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Effects of outcomes and random arbitration on emotions in a competitive gambling task

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Research on self-serving biases in judgments and decision-making suggests that individuals first evaluate the outcomes they get, and then the procedures by which these outcomes were obtained. Evidence also suggests that the appraisal of the former (outcome favorability) can bias the appraisal of the latter (procedural fairness). We investigated the nature of the emotions that are elicited by these appraisals by using a new paradigm in which participants performed a choice task between pairs of competing gambles against a virtual opponent. Conflicts (when the participant selected the same gamble as his virtual opponent) were resolved by a neutral arbitrator who either confirmed the participant's choice ("*pro-self*") or attributed his gamble to the virtual opponent ("*pro-competitor*"). Trials in which the participant and his virtual opponent selected different gambles ("*no-conflict*") served as a control condition. In order to validate this new task, emotional reactions to the outcomes of the gambles were measured using self-reports, skin conductance responses, and facial electromyography (zygomaticus, corrugator, and frontalis). In no-conflict trials, effects of counterfactual thinking and social comparison resulted in (i) increased happiness as well as SCR and zygomaticus activity for wins compared to losses (valence effect) and for high compared to low gains (magnitude effect), and (ii) increased anger, regret, disappointment, and envy for losses compared to wins (valence effect). More importantly, compared to no-conflict trials and to pro-self awards with similar outcomes, pro-competitor awards increased subjective reports of anger for unfavorable outcomes, and increased happiness and guilt for favorable outcomes. Although the outcomes were independent from the arbitrators' decisions, and both the arbitrators' decisions and the outcomes were kept equally likely, individuals tended to attribute their outcomes to unfair arbitrators, reacting emotionally, especially when the modification of their initial choice for a gamble led to a negative outcome.

Keywords: conflict, arbitration, emotion, appraisals, procedural justice, distributive justice, outcome favorability, self-serving bias

INTRODUCTION

Emotions are central to decision-making processes, both as an input and as an output (Han and Lerner, 2009). The decisions we make have consequences that affect our emotions, and many choices are guided by an anticipation of these emotions (Mellers, 2000). Numerous parameters, such as the probability and magnitude of potential gains and losses are key determinants of one's emotional reaction to the outcomes of a decision (Mellers, 1997). Previous research has indicated that at least four main factors affect the type and intensity of one's emotional response to a given outcome. First, the outcome one gets; Gains elicit happiness and satisfaction, whereas losses induce sadness and disappointment. Second, the comparison of the obtained outcome with an alternative outcome that could have been obtained under a different choice (counterfactual comparison); Individuals experience regret or relief when the outcome they receive is respectively worse or better than an alternative outcome that could have been obtained under a different choice (Zeelenberg et al., 1998; Coricelli et al., 2005; Van Dijk and Zeelenberg, 2005).

Third, the comparison of one's outcome with a better or worse outcome received by someone else, like in competitive settings, elicits envy or, respectively, gloating and schadenfreude (Heider, 1958; Benzeev, 1992; Bault et al., 2008). Individuals learn to anticipate these negative emotions and optimize their decisions to minimize their likelihood of occurrence (Coricelli and Rustichini, 2010). Effects are generally more pronounced in social compared to individual context (Bault et al., 2008). Fourth, beyond outcomes, the procedure by which an outcome is obtained also affects an individual's emotions (Loewenstein et al., 1989; Cremer and Van Hiel, 2006). For instance, individuals do not react in the same way to outcomes that are generated by humans vs. computers (Van't Wout et al., 2006), randomly vs. intentionally (Nelissen and Zeelenberg, 2009), and whether someone can be hold responsible vs. not (Smith and Ellsworth, 1985).

An important determinant of one's reaction to the outcome of a situation is the appraisal of justice. Perceived injustice is a primary elicitor of anger and guilt (Mikula et al., 1998; Weiss et al., 1999; Krehbiel and Cropanzano, 2000). Current theories of justice (Homans, 1961; Adams, 1965; Walster and Walster, 1975; Mikula and Wenzel, 2000) postulate that anger and guilt emerge in the context of disadvantageous and advantageous injustice, respectively.

An extensive body of research suggests the existence of self-serving biases in the perception of justice (Walster et al., 1978; Messick and Sentis, 1979; Thompson and Loewenstein, 1992; Loewenstein et al., 1993; Babcock et al., 1995). Favorable outcomes are rated higher on both distributive and procedural fairness, and people report higher satisfaction with outcomes when they consider that either the outcomes themselves, or the procedure that arrived at these outcomes, was fair (Skitka et al., 2003).

Studies examining the impact of outcomes and procedures on specific emotions also suggest that there may be some interactive effects (Brockner and Wiesenfeld, 1996). In two experiments, Cropanzano and colleagues found that outcome favorability affected self-ratings of happiness and disappointment, whereas anger and guilt were influenced by specific combinations of outcome favorability and procedural fairness. When an objectively unfair procedure was used, unfavorable outcomes elicited anger, whereas favorable outcome elicited guilt (Weiss et al., 1999; Krehbiel and Cropanzano, 2000). These emotional reactions may reflect the experience of disadvantageous and advantageous injustice, respectively. These findings suggest that individuals evaluate first the favorability of outcomes, and then the fairness of the process (Copanzano and Folger, 1991; Montada, 1994; Weiss and Cropanzano, 1996). Moreover, they suggest that the appraisal of the former (distributive justice) not only interact with, but can also bias, the appraisals of the latter (procedural justice), in a self-serving manner. Unless they are provided with persuasive evidence that the process was not unfair, people are more likely to attribute unfavorable outcomes to unfair procedures (Francis-Gladney et al., 2010). For the first time, we investigated the emotional correlates of this effect on self-reported emotions, physiological arousal and facial expressive behavior.

The present study examined the impact of random arbitration (the modification of a party's decision using a random rule) on the emotional reactions to outcomes in a competitive gambling task. We used a simple choice task between pairs of competing gambles, similar to previous research (Coricelli et al., 2005; Bault et al., 2008). In reality, participants were playing against a computer that was programmed to select a different gamble than the participant in half of the trials (no-conflict trials) and the same gamble in the other half of the trials (conflict trials), in random order. Conflicts were resolved by an arbitrator attributing the chosen gamble to one of the players and the non-chosen gamble to the other player, ostensibly using a 50:50 random rule (like flipping a coin). Thus, the arbitrator either confirmed the participant's initial choice ("pro-self-award", 50% of the trials) or granted his choice to his opponent ("pro-competitor-award", 50% of the trials). The gambles were then played and revealed the outcomes (50% win, 50% loss).

Our goal was to directly compare how individuals evaluate and respond to the outcomes of their decisions under three arbitration contexts: (i) *no-conflict*, (ii) *pro-self awards* (i.e., trials in which the arbitrator confirmed the participant's decision), and (iii) *pro-competitor awards* (i.e., trials in which the arbitrator attributed the participant's chosen gamble to his/her opponent).

The fact that each arbitrator was not awarding an outcome but a gamble was important in order to dissociate the effects of outcomes from the effects of arbitration and study the impact of the former on the latter. Participants were informed that the arbitrator would do a 50:50 random choice (e.g., flip a coin) to decide whose choice would prevail. Thus, the arbitration procedure itself was neither intended to be perceived as fair or unfair, nor was it intended to be perceived as advantageous or not.

MATERIALS AND METHODS

PARTICIPANTS

Twenty paid healthy volunteers (14 women, mean age 24.2 ± 5 year olds) recruited among the student population of the University of Geneva participated in this experiment in return for payment. The study was approved by the Geneva Psychology Research Ethical Committee, and written informed consent was obtained from all participants. Individuals with symptoms or a history of psychiatric care, neurological disease, or head injury were not included.

TASK AND PROCEDURE

Subjects sat in a dimly lit sound-attenuated cabin, in front of a 17″ computer screen placed at a viewing distance of 90 cm. Participants performed a computerized two-player gambling task in competition with a virtual opponent (see **Figure 1**). In each of 64 trials, a participant and his (virtual) opponent were requested to choose one of the two competing gambles with the aim of maximizing their financial gains. Participants first indicated their choice before the choice of their opponent was displayed. The gamble chosen was indicated by a white frame around it. After a variable delay (1000–2500 ms), the opponent's choice was indicated by a black frame around the selected gamble. If the gambles chosen by the two players were different (no-conflict trials), the gambles were played and the outcomes were displayed. Trials in which the two players had chosen the same gamble were labeled conflict trials. Participants were told that in the event of a conflict between the two choices, an arbitrator (represented by a neutral face appearing in the foreground of the gambles) would either confirm the participant's choice and attribute the non-selected gamble to the opponent (pro-self arbitration), or confirm the opponent's choice and attribute the non-selected gamble to the participant (pro-opponent arbitration). As in no-conflict trials, the gambles were then played and the outcomes displayed. After each trial, participants were requested to report the intensity of subjectively experienced emotions using a series of 7-points Likert-type scales. The following emotional labels were used, in random order: anger, happiness/satisfaction, sadness/disappointment, regret, guilt, and envy. In addition to self-reports, we measured physiological arousal using skin conductance recordings, and expressive behavior using facial electromyography (EMG).

We used four different gambles that differed in terms of probabilities of winning (20, 40, 60, and 80%) and magnitude

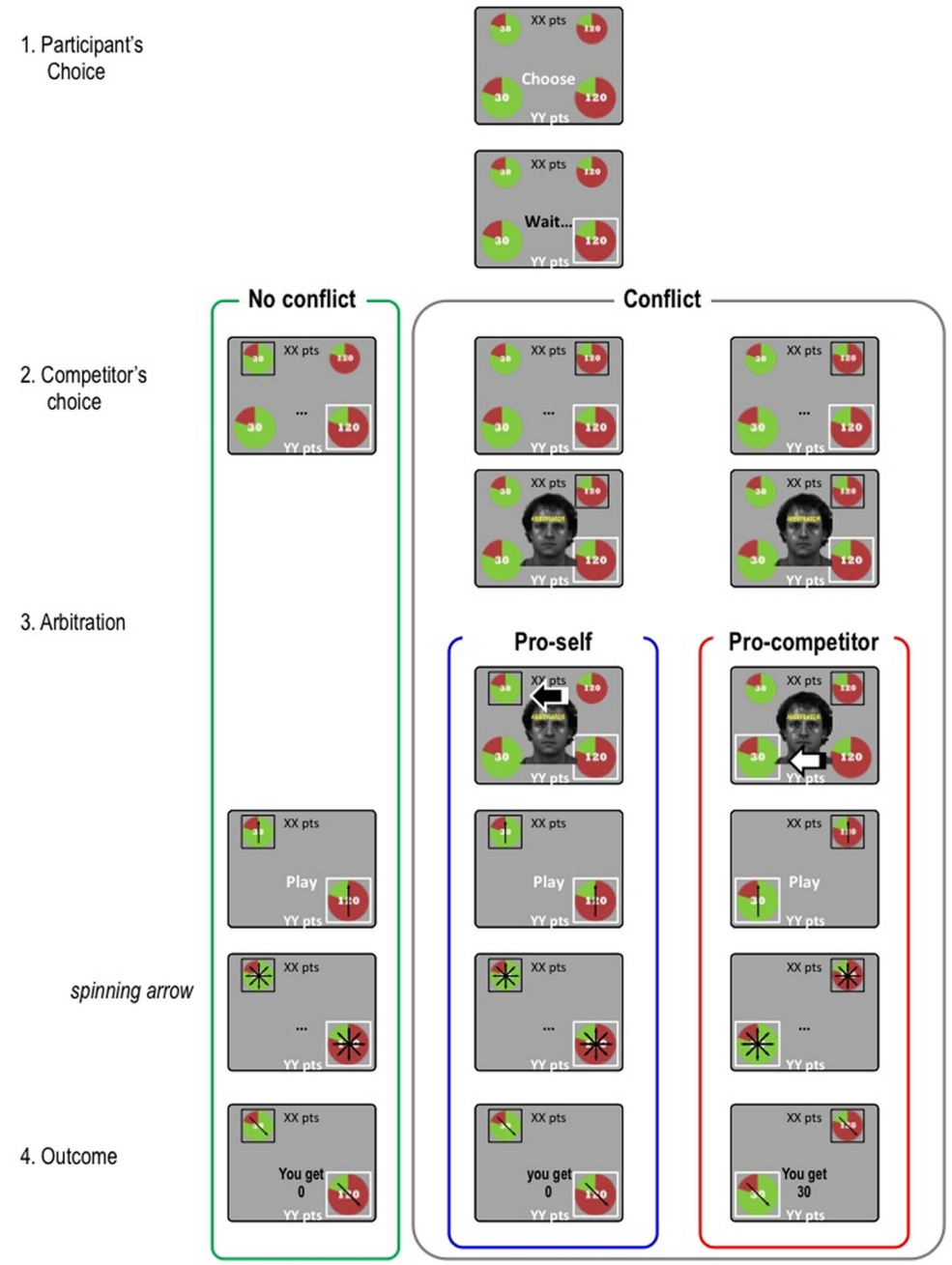

FIGURE 1 | Description of the task: trial events for the three different arbitration conditions (no-conflict, pro-self awards, and pro-competitor awards).

of potential gain (120, 60, 40, and 30 points) but the product of both was constant, i.e., equal expected value. For each pair of gambles, the probabilities of winning added up to 100% to ensure that there was a winner and a loser in each trial. In 32 trials, one of the gambles offered a 20% chance of winning 120 points and the other offered an 80% chance of winning 30 points. In another 32 trials, one of the gambles offered a 40% chance of winning 60 points and the other offered a 60% chance of winning 40 points. Thereafter, these trials are referred to as risky and safe trials respectively, because the variance between potential outcomes is respectively high and low (**Figure 2**). In reality, all the gambles played were programmed to provide an equal number of wins and losses[1]. This procedure was important to avoid frequency confounds, as

[1]In case of loss, the participant won nothing, whereas his or her opponent won the amount of his gamble. Although the outcome is a no-gain, we call it a loss trial considering both the competitive context and the social comparison of one's own outcome with the opponent's outcome.

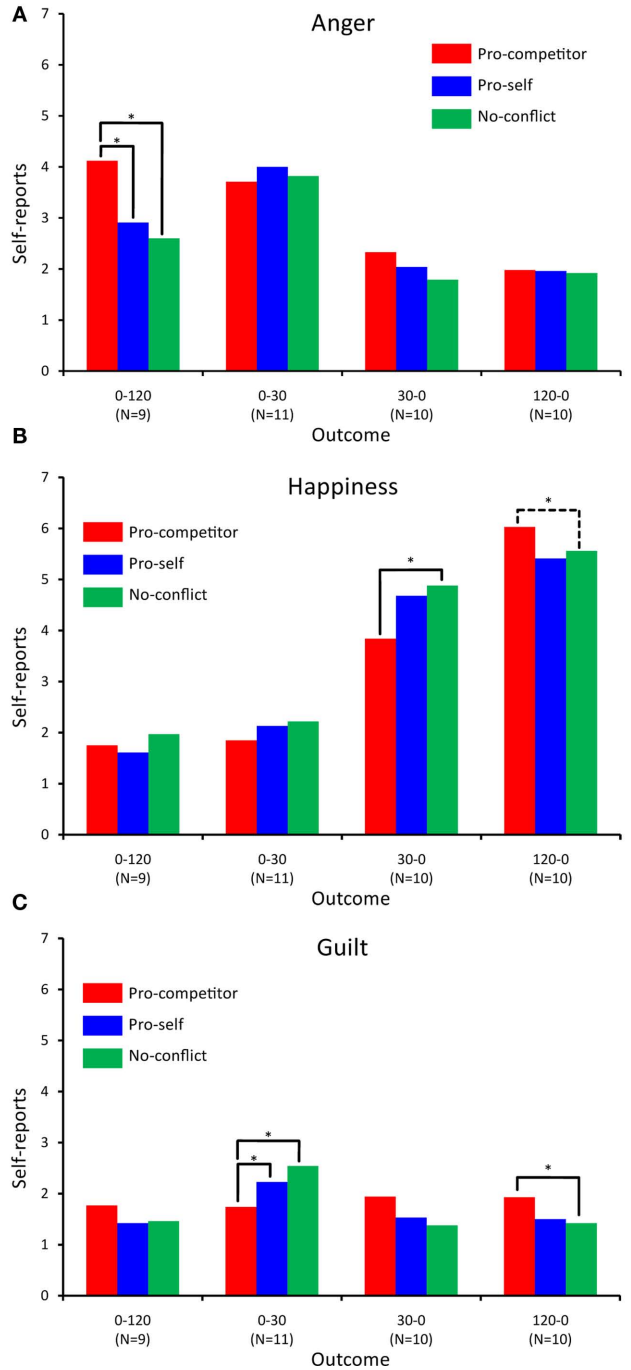

FIGURE 2 | Effects of arbitration on self-reported emotions as a function of outcome. Interactive effects of outcomes and arbitration. **(A–C)** Pro-competitor arbitration increases anger for high-loss (0–120), reduces guilt for low-loss (0–30), reduces happiness for low-gain (30–0), and increases guilt for high-win (120–0).

infrequent events trigger emotional reactions (Aue et al., 2007; Delplanque et al., 2009). It is noteworthy, however, that the post experiment questionnaire indicated that none of the participants had realized this. Because we could not predict our participants' decisions, the use of a virtual player allowed us to manipulate the opponent's choices in an interactive way, i.e., with respect to each participant's actual decisions. The task was programmed to ensure an equal number of trials in each condition (i.e., conflict vs. no-conflict, pro-self vs. pro-competitor awards, and wins vs. losses). More precisely, the virtual player's choices were contingent upon the participant's choices (50% same choice and 50% different choice). Similarly, the arbitrator assigned an equal number of pro-self and pro-other awards (50% pro-self and 50% pro-competitor awards). Again, this prevented us from any frequency confounds in our interpretation of emotional effects. Thus, whatever the participant's decisions, there were 32 conflict trials and 32 no-conflict trials. Among the no-conflict trials (control condition) the participant won 16 times and lost 16 times, regardless of the gamble he or she had selected. Among the conflict trials, there were 16 trials in which the participant's decision was maintained (*pro-self awards*, 8 winning and 8 losing trials) and 16 trials in which the participant's decision was changed (*pro-competitor awards*, 8 winning and 8 losing trials). The order of trials and conditions was fully randomized within and across subjects in order to reduce participants' ability to detect our experimental manipulations.

To increase participants' motivation and involvement in the task and thereby their emotional reactions, the points gained during the task were cumulated across trials and paid in cash after the experiment (100 points = 1 CHF). To increase competition, we told our participants that they would receive a bonus, but that this bonus would only be granted if they scored higher than their opponent, whereas they would receive only a base participation fee if they scored below their opponent.

PHYSIOLOGICAL RECORDINGS AND PROCESSING

Participants were instructed to keep their non-dominant forearm resting on the table throughout the duration of the experiment. Once a participant had signed his consent and completed the personality questionnaires, physiological sensors were attached. After that, participants were asked to find a comfortable sitting position and reminded to avoid any unnecessary movements and speech during the procedure. Moreover, they were instructed to stay alert, to keep their eyes open, and to breathe normally. Participants were provided with a computer mouse and the instructions for the experimental task. Physiological signals were assessed using TEL 100 Remote Monitoring System of Biopac Systems (Santa Barbara, CA, USA) with separate settings for electromyographic and electrodermal activities. Signals were transferred from the experimental room to the MP100 Acquisition Unit (16 bit A/D conversion) in an adjacent room and stored on computer hard disk (sampling rate 1000 Hz).

Physiological arousal: skin conductance responses

To examine whether arbitration decisions affected physiological arousal in our experimental paradigm, we recorded electrodermal activity continuously during the task and analyzed skin conductance responses offline. Electrodermal activity was recorded (high-pass filter: 0.025 Hz) by the constant voltage method (0.5 V). Beckman Ag–AgCl electrodes (8-mm diameter active area) filled with a skin conductance paste (Biopac) were attached to the palm side of the middle phalanges of the second and third fingers of

the participants' non-dominant hand. Specific skin conductance responses (SCRs) to outcomes were measured in microSiemens (μS) and analyzed offline. They were scored as changes in conductance (greater than 0.02 μS) starting in the 1000–4000-ms interval after the onset of the stimulus (Dawson et al., 1990). SCRs were square root transformed to normalize the data (Edelberg, 1972).

Emotion expression: facial electromyography

To determine whether arbitration decisions affected emotion expression in our experimental paradigm, surface EMG activity of facial muscles was additionally recorded. As an index of facial expression, activity of the Corrugator Supercilii, Zygomaticus Major, and Frontalis muscles was measured on the left side of the face at a sampling rate of 1000 Hz. Prior to application of the electrodes, the designated sites on the skin surface were cleaned with distilled water and cotton pads and abraded using fine emery paper. EMG recordings were obtained with 4-mm miniature Beckman Ag/AgCl electrode pairs filled with conductance gel (Biopac). In a bipolar configuration, electrodes were placed above the left eyebrow for assessment of Corrugator Supercilii muscle activity, on the left cheek in the middle of the mouth-to-ear tip line for Zygomaticus Major activity and above the eye brows for Frontalis activity. Sensor placement followed recommendations by Fridlund and Cacioppo (1986). Interelectrode distance (center to center) was 1 cm for each recording site. While the sensors were applied, participants were instructed to completely relax their face. Electrodes resistance was kept below 10 KO. EMG amplitude during the 500-ms before outcome presentation served as baseline. To allow us to examine the facial EMG response within 10 s after the presentation of the outcome, we expressed mean EMG amplitudes during subsequent 100-ms time intervals as a percentage of the mean amplitude of the baseline. Percentage scores were introduced to standardize the widely differing absolute EMG amplitudes of individual participants and thus enable comparison between individuals and groups (De Wied et al., 2006). Activity was then quantified as average of EMG amplitude within the 10-s[2] following the presentation of the outcome.

STATISTICAL ANALYSES

Analyses were confined to the 32 risky trials in which the variance between possible outcomes was high (**Figure 2**). Because most subjects (18/20) chose the more uncertain gamble of each pair (i.e., lower probability but higher amount) in more than half of the trials, there was a substantial amount of missing data (14%) that was not randomly distributed. Effects of outcomes and arbitration were analyzed separately using Friedman repeated-measure analyses of variance by rank, followed by pairwise Wilcoxon signed-rank tests in case of statistically significant effects[3]. There are four possible outcomes depending on the participant's and his opponent's gains (high-loss: 0–120, low-loss: 0–30, low-win: 30–0, and high-win: 120–0), and three arbitration conditions (no-conflict, pro-self decision, pro-competitor decision).

Before testing the effect of arbitration, it was important to show that our new paradigm indeed elicited emotional reactions in our participants. Therefore, we first examined whether the outcomes of gambles chosen by participants elicited the predicted pattern of emotional reactions, in the absence of arbitration. These analyses therefore focused on the no-conflict trials.

Effect of outcomes on self-reports

Because in social settings, and contrary to private ones, gains loom larger than losses (Bault et al., 2008), we predicted that participants would report greater levels of happiness for winning trials compared to losing trials (valence effect) and for high gains compared to low gains (magnitude effect). In contrast, we expected greater disappointment and regret for losses compared to wins (Coricelli et al., 2005). On loss trials, we expected that the magnitude of the other's gain would affect self-ratings of envy (Bault et al., 2008; Takahashi et al., 2009; Coricelli and Rustichini, 2010).

Effect of arbitration on self-reports

We hypothesized that the same outcome would be appraised differently and hence would lead to differential emotional responses under the various arbitration conditions. We predicted that participants' ratings of anger and guilt would reflect the interactive effect of outcome favorability and procedural injustice (Weiss et al., 1999; Krehbiel and Cropanzano, 2000). More specifically, outcomes of gambles obtained after a modification of one's initial choice (to which one may feel entitled) are more likely to be perceived as unfair and attributed to an external factor (e.g., the arbitrator). Therefore, we expected participants to report increased levels of anger after pro-competitor awards that resulted in a loss compared to no-conflict and pro-self awards that led to the same outcomes (i.e., disadvantageous arbitration for the participant but advantageous for his opponent). On the other hand, we expected increased guilt after pro-self awards that resulted in a gain in comparison to no-conflict and pro-competitor awards (i.e., advantageous arbitration for the participant but disadvantageous for his opponent). Due to self-serving biases in attribution (Francis-Gladney et al., 2010), we expected stronger effects of arbitration on losses (anger) compared to wins (guilt).

Effects of outcomes and arbitration on SCR and EMG

In addition to self-reported subjective emotions, we also expected an effect of outcomes and arbitration decisions on physiological arousal and facial expressive behavior. In the component process model (CPM) of emotion (Scherer et al., 2001; Sander et al., 2005), event appraisals, motivational shifts, physiological responses, motor expression, and subjective feelings are treated as dynamically interrelated and integrated components. Skin conductance is used as an index of emotional arousal which is generally correlated with emotional intensity (Sequeira et al., 2009). Facial muscles activity can provide additional information about the type of emotion experienced and eventually expressed. In particular, some emotional facial expressions have been associated with specific patterns of activity (Ekman and Friesen, 1978): the muscles responsible for smiling (zygomaticus major, e.g.,

[2]We chose a −500 to 10,000-ms time window to include the whole contraction until the return to baseline. Analyses with a −500 to 3,000-ms showed similar results.

[3]We performed additional repeated-measures ANOVAs on our data after transformation to fill missing values with linear trend interpolation and with mean substitution in order to test for the interactive effects of outcomes and arbitration. These analyses confirmed our results and are kept available to the reviewers if required.

happiness) being distinct from those responsible for frowning (corrugator supercilii, e.g., anger), and from those responsible for eyebrow rise (frontalis, e.g., surprise). Moreover, previous work shows that differential activity in these muscles is also sensitive to differences in appraisals, especially regarding novelty, valence (pleasantness), goal conduciveness, and fairness (Aue et al., 2007; Chapman et al., 2009; Delplanque et al., 2009).

We expected effects of outcomes and arbitration on physiological responses and facial expressions, mirroring self-reports (i.e., increased zygomaticus activity and SCR for gains compared to losses (Bault et al., 2008) and increased corrugator activity for losses obtained after pro-competitor arbitration compared to no-conflict trials).

RESULTS

EFFECTS OF OUTCOMES (NO-CONFLICT TRIALS)

Statistical effects of outcomes on emotions are summarized in **Table 1**.

Subjective self-reports

Analyses of the no-conflict trials showed a significant effect of outcome on all subjective assessments of emotions ($N = 13$, all $\chi^2 > 35$, $ps < 0.001$), except for guilt, which only showed a marginal effect ($N = 13$, $\chi^2 = 14.03$, $p < 0.060$). Participants reported increased anger, increased regret, and increased disappointment after low-losses compared to low-wins (all $ps < 0.01$) and after high-losses compared to high-wins (all $ps < 0.01$), but there was no significant difference between low-wins and high-wins or between low-losses and high-losses. Participants also reported increased happiness after low-wins compared to low-losses ($Z = 3.17$, $p < 0.01$), after high-wins compared to high-losses ($Z = 3.35$, $p < 0.001$), and after high-wins compared to low-wins ($Z = 3.11$, $p < 0.01$), but there was no difference between low-losses and high-losses. We also found increased guilt after low-losses compared to low-wins ($Z = 2.67$, $p < 0.01$), and greater envy after low-losses compared to low-wins ($Z = 2.9$, $p < 0.01$), and after high-losses compared to high-wins ($Z = 2.57$, $p < 0.05$).

Emotion expression (facial EMG) and physiological arousal (SCR)

Outcomes had a significant effect on the activity of the zygomaticus ($N = 12$, $\chi^2 = 21.64$, $p < 0.05$), which was significantly increased in high-wins compared to high-loss conditions ($Z = 2.41$, $p < 0.05$). There was no significant effect of outcomes on the activity of the corrugator and frontalis. Outcomes also had a significant effect on SCR ($N = 12$, $\chi^2 = 27.31$, $p < 0.001$), which was significantly increased after high-wins compared to high-losses ($Z = 3.18$, $p < 0.001$) and after high-wins compared to low-wins ($Z = 3.18$, $p < 0.001$).

In sum, results show an effect of outcome valence on self-reported emotions, SCR, and zygomaticus activity. Additional effects of outcome magnitude were observed on self-reports of happiness and SCR.

EFFECTS OF ARBITRATION

Figure 2 shows participants' subjective emotional reactions to outcomes as a function of arbitration.

Subjective self-reports

Arbitration had a significant effect on self-reported anger for high-loss outcomes (0–120: $N = 9$, $\chi^2 = 9.31$, $p < 0.05$). Participants reported more anger following pro-competitor awards compared to pro-self awards and no-conflict, but there was no difference between pro-self awards and no-conflict trials (Procomp vs. No: $Z = 3.11$, $p < 0.05$; Procomp vs. Pro-self: $Z = 2.20$, $p < 0.05$; Pro-self vs. No: $Z = 1.070$, NS).

Arbitration significantly affected self-reports of guilt for low-loss and high-win outcomes (0–30: $N = 11$, $\chi^2 = 7.091$, $p < 0.05$; 120–0: $N = 10$, $\chi^2 = 6.615$, $p < 0.05$). For low-losses (0–30), guilt was higher following pro-competitor awards compared to pro-self and to no-conflict, but there was no difference between pro-self and no-conflict (Procomp vs. Pro-self: $Z = 2.58$, $p < 0.05$; Procomp vs. No: $Z = 2.58$ $p < 0.05$; Pro-self vs. No: $Z = 1.57$, NS). For high-wins (120–0), guilt was higher after pro-competitor compared to no-conflict trials ($Z = 1.88$, $p < 0.05$).

Arbitration significantly affected self-reports of happiness for low-win outcomes ($N = 10$, $\chi^2 = 12.60$, $p < 0.05$) and there was a marginal effect for high-win outcomes ($N = 10$, $\chi^2 = 4.974$, $p < 0.09$). For low-wins, happiness was lower after pro-competitor awards compared to no-conflict trials (Procomp vs. No: $Z = 2.50$, $p < 0.05$; Procomp vs. Pro-self: $Z = 1.69$, NS; Pro-self vs. No: $Z = 0.66$, NS), whereas for high-wins, happiness was higher after pro-competitor awards compared to no-conflict trials (Procomp vs. No: $Z = -2.497$, $p < 0.05$; Procomp vs. Pro-self: $Z = 1.60$, NS; Procomp vs. No: $Z = -0.34$, NS).

Table 1 | Summary of statistical results for the effect of outcomes in the no-conflict situation.

		Self-reports						Physiology			
		Ang.	Dis.	Hap.	Reg.	Env.	Guilt	Zygo.*	Corru.	Front.	S.C.R.*
Valence	High-loss (0–120) vs. High-win (120–0)	↗	↗	↘	↗	↗	↗	↘			↘
	Low-loss (0–30) vs. Low-win (30–0)	↗	↗	↘	↗	↗	↗				
Magnitude	High-loss (0–120) vs. Low-loss (0–30)										
	High-win (120–0) vs. Low-win (30–0)			↗							↗

Ang. Dis. Hap. Reg. Env. Zygo. Corru. Front. S.C.R. refer respectively to Anger, Disappointment, Happiness, Regret, Envy, Zygomaticus, Corrugator, Frontalis, Skin Conductance Response. ↗ means that there is an increase (e.g., anger high-loss > anger high-win), ↘ means that there is a decrease (e.g., SCR high-loss < SCR high-win).

**Note that for zygomaticus activity and SCR, the effects are better understood as increased response for wins compared to losses rather than reduced responses for losses compared to wins.*

Arbitration did not affect self-reports of disappointment or regret. Friedman analyses revealed a significant effect of arbitral awards on envy in low-win outcomes (30–0: $N = 10$, $\chi^2 = 7.40$, $p < 0.05$). However, *post hoc* Wilcoxon tests did not show any significant difference between the three arbitration situations (all $ps > 0.19$).

Expressive behavior (facial EMG) and physiological arousal (SCR)

For technical reasons, data from two subjects could not be recorded. Hence, the analyses were performed on 18 subjects instead of 20. Friedman analyses showed an effect of arbitral awards on the activity of the frontalis for low-win outcomes (30–0: $N = 9$, $\chi^2 = 6.22$ $p < 0.05$). However, *post hoc* Wilcoxon analyses failed to find any significant difference between the three arbitration situations (all $ps > 0.17$). No significant effect of arbitral awards on SCR was observed in the Friedman analyses.

In sum, results show an effect of random arbitration on self-reports of anger, happiness, and guilt, depending on the final gambling outcome. Importantly, these effects were observed only when the participant's initial choice was affected by the arbitrator's decision.

DISCUSSION

This study investigated the consequences of random arbitration (using a 50:50 rule, such as flipping a coin) on the emotional reactions to outcomes of gambles in a competitive task.

EMOTIONAL EFFECTS OF OUTCOMES (NO-CONFLICT TRIALS)

In no-conflict trials, the outcomes of the gambles elicited the predicted pattern of emotional responses. Participants reported greater happiness on wins compared to losses (valence effect) and they reported increasing levels of happiness with increasing amount of gains (magnitude effect). In contrast, they reported more anger, regret, and disappointment with losses compared to wins (valence effect). Participants also reported more envy after a loss than after a win. These results can be considered as evidence for the validity of our task because they suggest that the emotions induced by our task are consistent with the current literature (Mellers, 1997; Zeelenberg et al., 2000; Bault et al., 2008). The fact that both electrodermal activity and zygomaticus activity also increased with increasing gains extends these findings to physiological measures of emotion and suggests that our participants actually experienced the reported emotions and that their subjective ratings do not only reflect social desirability effects.

Our results question the specificity of the effects that have been attributed to regret and envy in some previous studies (e.g., Coricelli et al., 2007; Bault et al., 2008). In these studies, emotions were measured using a single continuous scale labeled from very negative to very positive. Emotions were then categorized according to the experimental conditions: When the outcome of the non-chosen gamble was not revealed, the ratings were labeled "disappointment"; When the obtained outcome was worse than the outcome of the alternative, unchosen gamble, the ratings were labeled "regret", because this emotion is thought to reflect counterfactual comparison; Finally, when the outcome of the unchosen gamble was obtained by another individual the ratings were labeled "envy" because it is thought to arise from social comparison. In the present study, we used different scales for each emotion but failed to find any differential effect of outcomes on regret, disappointment, and anger, as well as on happiness and envy.

EMOTIONAL EFFECTS OF RANDOM ARBITRATION: PROCEDURAL JUSTICE

Consistent with an impact of arbitration on appraisals of injustice (Weiss and Cropanzano, 1996), we found increased anger and guilt following disadvantageous and advantageous pro-competitor awards respectively. However, random arbitration (the flipping of a coin), by definition, should not be perceived as procedurally unfair. The critical finding here is that arbitration affected subjective emotional feelings only when the participant's own choice was awarded to his opponent (pro-competitor) and not when the opponent's choice was awarded to the participant (pro-self), although the outcome was the same. This suggests that agency (i.e., being the target of another's actions) may play a key role in one's response to arbitration decisions. Subjects may have developed a sense of ownership and feel entitled to the gamble they originally chose. As a consequence, they may have overvalued it as compared to the gamble they did not choose (a phenomenon known as the "endowment effect", e.g., Kahneman et al., 1990) and they may have felt that they had been treated unjustly when dispossessed of their preferred choice by the arbitrator.

IMPACT OF OUTCOME FAVORABILITY ON PROCEDURAL FAIRNESS

Our study replicates and extends the existing literature on distributive and procedural justice, and their interaction (Brockner and Wiesenfeld, 1996; Skitka et al., 2003). Studies examining the interactive effects of outcomes and procedures on emotions show that people experience anger when they receive unfavorable outcomes from disadvantageously unfair procedures, whereas they experience guilt when they obtain favorable outcomes from advantageously unfair procedures (Weiss et al., 1999; Krehbiel and Cropanzano, 2000). The fact that we observed similar effects suggests that even a random procedure can, under certain circumstances, be perceived as unfair and elicit similar emotions. When their choice had been altered by the arbitrator, participants felt dispossessed, and subsequently reappraised the process as being biased, which resulted in increased levels of anger when the outcome turned out to be unfavorable, and increased happiness and guilt when the outcome turned out to be favorable. In addition, research on self-serving biases in attribution (Francis-Gladney et al., 2010) suggests that biases in attributions of causality, responsibility, and maybe intentionality may have led our participants to (re)appraise random arbitration as being biased and unfair, especially in the case of unfavorable outcomes. Overall, this pattern of result is consistent with the literature on egocentric biases in the perception of justice, and with the idea that the appraisals of outcome favorability can bias the appraisals of procedural fairness in such a way that it affects one's emotions (Weiss et al., 1999; Krehbiel and Cropanzano, 2000). However, given that we did not measure subjects' perception of fairness, we should emphasize the possibility for alternative interpretations, which may not involve (in)justice. For example, participants may experience and report anger because they feel dispossessed of their preferred choice, without perceiving this as being unfair.

JUSTICE AND EMOTIONS

The present results are consistent with appraisal theories of emotions, which postulate that emotions arise from the evaluation of a situation with regards to an individual's concerns (Frijda, 1986; Scherer et al., 2001). Each situation is appraised on a number of criteria, and the output of these appraisals is multidimensional, affecting not only the subjective experience of emotion but also physiological arousal and emotion expression, as well as action tendencies. In our study, the outcomes and the arbitration process may have been appraised on several dimensions, such as valence, goal conduciveness, causality (e.g., agency and intentionality), and normative significance (e.g., compatibility with internal standards and external norms). These dimensions are particularly important for the elicitation and differentiation of emotion, and research has already confirmed the importance of injustice appraisals in the experience of anger and guilt (Mikula et al., 1998), as well as in the experience and facial expression of disgust (Chapman et al., 2009). It should be noted, however, that injustice is not the only cause of anger and guilt. People tend to get angry when they cannot reach their goals, and they feel guilty when they are hold responsible for having harmed someone. It is unlikely, though, that these processes occurred in the present task, and therefore we doubt that these could account for the present findings.

Appraisal theories also discuss the consequences of emotions for individual and social behavior (Davidson et al., 2003). At the intrapersonal level, emotions modulate perception, attention, memory as well as more complex functions, such as flexibility, creativity, problem-solving, and decision-making (Dolan, 2002). At the interpersonal level, emotions play a fundamental role in communicating one's feelings (Ekman, 1993), action tendencies (Frijda and Tcherkassof, 1997) and orientation toward others (Knutson, 1996). This is particularly important as this information may in turn be used as incentives or deterrents for others' individual or social behavior (Cacioppo and Gardner, 1999). Indeed, previous research shows that positive emotions increase prosocial behavior, including intentions to trust and cooperate (Fehr and Fischbacher, 2004), whereas negative emotions by contrast contribute to antisocial, competitive, and aggressive behaviors. In addition, both intra- and inter-personal effects may have an impact on the perception of self and of the other, and thereby on the emergence, course, and management of conflict. Anger, for example, is probably the most prominent and pervasive emotion to arise in conflict (Allred, 1999). Humans tend to get angry when they encounter an obstruction to a goal (like possessing a scarce good), especially when they feel entitled to possession (or treated unjustly when dispossessed), and when they feel sufficiently powerful (by themselves or with the help of others) to assert their rights and reach their goal, if necessary with the help of violence. Because both parties in a conflict may show a similar selfish bias and therefore react in this manner, the consequence is often an escalation of anger and threats, in many cases leading to actual violence or war.

CONCLUSION

To conclude, the present study provided two major findings. First, we showed that the effect of outcome favorability on participants' emotions depends on both the valence (winning or losing the trial) and the magnitude (low or high amount) of the outcome. Winning increases positive emotions and decreases negative emotions compared to losing, and vice versa, but there was no significant difference between disappointment, regret, and envy. Further research should address more directly whether counterfactual thinking and social comparison affect these emotions differentially, as some previous studies suggest. Second, we showed that biases in the appraisal of outcome favorability can influence the appraisal of procedural fairness in an egocentric way. Although the outcomes were determined by gambles and were thus independent from the arbitration process, we found that arbitration using a neutral, objective, and impartial rule (a computer programmed to give equal numbers of pro-self and pro-competitor decisions to all participants) affected self-reports of anger, and to a lesser extent guilt, when the outcome of the received gamble was unfavorable and favorable, respectively. Importantly, these effects were observed for pro-competitor awards only, and despite the explanation that the arbitrator would decide randomly in each case, using a 50:50 coin flip, who would keep the selected gamble. Moreover, the gambles were also programmed to ensure an equal number of wins and losses after each arbitration decision. These results are consistent with the literature on self-serving biases in the perception of justice, and may be explained by the impact of outcome favorability on procedural justice. Critical factors are (a) whether one is personally affected by the process (e.g., self-serving biases in attribution, which may be activated by the felt dispossession), and (b) whether the received outcome is favorable or not (e.g., self-serving biases in appraisals of outcome favorability). Future research should clarify the role of expectations and attributions (e.g., causality, intentionality, responsibility) in appraisals of distributive and procedural justice, and their impact on emotions and self-serving biases in third-party conflict resolution. More significantly, compared to no-conflict trials and to pro-self awards with similar outcomes, pro-competitor decisions by a neutral arbitrator resulted in increased subjective reports of anger for unfavorable outcomes, and increased happiness and guilt for favorable outcomes. Despite the use of a neutral computer, which was programmed to ensure outcome equality, but was presented as being an arbitrator flipping a coin in each case with even odds, individuals emotional reactions may reflect their tendency to perceive a loss as being due to a bias in the arbitrator's decision, and to attribute their unsuccessful outcomes to an unfair arbitrator, rather than to an unfortunate gamble. This suggests that it may be impossible for arbitrators to ever be perceived as being neutral, objective, and independent, all the more so when they are not constrained to a random outcome generation process (e.g., flipping a coin), but when having to apply a legal syllogism whereby the facts and the law determine an outcome. Further research on this is important, as well as assessing emotional perceptions of bias in other forms of dispute resolution compared to arbitration (e.g., mediation or conciliation).

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