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Negative or positive? The effect of emotion and mood on risky driving

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ABSTRACT

This research explored how two states of affect, emotion and mood, would influence driver's risky driving behavior through risk perception and risk attitude. An experiment and a survey were adopted to test the two paths. In this model, negative affect played an opposite and more powerful role compared to positive affect. Study 1 was an experimental study with four treatment groups. Participants watched one of four video clips (traffic-related negative, traffic-unrelated negative, positive and neutral) and different emotions were induced. Negative emotion significantly elevated drivers' risk perception but such perception failed to develop an appropriate attitude for drivers. A more favorable risk attitude resulted in increased reports of speeding. Turning from a "point" effect to a similar "period" effect, a survey was carried out in Study 2 to explore the effect of positive and negative mood instead of emotion. Mood states affected drivers' risky driving behavior through risk perception as well as risk attitude, which was in line with the results of Study 1. The "bad is stronger than good" effect and the two paths in the model were discussed.

1. Introduction

With the growth of motor vehicle use in China, the amount of casualty and property loss is ever increasing. According to the annual statistical report of road traffic accidents in China, the number of traffic accidents, fatality, and injury have been declined since 2002–2011, with the number of recorded accidents reduced from 773.1 thousand in 2002 to 210.8 thousand in 2011, the number of fatality decreased from 109.4 thousand to 62.4 thousand. However, as the data revealed, the number of fatality and injury per accident was increasing. The traffic accident is still one of the main causes of people's deaths or disabilities (Bureau of Traffic Management, PRC, 2007, 2011). World Health Organization (2011) reported that traffic accident was one of the top 10 causes of death in middle-income countries in 2008. The traffic safety has also becoming a global issue of common concern. Hence, great concern and effort need to be put on road safety in China.

1.1. Positive and negative emotion

Among many factors that cause traffic accidents, human factor plays a more important role beyond other factors such as vehicle, road, etc. (Rumar, 1990; United States General Accounting Office, 2003; Wang, 1995). As a critical part of human being, emotion cannot be ignored when we are trying to reveal the nature of risky driving. Most work in this area was oriented towards road rage or aggressive driving in which emotion and behavior were intertwined (e.g., Dula & Ballard, 2003; Dula & Geller, 2003). An important work done by Mesken, Hagenzieker, Rothengatter, and de Waard (2007) revealed that specific emotions (i.e. anger, anxiety, and happiness) had different correlations to road events and speeding. However, there

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were some results in this study showing a closer relationship between the two negative emotions (Mesken et al., 2007). This was possible because the emotion or feeling people experience in daily life was usually complicated and mixed rather than specific. Embodied in a hurry city life, people could bring emotions, of any kind, and of any source, on road. There are often times (e.g., driving attentively in a busy traffic) when a person could hardly tell what the exact emotion he or she is experiencing instead of generally describing his or her feeling as "good" or "bad". There are also times when a person was emotionally aroused by something unrelated to driving situation before or during driving. As a result, in spite of the value for distinguishing the effects of every specific emotion, it is reasonable to examine the comprehensive effect of non-specific positive and negative emotions from a "valence-based" perspective (Barrett, 1998; Elster, 1998; Kuvaas & Kaufmann, 2004). Moreover, we focused mainly on the effect of incidental affect (Cohen, Pham, & Andrade, 2007), the source of which was not necessarily connected with driving risk or driving situations.

According to the cognitive theory of emotion, the attributes of emotions, "positive" and "negative", were in nature the *appraisals* we make on the events we encounter (Arnold, 1968). Such appraisals could be simply labeled as "good" or "bad". In other words, a positive emotion means an emotion that is (appraised as) pleasant, healthy, and carry positive attitude to self and others, and negative emotion vice versa (Robert & Lori, 2002). This categorization of emotion was confirmed in scale developing (Ostir, Smith, Smith, & Ottenbacher, 2005) as well as in some experimental studies (e.g. Ladhari, Brun, & Morales, 2008; Langer & Keltner, 2008).

1.2. Risky driving: perception and attitude

One of the mainstreams of the previous traffic research focused on two cognitive antecedents of risky driving, which were driving risk perception and risky driving attitude. Risk perception was originally used to describe people's subjective perception of a potential danger. The risk-as-feelings hypothesis proposed by Loewenstein, Weber, Hsee, and Welch (2001) argued that the feelings originated from the cognitive evaluation process would influence reciprocally on the current judgment. Through similar lines of thought, many researchers employed both a cognitive component and an affective component on risk perception. The former component represents judgment about the subjective probability of potential danger, while the latter one represents concern about oneself as a victim of the danger (Baron, Hershey, & Kunreuther, 2000; Fischhoff, de Bruin, Perrin, & Downs, 2004). In the transportation field, traffic risk perception was found to vary across different groups of people (Nordfjærn & Rundmo, 2009; Oltedal & Rundmo, 2007; Şimşekoğlu, Nordfjærn, & Rundmo, 2012). Some researchers believe that the subjective perception of traffic risk has an important effect on driving safety (Gregersen, 1996). Rundmo and Iversen (2004) found that a higher emotional-based perception of traffic hazard was related to a safer self-report driving behavior.

Defined as a psychological tendency to evaluate something with favor or disfavor, attitude is formed on the basis of cognitive, affective, and behavioral processes (Eagly & Chaiken, 1993). Attitude toward risk-taking in driving is the favorable/unfavorable evaluation or the receptivity of risky driving behavior. Researchers found that attitude toward risky driving could be changed through some kinds of interventions (Falk & Montgomery, 2009). According to the theory of planned behavior, attitudes toward a behavior could predict the behavioral intentions, and in turn affect the actual behavior jointly with perceived control of the behavior (Ajzen, 1991). Some studies revealed a fairly strong correlation between driving risk attitude and risky driving behavior as well as between driving risk attitude and accidents, with a higher preference to risky driving related to a higher propensity of risky driving behavior and traffic accidents (Iversen, 2004; Ulleberg & Rundmo, 2003; West & Hall, 1997; Yilmaz & Celik, 2004).

1.3. Emotion and risky driving: through perception and attitude

Then what role does emotion play in risky driving? How do positive and negative emotions affect driving-related perceptions, attitudes, and behaviors? Generally speaking, after an emotion arises and then "labeled", it would make people think and behave in line with its bonded appraisal (Strongman, 2003). A positive emotion would lead people to view things as favorable and to approach those things, while a negative emotion raises a tendency to avoid. Such tendencies might spread to anything at hand regardless of how the emotion arises.

According to Affect Infusion Model (AIM) (Forgas, 1995), when people engaged in a deliberating information process, emotion would activate valence-congruent memory or information related to the judgment. When people engaged in a heuristic information process, emotion would serve as a direct input of information in guiding the judgment. Both processes could lead to a valence-congruence judgment of the object. Apart from the traffic area, an earlier research carried out by Johnson and Tversky (1983) found that people showed a higher risk perception of risk events after negative emotion was induced. A recent study about consumer decision-making also revealed that consumers' positive emotion exert a significantly negative influence on travel-related financial, physical and psychological risk perception, and vice versa (Lin, 2008). When it applies to traffic situation, we predicted that emotion would exert similar valence-congruent effect on people's driving risk perception. Specifically, positive emotions would lead people to retrieve good components of risk driving, which links to a low risk perception. In contrast, negative emotion would raise people's risk perception. Slovic, Finucane, Peters, and MacGregor (2007) proposed a similar theoretical framework arguing that risk and benefit perception of a certain event were related, through the mechanism of "affect heuristic". Specifically, positive affect was related to a lower risk perception and a higher benefit perception, and vice versa for negative affect.

Clore and Schnall (2005) argued that the affective influence on attitude comes from the key common ground that both affect and attitude are evaluative. Emotions serve as a cue in the evaluating process (Cohen et al., 2007). Positive (pleasant) and negative (unpleasant) emotion would lead to good or bad evaluation of an object. A study revealed that people did not accept genetically modified food because of the anxiety and fear about unknown events and dangers (Townsend, 2006). Thus emotion would affect people's attitude toward risky driving through a mood-congruent manner. We predicted that people with positive emotion would consider faster or riskier driving as more favorable than people with negative emotion. This logic is similar and consistent with risk perception while driving. In the transportation field, researchers have tried to reduce people's favorable attitude towards some high-risk driving behavior through the use of emotion and shock advertising campaigns (Guria & Leung, 2004).

As mentioned above, emotions would affect people's tendencies toward approaching or avoiding things, both cognitively and behaviorally. People with positive emotion would be more tempted towards risky driving than with negative emotion. This direct path could exist because the effect of emotion on behavior is sometimes automatic (Strongman, 2003) and thus beyond the cognitive control. In addition, risky driving behavior was influenced by two cognitive antecedents, which are driving risk perception and risky driving attitude. Thus we predicted that positive emotion would increase the risky driving behavior through either lowered risk perception or heightened risk attitude and that negative emotion would have the reverse effect.

In summary as showed in Fig. 1, emotion would affect individual's driving risk perception (a1), driving risk attitude (a2) and risky driving behavior (b) through direct paths, and the influence on risky driving behavior would also be through two cognitive indirect path (c1 and c2). Positive and negative emotion would exert an opposite effect, with positive emotion reducing driving risk perception and raising driving risk attitude and risky driving behavior, while negative emotion vice versa.

1.4. Current study

In the current study, we focused mainly on the effect of incidental affect, which was usually resulted from the situation of judgment and decision-making. Mood and emotion are both considered as two different kinds of affective states. Through content analysis, Beedie, Terry, and Lane (2005) offered some major points in discriminating the two states. Emotion arises with clear reasons or causes while mood is only a kind of general affective background. Furthermore, the duration of emotion is usually short and the whole process of an emotion from arising to fading could be easily traced. Mood is a tender and long-term state. These two kinds of states reflect two perspectives for discussing the effect of emotion and it was necessary to test the hypothesized model from these two perspectives. Actually, we could abstract the effects of the two states as a "point" effect for emotion vs. a "period" effect for mood.

Thus we conducted two studies with corresponding methods to verify the proposed model. In Study 1, the emotion induction was employed to examine the "point" effect of positive and negative emotion on risk perception and risk attitude. It is predicted that, in line with the cognitive theory, compared with the control group, the positive-emotion group should have a lower risk perception and a more favorable risk attitude, resulting in a more risky driving behavior, while the negative-emotion group should show opposite effects. While Study 1 was a lab study with strict experimental control, a survey was conducted to explore the relationships among mood, driving risk perception, driving risk attitude, and risky driving behavior during a period of time. It is hypothesized that the proposed model in Fig. 1 would be verified both from these two perspectives.

2. Study 1

In Study 1 we used video clips to induce emotion (Forgas & Moylan, 1987; Yuen & Lee, 2003). Three traffic-unrelated video clips were used to induce positive, negative, and neutral emotion. Moreover, since advertisements with traffic accidents were widely used in traffic safety education, two negative-emotion groups were adopted, induced by a traffic-unrelated and a traffic-related video respectively. We expected that these two negative emotion groups would display similar effect on driver's risk perception, risk attitude and risky driving behavior.

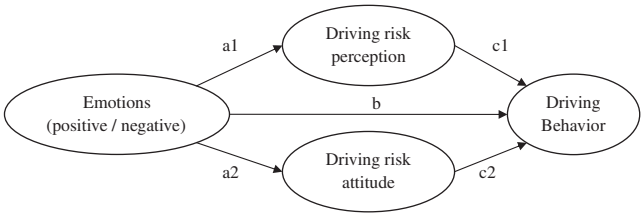

Fig. 1. A basic model of the study.

2.1. Method

2.1.1. Participants

Two hundred and fifty-eight adult drivers were recruited from four motor vehicle offices[1] in Beijing. Participants were told that they would take an investigation about driving. The participants were made sure that this investigation was voluntary and anonymous. Forty records were discarded due to incomplete data or random responses. The remaining sample consisted of 218 drivers. There were 204 male drivers (93.6%) and nine female drivers (4.1%). Five drivers (2.3%) did not indicate their gender. The average age of the drivers were 34.10 (±7.70) years old, ranging from 20 to 56 years old. The average years of driving experience were 7.33 (±5.46) years, ranging from 1 to 30 years. Sixty-seven (30.7%) of the participants were professional drivers and the other participants were private drivers. This attribute of participants was defined as the variable "profession" which would be mentioned in this paper. The participants were randomly assigned to one of the four conditions, with 73 drivers to traffic-related negative emotion group, 43 to traffic-unrelated negative emotion group, 46 to positive emotion group, and 56 to control group.

2.1.2. Materials of emotion induction

There were four video clips in all, each about 6 min long.

Traffic-related negative emotion was induced by a video clip depicting some cases of traffic accident and tragic scenes after accidents.

Traffic-unrelated negative emotion was induced by a video clip depicting cases of fire hazards and tragic scenes after fires.

Traffic and fire accidents are both real risky events caused by human beings and both bring about economic and life loss. The two kinds of accidents are matched in severity.

Positive emotion was induced by a video clip depicting some plots of funny family life (not involving any traffic-related events).

The video clip for the control group is an introduction video of Peking University.

2.1.3. Measures

2.1.3.1. Emotion. Three pairs of adjectives (pleasant–unpleasant, tense-relaxed, vigorous-tired) were used to measure emotion according to the three fundamental bipolar dimensions of mood raised by Matthews, Pitcaithly, and Mann (1995). Another dimension was added to rate overall feeling: feeling bad-feeling good. Scale endpoints were 1 and 5. Cronbach's α of the scale is =.89. The average score of the four items was used in the statistical analysis.

2.1.3.2. Driving risk perception. In order to let all the participants understand the traffc accidents clearly and consistently, traffic accidents were described in three levels—serious, moderate and slight—according to Xu (2005). For each level of accidents, a definition and a short description were offered (e.g. slight traffic accidents are such kinds of accidents as scrapes, etc., resulting in slight car damage, slightly or no injured people). After the participants have made sure the meanings of each level of accidents, they were asked to rate on driving risk perception. Probabilities of the accidents were measured as the cognitive component of risk perception. Some research also included participants' emotional or affective response to the risk source as the affective component of risk perception (Rundmo & Iversen, 2004; Rundmo & Sjöberg, 1998). Thus for each level of accident, participants were asked to rate probability in general, probability for self, and worry concerning the traffic accident (nine items in total). For example, one of the items is "*In general*, how many on-road vehicles would be involved in *serious* accidents everyday in Beijing?" Participants were asked from 0 (hardly none) to 10 (a lot). For each dimension (general probability, self-probability, and worry) of risk perception, an average score of the three items (serious, moderate, and slight traffic accident) was calculated and used as a sub-scale score in the statistical analysis. A higher score indicated a higher risk perception of driving risk. The Cronbach's αs of the three sub-scales were all above .80 (84, .83, .83 for general probability, self probability, and worry, respectively).

2.1.3.3. Driving risk attitude. Six dimensions of the Driving Risk Attitude Scale (Ulleberg & Rundmo, 2002; Zhuang, Bai, & Xie, 2008)[2] were used to measure drivers' attitude toward risky behavior in traffic. These dimensions (traffic-flow, speeding, riding with an unsafe driver, drinking and driving, showing off, joy-riding) were selected due to a clear discrepancy from the *perception* of risk (an estimated probability and related worry about traffic accident) and mere representation of the attitude toward risky driving. Eighteen items were used totally. For example, participants were asked to rate from 1 (strongly disagree) to 5 (strongly agree) on the item "There are many traffic rules which cannot be obeyed in order to keep up the traffic flow." A higher score indicates a more receptivity of risky driving. Confirmation factor analysis showed that the items fit the proposed structure well (Chi-square/*df* = 1.78, RMSEA = .06, GFI = .90, AGFI = .86, CFI = .88). The Cronbach's α of this scale in this study is .82.

[1] A motor vehicle office is affiliated to the local traffic management bureau. The major responsibility is the management of all the local motor vehicles and drivers. It is also responsible for vehicle inspection, issues of driving licenses and license plates, etc.

[2] We used a Chinese version of Driving Risk Attitude Scale which was revised and validated by Zhuang et al. (2008). The original items were selected from Ulleberg and Rundmo (2002).

Fig. 2. An example of the pictures in the measure of risky driving behavior.

2.1.3.4. Risky driving behavior. After seeing the video clip, the participants were showed three pictures of the road on TV after the video clips and were asked to report the speed they would like to drive on these three kinds of roads. The participants were told that there was no speed limit in these roads and were asked to report a speed as they wish to drive on each road (see Fig. 2 for an example of the pictures.).

2.1.4. Procedure

Participants took the experiments in groups, which consist of about 25 participants in each group. Participants were asked to sit in a classroom and take the pre-test of emotion first. Then the video clip was played to induce emotion. Soon after that, participants were asked to take the post-test of emotion and the measure of driving risk perception, driving risk attitude, and risky driving behavior. For the two negative emotion groups, the video clip for positive emotion induction was played at the end of the experiments to relieve the participants' negative emotion.

2.2. Result

2.2.1. Emotion induction

Repeated measures showed that the interaction between groups and induction was significant ($F(3,211) = 51.26$, $p < .001$, $\eta^2 = .42$). We used two one-way ANOVAs to examine simple effects and the results showed that only the difference of post-induction emotions among the four groups reached statistical significance ($F(3,212) = 77.84$, $p < .001$, $\eta^2 = .52$). Post-hoc test (LSD) showed that the emotion score of the two negative emotion groups (traffic-related and traffic-unrelated) were both significantly lower than that of the control group ($ps < .001$), and the control group significantly lower than positive emotion group ($p < .001$). There was no significant difference between the two negative groups (p = NS). These results indicated that emotion induction was effective (see Fig. 3).

2.2.2. Driving risk perception

Risk perception and risk attitude of the four experimental groups are displayed in Fig. 4. As for driving risk perception, one-way ANOVA revealed that the four groups were significantly different in the worry sub-scale ($F(3,214) = 2.68$, $p < .05$, $\eta^2 = .04$). Post-hoc test (LSD) indicated that concern of traffic-unrelated negative group was significantly higher than positive group ($p < .05$) as well as higher than control group ($p < .05$) (see Fig. 4).

One-way ANOVA also revealed that the difference of the four groups on self probability component reached marginal significance ($F(3,213) = 2.57$, $p = .055$, $\eta^2 = .04$), with post hoc test (LSD) showing that the participants in the traffic-related group thought they were more likely to get involved with traffic accidents than those in the traffic-unrelated group ($p < .01$) (see Fig. 4).

2.2.3. Driving risk attitude and risky driving behavior

Emotion did not have a direct effect on risk attitude, yet further analysis showed that emotion interacted with risk perception to affect driving risk attitude. In order to explore the moderation effect of emotion on the relationship between risk perception and risk attitude, we dichotomized the total sample into of high vs. low risk perception groups according to the median of the combined scores of risk perception. Then we computed a 2×4 ANOVA on driving risk attitude, with risk perception (high vs. low) and experimental group as independent variables. Neither of the independent variable had a main effect on risk attitude, while the interaction reached significance ($F(3,207) = 2.79$, $p < .05$, $\eta^2 = .04$). Simple effect tests showed

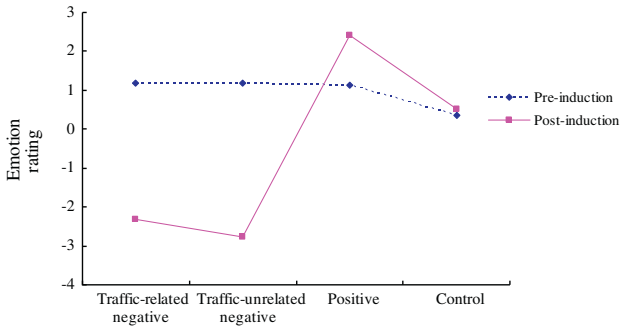

Fig. 3. Pre- and post-test emotions of the four groups (Study 1).

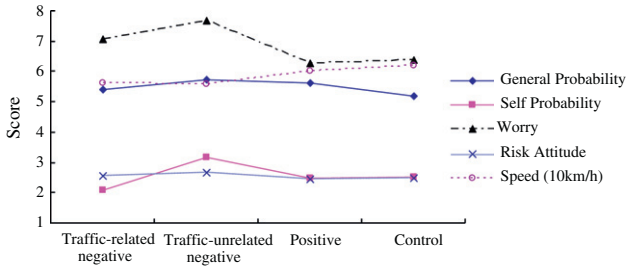

Fig. 4. Risk-related measures of the four groups (Study 1).

that driving risk perception positively affected driving risk attitude only in the two negative emotion groups (for traffic-related negative group, $t(69) = 1.941$, $p = .056$, $\eta^2 = .05$; for traffic-unrelated negative group, $t(54) = 2.270$, $p = .027$, $\eta^2 = .09$) (see Fig. 5).

Emotion failed to exert effect on participants' self-reports of speed. However, regression analysis revealed a significant effect of risk attitude on reported speed, after the demographic variables were controlled in the first step (see Table 1).

2.3. Discussion

The three traffic-unrelated groups differ at the worry sub-scale of risk perception. Participants in the negative group were more worried about getting involved in a traffic accident than those in the control group and the positive emotion group. This partly supported our hypothesis for negative emotion exerted more influence than positive emotion. Furthermore, emotion moderated the effect of driving risk perception on driving risk attitude. When in negative emotion, individual's high risk perception led to a high receptivity of risk. This pattern did not exist in the positive emotion or the control group. Some research found that self-regulatory failure was related to people's negative state (e.g. stress) because such state would make

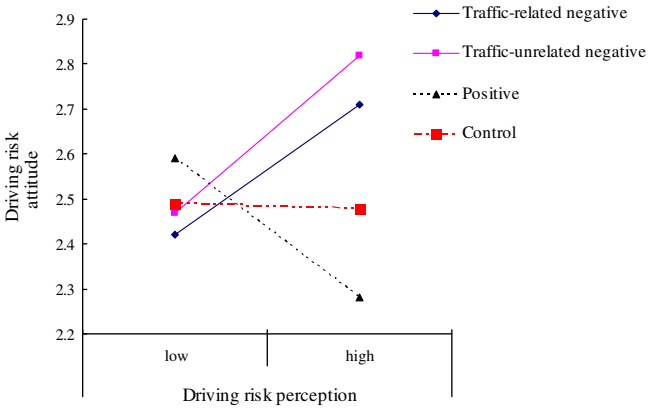

Fig. 5. Driving risk attitude with low/high driving risk perception among four groups.

Table 1
Regression analysis on speed (Study 1).

Independent variables	Step 1 Standardized coefficients (β)	Step 2 Standardized coefficients (β)
Age	−.199*	−1.720
Gender	−.105	−1.497
Driving age	.019	−.316
Profession	.000	.288
Risk attitude		3.482**
F	2.349	4.413**
Adjusted *R* square	.027	.080

* $p < .05$.
** $p < .01$.

people allocate resources to the stimuli or threats that cause the negative state and thus they would not have enough capacity to regulate themselves (Hofmann, Rauch, & Gawronski, 2007; Kirschenbaum, 1987). In the current study, drivers with negative emotion might suffered similar self-regulatory failure and could not rationally form a low risk attitude through raised risk perception.

Results also showed that a more favorable attitude toward risky driving would lead to a higher driving speed in a speed-choosing task, which indicated a more risky driving behavior. This was quite consistent with common sense. Yet emotion failed to exert any direct or indirect effect on risky driving behavior and this result seemed to be disconnected with the results above. Although not statistically supported, we could see a reasonable chain starting at emotion through traffic risk perception or attitude towards risky driving behavior. Such lack of support may result partly from the possible limitations of lab experiments, in which the participants may deliberately make some endeavor to keep the effect of emotion away from the following tasks. Moreover, the effect of emotion on risky driving behavior, which was measured in the last step, might fade away.

There is an interesting result that the drivers in the traffic-related negative emotion group responded differently on risk perception compared with those in the traffic-unrelated negative emotion group. The two groups of people both experienced negative emotion and no significant difference existed in the degrees of emotion. However, those who watched the traffic-related tragic video clip estimated a lower probability for themselves to be involved in traffic accidents. The worry scores reported by the drivers in the traffic-related negative group fell between those reported by the traffic-unrelated negative group, and those reported by the positive emotion and control groups, with no significant difference from any of these groups. This seems inconsistent with the "affect heuristic" framework in judging risk perception and benefit perception (Slovic et al., 2007) or "emotional heuristic" in people's decision making in driving (Summala, 1985), which both suggested that people would have an emotional response of raising risk perception towards a hazard such as traffic accidents when some negative information or "ostensive" risk were linked to that hazard. This might be caused by two reasons. Firstly, the traffic accidents in the video clip were so severe and shocking that people might regard themselves as too far away from their real life. People may have a strong desire to keep away from such accidents in their everyday life. Similar evidences were found in health education research. For example, Brown and Richardson (2012) found that the persuasiveness of a distressing health-promoting message was impaired by the reduced attention from the participants. With such a strong desire to avoid severe accidents, drivers are likely to underestimate the probability so as to achieve "cognitive balance" (Heider, 1946). This could also be partly supported by the result that drivers generally rate the general traffic risk higher than the self risk of being involved in an traffic accident (5.49 vs. 2.53, $F(1,216) = 234.23$, $p < .001$, $\eta^2 = .52$). A study of road safety advertisement in Spain also found that harsh and bloody advertisement only took effect following a serious of mild advertisements (Castillo-Manzano, Castro-Nuño, & Pedregal, 2012). This result indicated that previous mild messages could make shocking message more acceptable and reasonable, and thus, more persuasive.

Secondly, the traffic accidents in the video clip were mostly caused by drivers' carelessness such as fatigue driving and drunk driving. Due to fundamental attribution bias, people were likely to make internal attribution to these accidents but might not do the same when imagining themselves in the accidents. This was also consistent with defensive attribution theory (DAT) which argues that people are less willing to use internal attribution when accidents are more serious (Stewart, 2005). This means people might be confident in themselves, considering both driving skills and driving virtues (e.g., Harré, Foster, & O'Neill, 2005). In this study, people may think they have more personal control in driving situations than in firing situations. Thus they perceived a lower self probability of being involved in traffic accidents and reported a lower worry about the potential danger. Moreover, for drivers in the traffic-related negative group, the feeling of worry in judging the traffic risk might be blocked by the negative emotions triggered by the video clip itself.

3. Study 2

In Study 1, positive and negative emotions showed some effects on driving risk perception and driving risk attitude, which partly supported the "point" effect. Focusing on another kind of state of affect and using a different method, we would explore a similar "period" effect of positive and negative mood on risky driving in Study 2.

3.1. Method

3.1.1. Sample

With the help of four motor vehicle offices in Beijing, surveys were delivered to 700 drivers, with 570 returned (81.4%) and 500 valid (71.4%). In the remaining 500-driver sample, 430 (86.0%) were male and 61 (12.2%) were female. Nine drivers (1.8%) did not indicate their gender. The average age of the drivers were 37.86 (±9.85) years old, ranging from 20 to 73 years old. Among the 500 drivers, 74 had driven for less than 2 years, while 186 drivers had an experience of driving over 10 years. As for the profession, 191 (38.2%) of all the participants were professional drivers.

3.1.2. Measures

3.1.2.1. Mood. Participants' moods in the recent two weeks were measured by the Profile of Mood States (POMS) (Chinese version) (Zhu, 1995). This scale consists of six subscales, with 65 items including seven distracters that were not used in this study. Participants rated 58 items in all on 5-point scales (1 – "not at all", 5 – "quite a lot"). Exploratory factors analysis with principal axis factoring and promax rotation revealed three factors and 28 items remained. The three factors named as "dejection", "anger", and "vigor", with the Cronbach's αs .94, .86, .82, respectively, explained 51.76% of the variance in all. The factor scores were used in data analysis.

3.1.2.2. Driving risk perception and driving risk attitude. Identical with Study 1.

3.1.2.3. Driving behavior. Participants' driving behavior in the recent one month was measured by the revised Driving Behavior Questionnaire (DBQ) (developed by Reason, Manstead, Stradling, Baxter, and Campbell (1990); translated and validated by Zhuang, Bai, and Xie (2008)). This 21-item scale consists of four factors (dangerous mistake, non-specific violation, harmless mistake, and aggressive violation).

3.1.3. Procedure

Participants were asked to answer the paper survey containing the measures listed above.

3.2. Result and discussion

The correlation matrix of the variables was showed in Table 2. The two negative mood states were significantly related to nearly all variables under examination, while vigor, the positive component of mood, did not relate to any except one variable. Regression analysis found that mood remained a significant predictor on drivers' behavior, after controlling for the idiographic variables (see Table 3). In detail, dejection and anger were significant predictors, showing that worse moods were related to more dangerous driving behavior. Dejection was also a significant positive predictor of attitude toward risky driving (see Table 4). The mediation effect of driving risk attitude and driving behavior was then tested according to Baron and Kenny (1986)'s recommended procedure (see Table 5). The Sobel test further indicated a significant mediation effect (Sobel $z = 3.98$, $p < .01$).

The three mood states failed to predict risk perception (none of the three betas reached significance .05). Yet, we still tried to reveal the effect of this variable in a more comprehensive model. We tested the proposed basic model (see Fig. 1, with emotion replaced by mood) using AMOS 17.0 and all the pathways reached significance of .05. The indexes of model fit were acceptable ($\chi^2/df = 3.41$, CFI = .92, RMSEA = .07, see Fig. 6).

Similar as in Study 1, negative mood revealed a stronger effect than positive mood. The dejection and anger dimensions of mood significantly correlated to nearly all the variables studied, while such strong correlations was not found in the vigor dimension. There was a chain starting from the negative mood dejection through risk attitude and ending at driving behavior (risky or dangerous driving). This mediation effect of dejection also supplemented Study 1, in which only the relation between risk attitude and speeding (driving behavior) was found.

Table 2
Correlations and reliabilities of the scales (Study 2).

	Mean	S.D.	1	2	3	4	5	6	7	8
1. Mood-dejection	0	1	(.94)							
2. Mood-anger	0	1	.79**	(.86)						
3. Mood-vigor	0	1	−.30**	-.08	(.82)					
4. General probability	4.38	2.43	.05	.13**	.06	(.81)				
5. Self probability	1.58	1.88	.25**	.20**	−.08	.30**	(.84)			
6. Worry	3.93	3.62	.11*	.14**	.10	.21**	.28**	(.93)		
7. Driving risk attitude	2.38	.66	.27**	.23**	−.06	−.04	.15**	−.02	(.84)	
8. Risky driving behavior	1.91	.74	.58**	.53**	−.10*	.04	.28**	.12**	.38**	(.94)

* $p < .05$.
** $p < .01$.

Table 3
Regression analysis on risky driving behavior (Study 2).

Independent variables	Step 1 Standardized coefficients (β)	Step 2 Standardized coefficients (β)
Age	−.063	.000
Gender	.020	−.005
Driving age	−.111*	−.059
Profession	.164**	.118**
Mood-dejection		.448**
Mood-anger		.163*
Mood-vigor		.015
F	6.230**	68.877**
Adjusted *R* square	.050	.374

* $p < .05$.
** $p < .01$.

Table 4
Regression analysis on driving risk attitude (Study 2).

Independent variables	Step 1 Standardized coefficients (β)	Step 2 Standardized coefficients (β)
Age	−.059	−.033
Gender	.100	.090
Driving age	.028	.051
Profession	.127*	.110*
Mood-dejection		.218*
Mood-anger		.037
Mood-vigor		.001
F	2.135	8.355**
Adjusted *R* square	.011	.064

* $p < .05$.
** $p < .01$.

Table 5
Mediation analysis with risky driving behavior as dependent variable (Study 2).

Independent variables	Step 1 Standardized coefficients (β)	Step 2 Standardized coefficients (β)	Step 3 Standardized coefficients (β)
Age	−.065	−.011	−.001
Gender	.019	−.005	−.029
Driving age	−.111*	−.055	−.069
Profession	.163**	.130**	.101*
Mood-dejection		.570**	.506**
Driving risk attitude		.	.261**
F	6.203**	196.650**	43.605**
Adjusted *R* square	.050	.366	.428

* $p < .05$.
** $p < .01$.

Secondly, the coefficient between mood and risk perception was negative, which meant that more negative moods would lead to higher risk perception. This was also similar to the results in Study 1. The perception of traffic risk may be shadowed by the cognitive nature of affective state. An odd result in the final model was that risk perception was positively related to risky driving behavior. It seemed unreasonable that those who were aware of the danger would still approach it. The reason behind that may be that Study 2 was a cross-sectional design and causal relationship could hardly be determined. People may first remember the dangerous behavior in driving and then raise the perception of traffic risk.

4. General discussion

Through two different kinds of methods, we tried to give a comprehensive picture about how two affective states (emotion and mood) influence drivers' traffic-related cognition and behavior. In Study 1, we found that drivers with negative

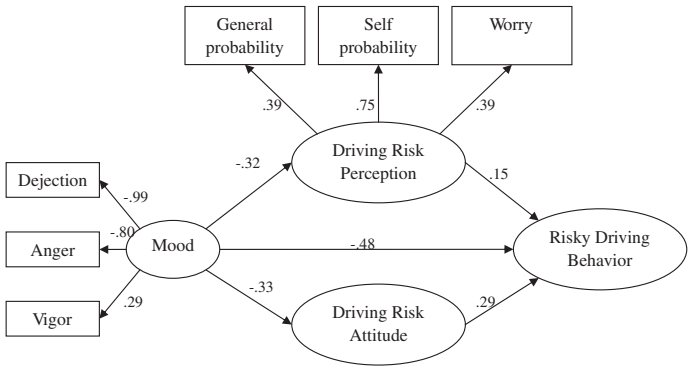

Fig. 6. The tested model in Study 2.

emotion showed a raised perception of traffic risk compared with those with positive emotion or neutral emotion. However, such a comparatively larger perception resulted in a higher receptivity of risky driving (attitude), and a higher attitude toward risky driving was closely related to higher tendency of risky driving. In Study 2, a more negative mood also resulted in a higher risk perception, a higher attitude toward risky driving and a higher self-reported risky driving.

In this research, there were two main ways that emotion or mood passed on its influence. One of them was that through driving risk attitude. The two studies in the research both showed that negative affect would destroy drivers' rational judgment and drivers were more likely to consider risky driving as acceptable. Moreover, such change in attitude did result in driving behavior (speeding in Study 1 and dangerous driving in Study 2). As discussed in Study 1, this may represent a kind of self-regulatory failure. Another explanation might be the mood maintenance hypothesis (Isen, Nygren, & Ashby, 1988). When people are not happy, they would try their best to get away from such a state. So they usually turn to the riskier choice for the possible high reward (Hocey, Maule, Clough, & Bdzola, 2000). When this applies to depressed or angry drivers, some specific "rewards" offered by risky driving (e.g. joy-riding, time-saving) would pop out. Considering the close relationship between driving risk attitude and risky driving, this pathway seems more instant.

Another pathway was through risk perception. The results in the two studies were both consistent with the basic cognitive theory of emotion. Drivers' perception on traffic risk was linked with the appraisal nature of affective states. However, traffic risk perception in this research did not have a close relationship with risky driving behavior, suggesting that this pathway may involve a "time-delay" and may be clearer in the long run. It is likely that these two cognitive pathways could both exist and time might be imported as an important variable.

In both studies, we found that negative affect showed a stronger effect than positive affect. This result confirmed the assertion made by Baumeister, Bratslavsky, Finkenauer, and Vohs (2001) that "bad is stronger than good". In Study 1, negative emotion induced by a traffic-unrelated negative video successfully raised drivers' perception of traffic risk, while in Study 2 negative mood showed a stronger effect on drivers' attitude toward risky driving and self-reported risky driving behavior. A study in consumer research also found that negative emotion in consumption was the "single most important predictor of perceived risk" (Chaudhuri, 1997). From these results we could infer that negative affect helped in raising people's risk perception, but such effect was not immediately manifested on behavior. On the other hand, the unsafe effect of negative affect on risky driving attitude would immediately transformed to behavioral effect. Thus it is reasonable to use negative appeal in traffic safe education for its potential effect in shaping people's safe driving behavior, while we could not ignore the "on-road" effect of negative affect. It would be better to warn the drivers that do not carry negative emotion onto road in case "bad is stronger than good". Moreover, the phenomenon that "bad is stronger than good" also imply that negative affect might be more complicated than positive affect. It is necessary for future research to explore more deeply specific negative emotions and to find out how these effects might "sum up" to influence the whole driving process.

Moreover, Study 1 showed that although the video clip about traffic accidents successfully induced drivers' negative emotion, such emotional arousal could not alarm drivers sufficiently, so we might be careful in selecting advertising materials. If we just want to give people a certain degree of shock in emotion, videos about serious accidents are useful. But accidents of moderate severity may be more relevant to people themselves as well as their everyday life and thus more effective in serving the goal of changing people's cognition and behavior. It may be important in decision making to consider the association between emotion-inducing materials and objects of risk perception. Comparisons of traffic-related/-unrelated positive and negative emotions need to be systematically studied in future research. For example, if people believe negative traffic events (e.g., a severe accident) are less likely happen to themselves (leading to ineffective safety education), a positive traffic event (e.g. surviving due to fastened seat-belt) might be considered as more likely to occur to oneself and thus more persuasive. As we have mentioned before, such association might have something to do with the relevance to self. Thus potential theoretical contributions might exist in the endeavor of classifying emotions from this point.

One limitation of this research is that both studies were cross-sectional. The results of Study 1, which was an experimental design, were possibly free of such limitation because emotion induction has been confirmed as a valid method. The causal

relationship, however, was insufficiently proved in Study 2. Longitudinal research is needed to offer more solid conclusions about these results and the two pathways (instant and long-term) of the effect of emotion could be tested. Another limitation is that the emotion was induced in lab-setting. The effect of emotion might fade in a short period of time, which prevented us from precisely revealing the effect of emotion in real driving. The measure of driving behavior (speed) was also quite simple and future research could explore the effects on speeding need under different road types and conditions as well as under different levels of speed limit. More verification of the results would be achieved through on-road experiments.

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