Implicit measures of attitudes toward gambling: An exploratory study

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Abstract

Gambling researchers have used self-report measures in order to assess gamblers' attitudes toward gambling. Despite their efficiency, self-report measures of attitudes often suffer self-presentation and social desirability bias when they are used to assess socially sensitive or stigmatized issues. This concern has led to the recent development of indirect, non-reactive measures of attitudes in psychology. These implicit measures of attitudes tend to reveal automatic, impulsive mental processes, whereas the self-report measures tap conscious, reflective processes (F. Strack & R. Deutsch, 2004). In this paper, we demonstrate how response latency-based measures can be used to investigate attitudes toward gambling. We report findings of our empirical study, in which evaluative priming (Fazio et al., 1995) and the Single Category Implicit Association Test (SC-IAT; Karpinski & Steinman, 1996) were used to assess implicit attitudes toward gambling, and the Single Target IAT was adapted to assess implicit arousal-sedation associations of gambling. With a sample of 102 undergraduate students, we found that latency-based measures of attitudes toward gambling were not significantly correlated with self-report measures. Moderate-to-high-risk gamblers held more positive attitudes toward gambling in the SC-IAT and exhibited more positive and more negative attitudes toward gambling in the evaluative priming task than did low-risk gamblers.

Keywords: implicit attitudes, attitudes toward gambling, automatic processing, response latency

Introduction

Attitudes are defined as "a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor" (Eagly & Chaiken, 1993, p. 1). Attitudes are an important construct in psychology and behavioural science because they provide valenced summaries of an object or issue that serve as "predisposition or readiness for response" (Allport, 1935, p. 805). In other words, attitudes signal individuals about whether objects are good or bad and thus serve as an important precursor of relevant behaviour. Attitudes have been theorized as being one of the most important predictors of behaviours (e.g., Fazio, 1990; Fishbein & Ajzen, 1975), and attitudes have been found to be highly predictive of addictive behaviour (e.g., Leigh, 1989a). The importance of studying attitudes toward gambling has been recently recognized in the field of gambling (e.g., Breen & Zuckerman, 1999; Jackson, Dowling, Thomas, Bond, & Patton, 2008; Kassinove, 1998; Moore & Ohtsuka, 1997).

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The assessment of attitudes has traditionally relied on self-report measures in the area of gambling and addiction research, as well as in psychology. Even though self-report measures of attitudes have many advantages, such as efficiency and reliability, they are often subject to limitations. According to Brunel, Tietje, and Greenwald (2004), self-report measures of attitudes are based on three assumptions: (a) that the participant has already formed an opinion or is able to construct one spontaneously, (b) that the participant has conscious access to his or her attitudes, and (c) that the participant is willing to share his or her attitude accurately with the researcher. Among these, the second and the third assumptions are problematic in assessing attitudes toward addiction and gambling. Because gambling activities are often socially stigmatized (Preston, Bernhard, Hunter, & Bybee, 1998), explicit attitude measures may suffer substantial impression management issues and social desirability bias. In other words, gamblers are highly likely to be motivated to underreport their favourable beliefs about gambling on self-report measures. Furthermore, individuals who recently started gambling may not have conscious access to their attitudes toward gambling because they have not had sufficient opportunities to deliberate on their gambling experience. These limitations of self-report measures of attitudes have led psychologists to consider implicit or automatic measures of attitudes (Greenwald & Banaji, 1995) toward sensitive objects and issues.

Overall, the topic of automatic processes has not received wide attention in the field of gambling. We review a small number of recent studies on automatic activation of gambling-related *non-evaluative* associations. McCusker and Gettings (1997) used a modified Stroop task in order to explore the automatic accessibility of gambling concepts in problem gamblers' memory. In the classic Stroop task, participants are instructed to name, as quickly as possible, the colour of ink in which words (e.g., red) are written. Participants tend to take longer to do so when other colour name words (e.g., blue, yellow) are presented than when non-colour words are presented. This finding is interpreted as the automatic activation of a colour word's meaning interfering with the task of naming ink colour. McCusker and Gettings (1997) found that when asked to name the colour of ink in which words were written, problem gamblers took much longer to colour name gambling-related words than non-gambling words. Similarly, Boyer and Dickerson (2003) reported that gamblers who suffer impaired control took significantly longer to name the colour of the words related to gambling, whereas this finding was not observed among high control gamblers. These findings suggest that gamblers have a high activation potential of gambling-related associations in their memory due to frequent gambling.

Zack and Poulos (2004) studied the priming effect of an amphetamine on automatic activation of the gambling concept. The priming of the amphetamine significantly increased problem gamblers' response to gambling words in the lexical salience task, but it inhibited their responses to neutral words. As expected, the amphetamine's selective activation of gambling words was not observed among non-problem gamblers. In another study, Zack, Stewart, Klein, Loba, and Fragopoulos (2005) assessed the extent to which gambling wins are associated with alcohol consumption in problem gamblers' memory using a response time-based measure. They found that gamblers who drank when they won showed faster response times on trials when alcohol-related words were paired with gambling win words than when they were paired with gambling loss words. This finding suggests that frequent drinking in response to gambling wins creates strong associations between gambling wins and alcohol in the gambler's memory. These automatic associations are likely to prompt gamblers to drink when they are winning or when they anticipate winning.

These studies clearly demonstrate the importance of automatic memory processes in studying the psychology of gambling. However, to the best of our knowledge, no previous study has investigated the implicit attitudes or automatic processes behind the evaluation of gambling. In the next section, we provide a brief overview of implicit attitudes and recently developed measures of implicit attitudes.

Implicit attitudes

According to dual process models, addictive behaviours are determined by the dynamic interaction of two different qualitative processes: the fast, automatic "impulsive system" and the slow, deliberative "reflective system" (Strack & Deutsch, 2004). The reflective system is responsible for carrying out processes of rule-based reasoning and of symbolic representation. For example, the reflective system generates deliberative judgments and decisions, and serves executive functions, such as scheduling casino trips in advance, resisting the temptation to gamble, or preparing plans for reducing the frequency of casino visits. Because the reflective system is slow and amenable to conscious access and deliberation, self-report measures are suitable for assessing the reflective processes of gambling.

On the other hand, the impulsive system refers to "a network in which information is processed automatically through a fast and parallel spread of activation along the associative links between contents" (Strack & Deutsch, 2004, p. 208). Specifically, the impulsive system represents patterns of activation in an association network, which are organized on the basis of close temporal or spatial proximity. For example, the impulsive system is mainly responsible for the simultaneous activation of the concept of gambling and positive affect in memory, which is thought to be prevalent in individuals who find themselves engaging in Internet gambling against their resolution not to gamble on-line. Unlike the reflective system, the impulsive system is posited to operate on the basis of automatic activation of associative links in memory and to require little cognitive capacity (Strack & Deutsch, 2004). Implicit measures of attitudes have been considered one promising way of assessing the strength of automatic association between a focal concept (e.g., gambling) and valence (i.e., positivity/negativity) in memory.

A popular definition of implicit attitudes is "introspectively unidentified traces of past experience that mediate favorable or unfavorable feeling, thought, or action toward social objects" (Greenwald & Banaji, 1995). Even though this definition of implicit attitudes is often interpreted as implicit measures of attitudes that provide "unconscious" access to attitudes, recent studies show that individuals often realize that they possess the attitude that is being assessed by response time-based measures (De Houwer, 2006). However, recent empirical findings suggest that response time-based implicit measures of attitudes have other functional properties of "automatic" or "implicit" mental operation. Specifically, compared with self-report measures, implicit measures of attitudes are less susceptible to deception and social desirability bias (i.e., "uncontrollable") and reflect the to-be-measured attitude even though individuals try not to reveal it (i.e., "unintentional") or even when individuals' cognitive resources are diverted into other demanding tasks (i.e., "efficient"; see De Houwer, 2006, for a review). These automatic properties of implicit measures of attitudes are ideal in assessing attitudes toward objects or issues that individuals are motivated to hide or underreport.

Originally developed to assess attitudes toward racial stereotyping (e.g., Greenwald & Banaji, 1995), several implicit measures of attitudes have been developed and used to study diverse issues, such as attitudes toward racial and gender stereotypes, consumer products (e.g., Brunel et al., 2004), and voting behaviour (Bassili, 1995). Despite several differences between these measures, the commonality is that they indirectly assess attitudes by measuring response latency; in other words, they measure how quickly participants perform some tasks that are indirectly associated with the target issue. It is inferred that the faster a participant responds to the combination of the focal issue (e.g., slot machines) and positive stimuli (i.e., words or pictures), in comparison to their response time to the same focal issue and negative stimuli, the more favourable are their attitudes toward the focal issue. Previous research on implicit attitudes toward addictive behaviours such as smoking and alcohol use attests to the usefulness of implicit measures of attitudes (see Wiers & Stacy, 2006, for a review). For example, a recent meta-analysis by Rooke, Hine, and Thorsteinsson (2008) of 72 studies confirmed a strong relationship between implicit attitudes toward substance use (including alcohol and cigarettes) and substance use behaviour ($r = .27$, $p < 0.001$).

Implicit measures of attitudes may be also highly relevant in the clinical setting because their indirectness enables clinical practitioners to circumvent gamblers' motivations to hide or underreport their positive attitudes toward gambling. Furthermore, implicit measures of attitudes may be particularly useful to detect extremely positive automatic associations of gambling in some gamblers before their gambling problem becomes extremely serious. However, to the best of our knowledge, implicit measures of attitudes have never been used to assess attitudes toward gambling.

The main purpose of this manuscript is to introduce implicit measures of attitudes to the field of gambling research and to demonstrate the implementation of these measures in the gambling context. We will offer a brief overview of implicit measures of attitudes used in the fields of alcoholism and smoking and of the major findings from previous research. Next, we will report our empirical study in which three implicit measures of attitudes toward gambling, as well as explicit measures of gambling attitudes, were employed. We will discuss major findings of the study and implications for future research.

In this section, we provide a brief overview of implicit attitude measures used recently in alcoholism and smoking research, and a synopsis of the major findings (for an extensive review, see Wiers & Stacy, 2006).

Evaluative priming. The evaluative priming procedure was originally designed by Fazio, Jackson, Dunton, and Williams (1995) to assess implicit attitudes toward racial prejudice. In this paradigm, respondents are first asked to categorize positive and negative words followed by a mask (e.g., a string of X's). In the next phase, respondents are briefly presented with exemplars of attitude objects, such as visuals (e.g., bottles of alcoholic beverage) or words (e.g., "bar," "whiskey"), which are immediately followed by the mask and the presentation of positive and negative words (i.e., "targets"). The participant's task is to categorize the target word as quickly as possible by pressing a "good" or a "bad" response key. Responses to the target are likely to be faster if the evaluations of the prime and the target match (e.g., both are negatively evaluated) than if they mismatch. The magnitude of the response time difference between the match and the mismatch indicates a person's attitude toward the prime.

Palfai and Ostafin (2003) used this procedure to assess implicit attitudes toward alcohol. Participants engaged in the evaluative priming task either before or after consumption of beer. The investigators found that heavy drinkers responded significantly faster in response to positive words than to negative words, which were preceded by alcohol-related words, after they consumed beer. But heavy drinkers' response time to negative words was also faster when preceded by alcohol-related words than it was when preceded by neutral words. This finding indicates that heavy drinkers' implicit attitude is ambivalent even though it is more positive than negative.

The advantage of evaluative priming is that it is better suited to explore ambivalent attitudes toward the focal category because this procedure was designed to separately assess positive and negative automatic associations of the category.

The Implicit Association Test. The Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998) is probably the most widely used implicit measure of attitudes in the field of social cognition. The IAT is designed to assess the extent to which the target issue or object (e.g., alcoholic drinks) is more or less strongly associated with positivity rather than negativity relative to the comparison issue or object (e.g., soft drinks). In the IAT, this relative strength of automatic associations is revealed by faster or slower performance in categorizing stimuli in the two different combinatory key assignments. The task for participants is to categorize a series of stimuli appearing in the centre of the computer screen into four categories (e.g., alcohol, soft drinks, positive, and negative) by typing one of the two keys. In one combination block, the target issue and the positive category are assigned to one key and the comparison issue and the negative category are assigned to another key. In the other combination block, the key assignment is reversed. The less time it takes for the participant to respond to stimuli in the former versus the latter combination task, the more strongly the target (e.g., alcohol) is associated with the positive valence than the negative valence relative to the comparison category (e.g., soft drinks). In essence, the IAT assesses attitudes toward the focal issue relative to another issue in a bipolar fashion (e.g., on a positive-negative continuum).

Wiers, van Woerden, Smulders, and de Jong (2002) used the IAT to assess heavy and light drinkers' attitudes toward alcoholic drinks relative to soft drinks on the valence dimension. These researchers found that both heavy and light drinkers were much faster when alcoholic drinks were associated with negative words (and sodas with positive words) than when alcoholic drinks were associated with positive words (and sodas with negative words). In other words, both heavy and light drinkers held negative implicit attitudes toward alcoholic drinks relative to soft drinks. In contrast, both groups of drinkers reported positive attitudes on the explicit measures (above the midpoint of the scale). This finding showed a clear dissociation between explicit and implicit measures of attitudes toward alcoholic drinks.

In the same study, Wiers et al. (2002) adapted the IAT to assess drinkers' implicit associations of alcoholic drinks relative to soft drinks on the arousal-sedation dimension. They found that heavy drinkers were much faster when alcoholic drinks were associated with arousal words (and sodas with sedation words) than when alcoholic drinks were associated with sedation words (and sodas with arousal words). In other words, heavy drinkers showed stronger arousal associations toward alcoholic drinks relative to soft drinks. Light drinkers did not show such a difference. Finally, the combined score of the two IATs significantly increased the prediction of alcohol use, after the investigators controlled for age, gender, and explicit measures of attitudes. Similar findings were reported in Wiers et al. (2003); Wiers, van de Luitgaarden, van den Wildenberg, and Smulders (2005); and De Houwer, Crombez, Koster, and De Beul (2004).

One disadvantage of the standard IAT is that it assesses participants' attitudes toward a focal object *in relation to* another object (i.e., the "comparison category"). For example, the IAT has been used to study individuals' attitudes toward alcoholic versus non-alcoholic drinks in the field of addiction research. This poses challenges when there is no natural comparison category, as unfortunately is the case with both smoking and gambling. Specifically, the positivity of individuals' attitudes toward gambling assessed with the IAT will be highly dependent on the attractiveness of the comparison category. Furthermore, the relative nature of the standard IAT makes it difficult to draw a conclusion from, say, negative implicit attitudes toward alcohol versus soft drinks. This result may be because individuals have a negative attitude toward alcohol, or because they have a positive attitude toward soft drinks, or both.

Single Category IATs. Recently, researchers have developed IAT variants that are designed to assess absolute attitudes toward a single object or issue: Single Target IAT (ST-IAT; Wigboldus, Holland, & van Knippenberg, 2004) and Single Category IAT (SC-IAT; Karpinski & Steinman, 2006). These two procedures are conceptually identical, differing only in minor procedural details. Even though the SC-IAT has not been used to assess attitudes toward addiction behaviour, it has been successfully used to gauge individuals' attitudes toward tempting food (e.g., chocolate and potato chips; Friese, Hofmann, & Wänke, 2008). Huijding and de Jong (2006) used the ST-IAT to assess attitude toward smoking and found that habitual smokers showed strong positive (rather than negative) implicit associations with pictorial smoking stimuli. In contrast, non-smokers showed negative (rather than positive) implicit associations with smoking stimuli. Furthermore, Huijding and de Jong (2006) reported that implicit associations assessed with the ST-IAT were significantly correlated with craving for smoking, but self-reported attitudes were not. This finding is in contrast to previous findings based on the standard IAT that heavy smokers showed negative implicit attitudes in relation to contrast categories (e.g., Swanson, Rudman, & Greenwald, 2001).

In our view, the SC-IAT and ST-IAT are better suited to the assessment of automatic associations of gambling than the standard IAT because they are designed to assess automatic cognitions in an absolute rather than a relative manner.

Research questions

In this paper, we pursue the following two research questions. First of all, we attempt to explore the utility of response latency measures of attitudes in assessing individuals' attitudes toward gambling. We expect that to the extent that response latency measures of attitudes tap more automatic processes of gambling than do self-report measures of attitudes, the association between the two will be relatively small.

Further, we predict that individuals with a greater risk for gambling problems will have more positive implicit measures of attitudes than will those with a lower gambling risk. In other words, problem gamblers are likely to have highly accessible automatic links between the concept of gambling and positive affect because of the high frequency and long duration of their gambling activities. Thus, the strength of positive implicit associations of gambling is likely to increase as problem gambling severity rises.

However, it is possible that problem gamblers may also have a strong automatic association between the concept of gambling and negative affect in their memory to the extent that they consistently experience negative affect in the course of gambling (e.g., disappointment, guilt). The view that as the frequency of substance use increases, both positive and negative automatic associations about substance become highly accessible has received empirical support (e.g., Jajodia & Earleywine, 2003). This finding was often obtained when researchers used implicit measures of attitudes that enabled them to separately assess positive associations and negative associations of gambling (e.g., evaluative priming task). Unlike IAT variant procedures, the evaluative priming task produces unipolar effect sizes, one for positive implicit associations and another for negative implicit associations. We predict that the evaluative priming task will reveal that as a gambling problem becomes move severe, both positive and negative automatic gambling associations will become stronger. In contrast, SC-IAT produces the bipolar effect size estimate, or the extent to which the focal object or issue is more strongly or weakly associated with the positive category than the negative category. Because we do not have an a priori hypothesis about the directionality of the SC-IAT effect estimate, we decided to investigate this issue in an exploratory fashion.

Lastly, we assessed the strength of automatic arousal-sedation associations of gambling. Arousal-sedation has been conceptualized as a predominant dimension of human affective experiences along with valence (Lang 1995; Russell, 1980). Previous findings that problem gamblers revealed greater autonomic arousal when exposed to gambling stimuli (Sharpe, Tarrier, Schotte, & Spence, 1995) suggest the possibility that problem gamblers may have strong automatic arousal associations. Related to these results, recent findings from alcohol research showed that heavy drinkers had stronger arousal-related automatic associations than did light drinkers, whereas the two groups did not differ in sedation-related automatic associations (De Houwer et al., 2004). Thus, we hypothesized that to the extent that problem gamblers strive for increasingly more intense stimulation and excitement from the act of gambling than other gamblers do, the index of problem gambling is likely to be positively correlated with arousal-implicit associations of gambling.

We presumed that the arousal-sedation dimension might be highly informative in gambling attitudes even though this dimension was distinct from the valence or attitudes. In other words, it is likely that gambling motivations are accounted for by the extent to which gambling is automatically associated with arousal and/or sedation. The arousal-sedation dimension was found to be an important component of implicit associations of alcohol (Wiers et al., 2002). This presumption is further corroborated by findings from research in emotions that arousal and valence are two predominant dimensions of human affective experiences (Lang 1995; Russell, 1980).

Method

Participants

One hundred and five undergraduate students in a medium-sized university in North America participated in the study in exchange for partial course credits (mean age = 21 years, $SD = 1.12$). Fifty-six percent of the participants were male. The majority were Caucasian (i.e., 78%), and 17% were of Asian decent.

Instruments

Measure of problem gambling. We used the Canadian Problem Gambling Index (CPGI; Ferris & Wynne, 2001) in order to measure the degree of problem gambling. The CPGI offers a 9-item based index that assesses problem gambling behaviour and consequences (e.g., "How often have you bet more than you could really afford to lose?", "How often has your gambling caused any financial problems for you?"). Each item uses a 4-point scale, anchored by 0 (*never*) and 3 (*sometimes*).

Explicit measures of attitudes. We selected Breen and Zuckerman's (1999) Gambling Attitudes and Beliefs Scale (GABS) as a self-report measure of attitudes toward gambling. GABS is a 35-item, 4-point scale, which is anchored by *strongly disagree* and *strongly agree*. GABS items were constructed to capture a wide array of positive evaluation of gambling (e.g., "Gambling makes me feel alive"), cognitive biases and irrational beliefs (e.g., "Sometimes I just know I am going to have good luck"), and chasing behaviours (e.g., "If I lose, it is important to stick with it until I get even"). According to the authors, all the items of GABS loaded on one big factor, which can be represented as a general affinity to gambling.

In addition, we included Steenbergh, Meyers, May, and Whelan's (2002) Gamblers' Beliefs Questionnaire (GBQ) as another self-report measure of gambling cognition. GBQ is a self-report measure of gambling-related cognitive distortions that assesses illusion of control and overestimation of the likelihood of winning. Even though GBQ is not a measure of gambling attitudes, we included it to assess non-evaluative gambling-related cognitions.

Implicit measures of attitudes toward gambling. We used three response latency procedures in order to assess participants' implicit gambling associations. All of the implicit attitude procedures were designed with DirectRT software.

Evaluative priming. We adapted Fazio et al.'s (1995) evaluative priming procedures in order to assess automatic positive and negative associations of gambling. The purpose of the first block was to obtain baseline data. The mask (i.e., a string of X's) was shown for 300 ms and was followed by positive words or negative words (see the Appendix for the list of words used in the procedure). Participants were asked to categorize each of the words in the positive and negative categories as fast as possible. One half of the participants pressed the "/" key in response to pleasant words and the "Z" key in response to unpleasant words. The key assignment was the opposite for the other half of the participants. The DirectRT software recorded response time, categorizing the positive words (i.e., P_N) and the negative words (i.e., N_N).

In the second block, participants were exposed to "target" (i.e., gambling) visuals (e.g., playing slot machines). Participants were told that they would be asked to remember these visuals in the next phase. The third block involved a recognition test of the visuals presented in the second block. Participants were asked to press the "/" key if the visual had appeared in the previous task or to press the "Z" key otherwise. Each visual remained on the screen for a maximum of 5 s. A 2.5-s interval separated each trial. Participants were exposed to eight "target" visuals that had appeared in Block 3 and eight "filler" visuals not previously presented (i.e., non-gambling related visuals such as playing pool).

The last block involved the priming followed by participants' response to the target. Specifically, gambling visuals were primed for 275 ms, followed by the mask (i.e., a string of X's) and a 250-ms interval before the onset of the target adjectives, which were either positive or negative. A 2.5-s interval separated each trial. Half of the participants were asked to press the "/" key if the target word was positive and the "Z" key if it was negative. The key assignment was the opposite for the other half. The DirectRT software recorded response time for categorizing the positive words (i.e., P_X) and the negative words (i.e., N_X) following the participants' exposure to the gambling visuals. Response latency for gambling-positive association was calculated as the extent to which brief exposure to gambling visuals facilitated the task of categorizing positive (negative) words in Block 4 compared with the baseline task in Block 1. We followed the convention of subtracting the reaction time (RT) in Block 4 from the RT in Block 1 for positive associations and negative associations separately (i.e., the priming positive latency = P_N-P_X; the priming negative latency = N_N-N_X). Thus, the positive sign of the latency indicated that the facilitation effect of priming visuals was strong in relation to the baseline.

SC-IAT. We adapted Karpinski and Steinman's (2006) SC-IAT procedure in order to assess the non-relative implicit attitude toward gambling. Our SC-IAT unfolded in two stages, each of which consisted of one practice block and two test blocks. In the first phase, participants were instructed to press a left-hand key (e.g., the "E" key) as soon as possible in response to exemplars of the "pleasant" category and the target category (i.e., gambling) and to press a right-hand key (e.g., the "I" key) in response to exemplars of the "unpleasant" category. Following the procedures used by Karpinski and Steinman (2006), each block included in the first phase consisted of 24 trials, and gambling pictures, "pleasant" words, and "unpleasant" words were presented in a 7:7:10 ratio in order to prevent a response bias. In the second phase, the "unpleasant" category and the target category were assigned to the right-hand key, and the "pleasant" category that was assigned to the left-hand key was categorized on a different key. In each block included in the second phase, gambling pictures, "pleasant" words, and "unpleasant" words were presented in a 7:10:7 ratio. When participants made an inaccurate response, a red X appeared in the centre of the screen for 150 ms until it was followed by a correct response. We did not use a response window (i.e., "Please respond more quickly!"), which appeared if participants failed to respond within 1,500 ms in the study by Karpinski and Steinman (2006).

To compute the effect size of the SC-IAT, we followed the calculation procedure reported in Karpinski and Steinman (2006). As in Karpinski and Steinman (2006), data from the practice blocks were discarded. Responses of less than 350 ms were discarded and error responses were replaced with the block mean plus an error penalty of 400 ms. Then we subtracted the average response times of the test blocks in the first phase from the average response times of the test blocks in the second phase. The effect of valence SC-IAT was computed by dividing this quantity by the standard deviation of correct response times and error response times that included the 400-ms error penalty within test blocks. Thus, higher SC-IAT scores reflected faster response to positive rather than to negative gambling associations.

Arousal-Sedation ST-IAT. We assessed automatic arousal-sedation gambling associations with the ST-IAT procedure (Wigboldus et al., 2004) because there is no obvious contrast category for gambling. This variant of IAT consisted of five blocks. In the first block, participants categorized arousal and sedation exemplars (e.g., "calming," "exciting") into the arousal category (i.e., "E" key) and the sedation category (i.e., "I" key). In the second block, participants were instructed to press the "E" key in response to gambling and non-gambling images. In the third block, the arousal category and the target category (i.e., "gambling") were categorized on to the same left-hand key (the "E" key), whereas the sedation category was assigned to the "I" key. The third block consisted of 32 trials, in which gambling visuals, "arousal" words, and "sedation" words were presented in an 8:8:16 ratio. In the fourth block, participants were asked to press the "I" key in response to images. The fifth block was also the same as the third block, except that the sedation category and the target category were paired together (i.e., the "I" key) this time, whereas the arousal category was assigned to the "E" key. In the fifth block, gambling visuals, "arousal" words, and "sedation" words were presented in an 8:16:8 ratio. The key assignment was counterbalanced for one half of the participants, and no significant effect of key assignment was found. We followed the D scoring algorithm (Greenwald, Nosek, & Banaji, 2003) to compute the effect of arousal-sedation ST-IAT. Higher D scores reflected faster performance when gambling shared the key with arousal words rather than with sedation words.

Table 1
Means of self-report measures across the gamble groups

	Non-gambler (CPGI = 0)	Low-risk gambler (CPGI = 1–2)	Mid-to-high-risk gambler (CPGI = > 3)	F [2,102] (p-value)
N	54	30	21	
Means of CPGI score	0_a	1.33_b	5.42_c	193.21 ($p < .001$)
GABS	2.15_a	2.36_b	2.63_c	17.52 ($p < .001$)
GBQ	2.32_a	2.91_b	3.72_c	23.71 ($p < .001$)

Note. Means that bear different letters across each row are significantly different under $p < .05$. CPGI = Canadian Problem Gambling Index (Ferris & Wynne, 2001). GABS = Gambling Attitudes and Beliefs Scale (Breen & Zuckerman, 1999). GBQ = Gamblers' Beliefs Questionnaire (Steenbergh et al., 2002).

Procedures
Participants completed the study in groups of 2 or 3. After filling out a consent form, participants sat in front of an IBM-compatible computer. They completed the three implicit attitude tasks in the order of evaluative priming, the arousal-sedation IAT, and the SC-IAT. Two-minute distractor tasks were inserted between tasks, in which participants solved simple calculation questions.

When participants completed the implicit tasks, they were given a booklet that contained GABS, GBQ, and CPGI scales, as well as the final page that asked their age, gender, and whether English was their mother tongue. After this, participants were thanked and debriefed about the purpose of the study. Each session took approximately 30 min.

Results

Problem Gambling Index
Internal consistency of the CPGI was acceptable (coefficient alpha = 0.60). As recommended by Ferris and Wynne (2001), participants were classified into four CPGI status categories. Fifty-four participants were non-gamblers (i.e., a CPGI score of zero), 30 participants were low-risk gamblers (i.e., a CPGI score of 1–2), 17 participants were moderate risk gamblers (i.e., a CPGI score of 3–7), and 4 participants were pathological or high-risk gamblers (i.e., a CPGI score of 8 and above). The omnibus test of one-way analysis of variance (ANOVA) of group means was significant ($F_{2,102} = 193.21$, $p < .001$). As expected, mid-to-high-risk gamblers had the highest score, followed by moderate-risk gamblers and then by low-risk gamblers (see Table 1). Because the number of high-risk gamblers was extremely small, we combined moderate-risk gamblers and problem gamblers to create the category of moderate-to-high-risk gamblers.

Explicit measures of attitudes
GABS showed good internal consistency (coefficient alpha = 0.87). GABS was highly correlated with problem gambling tendency measured with the CPGI ($r = .48$, $p < .01$).

The means of GABS per CPGI gambling status listed in Table 1 showed that mid-to-high-risk gamblers indicated the most positive explicit attitudes, followed by low-risk gamblers and non-gamblers. The one-way ANOVA showed that the mean difference of GABS was significant across these three groups of individuals ($F_{2,\,102} = 17.52, p < .01$). Further, Tukey post hoc tests showed that mid-to-high-risk gamblers reported more favourable attitudes toward gambling than did low-risk gamblers. Moreover, mid-to-high-risk gamblers' mean scores on GABS were not significantly different from the midpoints (i.e., 2.5), which indicated that even mid-to-high-risk gamblers indicated neutral attitudes toward gambling. Table 1 shows that differences in the GBQ score between the three groups were also significant.

Implicit measures of attitudes

The raw means and standard deviations of the RT scores of the three implicit measures of attitudes are reported in Table 2. We determined the reliability of each latency index for IAT variants by calculating latency scores separately for each of the two test blocks and gauging the correlation between the two latency scores, following the procedure used by Karpinski and Steinman (2006, p. 19). Specifically, because simply dividing test block trials into halves underestimates the reliability of the entire measure, we applied the Spearman-Brown correction in order to compensate for this underestimate of the true internal consistency for the entire measure (designated adjusted *r*; Nunnally, 1978). The adjusted *r* was .54 for the valence SC-IAT latency score, whereas it was .61 for the arousal-sedation ST-IAT latency score. Even though these reliability estimates were slightly lower than reliabilities of standard IAT (e.g., Greenwald et al., 2002), they were comparable to reliability estimates of SC-IAT scores reported by Karpinski and Steinman (2006). Thus, the reliability of our gambling SC-IAT and arousal-sedation ST-IAT was deemed acceptable. On the other hand, reliability estimates for the priming task was relatively low: .45 for the gambling-positive index and .28 for the gambling-negative index. However, our estimates were considered comparable to low reliability estimates of the priming task reported in previous studies (Fazio & Olson, 2003). In addition, engaging in the three RT tasks involved relatively infrequent errors (8.25% for the valence SC-IAT, 10.45% for the arousal-sedation ST-IAT, and 11.02% for the priming task).

First, we calculated zero-order Pearson correlations between latency indices (see Table 3). The priming positive latency was positively correlated with the priming negative latency ($r = .45, p < .01$). Neither positive latency nor negative latency drawn from the priming procedure was significantly correlated to the response latency scores of IAT variants. However, we found a significantly positive correlation between valence SC-IAT latency and arousal-sedation ST-IAT latency ($r = .19, p = .04$).

Next, we computed correlations between self-report measures and response latency indices (see Table 4). Because the CPGI score was negatively skewed, we computed Kendall's tau to calculate correlations between the CPGI score and response latency indices. We used the Pearson correlation for GABS and GBQ.

The priming positive and negative latencies were not significantly correlated with any self-report measures. The SC-IAT latency was positively correlated with the CPGI score

Table 2
Means and standard deviations of raw RT scores

The Evaluative Priming Task	Non-gamblers	Low-risk gamblers	Mid-to-high-risk
1st phase "Positive"	733.53 (230.81)	666.45 (191.14)	819.06 (230.79)
1st phase "Negative"	755.85 (201.43)	667.68 (152.42)	832.16 (255.52)
Last phase "Positive"	862.81 (385.81)	865.69 (349.38)	772.59 (343.89)
Last phase "Negative"	963.87 (481.31)	929.91 (391.21)	872.55 (392.17)

The Single Category IAT	Non-gamblers	Low-risk gamblers	Mid-to-high-risk
Test Block I (positive vs. gambling or negative)	738.29 (266.81)	745.15 (289.49)	837.55 (357.63)
Test Block I (gambling or positive vs. negative)	712.48 (290.74)	689.85 (225.57)	806.24 (357.63)
Test Block II (positive vs. gambling or negative)	735.39 (247.99)	755.18 (248.89)	820.28 (378.09)
Test Block II (gambling or positive vs. negative)	717.16 (272.22)	697.82 (261.48)	773.79 (339.99)

The Arousal-Sedation ST-IAT	Non-gamblers	Low-risk gamblers	Mid-to-high-risk
Combination Block I (arousal versus gambling or sedation)	810.63 (306.99)	746.34 (257.77)	830.92 (285.40)
Combination Block I (gambling or arousal versus sedation)	742.23 (258.12)	740.92 (281.07)	821.32 (340.84)
Combination Block II (arousal versus gambling or sedation)	832.27 (284.62)	771.56 (255.55)	843.07 (300.67)
Combination Block II (gambling or arousal versus sedation)	784.06 (298.77)	754.65 (270.83)	826.54 (332.65)

Note. Numbers in parentheses are standard deviations. IAT = Implicit Association Test; RT = reaction time; ST-IAT = Single Target Implicit Association Test.

($r = 0.29$, $p < .01$), which indicated that individuals with greater gambling risk were faster in responding to gambling pictorials when they shared the key with positive stimuli than when they shared it with negative stimuli in the SC-IAT task. The SC-IAT score was also positively correlated with GBQ, which is a measure of gambling-related cognitive distortion ($r = 0.19$, $p = .05$). However, the correlation between SC-IAT and GABS was below the

Table 3
Correlations between response latency indices

	1.	2.	3.	4.
1. Evaluative priming positive latency				
2. Evaluative priming negative latency	0.45* (< .01)			
3. Evaluative priming difference score	−0.61* (<.01)	0.50* (<.01)		
4. Valence SC-IAT latency	−0.04 (.73)	0.19 (.07)	0.08 (.43)	
5. Arousal-Sedation ST-IAT latency	0.05 (.65)	−0.01 (.94)	0.07 (.46)	0.19* (.04)

Note. Numbers with an asterisk are significant at $p < 0.05$. *P*-values are reported in parentheses. SC-IAT = Single Category Implicit Association Test; ST-IAT = Single Target Implicit Association Test.

Table 4
Correlations between response latency indices and self-report measures

	Priming positive	Priming negative	Priming difference	Valence SC-IAT	Arousal- Sedation ST- IAT
CPGI	0.08 (.30)	0.01 (.92)	−0.09 (.39)	0.29* (<.01)	0.05 (.56)
GABS	0.10 (.35)	0.01 (.97)	0.04 (.73)	0.12 (.22)	0.02 (.81)
GBQ	0.09 (.40)	0.00 (.98)	0.04 (.69)	0.19* (.05)	0.06 (.52)

Note. Numbers with an asterisk are significant at $p < 0.05$. *P*-values are reported in parentheses. CPGI = Canadian Problem Gambling Index; GABS = Gambling Attitude and Beliefs Scale (Breen & Zuckerman, 1999); GBQ = Gamblers' Beliefs Questionnaire (Steenbergh et al., 2002); SC-IAT = Single Category Implicit Association Test; ST-IAT = Single Target Implicit Association Test.

conventional significance level. On the other hand, the arousal-sedation ST-IAT score was not significantly correlated with any of the self-report measures.

Finally, we conducted a one-way ANOVA for each response latency index. The main effect of the CPGI group was significant for positive latency indices from the evaluative priming procedure and the SC-IAT. Table 5 lists the omnibus *F* statistics associated with each latency index and the means of the response latency indices for the three CPGI status groups. Even though the omnibus *F* statistics for evaluative priming latency scores were only marginally significant, the Tukey comparison showed that, compared with low-risk gamblers, mid-to-high-risk gamblers were significantly faster for both positive and negative latencies of the evaluative priming ($t = 2.24$, $p < .02$ and $t = 2.37$, $p = .02$, respectively). Furthermore, mid-to-high-risk gamblers were also significantly higher than non-gamblers and low-risk gamblers in the SC-IAT scores. However, a significant mean difference between the three categories of problem gambling risk was not observed for the arousal-sedation ST-IAT.

Table 5
Means of response latency indices per CPGI status group

	Non-gambler	Low-risk Gambler	Mid-to-high-risk gambler	F [2,102] (p-value)
Evaluative priming				
Positive latency	-96.18_a	-229.61_a	22.67_b	2.58 (.08)
Negative latency	-206.06_a	-414.56_b	-79.52_a	2.87 (.06)
Valence SC-IAT	-0.06_a	-0.06_a	0.14_b	5.26 (<.01)
Arousal-Sedation ST-IAT	0.07_a	0.08_a	0.06_a	0.52 (.59)

Note. Means that bear different letters across each row are significantly different under $p < .05$. CPGI = Canadian Problem Gambling Index; SC-IAT = Single Category Implicit Association Test; ST-IAT = Single Target Implicit Association Test.

Discussion

In this paper, we provided a brief overview of response latency measures of attitudes and discussed how these measures may help gambling researchers better understand automatic, impulsive associations of gambling. Specifically, we maintained that whereas self-report measures provide a reliable and efficient measurement of deliberative processes of attitudes, response latency measures help researchers tap automatic processes of attitudes toward gambling. We reported findings from our empirical study that employed response latency measures as well as self-report measures of attitudes toward gambling. Our findings indicated that response latency measures of attitudes used in this study were reliable and valid.

Our empirical study revealed several interesting findings. First of all, we found evidence that implicit measures of attitudes reflect more positive automatic associations in problem gamblers' memory structure. Specifically, our valence SC-IAT was positively correlated with the index of problem gambling severity (i.e., CPGI). Also, we found that moderate-to-high-risk gamblers held more positive attitudes toward gambling than did low-risk gamblers and non-gamblers. The finding that as gambling problem severity increases, the automatic association between the concept of gambling and positivity relative to negativity becomes stronger is probably due to the possibility that positive affect associated with gambling (i.e., pleasure or relaxation) is more proximal than negative affect (e.g., guilt, disappointment) among high-risk gamblers. Further, this finding is consistent with empirical findings from the field of substance use and addiction that heavy substance users' implicit attitudes toward the substance are more positive than those of other individuals (e.g., Rooke et al., 2008).

However, our findings from the evaluative priming procedure were more complex. Moderate-to-high-risk gamblers held not only more positive but also more negative attitudes toward gambling than did low-risk gamblers. Thus, our moderate-to-high-risk gamblers' attitudes toward gambling can be characterized by implicit ambivalence. This finding suggests that as individuals become more vulnerable to gambling severity, not only positive but also negative automatic gambling associations become stronger. This interpretation was corroborated by the finding that the "positive" latency was positively correlated with the "negative" latency in both the evaluative priming task and the valence SC-IAT. Furthermore, this is analogous to a recent finding in the alcoholism domain that habitual drinkers had strong positive and negative associations of alcohol (Houben & Wiers, 2006).

Even though our finding from evaluative priming may appear at odds with the finding from the valence SC-IAT, there is no reason to cast doubt on either finding. There are at least two different reasons for the seemingly conflicting results. On the one hand, the SC-IAT procedure is a bipolar measure of attitudes in which participants are asked to map their attitudes toward gambling in the positive-negative bipolar dimension. Further, the convention of taking the difference of two combination blocks (i.e., the "gambling + positive" vs. negative block and the positive vs. "gambling + negative" block) prevents researchers from exploring the possibility that individuals have simultaneously strong positive and negative attitudes toward the focal concept. In contrast, evaluative priming is designed to provide a unipolar measure of attitudes because it separately records participants' improved response latency for positive and negative targets when the targets are preceded by primes (e.g., pictures of gambling scenes) compared to when such primes are not used (i.e., the baseline condition). Thus, our finding can be explained by the possibility that as gambling severity increases, both positive and negative automatic associations become stronger but at different rates. We presume that unipolar measures of implicit attitudes provide a better assessment of automatic evaluative processes that lie behind socially sensitive issues, such as gambling and addiction. Recently, Houben and Wiers (2006) reported the development of a unipolar variant of IAT that separately measured latencies on the positive-neutral dimension and on the negative-neutral dimension. It would be interesting to employ unipolar IAT and evaluative priming to assess implicit attitudes toward gambling in a unipolar way and to see if the results converge.

Aside from the unipolar versus bipolar distinction, another reason for seemingly different results obtained from the SC-IAT and evaluative priming is that the underlying processes behind these procedures substantially differ in at least two important ways (Fazio & Olson, 2003. First, even though both procedures are regarded as measures of automatic attitudes and preference, the term "automatic" has different meanings for each procedure. In the priming procedure, exposure to the prime activates the positively or negatively valenced associations and readies the participant when the subsequently presented target word is evaluatively congruent. Therefore, the evaluative priming procedure is automatic in the sense that it assesses "the spontaneous activation of evaluative associations in response to the primed stimulus" (Fazio & Olson, 2003, p. 315). On the other hand, the IAT procedure is considered automatic in the sense of uncontrollability rather than spontaneity. In other words, it is possible that participants who engage in the IAT task find it difficult to control their sorting responses even though they are consciously aware of the relative ease of sorting tasks. Second, the average response latency across the set of exemplars of the focal category is used as a measure of attitude toward the category in the priming procedure. Thus, the validity of priming measures depends on the representativeness or prototypicality of the exemplar chosen to serve as primes (Fazio & Olson, 2003, p. 313). In contrast, the IAT assesses the extent to which the category label (e.g., "gambling"), rather than individual exemplars of the focal category, is associated with positive or negative valence.

Our finding of low correlations between latency scores of the two procedures may be due to the possibility that the visuals used in the priming task were not equally prototypical of the gambling category. Alternatively, it is possible that different results might have emerged if we had used “slot” or “poker” rather than “gambling” as the category label in the IAT.

On the other hand, we found that self-report measures of attitudes (i.e., GABS and GBQ) were more positively correlated with problem gambling severity. Even though mid-to-high-risk gamblers expressed more positive attitudes toward gambling than did low-risk gamblers, their attitude was not significantly different from the midpoint. The best interpretation of this finding is that even mid-to-high-risk gamblers expressed neutral attitudes toward gambling in the self-report mode, which is an indication that their response was partially influenced by self-presentation bias.

Further, we found that our response latencies of gambling attitudes were not strongly correlated with self-report measures of attitudes. Latency scores derived from priming were not significantly correlated with any of the self-report measures of gambling cognition. The valence SC-IAT latency score was only weakly correlated with a self-report measure of gambling-related cognitive distortion (i.e., GBQ), but its correlation with GABS was not significant. The lack of strong convergence between implicit measures and self-report measures of gambling attitudes may be simply attributed to the use of different modes of response (i.e., response latency vs. rating). However, there are at least two other explanations for the lack of strong convergence between explicit and implicit attitudes toward gambling. First, this divergence may occur because response latency measures of attitudes have the property of being “uncontrollable” and thus suffer less social desirability bias than do self-report measures (De Houwer, 2006). For example, even though our mid-to-high-risk gamblers may have tried to underreport their positive attitudes toward gambling, SC-IAT and evaluative priming are generally known to be less susceptible to such attempts. On the other hand, an alternative explanation for this finding may be that the bipolar scale used in the self-report measures of attitudes (i.e., “I agree” vs. “I disagree”) is ill-suited to capture ambivalent attitudes (Cacioppo, Gardner, & Berntson, 1997; Leigh, 1989b). When responding to the bipolar scale, individuals who hold ambivalent attitudes tend to choose the midpoint, which is offered as the neutral attitude option. Thus, neutral attitudes reported by mid-to-high-risk gamblers may also be interpreted as ambivalent attitudes. However, this concern is partially mitigated by the fact that the GABS employed an even-numbered point scale and thus a neutral midpoint was not available to participants. However, a stricter test of superiority of response latency measures in assessing gamblers’ ambivalence toward gambling would require the use of a unipolar scale self-report measure of attitudes, which gauges positive and negative attitudes of gambling separately. Future studies are necessary in order to test this possibility.

However, we did not find a significant difference between mid-to-high-risk gamblers and low-risk gamblers in the arousal-sedation gambling IAT. One possible reason for this null effect may be derived from the distinction of the coping versus enhancement motive of gambling (Stewart & Zack, 2008). Some high-risk gamblers may have a predominantly coping motive (i.e., finding solace from stress and negative affect), whereas other high-risk gamblers may have a predominantly enhancement motive (i.e., seeking excitement and arousal from gambling). It is possible that the bipolarity of our ST-IAT procedure may be ill-suited to detect copers and enhancers in the high-risk gambler segment. Alternatively, if only problem gamblers have extremely strong automatic associations of gambling related to arousal or sedation, our study lacks sufficient power to detect this difference because of the small number of problem gamblers included. It is necessary to conduct a study in which the arousal-sedation gambling IAT is administered to a clinical sample that includes a large number of problem gamblers.

We note that one of the criticisms of the IAT is that it seems to pick up environmental associations in society or a general opinion about an object (i.e., "extra-personal influences"; Karpinski & Hilton, 2001). Applied to the gambling context, negative implicit attitudes toward alcoholic drinks may reflect extra-personal cultural norms about gambling (e.g., "gambling is bad for you") rather than, or in addition to, individuals' unique associations. Olson and Fazio's (2004) personalized IAT has been developed as an alternative to the standard IAT, and this procedure was successfully used by Houben and Wiers (2007). Houben and Wiers' (2007) personalized IAT revealed that heavy drinkers held significantly more positive automatic attitudes toward alcohol than they did to soda. Our finding that mid-to-high-risk gamblers showed faster RT for both positive and negative latencies of the SC-IAT suggests that the concern for extra-personal influences probably was not high in our study. However, it is possible that the personalized IAT procedure may help reveal additional insights into uniquely personal processes.

Finally, it should be emphasized that implicit measures of attitudes toward gambling are not necessarily "better" measures than self-report attitude measures. Self-report measures are valid measures of attitudes as long as participants are aware of their attitudes toward the topic of interest and are not motivated to underreport or hide their attitudes from the researcher. Self-report measures also have the advantage of being efficient and inexpensive to administer. However, implicit measures of attitudes are useful when individuals have not had opportunities to deliberate on their (dis)liking of gambling or when they are unwilling to disclose their positive attitudes to others. Furthermore, according to theorists of dual processes, implicit attitudes are valuable in predicting spontaneous behaviours, whereas self-report measures of attitudes predict deliberative behaviours well (Fazio, 1990; Wilson, Lindsey, & Schooler, 2000). In addition, implicit attitudes tend to be a better predictor of actual behaviour than self-report measures of attitudes when individuals' mental resources are depleted or when they are under time pressure (Friese et al., 2008). Because gamblers' mental resources are reduced when they engage in gambling activity for a long time, their gambling behaviour toward the end of a long session is likely to be better predicted by implicit measures of attitudes than by explicit measures.

In this study, we demonstrated that response time-based attitude measures of gambling have acceptable reliability and validity. We acknowledge that this study had several limitations. We used a non-clinical university student sample, and thus our sample did not include many individuals with high problem gambling severity. It would be ideal to conduct a similar study using a clinical adult gambler sample and to look into whether stronger effects of implicit attitudes toward gambling are obtained. In addition, we used a fixed order of response latency measures for all participants. We always presented the evaluative priming task because this task is believed to be more reactive than IAT variants to participants' knowledge of the purpose of the experiment (Sherman, Rose, Koch, Presson, & Chassin, 2003). However, it is possible that the fixed order might serve as a confounding factor because response latencies might have become faster overall in the last task than in the first task. It is necessary to counterbalance the order of presenting response time-based measures in future studies and to assess potential order effects. Another limitation of our study is that we were not able to test the predictive validity of the implicit attitude measures because we did not collect behavioural measures of gambling. We feel that it is necessary to assess the extent to which implicit measures of attitudes predict future gambling frequency and the amount of money spent on gambling over and above self-report measures of attitudes. This will provide a stringent test of practical utility of implicit measures of gambling.

In sum, we applied the implicit attitude assessment procedures to the study of gambling and illustrated the utility of these techniques in this paper. We hope that gambling researchers will adopt these techniques and explore automatic processes that underlie attitudes toward gambling.

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References

Allport, G.W. (1935). Attitudes. In C.M. Murchison (Ed.), *Handbook of social psychology* (pp. 798–844). Winchester, MA: Clark University Press.

Bassili, J.N. (1995). Response latency and the accessibility of voting intentions: What contributes to accessibility and how it affects vote choice. *Personality and Social Psychology Bulletin*, 21, 686–695.

Boyer, M., & Dickerson, M. (2003). Attentional bias and addictive behaviour: Automaticity in a gambling-specific modified Stroop task. *Addiction*, 98, 61–70.

Breen, R., & Zuckerman, M. (1999). Chasing in gambling behavior: Personality and cognitive determinants. *Personality and Individual Difference*, 27, 1097–1111.

Brunel, F.F., Tietje, B.C., & Greenwald, A.G. (2004). Is the Implicit Association Test a valid and valuable measure of implicit consumer social cognition? *Journal of Consumer Psychology*, 14, 385–404.

Cacioppo, J.T., Gardner, W.L., & Berntson, G.G. (1997). Beyond bipolar conceptualizations and measures: The case of attitudes and evaluative space. *Personality and Social Psychology Review*, 1, 3–25.

De Houwer, 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 Publishers.

De Houwer, J., Crombez, G., Koster, E.H.W., & De Beul, N. (2004). Implicit alcohol-related cognitions in a clinical sample of heavy drinkers. *Journal of Behavior Therapy and Experimental Psychiatry*, 35, 275–86.

Eagley, A., & Chaiken, S. (1993). *The psychology of attitudes*. Fort Worth, TX: Harcourt Brace Jovanovich College Publishers.

Fazio, R.H. (1990). Multiple processes by which attitudes guide behavior: The MODE model as an integrative framework. In M.P. Zanna (Ed.), *Advances in experimental social psychology* (Vol. 23, pp.75–109). San Diego, CA: Academic Press.

Fazio, R.H., Jackson, J.R., Dunton, B.C., & Williams, C.J. (1995). Variability in automatic activation as an unobstrusive measure of racial attitudes: A bona fide pipeline? *Journal of Personality and Social Psychology*, 69, 1013–1027.

Fazio, R.H., & Olson, M.A. (2003). Implicit measures in social cognition research: Their meaning and use. *Annual Review of Psychology*, 54, 297–327.

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

Fishbein, M., & Ajzen, I. (1975). *Beliefs, attitude, intention, and behavior: An introduction to theory and research*. Reading, MA: Addison-Wesley.

Friese, M., Hofmann, W., & Wänke, M. (2008). When impulses take over: Moderated predictive validity of explicit and implicit attitude measures in predicting food choice and consumption behaviour. *British Journal of Social Psychology*, 47, 397–419.

Greenwald, A.G., & Banaji, M.R. (1995). Implicit social cognition: Attitudes, self-esteem, and stereotypes. *Psychological Review*, 102, 4–27.

Greenwald, A.G., Banaji, M.R., Rudman, L.A., Farnham, S.D., Nosek, B.A., & Mellot, D.S. (2002). A unified theory of implicit attitudes, stereotypes, self-esteem, and self-concept. *Psychological Review*, 109, 3–25.

Greenwald, A.G., McGhee, D.E., & Schwartz, J.L.K. (1998). Measuring individual differences in implicit cognition: The Implicit Association Test. *Journal of Personality and Social Psychology*, 74, 1464–1480.

Greenwald, A. G., Nosek, B. A., & Banaji, M. R. (2003). Understanding and using the Implicit Association Test: I. An improved scoring algorithm. *Journal of Personality and Social Psychology*, 85, 197–216.

Houben, K., & Wiers, R.W. (2006). Assessing implicit alcohol associations with the implicit association test: Fact or artifact? *Addictive Behaviours*, 31, 1346–1362.

Houben, K., & Wiers, R.W. (2007). Are drinkers implicitly positive about drinking alcohol? Personalizing the alcohol-IAT to reduce negative extrapersonal contamination. *Alcohol & Alcoholism*, 42, 301–307.

Huijding, J., & de Jong, P.J. (2006). Automatic associations with the sensory aspects of smoking: Positive in habitual smokers but negative in non-smokers. *Addictive Behaviors*, 31, 182–186.

Jackson, A.C., Dowling, N., Thomas, S.A., Bond, L., & Patton, G. (2008). Adolescent gambling behaviour and attitudes: A prevalence study and correlates in an Australian population. *International Journal of Mental Health and Addiction*, 63, 325–352.

Jajodia, A., & Earleywine, M. (2003). Measuring alcohol expectancies with the implicit association test. *Psychology of Addictive Behaviors*, 17, 126–133.

Karpinski, A., & Hilton, J.L. (2001). Attitudes and the implicit association test. *Journal of Personality and Social Psychology*, 81, 774–788.

Karpinski, A., & Steinman, R.B. (2006). The Single Category Implicit Association Test as a measure of implicit social cognition. *Journal of Personality & Social Psychology*, 91, 16–32.

Kassinove, J. (1998). Development of the Gambling Attitude Scales: Preliminary findings. *Journal of Clinical Psychology*, 54, 763–771.

Lang, P.J. (1995). The emotion probe: Studies of motivation on alcohol. *American Psychologist* 50, 372–385.

Leigh, B.C. (1989a). Attitudes and expectancies as predictors of drinking habits: A comparison of three scales. *Journal of Studies on Alcohol*, 50, 432–440.

Leigh, B.C. (1989b). In search of seven dwarves: Issue of measurement and meaning in alcohol expectancy research. *Psychological Bulletin*, 105, 361–373.

McCusker, C.G., & Gettings, B. (1997). Automaticity of cognitive biases in addictive behaviours — further evidence with gamblers. *British Journal of Clinical Psychology*, 36, 543–554.

Moore, S.M., & Ohtsuka, K. (1997). Gambling activities of young Australians: Developing a model of behaviour. *Journal of Gambling Studies*, 13, 207–236.

Nunnally, J. (1978). *Psychometric theory*. New York: McGraw-Hill.

Olson, M.A., & Fazio, R.H. (2004). Reducing the influence of extrapersonal associations on the implicit association test: Personalizing the IAT. *Journal of Personality and Social Psychology*, 86, 653–667.

Palfai, T.P., & Ostafin, B.D. (2003). Alcohol-related motivational tendencies in hazardous drinkers: Assessing implicit response tendencies using the modified IAT. *Behavioural Research and Therapy*, 41, 1149–1162.

Preston, F., Bernhard, B., Hunter, R., & Bybee, S. (1998). Gambling as stigmatized behavior: Regional labeling and the law. *Annals of the American Academy of Political and Social Science*, 556, 186–196.

Rooke, S. E., Hine, D. W., & Thorsteinsson, E. B. (2008). Implicit cognition and substance use: A meta-analysis. *Addictive Behaviors*, 33, 1314–1328.

Russell, J.A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology*, 39, 161–1178.

Sharpe, L., Tarrier, N., Schotte, D., & Spence, S. (1995). The role of autonomic arousal in problem gambling. *Addiction*, 90, 1529–1540.

Sherman, J.S., Rose, J.S., Koch, K., Presson, C.C., & Chassin, L. (2003). Implicit and explicit attitudes toward cigarette smoking: The effects of context and motivation. *Journal of Social and Clinical Psychology*, 22, 13–39.

Steenbergh, T., Meyers, A., May, R., & Whelan, J. (2002). Development and validation of the Gamblers' Beliefs Questionnaire. *Psychology of Addictive Behavior*, 16, 143–149.

Stewart, S.H., & Zack, M. (2008). Development and psychometric evaluation of a three-dimensional Gambling Motives Questionnaire. *Addiction*, 103, 1110–1117.

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

Swanson, J.E., Rudman, L.A., & Greenwald, A.G. (2001). Using the implicit association test to investigate attitude-behaviour consistency for stigmatized behaviour. *Cognition and Emotion*, 15, 207–230.

Wiers, R.W., Wood, M.D., Darkes, J., Corbin, W.R., Jones, B. T., & Sher, K.J. (2003). Changing expectancies: cognitive mechanisms and context effects. *Alcoholism Clinical and Experimental Research*, 27, 186–197.

Wiers, R.W., & Stacy, A.W. (2006). *Handbook of implicit cognition & addiction*. Thousand Oaks, CA: Sage.

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

Wiers, R.W., van Woerden, N., Smulders, F.T., & de Jong, P.J. (2002). Implicit and explicit alcohol-related cognitions in heavy and light drinkers. *Journal of Abnormal Psychology*, 111, 648–658.

Wigboldus, D.H.J., Holland, R.W., & van Knippenberg, A. (2004). *Single target implicit associations*. Unpublished manuscript.

Wilson, T.D., Lindsey, S., & Schooler, T.Y. (2000). A model of dual attitudes. *Psychological Review*, 107, 101–126.

Zack, M., & Poulos, C.X. (2004). Amphetamine primes motivation to gamble and gambling-related semantic networks in problem gamblers. *Neuropsychopharmacology*, 29, 195–207.

Zack, M., Stewart, S.H., Klein, R.M., Loba, P., & Fragopoulos, F. (2005). Contingent gambling-drinking patterns and problem drinking severity moderate implicit gambling-alcohol associations in problem gamblers. *Journal of Gambling Studies*, 21, 325–354.

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Dr. Sunghwan Yi is an assistant professor at the Department of Marketing & Consumer Studies, University of Guelph, Ontario. Having been trained in consumer psychology and social cognition, he has recently expanded his research interests in gambling and impulsive consumer behaviour. His recent research interests include automatic associations of impulsive consumer behaviour, such as gambling, tempting foods, and shopping, as well as the use of coping responses to self-regulation failure in the context of gambling, overeating, and shopping. He has employed up-to-date methodologies such as response time latency-based measures of attitudes and Ecological Momentary Assessment.

Dr. Vinay Kanetkar is an associate professor at the Department of Marketing & Consumer Studies, University of Guelph, Ontario. He holds a doctorate in commerce and a master's degree in architecture. His research explores consumer processing of implicit and explicit marketing stimuli, particularly price and advertising and managing price and value responsiveness.

Appendix

Word exemplars used in latency tasks

Evaluative priming		SC-IAT		Arousal-Sedation IAT	
Positive	Negative	Positive	Negative	Arousal	Sedation
good	nasty	terrific	awful	thrilling	serenity
pleasant	awful	awesome	bad	electrifying	soothing
excellent	unpleasant	marvelous	terrible	exhilaration	relaxation
nice	terrible	great	depressing	stimulating	contentment
terrific	bad	splendid	humiliating	energetic	restful
awesome	disagreeable	wonderful	painful	arousal	at ease
marvelous	dreadful	superb	disastrous	animating	unwinding
great	appalling	friendly	disappointing	cheerful	peaceful
		satisfying	discouraging	vigorous	tranquil
		enjoyable	gloomy	enthusiastic	quiet

Note. IAT = Implicit Association Test; SC-IAT = Single Category Implicit Association Test.