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BRIEF REPORT

Emotion regulation and risk taking: Predicting risky choice in deliberative decision making

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Only very recently has research demonstrated that experimentally induced *emotion regulation* strategies (cognitive reappraisal and expressive suppression) affect risky choice (e.g., Heilman et al., 2010). However, it is unknown whether this effect also operates via *habitual* use of emotion regulation strategies in risky choice involving deliberative decision making. We investigated the role of habitual use of emotion regulation strategies in risky choice using the "cold" deliberative version of the Columbia Card Task (CCT; Figner et al., 2009). Fifty-three participants completed the Emotion Regulation Questionnaire (ERQ; Gross & John, 2003) and—one month later—the CCT and the PANAS. Greater habitual cognitive reappraisal use was related to increased risk taking, accompanied by decreased sensitivity to changes in probability and loss amount. Greater habitual expressive suppression use was related to decreased risk taking. The results show that habitual use of reappraisal and suppression strategies predict risk taking when decisions involve predominantly cognitive-deliberative processes.

Keywords: Emotion regulation; Anticipated emotion; Risk taking; Deliberative processes; Columbia Card Task.

During the previous decade, a trend emerged in decision research highlighting the influence of emotion on decision making (e.g., Lauriola & Levin, 2001; Loewenstein, Weber, Hsee, & Welch, 2001; Weber & Johnson, 2009). One important line of such research has shown that decision makers often are influenced by *anticipated emotions*, which are generated by considering the potential choice outcomes (e.g., Mellers & McGraw, 2001). "Anticipated emotions are a component of the expected consequences of the decision. They are '*cognitive*' emotions that are

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expected to occur when outcomes are experienced" (Loewenstein et al., 2001, p. 269). For instance, people who overestimate positive emotions related to favourable outcomes would tend to be overly risk seeking. By contrast, people who overestimate negative emotions related to unfavourable outcomes would tend to be overly risk averse (Mellers & McGraw, 2001).

From a different line of research, pioneered by Gross and colleagues (Gross & John, 2003), we know that people feeling an emotion often use specific emotion-regulation strategies to down-regulate emotions in a wide range of life domains (e.g., interpersonal relationships, problem solving, etc.). Gross and John's (2003) two-factor model provides an emotion-regulation theory: The model distinguishes between antecedent-focused strategies versus response-focused strategies. Antecedent-focused strategies are based on cognitive reappraisal, which represents one's ability to reframe a situation in order to change its emotional impact (Gross, 2002). For instance, before making a risky decision, decision makers can change the way they view the potential outcomes of their choice in order to minimise or modify their emotional impact on decision making. In contrast, response-focused strategies (i.e., expressive suppression) are based on the ability to inhibit the current emotion-expressive behaviours (Gross, 2002). For instance, decision makers may maintain a "poker-face" while bluffing during a card game in order to inhibit their emotions. Gross and John (2003) suggested that these two types of emotion-regulation strategies are independent of each other and that they can be differentially employed by individuals, either habitually (i.e., in the form of a personality disposition) or momentarily (e.g., situationally induced).

Most recently, the two research lines, on emotions in decision making and on emotion-regulation strategies, have converged in the investigation of whether decision makers use strategies of emotion regulation during decision making and whether differences in emotion regulation might explain differences in decision making. More generally, Westen and Blagov (2007) have argued that every decision can be viewed also as an act of emotion regulation, because the goal of any decision can be to minimise one's future negative affective states and/or to maximise one's future positive affective states. According to this view, it is thus possible that reappraisal and/or suppression may indeed substantially affect individuals' choices. More specifically, research has started to investigate the role of emotion regulation (not always constrained to cognitive reappraisal and expressive suppression) in decision making: Several recent neuroscience studies (Martin & Delgado, 2011; Sokol-Hessner et al., 2009; Sokol-Hessner, Camerer, & Phelps, 2012) investigated the role of cognitive emotion regulation during financial decision making, its effect on loss aversion, and its neural correlates. To summarise briefly, these studies showed that cognitive emotion regulation can reduce risk-taking levels (Martin & Delgado, 2011), loss aversion (Sokol-Hessner et al., 2012), and the arousal related to losses (Sokol-Hessner et al., 2009). In contrast, relatively less attention has been paid to the role of expressive suppression during decision making.

In addition, two behavioural studies have focused on the same two emotion regulation-strategies that we did: Miu and Crisan (2011) have shown that situationally induced reappraisal—in comparison to suppression—reduced the susceptibility to framing effects in risky choice. Most relevant to our current study, Heilman, Crişan, Houser, Miclea, and Miu (2010) have shown that experimentally induced emotion-regulation strategies influenced performance on a risky choice task, the Balloon Analogue Risk Task (BART; Lejuez et al., 2002): Participants in the suppression condition took significantly less risk than participants in the reappraisal condition. Importantly, Heilman et al. used a decision-making paradigm in which participants receive immediate feedback about the outcomes of their decisions. In such cases, if effects of emotion-regulation strategies on decisions are observed, we cannot say for sure via which of two possible pathways emotion regulation affected decision making. On the one hand, it is possible that emotion regulation had an effect on anticipated

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emotions that occur during the decision-making process, before the outcome of the decision is learned. On the other hand, it is possible that emotion regulation had an effect on feedback-based emotions, i.e., emotions triggered when participants learned about the (good or bad) outcomes that result from their decisions, such as the negative emotion triggered by a loss of money or the positive emotion triggered by a win of money. It has been shown that emotions triggered by previous feedback are likely to affect subsequent decisions (Weber & Johnson, 2009).

To summarise, previous research has shown not only that emotions themselves can affect risky choices, but that situationally induced emotion-regulation strategies can also affect decision making. In contrast to the role of situationally induced emotion-regulation strategies, in the current paper we were interested whether *naturally occurring* individual differences in the emotion-regulation strategies people habitually adopt may affect their risky choices. A further goal of the current study was to extend the existing research with respect to the type of emotions likely to be involved, namely whether emotion regulation has an effect on risky decision making when no feedback-related emotions are involved, but participants can be expected to use anticipated emotions to make their decisions.

Consistent with the latter goal, we chose a task that does not give immediate feedback about the outcomes of participants' decisions, but instead delays feedback until all decisions have been made. Thus, on logical grounds, we can rule out that the associations we might observe between participants' emotion-regulation strategies and their risky decisions have been caused by the regulation of feedback-related emotions. By extension, if we still observe effects of emotion regulation, it is plausible that emotion-regulation strategies operated via anticipated emotions.

In particular, we had two main hypotheses, based on prior research (regarding emotion regulation: Gross & John, 2003; Heilman et al., 2010; regarding decision making in the cold CCT: Figner, Mackinlay, Wilkening, & Weber, 2009; Figner & Weber, 2011): First, we predicted that individuals with a stronger tendency for habitual use of cognitive reappraisal would show increased risk taking compared to individuals with a lower such tendency. Second, we predicted that individuals with a stronger tendency for habitual use of expressive suppression would show decreased risk taking compared to individuals with a lower such tendency. We expected that reappraisors would make relatively riskier choices because they are more likely to focus on positive (vs. negative) emotions triggered by positive potential outcomes. In contrast, we expected that suppressors would make relatively less risky choices because they are more likely to focus on avoiding negative emotions triggered by negative potential outcomes. In addition, we were interested whether individual differences in emotion-regulation strategies are related to differences in the sensitivity to changes in probability, gain amounts, or loss amounts (explanations see below).

METHODS

Participants

Fifty-three undergraduate students at the University of Rome "Sapienza" participated in the study ($M_{age} = 21.73$, $SD = 4.05$; range 19 to 44 years; 66% females). As reimbursement, participants received course credit plus a variable payment in the form of a prepaid mobile phone card whose amount was determined by the outcome of one of the CCT game rounds (with 1 point = 1 cent), randomly selected at the end of the task.

Measures

Emotion Regulation Questionnaire. The Emotion Regulation Questionnaire (ERQ: Gross & John, 2003) is a 10-item self-report scale assessing two individual strategies that people adopt in order to regulate their emotions: cognitive reappraisal and expressive suppression. Respondents rate the extent to which they agree with self-descriptive statements reflecting cognitive reappraisal (e.g., "When I want to feel less negative emotion, I change the way I'm thinking about the situation")

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or expressive suppression (e.g., "When I am feeling negative emotions, I make sure not to express them"). Ratings are made on a 7-point Likert-type scale with the response anchored at the ends with 1 (*Strongly disagree*) and 7 (*Strongly agree*). The ERQ produces an overall score of "reappraisal" and an overall score of "suppression", quantifying the two independent emotion-regulation strategies for each participant. Previous studies (Gross, 2002; Gross & John, 2003; John & Gross, 2004) found associations between cognitive reappraisal and positive mood and between expressive suppression and negative mood. Somewhat less strong effects were also found for the negative association between cognitive reappraisal and negative affect and the positive association between expressive suppression and negative affect (e.g., depression). These same studies also showed that emotion-regulation strategies predict psychological well-being outcomes (e.g., life satisfaction, positive interpersonal relationships, personal growth, and environmental mastery). In our study, we used the Italian ERQ version (Balzarotti, John, & Gross, 2010). The psychometric properties of the Italian ERQ version have been found to be reasonable with alpha reliabilities averaging .84 for reappraisal and .72 for suppression (Balzarotti et al., 2010). Consistent with these findings, the internal consistencies in our own sample were .81 for reappraisal and .74 for suppression.

PANAS. Because previous studies (Gross & John, 2003; John & Gross, 2004) have shown strong associations between emotion-regulation strategies and mood, we assessed participants' mood states in order to be able to control for potentially confounding effects. Positive and negative mood states were operationalised by summing the 10 positive and 10 negative affect items, respectively, in the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). Participants were instructed to rate how they felt "right now" on a scale from 1 (*Very slightly or not at all*) to 5 (*Extremely*). Watson and colleagues reported alpha coefficients of .88 and .87 for positive and negative mood, respectively. We observed alpha coefficients of .79 for positive mood and .86 for negative mood.

Columbia Card Task (CCT). The "cold" CCT (Figner et al., 2009; Figner & Weber, 2011; Gladwin, Figner, Crone, & Wiers, 2011) was developed to assess risk taking and underlying information use in risky choice under predominantly deliberative conditions, i.e., when decisions are made with the involvement of mainly "cold" cognitive processes. Several experiments using self-reports, skin-conductance measurement, and convergent validity with other measures (Figner et al., 2009) established that the cold version involves mainly deliberative cognitive processes and triggers comparatively little emotional arousal. This contrasts with the "hot" affective version of the CCT, which was specifically designed to trigger substantial involvement of affective decision-making processes (the hot CCT achieves this by incorporating both immediate feedback about participants' choices and incremental stepwise risky decisions instead of the "overall" type of decisions in the cold CCT; for details see below). For example, in the cold CCT participants report to more strongly rely on "mathematical decision strategies" compared to the hot CCT, while in the hot CCT, they report to rely more on their "gut feelings" and to experience greater emotional arousal when making their decisions, compared to the cold CCT (Figner et al., 2009; Figner & Weber, 2011).

In the current study we used a shortened version that consisted of 24 game rounds (described in Figner & Weber, 2011; compared to the longer version consisting of 54 game rounds described in Figner et al., 2009). Thus, participants played a total of 24 game rounds, constructed from a full factorial combination of 2 levels of probability (Number of Loss Cards: 1 or 3) $\times$ 2 levels of gain amount (Gain: 10 or 30 points per gain card) $\times$ 2 levels of loss amount (Loss: 250 or 750) $\times$ 3 repetitions of each of the eight combinations (Block). Within each block, order of trials was randomised. In each game round, 32 cards are presented face down and the participant indicates how many cards he/she

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wants to turn over in the current round. All the relevant information (probability, gain amount, loss amount) is shown at the top of the screen and participants indicate their choice by clicking on one of 33 buttons (ranging from 0 to 32 cards to be turned over). The main variable of interest is how many cards participants choose to turn over in each of the 24 game rounds. For each gain card that they turn over, they win the number of points the gain cards are worth in the current game round. However, if they encounter a loss card, the current game round is over (i.e., no more cards are turned over in that game round) and the loss amount is subtracted from the points they had accrued in the current game round. Each new game round starts with a score of 0 points. Based on the main dependent variable (the number of cards chosen in each of the 24 game rounds) we derived four constructs of interest: (1) The risk-taking level is the average number of cards chosen per game round. Using multilevel-analysis (details below), we additionally investigated participants' sensitivity to changes in each of the three "economic primitives" in the CCT (probability, gain amount, loss amount), thus giving us insight into how strongly or weakly participants adjusted the level of risk taking when (2) the probability to lose was low (1 loss card) versus high (3 loss cards), (3) the gain amount was low (10 points per gain card) versus high (30 points per gain card), and (4) the loss amount was low (250 points) versus high (750 points). According to the mathematically optimal strategy (assuming risk neutrality and loss neutrality), changes in all three primitives should affect participants' risk-taking levels.

The systematic variation of these three crucial primitives in risky choice is an advantage of the CCT over other risk tasks, because this allows for the assessment of whether and how these three factors influence the risky decisions. Accordingly, the CCT enables us to investigate the mechanisms underlying individual differences in risk taking (e.g., whether it is due to individual differences in the sensitivity to changes in gains, losses, and/or probabilities), shedding light on different potential motivations for greater or lower risk taking (see Figner & Weber, 2011; Schonberg, Fox, & Poldrack, 2010).

Procedure

Participants were tested on two separate occasions, four weeks apart, which were framed as two unrelated studies. We chose this procedure to more conservatively test the predictive power of the emotion-regulation variables: In the first session, participants filled out a self-report battery, which included the Emotion Regulation Questionnaire (ERQ; Balzarotti et al., 2010) and other scales unrelated to the goals of the current study. The questionnaires were administered in small-group sessions of about eight people. Gender and age information was also collected. Four weeks later, in the second session, participants played the cold CCT in an individual setting on a desktop computer, according to the procedure described by Figner et al. (2009). Mood state (i.e., PANAS) was assessed before participants played the CCT. The experimenter did not know the participants' scores on the self-report battery.

RESULTS

To investigate our hypotheses of the relationship between risk taking (average number of cards chosen per game round) and habitual use of emotion-regulation strategies, we computed correlations between habitual use of cognitive reappraisal, expressive suppression, risk taking, and as covariates, positive and negative mood states. As predicted and shown in Table 1, reappraisal and suppression were significantly correlated with risk taking, in opposite directions: Stronger habitual use of reappraisal was associated with increased risk taking while stronger habitual use of suppression was associated with decreased risk taking.

These results were confirmed by a single multiple regression model in which risk taking was simultaneously regressed on participants' reappraisal and suppression scores (reappraisal: $\beta = 0.32$, $p < .05$; suppression: $\beta = -0.33$, $p < .05$).

Table 1. *Means, standard deviations, and intercorrelations among independent variables and risk taking*

	1	*2*	*3*	*4*	*5*
1 Cold CCT	1				
2 ERQ: Reappraisal	.30*	1			
3 ERQ: Suppression	−.31*	.07	1		
4 Positive mood	.25†	.12	−.36**	1	
5 Negative mood	−.08	−.03	.25†	−.01	1
M (*SD*)	12.43 (4.85)	4.28 (1.09)	2.88 (1.01)	31.22 (6.16)	18.05 (7.50)

Note: $^{**}p < .001$; $^{*}p < .05$; $^{\dagger}p < .10$.

To investigate whether these effects were affected by sex, age, or positive or negative mood states, risk taking was used in a hierarchical regression analysis in which these covariates (sex, age, mood scores) were entered as the first step in the analysis. Reappraisal and suppression were then entered as the second step. As can be seen in Table 2, controlling for these covariates effects did not substantially change the relationship between emotion regulation strategies and risk taking.

To investigate whether habitual use of emotion-regulation strategies is related to how sensitive individuals are to changes in probabilities, gain amounts, and loss amounts, we used a multilevel model in which the number of cards chosen in each of the 24 game rounds was the dependent variable, and the three primitives (probability, gain amount, and loss amount) as well as reappraisal scores and suppression scores were the independent variables. The repeated-measures nature of the data was modelled by including a participant-specific random intercept using the lme4 package in R (e.g., Baayen, Davidson, & Bates, 2008; Gelman & Hill, 2007). *P*-values were determined using Markov chain Monte Carlo sampling as implemented in the pvals.fnc function in the package languageR (Baayen et al., 2008).

The crucial test of whether emotion-regulation strategies are related to differences in sensitivities to probability, gain amount, or loss amount is whether the analysis shows significant interactions between emotion-regulation strategy scores and each of the three primitives. We found a significant interaction between reappraisal on the one hand and probability sensitivity (coeff = −0.043; $p = .03$) and loss sensitivity (coeff = −0.047; $p = .02$) on the other hand: Participants with higher scores on reappraisal were less sensitive to changes in both probability and loss amount compared to participants with lower scores on reappraisal. All other relevant

Table 2. *Hierarchical regression analysis of risky behaviour*

		Measure of risky behaviour				
		Number of cards chosen in cold CCT				
	Predictors	R^2	*Adj.* R^2	*Model F*	*df*	β
Step 1	Sex	.075	−.006	0.928	(4, 46)	0.04
	Age					0.05
	Positive mood					0.24
	Negative mood					−0.08
Step 2	ERQ: Reappraisal	.220	.113	2.100	(6, 44)	0.30*
	ERQ: Suppression					−0.33*

Note: $^{*}p < .05$.

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interactions were non-significant ($p > .1$). As in the analysis of risk-taking levels, adding age and sex as covariates did not change the results.

DISCUSSION

The results of the present study offer evidence that habitual use of different emotion-regulation strategies (cognitive reappraisal and expressive suppression) are significant predictors of risk taking when predominantly deliberative "cold" cognitive processes are involved in the decisions. Importantly, in contrast to earlier work, the risky choice task we used did not involve emotional feedback-related processes triggered by the processing of outcomes following from participants' decisions. In the—to the best of our knowledge—only other study on the role of cognitive reappraisal and expressive suppression in risk taking (Heilman et al., 2010), emotion-regulation processes may have affected risky choice either via anticipated or via feedback-related emotions, or both. In the current study, participants did not receive feedback about the outcomes until they had finished the risky choice task, thus showing that emotion regulation predicts risky choice in the absence of emotions triggered by the outcomes of their decisions. Thus, the results of our study not only support Heilman et al.'s (2010) findings (replicating their results of reappraisal and suppression on risk taking), but extend them in three ways: First, we show that *naturally occurring* individual differences in the habitual use of emotion-regulation strategies (in contrast to situationally induced emotion-regulation strategies) are significant predictors of risk taking, thus supporting the ecological validity of the effects of emotion regulation on risk taking beyond experimentally induced temporary differences in emotion-regulation strategies (which was the previous studies' approach, e.g., Heilman et al., 2010; Miu & Crisan, 2011). Second, we show that emotion-regulation strategies are significant predictors of risky choice in a task that triggers mainly deliberative "cold" cognitive decision-making processes and does not involve immediate outcome feedback (Figner et al., 2009). Third, our study sheds light on the possible involved psychological mechanisms underlying emotion regulation as we found that greater habitual use of cognitive reappraisal was associated with less sensitivity to both the probability and the magnitude of potential losses, which is consistent with recent neuroscience work on the role of cognitive emotion strategies (though not necessarily cognitive reappraisal specifically) (Martin & Delgado, 2011; Sokol-Hessner et al., 2009, 2012). It is worth pointing out that the effect on sensitivity to crucial economic primitives is not a general one, as we observed the effect for the probability and the magnitude of losses, but not for the magnitude of gains. Thus, it is tempting to speculate that the effect is specific to negative aspects of a risky situation. Interestingly, in the emotion-regulation model by Gross and colleagues (Gross & John, 2003), it is posited that emotions may be regulated via *attentional deployment* (see Gross & John, 2003, for more details), a feature specific to antecedent-focused strategies such as cognitive reappraisal. Thus, within the emotion-regulation framework, our results suggest that the reappraisal strategy—at least in the task we used—may have operated mainly via decreasing the attention given to negative aspects of the risky choices. Future studies could more directly assess attention to negative versus positive information to specifically target and investigate this potential mechanism.

Some limitations of our study need to be acknowledged. First, our evidence on the relationship between emotion regulation and risky choice is only correlational; accordingly, we cannot rule out that our results have been caused by a third variable, related to both emotion regulation and risky choice. This was the price we paid for investigating naturally occurring individual differences in emotion-regulation strategies, instead of experimentally manipulating them.

Second, previous studies (Gross & John, 2003; John & Gross, 2004) have shown several links between emotion-regulation strategies on the one hand and various personality characteristics on the other hand, such as openness to experience, neuroticism and extraversion, self-esteem, negative

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affect (e.g., depression), dispositional coping, and optimism. It was beyond the scope of the current study to investigate all of these, but we cannot rule out that these or other personality dispositions may mediate or moderate our results. Gross and John's (2003) study, considering a large pool of variables, reported substantial effect sizes for the relationship between emotion-regulation strategies and mood. Therefore, we investigated at least one potential alternative explanation, namely that emotion regulation might have affected mood (e.g., Gross & John, 2003) and, in turn, mood might have affected risky choice (e.g., Yuen & Lee, 2003). To investigate that possibility, we assessed participants' mood before they did the CCT. As we found that risk taking was not significantly associated with mood, we can rule out this one potential alternative explanation. Nevertheless, it would be interesting to investigate possible pathways by which personality characteristics might mediate or moderate the effect of emotion regulation on risky choice. For instance, greater reappraisal might increase people's optimism, leading to increased risk taking. By contrast, greater suppression might decrease people's optimism, leading to decreased risk taking.

Importantly, a previous study (Richards & Gross, 2000) showed that suppression—but not reappraisal—impaired memory during information processing. Accordingly, suppression, by impairing memory during information processing, might affect decision making. Thus, future studies could investigate whether cognitive variables such as memory function might moderate the effect of emotion-regulation strategies on decision making.

To conclude, our results increase the knowledge about emotion-regulation theory (Gross & John, 2003) and are also relevant for research lines that rely on affective forecasts in decision making processes (e.g., Mellers & McGraw, 2001). More broadly speaking, investigations using behavioural risky choice tasks (such as the Columbia Card Task; Figner et al., 2009; Figner & Weber, 2011) promise novel insights into the connections between emotion regulation and risky behaviours across various fields including psychology, economics, and neuroscience (e.g., Schonberg et al., 2010). Thus, if during the past decade emotion itself has played an important role in decision research, perhaps emotion regulation is bound to play an increasingly prominent role in the current decade.

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