Journal of Gambling Issues
Issue 34, December 2016

http://igi.camh.net/doi/pdf/10.4309/jgi.2016.34.7
DOI: http://dx.doi.org/10.4309/jgi.2016.34.7

Special Issue: *JGI* Scholar's Award, Category B

The Role of Memory Associations in Excessive and Problem Gambling

Morgann Stiles,[1] Amanda Hudson,[1] Cynthia Ramasubbu,[1] Susan Ames,[2] Sunghwan Yi,[3] Karen Gough,[3] & Sherry H. Stewart[1,4]

[1] Department of Psychology and Neuroscience, Dalhousie University, Halifax, NS, Canada
[2] School of Community & Global Health, Claremont Graduate University, Claremont, CA, USA
[3] Department of Marketing & Consumer Studies, University of Guelph, Guelph, ON, Canada
[4] Department of Psychiatry, Dalhousie University, Halifax, NS, Canada

Abstract

Outcome expectancies (OEs), or beliefs about the consequences of engaging in a particular behaviour, are important predictors of addictive behaviours. In Study 1 of the present work, we assessed whether memory associations between gambling and positive outcomes are related to excessive and problem gambling. The Gambling Behaviour Outcome Association Task (G-BOAT) was administered to a sample of 96 community-recruited gamblers. On the G-BOAT, participants responded to a list of positive outcome phrases with the first two behaviours that came to mind. Those with more problematic gambling (as measured on the Problem Gambling Severity Index) and greater gambling involvement (as measured by time and money spent gambling on the Gambling Timeline Followback) responded to positive outcome phrases on the G-BOAT with more gambling-related responses. In Study 2, we administered G-BOAT to a community-recruited sample of 61 gamblers, who also completed a computerized reaction time measure of implicit gambling OEs, an explicit self-report measure of gambling OEs, and a measure of gambling frequency. Consistent with Strack and Deutch's (2004) reflective-impulsive model, memory associations on the G-BOAT and positive OE scores on the explicit Gambling Expectancy Questionnaire each predicted unique variance in frequency of gambling behaviour. These studies are among the first to demonstrate the important role of memory associations in excessive and problem gambling.

Keywords: gambling, outcome expectancies, implicit cognitions, explicit cognitions

Résumé

Les résultats escomptés (RE), c'est-à-dire la croyance dans les conséquences d'un comportement donné, constituent une importante variable explicative des comportements liés à la dépendance. L'étude 1 a évalué si des associations mémorielles entre le jeu et des résultats positifs sont reliées aux problèmes de jeu compulsif. La tâche d'association de résultats découlant de comportements liés au jeu (Gambling Behaviour Outcome Association Task [G-BOAT]) a été administrée à un échantillon de 96 joueurs recrutés au sein de la collectivité. Dans le cadre de la G-BOAT, une liste de locutions exprimant un résultat positif était présentée aux participants et ceux-ci devaient répondre en indiquant pour chacune des locutions les deux premiers comportements qui leur venaient à l'esprit. Ceux qui présentaient un problème de jeu plus grave (selon l'indice de jeu problématique) et qui s'adonnaient davantage au jeu (selon le suivi du temps passé à jouer et de l'argent dépensé effectué à l'aide de l'outil Gambling Timeline Followback) ont donné des réponses liées au jeu plus fréquemment que les autres. Dans le cadre de l'étude 2, la G-BOAT a été administrée à un échantillon de 61 joueurs recrutés au sein de la collectivité. Ceux-ci ont en outre fait l'objet d'une mesure informatisée du temps de réponse (TR) pour les RE liés au jeu implicites, d'une autoévaluation des RE liés au jeu explicites et d'une mesure de la fréquence des comportements liés au jeu. Conformément au modèle de réflexion et impulsion de Strack et Deutch (2004), les associations mémorielles obtenues dans le cadre de la G-BOAT et les résultats relatifs aux RE positifs obtenus dans le cadre du questionnaire sur les attentes quant au jeu ont dans les deux cas permis de prévoir une variance unique concernant la fréquence des comportements liés au jeu. Ces études fournissent ainsi un premier ensemble de données probantes relativement à l'importance des associations mémorielles dans l'apparition des problèmes de jeu compulsif.

General Introduction

Outcome expectancies (OEs) are the beliefs an individual holds about the consequences of engaging in a particular behaviour (Leigh, 1989). These OEs can be either positive or negative. For example, a gambler might believe that engaging in gambling will result in feelings of excitement (a positive OE) or that gambling behaviour will lead to feelings of shame (a negative OE). OEs have been frequently studied in relation to a variety of forms of substance misuse. In alcohol research, OEs have been found to contribute to alcohol use, drunkenness, and binge drinking (Dieterich, Stanley, Swaim, & Beauvais, 2013). Positive OEs have a larger impact on hazardous alcohol use than do negative OEs and have a causal role in predicting drinking (i.e., Zamboanga, Horton, Leitkowski, & Wang, 2006). Such findings regarding the importance of OEs in the substance abuse field have led researchers to suggest that OEs may also be important in understanding gambling behaviour (Stewart, Yi, & Stewart, 2014), given the similarities between substance abuse and problem gambling as addictive behaviours (American Psychiatric Association, 2013; Potenza, 2006).

In gambling research, OEs have been measured both directly and indirectly with explicit and implicit cognitive tasks, respectively. In assessing explicit cognitions, individuals are asked to directly introspect about causes or correlates of their behaviour. These types of assessments often involve self-report measures of beliefs, attitudes, and expectancies and are believed to accurately reflect cognitive processes that may govern behaviour. However, given that individuals may take time to consciously and deliberatively reflect on their behaviour, it is possible to control or filter responses (Latu et al., 2011; Renner, Gula, Wertz, & Fritzsche, 2014). In contrast, implicit measures tap into thoughts or cognitive processes that do not require an individual's conscious awareness (DeHouwer, 2006). These measures of cognition tap into automatically activated cognitive processes influenced by past experience through means that circumvent conscious deliberation. Hence, implicit measures involve indirect assessments of behaviour that assess relatively non-reflective cognitive processes revealed when an individual applies previously acquired knowledge without awareness. It may be useful to assess both explicit and implicit cognitions, given their theoretical independence.

As outlined in the reflective-impulsive model of Strack and Deutsch (2004), behaviour is controlled by distinct, but interacting, systems: the reflective system and the impulsive system. The reflective system involves conscious decision processes assessed with explicit measures, whereas the impulsive system involves more unconscious associative processes assessed with implicit measures. Both of these cognitive processes are said to independently affect behaviour (Strack & Deutsch, 2004).

To tap into the impulsive system and index associative processes, in the current set of studies, we used an OE measure from the substance use literature and adapted it for use with gamblers, the Gambling Behaviour Outcome Association Task (G-BOAT). The original BOAT was developed for alcohol research: Stacy, Leigh, and Weingardt (1994) theorized that repeated pairings of alcohol use behaviour with positive outcomes lead to those associations being more readily accessible in memory. Consistent with this prediction, Stacy and colleagues (1994) showed that more alcohol-related responses generated on the BOAT were associated with greater self-reported alcohol use. This finding was replicated and extended in a prospective study, with more alcohol-related responses on the BOAT predicting future alcohol use (Stacy, 1997).

Consistent with the original alcohol BOAT, participants completing the G-BOAT are instructed to read outcome phrases (some potentially associated with gambling) and respond quickly with the first behaviours or actions that come to mind. No mention of the target behaviour appears in the instructions. Thus, the task allows for free competition among behavioural associates of the ambiguous outcomes presented. Any outcome that has previously been associated with a behaviour (e.g., having fun while gambling) is expected to elicit a related response from memory. These associations may be activated by the presentation of an expected outcome, even without the individual's conscious awareness of this association. If an individual repeatedly achieves a given outcome by engaging in a particular behaviour, then the memory association between the behaviour and the outcome is strengthened and should become highly accessible. Memory associations are established and strengthened through repetitive experiences with a target behaviour (Stacy, 1995, 1997), and the strength of established associations between a behaviour (e.g., gambling) and its outcomes determines whether a gambling-consistent cognitive state is easily activated (Stacy, 1995, 1997). After gambling-consistent associations are established, desiring a particular outcome (e.g., having fun) may automatically activate thoughts about gambling behaviour and elicit associated patterns of behaviour.

The G-BOAT requires automatic thought by requesting immediate associations (much like Jung's free-association procedure; Jung & Von Franz, 1964). The task is an indirect measure of behaviour-specific associations, tapping into associations between possible behavioural outcomes and a target behaviour—in this case, between gambling behaviour and positive outcomes (i.e., how readily gambling behaviours come to mind when presented with a potential gambling-related outcome).

In the present project, the G-BOAT was used in a set of two studies that are among the first to investigate the role of memory associations in excessive and problematic gambling. In Study 1, we investigated relations between (a) memory associations between gambling and gambling-related outcomes on the G-BOAT and (b) time and money spent gambling, as well as gambling problems. In Study 2, we determined whether the G-BOAT explained unique variance in gambling frequency, after we accounted for variance explained by an explicit self-report measure of gambling OEs. We also calculated variance in gambling frequency that was jointly contributed by G-BOAT and explicit gambling OE measures, thereby demonstrating the shared and distinct predictive utility of automatic memory associations and explicit OEs. As a secondary aim in Study 2, we examined the correlation between G-BOAT scores and reaction times (RTs) on another implicit measure of gambling OEs (the Affective Priming Task), as well as the explicit self-report measure of gambling OEs.

Study 1

Versions of the BOAT have been previously used to study the role of memory associations in substance use. For example, Stacy et al. (1994) showed that alcohol-related BOAT responses were associated with alcohol use, with the number of alcohol-related responses generated on the BOAT showing a positive correlation with frequency of self-reported alcohol use. A version of the BOAT was also developed for use in marijuana research (i.e., the M-BOAT). Responses on the M-BOAT were found to be a strong, independent predictor of marijuana use (Ames et al., 2007). Because the BOAT and M-BOAT have been established for use in the study of alcohol and marijuana use, respectively, which share similarities with other addictive behaviours, such as gambling, it is important to consider the usefulness of the BOAT in gambling research. With more comprehensive measures of gambling OEs, including memory association tasks, researchers stand to learn more about the cognitive processes involved in problem gambling.

The current study examined how memory associations between outcomes and gambling, as reflected by self-generated gambling-related responses on the G-BOAT implicit task, correlate with excessive and problem gambling. Specifically, positive correlations were expected between both time and money spent gambling and gambling-related G-BOAT responses. Similarly, a positive correlation was expected to exist between problem gambling severity on the Problem Gambling Severity Index (PGSI) and gambling-related G-BOAT responses.

Method

Participants. Ninety-six gamblers (66 men and 30 women) were recruited from the community via posters, newspaper advertisements, and local classified websites. Participant ages ranged from 19 to 71 years (M = 29.6; SD = 12.1). Participants must have engaged in any of the following at least once over the past 90 days: online gambling, casino gambling, casino games outside of a casino, electronic gambling machines, horse betting, or dice games for money. Participants' first language had to be English given the verbal nature of the G-BOAT, and those who were actively trying to quit gambling were excluded from the study (to prevent an inadvertent precipitation of relapse; Binde, 2009). Eligibility was confirmed via phone screening. The data for only 95 participants (65 men, 30 women; mean age = 29.7 years) were included in the present study because one participant did not provide full data on all measures. These participants were part of a larger study concerning the effects of gambling advertisements on gambling expectancies (Stewart, Yi, Ellery, & Stewart, 2016). All data presented in the current study were collected from participants prior to exposure to any gambling advertisements. Participants in the current study were aware they were participating in a gambling study, which was necessary, as we were interested in recruiting gamblers and for ethical reasons wished to avoid deception or misdirection.

According to PGSI scores, the sample consisted of 11 non-problem gamblers, 27 low-risk gamblers, 39 moderate-risk gamblers, and 19 high-risk or problem gamblers. PGSI scores ranged from 0 to 21 and the average score was in the moderate-risk range (see Table 1).

Procedure. At the time of recruitment, participants completed the PGSI and screening for study eligibility. Those participants who met the eligibility requirements came into the lab for a testing session. First, they provided written informed consent and then they completed the G-BOAT, followed by the Gambling Timeline Followback (G-TLFB). Participants completed a number of other tasks during this

Table 1

Correlations and Descriptive Statistics for G-BOAT, PGSI, Money Spent Gambling in Last 90 Days (G-TLFB-Money), and Time Spent Gambling in Last 90 Days (G-TLFB-Time) (Study 1)

	G-BOAT	PGSI	G-TLFB-Money	G-TLFB-Time
G-BOAT	-			
PGSI	.507**	-		
G-TLFB-Money	.353**	.339**	-	
G-TLFB-Time	.363**	.671**	.255*	-
Mean (*SD*)	1.21 (1.80)	4.73 (4.57)	$349.27 (609.30)	1,197.18 min (2910.58)

Note. G-BOAT= Gambling Behaviour Outcome Association Task; PGSI= Problem Gambling Severity Index from the Canadian Problem Gambling Index (Ferris & Wynne, 2001); G-TLFB-Money = Gambling Timeline Followback - money dimension (Weinstock et al., 2004); G-TLFB-Time = Gambling Timeline Followback - time dimension (Weinstock et al., 2004). $^{*}p < .05$. $^{**}p < .01$.

lab session, but only those tasks that are relevant to the current study are reported. Participants were compensated $30 for their time and effort.

Materials

Gambling Behaviour Outcome Association Task (G-BOAT). Participants were given the 21-item pencil-and-paper word association task containing 10 phrases denoting outcomes potentially associated with gambling-related behaviour, interspersed with 11 control outcome phrases unlikely to be associated with gambling. Instructions provided to the participants were as follows: “Please write the first and second action or behaviour that each phrase makes you think of. Each response should be honest and immediate.” The 10 potentially gambling-related outcome phrases include items such as “I feel relaxed” or “I have fun,” and the neutral phrases included items such as “Pleasing relatives” or “Gaining intelligence.” Two research assistants independently scored whether the responses to the 10 items of interest were gambling-related (1) or not (0) across all participants. Any outcome phrases left blank were scored as non-gambling responses; blanks were infrequent (1.2%). As each gambling-related response was given a point, the possible range of scores on the task was 0–20. Values for skewness and kurtosis were 1.83 and 3.11, respectively, indicating that G-BOAT scores were approximately normally distributed, but with a slight positive skew. As such, we present analyses using the G-BOAT scored both continuously and dichotomously (i.e., 1 for any gambling responses vs. 0 for no gambling responses on the G-BOAT).

Problem Gambling Severity Index (PGSI). The PGSI is part of the Canadian Problem Gambling Index, which measures both problem gambling behaviour and the consequences of that behaviour (Ferris & Wynne, 2001). Participants were requested to respond, using a scale of 0 (*never*) to 3 (*always*), regarding how often a given behaviour or consequence had happened with respect to their gambling in the last 12 months. Total scores across this nine-item index can be used to place gamblers into different categories of problem gambling severity: non-problem gambler (score of 0), low-risk gambler (score of 1–2), moderate-risk gambler (score of 3–7), or high-risk gambler (score of 8 or more). Scores can also be treated continuously, as they were in the present study, to assess the severity of gambling problems. This measure has shown good internal consistency ($\alpha = .84$) and adequate test-retest reliability ($r = .78$) in prior work (Wynne, 2003). In the present sample, the internal consistency for the PGSI was good at $\alpha = .86$.

Gambling Timeline Followback (G-TLFB). The G-TLFB method uses a calendar to retrospectively record frequency and intensity of the target behaviour along multiple dimensions (Weinstock, Whelan, & Meyers, 2004). The calendar is used to elicit specific memory cues (e.g., special events) to help anchor participants' retrospective accounts of their target behaviour. Use of this method originated in alcohol research (Sobell, Maisto, Sobell, & Cooper, 1979) and its validity has been established through many subsequent studies with alcohol and other addictive substances (e.g., Brandon, Copeland, & Saper, 1997; Carey & Maisto, 1987; Dawes, Frank, & Rost, 1993; Hersh, Mulgrew, Van Kirk, & Kranzler, 1999).

The G-TLFB assesses gambling behaviour across several dimensions, including time and money spent gambling. Participants in the current study were given a calendar to retrospectively record their gambling behaviour over the past 90 days. Weinstock and colleagues (2004) examined the use of the G-TLFB method in young gamblers (*M age* = 21.5 years) and found that it demonstrated good concurrent validity with gambling screening measures, including the Massachusetts Gambling Screen (Shaffer, LaBrie, Scanlan, & Cummings, 1994) and the South Oaks Gambling Screen (Lesieur & Blume, 1987). The same G-TLFB was used in the current study to examine two dimensions of gambling: time spent gambling, in minutes, and money spent gambling, in dollars. These two indices were selected because previous gambling research has found positive OEs to correlate with time and money spent gambling (Stewart, Stewart, Yi, & Ellery, 2015).

Results

First, the reliability of the G-BOAT scores across two raters was examined. To examine the degree of agreement of overall scores, we used Pearson correlations of each rater's total scores. To examine agreement at the item level, we used the kappa coefficient. Inter-rater reliability for the G-BOAT was high for both indices ($r = .97$, $\kappa = 0.89$), indicating that raters showed strong agreement at both the total score and individual item levels. Because of the high inter-rater agreement, the following primary analyses were conducted using only the first rater's coding. The same significant correlations emerged when we used the second rater's scores in analyses.

Pearson correlational analyses were conducted to examine any relationships between the G-BOAT and the two criterion measures (PGSI and G-TLFB). Significant positive relationships were found between the G-BOAT and PGSI, as well as between the G-BOAT and both time and money spent gambling, as measured on the G-TLFB.

However, given that over half (54.6%) of the participants did not provide a gambling-related response, we performed supplemental sensitivity analyses to test the robustness of our original analyses, using point biserial correlations with G-BOAT scores as a dichotomous variable. The pattern and significance of the correlational results remained the same when a dichotomous variable was used to indicate “no” or “one or more” gambling-related responses on the G-BOAT, as reported above with the use of a continuous variable and Pearson correlational analyses (see Table 1).

Discussion

The primary aim of Study 1 was to investigate memory associations between gambling behaviour and positive outcomes using the G-BOAT and to examine whether such memory associations are related to gambling involvement and gambling problems. This adapted indirect measure of memory associations showed a high inter-rater reliability across two indices, suggesting it can be scored reliably at the level of the individual item and the total score. Moreover, the expected positive correlation between G-BOAT and PGSI scores implies participants with more problematic gambling (as indicated by higher PGSI scores) were more likely to generate gambling-related behavioural responses when positive outcomes were presented. Similarly, and as expected, those participants who showed more involvement in gambling (indicated by the time and money spent indices from the G-TLFB) were also more likely to generate more gambling-related behavioural responses to the ambiguous outcome phrases on the G-BOAT. This finding suggests that those who are more involved in gambling have more implicit memory associations between gambling and positive outcomes. This could be because greater gambling involvement provides more learning opportunities to form stronger associations between gambling and positive outcomes and/or because stronger automatic memory associations promote greater gambling involvement.

Of note is that a large number of participants did not provide any gambling-related responses. This was likely because the participants were not necessarily regular gamblers but had simply performed a gambling-related behaviour in the past 3 months. Because the G-BOAT does not identify a target behaviour, it can result in low-frequency responses generated in response to stimuli, since any associate of the presented outcome can be generated, thus allowing free competition among learned associates to various ambiguous outcomes. This is unlike implicit RT tasks that tend to assess relative associations and provide specific categories and exemplars chosen for the task. On the G-BOAT, as gambling behaviour increases, it is expected that more gambling-related responses will be generated.

The G-BOAT and other implicit measures are useful additions to the gambling research field, given the potential problems with social desirability on explicit tasks when assessing behaviour (Ladouceur et al., 2000). An advantage to the use of the G-BOAT is that it is time efficient, cost-effective, and easily administered and it scored in comparison to some existing implicit RT measures of gambling OEs (Stacy et al., 1994). Use of various implicit measures in conjunction with explicit tasks allows for assessment of both reflective and impulsive systems with respect to gambling behaviour (Stewart et al., 2014), a focus of Study 2.

Study 2

Study 2 served to further examine the utility of memory associations in gambling research by examining the relations of responses on the G-BOAT with other established measures of gambling OEs. Specifically, we examined the correlations of the G-BOAT with the Gambling Expectancy Questionnaire (GEQ; a self-report questionnaire established as an explicit gambling OE measure; Gillespie, Derevensky, & Gupta, 2007b) and the Affective Priming Task (an implicit computerized RT task; Fazio, Sanbonmatsu, Powell, & Kardes, 1986). In addition, we investigated whether the G-BOAT memory association task explained unique variance in gambling frequency, after we accounted for variance explained by an explicit self-report measure of gambling OEs. Finally, in Study 2 we recruited individuals with more gambling experience in order to evaluate the influence of greater gambling involvement on behavioural responses generated on the G-BOAT.

The GEQ is a commonly used explicit measure stemming from methods for measuring expectancies in alcohol use. Developed by Gillespie, Derevensky, and Gupta (2007a), this 23-item questionnaire focuses on consciously expected positive and negative outcomes from gambling, measured across five scales. The GEQ has been shown to be valid in predicting problem gambling, with problem gamblers scoring higher than non-problem gamblers on both positive and negative OEs (Gillespie et al., 2007b).

In addition to assessing implicit cognitions through memory association tasks such as the BOAT, one can use computerized RT measures as alternative indirect measures of these automatic associations. For example, these associations can be measured through an Affective Priming Task (Fazio et al., 1986), which is an RT task measuring the time it takes to respond to positive or negative adjectives that are preceded by primes. The speed at which the positive evaluation of gambling is called upon from memory is reflected in the latency to categorize positive adjectives that are preceded by gambling primes (Fazio et al., 1986). Comparable implicit affective tasks have been applied in the gambling literature, whereby positive or neutral, or negative or neutral, attribute words were intermixed with gambling pictures and participants were required to rapidly identify the type of word (Brevers et al., 2013). In the current study, we used a version of Fazio et al.'s task, modified by Stewart et al. (2014), to measure RT latencies to respond to gambling-relevant outcomes preceded by gambling and non-gambling pictures. Although both negative and positive OEs were presented, the current study's analyses focused on RTs to categorize positive OEs, as these were the type of OEs examined in the G-BOAT. Stewart and colleagues (2015) demonstrated the validity of the Affective Priming Task in predicting gambling behaviour, as measured by self-reported gambling.

We predicted that the G-BOAT would show convergent validity with both the GEQ and the Affective Priming Task. We were also able to examine the discriminant validity of the G-BOAT by determining whether it correlated specifically with gambling trial RTs of the Affective Priming Task, and not with non-gambling (control) trial RTs. In line with Strack and Deutsch's (2004) reflective-impulsive model of behaviour, which suggests that implicit and explicit cognitions independently affect behaviour, we hypothesized that implicit (G-BOAT) memory associations and explicit (GEQ) measures would uniquely predict gambling frequency, thus reflecting the incremental validity of automatic memory associations.

Method

Participants. Sixty-one adult regular gamblers were recruited from two universities and the community at large. The sample of participants was predominantly male (37 males, 24 females) with an average age of 46.36 years (SD = 19.56) and a range of 19–80 years. The average gambling severity of the participants was moderate, as measured by the PGSI (M = 4.46, SD = 4.48).

To be eligible, participants had to be regular gamblers (i.e., have gambled a minimum of three times in the 2 months prior to the study at a casino, online, or on electronic gambling machines), be at least 19 years of age, speak English as their first language, and not be actively trying to quit gambling. Participants were recruited via advertisements posted around the universities, on SONA (a university website listing current psychological research studies), on classified websites (e.g., Kijiji), and on social networking websites (e.g., Facebook). Participants were part of a larger study examining the effects of lab context on gambling behaviour and OEs (Hudson, Gough, Yi, & Stewart, 2016).[1] As in Study 1, participants were aware they were participating in a study on gambling.

Procedure. After eligibility was determined by phone screenings, participants were scheduled to come to the lab for a testing session. Upon arrival, written informed consent was obtained. The tasks of interest were then completed in the following order: the Affective Priming Task, GEQ, and G-BOAT. After completing these tasks, participants completed the PGSI for sample description purposes. Participants completed a number of other tasks during this lab session, but only those tasks that are relevant to the current study are reported here. Participants were compensated \$20 or 1.5 credit hours toward an eligible class (only for students at the university where the study was conducted).

Measures

Gambling Frequency. As part of the eligibility screening, participants had to indicate how often they gambled in the past 2 months. This was also used as a measure of gambling frequency in analyses.

[1]Participants in both lab environments responded similarly on all measures presented in the current study and thus results were collapsed across lab contexts.

Behaviour Outcome Association Task. Participants completed the G-BOAT as in Study 1. Once again, two independent raters scored the task, blind to each other's scores. Only the first rater's scores were used in analyses. Similar findings were observed when analyses were conducted by using the second rater's data.[2] Values for skewness and kurtosis were 2.02 and 4.28, respectively, indicating that G-BOAT scores were slightly positively skewed. As such, we conducted analyses with dichotomous G-BOAT scores (1 for any gambling responses vs. 0 for no gambling responses on the G-BOAT), as well as with the more traditional continuous BOAT score.

Gambling Expectancy Questionnaire (GEQ). Participants completed the 23-item explicit GEQ (Gillespie et al., 2007a). This is a pencil-and-paper task in which participants are asked to rate on a scale of 1 (*no chance*) to 7 (*certain to happen*) their belief as to how likely the stated outcome is to happen as a consequence of gambling. Items include, for example, "I get rich" or "I feel excited." The five scales of the GEQ represent both positive (enjoyment/arousal, self-enhancement, and money) and negative (over-involvement and emotional impact) gambling OEs (Gillespie et al., 2007a). Each participant was given a total score for an overall higher order positive subscale of the GEQ, calculated by summing across the three positive subscales (see Stewart et al., 2015). This higher order subscale showed good internal reliability in the present study ($\alpha = .86$). Only the positive subscale score was used in the current study, as we were interested in examining convergence with the G-BOAT.

Affective Priming Task. Participants completed this task on the computer, where they viewed a prime picture (gambling or non-gambling-related) for 200 ms, followed by a blank screen for 100 ms and then an OE target word (positive or negative), and were required to respond to the target word with a key press. If the word was positive, half the participants were instructed to respond by clicking the "Z" key, and for negative words, the "/" key. The other half of the participants had these keys reversed to control for any right-hand dominance. The RT latency between the time the target word was presented and the key was pressed was the measure of interest here. The positive and negative gambling OE target words used in the task were selected from a review of self-report measures on gambling OEs (Stewart et al., 2014), including words such as "fun" and "winning." Only trials involving positive OE target words were included in the analyses, as we were interested in examining correlations with the G-BOAT, which assessed only positive OEs. The Affective Priming Task has been shown to have good validity and good internal consistency, with split-half reliabilities that are satisfactory to high (Hudson et al., 2016; Stewart et al., 2015).

Results

To examine convergence between responses generated on the G-BOAT and the other two gambling OE measures used in the study (GEQ and Affective Priming Task), we conducted Pearson correlational analyses. Two research assistants independently

[2]Findings remained the same when analyses were conducted by using the second rater's data, although the correlation between the G-BOAT and RT measure became marginally significant ($p = .08$).

Table 2
Correlations and Descriptive Statistics for the G-BOAT, GEQ, and Affective Priming Task (Study 2)

	G-BOAT	GEQ	Priming task (gambling)	Priming task (non-gambling)
G-BOAT	-			
GEQ	.38**	-		
Priming task (gambling)	-.29*	-.25	-	
Priming task (non-gambling)	-.22	-.19	.87**	-
Mean (*SD*)	1.65 (2.17)	3.98 (.75)	1,049.47 ms (400.14)	1,027.78 ms (345.03)

Note. G-BOAT = Gambling Behaviour Outcome Association Task; GEQ = Gambling Expectancy Questionnaire (Gillespie et al., 2007a). Priming task (gambling) = reaction times (RTs) for positive outcome words on gambling-primed trials. Priming task (non-gambling) = RTs for positive outcome words on non-gambling-primed trials.
$^*p < .05$. $^{**}p < .01$.

scored participants' responses on the G-BOAT, rating whether the response was gambling related or not, providing a summed continuous gambling score for each participant with a possible range of 0–20. Since 37.1% of participants did not respond to any of the G-BOAT phrases with a gambling-related response, supplemental analyses were conducted by using a dichotomous variable approach (1 for any gambling responses vs. 0 for no gambling responses on the G-BOAT). The results were identical in pattern and significance to those obtained by using the analyses of continuous variables, except in one case, which is noted below.

Further, given the high inter-rater reliability (r = .96 and κ = 0.88), subsequent analyses were completed with the first rater's responses only. Any outcome phrases left blank were scored as a non-gambling response; blanks were infrequent. Less than 1% of spaces for the G-Boat were left blank.

A significant negative correlation was found between the G-BOAT and RTs to the gambling-primed positive trials on the Affective Priming Task (Table 2). Moreover, this relationship to the G-BOAT was specific to the gambling-primed trials, as there was no significant correlation between G-BOAT scores and RTs to the non-gambling primed trials on the Affective Priming Task (Table 2). A positive correlation of similar magnitude was also found between the G-BOAT and the higher order positive subscale of the explicit measure, the GEQ (see Table 2). Thus, as predicted, the G-BOAT showed convergence with two established measures of gambling OEs. However, the significant negative correlation between the G-BOAT and the Affective Priming Task gambling-primed trials did not persist when we used the dichotomously scored G-BOAT.

To examine the incremental contributions of the G-BOAT and the self-report measure of positive gambling OEs in predicting gambling frequency, we conducted two separate hierarchical regressions. In the first model, the GEQ was entered in the first step and the G-BOAT was entered in the second step, with self-reported gambling frequency as the dependent variable. In the second model, the G-BOAT was entered in the first step and the GEQ was entered in the second step, with self-reported gambling frequency as the dependent variable. In the first model, after we controlled for the GEQ, the G-BOAT remained a significant unique predictor of gambling frequency ($\Delta R^2 = .13$, $p < .01$). In the second model, after we controlled for the G-BOAT, the GEQ remained a significant unique predictor of gambling frequency ($\Delta R^2 = .06$, $p = .04$). Together, the GEQ and G-BOAT accounted for 29% of the variance in gambling frequency (cumulative $R^2 = .29$), with 45% of that explained variance being uniquely contributed by the G-BOAT, 21% being uniquely contributed by the GEQ, and the remainder (34% of the variance) being shared between the G-BOAT and the GEQ (Figure 1).

To determine whether the tendency to make a gambling response (y/n) on the G-BOAT varied across the two studies (which used gamblers with differing levels of involvement), we conducted a chi-square test. Results revealed that significantly more participants gave at least one gambling response on the G-BOAT in Study 2 than in Study 1 ($\chi^2 = 6.52$, $p = .011$). This may reflect a tendency to associate gambling behaviours with the positive cues for gamblers who show greater gambling involvement, given that inclusion criteria entailed more frequent gambling in Study 2 than in Study 1.

Discussion

The purpose of this study was to examine distinct and overlapping contributions of implicit and explicit measures of positive gambling OEs in predicting frequency of gambling activities. We also determined whether the G-BOAT showed convergence with established gambling OE measures. Results indicated that the G-BOAT showed significant correlations with both the explicit and implicit tasks used in the study. These results imply that those participants who immediately responded to positive outcome phrases with gambling-related behaviours on the G-BOAT also tend to self-report more positive OEs on the GEQ. Similarly, those who responded with more gambling-related behaviour on the G-BOAT also displayed faster RTs to gambling-primed positive words on the Affective Priming Task. It is noteworthy, however, that the correlation between the G-BOAT and Affective Priming Task did not remain statistically significant when we used the second rater's data, or when we used a dichotomous G-BOAT variable. The failure of this relation to hold up to sensitivity tests may reflect different aspects of automatic memory associations assessed by the two tasks (Ames et al., 2007).

These results further support the use of the G-BOAT within gambling research, as these correlations generally show this task to have convergent validity with other established gambling OE measures. With regard to the nature of the G-BOAT, findings suggest it contains elements of both implicit and explicit tasks. The G-BOAT was designed as an implicit task because it requires quick, automatic thought. However, in this study, the G-BOAT also required written responses and had no imposed time limit, thus allowing for potential deliberation, which may explain the contribution of explicit processes to the task. The G-BOAT also appears to have discriminant validity, based on our finding that G-BOAT responses were associated with latencies to respond on gambling-primed trials of the Affective

Priming Task, but not with non-gambling (control) primed trial RTs. However, we were unable to show that the relation with the gambling-primed trial RTs was significantly stronger than the relation with the non-gambling-primed trial RTs.

The finding that the G-BOAT contributed unique variance in predicting gambling frequency, as well as variance that was shared between the G-BOAT and the GEQ, highlights the importance of using both measures in assessing OEs in gambling. These findings also speak to the incremental validity of the G-BOAT in that memory associations were found to predict gambling frequency over and above the prediction by self-reported positive OEs on the GEQ alone. In terms of clinical implications, these results illustrate the potential need to target both implicit and explicit gambling OEs in treating excessive gambling.

General Discussion

These two studies suggest that automatic memory associations are important to consider in gambling research because they may lead to or affect gambling behaviour, potentially increasing the likelihood of excessive and problem gambling (Stewart et al., 2015). Furthermore, automatic memory associations as assessed with the G-BOAT added unique and shared variance with an existing self-report measure of positive gambling OEs when predicting gambling frequency. Our results support the notion that explicit and implicit measures tap different cognitive systems and both are crucial to include in examining gambling OEs.

In Study 1, we adapted the G-BOAT from a measure that was previously used in alcohol and substance use research to one that was specific to gambling, and we tested how gambling responses on the G-BOAT are associated with excessive and problem gambling in a sample of community-recruited gamblers. Greater gambling responses on the G-BOAT were associated with greater gambling involvement and more gambling-related problems, as measured by the G-TLFB and PGSI, respectively. Study 2 demonstrated that the G-BOAT correlates significantly with two established measures of gambling OEs (i.e., the GEQ and the Affective Priming Task), and that automatic memory associations on the G-BOAT uniquely predict variance in gambling frequency, above and beyond that accounted for by self-reported OEs. Both studies established strong inter-rater reliability for the G-BOAT across two raters at both the individual item and the total score level.

It is important to take into consideration some limitations of these studies for future research. RT tasks may be less subject to social desirability bias, since the G-BOAT requires verbalization or self-generation of an action or behaviour, and it is therefore possible that some individuals may filter or block associative responses by writing down something other than the first behaviour or action, as instructed. However, the instructions ask participants to provide an immediate response, and those with strong associations between gambling and associated outcomes are more likely to write down a gambling-related response if the behaviour is highly accessible in memory. Furthermore, with open-ended association tasks such as the G-BOAT, the strength of associations can be evaluated. Since the task does not provide a target behaviour, any associate of any behaviour can be generated in response to ambiguous outcomes based on accessibility of associations in memory (Stacy et al., 1994), something that RT tasks cannot do directly. Rather, RT tasks infer strength of associations through speed of activation of the outcome following presentation of the behaviour or vice versa. Further, RT tasks tend to constrain association categories or limit the possible connections among potential associates; that is, there is no generation of associates, only reaction to the associates provided that may or may not be meaningful to the individual. Another potential limitation is that it is possible that participants were primed to respond to the G-BOAT outcomes with gambling-related responses, given their awareness that they were participating in a study on gambling involvement. However, this provision of information was necessary in order to recruit participants who met gambling inclusion criteria, as well as to avoid misdirection or deception. Furthermore, the low gambling response rate on the G-BOAT suggests that this was likely not an issue.

It is also possible that G-BOAT statements could be processed as antecedents to gambling behaviours rather than outcomes (e.g., “when I am making money, I will gamble” rather than “when I gamble, I will be making money”). This limitation is inherent in other implicit measures of OEs as well. Priming effects on the G-BOAT may have been at play, as both studies were part of larger gambling studies, though care was taken to present the G-BOAT before the G-TLFB and on a different occasion from the PGSI in Study 1. Additionally, if priming effects were present, we would expect to see higher mean levels of gambling responses on the G-BOAT in Study 2. In contrast, gambling responses occurred in relatively low frequency on the G-BOAT in both studies. Even with this low rate of gambling responses, G-BOAT responses were predictive of important outcomes. Future work could examine whether gambling response rates are higher on this measure in a clinical sample of problem gamblers.

Future research might also consider imposing time limits for responding to the outcome phrases on the G-BOAT to ensure greater automaticity of responses. This could help better establish the G-BOAT as an implicit task (Palfai & Wood, 2001; Stacy, 1997; Stacy et al., 1994). In fact, minimizing time to respond is consistent with the use of this task in the study of alcohol and marijuana use behaviours (e.g., Ames et al., 2007). Creating a computerized version of the G-BOAT would be ideal for setting time constraints (e.g., Ames, Grenard, & Stacy, 2013; Grenard, Ames, & Stacy, 2013). Future gambling research might look at how gambling cue exposure affects the generation of gambling responses on the G-BOAT (see Stewart et al., 2014, for a relevant design) and might examine the G-BOAT’s psychometric properties in a clinical sample.

To advance understanding of gambling behaviour, it is important to use a variety of methods to tap into both deliberate/reflective and automatic cognitive processes when conducting gambling research. Indeed, Study 2’s finding that the G-BOAT and GEQ contributed shared *and unique* variance in explaining gambling frequency speaks to the importance of including both types of measures in assessing OEs. Further, in supplemental sensitivity analyses, it was shown that the G-BOAT and the Affective Priming Task were non-redundant. This finding further points to the strength of the use of multiple methods for assessing cognitive processes. Both the G-BOAT and computerized RT tasks provide different methods of tapping various aspects of associations in memory (Ames et al., 2007).

By using both explicit and implicit measures, one can assess gambling OEs more broadly, as explicit and implicit cognitions have been shown to be acquired differently, to guide behaviour differently, and to express themselves differently physiologically (McLelland, Koestner, & Weinberger, 1989). Stewart et al. (2015) found the Affective Priming Task and the GEQ contributed both unique and shared variance in predicting gambling behaviour, as measured by the G-TLFB. Our results build on this work by demonstrating similar findings with an alternative implicit measure of gambling OEs. The promising results seen here with the G-BOAT suggest that future research should adapt other implicit association measures from the alcohol and drug use literature, such as Stacy's (1995) ambiguous cueing memory association task, for potential use in further examining the role of automatic memory associations in problematic gambling.

Although the present research evaluated the additive, independent, predictive effects of explicit and implicit cognitions with respect to gambling, current research in other addictive behaviours has shown interactive or dual-process effects by using several methods (e.g., Ames et al., 2013; Grenard et al., 2008, 2013; Houben & Wiers, 2009; Thush et al., 2008). In a dual-process approach, decisions to engage in a particular behaviour are believed to result from an interaction between impulsive/associative and reflective/control systems. In a commonly studied form, this interaction suggests that the reflective system may dampen or block effects of implicit associations on behaviour. Dual-process interaction and longitudinal research are needed to further the understanding of gambling behaviour.

In sum, with sound measures of OEs in place such as the GEQ, the Affective Priming Task, and now the G-BOAT, researchers will be able to learn more about gambling behaviour and ultimately use that information for problem gambling treatment and prevention. In the clinical setting, methods are used that target both implicit and explicit gambling OEs. Alcohol research has shown that altering these expectations leads to successful reduction in drinking (Darkes & Goldman, 1993; Houben, Havermans, & Wiers, 2010; Wiers, Van de Luitfaarden, van den Wildenberg, & Smulders, 2005). Methods aimed at reducing positive gambling OEs—both explicit OEs and automatic memory associations—may help in the treatment of problem gambling.

References

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: Author.

Ames, S. L., Grenard, J. L., & Stacy, A. W. (2013). Dual process interaction model of HIV-risk behaviors among drug offenders. *AIDS and Behavior*, *17*, 914–925.

Ames, S. L., Grenard, J. L., Thush, C., Sussman, S., Wiers, R. W., & Stacy, A. W. (2007). Comparison of indirect assessments of association as predictors of marijuana use among at-risk adolescents. *Experimental and Clinical Psychopharmacology*, *15*, 204–218.

Binde, P. (2009). Exploring the impact of gambling advertising: An interview study of problem gamblers. *International Journal of Mental Health and Addiction*, *7*, 541–554.

Brandon, T. H., Copeland, A. L., & Saper, Z. L. (1995). Programmed therapeutic massages as a smoking treatment adjunct: Reducing the impact of negative affect. *Health Psychology*, *14*, 41–44.

Brevers, D., Cleeremans, A., Hermant, C., Tibboel, H., Kornreich, C., Verbanck, P., & Noël, X. (2013). Implicit gambling attitudes in problem gamblers: Positive but not negative implicit associations. *Journal of Behavior Therapy and Experimental Psychiatry*, *44*, 94–97.

Carey, K. B., & Maisto, S. A. (1987). Effect of a change in drinking pattern on the cognitive function of female social drinkers. *Journal of Studies on Alcohol*, *48*, 236–242.

Darkes, J., & Goldman, M. S. (1993). Expectancy challenge and drinking reduction: Experimental evidence for a meditational process. *Journal of Consulting and clinical Psychology*, *61*, 344–353.

Dawes, M. A., Frank, S., & Rost, K. (1993). Clinician assessment of psychiatric comorbidity and alcoholism severity in adult alcoholic in patients. *American Journal of Drug and Alcohol Abuse*, *19*, 377–386.

DeHouwer, J. (2006). What are implicit measures and why are we using them? In R. W. Wiers & A. W. Stacy (Eds.), *The Handbook of Implicit Cognition and Addiction* (pp. 11–28). Thousand Oaks, CA: Sage.

Dieterich, S. E., Stanley, L. R., Swaim, R. C., & Beauvais, F. (2013). Outcome expectancies, descriptive norms, and alcohol use: American Indian and White adolescents. *Journal of Primary Prevention*, *34*, 209–219.

Fazio, R. H., Sanbonmatsu, D. M., Powell, M. C., & Kardes, F. R. (1986). On the automatic activation of attitudes. *Journal of Personality and Social Psychology*, *50*, 229–238.

Ferris, J. & Wynne, H. (2001). *The Canadian Problem Gambling Index: User's manual*. Toronto, ON: Canadian Centre on Substance Abuse.

Gillespie, M. A., Derevensky, J., & Gupta, R. (2007a). Adolescent problem gambling: Developing a gambling expectancy instrument. *Journal of Gambling Issues*, *19*, 51–68.

Gillespie, M. A., Derevensky, J., & Gupta, R. (2007b). The utility of outcome expectancies in the prediction of adolescent gambling behaviour. *Journal of Gambling Issues*, *19*, 69–85.

Grenard, J. L., Ames, S. L., & Stacy, A. W. (2013). Deliberative and spontaneous cognitive processes associated with HIV-risk behaviour. *Journal of Behavioral Medicine*, *36*, 95–107.

Grenard, J. L., Ames, S. L., Wiers, R., Thush, C., Sussman, S., & Stacy, A.W. (2008). Working memory capacity moderates the predictive effects of drug-related associations on substance use. *Psychology of Addictive Behaviors*, *22*, 426–432.

Hersh, D., Mulgrew, C. L., Van Kirk, J., & Kranzler, H. R. (1999). The validity of self-reported cocaine use in two groups of cocaine abusers. *Journal of Consulting and Clinical Psychology*, *67*, 37–42.

Houben, K., Havermans, R., & Wiers, R. (2010). Learning to dislike alcohol: Conditioning negative implicit attitudes toward alcohol and its effect on drinking behaviour. *Psychopharmacology*, *211*, 79–86.

Houben, K., & Wiers, R. W. (2009). Response inhibition moderates the relationship between implicit associations and drinking behavior. *Alcoholism: Clinical and Experimental Research*, *33*, 626–633.

Hudson, A., Gough, K., Yi, S., & Stewart, S. H. (in press). Eye on the prize: High risk gamblers show sustained selective attention to gambling cues. *Journal of Gambling Issues*.

Jung, C. G., & Von Franz, M. L. (1964). *Man and his symbols* (Vol. 5183). New York, NY: Dell.

Ladouceur, R., Bouchard, C., Rhéaume, N., Jacques, C., Ferland, F., Leblond, J., & Walker, M. (2000). Is the SOGS an accurate measure of pathological gambling among children, adolescents and adults? *Journal of Gambling Studies*, *16*, 1–24.

Latu, I. M., Stewart, T. L., Myers, A. C., Lisco, C. G., Estes, S. B., & Donahue, D. K. (2011). What we "say" and what we "think" about female managers: Explicit versus implicit associations of women with success. *Psychology of Women Quarterly*, *35*, 252–266.

Leigh, B. C. (1989). In search of the Seven Dwarves: Issues of measurement and meaning in alcohol expectancy research. *Psychological Bulletin*, *105*, 361–373.

Lesieur, H. R., & Blume, S. B. (1987). The South Oaks Gambling Screen (SOGS): A new instrument for the identification of pathological gamblers. *American Journal of Psychiatry*, *144*, 1184–1188.

McLelland, D. C., Koestner, R., & Weinberger, J. (1989). How do self-attributed and implicit motives differ? *Psychological Review*, *96*, 690–702.

Palfai, T., & Wood, M. D. (2001). Positive alcohol expectancies and drinking behavior: The influence of expectancy strength and memory accessibility. *Psychology of Addictive Behaviors*, *15*, 60–67.

Potenza, M. N. (2006). Should addictive disorders include non-substance-related conditions? *Addiction*, *101*, 142–151.

Renner, W., Gula, B., Wertz, M., & Fritzsche, S. (2014). Asymmetric mutual social perception of Austrians and Germans: A social identity approach assessing implicit and explicit attitudes. *International Journal of Business and Social Research*, *4*, 50–57.

Shaffer, H. J., LaBrie, R., Scanlan, K. M., & Cummings, T. N. (1994). Pathological gambling among adolescents: Massachusetts Gambling Screen (MAGS). *Journal of Gambling Studies*, *10*, 339–362.

Sobell, L. C., Maisto, S. A., Sobell, M. B., & Cooper, A. M. (1979). Reliability of alcohol abusers' self-reports of drinking behavior. *Behavior Research and Therapy*, *17*, 157–160.

Stacy, A. W. (1995). Memory association and ambiguous cues in models of alcohol and marijuana use. *Experimental and Clinical Psychopharmacology*, *3*, 183–194.

Stacy, A. W. (1997). Memory activation and expectancy as prospective predictors of alcohol and marijuana use. *Journal of Abnormal Psychology*, *106*, 61–73.

Stacy, A. W., Leigh, B. C., & Weingardt, K. R. (1994). Memory accessibility and association of alcohol use and its positive outcomes. *Experimental and Clinical Psychopharmacology*, *2*, 269–282.

Stewart, M. J., Stewart, S. H., Yi, S., & Ellery, M. (2015). Predicting gambling behaviour and problems from implicit and explicit positive gambling outcome expectancies in regular gamblers. *International Gambling Studies*, *15*, 124–140.

Stewart, M. J., Yi, S., Ellery, M., & Stewart, S. H. (submitted). An examination of the effects of gambling advertisements on the activation of implicit vs. explicit gambling outcome expectancies among regular gamblers. *International Gambling Studies*. Submitted March, 2016.

Stewart, M. J., Yi, S., & Stewart, S. H. (2014). Effects of gambling-related cues on the activation of implicit and explicit gambling outcome expectancies in regular gamblers. *Journal of Gambling Studies*, *30*, 653–668.

Strack, F., & Deutsch, R. (2004). Reflective and impulsive determinants of social behaviour. *Personality and Social Psychology Review*, *8*, 220–247.

Thush, C., Wiers, R. W., Ames, S. L., Grenard, J. L., Sussman, S., & Stacy, A. W. (2008). The interactions between implicit and explicit cognition and working memory capacity in the prediction of alcohol use in at-risk adolescents. *Drug and Alcohol Dependence*, *94*, 116–124.

Weinstock, J., Whelan, J. P., & Meyers, A. W. (2004). Behavioural assessment of gambling: An application of the timeline followback method. *Psychological Assessment*, *16*, 72–80.

Wiers, R.W., van der Luitgaarden, K., van den Wildenberg, E., & Smulders, F. T. Y. (2005). Challenging implicit and explicit alcohol-related cognitions in young heavy drinkers. *Addiction*, *100*, 806–819.

Wynne, H. J. (2003). *Introducing the Canadian Problem Gambling Index*. Edmonton, AB: Wynne Resources.

Zamboanga, B. L., Horton, N. J., Leitkowski, L. K., & Wang, S. C. (2006). Do good things come to those who drink? A longitudinal investigation of drinking expectancies and hazardous alcohol use in female college athletes. *Journal of Adolescent Health*, *39*, 229–236.

****

Submitted October 5, 2015; accepted November 15, 2016. This article was peer reviewed. All URLs were available at the time of submission.

For correspondence: Amanda Hudson, PhD, Department of Psychology and Neuroscience, Dalhousie University, Halifax, Canada. E-mail: a.hudson@dal.ca

Competing interests: None declared.

Ethics approval: The present study received approval from Dalhousie and Guelph University Research Ethics Boards (REB# 2013-3152).

Acknowledgements: This project was supported by a Manitoba Research Gambling Program grant to S.H. Stewart and S. Yi.