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as of 24-May-2023

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STEM Participants:

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Accomplishments: Please see attached document.

Training Opportunities: Nothing to Report

Results Dissemination: Please see attached document.

Honors and Awards: Nothing to Report

Protocol Activity Status:

Technology Transfer: Nothing to Report

PARTICIPANTS:

Participant Type: PD/PI

Participant: David Matsumoto

Person Months Worked: 15.00

Project Contribution:

National Academy Member: N

Funding Support:

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Participant: Hyisung Hwang

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Article Title: Multiple Discrete Emotions have Differential Effects on Risky Behavior

Authors: David Matsumoto, Matthew Wilson

Keywords: Discrete emotions, fear, sadness, disgust, balloon analogue risk task, risky behavior

Abstract: We report results from two studies examining five discrete emotions (anger, disgust, fear, happiness, sadness) and neutral on a behavioral task of risky decision making (the Balloon Analogue Risk Task). We tested two hypotheses concerning single and combinatorial effects of the emotions based on previous theoretical and empirical work delineating triggers and functions of discrete emotions. As predicted, a fear-sadness combination produced the highest risk-taking behavior (pumps), higher than an anger-disgust combination. Sadness also produced more risky behavior than did disgust, as predicted. These findings were discussed vis-à-vis understanding implications of specific, discrete emotions on risky, ambiguous judgment and decision making.

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Article Title: Incidentally Elicited Multiple, Discrete Emotions have Differential Effects on Risky Behavior: The Action Priming Perspective

Authors: David Matsumoto, Matthew Wilson

Keywords: Discrete emotions, fear, sadness, disgust, balloon analogue risk task, risky behavior

Abstract: We present a novel theoretical framework called the Action Priming Perspective with which 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, 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 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. Sadness also produced more risky behavior than did disgust, as predicted. At the same time, these effects 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.

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Partners

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I certify that the information in the report is complete and accurate:

Signature: David Matsumoto

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Major Goals

The Major Goals of the project were to examine the effects of specific, discrete emotions on risky or ambiguous judgment and decision making (hereafter aJDM). Thus, the background of the project remains the same as described in the previously submitted IPRs and we do not include that here. Also, there are no changes to the specific objectives of the project in order to address the Major Goals, which include the following:

1. Conduct pilot studies to determine the most appropriate stimuli to use to elicit specific, discrete emotions in laboratory settings reliably.
2. Conduct a major study examining the effects of five specific emotions and a neutral condition on aJDM.
3. Conduct a second replication study involving a different DV assessing aJDM.
4. Conduct more specific studies on targeted emotions, based on previous results and lessons learned in different methodological parameters.

Accomplished

Specific Objectives

All major objectives were accomplished during the project period.

Objective 1: Conduct pilot studies to determine the most appropriate stimuli to use to elicit specific, discrete emotions in laboratory settings reliably.

This goal was accomplished and reported in the 31 August 2021 IPR (Study 1). At project commencement, we conducted literature searches for both measures of emotion elicitation and ambiguous and risky judgment and decision making (aJDM). Based on our review of the literature, we designed and conducted a pilot study on selected images from the International Affective Pictures System (IAPS; Lang et al., 1997) to use as emotion eliciting stimuli in our studies. Stimuli were selected on the basis of previous normative data indicating high degrees of reliability on judgments of emotion categories (i.e., discrete emotions) but with differences across data sets and reports (Barke et al., 2012; Libkuman et al., 2007; Mikels et al., 2005; Xu et al., 2017). This pilot study was completed in mid-August 2020 and was the basis of our stimuli for all remainder studies in this project.

Objective 2: Conduct a major study examining the effects of five specific emotions, and a neutral condition on aJDM.

This goal was accomplished and reported in the 31 August 2021 IPR (Study 2). The methodology for this study was described in that IPR and approved by both SFSU and ARO IRBs. This study examined the effects of five different discrete emotions on the same aJDM task. Anger, disgust, fear, happiness, sadness and a neutral condition were elicited using a standard emotion eliciting procedure (IAPS images selected on the basis of previous norm data). The elicitation

procedures involved a paradigm used in previous studies demonstrating successful elicitation of discrete emotion states using images (Matsumoto et al., 2016, 2017). After emotion elicitation participants completed a validated self-report measure of risk taking – the Domain Specific Risk Taking Scale (DOSPRT; Blais & Weber, 2006; Highhouse et al., 2017; Shou & Olney, 2020).

We began data collection for this study in August 2020 and completed data collection in December 2020; final N was 413 but data were filtered for analyses, resulting in an $N = 307$. Analyses focusing on main hypotheses began in January 2021 and were completed in April 2021; a paper based on the main findings was drafted and submitted for publication thereafter, and subsequently published in *Current Psychology* (previously uploaded to ARO Extranet). Secondary analyses focusing on individual differences in risk propensities with possible emotion moderation of formed the basis for Study 7 below.

Objective 3: Conduct a second replication study involving a different DV assessing aJDM.

This goal was accomplished and reported in the 31 August 2022 IPR (Study 3). The methodology for this study was approved by both SFSU and ARO IRBs. We designed a study to replicate the findings reported above in Objective 2 using a behavioral task of aJDM; the Balloon Analogue Risk Task (BART; Lejuez et al., 2002) was used instead of a self-report measure of risk propensities. The methodology for this study was essentially the same as that described above in the study that addressed Objective 2, with the exception of the dependent variable (BART) and substitution of some IAPS images based on the findings from Studies 1 and 2.

We began data collection for this study in January 2021 and completed data collection in May 2021; final N was 311 but data were filtered for analyses, resulting in an $N = 236$. Analyses focusing on main hypotheses were completed in May 2021 and a paper based on the main findings was drafted and submitted for publication thereafter. However, we later made the decision to merge the description and report of findings from this study with the next (Study 4) to produce a single, two-study manuscript.

Objective 4: Conduct more specific studies on targeted emotions, based on previous results and lessons learned in different methodological parameters.

This goal was accomplished and reported in the 31 August 2022 IPR (Study 4), with additional studies and new information reported here in this Final Report (Studies 5-7). The methodology for Study 4 was approved by both SFSU and ARO IRBs. We designed a study to replicate and extend the findings reported above in Study 3 using the same procedures but with a different methodological parameter – changing the riskiness of the BART. This was done by changing the chance rates by which balloons will explode in each trial by manipulating the maximum number of pumps allowed before explosion. The version of the BART used in Study 3 involved a chance rate for balloon explosions set at 32 pumps, the standard setting of the BART. In Study 4, we set this max rate to be 16; that is, the task was set so that the balloon would burst more often, making the task riskier. All other aspects of the study were the same as in Study 3.

The findings replicated and extended those of Study 3 with important boundary effects. We submitted a manuscript reporting Studies 3 and 4 as a single paper to a journal and received a revise and resubmit decision in March 2023. Based on the reviewers' comments, we reanalyzed data and revised the paper thoroughly and resubmitted the paper to the journal in May 2023 (uploaded to ARO Extranet). At the time of this writing, the revised paper is currently under review.

After the data collection for Study 4 was completed, we designed and conducted Study 5. The methodology for this study was approved by both SFSU and ARO IRBs. We designed this study to replicate and extend the findings reported above in Studies 3 and 4 using the same procedures but with a different risk setting on the BART. To recall, the risk setting in Study 3 was set so that the maximum pumps allowed on a trial were 32; in Study 4 it was 16. In Study 5, we set this rate at 48 (i.e., balloons exploded randomly much less frequently). All other aspects of the study were the same as in Studies 3 and 4.

Data collection for this effort was completed in May 2022 (N approximately 300) and data cleaning and management was completed shortly thereafter. Preliminary analyses were completed in Fall 2022, which indicated that risk level may moderate the effects of the specific, discrete emotions on risky behavior, at least when using the BART (a common measure used in the literature to assess risky behavior). However, we opted not to complete analyses on this and subsequent studies until the currently submitted paper for Studies 2 and 3 was adjudicated. In the meantime, we had opted to launch a Study 6 with the standard risk settings to replicate the original findings from Study 3.

Study 6 was a replication of Study 3 reported in our previous IPRs and above. Data collection began in July 2022 and completed in Fall 2022 (December), when the project period had ended. As with Study 5 above, we have cleaned the data and conducted preliminary analyses, but have opted not to complete analyses on this study until the paper for Studies 2 and 3 has been adjudicated.

As we have been waiting for adjudication of the main papers for the project, we have completed secondary analyses of the data from Study 2 to examine individual differences in risk propensities and possible emotion moderation of such differences (Study 7). Findings for this effort are described below and were reported in a paper that was submitted for publication (uploaded to ARO Extranet). We are currently revising this paper as well.

Significant Results

Study 1

This study resulted in a new normative data set of reliability judgments for 75 IAPS images that previous studies have shown to elicit discrete emotions but with differences among studies (Barke et al., 2012; Libkuman et al., 2007; Mikels et al., 2005; Xu et al., 2017). As mentioned above, these results informed our selections of images in Study 3 and will be used to guide stimulus selection for future studies as well.

Study 2

The main findings from this study were as follows:

1. The combination of all emotions produced higher risk scores compared to a neutral state, consistent with a large literature demonstrating negative effects of various emotional states and affect on aJDM.
2. Different discrete emotions or their specific combinations produced differential degrees of risk propensities.
 - a. In particular, the fear-sadness combination produced higher risk scores than neutral.
 - b. The fear-sadness combination produced higher risk scores than the anger-disgust combination.
 - c. Sadness produced higher risk scores than happiness and disgust.

A paper based on the main findings, which were novel to the literature, was published in *Current Psychology* (previously uploaded to ARO Extranet).

Studies 3 and 4

The main findings from Study 3 using a behavioral task of risky aJDM were as follows:

1. The fear/sadness combination produced more pumps (i.e., more risky behavior) on four measures of risky behavior than did the anger/disgust combination, and
2. sadness produced more pumps than disgust.

These findings replicated those of Study 2 but were important because we utilized a behavioral task (the BART) instead of a self-report measure of risk tendencies; they were also the first to compare multiple emotions with each other on the same behavioral task, a novel methodological contribution to the literature. They pointed to the idea that *fear and sadness produce more risky behavior than do other emotions*, a novel finding in the literature.

The main findings from Study 4 were as follows:

1. The fear/sadness combination produced more pumps (i.e., more risky behavior) than did the anger/disgust combination, but only on one measure of risky behavior, and
2. Sadness produced more pumps than disgust.
3. Individual differences in perceptions of uncertainty of the task was directly associated with all four measures of risky behavior (these perceptions were not associated with risky behavior in Study 3).

The Study 4 findings were not as strong as those of Study 3 and may have occurred because the risk settings on the BART had the opposite effect than those intended; quicker balloon explosions may have resulted in less, not greater, uncertainty in the task, reducing the effects of incidentally elicited emotions. Lower perceived 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.

Studies 5 and 6

On hold until final adjudication on the paper for Studies 3 and 4 above is completed, as different analyses in that paper may require different analyses for Studies 5 and 6. We intend to complete these analyses and submit papers based on these analyses after the reporting period for this project has been completed.

Study 7

To date, the main findings indicated that different individual difference variables predicted different types of risk propensities. For example,

1. Gender, age, and self-reported annual income predicted risk tendencies related to ethical and health/safety issues, but not risk tendencies related to financial, social, or recreational issues.
2. Different types of traits predicted different risk tendencies:
 - a. Agreeableness and Conscientiousness predicted risk tendencies related to ethical and health/safety related issues, while
 - b. Extraversion predicted risk tendencies associated with financial, social, and recreational issues.

3. Other psychological constructs specifically associated with uncertainty also were associated with predicted risk scores, but only those related to financial, social, and recreational domains.
 - a. Inhibitory Anxiety was negatively associated with risk tendencies, indicating that individuals with greater anxiety vis-à-vis dealing with uncertain or ambiguous situations had lower risk propensities associated with financial, recreational, and social concerns. This suggested that anxiety may buffer against risky decisions.
 - b. Interaction-based behavioral inhibition was positively associated with risk tendencies, indicating that individuals with greater interactional based fear (i.e., fears in interacting with others) had higher risk scores on this risk tendency.

All these findings are new to the individual difference literature vis-à-vis risk propensities and were previously submitted to ARO Extranet.

Key Outcomes or Other Achievements

To date, we have documented key findings concerning the differential effects of different, discrete emotions on aJDM using a range of emotions in the same elicitation task on the same outcome variable. The methodology used and findings obtained have been novel to the field. With regard to risky behavior, all emotions are not the same; different emotions have differential effects on risky behavior. In particular, fear and sadness have been shown to produce the riskiest propensities and risky behavior, especially sadness. Disgust has been shown to produce much less risky behavior than other emotions and neutral.

The individual difference findings reported above in Study 7 (internal reference S325) are also novel to the field and highlight the potential roles of age and socioeconomic status (assessed by self-reported annual income) on risk propensities. Those findings also suggested that traits are associated with different higher-order risk propensities, and that constructs associated with ambiguity (intolerance of ambiguity, behavioral inhibition) may be associated with different types of risk propensities.

Training Opportunities

Nothing to report.

Results Dissemination

A paper reporting the main findings of Study 2 was published in a peer-review journal (uploaded to ARO Extranet).

A revised paper reporting the main findings of Studies 3 and 4 is currently under review for publication at a peer-review journal (uploaded to ARO Extranet).

A paper reporting the main findings from Study 7 is currently being revised for resubmission to a peer-review journal (original version previously uploaded to ARO Extranet).

Honors and Awards

Nothing to report.

Technology Transfer (patent applications, inventions, licenses, interaction with DoD laboratories)

Nothing to report.

Participants

PI – David Matsumoto

Co-PI – Hyisung C. Hwang

Students

Number of students receiving STEM degrees during the reporting period: 0

Number of undergraduate and graduate STEM participants during the reporting period : 0

Products

Nothing to report.

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