WIN!! vs. win:
Impact of "Outcome" Salience on Illusion of Control

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Abstract

In contingency judgment tasks (CJT) people typically overestimate their control over an outcome. We hypothesized that this outcome density effect (a type of illusion of control) may be due to an attentional bias toward positive outcomes, which may lead one to ignore negative outcomes and thus to underestimate their occurrence. In order to directly test this hypothesis, we manipulated the outcome's salience in a CJT, inducing participants to focus on either positive or negative outcomes. Results showed that enhancing the salience of positive outcomes (wins) enhanced participant's judgment of control more so than enhancing than of negative outcomes (losses). Moreover, when positive outcomes were salient, participants overestimated the amount of money they had earned during the experiment. In sum, the salience of the "outcome event" affected both judgment of control and memory for positive, more than for negative events, implying that attentional mechanisms may play an important the role in the illusion of control phenomenon.

Keywords: Illusion of Control; Density Outcome Effect; Salience; Attention; Memory; Mood.

Introduction

The desire for control is widespread across both normal (see Keinan, 2002) and psychiatric (e.g. Moulding & Kyrios, 2007) populations, often leading to magical thinking, superstitious behavior and distortion of reality (e.g. Bar-Hillel & Neter, 1996). According to Taylor and Brown (1988), although correlating with psychiatric disorders (e.g. Reuven-Magril, Dar & Liberman, 2008), a moderately amount of positively distorted self-perceptions and expectations about the future might be functional in preserving mental health, through maintaining an adequate self-esteem. An important aspect of any adaptive behavior is the ability to selectively attend to salient or relevant information (Bradley, 2009). In fact, biased attention leads to distorted perception, often observed in major clinical disorders such as, depression (e.g., Leyman et al., 2007) and anxiety (e.g., Bradley et al., 1998). The present study focuses on the role of attentional biases in the establishment of cognitive illusions, specifically, the illusion of control (Langer, 1975).

Jerkins and Ward (1965) observed that in an active contingency judgment task (CJT), where participants had to judge the contingency between their action and an outcome, the perceived control correlates with the desired outcome's density instead of the actual contingency. In an active CJT, observers typically have to perform an action (e.g., pressing a button) to which it may, or may not follow a desirable outcome. After the task they are asked to judge to what extent their action affected the outcome. The key finding is that people tend to base their judgment of control on the frequency of reinforcement instead of on the objective evaluation of the actual contingency (Jerkins & Ward, 1965). In other words, high outcome's density leads to a higher judgment of control, while lower outcome's density leads to an underestimation of control.

According to a study conducted by Alloy and Abramson (1979), only non-depressed individuals show the outcome density effect, while depressed subjects tend to estimate their control more realistically. Alloy and Abramson (1979) argued that the lack of the outcome density effect in depression (depressive realism) indicates that depressed people are "sadder but wiser" than non-depressed people. While non-depressed individuals seem to succumb to positive illusion, depressed people lack this illusion and show a more accurate judgment of the contingency between their actions and external effects. The outcome density effect has been referred to as a type of "illusion of control" (see Alloy & Abramson, 1979). In the illusion of control (Langer, 1975) people overestimate their chance to success, ignoring the objective evaluation of the actual contingency.

Only few studies (e.g., Msetfi et al., 2005) have proposed a link between the lack of illusion of control in depressed individuals and an attentional dysfunction. Msetfi and colleagues (2005) observed that differences between depressed and non-depressed individuals disappear at long inter trial intervals (ITI). They suggested that depressed people might be deficient in exploring all the contextual elements, due to an attentional deficit. This conclusion is supported by studies showing attentional deficits in depression (e.g. Paelecke-Habermann, Pohl & Leplow, 2005). Similarly, Allan, Siegel and Hannah (2007) suggested that differences between depressed and non-depressed people might rely on a change in the decision criterion related to the salience of the outcome (i.e. the one with lower density rate as in the case of low density outcome), instead of a distorted perception of contingency.

Here we suggest an alternative hypothesis, that illusion of control is due to an attentional bias toward positive outcomes, which may lead one to selectively ignore negative outcomes, thus, to underestimate their occurrence. There is a growing number of studies showing that major depression is characterized by an impairment of selective attention (e.g., Purcell et al., 1997), increased sensitivity to negative reinforcement (Pizzagalli et al., in press) and enhanced brain response to negative feedback (Santesso et al., 2008). Moreover, Nelson and Craighead (1977) showed that depressed individuals recall the frequency of the negative feedback more accurately that non-depressed individuals. An attentional bias toward negative outcomes could enhance the memory for negative feedback and therefore, improve the performance in the judgment task.

In their Experiment 3, Alloy and Abramson (1979) implicitly manipulated attention, associating either positive outcome with a monetary winning or negative outcome with a money loss, separately. Illusion of control was observed only when the positive outcome was associated with a monetary winning. It has now been documented that monetary rewards have strong effects on the attentional system (e.g., Della Libera & Chelazzi 2009), thus it is likely that the value assigned to the outcomes may have modulated the attentional pull of these events. Specifically, the money loss associated with the negative outcome may have encouraged the observer to attend to the negative outcomes, eliminating the bias and therefore, the illusion of control. On the other hand, emphasizing the salience of positive outcomes should enhance the bias, therefore leading to an increase of the illusion.

The goal of the present study was to directly test the hypothesis that attentional mechanisms are involved both in the judgment of control and in the memory for events, in the CJT. We asked observers to estimate their control over an outcome in an active CJT, by pressing one of two buttons in the attempt to maximize their winnings. In the present experiment, although the relative density of the outcome changed (P(O)=.25 or .75), the actual control (ΔP)—defined as the difference between the probability of the outcome given an answer and the probability of the outcome given the other answer—was zero.

We manipulated attention by means of the outcome's salience by having two salience conditions (blocked between subjects): a condition in which the negative outcome was perceptually more salient than the positive outcome, and a condition in which the positive outcome was more salient than the negative outcome. In order to evaluate whether attention also affects the memory representation for winning and losses, we also asked participants to estimate the amount of money they thought they won in the experiment. Predictions are straightforward: if illusion of control is modulated by a natural tendency to neglect negative outcomes, an increase of the negative event's salience should accompany a reduction of the illusion. On the contrary, an enhancement of positive event's salience should enhance the illusion. If the same attentional bias also affects memory for positive and negative events, we also expect salience to affect the perceived money winning or loss.

Method

Participants

Fifty-four females and 43 males (age=21±3) participated in the experiment. All participants had normal or corrected to normal vision, signed an informed consent before the experiment and were paid $8 per hour. Participants assigned to the high reward rate condition were given extra $5 at the end of the experimental session.

Stimuli and Materials

Stimuli (Figure 1) were presented on a 21-inch monitor running at 85Hz. All stimuli were white unless otherwise specified, and they were displayed on a black background. All writings were typed in white, Helvetica font. The fixation point appeared in the center of the monitor, and consisted of a cross sign subtending 0.6° visual angle. The "get ready" message appeared at fixation and occupied 1° visual angle vertically and 16° horizontally. The countdown numbers subtended about 1°x2° visual angle and replaced fixation, when displayed.

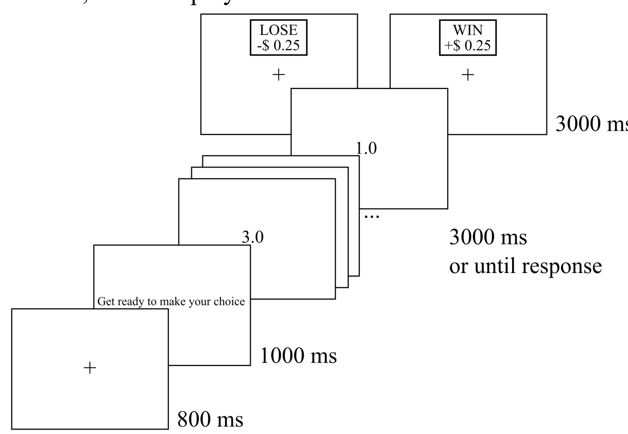

Figure 1. Stimuli used in the contingency judgment task.

The outcome display consisted in a box (6.4° x4.4° visual angle) located 6° above the fixation point. One of two messages could be displayed inside the box: the word "WIN" presented above the amount of money actually won on that trial, or the word "LOSE" above the amount of money lost on the trial (see Figure 1). On salient trials, the outcome boxes were very similar to the boxes on regular trials, with the only difference that the inner part was red and the outline was yellow; the font size was also increased.

Visual Analogue Mood Scales (VAMS) We used the VAMS to assess the mood of participants in the experiment. In this procedure, six positive adjectives are presented. The bottom of the page contained the question: "How do you feel right now?". Below the question, the adjectives: "Pleased", "Cheerful", "Optimistic", "Contented", "Satisfied" and "Happy" are displayed. Underneath each adjective there was a 100mm long line. Participants were verbally instructed to draw a mark along the line, at the point that best described their feelings, in that particular moment. Score varies from 0 to 100, with "Not at all" at the left-most position in the line, and "Very much" at the right-most position. Intermediate values correspond to intermediate states.

General procedure

Upon arrival to the lab, participants were asked to sign an informed consent and to fill out the first VAMS. Through the whole exchange, the experimenter acted very friendly, using a cheerful attitude and trying to set up a positive interaction. Participants then watched a 5 minutes long, pleasant movie after receiving a treat (i.e., a candy). After the video, they were asked to recall a happy memory. The goal of these manipulations was to improve participants' mood (e.g. Rottenberg, Raye & Gross, 2007), because it has been shown that positive mood enhances the illusion of control (Alloy, Abramson & Viscusi, 1981). Importantly, it was not our goal to study the effects of mood on the illusion of control, but simply to maximize the magnitude of the effect, so that we could in turn study modulations of this magnitude by our attention manipulations. Once these manipulations were completed, participants filled out a second VAMS and then, performed the CJT. A subset of participants also completed a third VAMS after the CJT.

Procedure

Participants sat in a comfortable chair, positioned at 56cm from the monitor and located in a dim-lighted, thermo-regulated room. Given that realistic circumstances enhance illusion of control (Matute, 1996), participants were told that they had the actual opportunity to win money depending on their button pressing, and they were asked to make an effort in order to figure out the best strategy to win more money. They were suggested to explore the use of the two buttons as much as possible. This was meant to discourage participants from adopting the strategy of pressing only one of the two buttons. Such strategy would not be desirable in this type of task because it would inflate the participant's perceived control. Even if the instruction were clear and effective (only two subjects pressed the same button throughout the whole task), uncontrolled imbalance was taken into account.

Each trial (Figure 1) begun with a fixation point, which participants were instructed to look at. One second later, a "Get Ready" message appeared (also 800 ms in duration). Following this message, participants were given 3 seconds to make a choice between two keyboard buttons ("c" or "n"). During this time, there was a numerical countdown display on the monitor, with the numbers 10 counting down towards one, three times in a row. The countdown stopped after 3 repetitions or upon the subject's response. This procedure had the purpose to maximize the illusion of control, which has been shown to increase using stopping devices (Ladouceur, & Savigny, 2005). Participants were simply asked to press a button during the countdown.

After the response, a box appeared for 3000 ms to tell participants whether they won or lost $0.25. If no response was detected, a warning message appeared and a new trial began.

After the task participants were asked to judge both, how much control they had over the outcome on a scale from 0 (no control) and 100 (complete control). Intermediate values corresponded to intermediate judgments of control. In addition, they had to indicate the total amount of dollars they believed to have earned throughout the whole experiment.

Design

Participants were randomly assigned to one of the six possible conditions (each made-up of 40 trials). There were two levels of reward frequency: low reward rate, in which the relative density of the positive outcome P(W) was 0.25—i.e., the negative outcome occurred 75% of the trials—and a high reward rate, in which the relative density of the positive outcome P(W) was 0.75—i.e., the negative outcome occurred 25% of the trials. One half of the participants were assigned the low reward rate condition and the other half was assigned the high reward rate condition. Within each group, one third of the subject were assigned to the control condition (identical salience for win and loss feedback messages), one third were assigned to the condition in which the negative outcomes (the loss events) were salient (the loss salient condition) and the remaining third received the one in which the positive outcomes (the win events) were salient (the reward salient condition).

Independently of the reward rate, the CJT gave participants no control ($\Delta P=0$). That is, the reward rate varied independently from which button the participant decided to press.

Data analysis

Six people were excluded from the analysis because of missing data; one was excluded for participating in the experiment twice and another one was excluded for providing an unrealistic answer about the winning's amount.

In order to evaluate the effectiveness of our mood induction procedure, and to rule out the possibility that our results could be caused by mood differences, a mixed ANOVA was carried out on the VAMS scores (before mood induction, after mood induction) with reward rate (low, high) and salience (control, loss salient, reward salient) as factors.

In order to evaluate the effect of attention on the outcome density effect, judgments of control and win were analyzed using a between-subjects ANOVA with reward rate (low, high) and salience (control, loss salient, reward salient) as factors. VAMS scores collected after mood inductions were included as covariate.

Judgments of control were corrected for the actual amount of control that participants experienced during the task, by means of the formula adapted from Allan (1980):

$$\Delta P = P(W \mid C) - P(W \mid \sim C)$$

where P(W|C) is the relative probability to win by pressing one button ("c") and P(W|~C) is the relative probability to win by pressing the other button ("n"). Judgments of control were also analyzed using a series of t-tests, in order to evaluate whether they differed from zero (correct estimation of control).

Judgments of winnings were corrected for the actual amount of money won during the CJT, so that positive values correspond to an overestimation of winnings and negative values correspond to an underestimation of the winnings.

Results

Mood The 3 (mood; before mood induction, after mood induction, after task) by 2 (reward rate; low, high) by 3 (salience; control, loss salient, reward salient) ANOVA on VAMS scores for happiness showed a significant effect of mood induction ($F_{2,132}$=10.3; p<.001). Happiness after mood induction (mean=82 ±16.15) increased by 12%, when compared to the first assessment (mean=70 ±19.29; p<.001) and decreased again after the experiment (p<.001). More important, there was a significant interaction ($F_{2,132}$=4.8; p<.01). Post hoc tests showed that, after the CJT, the mood in the high reward rate groups was higher than the one in the low reward rate (p<.001). Mood decreased by 26% after the CJT in the low reward rates groups (p<.01), while in the high reward rate condition it remained higher than the first assessment (p<.001) but it did not change with respect to the second assessment (p>.05).

Judgment of Control as a function of reward rate and Outcome Salience The 2 (reward rate; low, high) by 3 (salience; control, loss salient, reward salient) ANCOVA on judgments of control (corrected by the actual control, ΔP) showed a significant effect of the reward rate ($F_{1,90}$=25.23; p<.001). Participants assigned to the high reward condition (mean = 22.19) reported higher perceived control than the ones assigned to the low reward rate condition (mean = -4.19). The interaction between reward rate and salience showed a tendency towards significance ($F_{2,90}$=2.91; p=.06). In order to better understand this result, we ran an ANCOVA using reward rate (low, high) and only two levels of reward salience (control, loss salient). This analysis only showed an effect of the reward rate ($F_{1,58}$=8.32; p<.01). Participants who performed the high reward condition (mean = 15.41) reported higher perceived control than the ones assigned to the low reward rate condition (mean=-2.97). The interaction between reward rate and reward salience was not significant (F<1). A second analysis focused on the reward-salient results: we ran an ANCOVA with factors reward rate (low, high) and two levels of salience (control, reward salient). This analysis showed an effect of the reward rate ($F_{1,64}$=22.9; p<.001), with groups assigned to the high reward condition (mean = 23.66) reporting higher perceived control than the ones assigned to the low reward rate condition (mean = -5.08). More importantly, the interaction between reward rate and reward salience was significant, $F_{2,64}$=6; p<.05 (see Figure 2). Further post hoc analyses revealed that this significant interaction was reflecting the fact that the group assigned to the [high reward rate, reward salient] condition reported higher perceived control ($F_{2,31}$=7.1; p<.01) than the other groups.

Further analysis on the judgment of control, using Student's t-test, showed that none of ratings of control for the groups in low reward conditions differed than zero (all ps>.05). Moreover, judgments of control expressed by participants assigned to the high reward rate condition were significantly higher than zero only when the positive outcome (p<.001) was salient; when none of the outcomes was salient there was a tendency to significance (p=.06) while when the negative outcome was salient the judgments of control were no significantly higher that zero (p=.08).

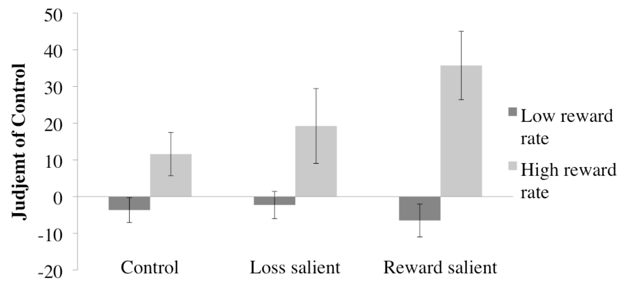

Figure 2. Reported judgment of control corrected by the actual control experienced during the task.

Winnings results The 2 (reward rate; low, high) by 3 (salience; control, loss salient, reward salient) ANCOVA on the difference between the reported and the actual winnings showed a significant effect of the reward rate ($F_{1,90}$=41.1; p<.001).

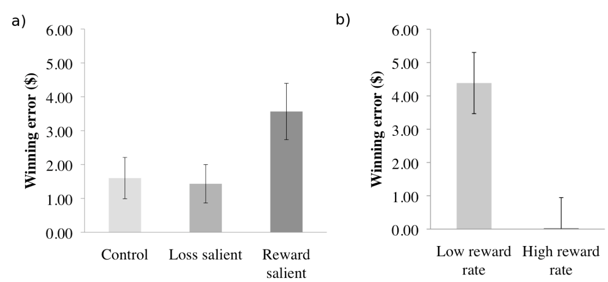

Figure 3. Errors in perceived money won, corrected for the actual winning displayed by a) salience and b) reward rate. Positive values indicate overestimation and negative values indicate underestimation of winnings.

The groups assigned to the low reward condition (mean = 4.39; corrected for the actual winning) overestimated their winnings more than the ones assigned to the high reward rate condition (mean =0.03). The analysis also showed an effect of salience ($F_{2,90}$=3.04; p<.05; Figure 3), with overall larger overestimation errors in the reward salient condition (mean = 3.5) compared to control and loss salient conditions (mean = 1.6, mean = 1.4, respectively). The interaction between reward rate and salience was not significant (F<1). Post hoc tests showed that the group assigned to the reward salient condition overestimated their winnings more than the ones assigned to the loss salient condition ($p<.05$); moreover, the difference between the control condition and the reward salient condition also tended towards significance ($p=.06$), but failed to reach it due to relatively larger variability in that condition, compared to the loss salient condition.

Discussion

The aim of this study was to evaluate the role of attention in the outcome density effect. We hypothesized that, if the illusion of control is caused by an attentional bias toward the positive outcome, increasing the negative outcome's salience should reduce the illusion. On the other hand, salient positive outcomes were expected to enhance the illusion.

The results partially confirmed our hypotheses: judgments of control were indeed inflated when the positive outcomes were made more salient; yet, judgments of control were unaffected by the salience of the loss outcomes.

Overall, our results replicated the traditional outcome density effect (Jerkins & Ward, 1965). Judgments of control of participants who were often rewarded were higher than those of participants who received fewer rewards. Furthermore, participants in the high reward rate condition tended to overestimate the control they exerted over the outcome ($p=.06$).

The enhancement of perceived control when the positive outcome occurs often and when it is more salient than the negative one, is in accordance with the hypotheses that attention modulates the illusion of control: the increased salience of positive outcomes likely attracted attention towards those events, enhancing a baseline bias towards attending to those events in the first place, increasing the illusion of control. That said, it is also important to note that equivalent salience manipulations on the feedback of "loss" events did not significantly modulate neither the illusion of control nor the perceived winnings in the task.

Our mood induction procedure was successful in enhancing the general mood in participants. Importantly, differences in the mood of participants across groups were not responsible for the differences observed in perceived control or winnings, since no difference in participant's mood was observed across conditions.

There may be several reasons why our salience manipulation failed to influence the illusion of control in the loss salient condition. It is possible that the specific colors we chose in our manipulation may have interacted differently with the perceptions of gain and loss. There is a lifetime associations between yellow and cautious behavior and red with maximum levels of hazard (see Williams and Noyes, 2007; for a review). If the observers interpreted the color of the outcome as a warning clue, it is possible that this encouraged them to abandon a risk taking strategy, which is common in gamblers and known to be correlated with illusion of control (Fenton-O'Creevy et al., 2003). Moreover, results showing that red color facilitates cognitive tasks in which negative stimuli are involved (Mehta, & Zhu, 2009) suggest that positive and negative salient outcomes may have been processed differently. Specifically, red may have increased accuracy in remembering the occurrence of the negative outcomes only. That said, this would not explain why the illusion grew in size in the reward condition. Lastly, it is well known that gains and losses are perceived asymmetrically to begin with (Kahneman & Tversky, 1979). As such, it is possible that loss aversion may have been at play in our experiment, making participants in the loss salient conditions overall more cautious than in the reward salient condition, or turned them into more "objective" assessors of the events (much like in the "depressed realism" effect). In contrast, participants in the reward salient condition may have been more prone to get excited about their winnings, inducing something like a positive-mood amplification of the illusion of control effect. Overall, the asymmetry in the effects of event salience on perceived control and perceived winnings has strong implications in terms of understanding some aspects of gambling behavior: in most gambling situations, loss events have little salience, whereas win events tend to be very salient. This may be contributing to increase levels of illusion of control in gambling scenarios (like slot machines), and further, our results suggest that simply increasing the salience of the loss events (making them as bright and noisy as win events) may be insufficient to counteract the increased illusion of control arising from salient win events.

A reverse outcome density effect was observed in the winning ratings. On the one hand, participants generally overestimated the amount of money won in the experiment. On the other hand, the biggest mistake in overestimating the amount of money was observed in the low reward rate condition (i.e., when the win events happened more rarely). This result, although surprising, could be due to a bias induced by the experimental procedure: subjects signed an informed consent in which they were promised a fixed amount for the experimental session, plus the possibility to increase their earnings for the day. This manipulation is intended to increase the illusion (Matute, 1996), but could have caused participants to be skeptical on the actual possibility to lose money during the experiment, encouraging them not to state a money loss.

A particularly striking result was the salience effect observed on the winnings recall. When the positive outcome was salient, participants overestimated the winnings more than in either of the other two conditions (salient loss outcome and control conditions). This result was independent of the reward rate and, although preliminary, might also be potentially relevant to gambling. Winnings are often exaggerated and amplified by means of lights, sound and colors and the saliency is not necessarily commensurate to the actual winning. This may not only increase the gambler's tendency to overestimate its own control over the situation but also to remember inflated winnings throughout the gambling experience.

In sum, in line with our initial hypothesis, attentional biases seem to partly contribute to the illusion of control phenomenon. Salience of the outcome, in fact, modulated both the contingency judgment and the memory for winnings. These results are promising and have potentially important implications for the understanding of cognitive mechanisms underlying gambling behaviors.

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