Effects of Induced Affective States on Decisions under Risk with Mixed Domain Problems

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Abstract

We investigated whether induced affective states can affect the process and outcomes of decisions under risk. A mood induction task was used to elicit a positive or negative mood in a sample of adult participants (N=48). The participants then responded to 28 decision problems, each offering a choice between two mixed-domain risky alternatives. The dependent variables of interest were decision-making choices, as well as an eye-tracking based attentional measure: the total fixation durations for certain critical aspects of the two presented risky decision options. Mood condition did not have a significant main effect on participants' choices, or on mean total fixation time for problems. However, fixation times showed a three-way interaction between mood condition, domain (gain versus loss), and time (block). The fixation time data also provided some general insights into participants' patterns of attention allocation during decision-making. They generally spent more time looking at values compared to probabilities, and more time looking at potential gains compared to losses (although this difference declined over time, especially for positive-mood participants).

Keywords: emotion; decision making; mood induction; affect; allocation of attention; eye tracking; risk; cognitive processing; strategy; choice

Incidental affect has been used to predict and explain a wide variety of judgments and decisions (Peters, Västfjäll, Gärling & Slovic, 2006). Incidental affect refers to feelings or mood states induced by a situation that is normatively irrelevant to a given decision. Most early studies on incidental mood induction took a simple valence-based approach, dividing emotions into positive and negative categories. Researchers found that individuals in a happy rather than a sad mood tend to make optimistic judgments and choices by overestimating the likelihood of positive outcomes and underestimating the likelihood of negative outcomes (Loewenstein & Lerner 2003; Johnson & Tversky, 1983; Raghunathan & Pham, 1999).

More recent research has focused on how particular affective states can affect the general information processing strategy adopted by an individual, towards more analytic or more heuristic strategies (Lerner 2015). Findings suggest that individuals who are in a happy mood are more likely to adopt a heuristic processing strategy, a tendency to use intuition and "gut feelings" with relatively little attention being paid to details. By contrast, individuals who are in a sad mood are more likely to adopt a systematic processing strategy, with careful analysis of information (Bolte, Goschke & Kuhl, 2003; George & Dane, 2016; Schwarz & Clore, 1996; Schwarz, 2000).

Affective states may influence decision-making because the decision maker selectively attends to, encodes, and retrieves emotion-relevant information (Niedenthal & Setterlund, 1994). This phenomenon can be seen as consistent with the affect infusion model (AIM), which posits that affectively loaded information influences an individual's cognitive and behavioral processes, pushing their decision outcomes in a mood-congruent direction (Forgas, 1995). If such mood priming occurs, then individuals in a positive mood should be more likely to access thoughts about the positive aspects of a risky situation compared to those in a neutral mood (Forgas & George, 2001; Nygren, Isen, Taylor & Dulin, 1996). Thus, positive moods may increase an individual's risk-taking tendency with mixed-domain options, because positive potential outcomes will be emphasized over potential losses, so that risky choices will be perceived as more favorable. Individuals in a negative mood, by contrast, are more likely to access thoughts about the negative aspects of risky situations, which consequently would lead to more conservative decision-making choices so as to avoid potential loss (Yuen & Lee, 2003).

Nevertheless, prior research provides mixed results regarding the direction of influence of incidental affect on decision-making processes (Lerner, Li, Valdesolo & Kassam, 2015). An alternative model, the mood-maintenance hypothesis (MMH), posits that incidental mood states motivate behavior such that individuals act to maintain or attain positive mood states (Kliger & Kudryavtsev, 2014). Accordingly, individuals in a positive mood avoid risk in order to maximize the likelihood of maintaining their positive mood, whereas individuals in a negative mood seek risk in an attempt to obtain gains that might relieve their negative mood (Mishra, et al, 2010; Mishra, 2014; De Vries, Holland, & Witteman, 2008; Hills, et al, 2002).

The contrasting predictions of these models, we argue, can be directly examined using eye-tracking based attentional measures, in studies of mixed domain decisions under risk. This type of design allows us to track individuals' focus of attention on both positive and negative aspects underlying their decision-making processes. Thus, by examining participant's attention to gain vs. loss information, we can assess whether participants' attention allocation is in line with the predictions of a mood-congruence (affect infusion) or mood-maintenance hypothesis.

Empirical Study

The purpose of the present study was to investigate the influence of induced affective states on the process and outcomes of decision-making with a set of risky choice problems. A mood induction task (watching short videos) was used to elicit a positive (happy) or a negative (sad) mood. Previous research has shown that the use of movie or story procedures is an effective means of manipulating participants' moods (Drouveli & Grosskopf, 2016; Ellard, Farchione & Barlow, 2012; Gerrards-Hesse, Spies, & Hesse, 1994; Westermann, Spies, Stahl, & Hesse, 1996). The decision-making task using mixed domain problems gave participants a chance to systematically compare and weigh different aspects of the two risky decision options. According to an affect infusion or mood congruence (AIM) account, positive mood should enhance attention to information about gains, while negative mood should make information about losses more salient and more viewed. In contrast, the mood-maintenance hypothesis (MMH) predicts that individuals in a negative mood should be especially motivated to attend to information about potential gains. Finally, from the standpoint of the heuristic/analytic dichotomy, we investigate the hypothesis that individuals in a negative mood may be more likely to adopt a systematic processing strategy, perhaps by calculating expected value or by using an equivalent procedure, whereas participants in a positive mood may be more likely to use a heuristic processing strategy (George & Dane, 2016; Schwarz & Clore, 1996; Schwarz, 2000).

It seems important in assessing the effects of incidental emotion on decisions to look at decision *process* (as well as outcomes). We accomplish this by using eye-tracking-based attentional measures. By studying attention in the context of mixed-domain decision problems under risk, we can track the decision-maker's focus of attention on positive (gain) and negative (loss) information. These aspects of the present study constitute a novel approach to investigating the possible influence of induced affective states on risky decision-making.

Method

Participants

Forty-eight participants were recruited from a large private University community in North America, either by responding to flyers posted on campus bulletin boards or for course credit. Participants included both undergraduate and graduate students (36 females and 12 males. Most (90%) participants ranged in age from 20 to 30 years, 94% had obtained at least a bachelor's degree, and 88% had completed a basic statistics course. They participated in the study for either a payment of $10 or course credit.

Overview of Procedure

Participants were tested individually. They were informed that the purpose of the study was to examine the factors influencing decision-making for problems involving potential financial gains and losses, and the process of how such decisions were made. Each participant was randomly assigned to one of two mood induction groups: positive or negative. The participant first was taken through a calibration procedure with the eye-tracker, to enable accurate gaze point calculations. Following the viewing of the mood-induction movie clip, the participant was asked to make choices for each of 28 risky decision problems displayed on a computer screen equipped with an eye tracking equipment. During this task, participants were encouraged to work at their own pace.

Mood Induction

Movie clips were used to induce emotions "incidental" to the decision task. Two movie clips of similar length (6 to 7 minutes), one categorized as "happy" (from *The Muppet Show*), and the other as "sad" (from *Schindler's List*), were utilized. These clips have previously been shown to successfully induce positive and negative mood states, respectively (De Vries et al., 2008). The success of the mood induction procedure of the experiment was checked via a self-reported mood questionnaire administered after the video watching and before the decision-making task. All participants were asked to rate on a 7-point Likert scale (ranging from 1 to 7) how well each of the following terms (*happy, joyful, cheerful, enthusiastic, sad, blue, upset, distressed*) described how they felt at that moment. All of the terms are taken from the PANAS-X positive and negative affect schedule (Watson & Clark, 1999), and have been previously classified as representing either a positive valence or a negative valence.

Mixed Decision-making Task

Twenty-eight risky decision problems were presented, each consisting of two decision options (labeled 'a' and 'b'). Each option was a risky mixed prospect, consisting of a loss and a gain with associated (complementary) probabilities. The display format for an example decision problem is shown in Figure 1. Note that an analytic strategy such as calculating expected value (EV) requires attention to both values and probabilities for both gains and losses of each decision option (all eight discrete pieces of information).

A Tobii model T60 eyetracker (version:3.2.3) with associated software was used to monitor the participants' attention paid to the eight consequential regions of each decision problem. Specifically, the eye tracking-based attentional measures included duration of fixations on eight critical regions, defined by: gain value, gain probability, loss value, and loss probability for each of the two decision options. The total fixation duration (TFD), in seconds, within each critical region or 'area of interest' (AOI) was computed as the total viewing time for each area across all episodes in which a participant had looked within the AOI, starting with a fixation within the AOI and ending with a fixation outside the AOI. Due to eyetracker calibration issues, we eliminated data from five participants whose fixations were not accurately identified, resulting in an effective N of 43 (positive mood condition n=21, negative mood condition n=22).

Participants' choices on the twenty-eight decision problems were also analyzed, including whether they chose the EV-maximizing option.

a. (+ \$300, .2; - \$ 70, .8)

b. (+ \$100, .9; - \$200, .1)

Figure 1. Display format for a sample decision problem offering a choice between option a and option b.

Results

As a manipulation check for the mood induction procedure, summary positive and negative mood rating scores were obtained by averaging the participants' self-ratings on the four relevant adjective scales: positive = (*happy*, *joyful*, *cheerful*, *enthusiastic*), negative = *(sad*, *blue*, *upset*, *distressed*). Figure 2 presents the mean rating scores on the positive words (Pos_Score) and negative words (Neg_Score), by condition (induced positive or negative mood). It can be seen that the mood induction was effective, as measured by the self-ratings of positive and negative mood. A multivariate ANOVA was conducted (overall) on the two self-rating summary dimension, and the overall omnibus F-test for the mood induction Condition was significant, $F(2, 45) = 89.112$, $p<.001$, suggesting strong mood-induction effects. Both positive (Pos_Score), $F(1, 46) = 97.04$, $p<.001$, and negative (Neg_Score), $F(1, 46) = 124.47$, $p<.001$, scores were significantly affected by the manipulation.

Decision outcomes:

To assess whether induced positive or negative mood affects the degree to which a participant engages in analytic processing, we first tested whether participants in the negative mood condition tended to show more EV-maximizing choices (based on EV calculations or equivalent procedures) than did participants in the positive mood condition. The relevant data consisted of information on participant's choice (a or b) for each pair of mixed domain problem. To analyze the data, we created a summary variable, EV score, defined as each participant's total number of EV-maximizing choices on those 28 pairs of problems. Therefore, these maximization scores could range from 0 to 28. Descriptive statistics showed that for the negative mood condition, $M = 19.3$, $s = 3.28$; for the positive condition, $M = 19.5$, $s = 3.88$. A one-way ANOVA indicated that this difference in the mean maximization score was not significant ($F(1, 46) = .026$, $p > .05$).

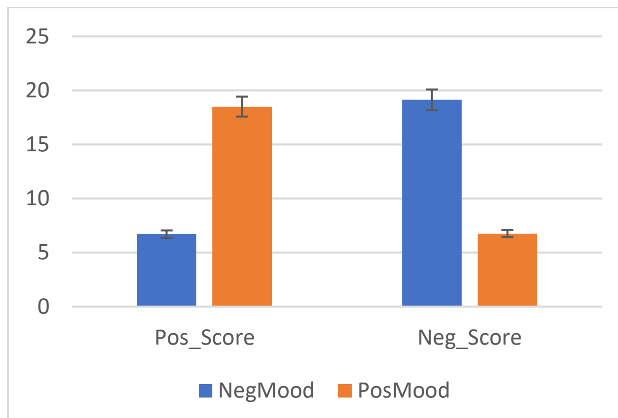

Figure 2. Results of the manipulation check for the effects of viewing two alternative videos (Condition = NegMood, PosMood) on self-rated positive and negative emotional valence.

Patterns of attention:

By analyzing the eye tracking-based attentional measure of total fixation durations (TFDs), we sought to find out how induced moods affect decision *process*, as reflected in the amount of attention that participants pay to certain critical aspects of the considered decision options. Specifically, we sought to answer the following questions: 1) Do participants in a positive mood state tend to pay more attention to positive aspects of the problems (as consistent with an affect infusion or mood congruence account, AIM)? 2) Are participants in a negative mood state more likely to pay attention to the negative aspects of the problem (as consistent with AIM), or more motivated to seek out positive information (as predicted by the mood-maintenance hypothesis, MMH)?

Because our decision-making task included 28 relatively difficult problems, time effects (due to fatigue and/or practice) were thought likely to occur. Also, it is possible that any effect of the emotion manipulation might be short-lived (Andrade & Ariely, 2009). Thus, we analyzed mean TFDs across four equal time blocks: problems 1-7, 8-14, 15-21, and 22-28. Due to practice/fatigue effects, we expected to see a decreasing trend in TFDs.

The marginal-mean TFDs and standard deviations are presented in Table 2, for the main effects of Type of information and Domain.

Participants in both mood conditions spent more time looking at values compared to probabilities, and more time looking at gains compared to losses. As expected, a time effect occurred whereby participants' fixation time spent on 'type' and 'domain' generally decreased from block 1 to block 4 (with exceptions for 'values' and 'losses' - an increase in TFDs from block 2 to block 3). One possible explanation is that block 3 contains relatively more high conflict problems (defined as having a small EV difference between the two options for each problem).

Table 2. Marginal (main effect) descriptive statistics for total fixation duration (TFD) by Type of information (values vs.probabilities) and by Domain (gains vs. losses) for each block of problems.

			Negative Mood		Positive Mood	
		Block	M	SD	M	SD
Type of Information:	Values	1	67.26	6.07	70.69	7.08
		2	45.54	4.54	49.70	5.50
		3	49.73	5.33	54.06	6.64
		4	44.16	5.41	47.33	5.60
	Probabilities	1	34.08	2.79	35.68	4.72
		2	25.17	2.40	28.64	3.85
		3	25.85	2.17	27.90	3.92
		4	25.59	2.41	26.05	3.99
Domain:	Losses	1	38.87	4.41	39.92	4.60
		2	26.85	2.72	29.76	3.74
		3	29.93	3.50	35.20	4.61
		4	26.86	3.26	31.71	4.81
	Gains	1	62.46	4.36	66.45	7.26
		2	43.86	4.15	48.58	5.75
		3	45.65	3.90	46.76	5.98
		4	42.89	4.53	41.66	5.02

Inferential Analyses

A repeated-measures ANOVA predicting mean TFD for each critical area was conducted using one between-subject factor of 'condition' (induced positive mood vs. negative mood), and three within-subject factors: 'domain' (potential gains vs. potential losses), 'type' of information (payoff values vs. payoff probabilities), and 'block' (1-4). Note that this analysis averages looking times (TFDs) for a given critical region (e.g., gain values) across the two decision alternatives.

In this ANOVA, statistically significant effects were found for the within-subject factors of Type ($F(1, 41) = 124$, $p < .001$), Domain ($F(1, 46) = 103.1$, $p < .001$) and Block ($F(2.685, 110.09) = 30.28$, $p < .001$), with a two-way interaction between Type and Domain ($F(1, 41) = 6.22$, $p = .017$), as well as a three-way interaction among Condition, Domain, and Block ($F(2.337, 95.814) = 2.99$, $p = .038$).

The descriptive and inferential results reveal that participants in both mood conditions spent significantly more time looking at values than probabilities, and more on gains than losses. However, it must be recognized that these main effects are to some degree confounded with the left-right position of these quantities on the screen, so some of the differences might be due to a reading order effect.

To interpret the interaction patterns, we first examined the significant three-way interaction among Condition, Domain, and Block. This interaction is shown in Figure 3. In this interaction, the payoff value and probability for a decision option are not separated, presumably because participants' looking times for these two components tended to be correlated. In Figure 4, it can be seen that looking times (TFDs) generally declined across the four blocks of problems (some small discontinuities between Blocks 2 and 3 are interpreted as being due to relatively difficult or high-conflict problems in Block 3). The main effect of Domain, with more time allocated to gain information, is also apparent. The interaction itself seems to be due to the fact that the difference in looking time for gains versus losses is very high in Blocks 1 and 2, and much lower in Blocks 3 and 4. This pattern is more apparent in Figure 3, which plots those gain versus loss differences directly by comparing the difference between gain values and loss values, and in Figure 4.

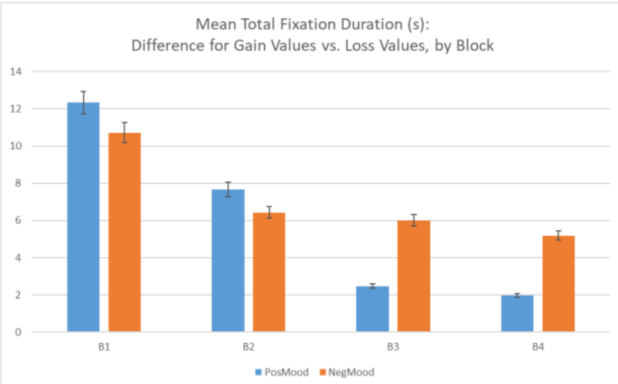

Figure 3. Mean Total Fixation Duration (s): Difference for Gain Values versus Loss Values, by Block and Condition.

Theoretically, the overall pattern of attention results can be explained in at least two ways. First, the positive induction may have had only a transitory effect, as follows. In the first two time-blocks, when the effects of the mood induction were presumably strongest, the pattern of means seems to be consistent with the Affect Infusion Model, such that participants in the positive mood condition paid slightly more attention to information about gains than did negative-mood participants. However, this difference declines in Blocks 3 and 4, perhaps due to a fading effect of the mood induction.

The second interpretation invokes the mood-maintenance hypothesis (MMH). According to the MMH, negative-mood participants focused more on information about potential gains rather than losses, in order to try to attain a positive mood state, and this difference in attention persisted across all four blocks. In contrast, positive-mood participants initially also paid more attention to gains, perhaps to maintain their positive mood. But this effect faded relatively quickly for the positive-mood participants. It is possible that the positive mood induction (watching a silly video) had a more transitory effect than the negative mood induction (watching a clip depicting Nazi murders). But this interpretation should be substantiated via future research.

Conclusion

The results did not provide evidence that induced positive or negative moods can affect the prevalence of analytic processing, at least as measured by EV-maximization success. Nor do they confirm the main predictions of the mood-congruence and mood-maintenance hypotheses regarding attention allocation, as measured by total fixation durations (TFDs). Neither a main effect of condition nor an interaction of condition with domain on attention was found.

However, a significant three-way interaction among Domain, Condition, and Block was found (Figure 4). The nature of the interaction suggests that the mood induction, particularly the positive induction, may have had only a3transitory effect. In the first two blocks, when the effects of the mood induction were presumably strongest, participants in both conditions paid more attention to information about gains, and participants in the positive mood condition paid slightly more attention to information about gains than did negative-mood participants. But this pattern is not confirmed by inferential tests. We should be aware that the samples size was relatively small. In order to detect effects of incidental emotion on such subtle patterns of attention allocation, many more participants would be needed.

Nonetheless, the significant main effects of Type of information and Domain (gain versus less) do suggest some insights into participants' allocation of attention in their decision-making processes. These significant effects suggest that participants, regardless of their assigned mood conditions, allocate more attention to value information than to probabilities, and more attention to gains than to losses. We plan future investigations to confirm and further explore these findings.

Further research in this area might also explore other types of emotion induction manipulations, of varying strengths and durations, to more fully investigate the effects of incidental emotion on decision process and outcomes.

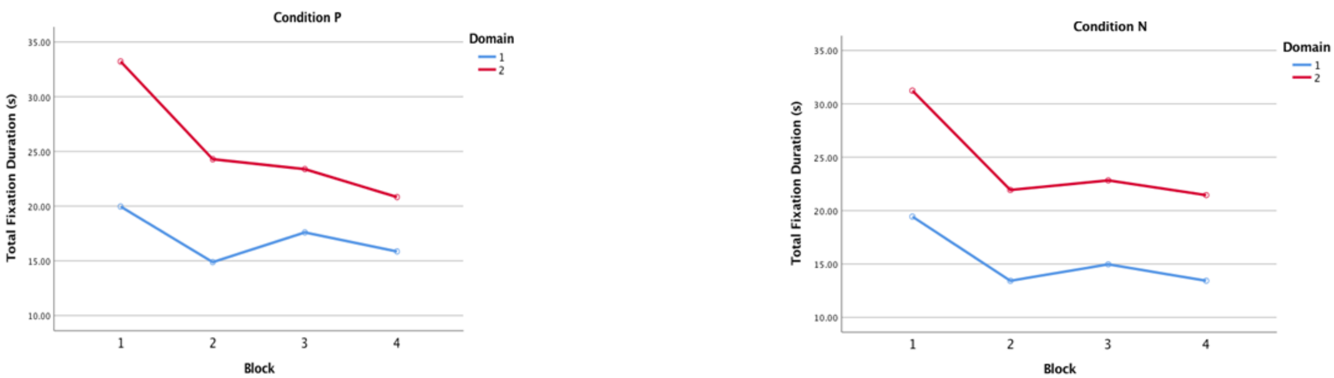

Figure 4. The three-way interaction among mood induction Condition (P=positive mood condition; N=negative mood condition), Domain (1=loss, 2=gain), and Block.

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