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Joint Effects of Impulsive and Self-Regulatory Process on Gambling Frequency

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Abstract

Dual process models propose that behaviour is influenced by the interactive effect of *impulsive* (i.e., automatic or implicit) and *self-regulatory* (i.e., controlled or explicit) processes. Recently, evidence from the alcohol literature demonstrates that the impulse to engage in risky behaviour is mitigated by a high *capacity* to self-regulate. The current study aimed to extend this model to behavioural addictions, namely frequent gambling behaviour. It was hypothesized that impulsive processes favouring gambling (positive implicit gambling cognition) would predict frequent gambling, but only if the capacity to self-regulate was low. A treatment-seeking sample of 57 adults with problem gambling ($M_{age} = 45.20$ years, 54% men) completed two Single Category Implicit Association Tests, one reflecting tension-reduction, and the other enhancement, implicit gambling cognition. Participants also completed self-report measures of past week gambling frequency and the Gambling Abstinence Self-Efficacy Scale, which provided a measure of the self-regulatory capacity to abstain from gambling when emotionally aroused. Controlling for age and gender, consistent with hypotheses, implicit tension reduction gambling cognition positively predicted gambling frequency at low ($p = .046$) but not at high ($p = .191$) self-efficacy for gambling abstinence when feeling emotionally bad. However, self-efficacy for gambling abstinence when feeling emotionally good was not supported as a moderator of the effect of implicit enhancement gambling cognition on gambling frequency. Results suggest that the cognitions inherent in the impulsive process leading to frequent gambling are tension reduction or escape-related. Furthermore, emotionally relevant nuances to the ability to self-regulate gambling do exist; these nuances may contribute to both risk model specificity and interventions.

Keywords: frequent gambling, implicit cognition, self-regulation

Résumé

Les modèles à doubles processus indiquent que le comportement est influencé par l'effet interactif de processus impulsifs (c'est-à-dire, automatiques ou implicites) et autorégulateurs (c'est-à-dire contrôlés ou explicites). Récemment, des preuves tirées de la littérature sur l'alcool démontrent que l'impulsion à s'engager dans des comportements à risque est contrebalancée par une forte capacité d'autorégulation. La présente étude visait à étendre ce modèle aux dépendances comportementales, à savoir le comportement de jeu fréquent. On a émis l'hypothèse que des processus impulsifs favorisant le jeu (cognition de jeu implicite positive) pourraient laisser présager un jeu fréquent, mais seulement si la capacité d'autorégulation était faible. Un échantillon de 57 adultes aux prises avec problème de jeu compulsif (moyenne = 45,20 ans, 54 % d'hommes) a effectué deux tests d'association implicites à catégorie unique, l'un reflétant la réduction de tension et l'autre, la cognition de jeu implicite. Les participants ont également rempli des une auto-évaluation de la fréquence de jeu de la semaine qui précédait et l'échelle d'auto-évaluation de l'abstinence (*Gambling Abstinence Self-Efficacy Scale*), qui mesure la capacité de s'abstenir de jouer lorsque l'émotion est forte. En contrôlant l'âge et le sexe, et à la lumière des hypothèses, la cognition de jeu implicite prédit positivement une faible auto-efficacité liée à la fréquence de jeu ($p = 0,046$) et non pas une haute auto-efficacité ($p = 0,191$) pour ce qui est de l'abstinence au jeu en situation d'émotion négative. Cependant, l'auto-régulation pour s'abstenir de jouer lorsqu'on se sent émotionnellement bien n'était pas considérée comme un modérateur de l'effet de la cognition de jeu implicite sur la fréquence de jeu. Les résultats suggèrent que les cognitions inhérentes au processus impulsif conduisant à un jeu fréquent sont la réduction de tension ou l'évasion. De plus, il existe des nuances pertinentes sur le plan émotionnel à la capacité d'auto-réglementer le jeu; celles-ci peuvent contribuer à la fois à la spécificité du modèle de risque et aux interventions.

Introduction

Problem gambling is a serious concern in Canada. The prevalence of problem gambling is 1–3% in the general population (Cox, Yu, Afifi, & Ladouceur, 2005) and this rate greatly increases among clinical populations (e.g., 10–14% in people with psychiatric illnesses) (Kessler et al., 2008; Nehlin, Grönbladh, Fredriksson, & Jansson, 2013). Mainstream and scientific reports show clearly that problem gambling is associated with several personal problems (e.g., increased suicidality) and societal harms (e.g., increased criminal activity to support gambling activities) (Blaszczynski & Nower, 2002; Stewart & Zack, 2008). Accordingly, more research is needed to identify central predictors of gambling and associated harms. A focus on

malleable factors, such as cognitive processes, may have particular clinical utility in the treatment of problem gambling.

Cognitive theories of addiction posit that gambling is a learned, goal-directed behaviour (e.g., Bandura, 1977; Griffiths, 1994). Over time and through experience, individuals are thought to form associations with gambling in memory, and these associations are thought to influence subsequent gambling behaviour. To illustrate, individuals may form positive associations with gambling—such as that gambling reduces tension, or that gambling enhances positive mood (Brevers et al., 2013; Evans & Coventry, 2006). In turn, when in situations associated with negative and positive emotions, respectively, these cognitions are activated, and increase the likelihood of gambling behaviour (Stewart & Zack, 2008; Zack, Stewart, Klein, Loba, & Fragopoulos, 2005). Accordingly, cognitive processes are conceptualized as *in the moment* or proximal predictors of gambling behaviour.

Dual process models provide a useful framework for understanding how cognitive processes influence addictive behaviour, including gambling (Stacy & Wiers, 2010). These models state that both automatic and controlled cognitive processes influence addictive behaviour. Automatic cognitive processes are commonly measured using implicit reaction time tasks (e.g., the Implicit Association Test [IAT]) (Greenwald, McGhee, & Schwartz, 1998; O'Connor, Lopez-Vergara, & Colder, 2012) and are thought to give rise to addictive behaviour via a cue-activated or impulsive process (Houben & Wiers, 2007). In contrast, controlled cognitive processes are often measured using explicit self-report measures and reflect cognitions that exert self-regulatory influences on addictive behaviour (Stewart & Zack, 2008). Indeed, research has shown that both automatic and controlled cognitive processes have unique effects on addictive behaviour (Stacy & Wiers, 2010), including problem gambling (Brevers et al., 2013; Florez et al., 2016; Stewart, M. J., Stewart, S. H., Yi, & Ellery, 2015).

Theoretical advances within the alcohol use literature show that there are different perspectives on how to conceptualize (and test) the influences of impulsive and self-regulatory cognitions on addictive behaviour. Traditionally, research in this area has taken an either/or approach, which pits these cognitions against each other (often in the same model) to examine how each independently predicts alcohol misuse (Reich, Below, & Goldman, 2010). The inherent goal of this approach is to identify which of these processes is a better predictor of alcohol use. For example, it has often been argued that impulsive processes should be most pivotal to spontaneous and risky drinking (e.g., Strack & Deutsch, 2004). This either/or approach has also been used frequently in the gambling literature (e.g., Brevers et al., 2013; Florez et al., 2016; Stewart, M. J. et al., 2015). However, emerging evidence suggests that it is erroneous to view addictive behaviour as guided simply by either impulsive *or* self-regulatory cognitions (Wiers et al., 2007). Rather, contemporary dual-process perspectives state that the interactive effects of these cognitive processes are important determinants of addictive behaviour (Stacy & Wiers, 2010). Notably, one emerging finding is that the effect of impulsive cognitive processes favouring alcohol misuse is present only if an

individual has a weak capacity to self-regulate, which is a controlled process (Grenard et al., 2008; Saleminck & Wiers, 2014; Thush et al., 2008; van Hemel-Ruiter, de Jong, Ostafin & Oldehinkel, 2015). We speculate that these interactive effects may also be highly relevant to problem gambling. To illustrate, when in an emotionally distressing situation, an individual with strong tension reduction implicit gambling cognition may be at risk for gambling and associated harms, but only if they lack the controlled ability to self-regulate in that situation. To our knowledge, the interactive effects of impulsive and self-regulatory cognitive processes have yet to be examined in behavioural addictions, such as problem gambling.

The goal of the present study was to examine the interactive effects of impulsive and self-regulatory cognitive processes on gambling frequency. These effects were examined in a sample of treatment-seeking problem gamblers. Based on contemporary dual-process models in the alcohol use literature (Stacy & Wiers, 2010; Wiers et al., 2007), we examined self-regulatory ability as a moderator of the effect of impulsive cognitive processes on gambling behaviour. We examined the effects of two types of impulsive processes, tension reduction and enhancement implicit gambling cognitions, on gambling behaviour. Self-regulatory capacity was assessed using a measure of individuals' perceived self-efficacy for abstaining from gambling (an effortful, self-regulatory process) in two contexts: when experiencing negative emotions and when feeling positive emotions (May, Wheland, Steenbergh, & Meyers, 2003). We predicted that implicit tension reduction gambling cognition would predict increased gambling frequency, but only when perceived self-efficacy for abstinence in emotionally distressing situations was low. In contrast, implicit enhancement gambling cognition was expected to predict increased gambling frequency, but only when perceived self-efficacy for abstinence in emotionally pleasant situations was low.

Method

Participants and Procedure

Participants were 57 treatment-seeking problem gamblers ($M_{age} = 45.20$ years; $SD_{age} = 17.76$, 54% men) who were recruited for a larger study evaluating a novel intervention for problem gamblers called *BEAT Gambling* (Stewart, et al., 2016). Inclusion criteria for the larger study were (a) scoring ≥ 3 on the Problem Gambling Severity Index (PGSI) from the Canadian Problem Gambling Index (CPGI) (Ferris & Wynne, 2001); (b) 19 years of age or older, and (c) at least one gambling activity within the past 2 months. Exclusion criteria were: (a) currently in treatment for gambling problem; (b) history of other disorder(s) that might interfere with ability to benefit from cognitive behavioural treatment for problem gambling (e.g., neurological disorder, mental retardation); and (c) inability to read. Pre-screening for these inclusion/exclusion criteria was completed via phone. Eligible participants were invited to complete an in-person intake session for the treatment study during which all measures for the current study were administered. Total scores on the PGSI for the 57 participants in the current study ranged from 4–26 ($M = 14.84$; $SD = 5.62$)

indicating a high level of gambling problems, on average. Moreover, the majority of the treatment sample (68%) reported that electronic gambling machine (EGM) play was their most preferred gambling activity. The Health Sciences Research Ethics Board at Dalhousie University approved all study procedures.

Measures

The measures employed in the current study were the Single Category Implicit Association Test (SC-IAT) (Karpinski & Steinman, 2006), the Gambling Abstinence Self-Efficacy Scale (GASS) (Hodgins, Peden, & Makarchuk, 2004), and the Gambling Activity Screen (GAS) (Doiron & Nicki, 2007).

Single Category Implicit Association Test (SC-IAT). Two variants of the SC-IAT (Karpinski & Steinman, 2006) were used to capture tension-reduction and enhancement implicit gambling cognition. The SC-IAT is computerized and participants are asked to categorize stimuli from a single object category (i.e., gambling pictures) and words from contrasting evaluative dimensions (e.g., calming words [e.g., “quiet,” “restful,” and “soothing”] and bad words [e.g., “brutal,” “disaster,” and “gross”]). The pictures chosen to depict gambling were images of EGM screens (see Figure 1 for sample images) given that this was the most commonly reported preferred gambling activity in our sample. The SC-IAT began with two sets of 24 practice trials, a test block of 72 trials, another set of 24 practice trials, followed by another test block of 72 trials (see Table 1). In block one (practice), calming and bad words were paired with the left and right keys, respectively. In block two (practice), gambling pictures were paired with the response key for the calming words (left key) and the bad words remained on the separate response key (right key). Block three (test) was identical to block two. In block four (practice), the gambling pictures were switched so that they were paired with the response key for bad words (right key) and the calming words were on a different response key (left key). Block five (test) was identical to block four. If participants more easily paired gambling stimuli with calming words in block three (vs. with bad words in block five), then they are said to have strong tension-reduction associations for gambling. An analogous SC-IAT was used to capture implicit enhancement gambling cognition; in this case the contrasting evaluative dimensions were excitement words (e.g., “arousal,” “cheerful,” and “thrilling”) vs. bad words. For the two versions of the SC-IAT, the bad words were drawn from Karpinski and Steinman (2006), while the calming and exciting words were drawn from Yi and Kanetkar (2010).

While there are multiple variants of the IAT, the SC-IAT is advantageous for measuring associations for object categories that do not have a natural “opposite,” such as gambling (see Karpinski & Steinman, 2006, for a full rationale). Also, the bivalent nature of evaluative dimensions in our SC-IAT (“positive [calming/excitement]” vs. “bad”) has ecological validity for assessing gambling attitudes because gambling contexts can be associated with positive and negative outcomes. D-scores were calculated according to the recommended procedures by Greenwald, Nosek, & Banaji (2003). D-scores were used to quantify the strength of



Figure 1. EGM Gambling images for the SC-IAT calming and exciting trials

Table 1
Block Content for the Single Category Implicit Association Tests

<i>Gambling Calming Single Category Implicit Association Test</i>				
Block	Task	Trials	Left Key	Right
1	Practice	24	Calming words	Bad words
2	Practice	24	Calming words + Gambling images	Bad words
3	Test	72	Calming words + Gambling images	Bad words
4	Practice	24	Calming words	Bad words + Gambling images
5	Test	72	Calming words	Bad words + Gambling images
<i>Gambling Exciting Single Category Implicit Association Test</i>				
Block	Task	Trials	Left Key	Right
1	Practice	24	Exciting words	Bad words
2	Practice	24	Exciting words + Gambling images	Bad words
3	Test	72	Exciting words + Gambling images	Bad words
4	Practice	24	Exciting words	Bad words + Gambling Images
5	Test	72	Exciting words	Bad words + Gambling Images

tension-reduction and enhancement gambling implicit associations. In our sample, the internal consistencies for the tension reduction SC-IAT was .65 and was .54 for the enhancement SC-IAT.

Gambling Abstinence Self-Efficacy Scale (GASS) (Hodgins et al., 2004). The GASS was used to capture perceived self-efficacy for abstaining from gambling in two contexts. Specifically, participants are asked to rate their ability to abstain from gambling in situations involving *positive emotions* (3-items; $\alpha = .65$) and *negative emotions* (9-items; $\alpha = .91$). Responses were captured on a 5-point scale, ranging from 0 = not confident at all, to 5 = extremely confident. Sum scores were used for each subscale.

Gambling Involvement. A modified version of the Gambling Activities Screen (GAS) (Doiron & Nicki, 2007) was used to assess gambling behaviour over the past seven days. Participants were asked about their *gambling frequency* (i.e., number of discrete gambling episodes) in the last week; reporting more than one episode per day was permissible. Previous research shows that this type of self-report is a valid and reliable indicator of gambling involvement (Gooding & Tarrier, 2009).

Data Analytic Procedure

Moderated regression analyses were used for hypothesis testing (Aiken & West, 1991). Predictor variables (SC-IAT scores and self-efficacy measures) were centered prior to creating interaction terms to reduce multicollinearity. Supported moderation effects were followed by simple slopes analyses. The simple slopes of implicit gambling cognitions predicting gambling behaviour were conditioned at high (+1 *SD*) and low

(-1 *SD*) values from the centered mean of self-efficacy (the moderator). This procedure allowed us to test interactions continuously and is the most widely used framework to test hypotheses related to moderation (Aiken & West, 1991).

Results

Data Screening, Descriptive Statistics, and Bivariate Correlations

Data were screened prior to correlational analyses, and hypothesis testing (Kline, 2009; Wilkinson, 1999). All variables had normal distributions and there were no missing cases. Descriptive statistics and bivariate correlations are presented in Table 2. On average, problem gamblers in our sample reported 5.52 discrete gambling episodes in the past week on the GAS (range = 0–17 episodes). Consistent with dual-process models, SC-IAT implicit cognition measures and measures of perceived self-efficacy for gambling abstinence were uncorrelated. These cognitive processes were also uncorrelated with gambling frequency. This finding is not surprising, given that contemporary dual-process models (e.g., Wiers et al., 2007) predict that impulsive and self-regulatory processes interact to predict gambling risk.

Hypothesis Testing

Moderated regressions were used to test hypotheses. First, gambling frequency from the GAS was regressed on age and gender (covariates), the two cognitive predictors of interest (SC-IAT implicit tension reduction gambling cognition, and self-efficacy for gambling abstinence when feeling negative), and their interaction term. As observed in Table 3, no main effects were supported, but the interaction term was statistically significant in predicting frequency of gambling behaviours in the past week. The interaction term accounted for an additional 8.8% of the variance in gambling frequency, above and beyond the covariates and main effects. As expected, follow-up simple slopes analyses (see Figure 2) showed that tension reduction implicit cognition was associated with increased frequency of gambling, but only when perceived self-efficacy for abstinence when feeling negative was low ($b = 7.25$, $t_{(51)} = 2.05$, $p = .046$, $f^2 = .09$). No statistically significant effect was observed at high

Table 2
Descriptive Statistics and Bivariate Correlations

	1.	2.	3.	4.	5.
1. SC-IAT: Tension Reduction Implicit Cognition	-	.31*	.01	-.03	.04
2. SC-IAT: Enhancement Implicit Cognition		-	-.20	-.25	.22
3. Self-efficacy for Gambling Abstinence when feeling negative			-	.56*	-.02
4. Self-efficacy for Gambling Abstinence when feeling positive				-	-.11
5. Gambling frequency					-
M	-0.09	0.08	19.01	6.35	5.52
SD	0.29	0.29	11.52	4.02	4.77

Note. * $p < .01$

Table 3
Interactive Effects of Implicit Cognition and Self-Efficacy for Gambling Abstinence on Gambling Frequency

Predictors	<i>B</i>	<i>SE</i>	β	<i>R</i> ² change	<i>t</i>	<i>p</i>
Gambling Frequency (criterion)						
Gender	-2.37	1.41	-0.24		-1.68	.10
Age	-0.08	0.04	-0.27		-2.04	.05
				.103		
SC-IAT: Tension Reduction Implicit Cognition	1.33	2.31	0.08		0.58	.57
Self-Efficacy for Gambling Abstinence when feeling negative	-0.04	0.06	-0.08		-0.62	.54
				.009		
SC-IAT: Tension Reduction Implicit Cognition X Self-Efficacy for Gambling Abstinence when feeling negative	-0.51	0.23	-0.30		-2.25	.03
				.088		
Gambling Frequency (criterion)						
Gender	-1.79	1.34	-0.18		-1.33	.19
Age	-0.06	0.04	-0.23		-1.61	.11
				.103		
SC-IAT: Enhancement Implicit Cognition	3.55	2.41	0.22		1.47	.15
Self-Efficacy for Gambling Abstinence when feeling positive	-0.09	0.17	-0.07		-0.51	.62
				.045		
SC-IAT: Enhancement Implicit Cognition X Self-Efficacy for Gambling Abstinence when feeling positive	-0.51	0.71	-0.10		-0.72	.48
				.009		

Note. Age and gender were covariates in models.

self-efficacy ($b = -4.57, t_{(51)} = -1.33, p = .191, f^2 = .04$). The variance explained by the full model (covariates, main effects, and the interaction term) was 20% (95% *CI* [.02, .37]).

Next, an analogous regression was conducted to examine the effects of implicit enhancement gambling cognition on gambling behaviour, as moderated by self-efficacy to abstain from gambling when feeling good. Gambling frequency was regressed on age and gender (covariates), the two cognitive predictors of interest (SC-IAT implicit enhancement gambling cognition, and self-efficacy for gambling abstinence when feeling positive), and their interaction term (see Table 3). No main effects were found and contrary to the hypothesis, the interaction term was not statistically significant. In fact, the interaction accounted for less than 1% of additional variance above covariates and main effects. This suggests that the effect of implicit enhancement gambling cognition on gambling behaviour was not moderated by self-efficacy for gambling abstinence when feeling positive. The variance explained by the full model was 15% (95% *CI* [.02, .35]).

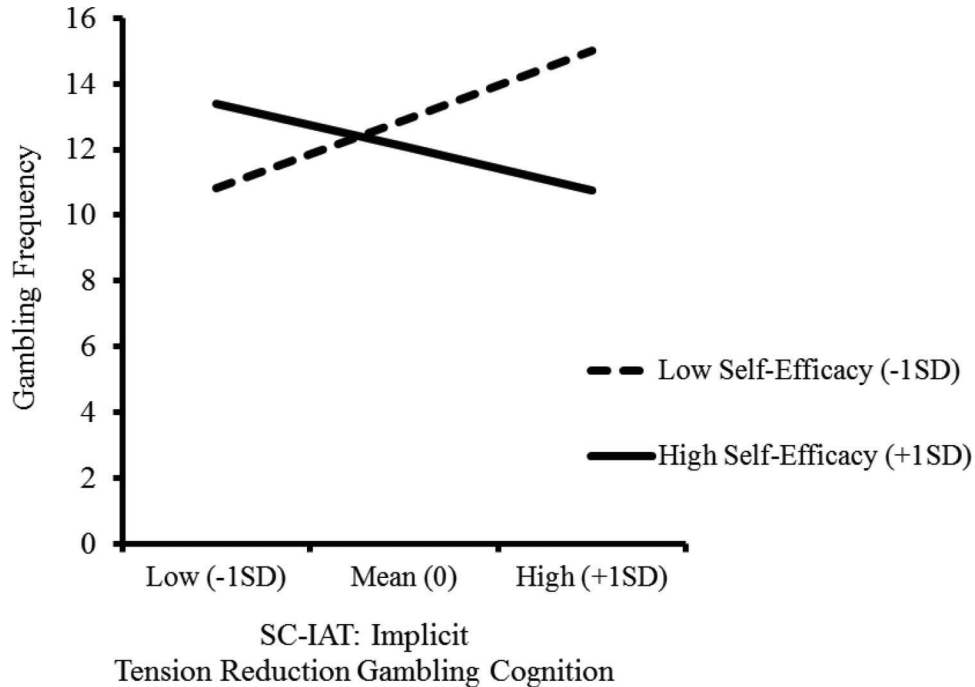


Figure 2. Simple Slopes for Tension Reduction Cognition Predicting Gambling Frequency at High and Low Self-Efficacy for Gambling Abstinence when experiencing Negative Emotion

Finally, we ran two multiple regressions to provide discriminant validity for the effects found above. Cognitive models of addiction suggest that implicit tension reduction and enhancement cognition should be particularly relevant (and strongly activated) in situations associated with the experience of negative and positive emotions, respectively. That is, an individual should not be at risk for gambling for tension reduction purposes when experiencing positive mood. Likewise, someone with strong enhancement implicit cognition should not activate these cognitions strongly when feeling emotionally bad. Accordingly, we would not expect self-efficacy to moderate the associations between implicit cognition and gambling frequency if the affective valence of the situation is incongruent with the valence of the implicit cognition. Accordingly, regression analysis did not support self-efficacy for gambling abstinence when feeling emotionally positive as a moderator of the effects of tension reduction implicit gambling cognition on gambling frequency ($p = .84$; $R^2 = .12$). Similarly, an additional regression analysis did not support the moderating role of self-efficacy for gambling abstinence when feeling emotionally negative on the effect of enhancement implicit cognition and gambling frequency ($p = .13$; $R^2 = .18$).

Discussion

The main goal of the present study was to examine the interactive effects of impulsive and self-regulatory cognitive processes on gambling frequency in a sample of treatment-seeking problem gamblers. Informed by contemporary dual-process

models of addiction (i.e., Stacy & Wiers, 2010; Wiers et al., 2007), we tested the prediction that perceived self-regulatory ability would moderate the influence of impulsive processes on gambling involvement. While these effects have been studied widely in the alcohol misuse literature (e.g., Thush et al., 2008; van Hemel-Ruiter et al., 2015; Wiers et al., 2007), the interaction of impulsive and self-regulatory processes had yet to be explicitly modelled in problem gambling. Overall, results provided partial support for our hypotheses. We found that strong tension reduction implicit gambling cognitions predicted increased gambling frequency, but only when one's perceived self-efficacy for abstaining from gambling when experiencing negative emotions was low. Apart from the main interactive effect of interest, we did not find support for first order effects of either tension reduction implicit gambling cognitions or self-efficacy on gambling frequency. Results did not support the role of enhancement implicit gambling cognition (at either the zero-order level or as moderated by self-efficacy) in predicting gambling frequency. Our findings suggest that the impulsive and self-regulatory processes that drive frequent gambling are tension reduction or escape-related.

We used a questionnaire to assess one's perceived ability to self-regulate, which holds utility for understanding how cognitive processes relate to gambling. The literature shows that self-efficacy is related strongly to motivation and one's ability to control behaviours in personally risky situations (Hendershot, Witkiewitz, George, & Marlatt, 2011). Both motivation and ability are central controlled processes in contemporary dual process models of addiction (Wiers et al., 2007). In fact, level of perceived self-efficacy is thought to be a central predictor of relapse risk among those treated for addictive behaviours (Hendershot et al., 2011). Informed by this, one could argue that self-efficacy is an important controlled cognitive process—one that captures the motivation and perceived ability to regulate behaviour in situations that pose a high level of risk (e.g., being able to resist strong urges to gamble when feeling sad). However, we should note that our measurement of self-regulation ability differs from extant dual-process studies testing interacting cognitive processes. Specifically, contemporary dual process studies tend to quantify self-regulation capacity using objective measures of executive functioning (e.g., working memory and/or inhibitory control) (e.g., Wiers, Eberl, Rinck, Becker, & Lindenmeyer, 2011). These studies show that strong implicit cognitive processes predict increased addictive behaviours, but only when executive functioning is low (Grenard et al., 2008; Saleminck & Wiers, 2014; Thush et al., 2008; van Hemel-Ruiter et al., 2015). Despite using a questionnaire measure of perceived self-regulatory capacity, our findings converge nicely with those of studies using objective self-regulatory measures. This provides promising initial support for interacting cognitive risk for problem gambling, which should be replicated in future studies using more objective measures of self-regulation ability.

Consistent with cognitive and social learning perspectives of addiction (Bandura, 1977; Griffiths, 1994), our results suggest that *context* (and related self-efficacy) may also contribute to coping-motivated problem gambling. Relative to more social forms of gambling (e.g., playing card games in a casino and/or with friends), some gambling activities, such as EGM play and online poker, are primarily solitary.

Our sample, in particular, reported that EGM play was their most preferred gambling activity. Social learning theories suggest that solitary gambling is a key mechanism in coping-motivated pathways to addictive behaviour (Bandura, 1977; Keough, Battista, O'Connor, Sherry, & Stewart, 2015; Keough, Wardell, Hendershot, Bagby, & Quilty, 2016). Specifically, individuals who are prone to high levels of negative affect (e.g., depression, and social anxiety) may isolate and spend less time around others. In turn, being alone is likely to give rise to even higher levels of negative affect and rumination or worry. Accordingly, theory predicts that being alone is a context that may increase the salience of the negatively reinforcing effects of gambling behaviour. Over time, it is believed that those who isolate and experience high levels of negative affect come to associate solitary gambling with emotional relief. This may result in the strengthening of tension reduction implicit cognitions, which then become activated and motivate more frequent gambling in solitary contexts. Moreover, being alone (and feeling emotionally bad) is likely to become a specific context associated with poor self-efficacy to abstain from gambling among those who struggle with high levels of negative affect. We were unable to examine the specific role of solitary gambling in our models, but this will be an important avenue for future research.

Overall, a main strength of our study is that we tested a theoretically-informed cognitive model of frequent gambling in a sample of treatment-seeking individuals with problem and/or pathological gambling. However, there are some relevant limitations to acknowledge. First, we had a relatively small sample size, which may have reduced our power to detect moderation effects. Accordingly, future work should replicate our findings with larger samples. Second, we were unable to examine gender-specific effects due to limited sample size. It will be important for future work to explore gender differences, given some literature showing that men seem to be at most risk for excessive gambling and associated harms (Bentall, Fisher, Kelly, Bromley & Hawksworth, 1989; Griffiths & Minton, 1997). Third, another potential limitation was that the SC-IAT used only EGM images as the gambling stimuli, which may have made the task more relevant to some gamblers than to others. It should be noted, however, that the selection of this stimuli was based on the fact that the majority of participants endorsed EGM play as their most preferred gambling activity. Similar to the effects found in the alcohol-use literature, we would also expect non-preferred gambling stimuli to activate implicit associations (O'Connor et al., 2012; Stacy & Wiers, 2010). Nevertheless, future studies should try to extend the present findings by employing other types of SC-IAT gambling stimuli (e.g., poker, roulette). Another potential limitation was that the internal consistency of the GASS Self Efficacy in positive situations scale was below the typical cutoff of 0.70 so the measurement error may have contributed to the failure to observe a significant interaction with this scale. Nonetheless, the alpha was above the cutoff for short scales and this scale was only three items. A similar limitation concerns the suboptimal internal consistencies of the SC-IAT used to capture implicit gambling associations. One final potential limitation was that the assessment of gambling frequency occurred within a relatively short time frame (i.e., past week) before treatment. It is possible that some participants may have already attenuated their

gambling behaviour, in anticipation for therapy in the larger study. This being said, we observed good variability in gambling frequency, which was our main outcome.

Our findings have clinical implications for the treatment of problem gambling. Our data suggest that frequent gambling is not a behaviour that is simply governed by strong impulses. This is in contrast to a popularized clinical perspective of problem gambling as a disease that is beyond an individual's control (e.g., Gambler's Anonymous). Our findings suggest that level of self-efficacy is an important contributing factor to the effect of impulsive processes on coping-related gambling. We found that tension reduction implicit gambling cognition predicted more frequent gambling activities, but only when one's self-efficacy for abstaining in negative affect situations was low. Clinically, this would suggest that self-efficacy for gambling abstinence—specifically when feeling emotionally bad—could be a viable target during treatment. If clinicians can work to improve self-efficacy among coping-motivated gamblers, then this may mitigate the influence of impulsive processes on frequent gambling and associated harms. Moreover, clinicians should also work with frequent gamblers to foster more effective coping strategies to manage high levels of negative affect.

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