Focusing on appraisals: How and why anger and fear influence driving risk perception

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ABSTRACT

I d c i : The present research explores how and why anger and fear influence driving risk perception. *Me h d :* Based on appraisal tendency framework, researchers hypothesized that anger and fear would influence driving risk perception in opposite directions due to their differences in appraisals. *Re :* Study 1 showed that anger reduced risk perception, whereas fear increased it. In Studies 2, 3, and 4, the researchers adopted the paradigm of reappraisal to investigate the causes of the opposite effects found in Study 1. Consistent with our hypothesis, appraisals accounted for these effects: After reappraisals along the dimensions of certainty (Study 2), control (Study 3), and responsibility (Study 4), the different effects between anger and fear on driving risk perception diminished or disappeared. In addition, fearful or angry experience mediated the effects of reappraisals on driving risk perception. *I ac i d :* The findings highlight the necessity to differentiate anger and fear in road safety management. Additionally, the current research also provides feasible methods (e.g., certainty, control, or responsibility reappraisal) to intervene in driving risk perception, which is important for driving safety.

The increasing number of traffic accidents all over the world (Bureau of Traffic Management, PRC, 2011; United Nations Economic Commission for Europe, 2011) heightens the need for identifying the causes of driving risk. A large volume of studies describe the significant role of emotion and its effects on driving (e.g., Deffenbacher, Lynch, Oetting, & Yingling, 2001; Hu, Xie, & Li, 2013; Mesken, Hagenzieker, Rothengatter, & de Waard,

There are two competing theories for the roles of anger and fear on risk perception. Scholars from a *valence-based perspective* advocated labeling emotions as either positive or negative, and examining these valence effects on risk perception. Key findings from this approach were that negative emotions elevated risk perception, whereas positive ones decreased it (Johnson & Tversky, 1983). Applying this perspective into driving research, researchers found similar results such that negative emotions increased risk perception compared with positive and neutral ones (Hu et al., 2013). From these results, however, it is difficult to draw a distinct line between anger and fear, as both are categorized as negative emotions. All we can do is to assume that because both anger and fear belong to negative emotions, they would similarly elevate driving risk perception.

By contrast, *appraisal tendency framework* (ATF; Han, Lerner, & Keltner, 2007; Lerner & Keltner, 2000, 2001), which contends that the research focus should be put on specific emotions beyond valence, makes the exactly opposite predictions. ATF presumes that though of the same valence, anger and fear differently affect risk perception. For instance, anger promoted more optimistic assessments for future events relative to fear (Lerner & Keltner, 2000). These findings were replicated in both laboratory and field studies (Fischhoff, Gonzalez, Lerner, & Small, 2012; Lerner, Gonzalez, Small, & Fischhoff, 2003; Lerner & Keltner, 2001). In line with ATF, fearful drivers should be prone to feel higher risk levels; angry drivers, however, may feel lower risk levels. Consistent with this prediction, anger was found to induce poor driving behaviors (e.g., Abdu, Shinar, & Meiran, 2012; Arnett, Offer, & Fine, 1997; Mesken et al., 2007) and cause accidents (Underwood, Chapman, Wright, & Crundall, 1999).

2. Why anger and fear differently influence risk perception

Why do the aforementioned opposite effects emerge such that anger reduces driving risk perception whereas fear increases it? According to ATF, an emotion is triggered by certain appraisals of an event (Han et al., 2007; Lerner & Keltner, 2000, 2001). More exactly, each emotion differs on the appraisals of certainty, control, pleasantness, attentional activity, anticipated effort, and responsibility (Ellsworth & Smith, 1988; Smith & Ellsworth, 1985). Such appraisals, in turn, determine how people with a specific emotion make future judgment (Han et al., 2007; Lerner & Keltner, 2000, 2001). The differences between two emotions in appraisals contribute to their differential effects on subsequent perception (Han et al., 2007; see also Bonifield & Cole, 2007; Winterich, Han, & Lerner, 2010; see the central panel in Fig. 1 for a conceptual model).

Regarding anger and fear, ATF assumes that they are located differently on the dimensions of certainty and control (Lerner & Keltner, 2000, 2001; Smith & Ellsworth, 1985). *Certainty* refers to the extent to which individuals perceive a situation as predictable or unpredictable. *Control* refers to the degree to which the cause of an outcome can be attributed to individual or situational factors (Lerner & Keltner, 2000; Smith & Ellsworth, 1985). Past research found that high certainty and individual control are associated with anger, whereas uncertainty and situational control are connected with fear (Lerner & Keltner, 2000; Smith & Ellsworth, 1985). In addition, one of the characteristics of uncertainty is unobservable, which is also a feature of high unknown risk in Slovic's (1987) "two-factor model". Situational control, however, contributes to high dread risk. Therefore, anger appears to reduce risk perception whereas fear increases the perception of risk.

Notably, ATF overlooks the difference between anger and fear in the appraisal of *responsibility*, which accounts for who (self vs. others) should be responsible for initiating an emotion-inductive event (Lerner & Keltner, 2000; Smith & Ellsworth, 1985). Although both responsibility and control identify the cause of an event, they are indeed different by definitions. In particular, control differentiates individual and situational factors, whereas responsibility focuses only on the individual factors and identifies self or other as the causes. Smith and Ellsworth (1985) showed that angry people were high in other-responsibility, whereas fearful ones were only moderately high. Notably, high other-responsibility means a

Emotion regulation model (Gross, 1998a)
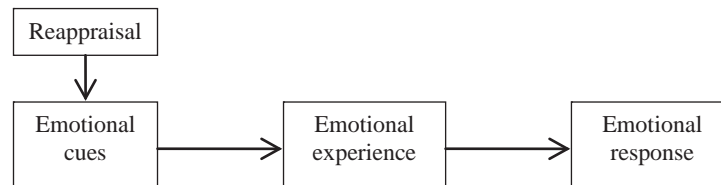
Conceptual model of the present research
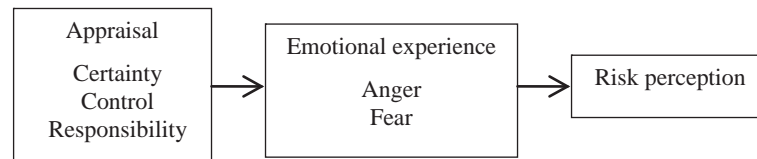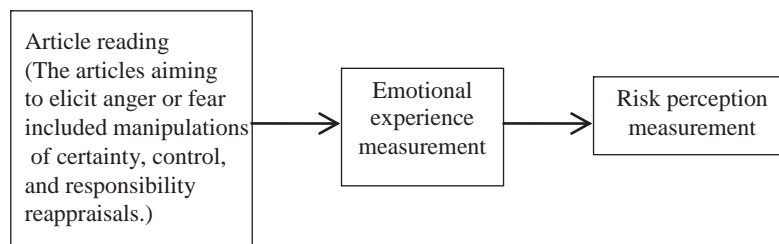
Main procedure of the present research

Fig. 1. Appraisal, reappraisal, emotional experience, and risk perception.

definite cause of an event, thus it is characterized by voluntary, which reduces dread risk. Therefore, we hypothesize that angry people would perceive less risk than fearful ones.

Based on the above reasoning, we assume that the opposite effects of anger and fear on risk perception are attributable to the differences between the two emotions in the appraisals of certainty, control, and responsibility. Lerner and Keltner (2001) evidenced the role of control but failed to verify the effects of certainty and responsibility. The current research aims to provide evidence for the roles of certainty, control, and responsibility in determining the ways that anger and fear influence driving risk perception.

3. The present research

The goals of the present research were twofold: to examine the opposing effects of anger and fear on driving risk perception and to explore the underlying causes for these effects. Specifically, we hypothesized that the differences between anger and fear in the appraisals of certainty, control, and responsibility led to the opposite effects. To this end, we experimentally manipulated certainty, control, and responsibility in order to diminish the differences between anger and fear in such appraisals. If the opposite effects were caused by appraisals, we predicted that the emotional experience of anger or fear would be weakened after manipulations on these appraisals, and that this would lead to lessening or complete elimination of difference in risk perception.

Inspired by the literature of emotion regulation, we adopted the reappraisal paradigm to manipulate appraisals. *Reappraisal*, by which individuals cognitively reevaluate an event so that they experience less emotional responses (Gross, 1998a), is one of the commonly used strategies in emotion regulation (e.g., Blechert, Sheppes, Di Tella, Williams, & Gross, 2012; Denson, Grisham, & Moulds, 2011; Gross, 1998a; Gross & John, 2003; McRae, Ciesielski, & Gross, 2012; Shiota & Levenson, 2012; Urry, 2009). It is noteworthy that reappraisal is characterized by its decreasing impacts on both emotional experience and behavioral expression (Gross, 1998a,b, 2001). Thus, when encountering an emotion-inductive event, the emotional response of people who reappraise an event is less strong than that of those who do not. The weakened experience of emotion then leads to less behavioral response (see the upper panel in Fig. 1 for emotion regulation model proposed by Gross, 1998a). Following this logic, we asked drivers to imagine an anger/fear-inductive event and then reappraise the situations along the dimensions of certainty, control, and responsibility. If appraisals accounted for the opposite effects of anger and fear on risk perception, the change in appraisals would bring about the change in emotional experience, and thus, risk perception.

To summarize, we aimed to examine the opposing effects of anger and fear on driving risk perception in Study 1. Specifically, drivers were primed with anger, fear, or neutral emotion, and their driving risk perception was assessed. In line with ATF, we hypothesized that anger would reduce risk perception, whereas fear would increase it. Study 2 (certainty), Study 3 (control), and Study 4 (responsibility) examined the roles of appraisals by employing the paradigm of reappraisal. Drivers were asked to read the articles aiming to elicit anger or fear, with or without reappraisal instructions. Both emotional experience and driving risk perception were measured (see the bottom panel in Fig. 1). We hypothesized that the difference between anger and fear on risk perception would no longer exist or at least be reduced after certain reappraisals, and that emotional experience mediated the relationship between reappraisal and risk perception.

4. Study 1: The opposite effects of anger and fear

We aimed to explore how anger and fear influence driving risk perception. Driver participants were randomly assigned to anger, fear, or neutral condition, and their risk perception including both cognitive and affective components (Rundmo & Sjöberg, 1998) was assessed.

We hypothesized that compared with neutral emotion, anger reduced risk perception but fear increased it.

4.1. Method

4.1.1. Participants and design

Ninety-seven drivers (55 men, 42 women, $M_{age} = 35.61$ years, $SD = 9.81$, $M_{driving\ experience} = 5.59$ years, $SD = 4.38$) participated. A one-factor between-participants design was employed, with primed emotion (anger/neutral/fear) serving as the independent variable and risk perception serving as the dependent variable. Control variables included age, gender, driving experience, type of profession, level of education, type of vehicles, average weekly driving miles, average weekly driving days, and the number of traffic accidents in the past year.

4.1.2. Emotion induction

Short articles were used to elicit emotions (Hemenover & Zhang, 2004; Raghunathan & Pham, 1999). Participants were randomly assigned to one of the three following conditions: anger ($N = 34$), fear ($N = 34$), or neutral ($N = 29$). In the anger condition, the article was about conflict between another driver and "I". Participants were required to read as the following part:

> *I have been driving in the traffic of one half half an hour. At an ... traffic ..., a car of the ... ..., which has been driving at a ... speed, a far ... difference in ... if ... fear ... and ... if ... in ... a ... I have ... be a ... ge ... and ... against the car. I ... driving a ... needed ... e ... that I ... be in the ... traffic. Finally, getting a chance, I needed a ... diea ... the car. As he ... e ... facing the car, I ... a ... the ... driver, ... he ... driving in the car ... he ... hard, with ... ... that he had been in fleeing the traffic. His ... ca ... de ... e ... have ... a be a ... a. The ... in the ... traffic a ... and I have ... a ... a ... age ... a far a ... A ... hi ... ie, the car behind ... begin ... high ... a ... flash in the car a ... The car ... igh ... reflected in the ... rear ... a ... e ha ... a ... d he ... d ... ie ... f he ... h ... b ... he ... e ... gea ... I a ... reaching he ... i ... f ... a ... ie ... ce. De ... ie he ... be ... d, I ... d ... eed ... a ... e ... f ... he ca ... beca ... e ... f he ... ied ... ad c ... di ... i ... I have ... ed ... e he ... de ge ... f he ca ... behind ... e. When I ge a cha ... ce ... ga ... ce bac ... a he ca ... igh behind ... e, I fi ... d ... ha ... i ... he ... ca ... ha ... I ... e ... a ... ed a ... hi ... e ... ag ... and igh a ... ha ... e ... ... he die ... f he ca ... i ... ig igh ... a ... e. Wi ... ha ... agg ... e ... ie a ... d di ... dai ... f ... ... , he e ... e ... he ... i ... d ... ad c ... ea ... e...*

In the fear condition, the article was about a traffic accident. Participants read about:

> *O ... he a ... bac ... he ci ... f ... a da ... i ..., I a ... d ... i ... g ... a ... i di ... g ... ai ... ad. Righ ... a ... he ... e ... f ... ai ... ga ..., a ... fa ... dde ..., I hea ... a ... gea ... d "B ... b!" A ... d he ... fi ... e ... d ... a ... c ... ea ... i ... g. I fee ... ha ... e ... e hi ... e ... hi ... g ... e ... e ... a ... d ... e ... begi ... c ... a ... h ... d ... he ... hi ... . The ... I ... e ... c ... ci ... e ... a ... d ca ... eca ... a ... hi ... ge ... e ... afe ... a ... d. Afe ... I ... e ... ie ..., I fee ... ic ... a ... e ... a ... d he ... I ... ea ... e ... ha ... i ... i ... a ... b ... d. I a ... c ... eed a ... d ... ded b ... iece ... f b ... e ... ga ... e ... . The ca ... d ... a ... e ... ... i ... ed. M ... eg a ... e ... ci ... he ca ... . I ca ... ... ea ... i ... h ... ... ch. I fee ... he ... i ... f ... ai ... a ... e ... a ... d ca ... ... ee a ... hi ... ga ... e ... . I ca ... ... hea ... ha ... f ... ie ... d a ... e ... a ... i ... g; ... e ... f he ... a ... e ... be a ... hi ... g ... hea ... i ... . I ... ... a ... he ..., b ... I a ... ... ha ... f ... c ... ci ... a ... d i ... e ... e ... f ... di ... g ... . I ... ic ... e ... e ... da ... i ... ide ... he ca ... . A ... I hea ... i ... he ... a ... f ... ai ... a ... da ... I ... e ... i ... he ... i ... ed ... ai ... f b ... d ... a ... d ... d. I d ... ... he e I a ..., h ... bad ... I a ... i ... ed, h ... ... fi ... ed ... a ... e ... di ... g. S ... dde ..., he ca ... ha ... e ... i ... h ... gea ... f ... ce. I ... ee ... hea ... he ... ... d ... f b ... a ... che ... b ... ea ... i ... g ... ff. I ... ee ... ... ha ... he ca ... i ... ha ... gi ... gi ... g ... he ... idde ... f he ... ... a ... d ... i ... fa ...*

ff a a   e .I a ca i h   e e a igh bea   f igh , ife
dea h ee   be a   a e f fa e…

In the neutral condition, participants read an introduction about the library of Peking University. Presented in Chinese, all the passages were approximately of the same length. In the conditions of anger and fear, participants were asked to imagine that they were the heroes in the story and to vividly experience the events of the story.

4.1.3. P ced e

Participants first took the emotion baseline test. Immediately after reading the articles and completing the manipulation checks, they took measures of risk perception and filled in a questionnaire about the control variables. At last, they were thanked and debriefed.

4.2. Mea e

4.2.1. E i ba e i e

Participants rated their emotion on 11-points scales (ea a -ea a , e e- ea ed, ig   - i ed, and fee i g bad-fee i g g d; Hu et al., 2013; Cronbach's $\alpha = .80$). The average score of the 4 items was used as the index of emotion baseline.

4.2.2. Ma i a i chec

Participants reported how much they felt angry and fearful respectively on an 11-point scale ($0 = d$ fee he e i a a , $10 = fee$ he e i e e   g) after reading the articles.

4.2.3. Ri   e ce i

Participants were presented with three traffic accidents with different causes (i.e., alcohol, speeding, or jumping a red light). For each accident, they rated the probability to be involved in ($0 = e e e   i e$, $10 = e e e i e$) and the level of their worry about it ($0 = d$ a a , $10 = e e e$) on 11-point scales. The average score of the 6 items was used as the index of risk perception (Cronbach's αs of the overall scale and two subscales were .84, .74, and .84). Higher scores indicated higher risk perception.

4.3. Re   a d di c i

A one-way analysis of variance (ANOVA) on emotion baseline revealed no significant difference among the anger ($M = .63$, $SD = 2.10$), fear ($M = 1.05$, $SD = 1.52$), and neutral ($M = 1.29$, $SD = 1.60$) conditions, $> .30$, indicating that participants in three conditions did not differ in emotion baseline. Moreover, a one-way ANOVA was conducted on manipulation checks. Results revealed that participants in the three conditions differed in both anger and fear, $F(2, 94) = 87.28$, $< .001$, $F(2, 94) = 120.15$, $< .001$. Specifically, participants in the anger condition ($M = 6.50$, $SD = 1.73$) felt more angry than those in the fear ($M = 2.00$, $SD = 2.54$) and neutral ($M = .28$, $SD = 1.31$) conditions (s $< .001$). In addition, participants in the fear condition ($M = 6.21$, $SD = 1.95$) felt more fearful than those in the anger ($M = 1.38$, $SD = 1.95$) and neutral ($M = .14$, $SD = .58$) conditions (s $< .001$). Therefore, the results demonstrated a successful manipulation of emotion induction.

Next, Pearson correlation tests showed that risk perception was influenced by gender ($= -.26$, $< .05$) alone among all control variables: Men drivers perceived more risks than women drivers. Most importantly, after controlling for gender, $F(1, 93) = 8.43$, $< .01$, $\eta^2 = .08$, risk perception was affected by emotion, $F(2, 93) = 31.16$, $< .001$, $\eta^2 = .40$. Specifically, fearful participants ($M = 5.67$, $SD = 1.61$) had higher scores than neutral ones ($M = 4.42$, $SD = 1.40$), $MD = 1.25$, $< .001$, whereas angry participants ($M = 3.03$, $SD = 1.15$) had lower scores than neutral ones, $MD = -1.34$, $< .001$. As hypothesized, anger reduced driving risk perception, whereas fear increased it, highlighting the significance of distinguishing anger and fear in driving scenarios.

It should be noted that regarding the assessment of risk perception, participants rated the possibility that they were involved in the traffic accidents caused by factors such as alcohol. Nevertheless, some drivers never drink but others drink frequently. To ensure that different levels of risk perception were caused by the discrete emotions per se rather than other factors such as the frequency of drinking, three accidents described by severity of consequences were adopted in the subsequent studies. Moreover, Study 1 showed that risk perception was influenced by gender alone among the multiple control variables, making it reasonable to exclude all other control variables in the subsequent studies.

5. S d 2: The   e f ce ai

In Study 2, we focused on the role of certainty in the opposite effects found in Study 1. We attempted to verify that certainty was one of the causes that are responsible for such opposite effects. Drivers were instructed to read the emotion-inductive articles. Before the emotions had been fully generated, we adopted the reappraisal paradigm in order to reduce the difference in certainty between anger and fear. More specifically, participants reading the conflict article were asked to reappraise the situation in order to reduce their sense of certainty. To the opposite, those reading the accident article were asked to reevaluate the situation to increase their sense of certainty. According to our reasoning, the reappraisal task would reduce emotion experiential responding (i.e., people felt less angry or less fearful), which in turn diminished the difference between anger and fear on risk perception.

5.1. Me h d

5.1.1. Pa ici a   a d de ig

One-hundred and fourteen drivers (66 men, 45 women, 3 unreported, $M_{age} = 35.57$ years, $SD = 8.97$) were randomly assigned to conditions in a 2 (emotion: anger/fear) × 2 (certainty regulation: reappraisal/non-reappraisal) between-participants design. Risk perception served as the dependent variable, emotional experience served as the potential mediator, and gender served as the control variable.

5.1.2. Ma i a i   f i de e de   a iab e

Participants in the anger ($N = 54$) and fear ($N = 60$) conditions read the articles used in Study 1. Immediately after, participants in the anger-reappraisal condition ($N = 28$) read about:

A he   e , I c e bac i h he ia i . Q i ec   a
e ec a i   ha he die   d a   a ei g i h e, he d e
*　gi e a   e e e. I a   de i g: I he c flic fi i hed?*
O i he   i g f a he cha ce " e e ge" e? I fac , I ha e
idea ha he i d a d I ca   edic ha   d ha e
af e   a d .

However, participants in the fear-reappraisal condition ($N = 30$) read about:

A he   e , I a   e ha I c ea hea he i e   f he
a b a ce a d ha he i e a e a   achi g he   e a e. The e-
f e, I f   e ha   f ie d a d I i be e c ed.

5.1.3. P ced e

Participants first took the emotion baseline test. Next, they were asked to read the articles. Afterwards, they took measures of emotional experience, risk perception and they completed manipulation checks. Finally, participants filled in a questionnaire about their demographic information and then they were thanked and debriefed. They were offered chances to win a cell phone card with a value of 50 RMB (renminbi).

5.2. Mea e

5.2.1. E   i   ba e i e
Identical to Study 1 (Cronbach's α = .84).

5.2.2. E   i a e e ie ce
Participants rated how much they felt angry and fearful after reading the materials on an 11-points scale (0 = *d   fee he e   i a a* , 10 = *fee he e   i   e   e e   g*).

5.2.3. Ri   e ce i
According to Hu et al. (2013), participants were presented with three traffic accidents of different levels, which were serious, moderate and slight. A brief description was provided for each level of accidents. Participants rated their risk perception, which was identical to Study 1 (Cronbach's αs of the overall scale and two subscales were .68, .56, and .69).

5.2.4. Ma i   a i   chec
In the anger condition, participants rated the extent to which they could predict what would happen between the other driver and them. Likewise, in the fear condition, they indicated the extent to which they could predict that their friends and themselves would be finally rescued on an 11-point scale (0 = *ab e   edic* , 10 = *f edic*).

5.3. Re   a d di c i

Before emotion induction, participants in the anger and fear condi-

6.2. Mea e

6.2.1. E   i   ba e i e
Identical to Study 1 (Cronbach's $\alpha = .84$).

6.2.2. E   i   a e   e ie ce
Identical to Study 2.

6.2.3. Ri   e ce i
Identical to Study 2 (Cronbach's αs of the overall scale and two subscales were .71, .54, and .69).

6.2.4. Ma i   a i   chec
In the anger condition, participants rated the extent to which the driver's aggressive behavior was controlled by individual. Likewise, in the fear condition, participants indicated the degree to which the life of their friends and theirs could be controlled by individual on an 11-point scale ($0 = i$ a i   a c   , $10 = i$ di id a c   ).

6.3. Re   a d di c   i

Participants in the anger and fear conditions did not differ in emotion baseline, $> .10$. Furthermore, a 2 (emotion) $\times$ 2 (control regulation) ANOVA on manipulation checks revealed a main effect for emotion, $F(1, 110) = 9.36$, $< .01$, $\eta^2 = .08$. In general, angry drivers ($M = 5.11$, $SD = 3.04$) were more apt to feel individual control compared with fearful ones ($M = 3.68$, $SD = 2.86$). More importantly, an interaction between emotion and control regulation was obtained, $F(1, 110) = 42.13$, $< .001$, $\eta^2 = .28$. Specifically, in the anger condition, people who reappraised the situation ($M = 3.85$, $SD = 3.09$) perceived less individual control than those who did not ($M = 6.32$, $SD = 2.50$), $F(1, 53) = 10.70$, $< .01$. However, in the fear condition, people who reappraised the situation ($M = 5.47$, $SD = 2.65$) perceived more individual control than those who did not ($M = 1.83$, $SD = 1.63$), $F(1, 57) = 40.10$, $< .001$. The results revealed a successful control manipulation.

Next, a mediation analysis was conducted for angry drivers and we did not find a mediation effect of angry experience between control reappraisal and risk perception. A similar mediation analysis was conducted for fearful drivers. As a result, fearful experience partially mediated the relationship between control reappraisal and risk perception (Sobel test, $Z = -1.64$, $< .05$). We depict the mediation results in Fig. 4. The results suggested that control appraisal was more crucial to fear than anger.

Last, we examined whether control reappraisal could reduce the difference between anger and fear on risk perception. A Pearson correlation analysis revealed that gender did not correlate to risk perception, $> .40$. A 2 (emotion) $\times$ 2 (control regulation) ANOVA on risk perception yielded a main effect for emotion, F

not (55%), χ^2 (1, $N=43)=3.87$, $<.05$. These results indicated that the responsibility regulation was effective.

Next, we conducted a mediation analysis for angry drivers. It was found that angry experience partially mediated the relationship between responsibility reappraisal and risk perception (Sobel test, $Z=2.33$, $<.05$). We depict the mediation results in Fig. 6. Next, a similar mediation analysis was performed for fearful drivers and we found that fearful experience did not play a mediation role. The reason for the results was that responsibility was a central appraisal for anger rather than fear (Lerner & Keltner, 2000; Smith & Ellsworth, 1985).

Last, we examined whether responsibility reappraisal reduced the difference between anger and fear on risk perception. A Pearson correlation test revealed no significant correlation between gender and risk perception, $>.60$. A 2 (emotion) $\times$ 2 (responsibility regulation) ANOVA on risk perception revealed main effects for both emotion and responsibility regulation, $F(1, 84)=80.13$, $<.001$, $\eta^2=.49$, $F(1, 84)=8.94$, $<.01$, $\eta^2=.10$, demonstrating that fearful people ($M=4.88$, $SD=1.09$) were higher in risk perception than angry ones ($M=3.17$, $SD=1.15$), and that participants in the reappraisal condition ($M=4.27$, $SD=1.06$) were higher in risk perception than those in the non-reappraisal condition ($M=3.68$, $SD=1.69$). Of our particular interest, there was an interaction between emotion and responsibility regulation, $F(1, 84)=26.74$, $<.001$, $\eta^2=.24$ (see Fig. 7). Specifically, in the non-reappraisal condition, angry people perceived less risk ($M=2.25$, $SD=0.76$) compared with fearful ones ($M=5.12$, $SD=0.10$), $F(1, 38)=104.95$, $<.001$. In the reappraisal condition, however, the difference between anger ($M=3.91$, $SD=0.85$) and fear ($M=4.67$, $SD=1.14$) diminished, $F(1, 46)=7.10$, $<.05$. Therefore, responsibility partially accounted for the opposite effects found in Study 1.

8. After test: Certainty, control, and responsibility

Although the scenarios were successful in changing the target appraisals in Studies 2, 3, and 4, it was difficult to find out whether other appraisals changed as well. Because an emotion can be experienced instantly and attenuates very quickly (Beedie, Terry, & Lane, 2005), to ensure the induced emotion could last until the experiments were completed, it was better not to include too many measures in one study. Here, an after test was conducted to ensure other appraisals were held constant during certain reappraisals.

8.1. Method

8.1.1. Participants and design

Seventy-seven students were randomly assigned to one of six conditions: anger-certainty, anger-control, anger-responsibility, fear-certainty, fear-control, or fear-responsibility.

8.1.2. Measures and procedure

Participants first read the emotion-inductive articles (identical to Study 1) and completed the measures of certainty, control, and responsibility (used in Studies 2, 3, and 4, respectively). After reappraising certain dimensions (identical to Studies 2, 3, and 4), they received the same measures of certainty, control, and responsibility again.

8.2. Results and discussion

Paired-sample tests showed that for anger-certainty, anger-control, anger-responsibility, fear-certainty, and fear-responsibility groups, the target appraisals changed ($s<.01$) whereas other appraisals were held constant ($s>.05$) as predicted. The only exception was the fear-control group. The target appraisal of control changed as predicted, $(15)=-5.26$, $<.001$, and responsibility was held constant, $>.30$. However, certainty changed as well, $(15)=-2.67$, $<.05$. Generally, the results indicated a success in changing the target appraisals and holding others constant. It was somewhat surprising at first glance

We demonstrated that driving risk perception was influenced by appraisals. In other words, people used their senses of certainty, control, and responsibility as information to appraise risk. This logic corresponds with feelings as information hypothesis (Schwarz, 2004) and risk as feelings hypothesis (Loewenstein et al., 2001), which assume that people judge risks based on their present feelings. In current studies, we found that people attended to their emotions (anger or fear) and senses of appraisals (certainty, control, and responsibility) underlying the emotions to judge driving risks.

Here is another question: Are there any key appraisals for anger and fear, respectively? On the one hand, we found that fearful experience mediated the effects of certainty and control reappraisals on risk perception, whereas angry experience mediated the relationship between responsibility reappraisal and risk perception. On the other hand, reappraisals of certainty and control changed risk perception more for fearful drivers than angry ones, whereas the reappraisal of responsibility changed risk perception more for angry drivers than fearful ones. Taken together, we suggest that responsibility is a central appraisal for anger; however, certainty and control are key appraisals for fear.

One major limitation of this research was that anger and fear were elicited by different materials. The same held true for the texts in reappraisals. However, using different materials to induce different emotions is a common way in emotion research. For example, participants were instructed to recall an experience in which they feel a specific emotion (Lerner & Keltner, 2001) or watch a video clip to induce positive or negative emotions (Hu et al., 2013). It is difficult to use a same story to elicit different emotions. As for the texts in reappraisals, it also seems to be impossible to use the same reappraisal instructions that should be coherent with emotion-inductive stories. Concerning about this, future research should adopt a stricter manipulation of emotions and reappraisals.

A further problem was that different risk perception in the anger and fear conditions might be caused by priming stories rather than emotions per se. The priming article for fear included a traffic accident whereas the article for anger did not. The conceptual accessibility to accident for fearful drivers may result in higher risk perception. However, the results of Studies 2, 3, and 4 supported that emotions themselves did influence risk perception. For participants in the anger condition, they read almost identical materials no matter whether they reappraised the event or not. Nevertheless, people in the reappraisal and non-reappraisal conditions reported different risk perception. The reason for such results was that emotional experience reduced by reappraisals affected risk perception. It was same for the fearful participants. Thus, the above results showed that the specific emotions themselves did influence driving risk perception.

Furthermore, some may wonder whether the changes of risk perception in Studies 2, 3, and 4 were actually caused by reappraisal or by another emotion regulation strategy named suppression. Reappraisal and suppression cast different effects on cognitive appraisals and behavioral responses (Gross, 1998a,b). Reappraisal changes both cognitive appraisals and responses, whereas suppression only influences affective responses. The results of manipulation checks demonstrated changes of certainty, control, and responsibility, indicating participants used the strategy of reappraisal rather than suppression.

We contribute to the research in how emotions color judgment in several ways. First, we introduced ATF into driving behavior and found that the opposite effects of anger and fear on driving risk perception. Thus, the current findings demonstrate the importance to differentiate fear and anger rather than treat them equally. Second, we focused on the antecedent of emotions, that is, appraisals and then explored the reasons of the opposite effects. To this end, experimental manipulations of appraisals are badly needed. Unfortunately, rarely had researchers used this kind of methods. However, paradigm of reappraisal enabled us to do so. Our findings derived from new methods supplied ATF with further support. Finally, we shed light on the appraisal of responsibility in distinguishing anger and fear. Certainty and control are two appraisals used to distinguish anger and fear (Fischhoff et al., 2012; Lerner & Keltner, 2000, 2001). However, responsibility is also an important dimension based on the fact that J0-1.y 13rception355.4(0hems)TJ-nsib reapp-26.2(J0--266.63a)-21t-29ency.

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