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Anger and intertemporal choice: The behavioral approach system and the interactive effects of trait and state anger

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ABSTRACT

This study investigated the effects of anger on intertemporal choice from three dimensions: state anger, trait anger, and the behavioral approach motivation system (BAS). Also, the study tested whether a delayed larger (LL) reward is risky compared to an immediate smaller (SS) reward. Participants ($N = 160$) were randomly assigned to either the anger or the neutral condition. Results showed that people with higher BAS scores tended to prefer a SS reward over a LL reward when they were in a temporarily angry mood. Furthermore, results presented an interactive effect between trait and state anger on choice preference for SS rewards in the anger condition. In addition, a negative relationship was shown between the individuals' preference for SS rewards and the individuals' preference for risky gains in decisions under uncertainty, which indicated that a future reward in intertemporal choice is risky. Both the effect of the BAS and the interactive effect between trait and state anger were explained from the perspective of risk preferences. These results suggest that both situational and biological-based affective information shape decisions and that the perspective of risk preference is the underlying mechanism for the impacts of emotions on decision-making.

1. Introduction

Incidental emotions, generated from sources unrelated to the decision-making tasks, influence subsequent decision-making processes. Considering people have differences in levels of dispositional affects (e.g., extroversion or trait anxiety), Loewenstein and Lerner (2003) state that a temporary emotional state and the corresponding dispositional affect may have an interactive impact on decision making. Recent studies on emotions and decision making have provided some evidence to support this view (Augustine & Larsen, 2011; Hirsh, Guindon, Morisano, & Peterson, 2010; Zhao, Cheng, Harris, & Vigo, 2015; Zhao, Childers, Sang, & Vigo, 2016a). For example, Hirsh et al. (2010) demonstrate that positive affect and extroversion interact together to influence intertemporal decision-making processes. Zhao et al. (2015) argue, however, that emotional state and the corresponding dispositional trait are not the only two factors that influence decision making. They further incorporate a behavioral motivation system, the conceptually neurological motivation system proposed in Gray's Reinforcement Sensitivity Theory (RST; Gray, 1982; Gray & McNaughton, 2000), into the study of anxiety and intertemporal choice. Holding that emotion can be better understood by considering the underlying dimensions (Barrett, 2006; Gray, 1994), we investigate the effects of anger on intertemporal choice from three dimensions: state anger, trait anger, and the behavioral motivation system.

According to the revised RST (Gray & McNaughton, 2000), three biologically-based behavioral motivation systems are present underlying behavior and affect: the behavioral approach system (BAS), the fight/flight/freeze system (FFFS), and the behavioral inhibition system (BIS). The BAS reacts to both conditioned and unconditioned positive stimuli, and facilitates appetitive behaviors. The BAS also generates positive affect and promotes feelings such as happiness, hope, and elation. On the other hand, the FFFS reacts to all aversive stimuli, conditioned and unconditioned, facilitates defensive behaviors (e.g., avoidance and freezing), and mediates the emotion of fear. The BIS works for the resolution of goal conflicts by inhibiting ongoing conflicting behaviors, engaging in risk assessment, and attending to the environment and memories which might help solve goal conflicts (Corr, 2009). This system is related to trait anxiety and the generation of anxiety.

By considering the behavioral motivation system, we may be able to better understand the effect of anger compared to other negative emotions (e.g., anxiety and fear). From the dimension of affective valence, anger is a negative emotion, the same as anxiety. However, from the dimension of motivational tendency, Harmon-Jones and his colleagues (Carver & Harmon-Jones, 2009; Harmon-Jones, 2007; Harmon-Jones & Allen, 1998; Harmon-Jones, Lueck, Fearn, & Harmon-Jones, 2006; Harmon-Jones, Sigelman, Bohlig, & Harmon-Jones, 2003) have provided neural evidence to support that both trait and state anger are related to approach motivation, and are dissimilar from anxiety. Thus, anger is

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related to the BAS which generally responds to positive stimuli and facilitates appetitive behaviors.

We have two reasons to hypothesize that individuals with a more sensitive reward system (i.e., the BAS) tend to choose immediate smaller (SS) rewards in intertemporal choice with a greater frequency than individuals with a less sensitive reward system when they are first in a temporarily angry mood (H1). First, Van Den Bergh, Dewitte, and Warlop (2008) demonstrate that men with higher BAS scores discount monetary rewards more steeply when they are first exposed to sex cues compared to men with lower BAS scores. This indicates a positive relationship between the sensitivity of the BAS and choice preference for SS rewards. Second, in intertemporal choice, a delayed larger (LL) reward is assumed riskier compared to a SS reward because the future is always riskier compared to the known present (Andreoni & Sprenger, 2012; Zhao et al., 2015). Considering that humans prefer sure gains over risky ones (Kahnman & Tversky, 1979), we argue that SS rewards is more appetitive compared to LL rewards. Thus, we reason that the BAS serves to urge people to approach SS rewards in intertemporal choice.

Dispositional affects tend to react in particular affective ways to a variety of events across time and situations (Frijda, 1994). Thus, the effect of induced anger on intertemporal choice may not be independent of trait anger. Lerner and Keltner (2001) demonstrate that angry individuals are as optimistic as happy individuals during risk assessment, as opposed to fearful individuals who are generally more risk-aversive. This indicates that individuals with higher levels of trait anger may, by nature, be more risk-taking. Moreover, recent studies demonstrate the interactive effects between emotional states and the corresponding dispositional traits on intertemporal choice (Hirsh et al., 2010; Zhao et al., 2015).

Hirsh et al. (2010) find that positive affect, eliciting from winning a puzzle game, moderates extroversion to shape subsequent intertemporal decisions. More specifically, for people in a low positive mood, extroverts show no significant difference in making a choice between a SS and a LL reward from non-extroverts. For people in a medium or high positive mood, extraverts tend to prefer a SS reward over a LL reward compared to non-extraverts. Furthermore, Hirsh et al. (2010) employ a "hot" motivational system (i.e., emotional arousal), appealing to the immediately available rewards, to explain the nature of the interactive effect between positive affect and extroversion (Metcalfe & Mischel, 1999).

Zhao et al. (2015) demonstrate that state and trait anxiety interact to influence choice preference for a SS reward in intertemporal decision making when people are first in a temporarily anxious state. Specifically, for people in a high anxious state, those with a high trait anxiety score tend to prefer a LL reward over a SS reward compared to those with a low trait anxiety score. For people in a low anxious state, those with a high trait anxiety score tend to prefer a SS reward over a LL reward compared to those with a low trait anxiety score. However, the psychological processes of a "hot" system was not applicable in explaining the interactive effect of state and trait anxiety because anxious people tend to prefer a LL reward when they are in a high anxious state (i.e., high emotional arousal). Instead, Zhao et al. (2015) propose the perspective of risk preference to explain the interactive finding of state and trait anxiety with the assumption that a future reward is risky compared to an immediate reward (Andreoni & Sprenger, 2012). When people are in a low anxious state, those with a high trait anxiety prefer SS rewards over LL rewards because trait anxiety is associated with risk-aversion (Eisenberg, Baron, & Seligman, 1998). Furthermore, since negative emotional states with high arousal lead to behaviors contrary to their risk tendencies, people with high trait anxiety tend to prefer LL rewards (i.e., high-risk-high-reward options) when they are in a high anxious state (Leith & Baumeister, 1996).

Based on Hirsh et al. (2010) and Zhao et al. (2015), we argue that the interactive effect between an emotional state and the corresponding dispositional affect on intertemporal choice may be a global effect, which mainly influences risk preferences toward choice options. Therefore, we hypothesize that trait anger moderates state anger to affect choice preference for SS rewards in intertemporal decision-making processes (H2). Considering the opposite risk tendencies between trait anger and trait anxiety, we specifically predict that for people in a high angry mood, those with high trait anger tend to prefer SS rewards over LL rewards compared to those with low trait anger, whereas for people in a low angry mood, those with high trait anger tend to prefer LL rewards compared to those with a low trait anger.

In addition, the present study examines whether LL rewards in intertemporal choice are risky by comparing individuals' choice preference for LL rewards with individuals' preference for risky gains in decision under risk. If people prefer both risky gains over sure gains in decision under risk and LL rewards over SS rewards in intertemporal choice, we argue that LL rewards are risky. Thus, we predict that peoples' preference for LL rewards is positively related to peoples' preference for risky gains (H3).

2. Method

2.1. Participants

Undergraduates ($N = 160$), 97 females and 63 males, were recruited to participate in the experiment to receive one course credit. Students were eligible for participation if they had no known diagnosed mental disorders. Participants were randomly assigned to either the anger condition or the neutral condition.

2.2. Measures

2.2.1. State-Trait Anger Expression Inventory (STAXI; Spielberger, Krasner, & Soloman, 1988)

The STAXI is a self-report measure of the experience and expression of anger. It consists of forty-four items in which ten items assess trait anger (i.e., how often people feel angry routinely) and another ten items measure state anger (i.e., how angry people feel like at a specific moment). Example items for trait anger are "I feel furious when I am criticized in front of someone I know" and "I have a fiery temper." Example items for state anger are "I feel like yelling at someone" and "I feel like banging on the table."

Similar as state and trait anxiety measured in Zhao, Harris, and Vigo (2016) and Zhao, Childers, Sang, and Vigo (2016a), we revised the original STAXI from a 4-point scale to a 9-point scale ranging from *1* (never) to *9* (extremely). Exactly the same as the two studies, we used non-intrusive procedures to induce emotion and predicted the induced anger would be very mild. However, the items in the STAXI assessing trait and state anger, especially state anger, reflect high intensity of anger. Thus, participants with different degrees of induced anger may be more often included into the same category using a 4-point scale as compared to using a 9-point scale (Blanton & Jaccard, 2006). Therefore, a 9-point scale may increase sensitivity and accuracy of assessing mild anger. Furthermore, since the revised scale point in STAI does not affect reliability and validity of the inventory (Zhao, Harris, & Vigo, 2016), we deduce the reliability and validity in the STAXI are not affected by revising the scale point. Cronbach's alpha was 0.875 for trait anger and 0.914 for state anger.

2.2.2. Sensitivity to punishment and sensitivity to reward questionnaire (SPSRQ) (Torrubia, Avila, Molto, & Caseras, 2001)

The SPSRQ has two scales: the sensitivity to punishment scale (SP) and the sensitivity to reward scale (SR). SPSRQ consists of 48 *yes-no* response items which assess individual differences in the sensitivity of two motivational systems: the Behavioral Approach System (BAS) and the Behavioral Inhibition System (BIS). Odd items belong to SP and even items to SR. Scores for each scale are derived by summing all *yes* answers. Participants were told that the questions included on the

questionnaires had no right or wrong answers. Example items for SR are "Would you like to be a socially powerful person?" and "Do you often do things to be praised?" Example items for SP are "Are you often afraid of new or unexpected situations?" and "Do you often refrain from doing something because of your fear of being embarrassed?" Cronbach's alpha was 0.773 for the BAS and 0.844 for the BIS.

2.2.3. Intertemporal choice questionnaire

We used the Monetary Choice Questionnaire (MCQ: Kirby, Petry, & Bickel, 1999) to measure individuals' preference between a SS and a LL reward. We calculated the summed choice on SS rewards as the dependent variable, the same as Zhao et al. (2015). The MCQ has 27 choice items. An example is "Would you prefer $31 today, or $85 in 7 days?" Participants were encouraged to make choices as though they might actually receive the hypothetical monetary rewards.

2.2.4. Risky decision making questionnaire

This 20-item questionnaire is employed to assess individuals' willingness to take risk (i.e., risk-taking tendency). In this questionnaire, there are two types of questions. Each type of questions involves a series of ten dichotomous financial choices between a certain and a risky outcome (Griskevicius, Tybur, Delton, & Robertson, 2011). The first type of questions asked is, "Do you want $____ for sure OR a 25% chance to get $1,000?" The dollar amount to be received for sure varied systematically ranging from $50 to $500. Also, the choice questions were presented in sequence ranging from low ($50) to high ($500), whereby the probabilistic equivalent choice of $250 was in the middle of the sequence. The second type of questions asked is, "Do you want $____ for sure OR an 80% chance to get $1000?" The dollar amount to be received for sure varied from $960 to $450. These choice questions presented in sequence ranged from high ($960) to low ($450), and the probabilistic equivalent choice of $800 was in the middle of the sequence. The two types of questions were placed one after the other. The first two questions are "Do you want $960 for sure OR an 80% chance to get $1000?" and "Do you want $50 for sure OR a 25% chance to get $1000?"

We calculated the summed choice on risky outcomes to indicate individuals' willingness to take risk. Participants who choose risky outcomes with a greater frequency tend to be more risk-taking. The relationship between the summed choice on LL rewards in intertemporal choice and the summed choice on risky gains in decision under risk indicates whether future rewards in intertemporal choice are risky. Participants were instructed to make choices as though they might actually receive the hypothetical monetary rewards and that their answers would not be rated on correctness.

2.2.5. Emotion induction

Following previous research studies (Zhao, Harris, & Vigo, 2016; Zhao, Childers, Sang, & Vigo, 2016a, 2016b), we induced emotions in specific ways. In the anger condition, we adopted three procedures to induce anger. First, we asked participants to read a paragraph about a case of student's suicide caused by school bullying. Next, we instructed participants to write about what aspects in the situation made them feel angriest. Furthermore, we let participants recall three angry experiences that were related to school bullying. Finally, we requested participants to describe vividly a past bullying experience they either witnessed or were the target of.

In the neutral condition, three procedures were used to match the emotion induction procedures in the anger condition. First, participants were asked to read a paragraph about the introduction of a brand new camera. They then were instructed to write a personal reflection on the advancements of technology based on the paragraph they read. In addition, they were told to recall three technological aspects of a camera they had. Finally, they were requested to vividly describe one technology they felt most important for their cameras.

2.3. Procedure

Upon arriving to the laboratory, participants were led into separate rooms. First, they read and signed a consent form. Next, they completed hard copies of questionnaires. These questionnaires included: STAXI (trait anger), anger induction questionnaire, the STAXI (state anger), the intertemporal decision-making questionnaire, risky decision-making questionnaire, and the SPSRQ. After that, participants were debriefed, thanked, and dismissed.

3. Results

Three outliers were removed from the study (i.e., 3 standard deviation below the mean), which left a final sample of 157 participants ($n_{anger} = 82$ and $n_{neutral} = 75$). We first examined whether emotion induction was successful. A t-test showed that participants in the anger condition reported significantly higher anger scores ($M = 19.76$, $SD = 11.82$) than participants in the neutral condition ($M = 14.43$, $SD = 8.46$), $t\,(155) = 3.268$, $p = 0.001$. Scores of trait anger ($M_{anger} = 37.72$, $SD = 12.92$; $M_{neutral} = 34.49$, $SD = 14.37$) and the BAS ($M_{anger} = 12.95$, $SD = 3.93$; $M_{neutral} = 11.97$, $SD = 3.69$) reported by participants in the two conditions did not show significant differences, $t\,(155) = 1.481$, $p = 0.141$; $t\,(155) = 1.603$, $p = 0.111$. Furthermore, choice preferences in the anger and neutral conditions did not show significant differences, $M_{anger} = 16.44$, $SD = 4.24$; $M_{neutral} = 16.51$, $SD = 3.73$; $t\,(155) = -0.106$, $p = 0.916$.

To analyze our data, we used a hierarchical linear regression model to examine whether state anger, trait anger, and the BAS predict individuals' preference for SS rewards (the summed SS choice, [MCQ]). Conditions, state anger, trait anger, the BAS, three two-way interactions, and one three-way interaction among conditions, state anger, and trait anxiety were included. This model was not significant, $R^2 = 0.083$, $F\,(8,148) = 1.677$, $p = 0.108$. Next, we specifically explored the effects of the BAS and trait anger in the anger condition, the same as the statistical method used in Strohminger, Lewis, and Meyer (2011) and Zhao, Harris, and Vigo (2016).

3.1. The anger condition

We examined a regression model ($R^2 = 0.115$, $p = 0.048$) with two blocks. The first block in the model consisted of state anger, trait anger, and the BAS. They did not account for a significant amount of variation in the summed SS choice, $F\,(3,78) = 1.318$, $p = 0.275$. The second block had a significant interaction between state and trait anger, $\Delta R^2 = 0.067$, $t = 2.418$, $p = 0.018$. Thus, H2 was supported. In the presence of other predictors, the BAS was marginally related to choice preference for SS rewards in the final model, $\beta = 0.211$, $p = 0.077$. As such, H1 was supported.

Following Aiken and West (1991), we depicted the interaction (see Fig. 1) between state and trait anger for participants at 1 standard deviation above and below the sample means of state and trait anger (i.e., high vs. low) based on the regression equation. Simple slope tests further demonstrated that individuals with high trait anger tended to choose more SS rewards than those with low trait anger when they were first in a temporarily high angry mood, $t = 1.921$, $p = 0.058$. For individuals with a low trait anger, those in a low angry mood tended to choose more SS rewards than those in a high angry mood, $t = -1.876$, $p = 0.064$.

3.2. The neutral condition

We also tested whether the model, regressing the summed SS choice on the BAS score, state anger, trait anger, and the interaction between state and trait anger, was significant for people who were not in an angry mood. Results showed that this model was not significant, $F\,(4,74) = 0.703$, $p = 0.593$. The interaction between state and trait

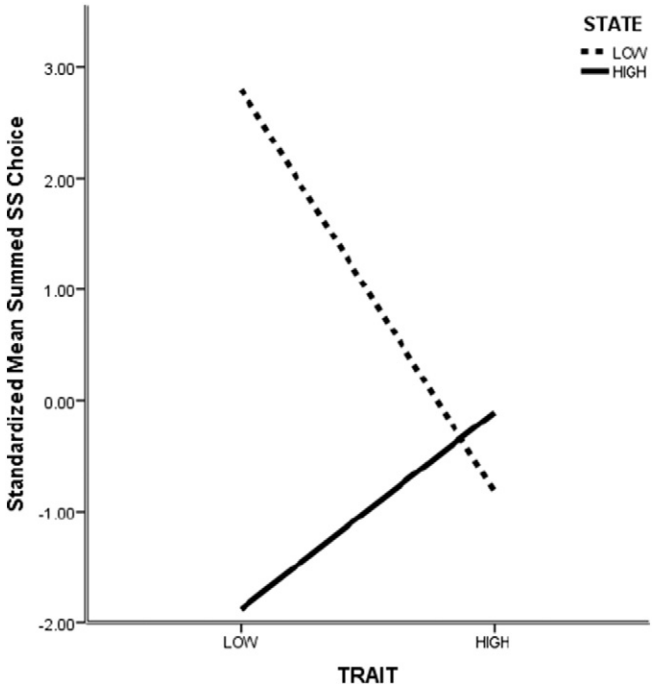

Fig. 1. Moderating effect of trait anger to state anger in the anger condition. All predicted scores of trait and state anger are represented at 1 standard deviation below and above the sample means. Both trait and state anger are continuous variables.

anger (see Fig. 2) was insignificant, $t = -0.429$, $p = 0.669$. Thus, specifically for people in a temporarily angry mood, the BAS and the interaction between state and trait anger tended to predict choice preference for SS rewards.

To examine whether LL rewards in intertemporal choice was risky, we conducted a bivariate correlation test. Results displayed a marginally positive relationship between the summed LL rewards in intertemporal choice and the summed risky gains in decisions under uncertainty, $r = 0.144$, $p = 0.070$, which indicates that future rewards are risky. Thus, H3 was supported.

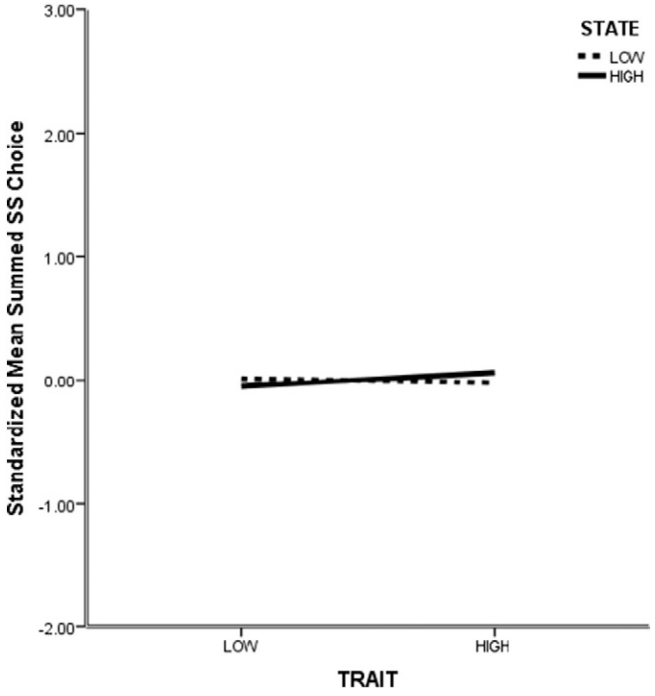

Fig. 2. Moderating effect of trait anger to state anger in the neutral condition. All predicted scores of trait and state anger are represented at 1 standard deviation below and above the sample means. Both trait and state anger are continuous variables.

4. Discussion

Incidental emotions influence subsequent intertemporal decision-making processes. Zhao et al. (2015) first studied the effect of anxiety on intertemporal choice from three dimensions: state anxiety, trait anxiety, and the behavioral inhibition system. Following this research line, the present study examined how induced anger influences intertemporal decision making. Specifically speaking, the effects of anger on choice preference between a SS and a LL reward were investigated from three dimensions: state anger, trait anger, and the behavioral approach system. Findings provided convergent evidence to support the effects of the behavioral motivation system and the interactive effect of an emotional state and the corresponding dispositional affect on intertemporal choice. In addition, the present study also tested the risky nature of LL rewards in intertemporal choice.

Though anger is a negative emotion in valence, it activates the behavioral approach motivation system (i.e., the BAS), similar to happiness (Carver & Harmon-Jones, 2009; Harmon-Jones, 2007). The BAS reacts to appetitive stimuli in general. In intertemporal decision making, a LL reward is risky, which is supported by the marginally positive relationship between the summed choice on LL rewards and the summed choice on risky gains in decision under uncertainty. As such, a SS reward is more appetitive compared to a LL reward in intertemporal choice (Kahnman & Tversky, 1979). Therefore, the BAS independently enhanced selection of SS rewards when people were first in an angry mood.

Consistent with Hirsh et al. (2010) and Zhao et al. (2015), the effects of state anger on intertemporal choice depended on trait anger. Thus, the interactive effect of an emotional state and the corresponding dispositional affect on intertemporal choice may be a global phenomenon for emotion and decision making instead of a specific phenomenon for a particular emotion. A deeper examination showed that the depicted pattern for the interaction between trait and state anger was opposite to the interactive pattern for anxiety (Zhao et al., 2015), but similar to the interactive pattern for positive affect (Hirsh et al., 2010). This suggests that dimensions of emotions (i.e., emotional state, the biological-based behavioral motivation system and dispositional affect), instead of emotional valence, have an impact on decision making.

The interactive effect between trait and state anger is in line with the perspective of risk preferences proposed to explain the nature of the interaction between trait and state anxiety (Zhao et al., 2015). Since anger is cognitively appraised as environmental certainty and under control, higher levels of anger are related to more risk-taking decisions and behaviors (Smith & Ellsworth, 1985; Lerner & Keltner, 2001). Thus, for people with low trait anger, those in a temporarily high angry mood were more risk-taking in their choice preference (i.e., selecting more LL rewards than SS rewards) than those in a temporarily low angry mood. Because negative moods with high arousal (e.g., anxiety and anger) may reverse people's risk tendencies associated with the affective traits (Leith & Baumeister, 1996), people with a high trait anger showed choice preference (i.e., preferring a SS reward over a LL reward) against risk-taking when they were in a temporary high angry mood.

Generally speaking, the interaction between trait and state anger is similar to the interaction between positive affect and extroversion that was found in Hirsh et al. (2010) study. In both studies, choice preference differed for people with a high or low dispositional affect only when they were experiencing a relatively high emotional state. When people were in a relatively low angry or happy mood, people with high or low trait anger or extroversion did not show significant differences in risk preferences related to choice options. This strongly suggests that the influence of a dispositional affect on decision making depends the corresponding emotional state. Thus, future studies should

take an interactionist perspective when attempting to examine emotion and choice.

In summary, the present study extended our understanding of emotion and choice in several ways. First, biological-based factors related to emotions, the dispositional affect and the behavioral motivation system, should be taken into consideration when studying emotion and choice. Though incidental emotions are generated from sources unrelated to the decision-making tasks of interest, they should not be treated just as a situational factor. Second and more important, the present study documents converging empirical evidence regarding how specific emotions shape choices. The findings for the present study are consistent with previous research (Zhao et al., 2015). Specifically, in this study and Zhao et al. (2015) study, the behavioral motivation system activated by a specific emotion influences individuals' preference between a SS and LL reward independently. Further, the emotional state and the corresponding dispositional affect interact to affect individuals' choice preference. Moreover, the perspective of risk preference is a better explanation and prediction of the findings than the existing theories or models on emotion and choice. For example, the affect-as-information model (Clore, Gasper, & Garvin, 2001), which emphasizes that emotion is directly used both as motivation and information, is too broad to explain the findings of the behavioral motivation system and the interaction between an emotional state and the corresponding trait on intertemporal choice. As stated earlier, the "hot" motivation system model (Metcalfe & Mischel, 1999) and valence-based perspective also cannot adequately explain the findings for anger and anxiety on intertemporal choice.

Considering all factors of interest were assessed by self-reported questionnaires, issues pertaining to biases and random variability exist. Future studies can consider different methods (e.g., behavioral or neuroscientific measures) to assess emotional state and the behavioral motivation system. We also acknowledge the limitation of the use of the fully hypothetical intertemporal choice questionnaire and the inadequate BIS/BAS measures based on original RST (Gray, 1982), which restrict generalization of the findings. Future studies may consider a partially incentivized design to assess intertemporal decision making and employ the Reinforcement Sensitivity Theory of Personality Questionnaire (RST-PQ; Corr & Cooper, 2016), a comprehensive descriptive model based on revised RST (Gray & McNaughton, 2000), to measure the behavioral approach motivation system activated by anger. Furthermore, the present study induced very mild anger. However, the items in the STAXI assessing state anger reflect high intensities of anger. Given that the level of anger induced in the present study does not match the levels assessed by the STAXI, the STAXI may not be the most appropriate scale to measure state anger for the purposes of the study. Future studies may consider using the Positive and Negative Affect Schedule (PANAS) to assess state anger when the experienced angry mood is predicted mild. Finally, the effects of the present findings are not strong (e.g., the BAS is marginally related to choice preference on SS rewards). This could be due to the sample size not being large enough for adequate power. As such, future replication studies may consider recruiting more participants.

Nevertheless, even with these limitations, we still argue that when studying emotions and decision making both individual and situational difference dimensions underlying specific emotions should be considered. In addition, because perceptions of risk underlie a variety of decisions in our routine life, future research may apply this perspective to predict and investigate how individuals make their health, financial, or social decisions.

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