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Using deliberate mind-wandering to escape negative mood states: Implications for gambling to escape

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TYLER B. KRUGER[1,2]*, MIKE J. DIXON[1,2], CANDICE GRAYDON[1,2], MADISON STANGE[1,2], CHANEL J. LARCHE[1,2], STEPHEN D. SMITH[3] and DANIEL SMILEK[1]

[1] Department of Psychology, University of Waterloo, 200 University Avenue West, Waterloo, ON, N2L 3G1, Canada

[2] Gambling Research Lab, University of Waterloo, Waterloo, ON, Canada

[3] Department of Psychology, University of Winnipeg, 515 Portage Avenue, Winnipeg, MB, R3B 2E9, Canada

FULL-LENGTH REPORT

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ABSTRACT

Background and aims: Slot machines are a pervasive form of gambling in North America. Some gamblers describe entering "the slot machine zone"—a complete immersion into slots play to the exclusion of all else. *Methods:* We assessed 111 gamblers for mindfulness (using the Mindful Attention Awareness Scale (MAAS)), gambling problems (using the Problem Gambling Severity Index (PGSI)), depressive symptoms (using the Depression, Anxiety, and Stress Scale), and boredom proneness (using the Boredom Proneness Scale). In a counterbalanced order, participants played a slot machine simulator and completed an auditory vigilance task. During each task, participants were interrupted with thought probes to assess whether they were: on-task, spontaneously mind-wandering, or deliberately mind-wandering. After completing each task, we retrospectively assessed flow and affect. Compared to the more exciting slots play, we propose that gamblers may use deliberate mind-wandering as a maladaptive means to regulate affect during a repetitive vigilance task. *Results:* Our key results were that gamblers reported greater negative affect following the vigilance task (when compared to slots) and greater positive affect following slots play (when compared to the vigilance task). We also found that those who scored higher in problem gambling were more likely to use deliberate mind-wandering as a means to cope with negative affect during the vigilance task. Using hierarchical multiple regression, we found that the number of "deliberately mind-wandering" responses accounted for unique variance when predicting problem gambling severity (over and above depression, mindfulness, and boredom proneness). *Conclusions:* These assessments highlight a potential coping mechanism used by problem gamblers in order to deal with negative affect.

KEYWORDS

mindfulness, depression, dark flow, mind-wandering, gambling

INTRODUCTION

Slot machine gambling is one of the most ubiquitous forms of casino gambling in North America (Schüll, 2014). For example, in our home jurisdiction of Ontario, Canada, there are over 23,000 individual slot machines (Ontario Lottery and Gaming Corporation, 2019). Despite their unique appeal, research has recognized that slot machines can pose serious problems for a small proportion of gamblers (Dowling et al., 2019; Pfund et al., 2020). For example, problem gamblers face a variety of difficulties ranging from financial troubles to health and/or relationship problems (Blaszczynski, Sharpe, Walker, Shannon, & Coughlan, 2005; Lahn, 2005; Li, Browne, Rawat, Langham, & Rockloff, 2017). Thus, it is essential to

*Corresponding author.
E-mail: tbkruger@uwaterloo.ca

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understand why slot machines have the propensity to create such problems and, more importantly, who is most likely to be negatively impacted by slot machine play.

In slot machine play, gamblers can spin and immediately receive feedback. This feedback serves to capture their attention and keep it locked in during the game. In fact, one particularly concerning characteristic of multiline slot machines is that they appear to be extremely engrossing for problem gamblers (Dixon et al., 2014; Murch, Chu, & Clark, 2017; Templeton, Dixon, Harrigan, & Fugelsang, 2015). For example, researchers have shown that problem gamblers notice less of their surroundings while playing slot machines (Diskin & Hodgins, 1999, 2001). This narrowing of attention is what some gamblers refer to as the "slot machine zone" (Schüll, 2005). Dixon et al. (2019b) have suggested that multiline slot machines may be especially good at fostering entry into this zone. The attention-capturing feedback during multiline slots play may also induce flow—a state referred to in positive psychology that is characterized by complete engagement with the current environment to the point where attending to task-relevant stimuli is effortless (Marty-Dugas & Smilek, 2018). Flow states also result in unusual cognitive experiences (e.g., distortions of time, losing the sense of self; Csikszentmihalyi & Csiks zentmihalyi, 1992; Csikszentmihalyi, Abuhamdeh, & Nakamura, 2014). Although flow is typically viewed as an intrinsically rewarding and favorable experience, Dixon and colleagues (2017, 2019a, 2019b) refer to the slot machine zone as a state of "dark flow" because of the potentially negative consequences this state engenders for the gambler. For example, gamblers may find themselves in a very pleasant state while playing slots but end up spending more time or money than initially planned.

The slot machine zone is especially intriguing given that problem gamblers struggle with mindfulness problems outside of the gambling context. Mindfulness is characterized by awareness and acceptance of the present moment with reference to one's thoughts, emotions, and bodily sensations (Bishop et al., 2004; Wheeler, Arnkoff, & Glass, 2017). Directing and focusing attention is an important characteristic of mindfulness. Previous research has shown that problem gamblers score lower on measures of mindfulness than their non-problem counterparts (Dixon et al., 2019b; Reid, Di Tirro, & Fong, 2014). Conversely, mind-wandering (the antithesis of mindfulness) occurs when attention is shifted away from the current task in the external environment towards unrelated, self-generated internal thoughts (Bertossi, Peccenini, Solmi, Avenanti, & Ciaramelli, 2017; Seli, Beaty, et al., 2018; Seli, Kane, et al., 2018; Smallwood & Schooler, 2006). Mind-wandering can also be demarcated into deliberate (i.e., intentional) and spontaneous (i.e., unintentional) mind-wandering. Studies have shown that these different types of mind-wandering are indeed dissociable cognitive experiences (see Seli, Risko, Smilek, & Schacter, 2016, for a review). Mind-wandering is estimated to occupy almost half our all waking activity and has been associated with negative affect, whereas an occupied mind generates positive affect (Killingsworth & Gilbert, 2010).

In attempting to regulate mood, some motivations for gambling may pose a greater risk for developing gambling-related problems than others. In particular, using gambling to provide relief from emotional distress or to help alleviate symptomology attributable to mood disorders may be particularly problematic (Matheson et al., 2018). In fact, depression is the most common comorbidity among gamblers, with a subset of problem gamblers using gambling as a way to self-medicate their depressive symptomology (Abbott & Volberg, 1996; Bjelde, Chromy, & Pankow, 2008; Blaszczynski & Nower, 2002; Dixon et al., 2017, 2019b; Getty, Watson, & Frisch, 2000; Griffiths & Auer, 2013).

A study conducted by Dixon et al. (2019b) investigated the complex relations among problem gambling severity, mindfulness, depression, and dark flow during slot machine play. They found that problem gambling severity was negatively correlated with mindfulness in everyday life, $r(127) = -0.49$ (i.e., the greater the problem gambling severity, the more mindfulness problems). They then assessed mindfulness while playing multiline slots. Specifically, they interrupted slots play to assess whether gamblers were either on-task (i.e., focused on the game) or off-task (i.e., thinking about anything unrelated to the game) just before the thought probe appeared. In contrast to the strong correlation between problem gambling severity and mindfulness problems in everyday life, when gamblers were probed during slots play, there was no correlation between problem gambling status and their tendency to mind-wander *while playing slots*. The authors concluded that the frequent celebratory feedback during multiline slot machine play may have served to rein-in minds of problem gamblers that would otherwise wander. Using the 21-item Depression, Anxiety, and Stress Scale (DASS-21) and the flow subscale of the Game Experience Questionnaire (GEQ), the researchers also explored the relations between depression and (dark) flow. They found positive correlations between depression and dark flow, $r(127) = 0.46$, and problem gambling severity and dark flow, $r(127) = 0.25$. The authors suggested that for problem gamblers, the sharp contrast between the propensity to mind-wander in everyday life and their experience of locked-in attention while playing multiline slots may prompt strong endorsements of dark flow during slots play. Given that flow states are associated with positive affect (Rogatko, 2009), this creates a situation where gambling becomes a maladaptive means of elevating mood—in other words, gambling to escape. In a more recent study, Kruger et al. (2020) replicated findings from Dixon et al. (2019b). They found that mindfulness in everyday life (assessed using the Mindful Attention Awareness Scale; MAAS) negatively correlated with problem gambling severity, $r(108) = -0.48$. While probing gamblers during slot machine play, they also replicated the finding that mindfulness problems in everyday life were eliminated in the slot machine context (i.e., there was no correlation between mindfulness while playing multiline slots and problem gambling severity).

In addition to the relatively robust correlations between depression, mindfulness problems and problem gambling severity, there is also a relationship between boredom and problem gambling. Boredom is a pervasive, subjectively unpleasant state that can emerge during monotonous or dull situations (Eastwood, Frischen, Fenske, & Smilek, 2012). Boredom has also been construed as a failure to engage with one's environment despite the motivation to do so

(Eastwood et al., 2012). Compared to non-problem gamblers, problem gamblers score higher on self-report measures of boredom proneness (Blaszczynski, McConaghy, & Frankova, 1990). Trait boredom proneness (i.e., the tendency to experience boredom regularly) has also been associated with increased mind-wandering and poorer sustained attention (Cheyne, Carriere, & Smilek, 2006; Isacescu, Struk, & Danckert, 2017). Researchers have also shown that having a lower tolerance for boredom is a significant factor in repetitive gambling behavior (Blaszczynski et al., 1990). Gambling may be, in part, a maladaptive coping strategy to alleviate boredom and its accompanying negative affect (Blaszczynski et al., 1990; Blaszczynski, Wilson, & McConaghy, 1986; Turner, Zangeneh, & Littman-Sharp, 2006). Thus, problem gamblers may experience boredom regularly in their everyday lives; but, while at the slot machine, they find their attention is regularly captured by the intermittent reinforcing feedback. If boredom is a failure to engage with the current environment (despite the motivation to do so), problem gamblers may use *deliberate* mind-wandering as a means to cope with a monotonous and unexciting task (i.e., if problem gamblers are unable to engage with a boring task, they may intentionally choose to think about something else; Seli, Cheyne, Xu, Purdon, & Smilek, 2015; Seli et al., 2016). We will test this hypothesis in the current study.

In previous experiments (e.g., Dixon et al., 2019b; Kruger et al., 2020), the MAAS is a *trait* measure of mindfulness whereas the thought probes interrupting slots play measures *state* mindfulness. Thus, there is the potential that method variance impacted the strong correlations between mindfulness problems and problem gambling (assessed at the trait level), and the absence of such correlations when mindfulness is assessed in the slot context (i.e., state mindfulness). One overarching goal of the current study was to provide a *state* measure of mindfulness outside of slot machine play. This would allow us to evaluate whether state mindfulness problems among problem gamblers are present during an attentionally demanding task (i.e., a vigilance task) but can be effectively eliminated in the slots context. Specifically, using the same thought probe methodology, we could demonstrate higher instances of mind-wandering during a vigilance task and lower instances of mind-wandering during slot machine play. A state-to-state comparison would reduce method variance and bolster the conclusion that slots rein in the wandering mind and eliminates the mind-wandering that problem gamblers' experience in everyday life.

In the current experiment, we assessed a wide range of gamblers. Given that previous research has shown that problem gambling status is positively related to depression, boredom, and mindfulness problems, our goal was to examine if the reinforcing sights and sounds of the slot machine serve to rein in the attention of bored minds that are prone to mind-wandering, fostering entry into "the zone," and ultimately elevating mood. More specifically, we also wanted to explore and validate whether those with more gambling problems do indeed mind-wander more than those without gambling problems by using an in-lab measure of mind-wandering. Here we sought to show that when problem gamblers are faced with a monotonous task, they would use deliberate mind-wandering as a maladaptive[1] means of attempting to regulate their affect. Specifically, we surmised that a prolonged, attention demanding task should induce boredom and negative affect which would prompt problem gamblers (more so than non-problem gamblers) to deliberately mind-wander as a means of coping with the negative affect. Importantly, if multiline slot machine play reins in the wandering mind and induces dark flow and positive affect, there would be no need for the problem gamblers to intentionally mind-wander during slots play, as there is no negative affect to avoid. Seen in this light, the strategy of deliberately mind-wandering to avoid negative affect, may actually relate to gambling for the purpose of escape—slots provide relief by inducing flow and positive affect, and thereby curtail the very need for deliberate mind-wandering.

Given that mindfulness problems, boredom proneness, and depression are all correlates of problem gambling and also relate to negative affect, it seems reasonable to suggest that deliberate mind-wandering may be a means to alleviate the negative state induced by these traits by problem gamblers. If so, the propensity to employ this coping strategy may uniquely account for problem gambling variance (over and above the traits related to negative affect). In sum, by comparing slots play to a repetitive vigilance task, we sought to test the following hypotheses: (1) we expected to see more flow, more positive affect, and less negative affect during slots play than during our vigilance task; (2) we hypothesized that there would be more instances of mind-wandering during our vigilance task than during slots play; (3) based on previous research from our lab, we expected to see a correlation between mindfulness problems in everyday life and problem gambling severity; (4) this correlation should be eliminated when we assess mindfulness during slots play; (5) based on previous research, we expected to replicate that depression, mindfulness, and boredom proneness are all correlated with problem gambling severity; and (6) show that *deliberate* mind-wandering during our vigilance task can account for unique variance when predicting problem gambling status—over and above depression, mindfulness, and boredom proneness.

METHODS

Participants

A total of 124 slot machine gamblers were recruited from Elements Casino Brantford in Ontario, Canada. This casino

[1]It can be construed that deliberate mind-wandering may be an *adaptive* way to deal with a monotonous task. However, given that we asked participants to perform a specific, albeit boring task, we viewed the use of deliberate mind-wandering to disengage with the task at hand as maladaptive. By analogy, consider a foreman asking a quality control worker to check parts coming off an assembly line for flaws. This would be a specific, boring, but important task where deliberate mind-wandering would likely be seen as maladaptive.

is a large venue with over 600 slot machines (Elements Casino Brantford, n.d.). Recruitment was conducted from September 16, 2019 to September 27, 2019. Participants were pre-screened during recruitment to ensure that they were all 19 years of age or older (the legal age to play a slot machine in Ontario), were not in treatment for problem gambling, and played a slot machine at least monthly. When filling out the slots-frequency of play question (see Canadian Problem Gambling Index (CPGI) below), one participant indicated that they played less than once per month (despite our attempt to recruit gamblers who played at least once per month or more) and one participant did not want to answer how often they played a slot machine. Ten participants were excluded for failing to follow instructions, two participants withdrew from the study early, and one participant experienced a technical error. This left 111 participants for analysis (56 female and 55 male). One participant did not disclose their age. The ages of the other 110 participants ranged from 23 to 92, with a mean of 59.25 years ($SD = 12.89$).

Apparatus

Slot machine simulator. Participants played a five-reel multiline slot machine simulator housed in a real slot machine casing, which emulated the look and feel of an actual slot machine. Participants played 20-lines on each spin and bet 1-cent per line, resulting in a bet of 20 cents per spin. Outcomes in which participants lost their entire spin wager were followed by a lack of feedback (i.e., no sounds or animations) and winning outcomes were accompanied by animations and auditory feedback provided by speakers housed within the slot machine casing. The length of the sound was proportional to the win size. The simulator also contained losses disguised as wins (LDWs), in which auditory and visual feedback were provided, but the total number of credits gained was less than the wager. The playing session consisted of 301 spins, comprised of 202 losses, 40 wins, and 59 LDWs. The overall payback percentage of the game was 92.01%. These relative frequencies of the different outcomes were based on the programming documents of a commercially available machine, and the payback percentage was one commonly used in slot machines in Ontario.

Force transducer. A force transducer was attached to a specially constructed computer mouse during our vigilance task described below. When depressed, the amount of pressure applied to the mouse button was translated to a millivolt signal recorded by an AD Instruments PowerLab (model 4/30).

Vigilance task. Participants completed a "force in sync task" in which they were instructed to press a modified mouse in synchrony with a series of presented tones. The task was presented using SuperLab 5.0 software (Cedrus Corporation). The tones consisted of a −20 decibel (dB) tone (soft), a −10 dB tone (medium), and a 0 dB tone (relatively loud). Tones were presented in triplets in the same repeating order of soft, medium, and loud. The tones were played over the built-in speaker of a Macintosh iMac. In addition to pressing the transducer in synchrony with the tones, participants were also instructed to modulate the force with which they pressed the transducer (i.e., for the soft tone they were instructed to apply a soft press; for the medium tone, a medium press; and for the loud tone, a hard press). Triplets were presented in six blocks. Blocks 1, 3, and 5 consisted of 42 triplets and blocks 2, 4, and 6 consisted of 43 triplets for a total of 255 triplets (or 765 mouse presses). Before beginning the vigilance task, participants were shown a demonstration of how the force transducer was sensitive to different forces in the LabChart software program. Before beginning the experimental trials, participants completed a practice block in order to familiarize themselves with the task.

Materials

Demographic questions. Participants completed demographic items regarding their age and gender.

Depression. Participants completed the depression subscale from the 21-item Depression, Anxiety, and Stress Scale (DASS-21; Lovibond & Lovibond, 1995). The seven-items were multiplied by two and summed to generate severity scores in order to make scores comparable to the DASS-42 (see Lovibond & Lovibond, 1995).

Boredom proneness scale—short form (SBPS). The boredom proneness scale—short form (SBPS) (Struk, Carriere, Cheyne, & Danckert, 2017) is an 8-item measure of trait boredom. The SBPS demonstrates good internal consistency and comparable construct validity to the original Boredom Proneness Scale (Struk et al., 2017).

Canadian Problem Gambling Index (CPGI). Participants also completed an item from the CPGI (Ferris & Wynne, 2001) that assesses the frequency in which gamblers engage with slot machine gambling. They answered this item by choosing one of the following frequencies: daily, 2–6 times a week, about once a week, 2–3 times a month, about once a month, between 6 and 11 times a year, between 1 and 5 times a year, never, or I prefer not to say.

Problem Gambling Severity Index (PGSI). The Problem Gambling Severity Index (PGSI) (Ferris & Wynne, 2001) is a nine-item screening tool that assesses gambling problems in the general population. The nine-items were summed to produce a score for problem gambling (ranging from 0 to 27) with higher scores indicating greater risk for problem gambling.

Mindful Attention Awareness Scale (MAAS). The MAAS (Brown & Ryan, 2003) is a 15-item questionnaire that assesses mindfulness in everyday life outside of gambling. The 15-items were averaged to produce a score for mindfulness with higher scores reflecting higher levels of dispositional mindfulness.

Game Experience Questionnaire (GEQ). Participants completed three subscales (flow, positive affect, and negative affect) from the core version of the GEQ (IJsselisteign, de Kort, & Poels, 2013) to assess their experience of the slot machine and vigilance task. The items from each subscale were averaged to compute scores for flow, positive affect, and negative affect.

Thought probes. During the slot machine session, participants were prompted with a thought probe after every 50-spins. The thought probe asked the participant to verbally indicate to the experimenter whether their thoughts were: on-game (i.e., thinking about the game), spontaneously mind-wandering (i.e., despite their best intentions to focus on the game, their mind had wandered), or deliberately mind-wandering (i.e., they *intentionally* chose to think about something else) immediately prior to the probe showing up. The experimenter recorded the participant's response on the tablet used for administering the survey measures. The total number of "on-game" responses were summed to produce an in-game mindfulness score with the scores ranging from 0 to 6.

During the force in sync task, participants were prompted with a thought probe after 126 or 129 force transducer presses depending on the block (126 for blocks 1, 3, and 5, and 129 for blocks 2, 4, 6). Similar to the slot machine session, there were six thought probes in which participants were asked to verbally indicate to the experimenter whether they were on-task, spontaneously mind-wandering, or deliberately mind-wandering. The experimenter recorded the participant's response on the tablet used for administering the survey measures. The total number of "on-task" responses were summed to produce an in-game mindfulness score with the scores ranging from 0 to 6.

Design

The experiment employed a within-subject design with all participants playing slots and completing the vigilance task. Half of the participants played the slot machine first, followed by the vigilance task, whereas the other half completed the vigilance task first.

Procedure

All participants approached the experiment station situated in the front lobby of the casino. After determining eligibility, participants were given an information letter containing a synopsis of the study and gave written, informed consent before participating. The University of Waterloo's Office of Research Ethics approved all procedures. Participants were informed that they would be given a $25 Walmart gift card for participating, and that they would be able to win up to an additional $10.00 CAD (in cash) depending on their slot machine balance at the end of the study. The simulator was pre-loaded with 1,000 credits (i.e., $10.00), and since all participants received the same outcomes, all participants ended up with 519 credits ($5.19). The $5.19 was rounded up to $10.00 for each participant.

Using the online survey software Qualtrics, participants first completed the demographic questions, CPGI, PGSI, MAAS, DASS depression subscale, and SBPS on a Lenovo tablet (model #TB-X103F). Participants then played the slot machine or completed the vigilance task (depending on their counterbalance order). After completing each task, participants answered the positive affect, negative affect, and flow items of the GEQ on the tablet. After the final spin following slots play, a pop-up message appeared on the slot machine telling the participants their final balance Participants were given a $25.00 Walmart gift card and their (rounded up) slot machine balance ($10.00 CAD for all participants). Participants were also given responsible gambling resources and the opportunity to take a feedback letter which included additional detail about the study.

Ethics

The study procedures were carried out in accordance with the Declaration of Helsinki. The Institutional Review Board of the University of Waterloo Office of Research Ethics approved the study. All participants were informed about the study and all provided informed consent.

RESULTS

Problem Gambling and Depression Scores

Using the interpretive categories of the PGSI suggested by Currie, Hodgins, and Casey (2013), the sample consisted of: 26 non-problem gamblers (PGSI score of 0), 55 low-risk problem gamblers (PGSI score ranging from 1 to 4), 21 moderate-risk problem gamblers (PGSI score ranging from 5 to 7) and 9 problem gamblers (PGSI score of 8 or greater). Using the interpretive categories suggested by Lovibond and Lovibond (1995), the majority of the sample ($n = 86$) scored within the normal range of depression scores (scores of 0–9), 15 participants were characterized with mild depression (scores of 10–13), seven with moderate depression (scores of 14–20), 2 with severe depression (scores of 21–27), and one with extremely severe depression (scores of 28 or more).

Order effects

In studies involving measures of mind-wandering (such as thought probes) there may be a time-on-task effect. Therefore, it is crucial to assess whether there were effects of which task was completed first. Since these effects could also impact other measures such as affect or flow, for all planned analyses we first assessed whether there were order effects (i.e., a change in effect sizes depending on which game was played first). If there were any effects of order, or any interactions involving order, the files were split to directly compare those who played the slot machine simulator first to those who completed our vigilance task first, since this is the only comparison uncontaminated by order. A significant main effect of order was found for our retrospective measure of positive affect, $F(1, 109) = 4.15$, $P = 0.044$, and a significant order by task interaction was found for our retrospective measure of negative affect, $F(1, 109) = 5.22$,

$P = 0.024$. There were no other indications of order effects for the other measures (i.e., all $ps \geq 0.26$).

Flow

Contrary to our prediction, we found no statistically significant difference in retrospective accounts of flow between slots play ($M = 1.52$; $SD = 0.86$) and our vigilance task ($M = 1.54$; $SD = 0.91$), $t(109) < 1$, $P = 0.82$. We also failed to replicate previous findings suggesting a positive relationship between retrospective flow ratings following slots play and problem gambling status, $r(109) = 0.116$, $P = 0.23$—however, this correlation coefficient is in the hypothesized direction. A correlation matrix for all study variables is included in Table 1. Further, retrospective flow ratings following slots play significantly correlated with: the number of on-task responses during slots play, $r(109) = 0.346$, $P < 0.001$; retrospective ratings of positive affect following slots play, $r(109) = 0.546$, $P < 0.001$; and retrospective ratings of negative affect following slots play, $r(109) = -0.308$, $P = 0.001$.

One participant failed to fill out the entire flow subscale of GEQ following the vigilance task and was not included in the subsequent analyses. Retrospective ratings of flow following our vigilance task were significantly correlated with: the number of on-task responses during our vigilance task, $r(108) = 0.478$, $P < 0.001$; retrospective positive affect ratings following our vigilance task, $r(108) = 0.476$, $P < 0.001$; and retrospective ratings of negative affect following our vigilance task, $r(108) = -0.434$, $P < 0.001$.

Interestingly, retrospective ratings of flow following slots also significantly correlated with retrospective ratings of flow following our vigilance task, $r(108) = 0.460$, $P < 0.001$, and retrospective ratings of positive affect following our vigilance task, $r(109) = 0.357$, $P < 0.001$. Similarly, retrospective ratings of flow following our vigilance task also significantly correlated with the number of on-task responses during slots play, $r(108) = 0.218$, $P = 0.022$, retrospective ratings of negative affect following slots play, $r(108) = -0.217$, $P = 0.023$, and retrospective ratings of positive affect following slots play, $r(108) = 0.303$, $P = 0.001$.

Affect

Since both positive and negative affect were found to be influenced by whichever task was completed first, we restricted our analyses to compare those who played slots first to those who completed our vigilance task first (the only contrast uncontaminated by order). We found that negative affect was significantly lower during slot machine play ($M = 0.90$; $SD = 0.73$) relative to our vigilance task ($M = 1.45$; $SD = 0.94$), $t(109) = -3.49$, $P < 0.001$. Similarly, we also found that positive affect was significantly higher during slot machine play ($M = 2.12$; $SD = 0.88$) relative to our vigilance task ($M = 1.16$; $SD = 0.94$), $t(109) = 5.56$, $P < 0.001$.

Thought probe responses and mindfulness

Contrary to our predictions, we found no statistically significant difference in the number of on-task responses between slots play ($M = 4.00$; $SD = 2.01$) and our vigilance task ($M = 3.73$; $SD = 2.13$), $t(110) = 1.26$, $P = 0.21$. Similarly, we also found no statistically significant difference in spontaneous mind-wandering between slots play ($M = 1.04$; $SD = 1.43$) and our vigilance task ($M = 1.25$; $SD = 1.49$), $t(110) = -1.43$, $P = 0.16$; there was also no statistically significant difference in deliberate mind-wandering between slots play ($M = 0.91$; $SD = 1.56$) and our vigilance task ($M = 1.01$; $SD = 1.58$), $t(110) < 1$, $P = 0.57$.

When assessing the number of on-task responses during our vigilance task, we found a significant negative correlation between the number of on-task responses and PGSI, $r(109) = -0.203$, $P = 0.032$. Further, based on previous research, we expected to see a significant correlation between mindfulness (from the MAAS) and PGSI scores. We also expected to see a non-significant correlation (i.e., the correlation should disappear) when assessing the number of on-task responses during slots play and PGSI scores. In this study, we replicated the correlation between mindfulness from the MAAS and PGSI, $r(109) = -0.440$, $P < 0.001$. When assessing the number of on-task responses during slots play, we found that the correlation between the number of on-task responses during slots and PGSI did indeed disappear, $r(109) = -0.124$, $P = 0.19$. Steiger's Z (Steiger, 1980) indicated that the magnitude of these correlations were significantly different, $Z = -0.262$, $P = 0.009$.

When we explored the *type* of mind-wandering during our different tasks, we found no significant relation between spontaneous mind-wandering during our vigilance task and PGSI. However, we found a significant relation between deliberate mind-wandering during our vigilance task and PGSI, $r(109) = 0.302$, $P = 0.001$. We found no significant relationships between spontaneous or deliberate mind-wandering during slot machine play and PGSI. Using Steiger's Z (Steiger, 1980), we found that the correlation between deliberate mind-wandering during our vigilance task and PGSI was significantly different from the correlation between deliberate mind-wandering during slot machine play and PGSI, $Z = -2.41$, $P = 0.016$, indicating that those who score higher on the PGSI are more likely to report deliberately mind-wandering during our attentionally demanding (and likely boring) vigilance task, but not during slots play.

We found no significant relationship between spontaneous mind-wandering during our vigilance task and boredom proneness. However, we found a significant positive correlation between deliberate mind-wandering during our vigilance task and boredom proneness, $r(109) = 0.245$, $P = 0.009$. We also found no significant relationships between spontaneous and deliberate mind-wandering during slot machine play and boredom proneness. When using Steiger's Z (Steiger, 1980) to compare the magnitude of the correlations between deliberate mind-wandering during slots and boredom proneness, $r(109) = 0.047$, $P = 0.63$, and deliberate mind-wandering during the vigilance task and boredom proneness, $r(109) = 0.245$, $P = 0.009$, we found that the differences in the magnitude of the correlations approached, but ultimately fell short of significance, $Z = 1.80$, $P = 0.071$.

Table 1. Zero order correlations for all study variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. PGSI	–														
2. Dep.	0.423***	–													
3. MAAS	−0.440***	−0.441***	–												
4. SBPS	0.481***	0.517***	−0.601***	–											
5. Slots On-Task	−0.124	−0.170	0.091	−0.131	–										
6. Slots Spont.	0.098	0.222*	0.016	0.110	0.598***	–									
7. Slots Delib.	0.039	0.045	−0.119	0.047	−0.675***	−0.117	–								
8. Slots Flow	0.116	0.028	−.042	0.022	0.346***	−0.174	−0.308**	–							
9. Slots Neg.	0.011	−0.016	0.056	−0.043	−0.531***	0.205*	0.492***	−0.308**	–						
10. Slots Pos.	0.008	0.056	−0.099	0.046	0.397***	−0.128	−0.372***	0.546***	−0.560***	–					
11. Vig. On-Task	−0.203*	−0.142	0.211*	−0.227*	0.402***	−0.344***	−0.177	0.171	−0.177	0.060	–				
12. Vig. Spont.	−0.031	−0.002	−0.106	0.062	−0.236**	0.406***	−0.107	−0.120	0.036	−0.020	−0.670***	–			
13. Vig. Delib	0.302**	0.196*	−0.187*	0.245**	−0.311**	0.084	0.325**	−0.129	0.198*	−0.057	−0.717***	−0.036	–		
14. Vig. Flow	0.111	0.098	−0.049	0.072	0.218*	−0.129	−0.159	0.460***	−0.217*	0.303**	0.478***	−0.312**	−0.342***	–	
15. Vig. Neg.	0.080	0.047	−0.057	0.072	−0.430***	0.252**	0.314**	−0.186	0.553***	−0.302**	−514***	0.304**	0.396***	−0.434***	–
16. Vig. Pos	0.008	−0.026	0.042	−0.034	0.222**	−0.142	−0.161	0.357***	−0.357***	0.616***	0.309**	−0.233*	−0.194*	0.476***	−0.526***

Note. Dep. = Endorsement of depression items on the DASS-21; SBPS = Boredom Proneness Scale-Short Form; Slots = Slot machine simulator; Vig. = Vigilance task; On-Task. = number of "on game" responses; Pos. = Endorsement of positive affect items on the GEQ; Neg. = Endorsement of negative affect items on the GEQ. $^{*}P < 0.05$; $^{**}P < 0.01$; $^{***}P < 0.001$.

Table 2. Hierarchical regression for variables predicting problem gambling severity

Model	*b*	*SE*	*β*	R^2	ΔR^2
Step 1				0.179***	
Constant	2.13	0.35			
Depression	0.23	0.05	0.42***		
Step 2				0.258***	0.080**
Constant	7.52	1.62			
Depression	0.15	0.05	0.28**		
Mindfulness	−1.06	0.31	−0.32**		
Step 3				0.296***	0.037*
Constant	3.51	2.31			
Depression	0.11	0.05	0.20*		
Mindfulness	−0.66	0.35	−0.20		
Boredom	0.10	0.42	0.26*		
Step 4				0.299***	0.028*
Constant	3.34	2.27			
Depression	0.10	0.05	0.19		
Mindfulness	−0.63	0.35	−0.19		
Boredom	0.09	0.42	0.23*		
Vig. Delib.	0.34	0.16	0.17*		

Note: Depression = Endorsement of the depression items of the DASS-21; Mindfulness = Scores from the MAAS; Boredom = Scores from the Boredom Proneness Scale; Vig. Delib = number of "deliberately mind-wandering" responses from the vigilance task.
*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

Hierarchical regression predicting PGSI

We used hierarchical regression in order to investigate whether problem gamblers in a situation that induces negative affect might *deliberately* mind-wander as a means of coping with this negative affect, and if so, whether this propensity would predict problem gambling status—over and above depression, mindfulness, and boredom proneness. Specifically, we used four independent variables to predict problem gambling status (measured by the PGSI). Depression ratings were entered at Step 1, mindfulness scores (from the MAAS) at Step 2, boredom proneness at Step 3, and the number of "deliberately mind-wandering" responses from our vigilance task at the final step. At Step 1, depression significantly contributed to the regression model, $F(1, 109) = 23.73$, $P < 0.001$, and accounted for 17.9% of the variation in PGSI score variance. At Step 2, mindfulness scores explained an additional 8.0% of the variation in PGSI score variance and this increase in R^2 was significant, $\Delta F(1, 108) = 11.61$, $P = 0.001$. At Step 3, boredom proneness explained an additional 3.7% of PGSI score variance and this increase in R^2 was also significant, $\Delta F(1, 107) = 5.70$, $P = 0.019$. At the final step, the number of "deliberately mind-wandering" responses explained an additional 2.8% of variation in PGSI score variance and this increase in R^2 was also significant, $\Delta F(1, 106) = 4.42$, $P = 0.038$. The overall regression model was significant when all four independent variances were included in Step 4, $F(4, 106) = 12.71$, $P < 0.001$, and accounted for 32.41% of PGSI score variance. Thus, in a situation that induces negative affect (like our vigilance task), it appears that problem gamblers may use deliberate mind-wandering as a means to cope with negative affect. For a full regression summary see Table 2.

DISCUSSION

Slot machine gambling is a pervasive form of casino gambling in North America and can create exceptional problems for some gamblers. During play, some gamblers describe a narrowing of attention and flow-like state in which they call the "slot machine zone." We sought to explore whether the reinforcing sights and sounds of the slot machine serve to rein in the attention of bored minds that are prone to mind-wandering and fostering entry into "the zone," ultimately elevating mood.

Compared to our vigilance task, we expected to see greater retrospective ratings of flow following slot machine play. Although the degree to which flow was experienced was correlated with how much positive affect was experienced, contrary to our prediction, we failed to find any significant differences in flow following slots play and our vigilance task. One potential explanation for the failure to find differences in flow between slots play and our vigilance task involves Type II error due to gamblers' interpretation of the flow items on the GEQ. For example, one of the flow items included, "I was deeply concentrated in the game." The lobby of the casino that we were stationed in was quite loud—louder than we anticipated. This was not a problem for our slot machine simulator as we were able to increase the volume on the speakers in order to overcome the background noise. However, even at maximum volume on the built-in speakers of the Macintosh computer that administered our vigilance task, some participants mentioned that the tones were harder to hear than the celebratory sounds of the simulator. Thus, participants may have been deeply concentrated with the slots game due to (dark) flow, but just as "deeply concentrated" in the vigilance task as they kept tight rein on their attention in order to fully hear the different tones.

Contrary to our prediction, we also found no significant difference in the number of "on-task" responses between the two tasks. Once again, the failure to find such differences may be attributable to participants straining to hear the tones in the vigilance task (i.e., compensating by focusing their attention to discriminate the tones). Even though we failed to find a difference in flow and mindfulness, we did find significant differences in effect as predicted. Gamblers reported greater negative affect following the vigilance task compared to the slot-machine session as well as the corollary—greater positive affect following slot machine play and lower positive affect following the vigilance task. In terms of negative affect, the repetitive and dull nature of our vigilance task likely contributed to a lowering of mood relative to the more exciting slots play. Similarly, the reinforcing feedback of the slot machine may have caused an elevation in mood relative to our vigilance task.

A novel and important finding involves the correlation between *deliberate* mind-wandering during our vigilance task and problem gambling severity. It appears that those who scored higher in problem gambling used deliberate mind-wandering as a maladaptive means of attempting to cope with the negative affect induced by the highly repetitive and boring vigilance task. By contrast, there was no relation between deliberate mind-wandering and problem gambling status during slots play. One interpretation is that since slots play induced positive affect, there was no longer a reason for problem gamblers to deliberately mind-wander since there was no negative affect from which to escape. We also showed similar relations between deliberate mind-wandering and boredom proneness—significant correlations in the (negative) vigilance task, non-significant correlations in the (positive) slots task. It appears that those who score higher in trait boredom may be using deliberate mind-wandering as a means of avoiding negative affect associated with boredom. However, we are more cautious about these claims since the magnitudes of the differences between these correlations in the vigilance and slots conditions fell just short of significance.

Consistent with previous research, we replicated a negative correlation between mindfulness in everyday life and depressive symptomology outside of the gambling context (de Lisle, Dowling, & Allen, 2011; Dixon et al., 2014, 2017; Lakey, Campbell, Brown, & Goodie, 2007; Reid et al., 2014). We also replicated a negative correlation between mindfulness in everyday life and problem gambling severity (Dixon et al., 2019a, 2019b; Kruger et al., 2020). This correlation between mindfulness in everyday life and problem gambling disappeared when mindfulness during slots play was assessed (using the number of on-task responses to thought probes), a finding that replicates Dixon et al. (2019b) and Kruger et al. (2020). Thus, it appears that slots play—with its more frequent reinforcing feedback—is capable of reining in the wandering mind.

Another novel finding involves the hierarchical multiple regression predicting problem gambling severity. We replicated and showed significant correlations between problem gambling and depression (Dixon et al., 2017, 2019b; Kruger et al., 2020), problem gambling and mindfulness problems (Dixon et al., 2019b; Kruger et al., 2020), and problem gambling and boredom proneness (Blaszczynski et al., 1990; Kruger et al., 2020). When we used multiple regression to predict problem gambling scores, we found that the number of "deliberately mind-wandering" responses significantly accounted for unique problem gambling severity variance, after accounting for depression, mindfulness, and problem gambling. This indicates that there is something particular about problem gambling that triggers these individuals experiencing gambling harm to *deliberately* mind-wander during a task that induces negative affect—perhaps problem gamblers are using deliberate mind-wandering as a means of attempting to alleviate such negative affect. Such a coping strategy is likely maladaptive as mind-wandering itself is associated with, and may contribute to negative affect (Killingsworth & Gilbert, 2010).

Our study has some limitations. For example, there were far fewer problem gamblers that participated in this study (n = 9) compared to previous studies (n = 39, Dixon et al., 2017; n = 26, Dixon et al., 2019b) which may have accounted for the failure to replicate the following findings. We failed to replicate previous studies showing a positive correlation between dark flow during slots play and depression outside of the gambling context. We also failed to show that dark flow was associated with problem gambling severity—a finding we have replicated in a number of studies (Dixon et al., 2017, 2019a, 2019b).

In conclusion, it seems that slot machines are capable of reining in the wandering mind and facilitating positive affect by providing the gambler with frequent reinforcing feedback. In environments that induce negative affect, it appears that problem gamblers may use deliberate mind-wandering as a means of attempting to cope with their current situation. Bored (and likely depressed) individuals may use slots to modulate their arousal levels and seek relief from the frequent (yet unpredictable) reinforcement during slots play. This complex relationship between problem gambling, mindfulness problems in everyday life, depression, and boredom may further help explain why some individuals are susceptible to, and ultimately negatively impacted by the slot machine zone.

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