Current Psychology
https://doi.org/10.1007/s12144-022-02868-8

Effects of multiple discrete emotions on risk-taking propensity

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Accepted: 2 February 2022

Abstract
Previous studies have examined the effects of discrete emotions on risk taking. One unstudied question in this literature involves comparisons of multiple discrete emotions, not limited to two (e.g., anger vs. sadness, anger vs. fear) on the same risky judgment and decision making (JDM) task. This study examined the effects of five different discrete emotions on the same risky JDM task assessing risk propensities. Anger, disgust, fear, happiness, sadness and a neutral condition were elicited in participants ($N = 307$ university students participating in partial fulfilment of course requirements) using a standard emotion eliciting procedure, after which they completed a self-report measure of risk propensities. Elicitation of a neutral state produced the lowest risk scores, while being emotionally elevated in general increased risk scores. Importantly, the emotions produced differential degrees of risk propensities with sadness producing the highest risk. These findings were discussed vis-à-vis differential functions of different discrete emotions.

Keywords Discrete emotions · Risky JDM · Anger · Disgust · Fear · Happiness · Sadness

Research on judgment and decision making (JDM) has a long history in the social and behavioral sciences. Although originally dominated by cognitive theories based on rational choice agents (Camerer, 2003; Kahneman & Tversky, 1979), recent decades have witnessed a slew of research that has demonstrated cognitive and situational constraints on JDM and bounded rationality (Simon, 1982, 1991). Within this evolution, the role of emotions in the JDM process have come to the forefront, from economic decision making (Naqvi et al., 2006) to decision making in stressful situations (Starcke & Brand, 2016), and this line of research has made major contributions to the field's understanding of JDM processes and outcomes.

Most early studies on the influence of emotions on JDM took a valence approach, examining the effects of incidentally elicited positive vs. negative affect on ambiguous or risky decision making (refer to reviews in Ferrer et al., 2020; Loewenstein & Lerner, 2003; Mellers et al., 1998). Although these programs contributed to getting emotions on the radar of JDM research, they did not consider fully the possible effects of specific, discrete emotions (Lerner & Keltner, 2000). In this paper, we examine the effects of multiple discrete emotions on risky JDM.

A Case for Examining Discrete Emotions

Emotions are socio-psycho-biological reactions that prime individuals' minds and bodies to act. They are products of an information processing system that resides in the subcortical areas of the brain and allows for action with minimal conscious processing (Cosmides & Tooby, 2000; Tooby & Cosmides, 2008). The emotion system is an evolved human potential and vestiges of our evolutionary history, and throughout that history, dealing with issues concerning birth, death, seduction, threats, natural disasters, rivals for mates, food and other resources was facilitated by emotions.

Although humans experience a myriad of emotions, the vast bulk of research documenting emotions as socio-psycho-biological reactions and explicating their intrapersonal, interpersonal, and sociocultural functions has focused on a small set of four-seven emotions known as basic emotions (the exact number depending on the researcher and the domain of emotion studied; e.g., refer to Ekman, 1999;

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Published online: 24 February 2022

Izard, 2007; LeDoux, 2000; LeDoux & Phelps, 2008; Panksepp, 1994, 2008). Different, discrete emotions exist to facilitate human adaptation to the many different types of concerns in the environment for survival and thriving; that is, different environmental concerns require different types of responses, facilitated by different emotional reactions.

Studies in this genre examining discrete emotions have demonstrated that when elicited, each emotion recruits an organized system of cognitive, psychological, and behavioral responses that gate perception and thinking; turn on unique physiological signatures; and produce specific expressive behavior, sensations and experiences, all of which prime the mind and body for action (Ekman, 1999; Hwang & Matsumoto, 2018; Keltner & Haidt, 1999; Levenson, 1999; Matsumoto & Hwang, 2013; Matsumoto et al., 1988; Scherer et al., 2001). In this paper, we focus on five such emotions: anger, disgust, fear, happiness, and sadness, as these are the emotions with the most such evidence for action priming. Anger is elicited by appraisals of goal obstruction, injustice, or norm violations, such as when rivals stole food, mates, and other resources; anger prepares the individual to remove obstacles to goals, i.e., to fight. Disgust is elicited by appraisals of contamination or rotten objects, such as ingesting spoiled foods or being exposed to blood or other contaminants; disgust facilitates the repelling or elimination of contaminated objects (e.g., vomiting). Fear is elicited by appraisals of threat, either physical or psychological, which are plentiful when living in nature; the purpose of fear is to avoid threats and reduce harm. Sadness is elicited by loss and the function of sadness is to facilitate the recouping of resources and call for help. Happiness is elicited by goal attainment and the function of happiness is to incentivize behavior for future goal attainment. These differential functions of discrete emotions have enabled humans to deal with multiple and different types of threats to survival in our evolutionary history (Cosmides & Tooby, 2000; Tooby & Cosmides, 2008).

Because emotions exist to facilitate adaptation to life problems by priming the mind and body for action (Frijda et al., 1989; Levenson, 1999), emotions in general should increase both risk-taking propensities (because of mind priming) and risky behavior (because of action priming) compared to neutral or no emotions, because adaptative behavior often involves risk. At the same time, because specific, discrete emotions have unique functions, they should also have differential implications for risky JDM. One way to consider these possible differential implications may involve an ordering of emotions vis-à-vis their implications for producing risky behavior. (Another way to do so would be to consider the effects of discrete emotions on specific types of risky behavior.) For instance, because the function of fear is to deal with immediate threats, fear may produce the most risk-taking propensities or behavior, vis-a-vis other emotions because of immediate survival issues. Likewise, the function of sadness is to recoup resources and recover from severe loss; thus, sadness may also produce high risk-taking behavior relative to other emotions because of perceptions that there is less to lose. The function of happiness is to incentivize future goal attainment, and the function of anger is to remove obstacles; thus, these emotions may also induce risky behavior but not on the level of fear or sadness. In the case of happiness or anger, risk-taking propensities and risky behavior may be more calculated in terms of cost–benefit considerations. The function of disgust is to repel or eliminate contaminated objects; thus disgust may also increase risky behavior but only in relation to the elimination of contamination; disgust may also reduce risk-taking propensities or risky behavior because ingestion of contaminated objects itself represent risky behavior in the first place.

Previous Research Examining Effects of Discrete Emotions

Past research examining differential effects of anger, fear, sadness, and to a lesser extent disgust has provided support for the idea that different, discrete emotions have differential effects on risky JDM. Much of this research has compared pairs of emotions to each other on study-unique dependent variables. For instance, sadness produced more impatience in participants and desire for money sooner (compared to disgust in Lerner et al., 2013), more consumption and spending (compared to neutral in both Cryder et al., 2008; Garg & Lerner, 2013), and heightened addictive substance abuse (compared to fear, anger, shame in Study 1; compared to disgust in Study 2; compared to neutral in Studies 3 and 4 in Dorison et al., 2020); these findings were aligned with the function of sadness to recoup resources. Anger produced more heuristic and risky decision making, especially among males (compared to sadness in Study 1 and to neutral in Studies 2 and 3 in Ferrer et al., 2017; refer also to review in Lerner & Tiedens, 2006), which was aligned with anger's function to facilitate competition and fighting. Fear increased risk estimates and public policy preferences (compared to anger in both Fischhoff et al., 2012; Lerner et al., 2003), consistent with the function of fear to reduce threats and harm, while disgust promoted disposal of possessions (compared to neutral in Han et al., 2012), consistent with the purpose of disgust for elimination. Collectively, these findings can be linked to differential triggers and functions of emotions described above, and have facilitated the development of models such as the emotion-imbued choice (EIC) model of JDM, which views the JDM process as infused with emotion at multiple stages (Lerner et al., 2015).

Although each emotion is unique and produces different intrapersonal, interpersonal, and sociocultural functions (Hwang & Matsumoto, 2018; Keltner & Haidt, 1999; Levenson, 1994, 1999), previous research has also demonstrated that combinations of them may function similarly vis-à-vis risk-related tasks. The combination of anger and disgust, for example, produced more aggressive and competitive JDM assessed by cognitions, verbal and implicit behavior and economic decision making games compared to fear and sadness (Matsumoto et al., 2015, 2016, 2017). Thus, certain discrete emotions may have similar themes that function comparatively or even collaboratively in association with risky JDM while at the same time being different from others. The combination of anger, contempt, and disgust has also been shown to fuel intergroup aggression compared to a fear-sadness combination (Matsumoto et al., 2015, 2014a, b). These findings likely occurred because fear and sadness both have protective features that focus on oneself (albeit differently), while anger and disgust have competitive, agonistic features.

Overview of the Current Study and Hypotheses

The above studies have provided evidence that different, discrete emotions appear to increase risky JDM depending on the type of risky task. But these studies generally compared pairs of emotions (or an emotion vs. neutral) on study-specific tasks. One unanswered question in this literature involves comparing a range of emotions, not limited to two, on the same risky JDM task. Such studies would allow for examination of differential effects of specific emotions on the same criterion (i.e., the same JDM task), and allow for investigations of how different combinations of discrete emotions may function similarly as well.

As mentioned earlier, all emotions may generally increase risky JDM because adaptive behavior is often inherently risky. But based on previous studies documenting similar effects of combinations of emotions, we also suggest that emotions such as fear and sadness would produce different and larger risks than other emotions because fear and sadness involve evaluations of threat and loss, respectively, related to the self. Fear and sadness involve more expansive orientations toward threats and losses, with potentially more devastating effects to the self, which may facilitate greater risk taking. Risky JDM tasks may amplify such tasks because risk, uncertainty, and ambiguity would augment the effects of fear or sadness, and risk and ambiguity could be considered affects related to fear and/or sadness. Anger and disgust should increase risk but not to the extent of fear and sadness, because anger and disgust involve more specificity about the nature of the elicitors (i.e., opponents or contaminated objects) and more constricted, focused cognitive and physiological gating (i.e., fighting or elimination). Happiness should also increase risk because of gating that would minimize risk (because of achievement), but such risk should be more measured and not as great as that of fear or sadness.

Also, because emotions prime both the mind and body for action, examining mental (risk-taking propensities) and bodily (risky behavior) outcomes may make sense. Thus, as an initial effort examining multiple emotions against each other on the same outcome variable, we tested these ideas by examining the effects of five different discrete emotions on the same risky JDM task assessing risk propensities (with allowance for future studies to examine risky behavior). Anger, disgust, fear, happiness, sadness and a neutral condition were elicited in participants using a standard emotion eliciting procedure, after which they completed a validated self-report measure of risk taking propensities. We tested the following hypotheses:

1. That the combination of all emotions would increase risk scores compared to neutral.
2. That the combination of fear and sadness would produce higher risk scores compared to neutral.
3. That the combination of anger and disgust would produce higher risk scores compared to neutral.
4. That the combination of fear and sadness would produce higher risk scores than the combination of anger and disgust.
5. That sadness would produce higher risk scores than happiness because of the protective and recouping features of sadness compared to the characteristics of happiness.

Methods

Design

The study was a one-way, between-subjects experiment; elicited Emotion Type was the independent variable with six levels (anger, disgust, fear, happiness, sadness, and neutral); the dependent variable was a self-report measure of risky behavior.

Participants

Data from an initial sample of $N = 413$ were filtered to include only respondents who completed the entire procedures described below within 60 min. A total $N = 307$ ($n = 58$ male, 221 female, 28 other or no response; $ns = 25$ African Americans; 58 Asian Americans, 59 European Americans; 108 Hispanic or Latinos; seven Middle Eastern, 19

multiracial or multiethnic, three Native Hawaiian or Pacific Islander, and the remainder Other or no response; mean age = 22.31, SD = 6.06) university students participated in partial fulfillment of class requirements. All were recruited anonymously using an online participant recruitment and management system. Participants were randomly assigned to one of the six emotion elicitation conditions, resulting in the following *n*s per condition: 53, 47, 51, 53, 56, and 47 for anger, disgust, fear, happiness, sadness and neutral, respectively. The achieved power given this design and sample size, $\alpha = 0.05$, and an effect size $f = 0.25$ was 0.94.

Pre-Session Measures

Participants completed a brief demographic scale and a 10-item version of the Big Five Inventory (Rammstedt & John, 2007) as part of the screening procedures for registering in the participant recruitment and management system. For this study, participants completed a self-report of their emotional states using a 15-item scale (guilt, fear, anger, embarrassment, worry, contempt, excitement, disgust, amusement, nervousness, surprise, interest, sadness, pride, and shame) rated on nine-point scales labeled 0 = *None*, 4 = *Moderate Amount* and 8 = *Extremely Strong*. This measure was administered three times: after consenting and prior to collection of any subsequent data, after presentation of the randomly assigned emotion eliciting stimuli, and at the end of the experimental session after the presentation of three positive emotion eliciting stimuli.

Participants also completed the Emotion Regulation scale from the Intercultural Adjustment Potential Scale (Matsumoto et al., 2001), the Rosenberg Self-Esteem Scale (Robins et al., 2001), the 12-item short version of the Intolerance of Uncertainty Scale (IUS) (Birrell et al., 2011; Buhr & Dugas, 2002; Carleton et al., 2007), the four-item Behavioral Inhibition Scales by Gest (BIS_G; Gest, 1997; Shatz, 2005), and the seven-item Behavioral Inhibition Scale by Carver and White (BIS_CW; Carver & White, 1994). As these measures were not germane to the purpose of the current study, no further mention of them will be made.

Emotion Eliciting Stimuli

Emotions were elicited using images from the International Affective Picture System (IAPS; Lang et al., 1997). Based on previously published studies on the IAPS images examining judgments of discrete emotions (Barke et al., 2012; Libkuman et al., 2007; Mikels et al., 2005; Xu et al., 2017), we selected six images that have reliably elicited anger (IAPS#s 2345, 3180, 6212, 6360, 6540, 9810), disgust (1111, 3160, 3250, 7380, 9301, 9325), fear (1113, 1120, 1205, 1300, 1304, 6300), happiness (1463, 1750, 2045, 2070, 2154, 8497), and sadness (2205, 2276, 2800, 2900, 3230, 9561), along with selections for neutral (5220, 7000, 7003, 7012, 7041, 9070).

Risk Taking Measure

Risk taking was assessed using the Domain-Specific Risk-Taking scale (DOSPERT; Blais & Weber, 2006; Weber et al., 2002), a 30-item, self-report questionnaire that evaluates the likelihood that respondents might engage in risky behaviors in five life domains (Social, Recreational, Financial, Ethical, Health/safety). This scale has demonstrated reliability and validity with related psychological constructs, gender differences, and behavioral data (Blais & Weber, 2006; Shou & Olney, 2020; Weber et al., 2002). Item presentation was randomized, and each item was assessed using a 7-point scale anchored 1, Extremely Unlikely, to 7, Extremely Likely.

Multiple studies have used a single score instead of domain specific scores (Dickason & Ferreira, 2018; Markiewicz et al., 2020; Mishra & Lalumière, 2011; Shou & Olney, 2020; Weber et al., 2002), and evidence based on principal component or factor analyses exists for a general risk taking propensity that predicts real-life outcomes (Highhouse et al., 2017; Mishra & Lalumière, 2011). Thus, in this study we computed a principal components analysis (PCA) on the DOSPERT scales; we also computed parallel analyses (Patil et al., 2017) to compare the obtained results to random correlation matrices. Based on comparison with parallel analyses, we extracted two components accounting for 68.17% of the cumulative variance (DOSPERT Scales 1 and 2). The Ethical (component loading = 0.92) and Health/Safety (0.77) scales loaded highly on Scale 1, while the other three scales loaded on the second (0.80, 0.71, and 0.66 for Financial, Social, and Recreational, respectively). No significant findings were obtained using the second component score; thus no further mention will be made of it.

Procedures

The study was conducted entirely online at a time and place of the participants' choosing. After providing implied consent, participants completed the pre-session measures, after which they were provided with instructions for the image observation task, which explained that a series of images will be presented one at a time for 10 s each and that participants would be asked to describe the most salient aspects of the image that may have elicited a reaction in them, and why. They were then shown a sample IAPS neutral image not used in the study and wrote their response to it using the same prompt. They were then shown the six images for an emotion; Emotion Type was randomized across participants. After presentation of the six images for an emotion,

participants then completed the self-reported emotion scale (the second time). These same procedures have been used in previous studies and have successfully elicited the intended discrete emotions (Matsumoto et al., 2016, 2017).

After the emotion elicitation task, participants completed the DOSPERT. Timing data were obtained when completing the DOSPERT, which captured participants' first and last clicks on the page, page submit, and click count. After the DOSPERT, participants rated five items as a manipulation check on the degree of ambiguity in responding to the DOSPERT using a five-point scale labeled Strongly Disagree (1) to Strongly Agree (5): I was uncertain about many questions, the question outcomes were ambiguous, the task was difficult, the task was risky, and the task made me hesitate; these items were averaged to create a composite score ($\alpha = 0.74$). They then saw three other positive IAPS images not used in the study and completed the same observational tasks on each, after which they completed the self-report emotion rating (the third time), were debriefed and provided instructions to receive compensation.

Results

Manipulation Checks and Preliminary Analyses

Did the Image Viewing Task elicit the Intended Emotions?

To examine if the emotion elicitation procedure produced the intended emotions, we computed a three-way mixed, overall ANOVA on the emotion ratings using Emotion Type (6), Pre-Post (2), and Emotion Rating (15) as factors. The three-way interaction was significant, $F(70, 3906) = 7.20$, $p < 0.001$, $\eta_p^2 = 0.114$. We then computed simple effects of Pre-Post separately for each Emotion Type and Emotion Rating. Anger images produced increases in anger, fear, disgust, surprise, sadness, shame, and decreases in excitement, amusement, interest, and pride. Disgust images produced increases in disgust and surprise, and decreases in worry, excitement, interest, sadness, and pride. Fear images produced increases in fear, disgust, and surprise, and decreases in embarrassment, sadness, pride, and shame. Happy images produced increases in amusement and decreases in guilt, fear, worry, nervousness, sadness, and pride. Sad images produced increases in sadness and decreases in excitement, amusement, interest, and pride. Neutral images produced decreases in worry, excitement, nervousness, and sadness. Although each emotion image produced changes in a variety of emotions, which is not uncommon (Barke et al., 2012; Libkuman et al., 2007; Mikels et al., 2005; Xu et al., 2017, increases in the intended emotion had the largest effects (*d*s for increases in target emotions were 0.90, 1.17, 0.48, 0.27, and 0.38 for anger, disgust, fear, happiness and sadness, respectively, and -0.68 for decrease in worry for the neutral condition; tables of descriptives and findings reported in the Appendix). Thus, the emotion elicitation worked as intended.

Was the DOSPERT Perceived as Risky or Ambiguous?

We computed a single-sample *t* test on the composite manipulation check score produced after participants completed the DOSPERT using the scale midpoint (3.0) as the comparison value. As a whole, participants disagreed about the uncertainty of the task ($M = 2.34$, $SD = 0.72$), $t(306) = -15.82$, $p < 0.001$, $d = -0.90$, which likely reflected uncertainty or ambiguity in answering the scale rather than its contents. Findings below, therefore, should be interpreted with this caveat. Interestingly, a univariate ANOVA on the manipulation check composite using Emotion Type as the independent variable produced a significant effect, $F(5, 301) = 3.03$, $p = 0.011$, $\eta_p^2 = 0.048$. Post-hoc comparisons with Bonferroni corrections indicated that anger produced higher uncertainty ratings than did happiness, $p = 0.007$.

Main Analyses

Descriptives for the original DOSPERT scales and the component risk score by Emotion Type are given in Table 1. We computed Gender (2) by Emotion Type (6) overall ANOVAs on the component risk score, with five planned contrasts consistent with our hypotheses: (1) a combination of all emotions vs. neutral, (2) a fear-sadness combination vs. neutral, (3) an anger-disgust combination vs. neutral, (4) anger-disgust vs. fear-sadness, and (5) happiness vs. sadness. (Although not hypothesized, Gender was included as a factor in the analyses for potential post-hoc follow-ups and for efficient variance partitioning.) The Emotion Type main effect was significant, $F(5, 274) = 2.45$, $p = 0.034$, $\eta_p^2 = 0.043$, suggesting overall differences in risk scores among the various emotion types elicited. Contrasts 1, 2, and 3 produced non-significant effects, indicating that there were no overall differences between neutral and the elicited emotions overall. Contrast 4 was significant, $p = 0.022$, indicating that the fear-sadness combination produced higher risk scores than did anger-disgust. Contrast 5 was also significant, $p = 0.005$; sadness produced significantly higher risk scores than did happiness. Thus, Hypotheses 2 and 4 were supported but not Hypotheses 1 or 3.

Because of the variation in profiles of emotional responses to the elicitation procedures, it was possible that some participants did not increase in the target emotion (despite overall mean increases in those emotions), possibly confounding the effects reported immediately above. Thus, we filtered the data to exclude all participants who did not increase on the target emotion ($n = 178$; see Table 1

Table 1 Descriptives (Means and Standard Errors) for Five DOSPERT Scales, DOSPERT Component Score, and Click Data by Emotion

DOSPERT		Anger	Disgust	Fear	Happiness	Sadness	Neutral
Social	M	4.44	4.85	4.87	4.97	4.65	4.56
	SE	0.15	0.16	0.15	0.15	0.14	0.16
Recreational	M	2.69	2.68	2.84	2.96	2.88	3.22
	SE	0.15	0.16	0.15	0.15	0.15	0.16
Financial	M	2.71	2.81	2.96	2.97	2.95	2.88
	SE	0.16	0.17	0.16	0.16	0.15	0.17
Ethical	M	2.03	2.20	2.28	2.14	2.35	2.20
	SE	0.14	0.15	0.14	0.14	0.13	0.15
Healthy/Safety	M	2.81	2.79	3.09	3.05	3.29	2.77
	SE	0.17	0.18	0.17	0.17	0.16	0.18
Component Score	M	0.19	-0.08	0.26	-0.07	0.52	0.12
	SE	0.18	0.15	0.16	0.15	0.16	0.22
Only Participants who increased on Target Emotion	M	0.29	-0.14	0.23	-0.15	0.62	-0.68
	SE	0.19	0.17	0.23	0.21	0.19	0.46
Click Data							
First Click	M	24.66	18.97	25.09	21.28	32.05	15.08
	SE	5.11	5.40	5.17	5.11	4.92	5.46
Last Click	M	199.39	168.25	177.36	185.16	182.75	160.35
	SE	13.29	14.03	13.43	13.29	12.78	14.19
Page Submit	M	204.31	170.71	179.30	186.92	184.26	163.06
	SE	13.44	14.19	13.58	13.44	12.93	14.35
Click Count	M	36.69	36.23	37.94	36.90	36.92	38.00
	SE	1.17	1.23	1.18	1.17	1.12	1.24

for descriptives) and recomputed the overall Gender (2) by Emotion Type (6) ANOVA on the component risk score using the same contrasts. The Emotion Type main effect was significant and with a larger effect size than the analysis above with all participants, $F(5, 152) = 3.45$, $p = 0.006$, $\eta_p^2 = 0.102$. Contrast 1 was significant, $p = 0.037$, indicating that all emotions in general increased risk. Contrast 2 was significant, $p = 0.012$, indicating that fear-sadness produced significantly higher risk scores than neutral. Contrast 3 approached significance, $p = 0.060$, indicating that anger-disgust produced higher risk scores than neutral. Contrast 4 was significant, $p = 0.038$, indicating that fear-sadness produced higher risk scores than anger-disgust. Contrast 5 was significant, $p = 0.004$, indicating that sadness produced significantly higher risk scores than did happiness.

Consistent with a sadness vs. disgust comparison in Lerner et al. (2013), we also computed an additional contrast comparing disgust and sadness, which was significant, $p = 0.002$, indicating that sadness produced significantly higher risk scores than disgust. A contrast comparing happiness vs. neutral was not significant. Thus, findings on participants who were aroused on the target emotions provided support for all four hypotheses: elevation in emotions in general increased risk but did so differentially, with fear-sadness producing higher risk scores than anger-disgust, and sadness producing higher risk scores than happiness or disgust.

Post-Hoc Analyses

The main effect of Gender in the overall ANOVA was significant, $F(1, 274) = 17.70$, $p < 0.001$, $\eta_p^2 = 0.610$, indicating that males ($M = 0.45$, $SE = 0.13$) self-reported more risk taking than females ($M = -0.14$, $SE = 0.06$), replicating previous gender differences (Blais & Weber, 2006; Weber et al., 2002). The interaction between Gender and Emotion was not significant, $F(5, 274) = 1.26$, $p = 0.209$, $\eta_p^2 = 0.026$, indicating that the findings above were not moderated by gender (but note the gender imbalance in the sample).

We computed the same Gender (2) x Emotion Type (6) ANOVAs on the DOSPERT click data (First Click, Last Click, Click Count, Page Submit; see Table 1 for descriptives by emotion). None of the Emotion Type main effects was significant. The happiness vs. sadness contrast on First Click, however, was significant, $p = 0.035$, indicating that happiness ($M = 21.22$, $SE = 5.83$) produced faster first responses than did sadness ($M = 36.81$, $SE = 6.33$); thus, sadness produced slower responses but with higher risk. In addition, the contrast between all emotions vs. neutral

on Click Count was significant, $p = 0.050$, indicating that all emotions in general ($M = 36.44$, $SE = 1.41$) produced less clicks in completing the DOSPERT than did neutral ($M = 39.82$, $SE = 1.94$). The lower click count suggested greater certainty in responses while at the same time associated with higher risk. This same pattern of results were obtained when cases were filtered for participants who only increased on the target emotions.

Finally, because our hypotheses involved combining fear with sadness and anger with disgust, we compared both pairs of emotions using Scheffe correction on the data for participants who increased on the target emotions. Neither pair was significant, $p = 0.985$ for anger vs. disgust; $p = 0.976$ for fear vs. sadness.

Discussion

Analyses involving participants who increased on the target emotions were clear and produced several noteworthy findings. First, the combination of all emotions produced higher risk scores compared to a neutral state; this finding was consistent with a large literature demonstrating negative effects of various emotional states and affect on risky JDM (Ferrer et al., 2020; Lerner et al., 2015; Loewenstein & Lerner, 2003; Mellers et al., 1998), and indicated the potential effects of being emotionally elevated as a whole on risk propensities. More importantly, different, discrete emotions or their specific combinations produced differential degrees of risk propensities. In particular, the fear-sadness combination produced higher risk scores than neutral and the anger-disgust combination, and sadness produced higher risk scores than happiness and disgust.

As described in the Introduction, different triggers and functions of the emotions produce different cognitive, physiological and experiential gating to produce differential effects, and different combinations of emotions (fear and sadness, anger and disgust) can function similarly vis-à-vis some types of risky behavior. Differential effects of discrete emotions have been demonstrated in a wide range of tasks (Cryder et al., 2008; Dorison et al., 2020; Ferrer et al., 2017; Fischhoff et al., 2012; Garg & Lerner, 2013; Han et al., 2012; Lerner & Tiedens, 2006; Lerner et al., 2003, 2013); the findings reported here were notable because they included a comparison of multiple discrete emotions on the same dependent variable.

Our findings suggested that a key emotion that had particularly strong effects on risky behavior may be the combination of fear and sadness, and in particular sadness. Previous research in this area had demonstrated that sadness produced more impatience and desire for money sooner (Lerner et al., 2013), more consumption and spending (Cryder et al., 2008; Garg & Lerner, 2013), and heightened addictive substance abuse (Dorison et al., 2020). Our results enhanced these previous findings, as the fear-sadness combination increased risk scores, and sadness on its own had significantly higher scores than disgust (and was not moderated by gender).

Also, inspection of the means indicated that sadness produced the highest degree of risk propensity among all emotions, followed by fear and anger and then disgust and happiness. (Although the post-hoc comparison between fear and sadness was not significant, this non-finding may have occurred because of the correction procedures used). One possible interpretation of this finding is that evaluations of loss that trigger sadness and the functions of sadness to recoup resources to cope with loss provide the strongest motivations for engaging in, or considering engaging in, risky behavior. Recovery – either physical or of self-concept – may be one of the strongest motivators of risky behavior, and loss may trigger risky behaviors to compensate for loss as a way to recover. Alternatively, losses perceived when sad may already mean that there's little or nothing left to lose, especially if perceptions of pain (which would serve as a buffer against risk) decrease, thus increasing the chance for risky behavior. Previous research has demonstrated that focus on the self (Cryder et al., 2008), deep thinking (Small & Lerner, 2008) and feelings of helplessness (Garg & Lerner, 2013) mediated the effects of sadness, which would be aligned with this interpretation. Our findings suggested additional possible mechanisms underlying sadness that should be explored in the future.

Our findings also demonstrated that not all negative emotions are the same, with the fear-sadness combination producing significantly greater risk scores than anger-disgust, and sadness producing significantly greater scores than disgust (and happiness). These differences could not be explained by aroused intensities of the target emotions alone, as the post-elicitation ratings of those target emotions were not ordered in the same manner; disgust had the highest post-elicitation mean ($M = 6.09$, $SD = 2.83$), followed by amusement ($M = 5.04$, $SD = 2.28$), anger ($M = 5.04$, $SD = 2.90$), sadness ($M = 4.70$, SD – 2,42), and fear ($M = 4.67$, $SD = 2.61$). Thus, a dimensional model based on valence and/or intensity could not account for these findings and there is something unique about each emotion that contributes to differential risky responding.

Even elicitation of happiness elevated risk scores (albeit non-significantly in participants filtered for increases in target emotions). On the surface this finding was counterintuitive because positive emotions have been shown to have buffering effects of stress on physical and mental health outcomes (Fredrickson, 2000; Kok et al., 2013; Stellar et al., 2015) and expansive cognitive consequences (Fredrickson,

2013; Fredrickson & Branigan, 2005; Huppert et al., 2004). In Frederickson's (2013) broaden-and-build theory, for instance, happiness should enlarge individuals' temporary cognition-behavior possibilities and promote exploration of novel and creative actions. Our data suggested that this consequence of positive emotions may increase risk propensities and/or behavior because, as suggested in the Introduction, elicitation of emotions in general may enhance risky behavior because adaptation requires risk. At the same time, that risk scores as a function of happiness were not as high as other emotions would suggest limits to the degree of risk when people are happy, perhaps "reasonable" risk, which would limit negative consequences but allow for personal growth.

The behavioral (click) data also provided some interesting nuances to the findings. Sadness produced slower first clicks when completing the DOSPERT compared to happiness, which would be expected as sadness should reduce behavioral response times. Thus, sadness elicitation produced slower initial response times but higher risk scores, suggesting that reducing speed in responding did not reduce risk (commensurate with previous findings concerning depth-of-thought; see Small & Lerner, 2008). Also, all emotions in general produced fewer click counts in completing the DOSPERT ratings (page submit), suggesting that being emotionally elevated produced some degree of certainty or confidence about one's ratings while at the same time producing higher risk.

The findings have some theoretical import as they suggest that different types of emotions have differential implications to risk propensities. Clearly, anger, disgust, fear, and sadness are all negative, but they have different triggers and functions, all of which implicate risk differently. Previous research examining pairs of emotions against each other or a single emotion to a neutral state all implied such effects, but our findings make the notion that different emotions have differential degrees of risk propensities clearer, as the current study was the first to compare multiple emotions against each other on the same risk-related task. Our findings also suggest an ordering of emotions according to their relevance for risk-taking and adaptive behavior, a notion not heretofore considered in emotion theory. Such an ordering would have implications for understanding brain evolution and structure, and the interpersonal and sociocultural functions of emotion vis-à-vis evolutionary history.

Empirically, these findings open the door to continued research on differential effects of separate, discrete emotions and their combinations on JDM. Future studies can examine the differential effects of discrete emotions on other types of JDM tasks, and especially behavioral and real-world tasks. Future research may also examine the important role of individual differences in multiple ways. For example, our data make abundantly clear that there is a wide range of emotional responses to emotional stimuli (as typically found in research involving emotion elicitation). Future research may examine individual differences in the differential effects of discrete emotions, as well as moderating effects of individual differences variables on such effects.

Our findings may also have practical implications for those who engage in risky behavior or manage others who engage in such behavior. Assessing risk-takers' emotional states prior to engaging in such behavior may be a beneficial idea in general, and the findings suggest different effects of different emotions to avoid in some situations, or perhaps enhance in others. Fear, sadness, and their derivatives may be emotions and affective states that are of particular importance to be aware of in risky situations.

The study was not conducted without limitations, including the nature of the emotion elicitation task. The emotions triggered were incidental to the task and were elicited using a viewing task (IAPS images); emotions related directly to the JDM task or with different elicitation procedures may produce different effects. The dependent variable (DOSPERT) was a self-report scale including 30 items. The effects observed may or may not extend to other tasks, especially behavioral or cognitive tasks. Also, the DOSPERT was administered immediately after emotion elicitation; thus, questions remain concerning the duration of emotion elicitation effects. Relatedly, the task here was not rated as very ambiguous or risky (but still produced the predicted effects); future studies will need to included tasks that are more ambiguous and riskier than the one used here. Finally, although we obtained support for the combinatorial hypothesis (anger and disgust vs. fear and sadness), differences within the combinations may exist as well. Future studies should tease these out in more sophisticated designs involving different risk measures.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s12144-022-02868-8.

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