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BRIEF REPORT

Induced Sadness Increases Persistence in a Simulated Slot Machine Task Among Recreational Gamblers

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Gambling may constitute a strategy for coping with depressive mood, but a direct influence of depressive mood on gambling behaviors has never been tested via realistic experimental designs in gamblers. The current study tested whether experimentally induced sadness increases persistence on a simulated slot machine task using real monetary reinforcement in recreational gamblers. Sixty participants were randomly assigned to an experimental (sadness induction) or control (no emotional induction) condition, and then performed a slot machine task consisting of a mandatory phase followed by a persistence phase. Potential confounding variables (problem gambling symptoms, impulsivity traits, gambling cognitions) were measured to ensure that the experimental and control groups were comparable. The study showed that participants in the sadness condition displayed greater gambling persistence than control participants (p = .011). These data support the causal role of negative affect in decisions to gamble and persistence, which bears important theoretical and clinical implications.

Keywords: depression, emotion induction, gambling disorder, laboratory gambling, sadness

Contemporary models of disordered gambling posit that gambling can constitute a dysfunctional strategy to cope with adverse emotions, psychopathological symptoms, or negative life events (Blaszczynski & Nower, 2002; Jacobs, 1986). Accumulating evidence has supported these models by revealing the existence of a subgroup of "emotional vulnerable gamblers", in whom gambling is used as a coping mechanism (Milosevic & Ledgerwood, 2010; Nower & Blaszczynski, 2017). Several studies have shown that coping motives are vulnerability factors for the development of disordered gambling symptoms (Canale, Vieno, Griffiths, Rubaltelli, & Santinello, 2015; Devos et al.,

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The present data were presented at two local conferences as written communications (posters). The first in Leuven (Belgium) in May 2014 and the second in Montpellier (France) in June 2014. Many thanks to Mike Aitken for work on the design and implementation of the slot machine task, and Celine Charlot for her help in collecting the data. Gaëtan Devos, Luke Clark, and Joël Billieux designed the study. Gaëtan Devos acquired the data and conducted the statistical analyses. Gaëtan Devos, Pierre Maurage, and Joël Billieux interpreted the results. Gaëtan Devos and Joël Billieux wrote the initial draft of the article. Pierre Maurage and Luke Clark reviewed the initial draft and participated in the writing of the final draft. Pierre Maurage (Research Associate) is founded by the Belgian National Foundation for Scientific Research (F.R.S.-FNRS, Belgium). The Centre for Gambling Research at UBC (Luke Clark) is supported by funding by the Province of British Columbia government and the British Columbia Lottery Corporation, a Canadian Crown Corporation; these bodies had no further involvement in the research design, methodology, conduct, analysis or write-up of the study, and impose no constraints on publishing. Luke Clark has provided paid consultancy to Cambridge Cognition Ltd, and has received honoraria and travel expenses from Svenska Spel (Sweden) and the National Center for Responsible Gaming (US).

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2017). Depressive disorders also constitute one of the most frequent comorbidities of disordered gambling (Petry, Stinson, & Grant, 2005), with evidence for reciprocal influences from longitudinal studies (Hartmann & Blaszczynski, 2016).

Although robust and consistent data link problem gambling to depressive symptomatology and negative affect, only two published studies have experimentally manipulated mood to measure the effect on gambling. First, Hills, Hill, Mamone, & Dickerson (2001) examined the impact of mood induction procedures (depressed, neutral, or happy) on persistence in regular and nonregular gamblers. This study showed that regular gamblers persisted more than the nonregular group in the depressed mood condition, whereas nonregular gamblers persisted more in the happy mood condition. The main limitation of this study is that the task involved a series of play or quit decisions with an incrementally decreasing reward schedule, such that there was an optimum 'quit point'. This probabilistic structure is different from real-world gambling situations, which reduces the ecological validity of the task. Moreover, no measure of affective state was taken prior emotional induction, which precluded testing for preinduction group differences in affective state, as a potential confounding factor. In the second study, Mishra, Morgan, Lalumière, and Williams (2010) used an authentic video lottery terminal in a design that factored both mood state and the presence of a peer observer. Participants were a student sample who was not preselected for gambling involvement. This study did not detect any influence of mood induction. Thus, the direct influence of induced sadness on realistic gambling games has not been directly tested in experienced gamblers.

The present study aims to address this knowledge gap by testing if induced sadness influences gambling behavior on a simulated slot machine task using real monetary reinforcement. We focus on persistence as a laboratory analogue of "loss chasing", one of the defining criteria for gambling disorder (American Psychiatric Association [APA], 2013) and the most frequently endorsed criteria in epidemiological data sets (Temcheff, Paskus, Potenza, & Derevensky, 2016; Toce-Gerstein, Gerstein, & Volberg, 2003). We hypothesized that gamblers in the sadness condition will display increased persistence compared to gamblers in the neutral mood condition. Our design controls for group differences in disordered gambling symptoms, and trait impulsivity and gambling-related cognitive distortions as two established risk factors for gambling problems (Canale et al., 2015; Michalczuk, Bowden-Jones, Verdejo-Garcia, & Clark, 2011; Navas et al., 2017).

Method

Participants and Procedure

Participants were recreational gamblers, who gambled at least once a month, spoke French and were aged 18 or over, recruited from the local community. The mean age was 32.15 ($SD = 14.48$; range: 18–70). Represented gambling types were scratch-cards (95%), lotteries (86.7%), poker (58.3%), online poker (50%), slot machines (41.7%), and others (15%). SOGS scores, assessing symptoms of disorder gambling, ranged from 0 to 8 ($M = 2.08$, $SD = 2.00$). Based on standard cut-offs (Lesieur & Blume 1987), 13 participants (21.7%) were nonproblematic gamblers (SOGS = 0; 10 in sadness group), 40 participants (66.7%) were at-risk gamblers (SOGS 1–4; 18 in sadness group), and 7 participants (11.7%) were problem gamblers (SOGS >4; 2 in sadness group). SOGS scores did not significantly differ between groups (see Table 1). Participants signed written informed consent. The ethical committee of the Psychological Sciences Research Institute of the Université catholique de Louvain approved the protocol. Participants were counterbalanced to two experimental groups (sadness vs. control, $n = 30$ per group). First, participants completed questionnaires evaluating sociodemographic variables and gam-

Table 1
Descriptive Statistics and Group Comparisons for Sadness and Control Groups Regarding Demographics, Psychological Measures, and Slot Machine Task Persistence Score

	Sadness Group ($n = 30$)		Control Group ($n = 30$)		
Variable name	*M*	*SD*	*M*	*SD*	Statistical Test
Age	31.97	13.44	32.33	15.68	$p = .923$
Men/women	16/14		16/14		$p = 1.00$
Educational level	14.60	2.14	14.20	1.80	$p = .434$
SOGS	1.77	1.87	2.40	2.11	$p = .224$
GRCS-total	60.83	17.38	69.27	22.11	$p = .106$
UPPS-P-Negative Urgency	9.63	2.93	10.17	3.10	$p = .496$
UPPS-P-Positive Urgency	10.87	2.35	11.13	2.56	$p = .675$
UPPS-P- (lack of) Premeditation	7.50	1.94	7.83	2.09	$p = .524$
UPPS-P- (lack of) Perseverance	6.60	2.28	7.63	2.63	$p = .110$
UPPS-P-Sensation seeking	11.03	2.11	11.03	2.17	$p = 1.00$
Gambling activities	%		%		
Lotteries	86.7		86.7		$p = 1.00$
Scratch-cards	93.3		96.7		$p = .554$
Poker online	56.7		43.3		$p = .302$
Poker	56.7		60.0		$p = .793$
Sports betting	40.0		26.7		$p = .273$
Slot machines	46.7		36.7		$p = .432$
Others	23.3		6.7		$p = .071$

bling habits. Then, mood ratings were taken using a single item sadness rating (Likert scale from 1 “not sad at all” to 10 “terribly sad”) and the negative affect items (e.g., distressed, upset, or nervous) from the Positive Affect and Negative Affect Schedule (PANAS) state version (Gaudreau, Sanchez, & Blondin, 2006; Watson, Clark, & Tellegen, 1988). Items of the PANAS are scored on a 5-point Likert scale (from 1 “very slightly or not at all” to 5 “extremely”) and the internal consistency of the scale was high (Cronbach’s alpha = .85). The PANAS does not contain items specifically relating to depressed or sad mood, and thus the single-item sadness rating was added to test the specificity of the mood induction procedure. The participants then watched a movie clip (sadness condition or neutral condition, see below), and filled out the 1-item sadness scale and PANAS-state a second time. Next, participants played a simulated 3-reel slot machine task composed of a mandatory phase (consisting of 25 trials) and a persistence phase, in which the participants could continue or stop the task at any point, up to a maximum of 25 trials. Persistence was calculated as the number of trials performed in the second phase. Following the slot machine task, participants completed questionnaires measuring symptoms of disordered gambling (SOGS; Lejoyeux, 1999; Lesieur & Blume, 1987), traits impulsivity (UPPS-P; Billieux, Rochat, et al., 2012) and gambling cognitions (GRCS; Grall-Bronnec et al., 2012; Raylu & Oei, 2004).

Emotional Induction

Movie clips used were taken from a normative database of emotional clips (Schaefer, Nils, Sanchez, & Philippot, 2010). For the experimental group, we used a movie clip eliciting sadness (an excerpt from the movie “City of Angels” where a woman dies in the arms of her husband after a road accident). For the control group, we used a neutral movie clip (an excerpt showing a person in front of his deck and another one shopping).

Slot Machine Task

The slot machine simulation was modified from the 2-reel slot machine task developed by Clark, Lawrence, Astley-Jones, and Gray (2009) to examine neural responses to “near-miss” outcomes. Our modification used a more conventional 3-reel game to enhance the ecological validity of the task (see Figure 1 for a screenshot). Three types of outcomes were delivered during the task: wins, near-misses (where the last reel stopped one position from the pay line), and full losses (where the last reel stopped from more than one position from the pay line). Each spin was initiated by pressing a spin button, which automatically deducted a 5-cent wager. Participants started the task with 6 Euros and were informed that they would receive any money earned at the end of the task. Matching symbols on the payline were awarded 50 cents as the win amount. Before starting each spin, participants had a “double-up” option to double their bet (i.e., betting 10 cents for a 1-euro win). The “double-up” option was added to increase active control and thus potentially promote gambling persistence (e.g., Clark et al., 2009). The mandatory phase comprised 4 wins (16%), 9 near misses (36%), and 12 losses (48%) in a pseudorandom order. Each participant finished the mandatory phase with a positive net score (6.75 to 7.50 Euros, depending on their use of the double-up option on wins and losses). This positive expectancy is important for obtaining an overall level of persistence, and variation in persistence, in laboratory designs (Billieux, Van der Linden, Khazaal, Zullino, & Clark, 2012; Devos, Clark, Maurage, Kazimierczuk, & Billieux, 2015). The persistence phase began immediately after the mandatory phase, and was signaled only by the appearance of a quit button in the bottom right corner of the screen. Participants were instructed that following the mandatory phase, they could quit whenever they want by clicking on the quit button. During the persistence phase, wins occurred in the same ratio, which is to say the persistence phase was not conducted ‘under extinction’ (Kassinove & Schare, 2001). On completion, participants received their winnings from the slot machine task.

Figure 1. The modified slot machine task. See the online article for the color version of this figure.

Three subjective ratings were acquired on each trial: “How do you rate your chances of winning?” (before the trial), “How pleased are you with the result?” and “How much do you want to continue to play?” (after the trial). The persistence measure (i.e., the number of trials in the nonmandatory phase of the task) was the primary dependent variable. The proportion of double-ups and the subjective ratings are reported as secondary measures and are not related to specific *a priori* hypotheses.

Control Variables

Three questionnaire measures were administered to confirm balancing of the two groups in gambling-related variables: (1) The UPPS-P Impulsive Behavior scale (Billieux, Rochat, et al., 2012) assessed impulsivity traits, comprising 5 facets: Negative Urgency (i.e., the tendency to engage in rash actions in response to intense negative affect), Positive Urgency, lack of Premeditation, lack of Perseverance, and Sensation Seeking, using a 4-point Likert scale from 1 (strongly agree) to 4 (strongly disagree). The internal consistencies (Cronbach’s alpha) of the 5 subscales in the current sample were .82, .75, .83, .86, and .69, respectively; (2) The Gambling-Related Cognitions Scale (GRCS; Raylu & Oei, 2004; French validation: Grall-Bronnec et al., 2012) was use to derive a global measure of gambling distortions, with the 23 items scored on a 7-point Likert scale from 1 (strongly disagree) to 7 (strongly agree). The Cronbach’s alpha value in this study was .87; (3) Symptoms of disordered gambling were assessed with the French version (Lejoyeux, 1999) of the South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987), which comprises 16 dichotomous (Yes/No) items based on the *DSM–III* (American Psychiatric Association [APA], 1980) criteria for pathological gambling. In the current sample, the Cronbach’s alpha for this scale was .70.

Statistical Analyses

Parametric (independent sample *t* test) and nonparametric (chi squared) tests were used to compare groups (sadness vs. neutral) on sociodemographics (gender, age, number of school years), gambling preferences, and control variables (symptoms of disordered gambling, impulsive traits and cognitive distortions). The manipulation check of the mood induction effectiveness on the one-item sadness scale and the PANAS-state was tested with a 2 [time, within groups] $\times$ 2 [condition, between groups] ANOVA. Group differences on the behavioral measures (persistence and double-ups) and subjective ratings were tested with independent-samples *t* tests. As *a priori* hypothesis pertained to the persistence variable, no correction for multiple comparisons was applied. We assessed the possible contribution of disordered gambling symptoms on persistence through the use of a Two-Way ANOVA with SOGS (nonproblematic, at-risk, problematic) and condition (experimental, control) as fixed factors.

Results

No significant group differences were found with regard to demographic variables, symptoms of disordered gambling, gambling activities, or impulsivity and gambling related cognitions (see Table 1). No preinduction differences between groups were evidenced for the PANAS-state and the sadness scale.

The manipulation check for the mood induction was tested using two 2 $\times$ 2 ANOVA models on the sadness rating and the PANAS-State scale. The sadness rating showed a significant Time $\times$ Group interaction, $F(1, 119) = 3.920$, $p = .050$, and significant main effect of Time, $F(1, 119) = 8.117$, $p < .01$. The main effect of Group was not significant, $F(1, 119) = .842$, $p = .361$. On the PANAS-State, the Time $\times$ Group interaction was nonsignificant, $F(1, 119) = 1.084$, $p = .300$, as were the main effects of Time, $F(1, 119) = 2.637$, $p = .107$ and Group, $F(1, 119) = .626$, $p = .431$. As the PANAS-State focuses on general negative affect but does not include a specific sadness item, the disparity with the single-item sadness rating suggests that our experimental manipulation specifically affected sadness.

In accordance with our primary hypothesis, a significant group difference was found for persistence on the slot machine task, $t(58) = 2.632$, $p = .011$; Cohen's $d = 0.7$, with elevated persistence in the sadness condition compared to the control condition.[1] The Two-Way ANOVA showed that the main effect of Group remained significant, $F(1, 59) = 5.124$, $p = .028$, but neither the SOGS, $F(2, 58) = .565$, $p = .571$ nor the Group X SOGS interaction, $F(1, 59) = .563$, $p = .456$ were significant. There was no effect of sadness on the "double-up" score or the subjective ratings (see Table 2).

Table 2
Descriptive Statistics and Group Comparisons for Sadness and Control Groups Regarding the Slot Machine Task Variables

Variable name	Sadness Group ($n = 30$) *M*	Sadness Group ($n = 30$) *SD*	Control Group ($n = 30$) *M*	Control Group ($n = 30$) *SD*	Statistical Test
Persistence	12.73	8.67	7.20	7.58	$p = .011$
Double up after win	.50	.40	.58	.43	$p = .487$
Double up after near-miss	.48	.38	.55	.30	$p = .399$
Double up after full-miss	.51	.36	.54	.34	$p = .794$
Pleased after win	.73	.23	.79	.23	$p = .353$
Pleased after near-miss	.26	.16	.22	.16	$p = .360$
Pleased after full-miss	.24	.16	.17	.15	$p = .077$
Continue after win	.65	.22	.70	.25	$p = .349$
Continue after near-miss	.54	.21	.60	.25	$p = .334$
Continue after full-miss	.56	.19	.59	.25	$p = .498$
Chance after win	.45	.22	.47	.20	$p = .728$
Chance after near-miss	.38	.20	.37	.20	$p = .913$
Chance after full-miss	.39	.21	.38	.17	$p = .750$

Discussion

The present study used a mood induction design to test the causal influence of sadness on slot machine persistence, in a group of recreational gamblers. In accordance with our hypothesis, participants in the sadness group displayed heightened persistence on the slot machine simulation. Our between-groups design controlled for sociodemographic variables and gambling-related variables (i.e., impulsivity traits, cognitive distortions, symptoms of disordered gambling), and we confirmed the efficacy of the mood induction procedure on subjective sadness.

The current report extends the extensive literature showing the comorbidity between gambling disorder and mood disorders (Petry et al., 2005) as well as self-report data on coping motives and expectancies (Stewart & Zack, 2008), by showing the causal impact of induced sadness. Some studies emphasized longer periods of gambling and need to gamble among individuals with higher levels of depressive symptomatology (Quigley et al., 2015; Rømer Thomsen, Callesen, Linnet, Kringelbach, & Møller, 2009).

Previous experimental studies found mixed results (Hills et al., 2001; Mishra et al., 2010). Indeed, one study emphasized an effect of mood induction but used a nongambling task with a changing reinforcement contingency (Hills et al., 2001), whereas another study did not find an effect of mood induction but used participants with limited gambling involvement (Mishra et al., 2010). Both studies also failed to control for preinduction mood state, which precluded the mood manipulation checks that we were able to run. Our study adds to the literature because it overcomes some of the limitations related to previous studies. Indeed, we recruited actual gamblers (instead of e.g., nongambling undergraduates), used a slot machine task directly adapted from traditional laboratory gambling paradigms (instead of a nongambling task), and controlled for preinduction mood state.

Although our results were obtained in a sample of essentially nonproblematic gamblers and should be confirmed in a clinical population, they support the potential relevance of targeting affective processes (e.g., emotion regulation strategies, aversive emo-

[1] Not all individual participants responded to the sadness induction. We ran a post-hoc analysis in the participants for whom induction was successful; i.e. in the sadness group, there was increased post-induction sadness (T2-T1 > 0; $n = 22$) and in the control group, the sadness rating was stable (T2-T1 $= 0$; $n = 19$). The effect size for the between group difference ($t(39) = 3.571$, $p < .001$; Cohen's $d = 1.1$) is a more accurate representation of the effect size for our hypothesis. Slot machine persistence differed between the two restricted groups ($t[39] = 3.551$, $p < .001$; Cohen's $d = 1.1$), with higher level of persistence in the sadness group compared to controls.

tions acceptance, and emotional reactivity management) in addition to self-control-related processes and cognitive distortions in the treatment of gambling disorder. Related interventions could include (among others) mindfulness-based techniques adapted to gambling (Griffiths, Shonin, & Van Gordon, 2016) or development of adaptive cognitive emotion regulation skills (Watkins, 2015).

As limitations, we used a nonclinical sample, and our recreational sample comprised of a relatively low proportion of slot machine players (41.5%). Past research indicates that slot machine gamblers display the highest levels of coping motives (MacLaren, Harrigan, & Dixon, 2012) as well as comorbid mood disorders (Bischof et al., 2016). Second, the design of our slot machine simulation involved some compromises to ecological validity, including acquisition of trial-by-trial subjective ratings, and a positive expectancy that was set to encourage persistence as our key dependent variable. These specific structural characteristics reduce the ecological validity of the slot machine task used and might ultimately impact on the generalizability of our findings. Although real-world slot machines are well-known to have a negative expectancy, in short sessions of play some degree of profit is reasonably common, given these games' volatility (e.g., Turner, 2011). Third, the effect of laboratory mood inductions is transitory in nature, and while we confirmed a change in sadness immediately prior to the slot machine task, we did not confirm the time-course for the recovery of induced mood. In addition, this manipulation check relied on a single-item sadness rating, and did not generalize to the broader negative affect items on the PANAS. Despite these limitations, our main hypothesis was confirmed, implying that the study successfully modeled an emotion-laden gambling situation within the laboratory context.

The present study thus offers an experimentally controlled extension on existing research having focused on the impact of aversive emotions on gambling. While these results should be confirmed in problem or pathological slot machine gamblers, they show, using an ecological gambling task and a controlled mood induction paradigm, the important role played by induced sadness on gambling persistence.

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