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Incidentally elicited multiple, discrete emotions have differential effects on risky behavior: The action priming perspective

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Abstract

We present a novel theoretical framework called the Action Priming Perspective to predict effects of discrete emotions on judgment and decision-making and report results from two studies examining five discrete emotions (anger, disgust, fear, happiness, and sadness) and neutral on a behavioral task of risky decision-making. We tested two hypotheses concerning single and combinatorial effects of the emotions based on previous theoretical and empirical work delineating the action priming functions of discrete emotions. As predicted, a fear–sadness combination, elicited separately but combined for analyses, produced the highest risk-taking behavior, higher than an anger–disgust combination (also elicited separately but combined for analyses). Sadness also produced more risky behavior than did disgust, as predicted. These effects, however, did not occur when the task was less uncertain. These findings were discussed vis-à-vis understanding implications of specific, discrete emotions on risky, ambiguous judgment and decision-making.

KEYWORDS
balloon analogue risk task, discrete emotions, disgust, fear, risky behavior, sadness

1 | INTRODUCTION

Research of the past two decades has increasingly demonstrated the influence of emotions on risky judgment and decision-making (JDM). This genre began with studies using a valence approach, testing effects of incidentally elicited positive and negative affects (Ferrer et al., 2020; Loewenstein & Lerner, 2003; Mellers et al., 1998). Subsequent studies examined the effects of discrete emotions such as anger, sadness, or disgust (Lerner & Keltner, 2000). For instance, studies have demonstrated that sadness produces more impatience and desire for money sooner compared with disgust (Lerner et al., 2013), more consumption and spending (Cryder et al., 2008; Garg & Lerner, 2013), and heightened addictive substance abuse (Dorison et al., 2020). Other studies have reported that anger produces more heuristic and risky decision-making, especially among men (Ferrer et al., 2017; Lerner & Tiedens, 2006). Fear has been shown to increase risk estimates and public policy preferences (Fischhoff et al., 2012; Lerner et al., 2003). Disgust has been shown to promote disposal of possessions (Han et al., 2012).

This literature has facilitated the development of models such as the emotion-imbued choice (EIC) model of JDM (Lerner et al., 2015), which suggests that emotions affect JDM in several ways. One involves individuals incorporating their predictions of their emotions resulting from the outcomes of their JDM process. Others include emotion effects through characteristics of the decision maker or options available, anticipatory influences of predicted emotions, frustrations caused by considering the decisions, and unrelated factors such as emotions arising from an unrelated event, which are known as incidental emotions, the focus of this study.

While the EIC posits roles for any emotion to influence the JDM process, different outcomes as a function of different emotions can be predicted by the Appraisal Tendency Framework (ATF; Lerner et al., 2015). This framework is based on the presumption

that appraisals underlying emotion elicitation frame the way JDM occurs. In this perspective, emotion appraisals activate cognitive and motivational predispositions to evaluate tasks consistent with the appraisals that triggered the emotion in the first place; such appraisals become an implicit perceptual lens for interpreting tasks and situations.

1.1 | A complement to ATF—An action priming perspective (APP)

Appraisals are not the only distinctive feature of emotions; so are their functions. That is, in addition to unique appraisal tendencies, each discrete emotion is also associated with specific action priming characteristics that prepare bodies for different actions. These characteristics exist because emotions are immediate, transient socio-psycho-biological reactions to stimuli that are perceived as meaningful and that may require potential action. They are vestiges of human evolutionary history and products of an information processing system that allows for action with minimal conscious processing (Cosmides & Tooby, 2000; Tooby & Cosmides, 2008). Emotions exist to facilitate adaptation to and problem-solving of different concerns in the environment related to survival, such as birth, death, threats, natural disasters, and cooperation and competition to deal with rivals for mates, food, and other resources. While emotions are indeed elicited by unique appraisals of stimuli (Matsumoto et al., 1988; Matsumoto & Hwang, 2013; Scherer et al., 2001), when elicited, they prime thinking and action by recruiting organized systems of psychophysiological and behavioral reactions that gate perception and thought, activate unique physiological signatures, and produce specific expressive behavior, sensations, and experiences (Ekman, 1999; Hwang & Matsumoto, 2018; Keltner & Haidt, 1999; Levenson, 1999).

Each discrete emotion has a unique reaction profile that primes specific action (Hwang & Matsumoto, 2018; Keltner & Haidt, 1999; Levenson, 1994, 1999), and we propose that these action primes have differential impacts on JDM. Anger, for instance, functions to prepare the mind and body to remove obstacles, that is, to fight. Disgust facilitates the repelling or elimination of contaminated or rotten objects (e.g., vomiting). Fear facilitates avoidance of threats and reduction of harm through fleeing or freezing. Sadness functions to recoup resources and call for help, and happiness incentivizes behavior toward future goals. These differential functions of discrete emotions have enabled humans to adapt to multiple and different types of threats to survival in their evolutionary history (Al-Shawaf et al., 2016; Cosmides & Tooby, 2000; Darwin, 1872; Plutchik, 2001; Tooby & Cosmides, 2008).

Here, we offer an Action Priming Perspective (APP) as a complement to the ATF to incorporate characteristics of discrete emotions from an evolutionary perspective that may lead to considering how discrete emotions may affect risky JDM tasks in general and on the same task. Although the existing literature examining discrete emotions described above has contributed much to enlightening the associations between discrete emotions and JDM, they all used different tasks in different studies, and for good reason; these tasks were likely chosen for maximal relevance to the specific hypothesized effects of the discrete emotions. A different approach that considers the APP could compare multiple discrete emotions against each other on the same task because task characteristics would be held constant. This would allow for an apples-to-apples comparison of the effects of different specific, discrete emotions because any differences in outcomes would be attributable to the action priming characteristics of the emotions.

Previous studies examining the effects of discrete emotions on aggressive cognitions and behavior have provided evidence to support this claim. In these studies, five discrete emotions were separately and incidentally elicited in members of ideologically motivated groups who completed a series of implicit and explicit hostility measures. A combination of the anger and disgust conditions (elicited separately but combined for analyses) produced more hostility-related language, aggressive cognitions, competitive decision-making using an economic decision-making game, use of force when manipulating a neutral object, and speed of body movement than did fear and sadness (also elicited separately but combined for analyses) (Matsumoto et al., 2016, 2017).

Another study more closely related to risky JDM also supported this claim (Matsumoto & Wilson, 2022). In that study, five emotions—anger, disgust, fear, happiness, and sadness—and a neutral condition were individually elicited in participants using images from the International Affective Picture System (IAPS; Lang et al., 1997), after which they completed the Domain Specific Risk-Taking scale (DOSPERT; Blais & Weber, 2006; Weber et al., 2002). Elevation in emotions tended to produce more risk-taking propensities than neutral; but importantly, different discrete emotions or their combinations produced differential degrees of risk-taking propensities. Testing the same emotion condition effects as did the studies described immediately above (Matsumoto et al., 2016, 2017), the combination of the fear and sadness conditions (elicited separately but combined for analyses) produced the highest risk-taking scores and was significantly greater than an anger–disgust combination of conditions (also elicited separately but combined for analyses). Sadness also produced higher risk-taking scores than disgust (consistent with a sadness vs. disgust comparison in Lerner et al., 2013) or happiness.

The results described above can be explained by considering the APP. For instance, the findings concerning fear and sadness likely occurred because, even though they were elicited separately, both involve more expansive orientations toward threats and losses, with potentially more devastating effects to the self and protective features that focus on oneself (albeit differently). Both would serve to protect and recoup resources because recovery—either physical or of the self—may be a strong motivator of risky behavior. Individuals in whom fear or sadness are elicited may facilitate greater risk-taking because risky behaviors may compensate for loss or threat as a way to recover. Perceptions of threats and losses may also imply mentally that there's little or nothing left to lose, especially if perceptions of pain decrease, which would serve as a buffer against risk. Risky and

ambiguous tasks may amplify such effects because risk and ambiguity may augment the effects of fear or sadness.

Contrastingly, anger and disgust have very different characteristics than fear and sadness. Anger has competitive, agonistic action priming features, while disgust is associated with action primes associated with the repelling of rotten objects and elimination; both these emotions would likely produce calculated levels of risky behavior. Anger and disgust should both affect risk but not to the extent of fear and sadness because anger and disgust action priming involve more constricted, focused cognitive and physiological gating on specific objects (the targets of fighting or elimination). Happiness should also increase risk because of gating that would minimize risk due to achievement or contentment, or less tension and worry about any consequences, but such risk should be more measured and not as great as that of fear or sadness.

1.2 | Overview of the current studies and hypotheses

In this paper, we test predictions based on the action priming characteristics of discrete emotions in two studies with a commonly used behavioral task of risky decision-making—the Balloon Analogue Risk Task (BART; Lejuez et al., 2002).[1] The BART models real-world risky behavior by balancing the potential for reward versus loss. In the task, participants are presented with a balloon and offered a chance to earn points by clicking a button to pump the balloon. Each click causes the balloon to inflate and points to be added to a counter. At some point, the balloon is overinflated and explodes; thus, each pump represents greater risk but also more potential reward. If participants choose to stop before the balloon explodes or if the balloon doesn't explode, they collect the points earned for that trial; but if the balloon explodes, no points are earned. Participants are not informed about the balloons' breakpoints; the absence of this information allows for testing both initial responses to the task and changes in responding as participants gain experience with task contingencies.

We examined the effects of the same five discrete emotions tested in the previous studies reviewed above (Matsumoto et al., 2016, 2017; Matsumoto & Wilson, 2022) on the BART. Anger, disgust, fear, happiness, sadness, and a neutral condition were elicited separately in participants after which they completed the BART. We tested two main hypotheses based on the findings from the previous studies described above reporting the effects of a combination of the fear and sadness conditions versus a combination of the anger and disgust conditions and of a sadness versus disgust comparison:

> **Hypothesis 1.** That a combination of the fear and sadness conditions (hereafter fear–sadness), elicited separately but combined for analyses, would produce more risky behavior than a combination of the anger and disgust conditions (hereafter anger–disgust), also elicited separately but combined for analyses.
>
> **Hypothesis 2.** That sadness would produce more risky behavior compared with disgust.[2]

2 | STUDY 1

2.1 | Methods

2.1.1 | 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 variables were four scores assessing risk-taking behavior derived from the BART (total pumps, pumps that occurred on trials that did not explode, pumps that occurred on trials that did explode, and an overall risk score, all described more fully below).[3]

2.1.2 | Participants

An initial sample of $N = 311$ was filtered to include those who completed the procedures within 60 min, resulting in a total $N = 236$ ($n = 62$ men, 171 women, three no response; $ns = 12$ African Americans, 69 Asian Americans, 35 European Americans, 83 Hispanic or Latinos, 10 Middle Eastern, 18 multiracial or multiethnic, two Native Hawaiian or Pacific Islander, and the remainder Other or no

[1]We acknowledge prior work that has raised questions about whether the BART assesses risk or uncertainty (De Groot & Thurik, 2018). This work suggested that risk is characterized by unknown outcomes with known probability distributions producing the outcomes, while uncertainty is characterized by unknown outcomes and unknown probability distributions; according to this definition, therefore, BART would be characterized as a measure of behavior under uncertainty. However, we maintain the description of it as a measure of risky behavior for several reasons. First, De Groot and Thurik's (2018) definitions of risk and uncertainty presume that they are different and separate from each other but a close read suggests that risk may be a part of uncertainty but not vice versa. Second, their characterizations may refer to the situation and not necessarily to the behavior produced, which may in fact be risky. Third, De Groot and Thurik (2018) themselves acknowledge that decision-making may shift from uncertainty to risk in the BART and that the distinction of when such shifts are made is unclear. For these reasons, we characterize the BART as a measure of risky behavior but encourage readers to interpret our findings with these caveats.

[2]Neither study or the analyses were preregistered as major changes in design and collection procedures were made in response to Covid restrictions that were put in place at the beginning of this project.

[3]To be clear, each emotion was elicited separately in a between-subjects design. To test the hypotheses of the combinatorial effects of some emotions (i.e., fear–sadness vs. anger–disgust), those emotion conditions were combined for analysis. We opted for this procedure instead of comparing each emotion separately for several reasons. First, as described in Section 1, the combined emotions may have overlapped characteristics vis-à-vis risky behavior, while clearly being discrete from each other; thus, there was some theoretical justification to do so. Second, several previous studies, cited in Section 1, have compared emotion conditions using these same combinations, and doing so here would allow for a direct comparison with previous studies; thus, there was some empirical justification to do so. Third, the combinatorial comparisons would allow for a more efficient analysis plan in reducing the number of comparisons required, thereby reducing experiment-wise error. Finally, as we report in the post hoc analyses for both studies, we compared the emotions that were combined for analyses to examine differences between them (and there were none obtained).

response; mean age = 21.77, *SD* = 4.45).[4] All were university students participating in partial fulfillment of class requirements and a $10 gift card, and who were recruited anonymously using an online participant recruitment and management system.

2.1.3 | Presession measures

Participants completed a brief demographic scale asking sex, age, and ethnicity 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 system. In 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 9-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 data, after presentation of the emotion eliciting stimuli as a manipulation check, and at the end of the experiment.

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 version of the Intolerance of Uncertainty Scale (IUS) (Birrell et al., 2011; Buhr & Dugas, 2002; Carleton et al., 2007), the four-item Behavioral Inhibition Scale by Gest (1997) (Shatz, 2005), and the seven-item Behavioral Inhibition Scale by Carver and White (1994). As these measures were not germane to the purpose of the current study, no further mention of them will be made.

2.1.4 | Emotion-eliciting stimuli

Emotions were elicited separately using images from the International Affective Picture System (IAPS; Lang et al., 1997) and in the same manner as in Matsumoto and Wilson (2022).[5] Six images per emotion were selected from pools based on previously published studies on the IAPS examining discrete emotion elicitation (Barke et al., 2012; Libkuman et al., 2007; Mikels et al., 2005; Xu et al., 2017): anger (IAPS#s 2691, 2751, 6312, 6360, 6540, and 9810), disgust (7360, 7380, 9300, 9301, 9322, and 9325), fear (1113, 1120, 1300, 1304, 1930, and 6300), happiness (1463, 1710, 1750, 2040, 2655, and 8497), and sadness (2205, 2276, 2800, 2900, 3230, and 3300), along with selections for neutral (2484, 7000, 7003, 7160, 7012, and 7041).

2.1.5 | Risk-taking measure

We utilized the Balloon Analogue Risk Task (BART; Lejuez et al., 2002; described earlier in Section 1). In this study, participants completed 10 trials and were given 10 s to complete each trial. Maximum pumps were set at 32 (which determined the probability of balloon explosions), and chance for balloon explosions was set to be randomized. Four scores were produced on each trial—points earned, whether or not the balloon exploded, number of pumps, and time remaining. We computed totals for each of these scores across the 10 trials for each participant.

For the main analyses below, we used four scores as they were directly associated with participants' risk-taking behavior: Total Pumps, mean pumps on trials where the balloon exploded (Pumps Explosion), mean pumps on trials where the balloon did not explode (Pumps No Explosion), and an Overall Risk Score. This latter score was computed on the basis of a principal components analysis on the four original scores that produced two components, with Total Pumps and Total Explosions both loading positively on one (factor loadings were 0.80 and 0.89, respectively, and no other score loading greater than 0.10; zero-order correlation between Total Pumps and Total Explosions = $r(316) = .41$, $p < .001$. (A report of analyses on the other BART scores [points, explosions, and time remaining] is provided in Supporting Information S1).

2.1.6 | Procedures

The study was conducted online. After consent, participants completed the presession measures, after which they were provided with instructions for the image observation task, which explained that a series of images will be presented singly 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, after which the six images for a single emotion were presented and participants wrote their responses to each image. Emotion Type was randomized across participants. After presentation of the six images for an emotion, participants then completed the self-reported emotion scale. These same procedures have been used in previous studies and have successfully elicited the intended discrete emotions (Matsumoto et al., 2016, 2017; Matsumoto & Wilson, 2022).

[4]We instituted the duration limitation as a measure of quality control on the data. The procedures for both studies were separated into two parts; Part 1 ended after the emotion elicitation and self-reported emotion manipulation check, and Part 2 ended at the end of the study. Both parts were seamlessly linked together so the separation of the studies was unobservable to the participants. Mean durations for Part 1 in Studies 1 and 2 were 156 and 135 min, respectively, which strongly suggested that some participants lost attention to the task and some may have even walked away and come back or may have been multitasking with other tasks or online studies. Because the dependent variable (BART) occurs in Part 2 right after the emotion elicitation in Part 1, the dependent variable task may not have occurred after emotion elicitation as intended for some participants. For these reasons, we adopted the duration criteria reckoning that a total time of 60 min was ample time for completion of the study in a single sitting. Pilot studies also indicated that the procedures could be completed comfortably in 50 min.

[5]A previous meta-analysis (Lench et al., 2011) demonstrated that images are the most effective methods to produce discrete emotions, but a subsequent meta-analysis (Ferrer et al., 2015) also concluded that videos may be more effective in online studies. In this study, we opted to use images because of the success of previous studies to do so, as well as to incorporate the possibility of in-person as well as online methodologies in this and subsequent studies.

After emotion elicitation, participants then completed the BART, after which they completed 10 items from the Anderson Word Fragment task (Anderson et al., 2003) as a filler task (not germane to this study and no further mention of it will be made). As a manipulation check, participants then rated five items about the tasks using a 5-point scale labeled *Strongly Disagree* (1) to *Strongly Agree* (5): I was uncertain, the outcomes were ambiguous, the tasks were difficult, the tasks were risky, and the tasks made me hesitate. These items were averaged to create a composite uncertainty score ($\alpha = .75$). Participants then saw three positive IAPS images not used in the study and completed the same observational tasks on each, after which they completed a self-report emotion rating again, were debriefed, and provided instructions to receive compensation.

2.2 | Results

2.2.1 | Manipulation checks and preliminary analyses

Emotion changes

To examine if the elicitation procedures produced the intended emotions, we computed a three-way mixed, overall ANOVA on the emotion ratings using Emotion Type (6), Pre-Post (2), and Rating (15) as factors. The three-way interaction was significant, $F(70, 3976) = 10.16$, $p < .001$, $\eta_p^2 = .152$. We decomposed this effect by computing simple effects of Pre-Post separately for each Emotion Type and Rating. Anger images produced increases in anger, fear, disgust, surprise, and sadness and decreases in excitement, amusement, interest, and pride. Disgust images produced increases in disgust and surprise and decreases in excitement, amusement, interest, sadness, and pride. Fear images produced increases in fear, disgust, and surprise and decreases in guilt. Happy images produced increases in amusement and decreases in fear, anger, worry, disgust, nervousness, sadness, and shame. Sad images produced increases in sadness and guilt and decreases in contempt, excitement, amusement, interest, and pride. Neutral images produced increases in surprise and decreases in excitement, interest, and shame. Each set of emotion images 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), but changes in the intended emotion had the largest effects for all emotions, with the exception of fear (*d*s for increases in target emotions were 1.05, 1.41, 0.25, 0.58, and 0.92 for anger, disgust, fear, happiness, and sadness, respectively). Thus, the emotion elicitation worked as intended. For fear, surprise had the largest effect size (1.00), and the findings below should be interpreted with this caveat (tables of descriptives and findings available in Supporting Information S1).

Uncertainty ratings of the BART

We computed a single-sample *t*-test on the composite manipulation check score produced after participants completed the BART using the scale midpoint (3.0) as the comparison value. As a whole, participants agreed that the task/situation was uncertain ($M = 3.20$, $SD = 0.78$), $t(235) = 3.95$, $p < .001$, $d = 0.77$. A one-way ANOVA on this score using Emotion Type (6) as the independent variable did not produce a significant effect.

2.2.2 | Main analyses

All participants

Descriptives for the four BART scores by Emotion Type are given in Table 1. We tested the hypotheses using SPSS Process (Hayes, 2013), a path analysis modeling tool that combines traditional mediation and moderation analyses (Baron & Kenny, 1986; MacKinnon et al., 2002) and assesses the conditional nature (moderation) of the direct effects of one variable on another, with or without indirect effects through another variable (mediation). PROCESS allows for specification of multiple types of moderation and mediation effects and bootstraps effects, allowing for an examination of confidence intervals in addition to null-hypothesis statistical testing. Because the emotion conditions had the intended effect on self-reported emotions, we utilized Model 4 (model examining the effects of a single mediator on the effects of an independent variable on a dependent) on the fear–sadness versus anger–disgust and sadness versus disgust comparisons on the four BART scores using changes in self-reported target emotion ratings as the mediator. Table 2 reports the effects only for the emotion condition comparisons involving the hypotheses; all effects are reported in Table S1.

For Hypothesis 1, the overall models were significant on Total Pumps, Pumps No Explosion, and Pumps Explosion; the fear–sadness combination produced more risky behavior than did the anger–disgust combination on these three variables. Changes in emotion ratings did not have direct effects on these variables once the emotion condition effects were accounted for, and the indirect effects were not significant. On Overall Risk, the overall model approached significance but there were no significant effects of the predictors. Thus, Hypothesis 1 was supported on three of four BART scores.

For Hypothesis 2, the overall models were significant on all four BART scores: Sadness produced more risky behavior than did disgust in all analyses. Changes in emotion ratings did not have a direct effect on risky behavior once the emotion condition effects were accounted for, and the indirect effects were not significant. Thus, Hypothesis 2 was supported on all four BART scores.

Participants filtered to include only those who increased on target emotion

Because of variation in profiles of emotional responses to the elicitation procedures, some participants may not have increased in the target emotion (despite overall mean increases in those emotions), possibly confounding the effects reported previously. Thus, we filtered the data to include only participants who increased on the target emotion and computed bootstrapped *t*-tests to examine differences between the fear–sadness versus anger–disgust and

		Anger	Disgust	Fear	Happiness	Sadness	Neutral
Study 1							
Total pumps	*M*	96.03	81.48	108.37	102.63	104.69	90.41
	SE	5.99	5.33	7.01	5.26	5.63	5.24
Pumps no explosion	*M*	9.72	8.63	11.34	10.29	11.49	8.95
	SE	0.72	0.62	0.80	0.65	0.66	0.65
Pumps explosion	*M*	9.05	7.03	10.07	10.15	9.61	8.69
	SE	0.67	0.56	0.75	0.73	0.66	0.58
Overall risk	*M*	0.06	−0.49	0.11	0.21	0.09	0.04
	SE	0.17	0.12	0.17	0.17	0.15	0.16
Study 2							
Total pumps	*M*	44.02	47.70	47.51	47.04	46.33	46.37
	SE	2.73	2.69	2.46	2.77	3.04	2.95
Pumps no explosion	*M*	4.32	4.78.	4.65	4.79	4.70	4.67
	SE	0.35	0.30	0.29	0.35	0.33	0.31
Pumps explosion	*M*	4.30	4.79	4.71	4.74	4.26	4.60
	SE	0.29	0.35	0.31	0.33	0.34	0.35
Overall risk	*M*	−0.13	0.13	−0.01	−0.03	−0.04	0.08
	SE	0.13	0.13	0.12	0.13	0.15	0.16

TABLE 1 Descriptives (means and standard errors) for total pumps, pumps no explosion, pumps explosion, and overall risk by emotion type, separately by target emotions, Studies 1 and 2.

sadness versus disgust comparisons on the four BART scores.[6] All analyses were significant (Table 3); thus, the findings reported for the total sample survived when participants were filtered to include only those who increased in the target emotions.

2.2.3 | Post hoc analyses

First BART trial

An argument could be made that emotion effects may be different on the first BART trial because it occurred immediately after the emotion manipulation and was not influenced by previous trials (unlike scores computed across all 10 trials). Thus, we computed the same mediation analyses on pumps produced on the first BART trial. No effect was significant, indicating that the effects reported in the main analyses were produced across the 10 trials.

Uncertainty ratings as mediator

We also computed the mediation analyses above using the uncertainty ratings as the mediator on the emotion condition comparisons. In all analyses, the fear–sadness combination produced more risky behavior than did the anger–disgust combination, and sadness produced more risky behavior than disgust. The uncertainty ratings did not affect risky behavior, and the indirect effects were not significant (see Table S2 for full report of effects).

[6]For these analyses, we opted for bootstrapped *t*-tests because the reduction in power due to the reduced sample sizes would prohibit meaningful mediation tests as conducted in the main analyses.

Other emotion comparisons

Examining whether other emotions or emotion combinations had effects on risky behavior was important to investigate whether emotion effects were isolated to the ones tested in the main analyses. We therefore examined several post hoc comparisons: the combination of all emotions versus neutral, anger–disgust combination versus neutral, and fear–sadness combination versus neutral. A one-way ANOVA using Emotion Type (6) as the independent variable on the four BART scores indicated that the fear–sadness combination produced significantly higher risk scores than neutral on Total Pumps and Pumps No Explosions, $p = .032$ and $p = .003$, respectively. All other effects were not significant.

We also tested the possibility that the differences in risky behavior could be accounted for by a positive versus negative differentiation among the emotions by recomputing the ANOVAs including a contrast comparing happiness versus an anger–disgust–fear–sadness combination on all four BART scores and a separate happiness versus sadness contrast. No effect was significant. Finally, because our hypotheses involved combining fear with sadness and anger with disgust, we compared both pairs of emotions using Scheffe corrections on all four BART scores. No effect was significant.

2.3 | Discussion

Findings on three of the four BART scores using the entire sample supported Hypothesis 1, and findings on all four BART scores supported Hypothesis 2. The fear–sadness combination produced more risky behavior than the anger–disgust combination, and sadness produced more risky behavior than disgust. These findings were important as they demonstrated theoretically predicted differential

TABLE 2 Effects of fear–sadness versus anger–disgust and sadness versus disgust comparisons in Studies 1 and 2.

	BART score	Coefficient	SE	*t*	*p*	LLCI	ULCI
Fear–sadness versus anger–disgust[a]							
Study 1	Total pumps	15.87	6.61	2.40	.018	2.82	28.91
	Pumps no explosions	2.03	0.77	2.65	.009	0.52	3.54
	Pumps explosions	1.66	0.73	2.27	.025	0.21	3.10
	Overall risk	0.27	0.17	1.59	.114	−0.07	0.60
Study 2	Total pumps	16.93	8.23	2.06	.041	0.72	33.15
	Pumps no explosions	1.20	0.97	1.23	.219	−0.72	3.12
	Pumps explosions	1.39	0.97	1.43	.153	−0.52	3.30
	Overall risk	0.42	0.40	1.04	.298	−0.37	1.20
Sadness versus disgust[b]							
Study 1	Total pumps	22.88	8.48	2.70	.009	6.00	39.76
	Pumps no explosions	2.59	0.99	2.63	.010	0.63	4.56
	Pumps explosions	2.80	0.94	2.99	.004	0.93	4.67
	Overall risk	0.51	0.21	2.43	.017	0.09	0.92
Study 2	Total pumps	25.29	12.60	2.01	.047	0.30	50.28
	Pumps no explosions	1.68	1.41	1.19	.235	−1.11	4.47
	Pumps explosions	2.51	1.51	1.66	.100	−0.49	5.51
	Overall risk	0.45	0.61	0.74	.463	−0.77	1.67

[a]Anger–disgust was coded as 0, and fear–sadness was coded as 1.
[b]Disgust was coded as 0, and sadness was coded as 1.

TABLE 3 Results of bootstrapped *t*-tests including only participants who increased in the target emotion, Study 1.

Fear–sadness versus anger–disgust							
	FESA ($n = 46$)	**ANDI ($n = 59$)**	***t***	***p***	**Cohen's *d***	**95% LLCI[a]**	**95% ULCI**
Total pumps	101.87 (5.85)	86.08 (4.24)	2.24	.028	0.44	1.86	30.74
Pumps no explosions	11.00 (0.67)	8.93 (0.52)	2.50	.014	0.49	0.42	3.76
Pumps explosions	9.28 (0.62)	7.88 (0.48)	1.84	.068[b]	0.36	−0.02	3.01
Overall risk	0.07 (0.14)	−0.33 (0.10)	2.44	.016	0.48	0.08	0.74
Sadness versus disgust							
	SA ($n = 26$)	**DI ($n = 37$)**	***t***	***p***	**Cohen's *d***	**95% LLCI**	**95% ULCI**
Total pumps	101.08 (6.66)	83.08 (5.85)	2.01	.048	0.52	0.52	36.88
Pumps no explosions	10.72 (0.68)	8.73 (0.68)	2.01	.048	0.51	0.01	3.96
Pumps explosions	9.36 (0.75)	7.33 (3.28)	2.15	.036	0.55	0.23	3.92
Overall risk	0.03 (0.17)	−0.45 (0.13)	2.31	.024	0.59	0.05	0.91

Abbreviations: ANDI, anger–disgust combination; DI, disgust; FESA, fear–sadness combination; SA, sadness.
[a]CIs are computed on the differences between the means.
[b]We interpret this *p*-value as support for the hypothesis given its directional nature (that FESA > ANDI).

effects among different discrete emotions or their combinations on the same ambiguous JDM task using a behavioral measure, as predicted by the APP. In general, they replicated and extended the findings reported previously by Matsumoto and Wilson (2022).

One limitation of the study concerned the risk settings used in the study, which were standard in the common usage of the BART task. A riskier setting may enhance the effects of the emotions; that is, a higher probability of balloon explosions would produce quicker explosions that would likely enhance risk associated with the task as it would magnify the emotions elicited (consistent with the notion in the EIC that emotions associated with the task can influence JDM). Thus, in Study 2, we set the BART to have explosions sooner than in Study 1, presumably increasing task riskiness. We hypothesized that the effects predicted originally would be replicated with larger effect sizes because of the increased riskiness. Also, we increased the sample size to allow for tests of sex differences.

3 | STUDY 2

3.1 | Method

3.1.1 | Participants

An initial sample of $N = 357$ was filtered to include those who completed the procedures within 60 min, resulting in a total $N = 325$ ($n = 184$ women, 140 men, one undeclared; $ns = 137$ African American or Black, seven American Indian or Native American or Alaska Native, 51 Asian American, 51 European American or White, 51 Hispanic or Latina/o/x, nine Middle Eastern, 13 Multiracial or Multiethnic, one Native Hawaiian or Pacific Islander, and the remainder Other or no response; mean age = 22.48, $SD = 4.44$). All were university students participating in partial fulfillment of class requirements and a $10 gift card and who were recruited anonymously using an online participant recruitment and management system.

3.1.2 | Procedures

The instruments, stimuli, and procedures were the same as in Study 1 with the sole exception that the BART settings were adjusted so that chance of balloon bursts in a trial was set at 16 as the maximum number of pumps (i.e., the balloon would burst more often), presumably making the task riskier.

3.2 | Results

3.2.1 | Manipulation checks and preliminary analyses

Emotion changes

We computed a three-way mixed, overall ANOVA on the emotion ratings using Emotion Type (6), Pre-Post (2), and Rating (15) as factors. The three-way interaction was significant, $F(70, 3934) = 8.35$, $p < .001$, $\eta_p^2 = .129$. We decomposed this effect by computing simple effects of Pre-Post separately for each Emotion Type and Rating. Anger images produced increases in anger, fear, worry, disgust, surprise, and sadness and decreases in excitement, interest, and pride. Disgust images produced increases in disgust, anger, embarrassment, surprise, and shame and decreases in excitement, interest, and pride. Fear images produced increases in fear, worry, disgust, and surprise and decreases in excitement, interest, pride, and shame. Happy images produced increases in amusement, excitement, and surprise and decreases in embarrassment and disgust. Sad images produced increases in sadness and decreases in excitement, interest, and pride. Neutral images produced decreases in guilt, anger, embarrassment, disgust, nervousness, and sadness.

As in Study 1, changes in the intended emotion had the largest effects for all emotions, except for fear (*ds* for increases in target emotions were 0.80, 1.71, 0.38, 0.41, and 0.48 for anger, disgust, fear, happiness, and sadness, respectively). Thus, the emotion elicitation worked as intended. For fear, disgust had the largest effect size (0.58) followed by surprise (0.53), and the findings below should be interpreted with this caveat (tables of descriptives and findings available in Supporting Information S1).

Uncertainty ratings of the BART

We computed a single-sample *t*-test on the composite manipulation check score produced after participants completed the BART using the scale midpoint (3.00) as the comparison value. Contrary to our expectations, participants disagreed that the task/situation was uncertain ($M = 2.87$, $SD = 1.06$), $t(324) = -2.25$, $p = .025$, $d = -0.13$, despite the presumably riskier BART setting. A one-way ANOVA using Emotion Type (6) as the independent variable on the manipulation check score produced no significant effects.

3.2.2 | Main analyses

All participants

Descriptives for the BART scores by Emotion Type are given in Table 1. We tested the hypotheses using SPSS Process Model 5 (model examining the effects of a mediator and a moderator on the effects of an independent variable on a dependent variable) to test the effects of the emotion condition comparisons on risky behavior using the changes in self-reported emotion ratings as the mediator, but we also included sex as a possible moderator because this analysis was more adequately powered than in Study 1.

For Hypothesis 1, the overall models were significant for Total Pumps, Mean Pumps Explosions, and Overall Risk. (Table 2 reports the effects only for the emotion condition comparisons; all effects are reported in Table S5.) On Total Pumps, the emotion condition was significant, indicating that the fear–sadness combination again produced more risky behavior than the anger–disgust combination, as predicted. The interaction was also significant, and conditional analyses indicated that the fear–sadness combination produced more risky behavior than anger–disgust for women but not men. There were no significant emotion condition effects on the other three BART scores.

For Hypothesis 2, the overall models were not significant on any BART score. The emotion condition effect was significant on Total Pumps, with sadness producing more risky behavior than disgust, as predicted. The interactions were also significant on Total Pumps and Mean Pumps Explosions; conditional effects analyses indicated trends for disgust to produce more risky behavior than sadness for men only. No effects were significant on Overall Risk or Mean Pumps no Explosions.

Participants filtered to include only those who increased on target emotion

As in Study 1, we computed bootstrapped *t*-tests to examine differences between the fear–sadness versus anger–disgust and sadness versus disgust comparisons on the four BART scores using only participants who increased on the target emotion. Unlike Study 1, only one analysis was significant and in the opposite direction: Disgust produced more Pumps

Explosions than did sadness. Thus, the findings reported for the total sample did not survive when participants were filtered to include only those who increased in the target emotions (Table 4).

Because sex moderated two of the sadness versus disgust comparisons in the main analyses, we recomputed the bootstrapped *t*-tests comparing sadness versus disgust separately for men and women. For women, none of the analyses was significant. For men, three of the four analyses were significant, all indicating that disgust produced more risky behavior than sadness (Table 4). The interpretation of these findings should be tempered by the restricted power in these analyses.

3.2.3 | Post hoc analyses

Differences in target coefficients between Studies 1 and 2

We tested differences in the coefficients for the fear–sadness versus anger–disgust and the sadness versus disgust comparisons on the four BART scores obtained in Studies 1 and 2 and reported in Tables 2 and 3. No comparison was significant, $-.35 < zs < .67$, $.503 < ps < .928$. Thus, the effect sizes for these comparisons were not statistically different between the two studies despite differences in statistical significance testing whether each coefficient was >0.

First BART trial

As in Study 1, we tested the hypotheses on the pumps produced on the first BART trial. No effects were significant. Thus, the effects reported earlier emerged after the first trial.

Uncertainty ratings as mediator

We recomputed the moderated mediation analyses above using the uncertainty ratings manipulation check as the mediator on both emotion condition comparisons. Interestingly, the effects of the emotion condition, sex, and their interaction were all not significant for all risk variables. The direct effects of the uncertainty ratings, however, were significant in all models, indicating that greater perceived uncertainty in the task was positively associated with more risky behavior. Thus, once all relevant variables were in the same model, the effects of emotion and sex disappeared, and the only variable to affect the risky behavior was the perceived uncertainty of task. (See Table S6 for fuller presentation.)

Other emotion comparisons

We examined the same post hoc comparisons as in Study 1: the combination of all emotion conditions versus neutral, anger–disgust combination versus. neutral, and fear–sadness combination versus neutral. An Emotion Type (6) ANOVA on all four BART scores produced no significant effects. We also tested the possibility that the differences in risky behavior could be accounted for by a positive versus negative differentiation among the emotions by recomputing overall ANOVAs including a contrast comparing happiness versus an anger–disgust–fear–sadness combination. No effect was significant on any BART scores. Finally, because our hypotheses involved combining fear with sadness and anger with disgust, we compared both pairs of emotions using the same contrast procedures as above using Scheffe correction; neither pair was significant for any BART score.

TABLE 4 Results of bootstrapped *t*-tests testing the hypotheses including only participants who increased in the target emotion, Study 2.

	Fear–sadness versus anger–disgust						
	FESA ($n = 53$)	**ANDI ($n = 77$)**	***t***	***p***	**Cohen's *d***	**95% LLCI[a]**	**95% ULCI**
Total pumps	45.23 (2.70)	49.62 (2.39)	1.21	.230	0.22	−2.91	11.75
Pumps no explosions	4.65 (0.31)	4.92 (0.28)	1.09	.270	0.12	−0.51	1.03
Pumps explosions	4.15 (0.33)	4.83 (0.28)	1.55	.123	0.28	−0.18	1.56
Overall risk	−0.09 (0.13)	0.16 (0.33)	1.41	.154	0.25	−0.10	0.61
	Sadness versus disgust						
	SA ($n = 27$)	**DI ($n = 46$)**	***t***	***p***	**Cohen's *d***	**95% LLCI**	**95% ULCI**
Total pumps	43.63 (4.12)	50.89 (3.02)	1.44	.155	0.35	−2.99	17.69
Pumps no explosions	4.52 (0.45)	5.06 (0.34)	0.98	.331	0.24	−0.61	1.69
Pumps explosions	3.82 (0.45)	5.11 (0.38)	2.14	.036	0.52	0.13	2.51
Overall risk	−0.17 (0.20)	0.28 (0.45)	1.81	.074	0.44	−0.06	0.97
	Sadness versus disgust (males only)						
	SA ($n = 11$)	**DI ($n = 21$)**	***t***	***p***	**Cohen's *d***	**95% LLCI**	**95% ULCI**
Total pumps	35.82 (4.22)	53.00 (4.56)	2.45	.021	0.91	5.72	28.42
Mean pumps no explosions	4.00 (0.62)	5.23 (0.51)	1.46	.155	0.55	−0.39	2.73
Mean pumps explosions	3.07 (0.26)	5.12 (0.55)	2.61	.014	0.97	0.94	3.16
Overall risk	−0.49 (0.25)	0.21 (0.22)	2.00	.054	0.75	0.06	1.29

Abbreviations: ANDI, anger–disgust combination; DI, disgust; FESA, fear–sadness combination; SA, sadness.
[a]CIs are computed on the differences between the means.

4 | GENERAL DISCUSSION

The hypotheses were mainly supported in Study 1: The fear–sadness combination (elicited separately but combined for analyses) produced more pumps on the BART than did the anger–disgust combination on three of four BART scores, and sadness produced more pumps than did disgust on all four BART scores. These emotion condition differences did not occur on the first BART trial in either study, did not affect any other BART outcome variable, and could not be accounted for by a simple positive–negative distinction among the emotions. Findings in Study 2 were equivocal, with the hypotheses supported on one of four BART scores for both comparisons.

The emotion condition differences reported in Study 1 were predicted based on the action priming functions of discrete emotions, the Action Priming Perspective (APP) as described in Section 1. The Study 1 results replicated findings from a previous study involving a self-report measure of risk-taking (Matsumoto & Wilson, 2022) and were consistent with previous studies on aggressive cognitions and behavior (Matsumoto et al., 2016, 2017). Based on the APP, on one hand, we suggested that fear and sadness would invoke greater risk-taking because they both trigger protective features that may include risky behavior in order to protect or recover the self. This concept is aligned with previous research demonstrating fear to increase risk estimates (Fischhoff et al., 2012; Lerner et al., 2003) and sadness to produce more impatience in participants and desire for money (Lerner et al., 2013), more consumption and spending (Cryder et al., 2008; Garg & Lerner, 2013), and heightened addictive substance abuse (Dorison et al., 2020). Outcomes of risky behaviors may be perceived as ways of compensating for losses or threats as ways for individuals to regain homeostasis, an idea originally suggested by Plutchik (1982, 1994, 2001). Perceptions of threats or losses may also imply mentally that there's little or nothing left to lose, especially if perceptions of pain decrease, which would serve as a buffer against risk. Risky and ambiguous tasks may amplify such effects because risk and ambiguity would augment the effects of fear or sadness because risk and ambiguity could be considered contexts associated with fear and/or sadness.

On the other hand, anger and disgust have very different functions. Anger's agonistic features and disgust's focus on elimination of rotten objects involve more specificity about the elicitors and thus may not trigger generic risky behavior, such as that represented by the BART. Inspection of the anger and disgust means in both studies and their comparison with the neutral condition would support such an interpretation. This idea is also aligned with previous studies that have reported that anger produces more heuristic and risky decision-making (Ferrer et al., 2017; Lerner & Tiedens, 2006). Thus, the effects of anger and disgust on ambiguous or risky judgments and decision-making may be more task-specific, whereas those of fear and sadness may be not in some contexts.

The Study 2 findings, however, were not as strong and supported the predictions only on Total Pumps. Importantly, the hypotheses were not supported in Study 2 in analyses involving only participants who increased on the target emotions. These non-findings may have occurred because of a misinterpretation on our part about the risk settings of the BART. Although we had suggested that higher probability of balloon explosions used in Study 2 would enhance the riskiness of the task, in fact, it might have had an opposite effect. The setting more likely reduced variation in the BART scores (as evidenced in Table 1) and may have led to more pronounced learning effects such that all participants approached an optimal solution (i.e., maximizing expected value). Uncertainty (and thus risk), therefore, may in fact have been reduced by this setting; the lower uncertainty ratings obtained in Study 2 would be consistent with this idea. Lower uncertainties and risk in the task may have mitigated any effects of the incidental emotion elicitation, and risky behavior may have been influenced more largely by the uncertainties/risk (or lack thereof) in the task itself.[7]

The difference between the two studies' findings concerning the uncertainty ratings that were obtained as a manipulation check after the BART may also corroborate that idea. In Study 1, these ratings were not associated with risky behavior; in Study 2, they were significantly associated with all BART scores and emotion condition effects disappeared. We interpret these findings as supporting the notion above that the balloon explosion settings in Study 2 created less uncertainty about the task and that participants' perceptions of uncertainty were the main driving factor producing more pump behavior, reducing any emotion condition effects. When the task was riskier (Study 1), those perceptions of uncertainty did not affect pump behavior as much, therefore allowing emotion condition effects to emerge. This suggests that the risk salience of the task may moderate emotion effects; that is, low uncertainty/risk tasks may produce their own set of emotions or affects that neutralize the possible effects of other emotions. This possibility should be followed in the future.

Study 2 did produce an interesting set of findings concerning possible sex moderation of the emotion effects. Overall, those analyses indicated that disgust produced more risky behavior than sadness but in men only, contrary to our predictions. Analyses including all participants pointed to such effects, and analyses of participants who increased in the intended emotions produced more consistent, significant results. The findings, however, were limited by restricted sample sizes, especially those in the post hoc analyses. Nevertheless, they suggested interesting effects that should be followed in future studies.

The findings reported here added to a growing literature of the effects of discrete emotions on ambiguous or risky JDM and point to other interesting questions for future research to address. Hopefully, the APP, along with the ATF, can facilitate such evolutions in the field. For example, given that the findings reported above were apparently moderated by the uncertainty of the task, future research may address the boundaries of possible emotion effects on risky behavior vis-à-vis perceptions of task uncertainty. Future research should also endeavor to search for mediators of the observed effects when they occur. The results from both studies indicated that individual

[7]We thank an anonymous reviewer for pointing this possibility out to us, along with relevant literature.

differences in changes in self-reported emotions did not mediate emotion condition differences once the effects of the emotion elicitation were accounted for. Other potential mediators should be tested, such as perceptions of threat and loss, pain, or beliefs that there's nothing to lose. Future studies should also examine how individual differences may potentially moderate the effects of emotion elicitations on risky behavior.

The findings were limited in several ways, one of which was the nature of the task. Although the BART is a well-used measure of risky behavior, it was the sole measure used in the studies reported here. Relatedly, participants were not paid according to the outcomes of their engagement with the BART, which may have reduced the ecological validity of the measure. Future studies will need to examine if the emotion condition differences observed here will be obtained with other measures of risky behavior. Another limitation concerned the fact that the two studies employed an incidental emotion elicitation procedure; that is, the emotions that were elicited were not directly associated with the task itself that produced the outcome data, and task-contingent emotions should be explored more in future studies. The reported sex differences were limited by low power, and future studies should be designed with adequate power to explore more fully such effects. Finally, the findings reported here were derived entirely from university student samples, and future studies should include nonstudents to increase the external validity of the findings.

In summary, we introduced the Action Priming Perspective (APP) as a complement to the Appraisal Tendency Framework (ATF) to predict differential effects of discrete emotions on risky behavior. While the ATF focuses on the appraisal aspects of the emotion elicitation process, the APP focuses on the action priming functions of emotions. Findings from Study 1 provided evidence for the APP, with a fear–sadness combination (elicited separately but merged for analyses) producing more risky behavior than an anger–disgust combination and sadness producing more risky behavior than disgust. The findings from Study 2 suggested an important boundary of the possible effects of discrete emotions on risky behavior. Collectively, the findings should encourage further research on the effects of discrete emotions on risky behavior and the conditions in which they occur.

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CONFLICT OF INTEREST STATEMENT

The authors declared no potential conflicts of interests with respect to the authorship and/or publication of this article.

DATA AVAILABILITY STATEMENT

Data are available upon requests to the lead author.

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REFERENCES

Al-Shawaf, L., Conroy-Beam, D., Asao, K., & Buss, D. M. (2016). Human emotions: An evolutionary psychological perspective. *Emotion Review*, *8*(2), 173–186. https://doi.org/10.1177/1754073914565518

Anderson, C. A., Carnagey, N. L., & Eubanks, J. (2003). Exposure to violent media: The effects of songs with violent lyrics on aggressive thoughts and feelings. *Journal of Personality and Social Psychology*, *84*, 960–971. https://doi.org/10.1037/0022-3514.84.5.960

Barke, A., Stahl, J., & Kröner-Herwig, B. (2012). Identifying a subset of fear-evoking pictures from the IAPS on the basis of dimensional and categorical ratings for a German sample. *Journal of Behavior Therapy and Experimental Psychiatry*, *43*(1), 565–572. https://doi.org/10.1016/j.jbtep.2011.07.006

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*(6), 1173–1882. https://doi.org/10.1037/0022-3514.51.6.1173

Birrell, J., Meares, K., Wilkinson, A., & Freeston, M. (2011). Toward a definition of intolerance of uncertainty: A review of factor analytical studies of the Intolerance of Uncertainty Scale. *Clinical Psychology Review*, *31*(7), 1198–1208. https://doi.org/10.1016/j.cpr.2011.07.009

Blais, A.-R., & Weber, E. U. (2006). A domain-specific risk-taking (DOSPERT) scale for adult populations. *Judgment and Decision Making*, *1*(1), 33–47. https://doi.org/10.1017/S1930297500000334

Buhr, K., & Dugas, M. J. (2002). The intolerance of uncertainty scale: Psychometric properties of the English version. *Behaviour Research and Therapy*, *40*(8), 931–945. https://doi.org/10.1016/S0005-7967(01)00092-4

Carleton, R. N., Norton, M. A. P. J., & Asmundson, G. J. G. (2007). Fearing the unknown: A short version of the Intolerance of Uncertainty Scale. *Journal of Anxiety Disorders*, *21*(1), 105–117. https://doi.org/10.1016/j.janxdis.2006.03.014

Carver, C. S., & White, T. L. (1994). Behavioral inhibition, behavioral activation, and affective responses to impending reward and punishment: The BIS/BAS scales. *Journal of Personality and Social Psychology*, *67*(2), 319–333. https://doi.org/10.1037/0022-3514.67.2.319

Cosmides, L., & Tooby, J. (2000). Evolutionary psychology and the emotions. In M. Lewis & J. M. Haviland-Jones (Eds.), *Handbook of emotions* (2nd ed., pp. 91–115). Guilford Press.

Cryder, C. E., Lerner, J. S., Gross, J. J., & Dahl, R. E. (2008). Misery is not miserly: Sad and self-focused individuals spend more. *Psychological Science*, *19*(6), 525–530. https://doi.org/10.1111/j.1467-9280.2008.02118.x

Darwin, C. (1872). *The expression of emotion in man and animals*. Oxford University Press. https://doi.org/10.1037/10001-000

De Groot, K., & Thurik, R. (2018). Disentangling risk and uncertainty: When risk-taking measures are not about risk [perspective]. *Frontiers in Psychology*, *9*, 2194. https://doi.org/10.3389/fpsyg.2018.02194

Dorison, C. A., Wang, K., Rees, V. W., Kawachi, I., Ericson, K. M. M., & Lerner, J. S. (2020). Sadness, but not all negative emotions, heightens addictive substance use. *Proceedings of the National Academy of Sciences*, *117*(2), 943–949. https://doi.org/10.1073/pnas.1909888116

Ekman, P. (1999). Basic emotions. In T. Dalgleish & T. Power (Eds.), *The handbook of cognition and emotion* (pp. 45–60). John Wiley and Sons, Ltd. https://doi.org/10.1002/0470013494.ch3

Ferrer, R. A., Grenen, E. G., & Taber, J. M. (2015). Effectiveness of internet-based affect induction procedures: A systematic review and meta-analysis. *Emotion*, *15*, 752–762. https://doi.org/10.1037/emo0000035

Ferrer, R. A., Maclay, A., Litvak, P. M., & Lerner, J. S. (2017). Revisiting the effects of anger on risk-taking: Empirical and meta-analytic evidence for differences between males and females. *Journal of Behavioral Decision Making*, *30*(2), 516–526. https://doi.org/10.1002/bdm.1971

Ferrer, R. A., Taber, J. M., Sheeran, P., Bryan, A. D., Cameron, L. D., Peters, E., Lerner, J. S., Grenen, E., & Klein, W. M. P. (2020). The role of incidental affective states in appetitive risk behavior: A meta-analysis. *Health Psychology*, *39*(12), 1109–1124. https://doi.org/10.1037/hea0001019

Fischhoff, B., Gonzalez, R. M., Lerner, J. S., & Small, D. A. (2012). Evolving judgments of terror risks: Foresight, hindsight, and emotion: A reanalysis. *Journal of Experimental Psychology: Applied*, *18*(2), e1–e18. https://doi.org/10.1037/a0027959

Garg, N., & Lerner, J. S. (2013). Sadness and consumption. *Journal of Consumer Psychology*, *23*(1), 106–113. https://doi.org/10.1016/j.jcps.2012.05.009

Gest, S. D. (1997). Behavioral inhibition: Stability and associations with adaptation from childhood to early adulthood. *Journal of Personality and Social Psychology*, *72*(2), 467–475. https://doi.org/10.1037/0022-3514.72.2.467

Han, S., Lerner, J. S., & Zeckhauser, R. (2012). The disgust-promotes-disposal effect. *Journal of Risk and Uncertainty*, *44*(2), 101–113. https://doi.org/10.1007/s11166-012-9139-3

Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. Guilford Press.

Hwang, H. C., & Matsumoto, D. (2018). Functions of emotions. In R. Biswas-Diener & E. Diener (Eds.), *Noba textbook series: Psychology*. DEF Publishers. https://nobaproject.com/modules/functions-of-emotions

Keltner, D., & Haidt, J. (1999). Social functions of emotion at four levels of analysis. *Cognition and Emotion*, *13*(5), 505–521. https://doi.org/10.1080/026999399379168

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (1997). *International Affective Picture System (IAPS): Technical manual and affective ratings*. NIMH Center for the Study of Emotion and Attention.

Lejuez, C. W., Read, J. P., Kahler, C. W., Richards, J. B., Ramsey, S. E., Stuart, G. L., Strong, D. R., & Brown, R. A. (2002). Evaluation of a behavioral measure of risk taking: The Balloon Analogue Risk Task (BART). *Journal of Experimental Psychology: Applied*, *8*(2), 75–84. https://doi.org/10.1037/1076-898X.8.2.75

Lench, H. C., Flores, S. A., & Bench, S. W. (2011). Discrete emotions predict changes in cognition, judgment, experience, behavior, and physiology: A meta-analysis of experimental emotion elicitations. *Psychological Bulletin*, *137*, 834–855. https://doi.org/10.1037/a0024244

Lerner, J. S., Gonzalez, R. M., Small, D. A., & Fischhoff, B. (2003). Effects of fear and anger on perceived risks of terrorism: A national field experiment. *Psychological Science*, *14*(2), 144–150. https://doi.org/10.1111/1467-9280.01433

Lerner, J. S., & Keltner, D. (2000). Beyond valence: Toward a model of emotion-specific influences on judgement and choice. *Cognition and Emotion*, *14*(4), 473–493. https://doi.org/10.1080/026999300402763

Lerner, J. S., Li, Y., Valdesolo, P., & Kassam, K. S. (2015). Emotion and decision making. *Annual Review of Psychology*, *66*, 799–823. https://doi.org/10.1146/annurev-psych-010213-115043

Lerner, J. S., Li, Y., & Weber, E. U. (2013). The financial costs of sadness. *Psychological Science*, *24*(1), 72–79. https://doi.org/10.1177/0956797612450302

Lerner, J. S., & Tiedens, L. Z. (2006). Portrait of the angry decision maker: How appraisal tendencies shape anger's influence on cognition. *Journal of Behavioral Decision Making*, *19*, 115–137. https://doi.org/10.1002/bdm.515

Levenson, R. W. (1994). Human emotions: A functional view. In P. Ekman & R. J. Davidson (Eds.), *The nature of emotion: Fundamental questions* (pp. 17–42). Oxford University Press.

Levenson, R. W. (1999). The intrapersonal functions of emotion. *Cognition and Emotion*, *13*(5), 481–504. https://doi.org/10.1080/026999399379159

Libkuman, T. M., Otani, H., Kern, R., Viger, S. G., & Novak, N. (2007). Multidimensional normative ratings for the International Affective Picture System. *Behavior Research Methods*, *39*(2), 326–334. https://doi.org/10.3758/BF03193164

Loewenstein, G., & Lerner, J. S. (2003). The role of affect in decision making. In R. J. Davidson, K. R. Scherer, & H. H. Goldsmith (Eds.), *Handbook of affective sciences. Series in affective science* (pp. 619–642). Oxford University Press.

MacKinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G., & Sheets, V. (2002). A comparison of methods to test mediation and other intervening variable effects. *Psychological Methods*, *7*(3), 83–104. https://doi.org/10.1037/1082-989X.7.1.83

Matsumoto, D., & Hwang, H. C. (2013). Facial expressions. In D. Matsumoto, M. G. Frank, & H. S. Hwang (Eds.), *Facial expressions* (pp. 15–52). Sage. https://doi.org/10.4135/9781452244037.n2

Matsumoto, D., Hwang, H. C., & Frank, M. G. (2016). The effects of incidental anger, contempt, and disgust on hostile language and implicit behaviors. *Journal of Applied Social Psychology*, *46*(8), 437–452. https://doi.org/10.1111/jasp.12374

Matsumoto, D., Hwang, H. C., & Frank, M. G. (2017). Emotion and aggressive intergroup cognitions: The ANCODI hypothesis. *Aggressive Behavior*, *43*, 93–107. https://doi.org/10.1002/ab.21666

Matsumoto, D., Kudoh, T., Scherer, K., & Wallbott, H. (1988). Antecedents of and reactions to emotions in the United States and Japan. *Journal of Cross-Cultural Psychology*, *19*(3), 267–286. https://doi.org/10.1177/0022022188193001

Matsumoto, D., LeRoux, J. A., Ratzlaff, C., Tatani, H., Uchida, H., Kim, C., & Araki, S. (2001). Development and validation of a measure of intercultural adjustment potential in Japanese sojourners: The Intercultural Adjustment Potential Scale (ICAPS). *International Journal of Intercultural Relations*, *25*, 483–510. https://doi.org/10.1016/S0147-1767(01)00019-0

Matsumoto, D., & Wilson, M. (2022). Effects of multiple discrete emotions on risk-taking propensity. *Current Psychology*, Published online 24 February 2022, *42*, 15763–15772. https://doi.org/10.1007/s12144-022-02868-8

Mellers, B. A., Schwartz, A., & Cooke, A. D. J. (1998). Judgment and decision making. *Annual Review of Psychology*, *49*(1), 447–477. https://doi.org/10.1146/annurev.psych.49.1.447

Mikels, J. A., Frederickson, B. L., Larkin, G. R., Lindberg, C. M., Maglio, S. J., & Reuter-Lorenz, P. A. (2005). Emotional category data on images from the International Affective Picture System. *Behavior Research Methods*, *37*(4), 626–630. https://doi.org/10.3758/BF03192732

Plutchik, R. (1982). A psychoevolutionary theory of emotions. *Social Science Information*, *21*(4–5), 529–553. https://doi.org/10.1177/053901882021004003

Plutchik, R. (1994). *The psychology and biology of emotion*. HarperCollins College Publishers.

Plutchik, R. (2001). The nature of emotions: Human emotions have deep evolutionary roots, a fact that may explain their complexity and provide tools for clinical practice. *American Scientist*, *89*(4), 344–350. https://doi.org/10.1511/2001.28.344

Rammstedt, B., & John, O. P. (2007). Measuring personality in one minute or less: A 10-item short version of the Big Five Inventory in English and German. *Journal of Research in Personality*, *41*(1), 203–212. https://doi.org/10.1016/j.jrp.2006.02.001

Robins, R. W., Hendin, H. M., & Trzesniewski, K. H. (2001). Measuring global self-esteem: Construct validation of a single-item measure and the Rosenberg Self-Esteem Scale. *Personality and Social Psychology Bulletin*, *27*(2), 151–161. https://doi.org/10.1177/0146167201272002

Scherer, K. R., Schorr, A., & Johnstone, T. (Eds.). (2001). *Appraisal processes in emotion: Theory, methods, research*. Oxford University Press.

Shatz, S. M. (2005). The psychometric properties of the behavioral inhibition scale in a college-aged sample. *Personality and Individual Differences*, *39*(2), 331–339. https://doi.org/10.1016/j.paid.2005.01.015

Tooby, J., & Cosmides, L. (2008). The evolutionary psychology of the emotions and their relationship to internal regulatory variables. In M. Lewis, J. M. Haviland-Jones, & L. Feldman Barrett (Eds.), *Handbook of emotions* (3rd ed., pp. 114–137). The Guilford Press.

Weber, E. U., Blais, A.-R., & Betz, N. E. (2002). A domain-specific risk-attitude scale: Measuring risk perceptions and risk behaviors. *Journal of Behavioral Decision Making*, *15*(4), 263–290. https://doi.org/10.1002/bdm.414

Xu, Z., Zhu, R., Shen, C., Zhang, B., Gao, Q., Xu, Y., & Wang, W. (2017). Selecting pure-emotion materials from the International Affective Picture System (IAPS) by Chinese university students: A study based on intensity-ratings only. *Heliyon*, *3*(8), e00389. https://doi.org/10.1016/j.heliyon.2017.e00389

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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