Differential Effects of Irrelevant Emotional Context on Regret and Rejoice: A Behavioural Economic Investigation of Decision Making under Risk

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Abstract This study investigates the role of incidental emotion and probability on two aspects of decision making: decision time and post-choice satisfaction (regret and rejoice). We used a modified regret paradigm in which people made choices in the context of pleasant, neutral and unpleasant emotional International Affective Picture System (IAPS) pictures present throughout the decision making and post-decision stages. Both pleasant and unpleasant emotional contexts led to a slower decision time compared to neutral context. With respect to post-choice feeling, participants experienced more regret after losing and less rejoice after winning in unpleasant compared to pleasant and neutral contexts. Further, we observed decreased regret rating from low to high risk conditions in the pleasant context. The regret rating was also observed to be more in the unpleasant compared to the neutral and pleasant contexts during low and high risk conditions, respectively. The results suggest that incidental emotions present during decision making do influence both decision time and post-choice ratings. These results imply that decision making theories need to consider incidental emotional context to explain decision making. We also discuss similarities and differences when incidental emotions are present during decision making with incidental emotions that are present prior to decision making.

Introduction

Affect has been shown to influence and be influenced by decision making (Bell 1982; Damasio 1994; Loomes and Sugden 1982; Mellers et al. 1997). For example, the decision affect theory (Mellers et al. 1997) argues that emotional experiences not only depend upon the utility of the obtained outcome and the unobtained alternative outcomes but also on our expectations regarding possible outcomes. The probabilities of the unobtained alternative outcomes alter post-decisional affect like regret or disappointment (Mellers et al. 1997; 2000). The greater emotional impact of the unexpected outcome compared to the expected outcome has been modelled as a surprise function in decision affect theory in addition to the originally proposed regret theory (Bell 1982; Loomes and Sugden 1982). More importantly, affective processes have been shown to facilitate information integration and influence decision making under risky situations (Damasio 1994; Gazzaniga et al. 2002). The studies mentioned above have focused mainly on explaining expected and anticipatory emotional influences on decision making.

In addition to anticipatory or actual emotional experience, incidental emotions that arise from factors unrelated to the decision at hand influence our decisions. Examples of these include emotional context or mood or emotional information present in the environment while making a decision (Bechara et al. 1994, 1996, 1997; Isen et al. 1987, 1988; 1999; Lerner et al. 2004; Schwarz and Clore 1983; Steffen et al. 2009). Incidental emotions influence decision making and experience by changing the expectations of the probability of future outcomes, or change the way the objective and emotional

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outcomes will be processed (Loewenstein and Lerner 2003). For example, a positive emotional context may enable the decision maker to reduce the regret caused by an adverse outcome.

One aspect of incidental emotions is mood; it influences information processing strategies and decision making (Forgas 1995, 2003; Park and Banaji 2000; Raghunathan and Pham 1999; Schwarz and Clore 1983). People in positive mood put less effort, use more superficial strategies to process information, use less information to reach decisions quickly, and show more confidence in their decisions (Clark and Isen 1982; Forgas 1995, 1998; Isen 1984; Isen et al. 1987). Those in a positive mood tend to be more optimistic compared to those in negative mood (Forgas 2003). In contrast, negative affect leads people to use a more effortful, systematic and analytic processing style (Mackie and Worth 1989; Schwarz 1990). Such strategies lead to a greater degree of anchoring bias in participants making judgments during a sad mood compared to a neutral mood (Bodenhausen, et al. 2000). Also depressed mood and negative affect directly influence the manner in which attentional resources are allocated; negative moods reduce the processing capacity and attention available to cognitive tasks (Ellis and Ashbrook 1988).

Appraisal patterns of each specific emotion influence a new situation and leads to emotion specific effects (Han et al. 2007; Lerner and Keltner 2001). Emotions characterized by a sense of certainty (e.g., contentment and anger) lead decision makers to rely on heuristic cues while emotions characterized by risk (e.g., worry and surprise) lead decision makers to scrutinize information carefully (Tiedens and Linton 2001). Sadness increases buying prices and decreases selling prices of an object; disgust decreases both buying and selling prices (Lerner et al. 2004). In another study, induced sadness decreased acceptance rate of unfair offers in an Ultimatum game and induced amusement did not bias the decision of the players (Harle' and Sanfey 2007). Thus, it appears people try to avoid loss when they were in a sad mood. Moods also influence post-decision experience with those in happy moods feeling worse about losses than those in a control condition (Isen et al. 1988). With respect to happiness, the results so far indicate that it influences different phases of decision making differently. Thus, it is still not clear whether emotions of different valence influence decision making in exactly opposite ways. Another question of interest is whether incidental emotions influence the different phases of decision making in a similar or different way.

In terms of risk, previous studies have shown that probability of outcomes is affect-inducing (Mellers et al. 1997; 2000; Loewenstein et al. 2001) and incidental moods can also influence probability perception (Arkes et al. 1988; Capra 2004; Fehr-Duda et al. 2011; Isen and Geva 1987). However, only very few studies (Bandhyobadhyay 2013a; 2013b) have investigated the role of incidental emotional information present in the environment during decision making in post-decision affect and how incidental emotions interact with the changes in probability of an outcome of decision. Hence, we investigate whether task irrelevant emotional information (positive or negative) present during decision making influences decision time and emotional response to a decision outcome. If irrelevant emotional context influences both decision making processes and post-decision emotional experience based on outcome, would it influence these processes in the same manner? Would these influences depend on the amount of risk present in the decision making situation?

In an earlier experiment, we found that priming individuals with incidental emotional context (pleasant, neutral and unpleasant emotions were manipulated using IAPS scenes) before a decision making task involving different levels of risk, influenced their decision time as well as post-choice satisfaction (Bandyopadhyay et al. 2013a). We found a significant interaction between emotion and level of risk for decision time and a significant effect of emotion on post-choice satisfaction ratings (regret and rejoice). For post-choice satisfaction, people felt more regret and less rejoice in unpleasant context compared to neutral and pleasant contexts. In the current experiment, our aim was to investigate whether a prolonged presence of irrelevant emotional context throughout all the phases of decision making will have a similar or different influence on decision time and post-choice satisfaction.

To answer these questions, we used a modified regret-rejoice paradigm (Chandrasekhar et al. 2008) in which risk is manipulated, and decision time (a measure of decision making process) and post-decision experience is measured. An individual feels regret when he makes a choice that results in an outcome worse than would have occurred had he made an alternative choice. An individual feels rejoice when the option chosen yields a more favorable outcome than an alternative decision. We manipulated risk (high risk: 1/3rd prior probability of winning and low risk: 2/3rd prior probability of winning) (Engelmann and Tamir 2009) and incidental emotion (presence of pleasant, neutral and unpleasant scenes as irrelevant emotional context) to study their effects on the decision time and pleasantness ratings. We used complex pictures from the International Affective Picture System (IAPS) that have been used in studies involving attention and decision making (Bandhyopadhyay et al. 2013a; Olivers and Nieuwenhuis 2006).

Previous studies have shown strong evidence for mood congruent effects on attitude judgments; feeling good makes our judgments more positive and feeling bad drives our evaluation in a negative direction (Bower 1981; Clark and Isen 1982; Isen 1984; 1987). We expected that the manipulation of incidental emotional information in the environmental context would alter the experience at the outcome (i.e., unpleasant or pleasant). In our earlier experiment with IAPS scenes as primes before the decision making phase, we found that

people felt more regret in the unpleasant condition compared to pleasant condition, and felt less rejoice in unpleasant compared to pleasant and neutral conditions (Bandyopadhyay et al. 2013a). Similarly, we predicted that incidental unpleasant emotion would increase the unpleasant experience after losing (regret) and decrease the pleasant experience after winning (rejoice). We also expected that positive scenes might also influence post-decision experience since they are present during decision making itself. In line with the decision affect theory (Mellers et al. 1997), we predicted that the amount of regret or rejoice would depend on the amount of risk with high probability of winning associated with less rejoice and more regret and low probability of winning associated with more rejoice and less regret.

Given that regret and rejoice are generated by different mechanisms (Chandrasekhar et al. 2008), we decided to analyze the effects of incidental emotions and probability separately for regret and rejoice. In terms of decision time, we hypothesized an interaction between emotion and level of risk. In terms of emotions, in our previous experiment we found that emotions made a person choose slower under high risk condition compared to neutral condition and there was a trend of faster decision time in the pleasant compared to neutral and unpleasant conditions (Bandyopadhyay et al. 2013a).

Method

Participants

Nineteen right-handed student volunteers (females=7, mean age=22.39 years) gave consent, received payment for participation, and participated in the experiment. The study was approved by the Institutional Review Committee at University of Allahabad.

Stimuli and Apparatus

The stimuli consisted of display containing three identical doors with an indicator of how many doors have 100 points hidden behind (prior probability — high: 2/3rd and low: 1/3rd probability of winning). We used the same 36 IAPS pictures used in a prior study (Bandyopadhyay et al. 2013b) for manipulating emotional context. The emotional scenes (12 scenes in each emotion - pleasant, neutral and unpleasant) were selected based on ratings from an Indian population (Lohani et al. 2013). They included pleasant (mean=7.47; SD=1.8), unpleasant (mean=2.88; SD=2.35), and neutral (mean=5.31; SD=1.8) pictures. The pictures were selected so that their arousal values were approximately equal for the pleasant (mean=5.76; SD=2.21), unpleasant (mean=5.57; SD=2.08) and neutral (mean=5.51; SD=2.14) scenes. The arousal values for pleasant, unpleasant and neutral scenes

did not differ from each other [$F(2,22)=2.374$, $p=0.117$] ensuring that the pictures differed only in terms of valence. The prior probability of winning was denoted by an image containing three circles, one green and two gray for 1/3 prior probability of winning, and two green and one gray for 2/3 probability of winning. This image appeared in location just above the doors. The experimental design was performed using E-Prime 2.0 software (Psychological software tools Inc., USA). The stimuli were presented on a 17″ monitor (85 Hz refresh rate: 1024×768 resolution) at a distance of 80 cm.

Procedure

At the beginning of each trial, participants were shown a display containing three doors presented against an emotional background scene. The nature of the emotional scene (pleasant, neutral and unpleasant) varied randomly between trials. The doors had +100 or −100 points hidden behind them (they either won 100 points or lost 100 points in a given trial). At the beginning of each trial, the number of doors (one or two) that contained +100 points (i.e., prior probability of winning) was indicated at the top of the display. The manipulation of probability allowed us to obtain different levels of experienced regret and rejoice depending on the outcome. In each trial, participants chose any one of the three doors displayed on the screen by clicking on a door. Subsequently, a blue arrow was shown on top of the selected door, as shown in Fig. 1. After the participants chose a door under a particular condition (high or low risk of winning), the outcome/point (+100 or −100) was displayed in red color on all the doors for three seconds. The emotional scenes remained in the background till the outcomes were shown. Then the participants were asked to rate their intensity of feeling (pleasant or unpleasant) based on the outcome (win or lose) using a horizontal visual analog scale (VAS) every trial. The scale ranged from −15 to +15 where −15 referred to 'very unpleasant' and 15 to 'very pleasant'. Participants used the mouse to move a cursor and to select their desired point on the continuous scale for pleasantness rating. Regret and rejoice were assessed on the basis of the pleasantness ratings (Chandrasekhar et al. 2008).

The outcome of each trial was predetermined so that participants won 1/3rd of the trials and lost 2/3rd of the trials in the high risk condition and they won 2/3rd of the trials and lost 1/3rd of the trials in the low risk condition in the experiment. The participants were informed that the probability of winning was random and independent of previous trials. There were a total number of 144 experimental trials (24 trials per condition) and 24 practice trials. Participants were given a small break after every 24 trials. The dependent measures were decision time (ms) and magnitude of rating (−15 to +15) provided after the outcome. Trials with inconsistent rating (negative

Fig. 1 An example experimental trial. At the beginning of a trial, participants were shown three closed transparent doors along with an emotional context (here is unpleasant) as a background and an indicator (probability) of how many doors have +100 points hidden behind them. Participants chose one of the doors by clicking on the closed doors. After that, the points behind all the doors were disclosed and the participant either won or lost based on whether or not there was a +100 point behind the doors she selected. After a delay of 3 s, participants rated their experience on a visual analog scale (VAS). The background scene was present until participants rated their experience
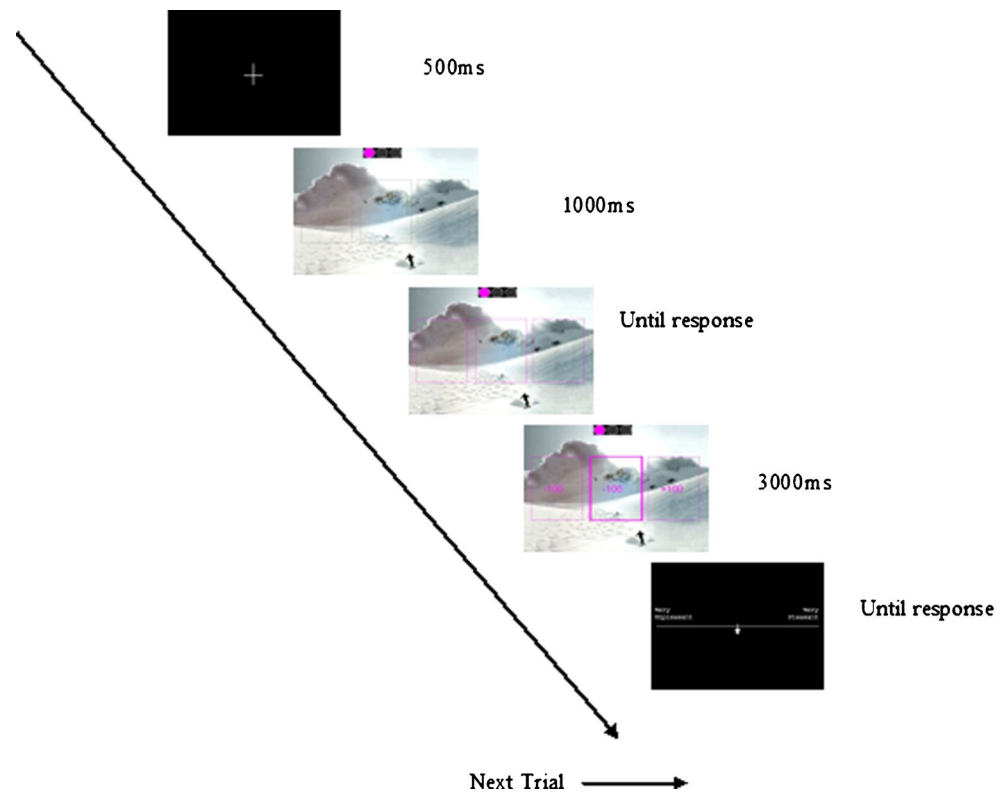
rating after winning or positive rating after losing) constituting only 0.51 % of trials were not included in the analysis.

Results

As in our prior studies (Bandyobadhyay et al. 2013a; 2013b), we used two dependent measures in the experiment: decision time and pleasantness rating. Decision time data was log transformed and analysed using a 3 (emotion)×2 (probability) repeated measures ANOVA. Similar analyses were done separately for the pleasantness experience in the regret and rejoice conditions (participants indicated regret when they lost and rejoice when they won in a given trial). Post-hoc analyses were performed using the Tukey test.

Decision Time

The main effect of emotion on decision time was significant, $F(2, 36)=12.288$, $p<.001$. Post-hoc comparisons showed that decision time was significantly slower in the unpleasant compared to the pleasant, $t(18)=3.740$, $p<.05$, and neutral contexts, $t(18)=7.107$, $p<.05$. People also made a slower decision in pleasant context compared to neutral context, however, the difference was only close to significance, $t(18)=3.366$, $p=0.07$. Thus, both pleasant and unpleasant emotional contexts slowed down decision making processes compared to a neutral emotional context (Fig. 2).

Pleasantness Rating

For the regret rating (result of losing), there was a significant effect of emotion, $F(2, 36)=6.178$, $p<.01$. Regret rating was more with the unpleasant context compared to the pleasant, $t(18)=4.635$, $p<.05$ and the neutral, $t(18)=3.878$, $p<.05$ contexts. The effect of probability was significant, $F(1, 18)=8.442$, $p<.01$ with more regret in the low risk compared to the high risk condition. The interaction between emotion and probability was also significant, $F(2, 36)=4.225$, $p<.05$. Post-hoc comparisons showed a significant difference between high and low risk conditions only for the pleasant context, $t(18)=8.173$, $p<.05$ with more regret in the low risk condition. In the high risk condition, regret was significantly more with the unpleasant compared to the pleasant context, $t(18)=7.629$, $p<.05$ and in the low risk condition, regret was more with the unpleasant compared to the neutral context, $t(18)=5.309$, $p<.05$. The results indicate that the effect of risk on regret is modulated by the emotional context (Fig. 3).

With rejoice rating (result of winning), there was a significant main effect of emotion, $F(2, 36)=23.370$, $p<.001$. Post-hoc comparisons show that participants experienced less rejoice in unpleasant compared to pleasant, $t(18)=7.874$, $p<.05$ and neutral contexts, $t(18)=4.732$, $p<.05$. Participants also showed a non-significant trend indicating more rejoice with the pleasant compared to the neutral context, $t(18)=3.142$, $p=.094$. This indicates that unpleasant context decreases the experience of rejoice and the pleasant context might increase

Fig. 2 Decision time as a function of emotional context
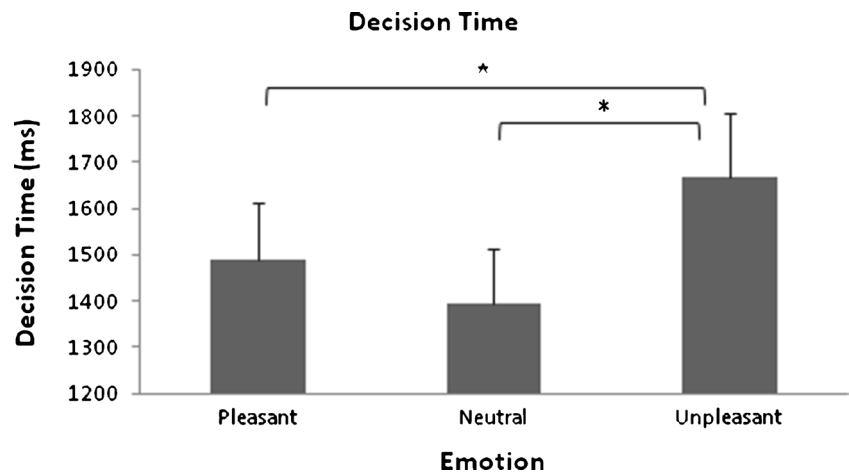
the experience of rejoice when the participant won in a given trial (Fig. 4). Unlike the regret condition, the interaction between emotion and probability was not significant.

Discussion

The results from this study clearly show that irrelevant emotional information influences decision making processes before the decision and post-choice experience. Decision times were influenced by both pleasant and unpleasant emotions presented during and post decision making, but were not sensitive to probability information. Importantly, the effect of incidental emotions on regret and rejoice was different. Regret experience was mainly influenced by unpleasant context compared to pleasant and neutral contexts, leading to a higher regret in unpleasant compared to pleasant and neutral contexts. Further, the effect of probability information on regret was modulated primarily by a pleasant context leading to a decrease in regret feeling under high uncertainty compared to low uncertainty. Thus we find that when people lose in an unpleasant context, irrespective of probability information,

they overall feel more regret compared to other emotional contexts. But, the effect of pleasant context on the regret experience is sensitive to probability information. Under high uncertainty, people felt less regret with pleasant compared to unpleasant context, and with low uncertainty people felt more regret with unpleasant compared to neutral context. However, irrespective of probability information, rejoice experience was influenced by both pleasant and unpleasant scenes with pleasant scenes increasing rejoice and unpleasant scenes reducing rejoice. It means that irrespective of probability information, in case of a loss, people's regret experience was affected only by unpleasant context, whereas in case of a win, their rejoice experience was affected by both pleasant and unpleasant contexts. However, interestingly, we also found that probability information affected people's post-choice satisfaction only when they lost compared to when they won, and that effect was mainly modulated by pleasant context. These effects indicate that the mechanisms involved in the incidental emotional effects on regret and rejoice could be possibly mediated by different mechanisms.

Results in the domain of decision time have a different trend compared to our previous study (Bandyopadhyay

Fig. 3 Pleasantness rating in the loss (regret) conditions as a function of emotional context
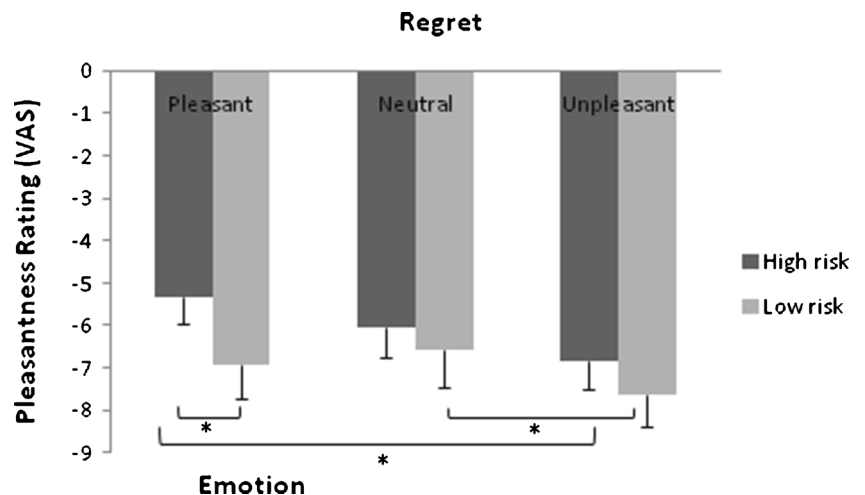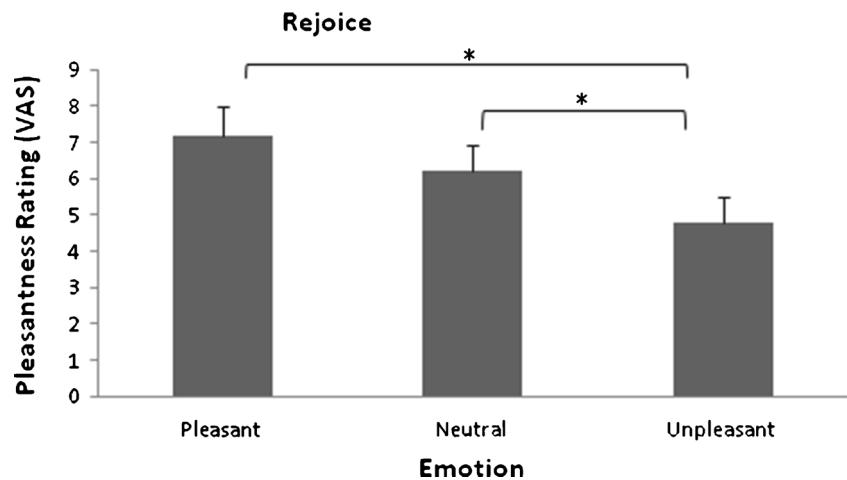
2013a). In the previous study, we found an interaction of emotion and probability for decision time, where people made slower choices in both pleasant and unpleasant conditions under high risk condition only, whereas, in our current experiment, we found the same effect irrespective of the level of risk involved in the gamble. A possible explanation is the duration for which the stimuli are presented with the pictures shown for longer duration in the current experiment. Also the pictures were present throughout the decision making phase unlike the previous experiment in which IAPS pictures were presented before the beginning of the trial. In contrast, in an earlier study (Bandyopadhyay 2013b) using happy, neutral and sad faces as emotional context throughout all the phases of decision making, we found that people chose faster in happy as well as sad context under low risk. Sad emotion was found to make them slower only under high risk. A possible explanation for this contrasting finding would be that IAPS scenes are higher in arousal, complexity and variety in terms of subtypes of emotions, which may lead more involvement of resources to process them compared to faces. This would further be more prominent for unpleasant scenes as they contain various kinds of negative emotions that are stronger compared to a sad emotional face. Thus, unpleasant emotional context leads to a slower decision time as they may serve as stronger distractors while making decisions. With pleasant emotions too, we found a similar trend as unpleasant emotions. Thus, we may say that in addition to complexity and arousal, presence of emotional content in the contextual stimuli may create higher distraction during a decision task, thereby increasing the overall decision time compared to neutral stimuli.

Earlier research assumed that in positive mood people process information faster, more superficially and with less effort compared to negative mood (Forgas 1995). Thus, one could expect a faster decision time in the pleasant context compared to the neutral context. Unpleasant context, on the other hand,

is expected to lead to a slower decision time compared to neutral context. However, this cognitive capacity based explanation for the differential influences of positive and negative emotions on information processing may not be sufficient. There are discrepant findings in the literature with respect to the way in which positive and negative emotions influence our processing strategies while making judgments (Ellis and Ashbrook 1988; Isen 1984; Mackie and Worth 1989). Some studies have found that negative affect reduces resources for processing information (Ellis and Ashbrook 1988); however, others have found that to be the case with positive emotions (Isen 1984; Mackie and Worth 1989). These authors found that the more superficial processing produced by happy mood when computing judgments can be reversed if extra processing resources such as more time becomes available as in the current experiment. Also, the emotional pictures might have acted as distractors resulting in longer decision time in the participants.

Moreover, the fundamental evolutionary significance of positive and negative affective states may not simply be to influence processing effort but to trigger equally effortful, but fundamentally different, processing styles (Bless 2000; Fiedler 2000). These processing strategies can produce very different judgmental outcomes (Forgas 1998), yet they can both be vigilant and effortful. This may explain why decision time was longer in both pleasant and unpleasant contexts compared to neutral context, but regret and rejoice were affected differently by the emotional context based on different outcomes.

In terms of pleasantness ratings, results are consistent with that of the previous experiment (Bandyopadhyay 2013a) with respect to rejoice. Pleasant pictures presented before or during the trial resulted in a larger rejoice compared to the unpleasant and neutral pictures. Similarly, there was no effect of risk. The regret felt by participants was influenced by risk in accordance with the decision affect theory (Mellers et al. 1997) with the participants feeling more regret in the low risk compared to

high risk condition. This effect is in accordance with the decision affect theory and was present mainly for pleasant pictures and the effect was not present or much reduced due to unpleasant pictures.

In terms of emotional context, we consistently found rejoice to be influenced by both pleasant and unpleasant context. However, the effect on regret was subtle with risk influencing regret only with the pleasant context. Unlike with positive pictures, the unpleasant pictures include a variety of negative emotions (fear, anger, disgust, sadness) and this may serve as a reason for unpleasant context to have a larger effect especially on regret experiences irrespective of risk. In a previous study, regret has been found to be associated with an appraisal tendency of responsibility compared to rejoice, i.e., people have a higher tendency to blame oneself after making a wrong choice compared to disappointment (Zeelenberg, et al. 2000). Thus, in regret, people will have lesser tendency to be influenced by risk or probability related factors compared to rejoice.

So far, there has been very little research that focused specifically on the effect of incidental emotional information on decision time and post-choice satisfaction. Our studies make a beginning and investigate how emotions unrelated to the decision making task affect the emotional feeling associated with the outcome of one's decision as well as decision time. This study complements the other studies on mood and decision making (Forgas 1995, 2003; Isen et al. 1987; Lerner and Keltner 2001) and enables us to further understand the effect of emotional context in decision making. Unlike the long-term mood effects (Lerner et al. 2004), the effects of transient incidental emotional information present in the environment mainly have short-term consequences for decision making or other cognitive processes (Bandyopadhyay et al. 2013a; Olivers and Nieuwenhuis 2006). The effect of incidental emotions is probably linked to differences in processing strategies induced by these emotions either before or during decision making (Bandyopadhyay et al. 2013a, 2013b; Gasper and Clore 2002; Harle' and Sanfey 2007; Lerner and Keltner 2001; Tiedens and Linton 2001). In addition, we have shown that the emotional response to an outcome is not only modulated by probability, but also by the emotional context. The models of regret (Bell 1982; Loomes and Sugden 1982; Mellers et al. 1997) have modeled regret and rejoice as a single function. However, in the current study, we found that regret and rejoice experience varied differently when decisions are made in different emotional contexts and different levels of risk. The post-decision emotional experience was influenced by the timing and duration of incidental emotions as well as the emotional content of those incidental emotions. Thus, it may be possible that regret and rejoice may need to be modeled differently in the future theories of affect and decision making, and the role of incidental emotions in post-choice satisfaction need to be taken into account in this regard.

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