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BRIEF REPORT

Effects of approach and withdrawal motivation on interactive economic decisions

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Although recent economic models of human decision making have recognised the role of emotion as an important biasing factor, the impact of incidental emotion on decisions has remained poorly explored. To address this question, we jointly explored the role of emotional valence (i.e., positive vs. negative) and motivational direction (i.e., approach vs. avoidance) on performance in a well-known economic task, the Ultimatum Game. Participants had to either accept or reject monetary offers from other players, offers that vary in their degree of unfairness. A main effect of motivational direction, but not valence, was observed, with withdrawal-based emotion (disgust and serenity) prompting more rejections relative to approach-based emotion (anger and amusement) and a neutral state. These results further confirm that subtle incidental moods can bias decision making, and suggest that motivational state may be a useful framework to study such decisions. Implications with regard to emotion, cognitive neuroscience, and clinical psychology are discussed.

Keywords: Emotion; Motivation; Approach; Avoidance; Decision making; Ultimatum Game.

INTRODUCTION

Models of human decision making have only recently begun to incorporate the effect of emotions on the decision process. One useful conceptual distinction has been made between incidental (i.e., task-unrelated) emotions and integral (i.e., task-driven) emotions (Lowenstein & Lerner, 2003). Incidental influences are of particular relevance, as they are ostensibly unrelated to the decision process, but can have a significant influence on decision making. To date, however, these affective-based models of decision making have relied on a relatively limited theoretical and cognitive framework of emotion, predominantly distinguishing emotional states based on their valence (i.e., negative vs. positive). Other dimensions of emotion, however, such as evolutionary-based motivational tendencies, may provide an equally valid and perhaps more useful framework to study how incidental emotion affects decision making. Therefore, this study

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examined the influence of incidental emotions on decision making, investigating whether a valence-based or motivational-state-based framework can better capture how emotions can bias decisions.

Valence-based vs. motivation-based emotional influences on decision making

There is by now good evidence suggesting that transient moods can influence people's goals, planning, risk perception and attitudes, suggesting that mood states may in turn impact decision making (Forgas, 2003; Zajonc, 2000). In comparison to neutral and negative moods, positive affect has been associated with higher confidence about a social encounter, higher expectations about success, more optimistic framing, greater co-operation, and less risky purchase decisions (Chuang & Linn, 2007; Forgas, Bower, & Moylan, 1990). In contrast, emotions with a negative valence are usually associated with lower confidence and a more effortful and vigilant processing style (Isen & Daubman, 1984), and with a focus on negative rather than positive consequences. Despite this body of work, however, recent studies have demonstrated contradictory effects of similarly valenced emotions on decision making, suggesting the limitations of a simple valence framework. For instance, two negatively valenced emotions, disgust and sadness, were found to have very different carry-over effects on the endowment effect, a well-replicated result whereby selling prices for an acquired object tend to exceed buying prices for the same object (Lerner, Small, & Loewenstein, 2004). Specifically, induced disgust eliminated the endowment effect, whereas sadness was found to reverse it. These results suggest that emotional valence alone cannot fully capture how transient affective states may bias decision making.

Rooted in evolutionary theories of motivated behaviour, an alternative to the valence model is that of approach and withdrawal motivational tendencies, proposing that organisms' emotional system can be subdivided into an aversive and appetitive apparatus (respectively promoting defensive and approach/exploration behaviour; Lang, Bradley, & Cuthbert, 1997; Schneirla, 1959). Factor analyses of emotional experience reports support a two-dimensional structure (i.e., valence and appetitive/aversive dimensions; Tellegen, Watson, & Clark, 1999). More recently, neurophysiological research has bolstered the approach–withdrawal model, showing that frontal electroencephalographic (EEG) asymmetry may index these broad motivational tendencies rather than emotional valence per se (Davidson, 2003). More relevant to the present study, the transient experience and expression of approach-based emotion (e.g., amusement, happiness, and anger) and withdrawal-based emotion (e.g., disgust and sadness) have been associated with greater left frontal and right frontal activity respectively (Davidson, Ekman, Saron, Senulis, & Friesen, 1990).

Despite the potential usefulness of this motivational dimension in the study of decision making, little research has explored the applicability of this model. Though not directly assessing decision making, some studies suggest that approach–withdrawal tendencies, indexed by task-independent (Pizzagalli, Sherwood, Henriques, & Davidson, 2005) and task-dependent (Miller & Tomarken, 2001) frontal EEG asymmetry, may be involved in the monitoring of monetary reward cues and in tracking incentive amounts. Together, these findings suggest that approach and withdrawal motivations may bias decision making by altering the subjective valuation of monetary incentives. In addition, such motivational tendencies may more readily prime individuals to engage or back away from social exchange, which is particularly relevant to interactive decision making.

Social decision making

Whereas canonical studies of decision making have typically examined choice between several alternatives (often with uncertain monetary gain or loss), there has been a recent interest in examining the decisions made in interactive contexts, which may better model many of the real-life choices we encounter. Thus, to assess decision making in this study, we used a well-known task, the Ultimatum

Game (UG; Guth, Schmittberger, & Schwarze, 1982). This two-person task involves dividing a sum of money provided by the experimenter. One player (the "proposer") makes an offer to the other (the "responder") of how to split the money. The responder can either accept the offer, in which case the money is split as proposed, or reject the offer, in which case neither player receives anything. Whereas standard game theoretic models of decision making predict that responders should accept any non-zero offers, responders actually typically accept only about 50% of unfair offers they receive (Camerer, 2003). Additionally, responders both report and demonstrate physiologically increased arousal and negative emotional responses when receiving unfair offers (Sanfey, Rilling, Aronson, Nystrom, & Cohen, 2003; Van't Wout, Kahn, Sanfey, & Aleman, 2006). Thus, the UG offers a simple interactive context with some ecological validity, making it very useful to study social decision making. The extensive UG literature in behavioural economics further provides normative levels of acceptance rates, which is an important behavioural check for our study. Finally, the responder role in the UG can provide a useful venue to study whether *incidental* emotions can bias decision making above and beyond task-related affective processes.

Present study

The present study was conducted to expand on an earlier study, in which we examined the effect of inducing positive and negative emotions (amusement and sadness, respectively) on responders' acceptance rates in the UG (Harlé & Sanfey, 2007). We found that induced sadness lowered acceptance rates of unfair offers as compared to an affectively neutral condition. In contrast, induced amusement did not bias acceptance rates. Though these results provide evidence that incidental emotion can bias economic decision making, it is still unclear what underlies the differential emotional findings. Indeed, amusement (like anger) tends to load high on the approach dimension in factor analyses of both behavioural and physiological measures (Christie & Friedman, 2004). Thus, because sadness and amusement are on opposite sides of both the valence (sadness is negative, amusement is positive) and the approach/withdrawal accounts (sadness leads to withdrawal, amusement to approach), it is difficult to interpret these data in terms of which overarching framework might prove more explanatory.

To address this question directly, we assessed the influence of induced emotions on decision making in the UG, using a 2×2 (valence and approach/withdrawal) design. In addition to the previously collected data using amusement (positive, approach), we also examined performance using the emotions of serenity (positive, withdraw), anger (negative, approach), and disgust (negative, withdraw).

Whereas anger and disgust have respectively been classified in the literature as approach-based and withdrawal-based (because they respectively prompt engagement with, and withdrawal from, an offending stimulus), positive withdrawal-based emotion has been harder to identify. Serenity was chosen because the calm and peace evoked by such emotion has a positive valence (Lutz, Slagter, Dunne, & Davidson, 2008), yet it is more likely to promote an inward-focused, meditative state, which may in turn make one less likely to react to (and thus to approach) an emotionally salient event (e.g., a partner offering an unfair deal). Empirical support for this rationale comes from the literature on mindfulness and relaxation meditation, which have been associated with increased well-being and reduced cognitive interference from emotionally provocative stimuli, using both behavioural and physiological (Skin Conductance Responses; SCRs) measures (Nielsen & Kaszniak, 2006; Ortner, Kilner, & Zelazo, 2007). Also, such emotion is more easily induced with video-clips than another common positive withdrawal emotion (i.e., relief), which is more likely to be associated with a preceding negative emotion.

Based on the UG literature and our previous study, we predicted that incidental emotion (of any type) would have no significant impact on acceptance of fair offers, almost all of which are typically accepted. However, unfair offers typically involve more conflict between monetary gain and unfair

treatment, and may be construed as more complex and thus more vulnerable to infusion of subtle mood states that may bias decisions (Forgas, 2003). If emotional valence alone biases UG decisions, we would expect emotions with a negative valence but with either motivational tendency (i.e., disgust and anger) to increase pessimistic framing and focus attention on the negative intentions of unfair offers. This would result in lower acceptance rates of unfair offers, relative to positive emotions. Thus, in this case, anger, like disgust and sadness, would lead to lower acceptance rates. Conversely, if the approach/withdrawal dimension biases UG decisions, we might expect withdrawal-based emotions (i.e., disgust and serenity), independent of valence, to motivate participants to disengage from an unfair offer (an emotionally provocative event). As a result, they may be more likely to retreat from the interaction than individuals in approach-based states, making them less likely to accept unfair offers. In this case, we would further expect that approach-based emotions (i.e., anger and amusement) would not have a significant impact on acceptance rates. Alternatively, individuals in withdrawal-based states may become less motivated to gain money (an approach-based incentive) and thus less likely to accept unfair offers despite the potential monetary gains, which would again lead to lower acceptance rates of unfair offers.

METHODS

Participants

A total of 204 participants (76% female) were randomly assigned to one of four emotion conditions. After removal of participants who reported confounded emotions (see below), the total sample was 179 participants (amusement, $n = 37$; anger, $n = 35$; serenity, $n = 33$; disgust, $n = 36$). Participants were recruited from the pool of psychology undergraduate students at the University of Arizona (age 18–46 years, $M = 19.1, \pm 2.4$), and received course credit for completing the experiment. To ensure that participants were sufficiently motivated to make real decisions, they were paid 10% of their actual earnings in the UG task, therefore participants also received between $4 and $7 in cash.

Mood induction (video clips)

To induce mood, we used short movie clips of 3–5 minutes' duration, a method widely used to induce discrete emotional states (Gross & Levenson, 1995), and shown to successfully induce not only the experience of a targeted emotion, but also the corresponding EEG frontal asymmetry predicted by the approach–withdrawal model (Davidson et al., 1990). We piloted all clips used for the present study, including those that had been previously reported in the literature (Gross & Levenson, 1995). For each clip, 16 basic emotions were rated on an 8-point Likert scale, with each distinct emotion measured as a single item. The two clips that most reliably and discriminately evoked the target affect in this pilot were used in this study to induce and sustain each emotion (Harlé & Sanfey, 2007). Thus, each participant viewed two clips inducing the same emotion (either anger, disgust, amusement, or serenity; see appendix). Clips were shown on a different computer from the UG task, and in a separate room. The true purpose of this task (i.e., mood induction) was concealed from participants, with clip viewing presented as a separate study ostensibly unrelated to the UG.

Decision task (Ultimatum Game; UG)

After being given detailed instructions about the UG, participants were asked to fill out a short questionnaire to test their understanding of the rules. They then played the game in the role of "responder", receiving one-time monetary offers from 16 different proposers, presented in a randomised order. The entire experimental task consisted of 2 blocks of 8 offers, each involving a $10 split, with one clip viewing preceding each block (after each clip viewing, participants were immediately escorted to the UG computer and started to play). Participants were told that they would be playing the game via a computer network with partners located at other universities. On each trial, subjects first saw a picture of their partner (i.e., proposer) for 4 seconds. These pictures were

selected from a pool of actual UG players' photographs from previous studies and were emotionally neutral (Sanfey et al., 2003). They then saw the proposer's offer, and had a maximum of 10 seconds to decide to either accept or reject this offer. Upon deciding by way of a key press, the outcome of the offer was presented for 4 seconds, and the next offer sequence followed. All participants saw the same set of offers, which included 3 fair ($5) offers, 6 moderately unfair offers (3 × $4 and 3 × $3), and 7 highly unfair offers (4 × $2 and 3 × $1). Participants were informed they would be playing for actual money at the beginning of the experiment, and reminded prior to each block.

Emotion-induction check and other measures

Immediately after completing the UG, participants were asked to evaluate their emotional experience in response to the clips, using the same rating scale employed in the pilot study (a 0–8 scale). This was done to assess the primary emotion(s) induced by the clips, and to control for appropriate induction of the targeted affect. To protect the validity of our hypothesis testing, some participants ($n = 25$) were removed from the analyses if they reported a confounded emotional response (i.e., if they reported ratings on the target emotion lower than their ratings on other non-target emotions). In most cases less than 5 participants per condition were removed, with the exception of the anger group, in which 7 participants reported equal levels of both anger and sadness, and the disgust group in which 9 participants reported both disgust and amusement. Participants also completed a 12-item questionnaire aimed at assessing their susceptibility to the mood-induction procedure. This instrument included a measure of emotional susceptibility (Caprara, Renzi, Alcini, D'Imperio, & Travaglia, 1983) and emotional contagion. Finally, qualitative measures based on participant observation and debriefing were used to verify both the effectiveness of emotional induction and whether subjects believed that the two tasks were entirely separate experiments.

RESULTS

Emotion manipulation

Strong and discrete mood induction effects were confirmed by separate analyses of variance (ANOVAs) on reported amusement, $F(4, 151) = 27$, anger, $F(4, 151) = 198$, and disgust, $F(4, 151) = 277$ (all ps $< .001$). More specifically, participants in the amusement group reported higher degrees of amusement ($M = 5.61$) in response to the clips than individuals in the neutral ($M = 1.96$) and other emotion conditions (means < 2.50; Bonferroni correction, ps $< .001$). Participants in the anger group reported higher degrees of anger ($M = 6.14$) than individuals in the other emotion conditions (means < 0.96; Bonferroni correction, ps $< .001$). The disgust group reported more disgust ($M = 6.38$) than the amusement ($M = 0.67$), and serenity ($M = 0.00$) conditions (Bonferroni correction, ps $< .001$), but reported similar levels of disgust to the anger group (M=5.91). This type of disgust in the anger condition could, however, reflect moral rather than physical disgust (as targeted in the disgust condition), which may conserve an approach rather than withdrawal motivation. Serenity ratings were only measured in the serenity condition (M=4.36), but were not collected for other emotion conditions (for which the initial rating scale did not include such emotion). However, based on the observed low ratings (< 2.5) of other positive emotions (i.e., happiness, contentment, etc.) in all conditions, it appears unlikely that serenity may have confounded other target emotions in the other conditions. Finally, separate ANOVAs revealed that participants' emotional contagion (M=3.34, $SEM = 0.07$) and emotional susceptibly ($M = 1.86$, $SEM = 0.09$) did not differ across conditions ($p > .05$).

Decision making: Individual-level acceptance rates

Aggregate acceptance rates were calculated for each type of offer (i.e., $1 though $5), by dividing the number of offers accepted by the total number of offers responded to. A mixed-model analysis of variance (ANOVA) was then conducted using

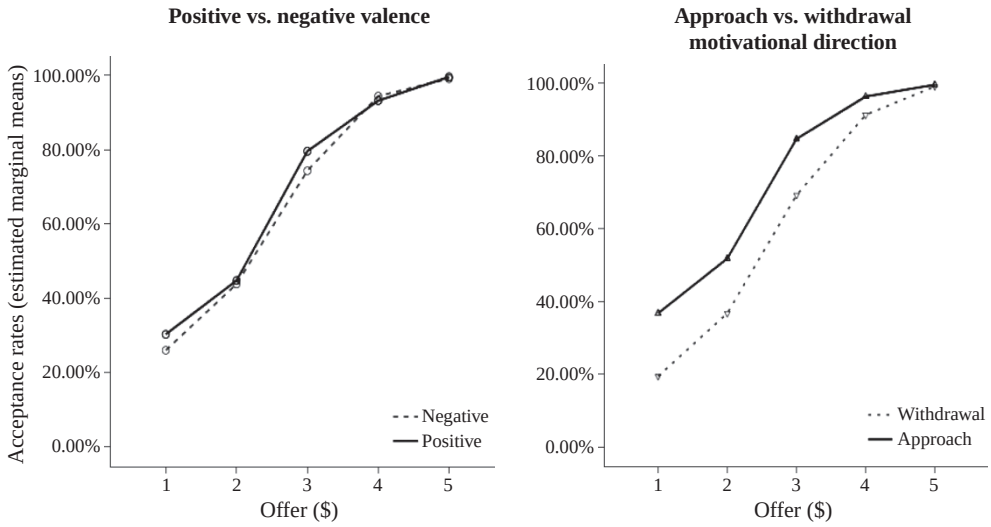

Figure 1. *Estimated marginal means of acceptance rates as a function of offer amount (out of $10) for each contrast of interest (valence: positive vs. negative; motivational direction: approach vs. withdrawal).*

this Offer Acceptance Rate as the dependent variable, the Offer Amount as the within-subject factor ($1, $2, $3, $4, $5), and two between-subject (and statistically orthogonal) contrast variables (negative–positive valence, withdrawal–approach motivation). The valence contrast compared anger and disgust (negative) with amusement and serenity (positive). The motivation contrast compared amusement and anger (approach) with serenity and disgust (withdrawal). In addition to a significant main effect of Offer Amount, $F(4, 171) = 125.00$, $p < .001$, a significant main effect of the motivational direction contrast (withdrawal vs. approach), $F(1, 174) = 8.67$, $p < .005$, was observed, with acceptance rates for withdrawal emotions (disgust, serenity) being consistently lower than acceptance rates for approach emotions (amusement, anger), after Bonferroni corrections ($p < .05$; see Figure 1). The valence contrast itself was not statistically significant ($p = .59$). An offer by motivational direction interaction was also observed, $F(4, 171) = 2.80$, $p < .05$ (with Huynh–Feldt correction), demonstrating that the difference in acceptance rates between withdrawal and approach emotions was significant for "unfair" offers ($1, $2, $3), $t(139) = 2.86$, $p < .005$, but not for "fair" ($4–$5) offers ($p = .16$). Acceptance rates for each emotion condition reflected such results, most noticeably for $1 and $2 offers (see Table 1).[1]

Trial-level analysis (generalised estimating equations)

To take advantage of trial-specific information, decision outcome was also analysed as a dichotomous outcome variable (i.e., reject vs. accept). Logit models were fitted to the data, with UG offer amount nested within participant, and participant nested within emotion condition. A first series of models was tested to predict decision making (i.e., acceptance or rejection) using fairness level and the contrast variables of emotional valence (positive–negative) and

[1] The effects of motivation on the rejection of unfair offers was strongest for disgust ($p < .05$) and marginal for serenity ($p = .10$), both when assessed with respect to a neutral induction condition ($n = 38$). Acceptance rates in the anger and amusement conditions, however, did not differ from those in the neutral condition ($p > .80$). Thus, priming effects occurred with withdrawal-based emotion, but not with approach-based emotion.

Table 1. *Acceptance rates (in %) by offer amount for each induced emotion*

	Offer amount				
	$1	*$2*	*$3*	*$4*	*$5*
Amusement	36.99	48.78	86.18	96.75	99.19
Anger	35.24	54.29	81.90	96.19	100.00
Disgust	17.12	35.14	67.57	92.79	98.20
Serenity	27.19	43.42	72.81	89.47	100.00

Note: Standard errors of the mean ranged from 0.00 to 7.13%.

motivational direction (approach–withdrawal) as predictors. A main effect of fairness level ($\chi^2 = 337.80$, $p < .001$; odds ratio: 3.01) was found, with higher offer amounts more likely than lower amounts to prompt acceptances. Further, there was an effect of motivational direction ($\chi^2 = 4.67$, $p < .05$; odds ratio: 0.51) with withdrawal-based emotional states less likely to lead to acceptances than approach-based emotions. Thus, while an extra offered dollar makes it three times more likely that an offer is accepted, a withdrawal motivation cuts the odds of accepting an offer in half relative to an approach-based emotional state. No main effect of valence ($p = .74$) or interaction terms were statistically significant.

DISCUSSION

In this study, we were interested in the degree to which incidental mood states affect social decisions. In particular, we explored whether either a positive–negative valence dimension or an approach–withdrawal motivational dimension might provide a better account of how emotions bias decision behaviour in the UG. Consistent with our previous work (Harlé & Sanfey, 2007), we found that simple emotional priming did indeed alter decision making in this task. More specifically, when discrete emotions were classified into two dimensions (positive/negative valence and approach/withdrawal motivation), the contrast of motivation significantly predicted acceptance rates of unfair offers, whereas valence did not. This was demonstrated by the fact that withdrawal-based emotional states (disgust, serenity) induced more rejections of unfair offers than approach-based states (anger, amusement).

The fact that both sadness and disgust lead to similar decision patterns regarding unfair offers lends credence to the hypothesis that a withdrawal construct, and not just behavioural inhibition, plays a role in biasing decisions in the UG. Indeed, whereas sadness may arguably be construed in terms of behavioural inhibition (i.e., a tendency to turn inward rather than withdrawal from a stimulus), disgust has by definition a strong behavioural activation component (retreating from the stimulus) and universally prompts withdrawal from offensive stimuli, rather than turning inward or freezing. Thus, the significantly lower acceptance rates in the disgust condition suggest withdrawal-based emotions may specifically bias such decisions. Therefore, while both activation/inhibition and approach/withdrawal dimensions may be relevant to economic decision making (Davidson, 2003), the present findings suggest that approach/withdrawal tendencies might play a more important role in the UG, and possibly in other types of financial decisions.

The most challenging emotion to induce was one that exhibits both positive valence and withdrawal motivation. Most positive affective states tend to promote an approach motivation, consistent with an evolutionary framework. In this study, serenity was chosen as a positive withdrawal-based

emotion because it has been shown to induce positive feelings such as calmness, peace, contentment and relief, but non-significant levels of other emotions such as ones used in the present study. In addition, serenity is most traditionally associated with meditative states, which therapeutically have been shown to promote detachment from external stimuli and a tendency to refocus attention towards internal experience (i.e., to withdraw from the external to the internal world; Lutz et al., 2008; Ortner et al., 2007). For these reasons, we believe that the induction of serenity in this study was effective in promoting positive affect combined with a withdrawal motivation. One limitation of this study, however, is that such induced emotion may have been more subtle in nature and less tied to an episodic context or story (such as in the other clips).

Acceptance rates of unfair offers were similar in the amusement and anger conditions, two approach-based emotions (Christie & Friedman, 2004; Davidson et al., 1990), and these rates did not differ significantly from acceptance rates in a neutral condition (see Footnote 1). This raises the possibility that these emotions were not induced as convincingly, or were shorter lasting, than the other emotional states. This seems unlikely, however, as participants' subjective ratings of the respective clips did not suggest that. Nonetheless, the anger condition was more challenging than others in regards to the selectivity of the mood induction. Though cases with target emotion ratings lower than non-target emotion ratings were systematically removed from the analyses, the anger condition still elicited disgust ratings on par with anger ratings. However, when these high disgust/anger cases were removed from the analyses, the present results were not affected.

The present study may also have broader implications for the investigation of the neural basis of social decision making, as one explanation for these data is that particular types of emotions, such as those with a certain motivational tendency, may "prime" specific cognitive, and even neural, processes that are involved in the decision-making process. For instance, specific neural regions related to emotional processing (anterior insula) and cognitive conflict (anterior cingulate cortex) have been associated with rejection of unfair offers in the UG (Sanfey et al., 2003). The present results suggest that negative withdrawal-based emotional states may further modulate such neural processes. For example, in comparison to neutral or approach-based emotion, disgust may result in enhanced insular activation on presentation of unfair offers. Such affective priming may translate into increased signalling of potentially aversive outcomes and thus prompt an avoidant response (i.e., withdrawal from the social exchange). In addition, although insular activation has been associated with a broad range of negative emotions in a variety of settings, studies with both humans (Paulus & Stein, 2006) and animals (Weiskrantz & Wilson, 1958) suggest that the anterior insular region is consistently involved in the anticipation of aversive stimuli and is necessary to implement harm withdrawal. Thus, our findings are consistent with the account that task-unrelated avoidant emotion may prime the insular region, resulting in heightened anticipation of aversive outcomes and hence more withdrawal responses.

In conclusion, based on the effect of transient task-irrelevant emotion on decisions in the UG, we found that partitioning affective states based on motivational tendency (approach–withdraw) could better account for the changes in decision making than using a valence (positive–negative) framework. These findings are of particular relevance for the field of social cognition as they show that subtle mood states may affect the very same cognitive or neural systems involved in the processing of social cues in interactive decisions. They also suggest that a motivational conceptualisation of emotion may be more useful in explaining the influence of emotional states on decision-making behaviour. Additionally, the present findings have clinical implications as they point to the potential existence of altered decision making in individuals suffering from mood disorders with a withdrawal motivational tendency (e.g., sadness, fear), such as depression or anxiety disorders. Thus, further research in these populations, and with ecologically valid decision

paradigms, is needed to improve our understanding of such disorders, as well as to develop more accurate models of human decision making.

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APPENDIX

Condition	*Clip 1*	*Clip 2*
Amusement	*Liar, Liar* (1987)	*When Harry Met Sally* (1989)
Anger	*Cry Freedom* (1987)	*This Boy's Life* (1993)
Disgust	*Trainspotting* (1996)	*Pink Flamingos* (1972)
Neutral	*Emma Goldman: A Documentary History of the American Years* (2003; documentary)	*The Global Dimension* (2003; a documentary on globalisation)
Serenity	*Views of Serenity* (2006; seashore/waves)	*Views of Serenity* (2006; sunset)