appraisal, implying that there is a likelihood that state anger is mainly influenced by drivers' cognitive appraisal of driving situations, irrespective of the level of their trait driving anger.

1.3. The research gap in understanding driving anger: Combined effects of individuals' characteristics and cognitive appraisal

Considering personal characteristics (e.g., beliefs and personality) constitutes an important source of cognitive appraisal and forms the motivational basis for cognitive appraisal and the imperative role of appraisal in emotions (Smith & Lazarus, 1993). It is possible that driving anger evoked while driving could be the result of the combined effects of drivers' characteristics (age and gender), dispositional traits and drivers' cognitive appraisal of driving situations.

Specifically, Bogdan-Ganea and Herrero-Fernández (2018) demonstrated that there were age and gender differences in pejorative labelling thinking when meeting anger-provoking scenarios, implying the divergence in cognition of driving situations across drivers' demographics. Also, there is evidence that age and gender significantly correlated with components of cognitive appraisal (Stephens et al., 2016; Albentosa et al., 2018), but it has not been fully explored yet if there are any substantive associations between them. With respect to personality traits, Tomaka and Magoc (2021) revealed that people high in Neuroticism are more likely to evaluate situations as threatening, while individuals high in Extraversion are prone to appraise contexts in a challenging manner, indicating how specific dispositions might contribute to an individual's appraisal. As presented above, Emotionality and Prsc have shown their positive association with trait driving anger, whereas it is unclear whether and how Emotionality and Prsc influence an individual's anger
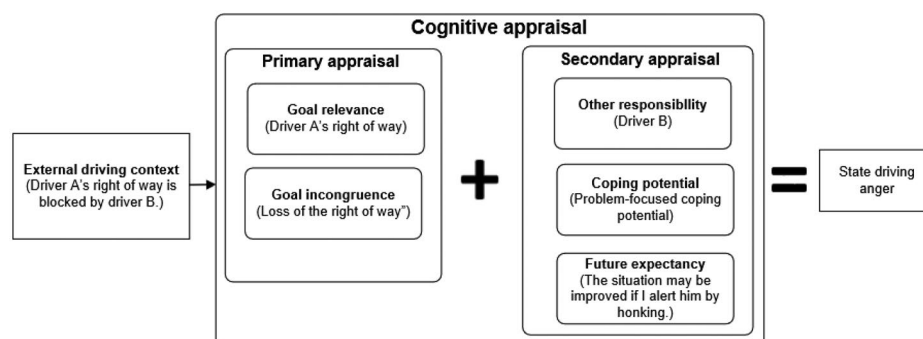

Figure 1. Example of a driver's cognitive appraisal in an anger-provoking situation.

while driving when considering the driver's cognitive appraisal. On the one hand, drivers higher in Emotionality (e.g., being involved in fearful and anxious content) may automatically identify threats from ambiguous stimuli, and evaluate equivocal triggers in a dangerous manner, which might lead to a more goal-oriented and incongruent cognitive appraisal while driving. On the other hand, Emotionality could have a closer relationship with emotional states, because of the sentimental contents involved in Emotionality (e.g., "I feel strong emotions when someone close to me is going away for a long time."). In light of the nature of Prsc, individuals with higher Prsc might be more aware of their inner thoughts and motivations, which might enhance the overinterpretation of the driving anger situations, thereby increasing state driving anger.

1.4. The present study

The present study aims to explore how drivers' characteristics (age and gender), and dispositions (Emotionality and Prsc) influence driving anger when considering cognitive appraisal of anger-provoking situations, expecting to provide more knowledge about individual differences in evaluating driving situations, which could also assist in designing and developing countermeasures in the target driver group. Figure 2 illustrates the proposed theoretical framework in the present study, which is inspired and adapted from previous studies (Deffenbacher et al., 2001; Demir et al., 2016; Stephens et al., 2016). Note that, the construct of cognitive appraisal is considered a latent variable measured by several components as referenced from previous studies (Smith & Lazarus, 1993; Albentosa et al., 2018). In brief, four study objectives are listed below:

1. To explore the relationship between Emotionality, cognitive appraisal, and state driving anger.
2. To examine the relationship between Prsc, cognitive appraisal, and state driving anger.
3. To testify effects of age and gender on cognitive appraisal undertaken in anger-provoking situations.
4. To probe if there are age and gender differences in state driving anger, Emotionality and Prsc.

2. Materials and methods

2.1. A Pilot survey for anger scenarios development

To choose the most appropriate anger-provoking scenarios for participants' cognitive appraisal assessment, the Measure for Angry Drivers was used (MAD, Stephens et al., 2019), because it was a more recently developed tool compared to the Driving Anger Scale (Deffenbacher et al., 1994). Some items in MAD were slightly modified based on Chinese driving contexts (e.g., changing item 7 to "Jaywalking pedestrians or cyclists cross in front of you forcing you to brake"). MAD was first translated through a back-translation procedure based on guidance from Guillemin (1995). The recruitment of 267 participants was undertaken by a survey company Wen Juan Xing (WJX, www.wjx.com) in June 2022, and the only criterion for participation was the holding of a valid Chinese driving license. All participants needed to log in on WJX's website through social media, e.g., WeChat, to take part in the online survey, and they received 10 RMB (approximately 1.4$) for appreciating the participation. Participants were asked to report their age, gender, and the degree to which they become angry across various driving situations (using MAD) on a
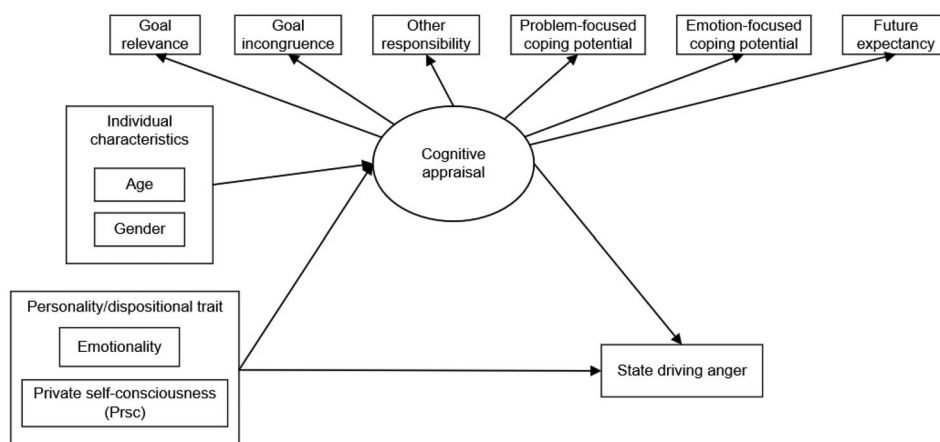

Figure 2. Proposed theoretical framework.

5-point scale (1= "not angry at all" to 5= "extremely angry"). However, as MAD has not been formally validated in China, an Explorative Factor Analysis (EFA) was performed to determine the structure of MAD. After a preliminary check, nine participants' answers were removed from the EFA, because of the lack of variability in their data (e.g., rating the same score on all items). The rest of the 258 valid participants (mean age = 31.04, SD = 6.82, 55% males) were analyzed through a principal axis factor analysis and varimax rotation in SPSS 24.0. The Kaiser-Meyer-Olkin (KMO) value was 0.869 and Bartlett's test of sphericity was significant ($p < 0.001$), indicating the scale was appropriate for factorial analysis. To obtain a reliable, significant enough, and non-redundant structure of MAD, the threshold of the item's loading was set to 0.45, based on the guidance of Ledesma et al. (2021). Finally, 17 items with a three-factor solution were found in the MAD, providing 51% explained total variance (see Table A1 in Appendix A). These three factors were then labelled Safety Blocking (SB, i.e., referring to situations provoking the driver's anger by causing safety risk), Travel Blocking (TB, i.e., referring to situations evoking the driver's anger by impeding driving progress) and Hostile Aggression (HA, i.e., referring to situations eliciting the driver's anger by posing hostile actions), and all factors showed adequate internal consistencies. The 17 item and three factors MAD was then applied in the main study survey.

2.2. Participants

Participant recruitment for the main survey was also supported by WJX in August 2022. The company posted the survey link on their platform and invited participants to attend if interested. All participants were compensated 20 RMB for their participation. Several criteria were set for the sample recruitment, including participants should have a valid Chinese driving license as well as to avoid recruiting university/college students excessively, because they may not drive frequently. In total, there were 601 respondents, but only 559 participants' responses (mean age = 32.11, SD = 5.48) were regarded as valid after data filtration (e.g., same-scored rating, attentional questions check, extreme completion time, etc.). It was found that a significant age difference between participants in the main survey and participants in the survey of pilot study by a summary independent sample t test ($p=0.026$), but they did not differ in gender ($p=0.11$). More information about participants

recruited in the main survey can be found in Table 1.

2.3. Measurements

2.3.1. Demographic information
This section asks participants to indicate age, gender, tenure of driving license, and traffic penalty points received in the last year.

2.3.2. The private self-consciousness scale (Prsc)
The 10 item Chinese version of the Prsc scale (Fan & He, 2013) was presented for assessing the propensity to focus attention on inner aspects of oneself (e.g., "I reflect about myself a lot"). Participants needed to respond on a 5-point scale (1 = "extremely uncharacteristic" to 5 = "extremely characteristic"). The higher score indicates a high level of Prsc. This scale shows an acceptable internal consistency in the present study (Cronbach's $\alpha = 0.71$).

2.3.3. The brief HEXACO inventory (BHI)
The Chinese version of BHI was used to measure participants' personality (Wu et al., 2020). According to De Vries (2013), the BHI is easy to understand and might be useful for explorative investigation in conjunction with other scales. The Chinese BHI has 24 items with six personality dimensions (H, E, X, A, C, O), participants were required to answer on a 5-point scale (1 = "strongly disagree" to 5 = "strongly agree"). However, only the descriptive information of the sub-scale Emotionality is considered in the present study due to the study scope. The higher score indicates the greater degree of Emotionality.

Table 1. Participants' demographic information (N = 559).

Variables	N	Proportion
Gender		
Male	272	48.7%
Female	287	51.3%
Age groups		
18-25 years old	23	4.1%
26-36 years old	456	81.6%
37-44 years old	57	10.2%
Over 44 years old	23	3.2%
Tenure of the driving license		
≤1 year	11	2.0%
2-3 years	125	22.4%
4-5 years	181	32.4%
6-10 years	171	30.6%
>10 years	71	12.7%
Traffic penalty points received in the last year		
0-1	287	51.3%
2-4	165	29.5%
5-8	95	17.0%
9-12	12	2.1%

2.3.4. State driving anger and cognitive appraisal

Drivers may face a variety of traffic situations, but many of these events share common themes. This similarity allows for a comprehensive analysis of how drivers assess and respond to traffic conditions at a broader level. Therefore, the 17 item and three factors MAD as described above were provided in three anger-provoking situations selection pools (i.e., SB, TB, and HA). Participants were asked to choose one scenario in each pool that they frequently encounter while driving and then imagine they are driving and meeting this event. The anger events selection results are presented in Table A2 in Appendix A. Next, participants needed to answer a single question Q1 (i.e., "To what extent do you feel angry?") on a 11-point scale (0 = "not at all" to 11 = "very much") for measuring the intensity of state driving anger. The Cronbach's alpha of state anger measurements was 0.68, considered acceptable for explorative research (Hair et al., 2019a).

Six questions were presented to measure different components of cognitive appraisal which were referenced from previous studies (Smith & Lazarus, 1993; Albentosa et al., 2018). Participants needed to answer these questions on a 11-point scale as mentioned above. Here is an example in SB scenarios pool questionnaire, Q2 goal relevance (i.e., "To what extent is this situation/event related to your goals/desires/interests, *e.g., driving safety*?"); Q3 goal incongruence (i.e., "To what extent does this situation/event hamper your goals/desires/interests, *e.g., driving safety*?"); Q4 other responsibility (i.e., "To what extent do you think the person/people who exert this circumstance should be responsible for it?"); Q5 problem-focused coping potential (i.e., "To what extent are you able to take action and change the situation to make it in line with your goals/desires/interests, *e.g., driving safety*?"); Q6 future expectancy (i.e., "To what extent do you believe that the situation would improve, either actually or psychologically, to be consistent with your goals/desires/interests, *e.g., driving safety*?"); Q7 emotion-focused coping potential (i.e., "To what extent are you able to emotionally adjust to the situation if the circumstances are inconsistent with your goals/desires/interests, *e.g., driving safety*?"). Importantly, questions related to state driving anger and components of cognitive appraisal (Q1-Q7) have the same sequence in TB and HA, but specifics indicated in "**e.g.,**" are different (Q2 to Q7, expecting Q4), i.e., punctually arriving at the destination in TB, personal well-being/driving esteem/courtesy in HA, thereby matching the relational theme of each anger-provoking

category. Overall, the Cronbach's alpha of appraisal items was 0.79.

2.4. Data analysis

Software SPSS 24.0 and Smart PLS 4.0 were used for data analysis. All variables were checked for normality, according to skewness (between -3 to 3) and kurtosis (between -7 to 7) within the acceptable range (Byrne, 2010). Pearson correlations were performed to detect whether there were any potential relationships among variables. Next, ANCOVAs were performed to explore if there were age and gender differences in state driving anger, Emotionality and Prsc.

In Smart PLS 4.0, a Partial Least Squared Structural Equation Modelling (PLS-SEM) approach was used to test the association between age, gender, Emotionality, Prsc, cognitive appraisal and state driving anger. According to Hair and Alamer (2022), PLS-SEM is useful for more than theory confirmation, and is particularly useful when understanding causal relationships among variables. However, model fit indices provide less insight into PLS-SEM models (Hair, 2017; Hair et al., 2019a), and demonstrating the reliability and validity of the construct and predictive performance of the model are more oriented (Hair et al., 2019b; Hair & Alamer, 2022). Thus, Composite Reliability (CR), Average Variance Extracted (AVE), and Variance Inflation Factor (VIF) were used to assess construct reliability, convergent validity, and multicollinearity, which can provide more information into variables and the PLS-SEM model (Hair et al., 2019a). Based on Fornell and Larcker (1981) criteria, CR higher than 0.6 and AVE over 0.4 suggest adequate reliability and validity of the construct. A VIF not exceeding 3 demonstrates the model is free of multicollinearity (Hair & Alamer, 2022). Moreover, R^2 was considered for measuring the model's explanatory power of each endogenous variable. Q^2 is a recommended indicator for the reflection of model predictive accuracy, which combines aspects of out-of-sample prediction and in-sample explanatory power (Hair et al., 2019a). Generally, Q^2 values higher than 0, 0.25 and 0.50 respectively imply small, medium, and large predictive accuracy of the PLS-SEM model (Hair et al., 2019a).

3. Results

3.1. Age and gender differences in state driving anger, Emotionality and Prsc differences

The Pearson correlation analysis is presented in Table 2. Driving experience was positively correlated with

age (r=0.509, p<0.01). Notably, a positive association between state driving anger and traffic penalty points received in the last year was observed (r =0.119, p<0.01). Emotionality was positively related to state driving anger (r=0.184, p<0.01). Similarly, Prsc had a positive correlation with state driving anger (r=0.151, p<0.01).

Exploring age and gender differences in state driving anger, Emotionality and Prsc may provide more understanding about Chinese driving anger. Driving experience was controlled, due to its strong correlation with age. Generally, 18-25-year-old drivers can be considered young drivers (Yang et al., 2022), but there could be some biases if using this as an age grouping rule, because of our sampling strategy. To acquire a balanced age group assignment, the present study uses the median value (age = 31) as a reference. The results are shown in Table 3.

Significant differences in state driving anger and Emotionality were found between the two age groups (age < 31 and age > 31). However, there was no significant difference in Prsc between these two age groups (p>0.05). In addition, males scored significantly lower than females on the Emotionality scale (F=36.977, p<0.001), but males and females showed identical levels in state driving anger (F =0.053, p>0.05) and Prsc disposition (F=0.008, p>0.05).

3.2 The role of age, gender, Emotionality and prsc in cognitive appraisal and state driving anger

Figure 3 depicts the association between age, gender, Emotionality, Prsc, cognitive appraisal and state driving anger. CR and AVE were respectively 0.82 and 0.48, indicating acceptable construct reliability and convergent validity of cognitive appraisal. The maximum VIF was 1.569, suggesting no multicollinearity issue in the present model. In addition, Q^2 was 0.27, revealing a medium predictive performance of state driving anger. Emotion-focused coping potential was removed because of a low factor loading (less than 0.50). As expected, state driving anger was significantly and positively predicted by cognitive appraisal (β=0.49, p<0.001). However, the path from age to cognitive appraisal was not significant (β=0.04, p >0.1). The relationship between gender and cognitive appraisal was significant (β=-0.12, p<0.001), suggesting males and females evaluated anger-provoking situations differently. Additionally, Emotionality and Prsc influenced drivers' cognitive appraisal and state

driving anger in differential ways. A positive relationship between Emotionality and state driving anger was observed (β=0.17, p<0.001), but Emotionality had no association with cognitive appraisal (β=0.05, p>0.1). In contrast, Prsc played a positive role in cognitive appraisal (β=0.17, p<0.001), but there was no direct link between Prsc and state driving anger. Interestingly, Prsc exerted a direct, significant, and positive relationship with state driving anger (β=0.16, p<0.001), if the cognitive appraisal construct was removed (not depicted in the above figure). In general, the model provides a 28.4% variance in predicting state driving anger.

To explore gender differences in components of cognitive appraisal, independent t tests were performed. Results suggested that males rated significantly higher than females in other responsibility ($t = 2.10, p < 0.05$) and problem-focused coping potential ($t = 2.04, p < 0.05$). This indicates that male drivers are more likely to attribute culpability to other road users and perceive a greater capacity to handle trigger events compared to female drivers.

4. Discussion

Appraisal of the driving context is more influential when determining emotional states and driving behaviors (Stephens & Groeger, 2009; Emo et al., 2016). However, less is known regarding whether and how drivers' characteristics and dispositions influence their cognitive appraisal while facing anger-provoking situations. The present study applied self-reported instruments to explore the influence of drivers' age, gender, Emotionality, and Private self-consciousness (Prsc) on cognitive appraisal undertaken while driving and state driving anger. Our results supported an earlier viewpoint that cognitive appraisal is essential for generating anger, along with high goal relevance, goal incongruence, other responsibility, and problem-focused coping potential (Lazarus, 1993). Moreover, this pattern of cognition increases the intensity of driving anger, which is consistent with the result of Stephens et al. (2016). Meanwhile, it was found that age had no relationship with drivers' appraisal of angry events, in line with the findings of Stephens et al. (2016). A possible reason is that the importance of goals set while driving may be similar for all drivers. For example, drivers (either young or old) always stress the goal of driving safety (Dogan et al., 2011). Also, Armitage et al. (2022) reported that age shows no effect on safe driving intention and general safe

driving behaviors, reflecting a universal value of safe driving among drivers. Similarly, the value of the goal related to driving punctuality may be the same for drivers. In other words, it is reasonable that drivers (irrespective of their age) have the same understanding and interpretation of travel-blocking scenarios, since both groups of drivers experience the same outcomes as a result of traffic congestion. However, it was found that male drivers evaluated anger-provoking situations in a more negative manner compared to female drivers. Specifically, males blame heavily the trigger and perceived high coping capacity to tackle the angry situations. This might stem from gender roles with males possessing more masculinity (e.g., "I am assertive") than females (Holt & Ellis, 1998), which could enhance the inappropriate and unreasonable cognitive appraisal.

Important findings revealed in the present study were that Emotionality and Prsc demonstrated different mechanisms in influencing drivers' appraisal and state driving anger. Specifically, Emotionality directly and positively influenced the state driving anger, supporting a result of previous study studies (Ābele et al., 2020). However, there was no association observed between Emotionality and drivers' cognitive appraisal, indicating that Emotionality does not make a difference to drivers' cognition in anger-related scenarios. Previous studies reported that Emotionality has no relationship with cognitive ability and cognitive appraisal of revenge (Edwin Sheppard & Boon, 2012; De Vries et al., 2021), demonstrating Emotionality may not be influential for individuals' cognition. Besides, another possible explanation is

that a mediator might exist between Emotionality and cognitive appraisal. This mediator is trait driving anger, and evidence has shown that drivers with higher Emotionality also manifest higher trait driving anger which contributes to unreasonable and inappropriate interpretations (cognitive appraisal) of the anger-evoking situations (Albentosa et al., 2018; Zhai et al., 2023). Based on the current model's results, it appears that Emotionality could be a proximal variable to state driving anger if cognitive appraisal is considered alongside, supporting the statement that Emotionality has a closer relationship and a better predictive power with affective states (Ashton et al., 2014).

In contrast, Prsc enhanced the drivers' cognitive appraisal while confronting anger stimuli. In essence, people high in Prsc show a higher level of self-awareness and they might easily access and reflect on their inner thoughts and motivations (Fenigstein et al., 1975). Importantly, an individual's cognitive process more or less involves the participation of self-awareness (Morin, 2011). Consequently, this commonality may establish the link between Prsc and the driver's cognitive appraisal. Interestingly, it was identified the direct association between Prsc and state driving anger after removing the cognitive appraisal construct in the model. Therefore, it could be inferred that the impact of Prsc on state driving anger is dominant via drivers' cognitive appraisal, but its effect might be direct on state driving anger if not considering drivers' cognitive appraisal. These dual pathways (i.e., direct and indirect) between Prsc and state driving anger reveal the complexity of the

Table 2. Pearson intercorrelation among variables (Two-tailed).

	Variables	1	2	3	4	5	6	7
1	Age	1						
2	Driving experience	.509**	1					
3	Traffic penalty points	0.002	−0.027	1				
4	Gender	−.085*	−.244**	−0.001	1			
5	State driving anger	−0.074	−0.016	.119**	0.010	1		
6	Emotionality	−.112**	−.213**	−0.003	.249**	.184**	1	
7	Prsc	−0.023	0.003	0.022	0.002	.151**	0.005	1

Notes: *p < 0.05, **p < 0.01, Gender: 0 = males, Prsc = Private self-consciousness.

Table 3. Results of ANCOVAs on state driving anger, Emotionality and Prsc.

	Age			Gender		
Variables	Age < 31 Mean (SD)	Age > 31 Mean (SD)	F	Male Mean (SD)	Female Mean (SD)	F
State driving anger	8.64 (1.36)	8.31 (1.57)	6.768**	8.50 (1.47)	8.48 (1.46)	0.053
Emotionality	3.35 (0.64)	3.18 (0.61)	10.234***	3.11 (0.62)	3.42 (0.59)	36.977***
Prsc	3.57 (0.46)	3.55 (0.45)	0.129	3.56 (0.44)	3.56 (0.46)	0.008

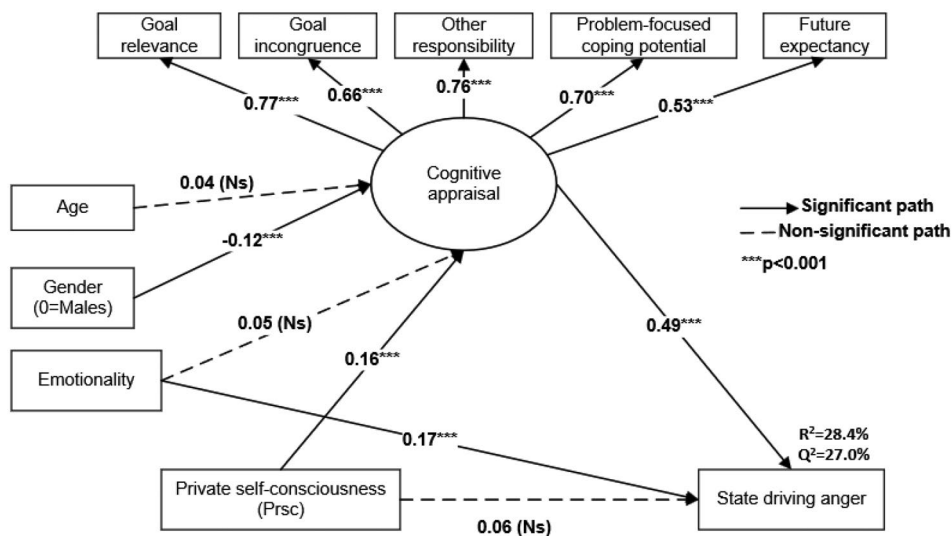Notes: **p < 0.01, ***p < 0.001, Prsc = Private self-consciousness.

Figure 3. Association between age, gender, Emotionality, Prsc, cognitive appraisal and state driving anger.
Notes: State driving anger used in the model was a mean of three state driving anger scored in three anger-provoking situations (SB, TB, and HA). Similarly, each component of cognitive appraisal in the model was calculated based on the mean of the corresponding component scored in the three anger-provoking situations. Emotionality was a mean score of the Emotionality sub-scale in BHI. Prsc was a mean score of 10 items on the Prsc scale.

emotional response while driving, implying the necessity of simultaneously incorporating both non-cognitive and cognitive factors to understand driving anger.

The current findings could add more insights into how specific dispositions are uniquely associated with an individual's cognitive appraisal and state anger, indicating the importance of considering an individual's dispositions in understanding cognitive appraisal and emotional states (Poluektova et al., 2023). This also implies the essence of treating Emotionality and Prsc independently in the context of driving anger. For example, drivers with higher levels of Emotionality may benefit from long-term intervention for emotional regulation, e.g., mindfulness-based interventions. Such interventions could assist drivers handle emotional stimuli more skillfully. However, for individuals high in Prsc, additional cognitive-related intervention might be required. High Prsc individuals might be more sensitive to their inner thoughts and inner motivation, but they might not establish the link between their thoughts and emotional response, retrospection could help individuals to be aware of how negative cognitive patterns result in emotional states, which could alleviate the effect of Prsc on cognitive appraisal.

A previous meta-analytic study by Moshagen et al. (2019) disclosed the gender difference in Emotionality, indicating females rated higher Emotionality than males. Therefore, the offset influence of gender

differences in Emotionality and components of cognitive appraisal could explain why female and male drivers showed identical levels of state driving anger. In addition, there is evidence that Emotionality is decreased as age increases (Ashton & Lee, 2016). Possibly, the difference in state anger between younger drivers and older drivers was caused by Emotionality. Accordingly, the current findings might highlight the importance of focusing on individual dispositions in specific gender categories and age ranges when designing related interventions for managing driving anger.

5. Limitations and future work

To be acknowledged, the current study had several limitations. Self-reported data is a commonly used approach to investigate drivers' psychological aspects and driving anger/behaviors. However, the social desirability effect cannot be ignored in the present study. Furthermore, due to the limitations of the cross-sectional design, it remains unclear whether the relationship between drivers' dispositions and their cognitive appraisal of driving situations remains stable over time. Therefore, longitudinal studies employing driving diaries could be considered to explore the variation among dispositional traits, cognitive appraisal and state anger. In addition, the study used an imaginary approach for the induction of anger, but there is a risk that the intensity of the anger state is not strong enough, this should be

further improved within a controlled laboratory environment by using interactive approaches (e.g., driving simulation) and multi-item assessment of state anger. It has been suggested that more items could describe a more accurate profile of personality's sub-facets (Credé et al., 2012). Therefore, further studies should use a full version of the HEXACO for evaluating personality to acquire more holistic information. Also, the tenure of a driving license might not fully capture a driver's experience, thus considering the frequency of driving and total mileage could provide more accuracy in measuring driving experience. Additionally, there was a significant age difference between participants in the survey of pilot study and the main survey, suggesting the present structure of MAD might not be the most appropriate for the main survey sample. Future studies should target to improve the anger scenarios development by reducing age differences in the sample and adding more Chinese-relevant anger-evoking situations. Due to the space limitation, it's valuable to examine whether males and females differ in cognitive evaluation when facing different themes of anger-provoking situations. This examination can provide more detailed understanding of associations between gender, cognitive appraisal and driving anger. Lastly, the present study merely focused on Chinese drivers, applying the proposed model to diverse driving populations could provide more insights related to individual characteristics and the appraisal process undertaken while encountering anger-evoking scenarios.

6. Conclusion

It is crucial to understand how drivers' characteristics and cognitive appraisal conjunctively influence angry states when confronting a range of anger-provoking situations. It was found that age was not associated with drivers' cognitive appraisal, but males tended to assess driving situations with more blame and a higher coping potential style than females. In addition, males and females showed similar levels of state driving anger, but females reported higher levels of Emotionality than males. Importantly, Emotionality and Private self-consciousness influence drivers' appraisal and state driving anger through different mechanisms. Emotionality is directly and positively related to state driving anger rather than drivers' cognitive appraisal. By contrast, Private self-consciousness enhanced the magnitude of state driving anger through drivers' cognitive appraisal undertaken on driving situations. This study might contribute to providing additional understanding of driving anger and promote relevant interventions designed in China.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Data availability statement

Data will be available made on reasonable request through the corresponding author.

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APPENDIX A

Table A1. The results of EFA on MAD in pilot study sample.

No	Item	Travel Blocking [α = 0.820]	Safety Blocking [α = 0.751]	Hostile Aggression [α = 0.717]	Mean	SD	Skewness	Kurtosis
13	You encounter road works and detours	0.758			1.86	1.037	1.11	0.33
18	Someone in front of you does not move off straight away when the light turns to green	0.702			2.69	1.103	0.12	−0.81
17	You are driving behind a large vehicle and you cannot see around it	0.689			2.76	1.192	0.12	−0.89
11	Someone pulls out right in front of you when there is no-one behind you	0.529			3.19	1.038	−0.24	−0.52
19	You are stuck in peak hour traffic	0.483			2.77	1.123	0.10	−0.79
8	A driver fails to give way to you when they are supposed to (e.g., intersections, roadside stop, underground car park, at give way sign, etc.)	0.462			3.25	1.033	−0.10	−0.69
1	Someone pulls out right in front of you without looking		0.738		3.71	0.906	−0.63	0.28
2	Someone moves in front of you suddenly and without leaving enough room, forcing you to brake hard		0.716		4.21	0.902	−1.10	0.98
4	Someone cuts in right in front of you forcing you to brake		0.692		4.01	0.971	−0.96	0.66
9	When you are trying to overtake another driver he/she speeds up		0.687		2.72	1.062	0.17	−0.54
12	When you are trying to merge, other drivers do not give way (preventing you merging)		0.631		3.24	0.913	−0.18	−0.66
7	Jaywalking pedestrians/cyclists cross in front of you forcing you to brake		0.567		3.92	1.054	−0.64	−0.16
10	A driver ahead of you is straddling two lanes		0.502		3.66	1.019	−0.28	−0.56
22	Another driver indicates anger/hostility when you do a perfectly legal maneuver			0.795	3.52	1.181	−0.52	−0.59
21	Someone makes a rude gesture towards you about your driving			0.757	4.06	0.991	−1.08	0.73
20	Someone shouts at you about your driving			0.716	3.96	0.938	−0.74	0.17
23	Someone beeps at you without reason			0.691	3.32	1.106	−0.30	−0.56

Table A2. Participants' anger-provoking scenarios selection in main survey.

Category of anger-evoking situations	Percentage sample selected
Safety Blocking	
Someone pulls out right in front of you without looking	6.4%
Someone moves in front of you suddenly and without leaving enough room, forcing you to brake hard	26.8%
Someone cuts in right in front of you forcing you to brake	28.8%
When you are trying to overtake another driver he/she speeds up	6.9%
When you are trying to merge, other drivers do not give way (preventing you merging)	5.0%
Jaywalking pedestrians/cyclists cross in front of you forcing you to brake	17.0%
A driver ahead of you is straddling two lanes	9.1%
Travel Blocking	
You encounter road works and detours	10.4%
Someone in front of you does not move off straight away when the light turns to green	19.7%
You are driving behind a large vehicle and you cannot see around it	13.9%
Someone pulls out right in front of you when there is no-one behind you	5.5%
You are stuck in peak hour traffic	33.3%
A driver fails to give way to you when they are supposed to (e.g., intersections, roadside stop, underground car park, at give way sign, etc.)	17.2%
Hostile Aggression	
Another driver indicates anger/hostility when you do a perfectly legal maneuver	26.7%
Someone makes a rude gesture towards you about your driving	31.3%
Someone shouts at you about your driving	20.8%
Someone beeps at you without reason	21.3%

Notes: Rounded to one decimal.