Problem Gambling: The Mediating Role of Impulsivity and Cognitive Bias

by

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Table of Contents

Abstract

Previous research has suggested that endorsement of erroneous gambling beliefs is positively associated with gambling intensity and severity (Xian et al., 2008). Likewise, higher levels of impulsivity have also been associated with increasingly severe problem gambling (Steel & Blaszczynski, 1998). This study examined whether impulsivity and cognitive bias were associated with pathological gambling, and if so, which best explained the relationship between gambling risk status and gambling behaviors. A sample of 80 undergraduate students from the University of Manitoba completed a number of measures assessing impulsivity, cognitive bias, gambling behavior, and gambling play. Results showed that probable pathological gamblers (N=40) scored higher in impulsivity (F (5, 74), $p < .005$) and cognitive bias (F (4, 75) = 11.94, $p < .001$) than non-pathological gamblers (N=40). A series of mediation models suggested that the effects of gambling group on some EGM play variables are mediated by cognitive bias, but not impulsivity. Moderated mediation models found that impulsivity moderates the mediating effect of cognitive bias on the relationship between gambling group and EGM play. These results support the treatment of erroneous gambling cognitions with pathological gamblers while it also gives support to the recent reclassification of Pathological Gambling as an "addiction and related disorder" in the DSM-V.

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List of Tables

List of Figures

Problem Gambling: The Mediating role of Impulsivity and Cognitive Bias

Pathological gambling (PG) has great costs both at an individual and societal level, including high rates of criminal activity, job loss, lost wages, and bankruptcy (Gerstein et al., 1999). Additionally, pathological gamblers often cause negative consequences to their families, workplaces, and community (Brown & Raeburn, 2001; Darbyshire, Oster, & Carrig, 2001; Willans, 1996). College students are especially vulnerable to developing gambling problems, as seen in a meta-analysis of reported lifetime prevalence rates for PG (Shaffer, Hall, & Vander Bilt, 1999). Shaffer and colleagues (1999) found college students had higher rates than both adults and adolescents (5.05% versus 1.71% and 4.25%, respectively). Additionally, studies have shown that 42–85% of college students gamble in a given year and 3–23% gamble at least weekly (LaBrie, Shaffer, LaPlante, & Wechsler, 2003; Lesieur et al., 1991). At this age, frequent engagement in gambling is dangerous, as it may lead to increased involvement in high-stakes gambling (Winters, Stinchfield, & Kim, 1995) and is known to predict future gambling problems (Fisher, 1993; Winters, Bengston, Door, & Stinchfield, 1998).

Electronic Gambling Machines (EGMs) are a category of gambling that includes various machines and are predominantly found in alcohol licensed establishments. The popularity of EGMs can be seen in the amount of gambling revenue it generates. The Canadian Partnership for Responsible Gambling (CPRG, 2010) reports that EGMs accounted for 69.4% of the total revenue generated by the Canadian gambling industry. Of the $9.1 billion dollars generated by EGMs across Canada in 2010, over a quarter comes from Video Lottery Terminals (VLTs). Specifically, VLTs are an electronic,

touch-based platform with access to multiple genres of games, including keno, poker, and slots. The key difference that separates VLTs from other EGMs is that each VLT machine is connected to a centralized computer system that allows the lottery jurisdiction to monitor game play and collect its share of revenue (NBGLC, 2012).

Parke & Griffiths (2006) examined EGM factors that contribute to the development, acquisition and maintenance of EGM gambling behavior. They identified two categories of characteristics: situational characteristics, which entice an individual to begin gambling, and structural characteristics, which aim to increase and maintain current gambling. Situational characteristics include the use of advertisements and the placement of EGMs. One especially significant structural characteristic is the use of an intermittent reinforcement schedule. Research has shown that operant conditioning, i.e., the when and how a behavior is rewarded, impacts the future strength and rate of response of a given behavior. An intermittent reinforcement schedule provides rewards for a behavior randomly, which enables a learned behavior to be increasingly resistant to extinction. EGMs operate on intermittent reinforcement schedules by rewarding play unpredictably and regularly. This encourages a high steady rate of responding, making EGM play a strongly learned behavior. Other examples of structural characteristics are the quick results of a bet, allowing users to get immediate gratification, and the near miss. According to learning theory, the immediate pairing of a behavior (e.g., gambling) and reinforcement increases the future strength and rate of response of a given behavior. Following this principle, the quick results of EGM gambling can create a strong relationship between betting and outcome. The strengthening of this relationship in turn can lead to increased gambling behavior. Near misses occur in slot machine gambling

when the outcome of a spin is a loss but appears close to a win (i.e., a result where the winning symbols almost line up). Near misses maintain gambling even though a close loss has the same net monetary value as a loss. Additionally, gambling severity has been shown to predict greater responses in the dopaminergic midbrain in response to near-miss outcomes (Chase & Clark, 2010). Near misses have been also found to enhance neural activity within the midbrain and the ventral striatum (Clark, Lawrence, Astley-Jones, & Gray, 2009; Habib and Dixon, 2010). This suggests that near-misses produce a positive reward signal encoded by the dopaminergic circuits that are known to be involved in reward expectancy and reinforcement learning (Schultz, Dayan, & Montague, 1997; Fiorillo, Tobler, & Schultz, 2003). Behaviorally, gamblers have demonstrated experiencing the excitement of a win with near misses, viewing a series of losses as close to winning (Griffiths, 1994). This may result in an increase in both time spent gambling and bet size. Côté et al. (2003) found that those who were presented with near misses in a continuous series of losses played 33% more games than a control group.

The availability, i.e., the frequency and proximity, of EGMs is another possible contributor of gambling problems. Across Canada, there are approximately 46,000 EGMs, with most found in Ontario and Quebec (CPRG, 2010). A nationally representative survey (Cox, Yu, Afifi, & Ladouceur, 2005) found that higher availability of EGMs is associated with higher rates of gambling problems. The presence of permanent casinos was also identified as a potential contributor. The influence of these two factors is demonstrated by the presence of both EGMs and casinos in four of the five provinces with the highest prevalence rates of gambling problems. A closer examination of the data, however, suggests that EGMs are the dominant influence. The two provinces

that have permanent casinos but no EGMs in the community (Ontario and British Columbia) ranked fifth and eighth in terms of prevalence of gambling problems in Canada. Additionally, despite Quebec having both EGMs in the community and casinos, the province has a low rate of gambling problems. Of all the provinces, Quebec has the smallest concentration of EGMs per 1000 population. In contrast, the two provinces (Manitoba and Saskatchewan) with the highest concentrations of EGMs per 1000 population, had the highest rates of gambling problems (Cox et al., 2005).

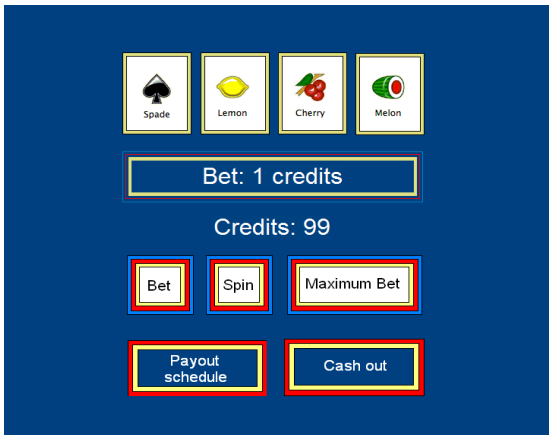
Among people with gambling problems, EGMs are one of the dominant forms of gambling. This is demonstrated through problem gamblers' gambling preferences, as they are more likely to switch from other forms of gambling to EGMs than vice versa (Winters, Stinchfield, Botzet, & Anderson, 2002; Winters, Stinchfield, Botzet, & Slutske, 2005). Additionally, EGMs are associated with faster rates of developing gambling problems. Breen & Zimmerman (2002) examined the time elapsed from when people started to engage in different forms of gambling to when they met DSM IV (APA, 2000) criteria for pathological gambling. On average, those who gambled on cards, horse racing, and sports as their primary gambling activity met criteria for PG 3.58 years after the first time they engaged in the activity. In contrast, those who identified EGMs as their primary gambling activity met criteria after 1.08 years (Breen & Zimmerman, 2002).

Although VLT availability and features of the machine are associated with higher rates of gambling and gambling problems, not every individual who plays VLTs develops a gambling problem. Despite their frequent use in casinos and the community, the majority of VLT players do not experience problems as a result of their play. Thus VLTs

themselves are not fully responsible for the development of PG and other factors must be at work.

According to Griffiths & Wood (2000), a given cluster of factors (i.e., genetic predisposition, social upbringing, psychological constitution, situational and structural characteristics of the machines) will produce a subsection of the population more likely to develop a severe gambling problem. Researchers have identified certain individual differences that may explain why some individuals are at a greater risk than others for developing severe gambling problems. These include personality traits like impulsivity, cognitive bias, negative emotion, risk taking, as well as socioeconomic characteristics like gambling versatility, education, substance dependence, mood and antisocial personality disorders (Myrseth, Pallesen, Molde, Johnsen, & Lorvik, 2009; Scherrer et al., 2007). Given the relationship between EGM gambling and gambling problems, and the potential importance of individual differences in understanding this relationship, the current study examines whether personality traits, like impulsivity and cognitive bias, affect EGM play behaviors. To study EGM play, participants played a simulated slots program, see Figure 1, which recorded different variables of play (i.e. time played, money spent, games played, max bet use, average bet size).

Figure 1. EGM simulation.



Impulsivity

Impulsivity is a complex trait that has been defined in a number of different ways, including both cognitively and behaviorally. Studies have shown that people with gambling problems have higher levels of impulsivity when compared to both recreational gamblers and non-gamblers (Blaszczynski, Steel, McConaghy, 1997; Steel & Blaszczynski, 1998). One way to behaviorally measure impulsivity is assess an individuals' ability to delay gratification for a greater prize in the future, known as delay discounting. Petry (2001a) examined delay discounting, comparing pathological gamblers and controls. Participants were offered the choice of $1,000, presented from 6 hours to 25 years in the future, or a smaller amount of money awarded immediately. Pathological gamblers were found to discount future rewards at a rate higher than controls. Additionally, higher scores on a pathological gambling questionnaire called the South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987) predicted delay discounting, irrespective of age, gender, years of education, substance abuse treatment and cigarette smoking history. The results of Petry (2001a) suggest pathological gamblers may be predisposed to select immediate gratification, despite the future consequences of doing so. In other words, pathological gamblers may not only be sensitive to winning but insensitive to losing. This could conceivably result in long, uninterrupted gambling sessions, leading to a greater risk of developing PG (Wanner, Vitaro, Carbonneau, & Tremblay, 2009). Because commercial gambling games have a negative expectancy (i.e., a "house edge") (Turner, 2011), individuals who play longer will lose more money, which can lead to financial and other hardships.

Biological and physiological components have been examined for a possible link between gambling severity and impulsivity. Krueger and colleagues (2005) explored a possible physiological link by examining heart rate and cortisol levels during gambling. They found that those with high impulsivity had higher heart rates than those lower in impulsivity. A positive relationship was found between impulsivity scores and severity of pathological gambling. While these findings identify a physiological component, research has demonstrated multiple other biological explanations to account for impulsivity's role in PG.

Dysfunction in multiple neurotransmitter systems seem to be involved in pathological gambling. Researchers have found dysfunction in serotonin, norepinephrine, and dopamine neurotransmitters, with each representing different aspects of PG (Hollander, Buchalter, & DeCaria, 2000). Irregularities in the dopamine system found in the D2, D3, and D4 dopamine receptors have been associated with a tendency for individuals to engage in addictive behaviors (Blum et al., 1996; Hollander & Rosen, 2000). This dysfunction in the dopamine system may also be responsible for the tolerance and withdrawal symptoms seen in pathological gamblers (Hollander et al., 2000). Serotonin is associated with behavioral initiation, inhibition, and aggression. Pallanti and colleagues (2006) administered a selective serotonin receptor agonist (m-CPP) to assess the effects of serotonin dysfunction in pathological gamblers. They found that pathological gamblers had an enhanced response to m-CPP, providing support that PG involves a dysfunctional in the serotonergic system. Specifically, m-CPP produced the feeling of a high, which the pathological gamblers identified as similar to the high they experience when gambling. Further support for the role of serotonin dysfunction in

gambling problems is provided by the work of Carrasco and colleagues (1994), who found that pathological gamblers have decreased platelet monoamine oxidase (MAO), a peripheral marker of serotonin function. They found that greater serotonin dysfunction was correlated with symptom severity and suggested that pathological gamblers maybe hypersensitive to postsynaptic serotonergic function. Carrasco and colleagues (1994) suggest that this manifests in the feeling of a high and may explain why gamblers lose control, which is one of the diagnostic criteria for PG in the DSM-IV. Finally, norepinephrine (NE) is linked with regulating arousal, mood, and impulse control. Norepinephrine dysfunction has also been identified in pathological gamblers, as they have increased levels of NE in their cerebro-spinal fluid (Hollander et al., 2000). This dysregulation of NE may explain the increased risk taking seen in pathological gamblers.

Frontal lobe dysfunction, specifically in the ventromedial prefrontal cortex, has also been identified as a possible neurobiological influence on PG (Cavedini, Riboldi, Keller, D'Annucci, & Bellodi, 2002). This area of the brain is involved in decision making and is important in the process of evaluating future consequences. Pathological gamblers have been found to have the same symptoms as individuals with lesions in the ventromedial prefrontal cortex, where both groups have a deficiency in their ability to make decisions and evaluate consequences (Cavedini, Riboldi, Keller, D'Annucci, & Bellodi, 2002). According to Cavedini and colleagues (2002), this deficiency produces insensitivity to future consequences in pathological gamblers, leaving them influenced only by immediate consequences.

While some research has found a link between impulsivity and PG, conflicting results are also found in the literature (Ladouceur, Dube , & Bujold, 1994; Allcock &

Grace, 1988; Petry, 2000; Langewisch & Frisch, 1998). Langewisch and Frisch (1998) found impulsivity was not predictive or associated with PG. The conflicting results may be due to the multiple definitions of impulsivity. Impulsivity has been defined as the inability to cease a behavior; the lack of forethought into the consequences of one's actions; a high sensitivity to immediate gratification; and insensitivity to punishment (Barratt & Patton, 1983; Eysenck & Eysenck, 1977; White et al., 1994). The complexity of conceptualizing and defining impulsivity has led to some methodological issues in research. One definition of impulsivity commonly used in the research literature is found in the DSM-IV's description of problem gambling. It defines impulsivity as 'the failure to resist an impulse, drive, or temptation to perform a harmful act to the person or to others' (American Psychiatric Association, 2000, *p*. 663). This definition lacks precision, as multiple meanings for impulsivity can be taken from this statement. The three main interpretations of impulsivity are as follows: lack of forethought into possible consequences, an unwillingness to delay gratification and a lack of restraint to delay. These multiple interpretations in turn have led to varied results. With researchers working with their own individual interpretation of impulsivity, their measures and interpretations of results are naturally conflicting. With confusion in its definition, further investigation of impulsivity is warranted.

Complicating the issue further, much of the research on the relationship between impulsivity and gambling problems also relies heavily on the use of self-report measures, often not including a behavioral measurement of performance. Although many of the self-report measures currently in use seem to correlate highly with one another (e.g., Barratt Impulsiveness Scale (Patton, Stanford & Barratt, 1995); the BIS/BAS scales

(Carver & White, 1994)), they show only modest overlap with behavioral measures of impulsivity (Barratt & Patton, 1983). Researchers like Goudriaan and colleagues (2008) argue that only behavioral measures of impulsivity are predictive of relapse and suggest that future gambling research will benefit more from behavioral measures than from self-report personality measures. Other studies have not shown any significant correlation between self-reported impulsivity and behavioral measures in PG (Petry, 2001b; Rugle & Melamed, 1993). For instance, Petry **(**2001b**)** was able to significantly discriminate people with gambling problems from non-gamblers using a behavior-based gambling measure, but these results did not correlate with self-reported impulsivity. It has been proposed that, due to its complex and multi-dimensional nature, self-report measures and behavioral measures tap different aspects of impulsivity (Funetes, Tavares, Artes, & Gorenstein, 2006). Fuentes and colleagues (2006) found that including a self-report measure, like the BIS (Patton, Stanford, & Barratt, 1995), with a behavioral measure, like the GO/NO task, increased the ability to discriminate impulsive from non-impulsive subjects. This suggests that each accounts for different aspects of impulsivity. The exclusion of behavioral measures may neglect unique variances of impulsivity not captured by self-report measures. Behavioral measures also have the benefit of assessing temporary fluctuations where self-report measures depend on accurate recall, insight, and honest responding. Self-report measures also tend to be broad in their time range, suiting them for more stable aspects of impulsivity. With both measures accounting for different unique variances of impulsivity, both are necessary when examining impulsivity. For these reasons, both self-report and behavioral measures of impulsivity are used in this study.

Dougherty and colleagues (2009) have examined the multi-dimensional nature of impulsivity in an effort to clarify its definition. They were particularly interested in the relationship between impulsivity and substance use disorders. Using measures like the NO/GO task (which requires individuals to press a button when one stimulus type appears and withhold a response when another stimulus type appears) and a discounting task (which requires participants to choose between smaller immediate rewards and larger delayed rewards where the magnitude of reinforcement and delay are systematically varied), they identified a three component model of impulsivity. Dougherty and colleagues' (2009) model of impulsivity consists of: response initiation; response inhibition; and consequence sensitivity. Response initiation refers to impulsivity occurring before the proper processing and evaluation of a stimulus. Response inhibition involves the failure to inhibit an already initiated response. Finally, consequence sensitivity involves continuing a response despite negative or less than optimal consequences (e.g., smaller reward or punishment). All three were identified using behavioral measures, and each assesses a unique component of impulsivity. Because gambling, especially in a game of chance, typically involves small rewards and punishment in the form of losing money (The Economist, 2010), consequence sensitivity seems to have the greatest applicability to the study of gambling. Thus, the current study uses Dougherty and colleagues' (2009) Two Choice Impulsivity Paradigm (TCIP) as a behavioral measure of impulsivity.

Cognitive Bias

Another variable that is thought to contribute to gambling problems is cognitive bias. Cognitive bias is listed in the DSM-IV as an associated feature of pathological

gambling, identified as distortions in thinking in the form of denial, superstitions, overconfidence in their perceived skill, or a sense of control over gambling outcomes (APA, 2000). These cognitions are inconsistent with how the machines operate, yet pathological gamblers fail to reconcile this incongruence. Inside every EGM is a computer chip, called a random number generator, which is responsible for generating the outcome of each individual gaming event (MLC, 2012). The chip constantly generates thousands of numbers at random and, at the moment the player presses a button to start a gaming event, it selects a number which is linked to a certain result that is subsequently displayed to the player. With the process of generating outcomes completely random, each spin has no impact on future spins, making outcomes unpredictable and beliefs about control over the machines unjustified. However, some EGM games offer better payouts than others and some incorporate some aspect of skill. For instance, video poker gives players greater control through card selection and has fixed odds, unlike slots, because it always uses a 52-card deck. This allows players to calculate their odds of winning, through their knowledge of what cards remain in the deck, and make more favorable decisions. Additionally, pay tables vary across video poker machines, with some machines having more liberal pay tables. Professional video poker players use this knowledge to seek out the best machine to play, giving them a slightly positive expected value, as long as they adhere to perfect strategy, which, in practice, is difficult to maintain. These game variations partially validate gamblers sense of control, but not completely. Behaviors like rubbing the screen or looking for hot machines (i.e., machines perceived to be ready to payout in the near future) are some examples of erroneous cognitions which have no impact on gambling outcomes.

Ladouceur and Walker (1996) have suggested a cognitive theory of gambling, explaining how cognitive bias might develop within gamblers. They suggest it begins with a fundamental error in the perception of randomness. This occurs through the development of an illusion of control, which Langer (1975) defined as expecting success higher than objective probability warrants. The illusion of control develops in chance settings when there are conditions that include choice, familiarity, involvement, and competition. These conditions are often partially or fully met in many forms of gambling. Through both the development of illusion of control and erroneous beliefs, gamblers develop strategies emphasizing the skills they believe are needed to win but in reality have no impact on gambling outcome (e.g., rubbing the screen, belief in hot versus cold machines, believing payouts are linked to seasonal patterns, etc.). These processes all work the same way by encouraging gamblers to believe they are exercising increased control.

Cognitive bias has been found to be an important factor in gambling severity (Sylvain, Ladouceur, & Boisvert, 1997). In a study examining the rates of erroneous gambling beliefs held by problem gamblers and non-problem gamblers, Joukhador and colleagues (2004) found that problem gamblers held more erroneous gambling beliefs than non-problem gamblers, and those beliefs were correlated with gambling intensity (i.e., gambling sessions per week, amount of money taken to each session, level of current debts, years of problem gambling, time spent gambling, and weekly losses). A second study (Xian, Shah, Phillips, Scherrer, Volberg, & Eisen, 2008) demonstrated a positive association between higher scores on measures of cognitive distortions and

pathological gambling symptoms, even after controlling for genetic and shared environmental influences and non-pathological gambling psychiatric disorders.

Not all research supports the relationship between erroneous gambling cognitions and gambling severity. For instance, Ellery & Stewart (in press) examined whether cognitive bias mediated the relationship between alcohol consumption and gambling behaviors for probable pathological and non-pathological gamblers. In the probable pathological gamblers group, alcohol consumption influenced gambling behavior, but not cognitive bias. In contrast, alcohol consumption affected cognitive bias but not gambling behavior for the non-pathological gamblers. These results demonstrated that cognitive bias did not explain the effects of alcohol on gambling behavior, finding no relationship between gambling thoughts and in-session gambling behaviors. May and colleagues (2005) designed a study to investigate the causal relationship between gambling-related irrational beliefs and increased in-session gambling behavior. They set out three conditions: the first group was given a message designed to increase their illusion of control (IOC), the second group was given a message to decrease IOC, and finally, a third group was given a neutral message. According to the cognitive theory of problem gambling, the first group should have demonstrated increased erroneous gambling beliefs and increased in-session gambling behavior compared to the other two groups. However, May and colleagues (2005) found that, despite an increase in erroneous gambling beliefs, the first group demonstrated no significant difference in gambling behaviors from the other groups. This study casts doubt on the causal role of cognitive bias, finding no link between erroneous gambling beliefs and gambling play. Cronce and Corbin (2010) reinforces the findings of Ellery & Stewart (in press) and May (2005), finding no

significant relationship between distorted gambling cognitions and in-session gambling behavior (i.e., average bet size). Given conflicting results in the current literature, additional research is needed to assess the contributions of cognitive biases to gambling behavior.

The current study uses a quasi-experimental, between-subjects design, with one independent variable (IV; SOGS classifications) with two levels (non-pathological, pathological), two mediator variables (IV_m; Impulsivity, Cognitive Bias) and five dependent variables (DV; money spent, number of presses of the "max bet" button, amount of time played, number of gaming events, average bet size). The purpose of this study is to examine if impulsivity, measured using both behavioral and self-report measures, and cognitive bias mediate the effect of gambler status (i.e., being a pathological gambler or non-pathological gambler) on gambling behaviors, and if so, which best explains the relationship between SOGS classifications and gambling behaviors during a simulated EGM gambling session. The first hypothesis is that probable pathological gambler status will be associated with more money spent, greater number of max bets, more time played, more gaming events played, and greater average bet size. The second hypothesis will test whether impulsivity mediates the effect of gambler status on gambling play, where it is predicted that impulsivity will explain the relationship between gambler status and gambling behaviors. The third hypothesis will test whether cognitive bias mediates the effect of SOGS classification on gambling, where it is predicted that cognitive bias will explain the relationship between gambler status and gambling behaviors. Finally, the fourth hypothesis will compare impulsivity and cognitive bias as simultaneous mediators of the effect of gambler status on gambling

behaviors. Because of the mixed results in previous literature about the influence of distorted gambling cognitions on in-session gambling behaviors, and the inclusion of behavioral measures of impulsivity in the current study, it is predicted that impulsivity will present as the primary mediator.

Method

Participants

Sample size was chosen following an *a priori* power analysis based on the effect sizes reported by Ellery & Stewart (in press). The results indicated that a sample size of 80 was sufficient to detect a treatment effect approximately 90% of the time. Participants consisted of 40 probable pathological gamblers and 40 non-pathological gamblers, as identified by the South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987), recruited from students attending first year psychology classes at the University of Manitoba.

Demographics

Table 1 on page 17 displays the means (and SDs) for the demographic variables as a function of SOGS category. Demographic variables (i.e., age, total years of education, and income) were analyzed in a set of ANOVAs or Chi-square analysis in the case of the two dichotomous demographic variables (i.e., gender and marital status, which was coded as either living with a partner or not living with a partner), in order to ensure comparability of the two groups. For the ANOVAs on the continuous demographic variables, there were no significant main effects of SOGS category on age, income, educational, and employment status, indicating that the conditions were balanced in terms of these demographic variables. The ANOVA on SOGS classification x SOGS

total score revealed a significant main effect (F (1, 78) = 101.75, $p < .001$). As theoretically expected, probable pathological gamblers had significantly higher SOGS scores than non-pathological gamblers [means (and SDs) = 7.8 (3.28) versus 2.2 (1.24)], supporting the validity of the gambler classifications. For the dichotomous demographic variables, no differences existed among the two groups, i.e., between probable pathological gamblers and non-pathological gamblers, in terms of marital status, χ^2 (2, N = 80) = 0.48, $p > .05$. Because, in the general population, the number of men with gambling problems is generally greater than the number women with gambling problems (Stoletenberg, Batien, & Birgenheir, 2007; Welte, Barnes, Wieczorek, Tidwell, & Parker, 2004), women with gambling problems were actively recruited for the study. As a result, the gambler groups were also balanced in terms of gender. The results suggest that the recruitment strategy was successful, and, overall, the conditions were balanced in terms of demographic variables.

Table 1

Means (and SDs) for the Demographic Variables as Functions of SOGS Category (Probable Pathological vs. Non-Pathological Gamblers)

	Non-pathological gamblers n = 40		Probable pathological gamblers n = 40	
	M	SD	M	SD
Gender % Male	50%	(n = 10)	50%	(n = 10)
Marital status % single	88%	(n = 35)	88%	(n = 35)
Age (years)	21.05	(6.17)	19.85	(2.83)
Years of education	2.78	(.62)	2.55	(.55)
Household income (rated 1 to 11)	7.42	(4.15)	7.45	(4.21)

Materials

EGM play was simulated and recorded via a computer program simulation of an EGM slots game (c.f. Hurley, Ellery, & Jamieson, 2010). The layout consisted of four digital reels, a spin button, a max bet button (which was equivalent to betting the highest wager), and an adjustable bet button allowing participants to wager one to ten credits per "spin", with one credit being equal to 10 cents. A payout schedule button allowed players to view the number of credits that would be won for each winning outcome, depending on the number of credits bet. When the program began, the player was presented with instructions on how to play and the value of each credit. The program was pre-loaded with 100 credits, or the equivalent of $10. The program was designed to provide the same sequence of outcomes to each participant, in order to ensure consistency in outcomes across individuals. Play ended when participants either ran out of money or decided to terminate. The program saved the data required to compute each of the outcome variables.

Qualtrics was used to create online versions of the self report questionnaires. Qualtrics is a web-based application which supplies tools to create online questionnaires and produces data in a useable form for statistic packages. All data is held in secure data centers with every account password-protected.

Measures

The Informational Biases Scale (IBS; Jefferson & Nicki, 2003). The Informational Biases Scale (IBS; Jefferson & Nicki, 2003) measures irrational beliefs about video lottery terminal play using a 25 item self-report questionnaire scored on a seven point Likert scale. The IBS has two factors: Misunderstanding of outcomes and Gamblers Fallacy.

Factor one measures general misconceptions of VLT outcomes and includes items like "It makes me upset when I almost win on VLTs" or" Winning on VLTs makes me feel skillful". Factor two measures the gambler's fallacy (thoughts that a random event can be predicted based on previously occurring independent events) and included items such as "The longer a VLT has gone without paying out a large sum of money, the more likely are the chances that it will pay out in the very near future" or "I have purposely avoided playing on VLTs that have recently paid out a lot of money".

Its development was based on the combination of gambling cognition literature and data collected from focus group interviews with VLT players. The IBS has excellent internal consistency, with a Cronbach's $\alpha = .92$ as reported by its authors. It has adequate construct validity, correlating with the SOGS (Lesieur & Blume, 1987) at $\underline{r} = .48$ and with the lifetime National Opinion Research Center DSM-IV Screen for Gambling Problems (NODS; Gerstein et al., 1999) at $\underline{r} = .38$, when administered to problem gamblers. Research has demonstrated the sensitivity of the IBS as an effective treatment outcome measure when psycho-education is used to modify irrational cognitions concerning VLTs (Doiron & Nicki, 2007).

Barratt Impulsivity Scale (BIS; Patton, Stanford, & Barratt, 1995). The Barratt Impulsivity Scale (BIS; Patton, Stanford, & Barratt, 1995) is a 30 item self-report questionnaire which measures different aspects of impulsivity. Each item consists of a statement in which the respondent must give one of the following responses: Rarely/never, occasionally, often, and almost always. Factor analysis of the BIS (Patton, Stanford, & Barratt, 1995) revealed six first-order and three second-order factors. The first-order factors are: Attention (focusing on the task at hand); Motor Impulsiveness

(acting on the spur of the moment); Self-control (planning and thinking carefully); Cognitive Complexity (enjoy challenging mental tasks), Perseverance (a consistent life style) and Cognitive Instability (thought insertions and racing thoughts). The three second-order factors are: Attentional Impulsiveness (combining Non- Attentional and Cognitive Instability); Motor Impulsiveness (combining Motor Impulsiveness and Non-Perseverance); and Non-planning Impulsiveness (combining Self-control and Cognitive Complexity). Alpha coefficients for the total BIS were within acceptable limits for use in applied studies (e.g., undergraduate students: $\alpha = 0.82$).

Gambling Activities Questionnaire. This author-compiled questionnaire, consisting of items used in previous studies (e.g., Dechant & Ellery, 2011), was used to gather information about gambling frequencies, time spent gambling, money spent on gambling, and alcohol and tobacco use while gambling.

Demographics and Information Questionnaire. This author-compiled questionnaire, consisting of items used in previous studies (e.g., Ellery, Stewart, & Loba, 2005), was used to gather information about age, gender, and family income.

The South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987). The SOGS is a 16-item self-report questionnaire which measures gambling behavior and determines an individual's gambler risk status. Only eleven of the items are scored to classify gamblers, with scores greater than or equal to five used to identify probable pathological gamblers (Lesieur & Blume, 1987). Scores of zero to four are classified as non-pathological gamblers and scores greater than five as probable pathological gamblers. The SOGS was created using from many different sources including Gamblers Anonymous' 20 questions, the DSM-III (APA, 1980) criteria for pathological gambling, and from clinical

experience with problem gamblers. The SOGS has an excellent internal consistency (α = .97) and a good test-retest reliability after 30 days (r = .71), thus indicating the SOGS is a reliable instrument (Lesieur & Blume, 1987). Examining three different populations (Gamblers Anonymous members, university students, and hospital employees) yielded false positive rates ranging from 0.7% to 1.4%, and false negatives ranging from 0.0% to 3.4% (Lesieur & Blume, 1987).

Problem Gambling Severity Index (PGSI; Wynne, 2003). Wynne (2003) designed the PGSI to classify gamblers into four categories: non-problem, low risk, moderate risk, problem gamblers. In this study, the PGSI will be used to validate the SOGS gambler risk status classifications. Its nine items are based on the DSM-IV criteria for pathological gambling, and scores have been shown to be correlated with the diagnosis (American Psychiatric Association, 1994). When scores are calculated, the PGSI assigns the recipient to one of the four classes based on their total score. Scores of 0 represent non-problem gambling, 1-2 represent low risk; 3-7, moderate risk; above 8, problem gambling. However a recent validity and reliability analysis of the four PGSI gambler classifications by Currie, Hodgins, & Casey (2013) only found strong evidence for the validity of the non-problem and problem categories. The low risk and moderate risk categories showed poor discriminant validity. They recommended combining the low and moderate risk categories to increase validity. Based on this recent finding, the three classifications will be used in the current study: non-problem, low/moderate risk, and problem gambler. Concerning the reliability of the PGSI, Wyne (2003) found a Cronbach's α coefficient of 0.84. Research has also found the PGSI to be both sensitive and specific. Using a cutoff score of 8 or greater, the instrument detected 83% of the

individuals in a validation study who met DSM-IV (APA, 2000) criteria for pathological gambling, and did not falsely identify any individuals as problem gamblers who did not meet DSM-IV (APA, 2000) criteria for pathological gambling (Wynne, 2003).

Gambler's Beliefs Questionnaire (GBQ; Steenbergh, Meyers, May, & Whelan, 2002). The GBQ is a 21-item self-report questionnaire which measures cognitive distortions concerning gambling. It consists of two factors: Luck/Perseverance (i.e., one's perception of chance being on their side) and Illusion of Control (i.e., one's perception that their actions influence gambling outcomes). Internal consistency for the overall GBQ score was excellent with a Cronbach's α of .93. The GBQ's two subscales ranged from good to excellent, with its authors reporting a Cronbach's α of .89 on the Luck/Perseverance subscale and .94 for the Illusion of Control subscale. Preliminary research by Steenbergh et al. (2002) has demonstrated that the GBQ has good test-retest reliability ($\underline{r}$ = .77) and convergent validity (GBQ was moderately correlated with average time spent gambling, $\underline{r}$ = .43).

Two Choice Impulsivity Paradigm (TCIP; Dougherty et al., 2009): The TCIP is a discrete-choice delay discounting procedure that involves the participant indicating their preference for smaller-sooner versus larger-later rewards. In total the participant makes 50 reward choices of this nature with two response options. The measure begins with the introduction of standardized instructions followed by a brief practice session. This practice session explains the two delay-reward contingencies without explicit information as to what the task is assessing. Following the practice session, two options appear on the screen in the form of circles and squares in black against a white background for each trial. The orientation for the shapes to be either left or right was randomly determined.

The participant then proceeds through the trials choosing between selecting a circle earning them five points after waiting 5 sec and selecting a square earning them 15 points after waiting 15 sec. After choosing a shape, the other shape disappeared with the selected shape fading to gray. After the scheduled delay elapsed, the shape changed back to black and flashed for 500 msec once per second; this indicated that the participant should click on the shape again to add the reward points they earned. Two independent measures are assessed in this measure: the proportion of smaller-sooner reward choices and the total number of consecutive larger-later reward choices and the proportion of smaller-sooner reward choices is used as an indicator more impulsive choices. The total number of consecutive larger-later reward choices is used as an additional indicator of one's ability to delay reward. Both measures were used in this study.

Procedure

All participants were directed to a computer desk where they were given an informed consent form in which they signed in order to participate in the study. Once the participant signed the consent form they were asked to complete the SOGS (Lesieur & Blume, 1987) as well as a few questions inquiring about how often they play VLTs. This ensured that participants had at least some experience with VLTs (i.e., having played at least twice in the last month). Those who did not meet this criterion were ineligible to participate in the study. Participants then completed a questionnaire package that included the demographics questionnaire, the gambling activities questionnaire, the BIS (Patton, Stanford, & Barratt, 1995) the GBQ (Steenbergh et al., 2002) and the PGSI (Wynne, 2003), with the order of these questionnaires randomized across participants.

Participants then completed the TCIP and were invited to play a slots program, see Figure 1. This program is a slots program that mimics many of the same features found on EGM slots. To play, participants selected how much they desired to bet for an upcoming spin through an adjustable bet button ranging from 1 credit to 10 credits. Once a bet was decided, participants pressed the spin button which triggered the spinning of the four slot reels. If the wheels stopped and displayed a winning combination of symbols (i.e. four sevens), the program rewarded the participant credits. Participants could access which combinations resulted in winnings through the payout schedule button. The game was pre-loaded with $10.00 worth of credits and participants were instructed to play as much or as little of the $10.00 as they wish and that upon termination they would be paid out whatever credits they have left. Once participants either ran out of credits or indicated that they wished to end their session, they were debriefed, thanked for their time and participation and paid whatever credits remained from the slots program.

Results

Transformations

The distributions of variables examined using analyses of variance (ANOVAs) had skew values that were within acceptable limits, i.e., they had sufficiently normal distributions as to not violate ANOVA assumptions. One exception was the PGSI score, which showed marked positive skew. This variable was therefore transformed using a square-root transformation. After transformation, skew values fell within acceptable limits.

Self Report Gambling Frequencies

Self-report gambling behavior variables were examined in a MANOVA, i.e.,

hours and money spent gambling per week, as well as frequency of assorted gambling behaviors (sports betting, poker, etc.). The MANOVA revealed a significant overall multivariate effect of SOGS category on the set of gambling behavior variables (F (1, 78) = 3.25, $p < .005$). Follow-up univariate ANOVAs showed that the overall effect was reflective of the significant effect of SOGS category on the sports betting ($F(1,80) = 17.04$, $p < .001$), slots play ($F(1,80) = 9.61$, $p < .01$), table games ($F(1,80) = 8.56$, $p < .01$), VLT (F (1,80) = 17.39, $p < .001$), Poker at home ($F(1,80) = 4.43$ $p < .05$), Public Poker ($F(1,80) = 8.30$, $p < .01$), Card games ($F(1,80) = 4.32$, $p < .05$), internet gambling ($F(1,80) = 6.86$, $p < .05$), hours per week spent gambling ($F(1,80) = 4.80$, $p < .05$), and money per week spent gambling ($F(1,80) = 9.98$, $p < .01$). These findings are expected due to pathological gamblers preference for a wider range of gambling activities than non-pathological gamblers (Kessler et al., 2011; Majer, Angulo, Aase, & Jason, 2008). These findings support the gambling classifications in the study. Table 2 on page 26 displays the means (and SDs) for the gambling frequency variables as a function of SOGS category.

PGSI Classifications

To determine the level of agreement between the SOGS and PGSI classifications, a Chi-square analysis was performed. The test revealed a significant difference between the two gambling classification measures, suggesting that the two measures classified differently. According to the results, the SOGS appeared to be the more sensitive measure. Classification differences are presented in Table 3 on page 27.

Table 2

Means (and SDs) for the Gambling Frequency Variables as a Function of SOGS Category (Probable Pathological vs. Non-Pathological Gambler)

Gambling activities (rated 1 to 9)	Non-pathological gamblers n = 40	Probable pathological gamblers n = 40	*F*	*p*
	M (SD)	M (SD)		
Sports betting	2.20 (1.54)	4.22 (2.69)	17.04	.000***
Lottery tickets	4.20 (1.79)	4.98 (2.09)	3.17	.079[a]
Charity gambling	2.95 (1.77)	3.12 (2.31)	.15	.705[a]
Bingo	2.52 (2.08)	2.55 (1.93)	.00	.956[a]
Slots play	4.45 (1.48)	5.73 (2.14)	9.61	.003**
Table games	3.35 (1.99)	4.83 (2.49)	8.55	.005**
VLT	3.68 (1.76)	5.45 (2.04)	17.39	.000***
Horses	1.80 (2.00)	1.75 (1.50)	.02	.900[a]
Poker public	1.83 (1.5)	3.10 (2.36)	8.30	.005**
Poker home	3.05 (1.91)	4.00 (2.12)	4.43	.039*
Card/Skill games	2.60 (2.05)	3.60 (2.25)	4.32	.041*
Internet gambling	1.65 (1.82)	3.08 (2.92)	6.86	.011*
Hours per week gambling	1.90 (1.46)	7.33 (15.60)	4.80	.031*
Money spent per week gambling (in dollars)	$36.21 ($40.41)	$78.93 ($63.82)	9.98	.002**

*$p<.05$
**$p<.01$
***$p<.001$
[a] Not statistically significant ($p>.05$)

A t-test was performed, with the transformed PGSI scores as a function of SOGS grouping, where a significant main effect was found; $t(78) = 5.96$, $p = 0.00$. As expected, probable pathological gamblers (M = 2.48, SD = .79) had higher PGSI scores than non-pathological gamblers (M = 1.38, SD = .86), supporting the validity of the SOGS classifications.

An ANOVA was performed to further examine the agreement between the SOGS

and PGSI classifications. The ANOVA found that the overall effect of PGSI classifications on SOGS scores was significant (F (2, 77) = 12.17, $p < .001$). Tukey's tests revealed the moderate and non-problem groups did not differ, $p = .255$. The remaining groups were found to be significantly different from each other, $p < 0.001$. When comparing SOGS and PGSI classifications, it is expected that the SOGS non-pathological classification should be equivalent to the PGSI's non-problem and the low/moderate classifications. The current study found no difference in SOGS scores between these two groups, supporting the use of SOGS classifications with our sample. In contrast, it expected that the SOGS classification of probable pathological gambler should be equal to the PGSI's classification of problem gambler. In this study 16 out of 40 probable pathological gamblers were classified as problem gamblers by the PGSI. This difference could be due to the excellent specificity of the PGSI (Wynne, 2003).

Table 3

PGSI Classifications as a Function of SOGS Category

SOGS classifications	PGSI classifications				
	Non-problem	Low/Moderate gamblers	Problem gamblers	χ_2	Φ
Non-pathological gamblers	7	32	1	19.21	0.49
Probable pathological gamblers	1	23	16		

Hypothesis Testing: Effects of SOGS category on Gambling Behaviors via MANOVA

The following behaviors were measured during the EGM play session: money spent time spent playing, average best size, max bet use, and number of gaming events. A

MANOVA revealed a non-significant overall multivariate effect of SOGS category on the set of the EGM play variables (F (5, 74) = 1.86, p = .112). However, follow up (SOGS category x EGM play variables) univariate ANOVAs found a main effect for max bet use (F (1, 78) = 4.85, p < .05). In other words, probable pathological gamblers when compared to non-pathological gamblers used the max bet feature more frequently [means (and SDs) = 25.95 (28.53) versus 13.6 (21.1)]. The remaining four EGM variables did not significantly differ between probable pathological gamblers and non-pathological gamblers in this analysis. However, these non-significant findings did not rule out the possibility of these variables being significant in a mediation analysis. Fortunately, a significant relationship between independent and dependent variables is not necessary to test mediation; only the indirect effect is required to be significant to establish mediation (Zhao, Lynch, & Chen, 2010). Means (and SDs) for the variables are presented in Table 4 on page 29.

In order to establish the theoretically expected (albeit statistically unnecessary; Zhao et al, 2010) differences in impulsivity and cognitive biases, a set of MANOVAs were also conducted to probe for significant differences between probable pathological gamblers and non-pathological gamblers in their impulsivity and cognitive bias scores.

A MANOVA revealed a significant overall multivariate effect of SOGS category on the set of impulsivity variables (F (5, 74) = 6.25, p < .005). Follow up (SOGS category x impulsivity variables) univariate ANOVAs showed that the overall effect was reflective of the significant effect of SOGS category on BIS Attentional Subscale (F (1, 78) = 9.00, p < .001), the BIS Motor Subscale (F (1, 78) = 10.49, p < .001), and the BIS Non-planning Subscale (F (1, 78 = 5.27, p < .001).

Table 4

Means (and SDs) for the EGM Variables as Functions of SOGS Category (Probable Pathological vs. Non-Pathological Gambler)

EGM Variables	Non-pathological gamblers	Probable pathological gamblers		
			F	*p*
	n = 40	n = 40		
	M (SD)	M (SD)		
Average bet size (in credits)	5.89 (2.56)	6.34 (2.56)	.71	.403[a]
Max bet use (total times in session)	13.6 (21.1)	26.54 (28.66)	4.85	.031*
Time played (in minutes)	7.4 (4.16)	7.90 (3.75)	.52	.474[a]
Money spent (in dollars)	$3.3 ($6.15)	$4.06 ($6.22)	.30	.584[a]
Number of gaming events (total spins in session)	73.4 (44.25)	75.15 (40.13)	.05	.832[a]

*$p<.05$
**$p<.01$
***$p<.001$
[a] Not statistically significant ($p>.05$)

In other words, probable pathological gamblers, when compared to non-pathological gamblers, were less future oriented [means (and SDs) for BIS Attention = 17.35 (3.29) versus 15.38 (2.56)], acted on the spur of the moment [means (and SDs) for BIS Motor = 23.85 (3.76) versus 21.43 (2.88)], and had diminished ability to focus on tasks at hand [means (and SDs) for BIS Non-planning = 26.3 (4.98) versus 23.83 (4.66)]. There were no significant effects in the MANOVA for the two behavioral measures of impulsivity.

A 2 x 4 MANOVA revealed a significant overall multivariate effect of SOGS category on the set of cognitive bias variables (F (4, 75) = 11.94, $p < .001$). Follow up

(SOGS category x cognitive bias variables) univariate ANOVAs showed that the overall effect was reflective of the significant effect of SOGS category on all four of the cognitive variables: GBQ Factor 1 (F (1,78) = 25.07, $p < .001$), GBQ Factor 2 (F (1,78) = 16.00, $p < .001$), IBS Factor 1 (F (1,78) = 42.87, $p < .001$), and IBS Factor 2 (F (1,78) = 25.27, $p < .001$). In other words, probable pathological gamblers when compared to non-pathological gamblers believed more in luck [means (and SDs) for GBQ Factor 1 = 53.23 (11.42) versus 67.6 (14.12)], believed more that they controlled gambling outcomes [means (and SDs) for GBQ Factor 2 = 28.03 (6.12) versus 34.73 (8.64)], endorsed the gambler's fallacy [means (and SDs) for IBS Factor 1 = 78.69 (13.51) versus 56.95 (16.08)], and misunderstood gambling outcomes [means (and SDs) for IBS Factor 2 = 42.73 (6.12) versus 33.55 (9.78)].

Hypothesis Testing: Mediation of the Effects of SOGS Category on Gambling Behaviors

A mediation analysis was performed in order to ascertain the variance in EGM play behaviors accounted for by SOGS classifications, impulsivity, and cognitive bias. A mediation analysis is a regression analysis that places causal structure and requires certain conditions. Through a series of regressions, mediation analysis determines the extent that one variable accounts for the relation between the predictor and the criterion. The mediation analysis in this study was performed according to the mediation procedure set forth by Zhao et al. (2010). They state that when establishing mediation, one only requires the indirect effect to be significant (i.e. the mediator variable must be significantly correlated with both the independent and the dependent variable). They recommend running a Preacher-Hayes script (Preacher & Hayes, 2004) to perform a

bootstrap procedure to determine whether the indirect effect is significant. A Preacher-Hayes script is a macro developed for statistical packages that estimates the path coefficients (a, b, c) in mediator model and generates bootstrap confidence intervals for both the total and specific indirect effects using one or more mediator variables. Next, one classifies the type of mediation by estimating the coefficients of the relationship between the dependent variable and the mediator variable, the mediator variable and the independent variable, and the dependent and the independent variable. This will indicate if the direct effect, the relationship between the dependent variable and the independent variable, is significant. The results of the tests for both the indirect and direct effects will determine what type of mediation is selected.

Hypothesis 1: Testing Impulsivity as a Mediator

A series of simple mediation models were performed to test whether impulsivity mediates the relationship between SOGS defined SOGS classifications and EGM play. Significance tests for each of the mediated effects of gambling group on EGM play were obtained using the estimation methods described by Preacher and Hayes (2004, 2008) including bootstrapped estimates for Confidence Intervals (for bootstrapping, z = 5,000 samples were requested). Direct and indirect effects were estimated for the effects of SOGS classification on the five EGM measures, with the three BIS subscales and two TCIP scores as mediating variables. No statistically significant results were found, indicating that neither self-reported nor behaviorally-assessed impulsivity mediated the relationship between SOGS classification and EGM play behaviors.

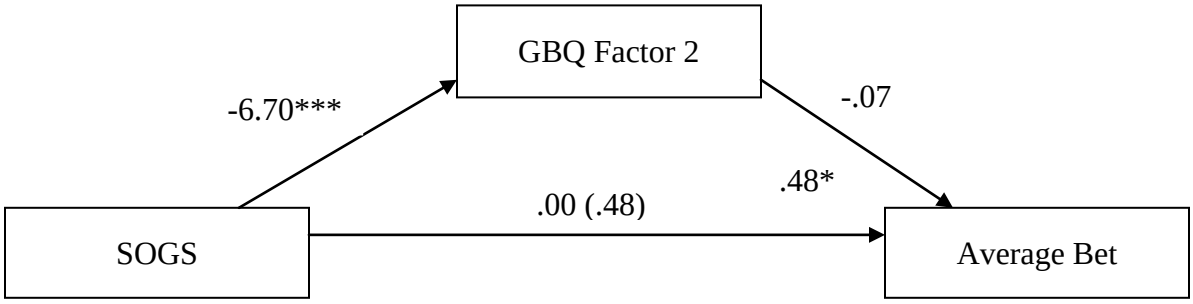
Hypothesis 2: Testing Cognitive Bias as a Mediator

A series of simple multiple mediation models were also conducted to test whether

cognitive bias mediates the relationship between SOGS classification and EGM play. Direct and indirect effects were estimated for the effects of SOGS classifications on the five EGM play measures, with the two GBQ factors and two IBS subscales as mediating variables. Raw score (unstandardized) coefficients for the significant paths in this model appear in Table 5 on page 34.Cognitve bias mediated the effect of SOGS category on three of the five gambling behaviors. The total R^2 for prediction of EGM play from SOGS classification and the cognitive bias measures ranged from .006 to .075.

The mediated effect of gambling group on average bet magnitude through the GBQ Factor 2 (Illusion of control) was significant, a1 x b1 = (-6.7 x -.07) = -.48, $p < .05$ (see Figure 2). These results support the hypothesis that the effect of SOGS classification on average bet size is mediated by beliefs in the illusion of control. Probable pathological gamblers' greater endorsement of the illusion of control over gambling was related to increases in average bet magnitude.

Figure 2. Path model for SOGS classification as a predictor of average bet magnitude, including paths to represent mediation by GBQ Factor 2 (Illusion of control).



The mediated effect of gambling group on number of gaming events through the IBS Subscale 2 (Misunderstanding of outcomes) was significant, a1 x b1 = (9.18 x 1.11) = 10.21, $p < .05$ (see Figure 3). These results support the hypothesis that the effect of

SOGS classification on number of gaming events is mediated by misunderstanding gambling outcomes. Probable pathological gamblers' greater endorsement of erroneous cognitions about gambling outcomes was related to more gaming events played.

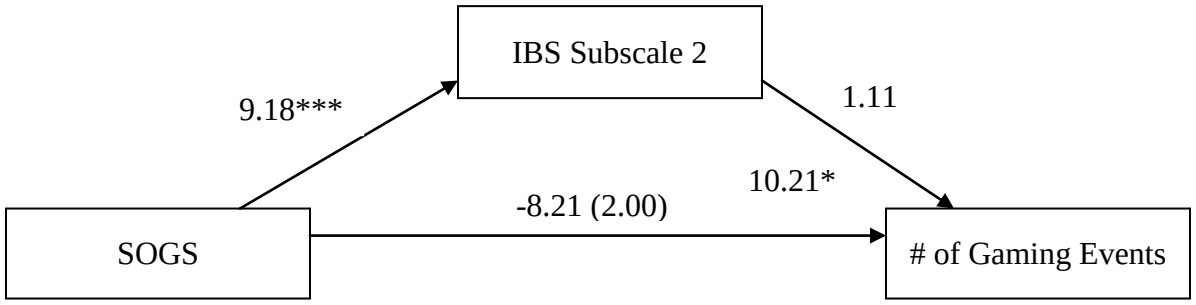
Table 5

Significant Results of Mediation Analyses for Cognitive Bias Mediators

Outcome variables	Total effect	Mediation by GBQ factor 1 (Belief in luck/perseverance)			Mediation by GBQ factor 2 (Illusion of control)			Mediation by IBS subscale 2 (Misunderstanding of outcomes)		
	c	a1	b1	a1 x b1	a1	b1	a1 x b1	a1	b1	a1 x b1
Average bet size	.48[a]	-14.38***	-.013[a]	.19[a]	-6.7***	-0.07[a]	.48*	9.18***	.02[a]	.19[a]
Number of game events (total spins in session)	2[a]	-14.38***	-.7[a]	10.05*	-6.7***	-.73[a]	4.92[a]	9.18***	1.11[a]	10.21*
Money spent (in dollars)	.76[a]	-14.38***	-.13*	1.81*	-6.7***	-.11[a]	.74[a]	9.18***	.16[a]	1.46*

N = 80
*p<.05
**p<.01
***p<.001
[a] Not statistically significant (p>.05)

Figure 3. Path model for SOGS classification as a predictor of number of gaming events, including paths to represent mediation by IBS Factor 2 (Misunderstanding of outcomes).



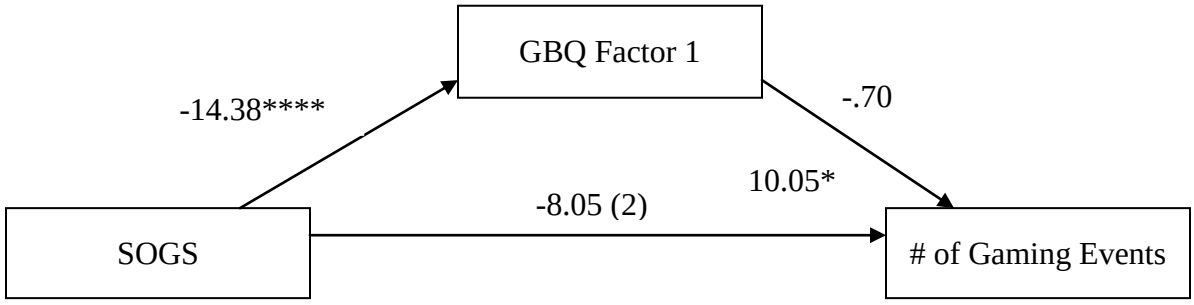
The mediated effect of gambling group on money spent through the IBS Factor 2 (Misunderstanding of outcomes) was significant, a1 x b1 = (9.18 x .16) = 1.46 $p < .05$ (see Figure 4). These results support the hypothesis that the effect of SOGS classification on money spent is mediated by beliefs in the misunderstanding of outcomes. Probable pathological gamblers' greater endorsement of erroneous cognitions about misunderstanding gambling outcomes was related to more money spent during the gambling session.

Figure 4. Path model for SOGS classification as a predictor of money spent, including paths to represent mediation by IBS Factor 2 (Misunderstanding of outcomes).

The mediated effect of gambling group on number of gaming events through the GBQ Factor 1 (Belief in luck/perseverance) was significant, a1 x b1 = (-14.38 x -.7) = 10.05 $p < .05$ (see Figure 5). These results support the hypothesis that the effect of SOGS classification on number of gaming events is mediated by beliefs in luck and perseverance. Probable pathological gamblers' greater endorsement of erroneous cognitions about gambling luck and perseverance was related

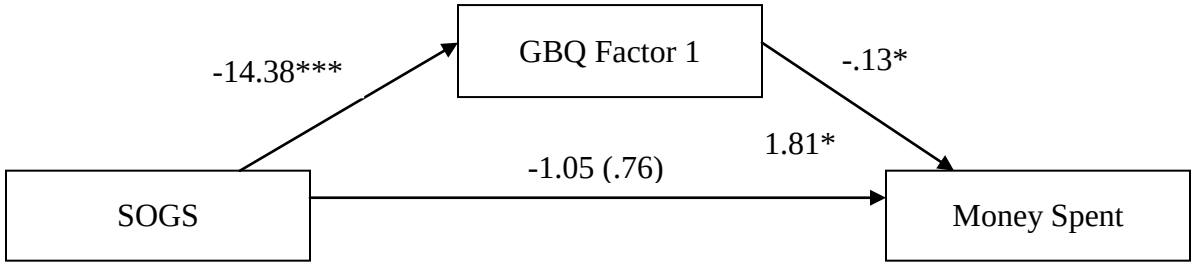
to their playing a greater of number of gaming events.

Figure 5. Path model for SOGS classification as a predictor of number of gaming events, including paths to represent mediation by GBQ Factor 1 (Belief in luck/perseverance).



The mediated effect of gambling group on money spent through the GBQ Factor 1 (Belief in luck/perseverance) was significant, a1 x b1 = (-14.38 x -.13) = 10.05 $p < .05$ (see Figure 6). These results support the hypothesis that the effect of SOGS classification on money spent is mediated by beliefs in luck and perseverance. Probable pathological gamblers' greater endorsement of erroneous cognitions about gambling luck and perseverance was related to more money spent during the gambling session.

Figure 6. Path model for SOGS classification as a predictor of money spent, including paths to represent mediation by GBQ Factor 1 (Belief in luck/perseverance).



Hypothesis 3: Impulsivity and Cognitive Bias as Simultaneous Mediators

With no impulsivity variables found to significantly mediate the relationship between SOGS classifications and EGM play, there was no logical need to run impulsivity and cognitive

bias as simultaneous mediators. The results of the test of the first hypothesis indicate that impulsivity does not mediate the effect of SOGS classifications on EGM play**.** This finding, in conjunction with the findings of the second hypothesis, demonstrated that cognitive bias is not only a better mediator than impulsivity but is also the only variable of the two that explains this relationship.

Post hoc Analyses

Moderation

Given the association between impulsivity and gambling severity in the gambling literature, it was unexpected to find no mediating effect. Rather than ruling out the influence of impulsivity completely, it is possible that impulsivity acts as a moderator, whereby different levels of impulsivity influences the relationship between gambler status and EGM play. To investigate this hypothesis, a series of moderation analyses were performed. These analyses revealed that impulsivity did not moderate this relationship and therefore simple moderation and mediation moderation could be ruled out. Another possible mechanism where impulsivity could have an influence is whether it moderates the mediating variable, cognitive bias. In this case, different levels of impulsivity would influence the strength of the mediating effect of cognitive bias on gamblers gambler status and EGM play. Using the procedure as described by Preacher and Hayes (2003), a bootstrapping analysis was performed to test this hypothesis. Results from the bootstrapping analysis (see Tables 6-8), showed that a significant pattern existed for impulsivity. Specifically, when analyzing the GBQ, both of its factors demonstrated a significant pattern indicative of moderated mediation. GBQ 1 (belief in luck/perseverance), see table 6, affected behavioural perseverance (as seen in game events played, money spent, time played) at every level of BIS Attention and BIS Motor. This effect is at its highest at higher levels of BIS

Attention and BIS Motor. However, for BIS Non-planning, GBQ 1 (belief in luck/perseverance) was associated with game events played only at the lowest level of BIS Non-planning and its effect on money spent was highest at lower levels of BIS Non-planning. In contrast, GBQ 2 (illusion of control), see table 7, was found to affect only the highest level of BIS Non-planning.

Table 6

Moderated Mediation Model: Indirect SOGS Classification on EGM Play Through Impulsivity Moderated by GBQ 1

	Conditional indirect effect								
	Game events played			Money spent			Time played		
	B	Boot SE	Boot 95% CI	*B*	Boot SE	Boot 95% CI	*B*	SE	Boot 95% CI
BIS ATT	9.12	5.49	[1.27-24.07]	1.62	.88	[.32-3.90]	.82	.52	[.08-2.28]
	10.47	5.45	[1.59-23.63]	1.86	.83	[.60-3.96]	.94	.52	[.14-2.28]
	11.83	7.16	[1.34-31.35]	2.10	1.12	[.40-4.98]	1.06	.68	[.10-2.90]
BIS MOTOR	8.12	5.04	[.21-20.48]	1.63	.80	[.42-3.65]	.78	.47	[.07-2.13]
	8.88	5.29	[.39-21.98]	1.78	.84	[.51-3.90]	.85	.50	[.06-2.13]
	9.64	6.88	[.26-28.16]	1.93	1.19	[.21-5.20]	.92	.66	[.03-2.77]
BIS NONPLAN	8.81	5.63	[.51-24.11]	1.64	.83	[.44-3.88]	ns	ns	ns
	ns	ns	ns	1.57	.74	[.43-3.37]	ns	ns	ns
	ns	ns	ns	1.51	.84	[.32-3.76]	ns	ns	ns

Note: *B* = unstandardized effect size, *B* values are -1 SD, $\bar{x}$, +1 SD

Table 7

Moderated Mediation Model: Indirect SOGS Classification on EGM Play Through Impulsivity Moderated by GBQ 2

	Conditional indirect effect		
	Average bet size		
	B	Boot SE	Boot 95% CI
BIS NON PLAN	ns	ns	ns
	ns	ns	ns
	.55	.39	[.02-1.57]

Note: *B* = unstandardized effect size, *B* values are -1 SD, $\bar{x}$, +1 SD

Analysis of possible moderated mediation effects on the IBS found significant patterns for only IBS 2 (misunderstanding of outcomes), see table 8. Specifically, IBS 2 (misunderstanding of outcomes) affected game events played and money spent at every level of BIS Attention, with higher effects when BIS Attention is high. In contrast, IBS 2 (misunderstanding of outcomes) affected game events played and money spent at two levels of BIS Motor, with higher effects when BIS Motor is low.

Table 8

Moderated Mediation Model: Indirect SOGS Classification on EGM Play Through Impulsivity Moderated by IBS 2

	Conditioned indirect effect					
	Game events played			Money spent		
	B	Boot SE	Boot 95% CI	*B*	Boot SE	Boot 95% CI
BIS ATT	7.43	4.66	[.51-19.26]	1.09	.66	[.05-2.74]
	10.51	5.80	[.78-23.73]	1.54	.83	[.08-3.44]
	13.60	8.37	[1.08-35.03]	1.99	1.22	[.10-5.04]
BIS MOTOR	11.88	6.65	[1.33-28.20]	1.68	.91	[.09-3.75]
	9.80	5.40	[1.23-23.10]	1.39	.76	[.11-3.21]
	ns	ns	ns	ns	ns	ns

Note: *B* = unstandardized effect size, *B* values are -1 SD, $\bar{x}$, +1 SD

Discussion

This study found that cognitive bias mediated the effect of SOGS classification on three of the five EGM play variables measured, with increased cognitive bias associated with increased EGM play. Specifically, cognitive bias was associated with increased average bet magnitude, number of gaming events played, and money spent gambling. Surprisingly, impulsivity did not mediate the relationship between SOGS classification and any of the EGM play variables. However, impulsivity was found to moderate the mediating effect of cognitive bias. Thus impulsivity, through its effect on cognitive bias, did influence the relationship

between SOGS classification and EGM play.

As hypothesized, the results of the MANOVA analyses revealed a significant overall effect for the impulsivity, cognitive bias, and EGM play variables. Follow-up univariate ANOVAs revealed that all four cognitive variables were higher in probable pathological gamblers than non-pathological gamblers. In contrast, only the three self report impulsivity variables were significantly higher in probable pathological gamblers but not the two behavioral measures of impulsivity. Finally, of the five EGM play variables, only max bet use was higher for probable pathological gamblers than non-pathological gamblers. Higher max bet use in probable pathological gamblers replicates similar findings by Ellery & Stewart (in press) and Ellery et al. (2005) by demonstrating an increased preference for riskier play among probable pathological gamblers. Ellery et al. (2005) found alcohol increased power betting (i.e., doubling an initial bet after seeing the first two cards in a five card video poker game) for probable pathological gamblers, and Ellery & Stewart (in press) found that probable pathological gamblers engaged in more double up betting (i.e., playing a game of beat the dealer to try to double a video poker win) than non-pathological gamblers. In both the Ellery studies and the current study, probable pathological gamblers had higher rates of riskier play.

Mediation analyses found that erroneous gambling cognitions affected some, but not all, of the EGM play variables, with increased cognitive bias associated with a riskier style of play. Overall, cognitive bias was associated with larger bet sizes, more gaming events played, and more money spent in the gambling session. Specifically, GBQ 2 (illusion of control) was found to be associated with higher average bet size among probable pathological gamblers. Amongst regular EGM gamblers, higher bet sizes are often perceived as more skillful. Although this belief is justified with some EGMs providing incentives for higher bets (i.e. different machines have

different payout tables with better payouts for higher bets), this belief has been over generalized to all EGMs. According to this belief, a win while betting anything lower than max is perceived as less skillful because the player failed to maximize their winnings. This erroneous gambling belief may offer some insight into the study's finding that higher endorsement of illusion of control beliefs are associated with higher average bet sizes. Endorsing these beliefs, including items such as "My knowledge and skill in gambling contribute to the likelihood that I will make money", could tap into this erroneous belief, resulting in higher average bet sizes among probable pathological gamblers. An examination of the items that make up the GBQ 1 (Perseverance) and IBS 2 (misunderstanding of machines) would find that the two are quite similar and may explain the similar findings across these factors (both factors were associated with number of gaming events played and money spent). Both factors focus on misunderstandings of how EGMs operate, which foster the belief that perseverance in play will produce favorable outcomes. In reality, EGMs operate purely on chance with each gambling outcome independent. Due to the probabilities programmed into the random number generators found in EGMs, all EGMs have a negative expectancy with longer play resulting in higher losses over time. Applying this negative expectancy effect to the current study, gamblers endorsing erroneous perseverance beliefs were associated with increasing losses with increased games play and money spent. Thus the study's findings replicate some known patterns of gambling behavior seen in probable pathological gamblers.

Cognitive bias did not mediate all gambling behaviors, as it was unrelated to max bet use and the duration of the gambling session. The difference in standard deviation in the max bet use could explain why there was no significant association found between cognitive bias and max bet use. One possible explanation for the finding of no association between time played gambling

and cognitive bias, could be due to the differences between the environment in the lab vs. actual gambling venues. The excitement and arousal that comes from a casino (i.e. lights, sounds, crowds, alcohol, and choice of gambling activity) could lead to gamblers having prolonged gambling sessions. These environmental reinforces were not present in a lab based environment, which could have led to shorter times played with less opportunity for cognitive bias to influence gambling behaviors.

The current study's finding of cognitive bias being associated gambling play conflicts with the some studies which found no significant relationship between gambling cognitions and gambling behavior (May et al, 2005; Cronce & Corbin, 2010; Ellery & Stewart, in press). These conflicting results could be explained by significant differences in the methodology and research design between the studies. One difference between the studies was the form of gambling selected to measure gambling play. The current study used a simulated slots program, like the Cronce and Corbin (2010) study, that differs from May et al (2005) and Ellery & Stewart (in press), who used roulette and video poker respectively. Slots, a game with high chance and little strategy, may pull for more erroneous gambling beliefs than roulette and video poker. With the purpose of many erroneous gambling cognitions centered on efforts to gain perceived control over games of chance, forms of gambling with less control could pull for higher rates of erroneous cognitions in gamblers. Thus, games high in chance and low in control (e.g., slots) should have higher rates of cognitive bias than games with higher elements of control and strategy (e.g., poker). With gambling consisting of a heterogeneous grouping of games, results from one form of gambling may differ from another. Indeed, generalizing results from the study of one form of gambling to other forms has long been recognized as a potential problem for gambling research (Dickerson, 1993). Future research could examine if these differences exist by

studying multiple forms of gambling when conducting gambling research.

Another key difference between the studies is the methodology and recruitment strategies used. The current study recruited for non-pathological and probable pathological gamblers who recently played EGMs, with participants required to have played EGMs at least twice in the last month to participate. In contrast, Cronce and Corbin (2010) recruited only non-pathological gamblers and only required its participants to have played a slot machine at least once in their lifetime. May et al. (2005) did not assess for gambling classifications and did not require participants to have a gambling history or any recent gambling behavior for inclusion in their study. With gambling severity found associated with increased cognitive bias (Xian et al., 2008), it follows that the current study had higher rates of cognitive bias which could explain why cognitive bias was associated with gambling play in the current study while other studies did not (Cronce & Corbin, 2010; May et al., 2005)

As expected, probable pathological gamblers, as classified by SOGS, endorsed erroneous cognitions about gambling at a higher rate than non-pathological gamblers. Cognitive bias was measured by two questionnaires, which although similar, have a key difference in scope. The Informational Biases Scale (IBS; Jefferson & Nicki, 2003) targets irrational cognitions about VLT play, using items that specifically address cognitions associated with VLTs. In contrast, the second cognitive bias questionnaire, the Gambler's Belief's Questionnaire (GBQ; Steenbergh et al. 2002), takes a broader scope through measuring erroneous cognitions across many forms of gambling. Probable pathological gamblers' greater endorsement of erroneous cognitions across both these measures demonstrates faulty understanding of both EGM gambling and gambling in general. Probable pathological gamblers endorsed significantly more erroneous cognitions about luck/perseverance (GBQ factor 1), controlling gambling outcomes (GBQ factor 2), gamblers'

fallacy (IBS 1), and misunderstanding of gambling outcomes (IBS 2). These higher rates of erroneous gambling cognitions among probable pathological gamblers replicate the findings by Joukhador, Blaszczynski, & Maccallum (2004), who found higher rates of erroneous gambling beliefs were correlated with gambling intensity and severity. Additionally, these results are consistent with the work of Xian et al. (2008) who demonstrated a positive association between higher scores of cognitive distortions and pathological gambling symptoms.

Contrary to hypothesis, mediation analysis revealed that neither the self report nor behavioral measures of impulsivity mediated the relationship between SOGS classification and EGM play. These results were unexpected given the multitude of studies demonstrating an association between impulsivity and gambling severity (Blaszczynski, Steel, & McConaghy,1997; Steel & Blaszczynski, 1998; Petry, 2001a; Petry, 2001b; Rugle & Melamed, 1993; Fuentes et al., 2006; Dougherty et al, 2009) and the fact that pathological gambling was until recently classified as an impulse control disorder in the DSM-IV (APA, 2000). Moreover, MANOVA revealed that, in the current study, all three of the self report measures of impulsivity were significantly higher among probable pathological gamblers.

Given the association between impulsivity and gambling severity in the gambling literature, further analysis for possible moderation effects for impulsivity was performed. These post hoc analyses revealed that impulsivity, through its moderated mediating effect on cognitive bias, does influence the relationship between gambling risk status and gambling play. This finding may explain some of the conflicting findings in the research literature, specifically, those studies which found no association between gambling severity and impulsivity. While many of these studies focused on a direct association between gambling severity and impulsivity, it is possible that impulsivity was demonstrating a moderating effect which was neglected. In the

current study, different types of impulsivity resulted in differential effects on the cognitive bias variables. Specifically, belief in luck/perseverance (GBQ 1) was found to affect behavioral perseverance (i.e., number of gaming events played, time played, and money spent) with this effect moderated by BIS Attention and BIS Motor. With every increase in these two types of impulsivity, there was a corresponding increase in the mediating effect of GBQ 1. In other words, higher levels of impulsivity moderated the effect of cognitive bias resulting in increases in money spent, games played, and time played. Specifically, higher BIS Attention manifests as an increase in intrusive and racing thoughts. With probable pathological gamblers, this style of thinking appears to be related to an increase in belief in luck/perseverance (GBQ1), which results in higher EGM play. In contrast, higher BIS Motor manifests as impulsive actions performed without thought. With probable pathological gamblers, these impulsive actions appear to lead to an increase in the belief in luck (GBQ 1) which results in higher EGM play. This relationship could be due to the inclusion of motor and behavioral perseverance items in the GBQ 1. In contrast, BIS Non-planning had a different effect, whereby higher levels of BIS Non-planning, resulted in less belief in luck/perseverance (GBQ 1). In other words, these impulsive actions do not appear related to GBQ1 as BIS Non-planning increases. This relationship is most likely due to the fact that belief in luck/perseverance is composed of cognitive and behavioral plans to improve gambling outcomes. At higher levels of BIS Non-planning, actions are performed without planning, with this type of impulsivity most likely interfering with the erroneous gambling plans of the GBQ1. Thus BIS Non-planning only moderates GBQ 1 at low levels. Endorsing one's belief in the illusion of control (GBQ 2) was found to affect average bet size with this effect moderated by BIS Non-planning. This effect was only found at the highest levels of BIS Non-planning. In probable pathological gamblers, the illusion of control creates the

perception that they are in control of the gambling process and outcomes. With this belief strongly endorsed, there is no need to use planning to gain control. Thus with probable pathological gamblers, BIS Non-planning moderates GBQ 2 at only the highest levels and results in higher average bet sizes. Finally, endorsing beliefs about misunderstanding gambling outcomes (IBS 2) was found to affect EGM play (i.e. game played and money spent) with this effect moderated by BIS Attention and BIS Motor. Higher BIS Attention produced a moderated effect of increased misunderstanding of outcomes (IBS 2). In other words, high rates of intrusive and racing thoughts produces an increase in beliefs about misunderstanding of gambling outcomes which increased EGM play. In contrast, the moderated effect of BIS Motor on IBS 2 was at its highest at lower levels. This diminishing effect at higher levels could be due to the focuses on impulsive actions and behaviors in BIS Motor. The IBS 2 items are more abstract and focus on cognitive beliefs. Without items on the IBS 2 tapping behaviors, it follows that BIS Motor has less of a moderating effect at higher levels.

While the fact that impulsivity did not mediate the effect of SOGS classification on EGM play was unexpected, perhaps impulsivity mediates between-session gambling in ways that are not detected in within-session gambling. Pathological gamblers have been found to have a preference for a wide range of gambling activities than non-pathological gamblers (Kessler et al., 2011; Majer et al., 2008). It is possible that impulsivity could affect gamblers much differently in a real, casino-like setting, versus laboratory conditions, due to the sheer amount of gambling options to choose from. For instance, impulsivity may play a part in deciding what to play, the switching of games, how many games are played overall, and whether gamblers play games simultaneously. Pathological gamblers, higher in impulsivity than non-pathological gamblers, could have a low attention span for long periods of gambling in one form (e.g., EGMs) that leads

them to frequently shift to different forms of gambling. This greater variability could act to keep these players more interested and invested in gambling, extending the overall duration of their gambling session, without influencing the amount of time spent playing any individual game. Longer gambling sessions could result in losing more and more money to sustain these longer periods of play. In other words, longer periods of sustained gambling would result in more exposure to harm.

Despite a significant association between gamblers status and max bet use, max bet use was not mediated by either the proposed impulsivity or cognitive bias mediators. One reason for this finding could be the absence of a significant mediator not proposed in this study that better explains the relationship between max bet use and SOGS classifications. Other individual differences may better explain the relationship between problem gambling severity and gambling behaviors. For example, previous research has found significant personality differences between pathological gamblers and non-pathological gamblers in both adolescents (Gupta, Derevensky, & Ellenbogen, 2006; Chiu & Storm, 2010) and adults (Chambers & Potenza, 2003). Specifically, pathological gamblers have been found to score higher on Neuroticism, lower on Conscientiousness, and higher on some impulsivity measures (Chambers & Potenza, 2003) than non-pathological gamblers (Bagby et al. 2007). Future studies could examine the role of personality differences to determine whether differences in variables like extraversion versus introversion affect EGM play.

In the research literature, two of the most frequently used gambling measures are the SOGS and the PGSI. The SOGS was used in the current study in order to maximize direct comparability of the results to previous studies of EGM play behavior (Ellery et al., 2005; Ellery & Stewart, in press). Both the SOGS and the PGSI seek to differentiate gambling pathology into

distinct classifications of increasing severity. With a common goal, these two measures should demonstrate convergent validity and agree on gambler group classifications. As expected, 39 out of 40 non-pathological gamblers were classified as non-problem and low/moderate risk gamblers on the PGSI. This agreement on classification reaffirms that these two groups are substantially similar and supports the use of the SOGS classifications with this sample. Also expected was that the SOGS classification of probable pathological gambler would agree with the PGSI's classification of problem gambler. However, the PGSI was more conservative in its classifications, with only 16 out of 40 probable pathological gamblers classified as problem gamblers.. The differences in agreement over the classification of probable pathological gamblers may speak to the differences between the SOGS and the PGSI. The key difference is that the SOGS was validated against DSM-III (APA, 1980) criteria for pathological gambling while the PGSI was validated against DSM-IV criteria (APA, 1994). Between these two editions of the DSM, several changes in the conceptualization and diagnosis of pathological gambling were made (Petry, 2006). First included in the DSM-III, pathological gambling was primarily viewed as an ability to resist urges and required the endorsement of three of seven items from a symptom list. This list mostly comprised of items relevant to the financial costs of pathological gambling. In contrast, the DSM-IV conceptualized pathological gambling as closer to a substance dependence disorder. A key difference between the two editions is the number of criteria for diagnosis of pathological gambling has risen from three of seven in the DSM-III to five of ten in the DSM-IV. This requirement has resulted in more stringent criteria to obtain a diagnosis of PG. Given these differences, it is possible that using PGSI classifications could have resulted in different results. With more stringent criteria for classifying problem gamblers, the PGSI would likely recruit a more pathological group of gamblers than the SOGS. This would

lead to larger differences between the non-problem and problem gambler groups, likely resulting magnifying the group differences in gambling cognitions and behaviours. Unfortunately, that hypothesis cannot be tested in this study, as participants were recruited and balanced according to SOGS classifications. To test this hypothesis, future studies could recruit participants according to the PGSI classifications and note any differences between their results and the current study

Further Limitations

Some further limitations of the current study involve issues of generalizability, ecological validity, and the EGM simulation program. First, ecological validity is reduced due to practical considerations, as exact replication of playing an EGM in its usual settings (i.e., bars and casinos) is challenging and lacks experimental control. Studies that have conducted research directly in these settings were restricted to conducting interviews for data and suffered from attrition (Baron & Dickerson, 1999). Due to the fact that EGM play was simulated via a computer program instead of an actual EGM machine, and was played in an artificial office-like setting, ecological validity is reduced. Second, generalizability will be limited, where any findings are restricted due to the sole reliance on a university based sample. While university students are an appropriate group to study, due to their frequent engagement in gambling and the greater prevalence of PG in this group relative to the general population (Shaffer, Hall, & Vander Bilt, 1999), the fact remains that not all of the current findings should be generalized to other populations, such as community-recruited gamblers. That said, the finding that probable pathological gamblers are more likely to engage in risky play is consistent with studies of community-recruited gamblers (cf., Ellery et al., 2005; Ellery & Stewart, in press). Finally the computer program responsible for simulating an EGM slots game does function in precisely the

same way as a real world EGM. One difference is a delay that takes place between certain gaming events in the EGM simulation. This delay is present whenever a win occurs as players must wait until the winning tone to finish before placing another bet. Real world EGMs do not have this limitation and allows its player to commence a new bet as soon as the results from the previous bet are revealed. The delay may explain the absence of difference in the amount of time spent and the number of gaming events played. Probable pathological gamblers may play faster than non-pathological gamblers in real life settings, but the simulation may have created a ceiling effect by slowing play to the point where any real differences were undetectable

The current study included a number of ways to measure impulsivity and cognition in an attempt to clarify the mixed findings of previous studies that examined the relationship between gambler status and EGM play. The results of the current study suggest some potentially interesting candidates for mediating and outcome variables that would narrow the focus of, and strengthen the design of, future studies. From this study's results it could be argued that similar results could have been achieved using only the IBS Factor 2 (Illusion of Control) as the sole mediator for cognitive bias and the number of gaming events played as the sole outcome variable. With the IBS and the GBQ findings similar results, only one of these measures should be needed to adequately assess cognitive bias. With the IBS more specific to the form of gambling of interest in this study, EGMs, it seems like the best fit of the two. When narrowing down to one outcome variable, number of gaming events produced the most consistent results, is more resistant to outlier, and is a useful operationalization of persistence at play, making it the best option.

Implications

The fact that impulsivity did not mediate the relationship between SOGS classification

and EGM play in the current study supports the recent changes in classification of Pathological Gambling in the DSM-5 (American Psychiatric Association, 2013). Pathological gambling is now called gambling disorder, and has been changed from a disorder of impulse control disorder to an Addiction and Related Disorder (Mitzner, Whelan, & Meyers, 2011). This is in keeping with the suggestion of Langewisch and Frisch (1998), who that found high impulsivity in individuals was not predictive of, or associated, with PG. Other research has documented the many similarities between pathological gambling and substance-based addictions. These similarities included clinical presentation, co-morbidity with Axis I and II disorders, association with personality factors, neurotransmitter involvement, genetic transmission, and treatment options (Petry, 2006; Potenza, 2006) - characteristics that pathological gambling did not share with impulse control disorders. Additionally in terms of treatment implications, clinicians have demonstrated promising results when using addiction models to treat gambling problems (e.g., Petry, 2006; Whelan, Steenbergh, & Meyers, 2007). The results of the current study suggest that impulsivity is still an important feature of gambling, as seen in its moderating effect on cognitive bias, but should not be considered a defining feature of gambling disorder. Overall, these results add to the evidence in support of the changes put forward in DSM 5.

The finding that cognitive bias mediates the effect of SOGS classification on EGM play supports Walker's (2005) claim that Cognitive Behavioral Treatment (CBT) is the most promising treatment approach for pathological gambling. A recent systematic review and meta-analysis of CBT (Gooding & Tarrier, 2009) has demonstrated the effectiveness of CBT in reducing gambling behavior. Overall, CBT was highly effective in reducing gambling behaviors within the first three months after therapy regardless of the type of gambling behavior practiced. Effect sizes suggested these significant results are still significant at six, twelve and twenty-four

month follow-ups. Additionally, individual and group therapies were found to be equally effective in 3 months after treatment, as well as all variants of CBT (cognitive therapy, motivational interviewing and imaginal desensitization). The results from the current study could offer an explanation on how CBT produces improvement. CBT, employing various cognitive restructuring techniques, challenges erroneous thoughts and beliefs. Through self report measures (i.e. the GBQ, IBS, or journaling) and techniques (i.e. thinking out loud technique) gamblers' erroneous gambling beliefs are identified. These beliefs are then challenged through systematically analyzing the accuracy and utility of each belief. Those beliefs found to be false would then be replaced with more realistic understandings of gambling and chance. The mediation results in the current study provides a potential model for understanding how reducing erroneous gambling beliefs through CBT can have a resulting change in play and, in time, gambling severity. According to the mediation results, a reduction in cognitive bias is likely to produce a simultaneous reduction in the gambling behaviors it mediates (i.e., money spent, average bet magnitude), possibly reducing these behaviors to a non-pathological level. Additionally, these results have possible treatment implications by identifying key erroneous gambling beliefs, linked to increased play, which could be targeted in treatment. Clinicians working with pathological gamblers could specifically target the erroneous beliefs which were found to be significant mediators in this study. Specifically, belief in luck/perseverance and misunderstanding of gambling outcomes are two categories of erroneous beliefs found to be associated with increases in gambling behavior (i.e. EGM play including money spent and games played). Given this association, these beliefs should be challenged when treating problem gamblers. Challenging these beliefs, such as “There are certain things I do when I am betting which increase the chances that I will win", should result in a corresponding reduction in

gambling play (i.e., games played and money spent). Challenging these beliefs would require the instruction of probability and how individual gambling outcomes are independent events. Closely associated with CBT treatment approaches, prevention efforts against disorder gambling typically focus on psycho-education and challenging erroneous beliefs. Gambling prevention programs often focus their attention on educating the public about how gambling games work and offer self regulating techniques to control gambling. As explained in regards to treatment, the current study's mediation results also offers a possible model to explain how prevention programs achieve results, while additionally offering specifically erroneous beliefs to target in future efforts.

Future Directions

The results of the current study suggest that impulsivity does not mediate the relationship between pathological gambling and within-session gambling behaviors. Like the current study, previous gambling research has examined the within-session behavior of gamblers on only one form of gambling, overlooking the possibility that the study of between-session gambling, or the study of multiple forms of gambling available within a single gambling session, may better reveal, in a more ecologically valid way, how pathological gamblers behave. One method to measure this effect would be to allow probable pathological and non-pathological gamblers choose from a range of different gambling games, measuring the differences in money spent, games play, and time played. Future studies could investigate if this method produces a different set of results than the ones typically seen in within-session gambling studies and whether impulsivity mediates this effect. Given that the current study found that probable pathological gamblers engaged in a wider variety of gambling activities and were more impulsive than non-pathological gamblers, future studies may find that problem gamblers may change gambling

activity more frequently than non-problem gamblers. These changes might alleviate boredom and stimulate gamblers to continue gambling, leading to prolonged gambling sessions. With gambling activities having a negative expectancy, longer play would lead to larger losses and, over time, more gambling problems. The availability of multiple forms of gambling within a single gambling session may reveal significant differences in gambling behavior between problem and non-problem gamblers, an effect that may be mediated by impulsivity**.**

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Appendix A: Consent Form

UNIVERSITY OF MANITOBA

CONSENT FORM

Study Title:
Problem Gambling: The Mediating role of Impulsivity and Cognitive Bias

Principal Investigator:
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This consent form is part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

Purpose of the Study
The purpose of this study is to examine how being impulsive and holding erroneous gambling beliefs influences the gambling behavior of different gambling groups.

Study Design
This study consists of one questionnaire package and two computer programs. We are going to collect data from 80 undergraduates at the University of Manitoba.

Who Can Participate in the Study
You may participate in this study if you are an undergraduate student who gambles regularly, that is, a student who has gambled at least twice in the past month (not counting lottery tickets). If you cannot read and write in English, you cannot participate in the study, as the survey is in English. Additionally, if you are currently abstaining or currently trying to abstain from gambling you cannot participate in this study due to the risk of relapse.

Procedures
If you agree to participate in this study, you will be asked to fill out a survey in the Addictions Lab, as well as two computer programs. The survey contains six questionnaires that measure gambling behaviours, gambling problems, and thoughts, such as beliefs about how games work, that are related to gambling. Each questionnaire consists of between 9 and 30 questions. Filling out the survey and completing the computer programs should take between 60 and 110 minutes.

Possible Risks and Discomforts
There is a small chance that reflecting on your gambling might make you uncomfortable. Additionally, playing a gambling simulation carries some risk; however, the simulation is controlled with a maximum of $10.00 to gamble with. If you feel uncomfortable at any point, you can choose to stop the study at any time with no penalty. Resources will also be provided with online links to lists of community resources that provide support for people with concerns about their gambling.

Possible Benefits
There are no direct personal benefits to you from participating in this study. You might learn more about gambling behaviours and beliefs about gambling. Your participation will help us to learn more about the kinds of gambling that undergraduates engage in, and how undergraduates think and behave when gambling.
C**ompensation / Reimbursement**
For your participation in this study, you will be given $10.00 to gamble with on a computerized slots program and will keep any winnings. Compensation will be in the form of cash and 4 credits towards your undergraduate psychology class, given out once you finish the questionnaires and decide to stop playing the VLT program. The 4 credits will be given out regardless if you finish or choose to withdraw from the study once you started it.

Confidentiality & Anonymity
Your participation will be confidential and rendered anonymous once results are sent out. We will be assigning a unique Participant Verification Number to each individual participant. Your survey answers will be combined with those of all of the other participants, and only group results will be reported.

Once it is collected your survey answers are collected, data will be stored on a computer in a password protected file that is accessible to the principal investigator. As well, Dr. Ellery (Thesis Supervisor), and researchers in Dr. Ellery's research lab, will also have access to the data. All paper based data collected will be stored in a locked cabinet in Dr. Ellery's research lab, with all identifying information (including the consent forms) being destroyed after the summary of results are sent out to participants(approximately May, 2013). A working copy of the data will be stored indefinitely. This stored copy may be re-analysis in future studies.

Questions & Feedback
If you have any questions about the study, you can contact Dr. Michael Ellery at michael_ellery@umanitoba.ca, or by phone at 474-7264. Only group results will be reported. If you are interested in receiving a written summary of the results of this study when it is complete, leave your email address with your signature. If you choose to be sent a written summary, you

should receive the results approximately in May, 2013.

Problems or Concerns
This research has been approved by the Senate Committee on the Ethics of Research Involving Human Subjects (Ft. Garry Campus). If you have any concerns or complaints about this project you may contact Dr. Michael Ellery at 474-7264 or michael_ellery@umanitoba.ca, or the Human Ethics Secretariat at 474-7122, or email margaret_bowman@umanitoba.ca. A copy of this consent form has been sent to you via email to keep for your records and reference.

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the researchers or involved institution from their legal and professional responsibilities. You are free to withdraw from the study at any time and/or refrain from answering any questions you prefer to omit, without prejudice or consequence. Credits will be awarded regardless if you withdraw.

Name:
_____Date:_____

Email (**If you want a summary of results**):_____

Signature: _____

Researcher Signature: _____Date:_____

Appendix B: Measures Administered

Participant ID: _____ Date: _____

DEMOGRAPHICS

Gender: Male Female Handedness: Right Left

Date of Birth _____ Age: _____ years

What is the highest level of education you have completed?

Less than high school	01
Completed high school	02
Some post-secondary	03
Completed post-secondary	04
Don't know	08
Refuse	09

Which of the following best describes your current employment status? READ LIST

Employed full-time	01
Employed part-time	02
Homemaker/unemployed /out of labour force	03
Student	04
Retired	05
Don't know	08
Refuse	09

Which of the following best describes your current marital status? READ LIST

Single (never married)	01
Married or cohabitating	02
Separated or divorced	03
Widowed	04
Don't know	08
Refuse	09

I'm going to read a list of income categories; please stop me when I get to the one that applies to your total household income before taxes. READ LIST

Less than $10,000	01
$10,000 to $20,000	02
$20,000 to $30,000	03
$30,000 to $40,000	04
$40,000 to $50,000	05
$50,000 to $60,000	06
$60,000 to $70,000	07

$70,000 to $80,000 08
$80,000 to $90,000 09
$90,000 to $100,000 10
More than $100,000 11
Don't know 88
Refuse 99

What ethnic or cultural groups do you belong to? PROBE: Any others? DO NOT READ LIST. RECORD UP TO THREE ANSWERS.

Canadian 00
Aboriginal/Native American/Indian 01
Metis 02
Inuit 03
Austrian 04
Black/African 05
Belgian 06
Bulgarian 07
Chilean 08
Chinese 09
Croatian 10
Czech 11
Danish 12
Dutch 13
East Indian 14
English 15
Filipino/a 16
Finnish 17
French 18
German 19
Greek 20
Hungarian 21
Icelandic 22
Indonesian 23
Iranian 24
Irish 25
Italian 26
Jamaican 27
Japanese 28
Korean 29
Loatian 30
Latvian 31
Lebanese 32
Pakistani 33
Peruvian 34
Polish 35
Romanian 36
Russian 37

Salvadorian 38
Scandinavian 39
Scottish 40
Serbian 41
Slovakian 42
Spanish 43
Swedish 44
Ukrainian 45
Vietnamese 46
Welsh 47
West Indian 48
Yugoslavian 49
Other 50
Don’t know 88
Refuse 99

Participant ID: _____ Date: _____

REGION ☐ U of M ☐ Brandon U

PARTICIPATION IN GAMBLING ACTIVITIES

The following are some questions about activities that you may or may not participate in. For each, please indicate if you participate daily, 2 to 6 times per week, about once a week, 2 or 3 times a month, about once a month, 6 to 11 times a year, 1 to 5 times a year, less than once a year, or never. How often do you…

Q1 Play sports lotteries like Sport Select or bet on sports pools?

Never	Less than once a year	1 to 5 times a year	6 to 11 times a year	About once a month	2 or 3 times a year	About once a week	2 to 6 times a week	Daily	Don't know	Refuse
01	02	03	04	05	06	07	08	09	88	99

Q2 Buy other lottery, instant win or scratch tickets at lottery kiosks or through subscriptions? IF ASKED FOR EXAMPLES: This includes 6/49, Super 7, POGO, breakopens or Nevada tickets, but not any charity tickets or charity breakopens.

Never	Less than once a year	1 to 5 times a year	6 to 11 times a year	About once a month	2 or 3 times a year	About once a week	2 to 6 times a week	Daily	Don't know	Refuse
01	02	03	04	05	06	07	08	09	88	99

Q3 Buy charity raffle or fundraising tickets, including charity lotteries, charity breakopens and charity Nevada tickets?

Never	Less than once a year	1 to 5 times a year	6 to 11 times a year	About once a month	2 or 3 times a year	About once a week	2 to 6 times a week	Daily	Don't know	Refuse
01	02	03	04	05	06	07	08	09	88	99

Q4 Play bingo for money?

Never	Less than once a year	1 to 5 times a year	6 to 11 times a year	About once a month	2 or 3 times a year	About once a week	2 to 6 times a week	Daily	Don't know	Refuse
01	02	03	04	05	06	07	08	09	88	99

Q5 Play electronic games, like slot machines, at a casino?

Never	Less than once a year	1 to 5 times a year	6 to 11 times a year	About once a month	2 or 3 times a year	About once a week	2 to 6 times a week	Daily	Don't know	Refuse
01	02	03	04	05	06	07	08	09	88	99

Q6 Play table games, such as blackjack and roulette, at a casino? IF ASKED FOR EXAMPLES: Table games include Baccarat and all kinds of poker, like Texas Hold'em and Pai Gow.

Never	Less than once a year	1 to 5 times a year	6 to 11 times a year	About once a month	2 or 3 times a year	About once a week	2 to 6 times a week	Daily	Don't know	Refuse
01	02	03	04	05	06	07	08	09	88	99

Q7 Play VLTs at a bar, lounge or racetrack?

Never	Less than	1 to 5	6 to 11	About	2 or 3	About	2 to 6	Daily	Don't	Refuse

	once a year	times a year	times a year	once a month	times a year	once a week	times a week		know	
01	02	03	04	05	06	07	08	09	88	99

Q8 Bet on horse races, whether live at the track or off-track?

Never	Less than once a year	1 to 5 times a year	6 to 11 times a year	About once a month	2 or 3 times a year	About once a week	2 to 6 times a week	Daily	Don't know	Refuse
01	02	03	04	05	06	07	08	09	88	99

Q9 Play poker for money in a bar, lounge or other public facility?

Never	Less than once a year	1 to 5 times a year	6 to 11 times a year	About once a month	2 or 3 times a year	About once a week	2 to 6 times a week	Daily	Don't know	Refuse
01	02	03	04	05	06	07	08	09	88	99

Q10 Play poker for money at home with friends or family?

Never	Less than once a year	1 to 5 times a year	6 to 11 times a year	About once a month	2 or 3 times a year	About once a week	2 to 6 times a week	Daily	Don't know	Refuse
01	02	03	04	05	06	07	08	09	88	99

Q11 Bet money on cards or games with family and friends, not including poker, or on games of skill such as pool, bowling or darts?

Never	Less than once a year	1 to 5 times a year	6 to 11 times a year	About once a month	2 or 3 times a year	About once a week	2 to 6 times a week	Daily	Don't know	Refuse
01	02	03	04	05	06	07	08	09	88	99

Q12 Bet money on the Internet on casino games, like poker or blackjack, or on sports?

Never	Less than once a year	1 to 5 times a year	6 to 11 times a year	About once a month	2 or 3 times a year	About once a week	2 to 6 times a week	Daily	Don't know	Refuse
01	02	03	04	05	06	07	08	09	88	99

Time and Money Spent Gambling

How many hours a week, on average, do you spend gambling? _____

(If unable to estimate per week, estimate per month or per year.)

How much money per week, on average, do you spend? _____

(If unable to estimate per week, estimate per month or per year.)

IF RESPONDENT ANSWERED 01 ("Never") TO ALL OF Q1 TO Q12, CODE AS A NON-GAMBLER.

Gambler 01
Non-gambler 02

IBS

The following is a list of statements about VLT use. Please read each statement carefully and indicate how much you agree or disagree with it by circling the appropriate number. Please do not take too much time in responding to the items.

1. I believe that some machines keep me from winning because they are programmed to produce fewer wins than normal.

1 2 3 4 5 6 7

Don't agree at all Partially agree Strongly agree

2. In some establishments, the VLTs are more likely to pay out than others.

1 2 3 4 5 6 7

Don't agree at all Partially agree Strongly agree

3. I would rather use a VLT that I am familiar with than one that I have never used before.

1 2 3 4 5 6 7

Don't agree at all Partially agree Strongly agree

4. The longer a VLT has gone without paying out a large sum of money, the more likely are the chances that it will pay out in the very near future.

1 2 3 4 5 6 7

Don't agree at all Partially agree Strongly agree

5. I have purposely avoided playing on VLTs that have recently paid out a lot of money.

1 2 3 4 5 6 7

Don't agree at all Partially agree Strongly agree

6. I know some VLT users who are just plain lucky.

1 2 3 4 5 6 7

Don’t agree at all Partially agree Strongly agree

7. I have a favorite VLT that I use.

1 2 3 4 5 6 7

Don’t agree at all Partially agree Strongly agree

8. One’s chances of winning are better if he or she gambles on a machine that has not paid out in a long time.

1 2 3 4 5 6 7

Don’t agree at all Partially agree Strongly agree

9. People win large amounts of money on VLTs on a fairly frequent basis.

1 2 3 4 5 6 7

Don’t agree at all Partially agree Strongly agree

10. Hearing about other people winning on VLTs encourages me to keep on playing.

1 2 3 4 5 6 7

Don’t agree at all Partially agree Strongly agree

11. When I see others winning on VLTs, I feel that my turn is coming, too.

1 2 3 4 5 6 7

Don’t agree at all Partially agree Strongly agree

12. There are certain strategies (for example, betting all of your credits at once) that one can use with VLTs to help him or her win.

1 2 3 4 5 6 7

Don’t agree at all Partially agree Strongly agree

13. It makes me upset when I almost win on VLTs.

1 2 3 4 5 6 7

Don’t agree at all Partially agree Strongly agree

14. If I win on a certain machine, I am more likely to use that machine again at a later date.

1 2 3 4 5 6 7

Don’t agree at all Partially agree Strongly agree

15. After a long string of wins on a VLT, the chances of losing become greater.

1 2 3 4 5 6 7

Don’t agree at all Partially agree Strongly agree

16. If I experience a long string of losses on a VLT, a big win must be coming just around the corner.

1 2 3 4 5 6 7

Don’t agree at all Partially agree Strongly agree

17. If I’m experiencing a losing streak, the thought that a win has to be coming soon keeps me gambling.

1 2 3 4 5 6 7

Don’t agree at all Partially agree Strongly agree

18. I know some people who gamble who are just plain unlucky with VLTs.

1 2 3 4 5 6 7

Don’t agree at all Partially agree Strongly agree

19. Thinking about times that I have won on VLTs encourages me to keep playing.

1 2 3 4 5 6 7

Don’t agree at all Partially agree Strongly agree

20. I sometimes find myself trying to win back money that I have lost on VLTs.

1 2 3 4 5 6 7

Don’t agree at all Partially agree Strongly agree

21. Winning on VLTs makes me feel skillful.

1 2 3 4 5 6 7

Don’t agree at all Partially agree Strongly agree

22. Sometimes, I’ll keep on playing VLTs because I get a strong feeling that I’m about to win.

1 2 3 4 5 6 7

Don’t agree at all Partially agree Strongly agree

23. I sometimes talk to the machine in order to make it do what I want. For example, I will sometimes mutter, “Come on! Come on!” under my breath.

1 2 3 4 5 6 7

Don’t agree at all Partially agree Strongly agree

24. Winning on VLTs encourages me to keep playing.

1 2 3 4 5 6 7

Don’t agree at all Partially agree Strongly agree

25. I tend to think more often about my wins than my losses on VLTs.

1 2 3 4 5 6 7

Don’t agree at all Partially agree Strongly agree

GBQ

Read each of the following statements carefully. Rate to what extent you agree or disagree with each statement by circling a number.

	Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree
I think of gambling as a challenge.	1	2	3	4	5	6	7
My knowledge and skill in gambling contribute to the likelihood that I will make money.	1	2	3	4	5	6	7
My choices or actions affect the game on which I am betting.	1	2	3	4	5	6	7
If I am gambling and losing, I should continue because I don't want to miss a win.	1	2	3	4	5	6	7
I should keep track of previous winning bets so that I can figure out how I should bet in the future.	1	2	3	4	5	6	7
When I am gambling, "near misses" or times when I almost win remind me that if I keep playing I will win.	1	2	3	4	5	6	7

Gambling is more than just luck.	1	2	3	4	5	6	7
My gambling wins are evidence that I have skill and knowledge related to gambling.	1	2	3	4	5	6	7
I have a “lucky” technique that I use when I gamble.	1	2	3	4	5	6	7
In the long run, I will win more money than I will lose gambling.	1	2	3	4	5	6	7
Even though I may be losing with my gambling strategy or plan, I must maintain that strategy or plan because I know it will eventually come through for me.	1	2	3	4	5	6	7
There are certain things I do when I am betting (for example, tapping a certain number of times, holding a lucky coin in my hand, crossing my fingers, etc.) which increase the chances that I will win.	1	2	3	4	5	6	7

If I lose money gambling, I should try to win it back.	1	2	3	4	5	6	7
Those who don't gamble much don't understand that gambling success requires dedication and a willingness to invest some money.	1	2	3	4	5	6	7
Where I get money to gamble doesn't matter because I will win and pay it back.	1	2	3	4	5	6	7
I am pretty accurate at predicting when a "win" will occur.	1	2	3	4	5	6	7
Gambling is the best way for me to experience excitement.	1	2	3	4	5	6	7
If I continue to gamble, it will eventually pay off and I will make money.	1	2	3	4	5	6	7
I have more skills and knowledge related to gambling than most people who gamble.	1	2	3	4	5	6	7
When I lose at gambling, my	1	2	3	4	5	6	7

losses are not as bad if I don't tell my loved ones.							
I should keep the same bet even when it hasn't come up lately because it is bound to win.	1	2	3	4	5	6	7

PGSI

Some of the next questions may not apply to you, but please try to be as accurate as possible by circling the answer that most applies. THINKING ABOUT THE LAST 12 MONTHS...

1. Have you bet more than you could really afford to lose?
Would you say never, sometimes, most of the time, or almost always?
<0> Never
<1> Sometimes
<2> Most of the time
<3> Almost always

2. Still thinking about the last 12 months, have you needed to gamble with larger amounts of money to
get the same feeling of excitement?
<0> Never
<1> Sometimes
<2> Most of the time
<3> Almost always

3. When you gambled, did you go back another day to try to win back the money you lost?
<0> Never
<1> Sometimes
<2> Most of the time
<3> Almost always

4. Have you borrowed money or sold anything to get money to gamble?
<0> Never
<1> Sometimes
<2> Most of the time
<3> Almost always

5. Have you felt that you might have a problem with gambling?
<0> Never
<1> Sometimes
<2> Most of the time
<3> Almost always

6. Has gambling caused you any health problems, including stress or anxiety?
<0> Never
<1> Sometimes
<2> Most of the time
<3> Almost always

7. Have people criticized your betting or told you that you had a gambling problem,
regardless of whether or not you thought it was true?

<0> Never
<1> Sometimes
<2> Most of the time
<3> Almost always

8. Has your gambling caused any financial problems for you or your household?
<0> Never
<1> Sometimes
<2> Most of the time
<3> Almost always

9. Have you felt guilty about the way you gamble or what happens when you gamble?
<0> Never
<1> Sometimes
<2> Most of the time
<3> Almost always

BIS-11

DIRECTIONS: People differ in the ways they act and think in different situations. This is a test to measure some of the ways in which you act and think. Read each statement and put an X on the appropriate circle on the right side of this page. Do not spend too much time on any statement. Answer quickly and honestly.

1. I plan tasks carefully.
    <1> Rarely/Never
    <2> Occasionally
    <3> Often
    <4> Almost Always/Always

2. I do things without thinking.
    <1> Rarely/Never
    <2> Occasionally
    <3> Often
    <4> Almost Always/Always

3. I make-up my mind quickly.
    <1> Rarely/Never
    <2> Occasionally
    <3> Often
    <4> Almost Always/Always

4. I am happy-go-lucky.
    <1> Rarely/Never
    <2> Occasionally
    <3> Often
    <4> Almost Always/Always

5. I don't "pay attention."
    <1> Rarely/Never
    <2> Occasionally
    <3> Often
    <4> Almost Always/Always

6. I have "racing" thoughts.
    <1> Rarely/Never
    <2> Occasionally
    <3> Often
    <4> Almost Always/Always

7. I plan trips well ahead of time.
   <1> Rarely/Never
   <2> Occasionally
   <3> Often
   <4> Almost Always/Always

8. I am self controlled.
   <1> Rarely/Never
   <2> Occasionally
   <3> Often
   <4> Almost Always/Always

9. I concentrate easily.
   <1> Rarely/Never
   <2> Occasionally
   <3> Often
   <4> Almost Always/Always

10. I save regularly.
   <1> Rarely/Never
   <2> Occasionally
   <3> Often
   <4> Almost Always/Always

11. I "squirm" at plays or lectures.
   <1> Rarely/Never
   <2> Occasionally
   <3> Often
   <4> Almost Always/Always

12. I am a careful thinker.
   <1> Rarely/Never
   <2> Occasionally
   <3> Often
   <4> Almost Always/Always

13. I plan for job security.
   <1> Rarely/Never
   <2> Occasionally
   <3> Often
   <4> Almost Always/Always

14. I say things without thinking.
   <1> Rarely/Never
   <2> Occasionally
   <3> Often

<4> Almost Always/Always

15. I like to think about complex problems.
<1> Rarely/Never
<2> Occasionally
<3> Often
<4> Almost Always/Always

16. I change jobs.
<1> Rarely/Never
<2> Occasionally
<3> Often
<4> Almost Always/Always

17. I act "on impulse."
<1> Rarely/Never
<2> Occasionally
<3> Often
<4> Almost Always/Always

18. I get easily bored when solving thought problems.
<1> Rarely/Never
<2> Occasionally
<3> Often
<4> Almost Always/Always

19. I act on the spur of the moment.
<1> Rarely/Never
<2> Occasionally
<3> Often
<4> Almost Always/Always

20. I am a steady thinker.
<1> Rarely/Never
<2> Occasionally
<3> Often
<4> Almost Always/Always

21. I change residences.
<1> Rarely/Never
<2> Occasionally
<3> Often
<4> Almost Always/Always

22. I buy things on impulse.
<1> Rarely/Never
<2> Occasionally

<3> Often
<4> Almost Always/Always

23. I can only think about one thing at a time.
<1> Rarely/Never
<2> Occasionally
<3> Often
<4> Almost Always/Always

24. I change hobbies.
<1> Rarely/Never
<2> Occasionally
<3> Often
<4> Almost Always/Always

25. I spend or charge more than I earn.
<1> Rarely/Never
<2> Occasionally
<3> Often
<4> Almost Always/Always

26. I often have extraneous thoughts when thinking.
<1> Rarely/Never
<2> Occasionally
<3> Often
<4> Almost Always/Always

27. I am more interested in the present than the future.
<1> Rarely/Never
<2> Occasionally
<3> Often
<4> Almost Always/Always

28. I am restless at the theater or lectures.
<1> Rarely/Never
<2> Occasionally
<3> Often
<4> Almost Always/Always

29. I like puzzles.
<1> Rarely/Never
<2> Occasionally
<3> Often
<4> Almost Always/Always

30. I am future oriented.

<1> Rarely/Never
<2> Occasionally
<3> Often

South Oaks Gambling Screen

1 Please indicate which of the following types of gambling you have done in your lifetime. For each type, mark one answer: "not at all," "less than once a week," or "once a week or more."

	not at all	*less than once a week*	*once a week or more*	
a.	_____	_____	_____	play cards for money
b.	_____	_____	_____	bet on horses, dogs or other animals (at OTB, the track or with a bookie)
c.	_____	_____	_____	bet on sports (parlay cards, with a bookie, or at Jai Alai)
d.	_____	_____	_____	played dice games (including craps, over and under or other dice games) for money
e.	_____	_____	_____	gambled in a casino (legal or otherwise)
f.	_____	_____	_____	played the numbers or bet on lotteries
g.	_____	_____	_____	played bingo for money
h.	_____	_____	_____	played the stock, options and/or commodities market
i.	_____	_____	_____	played slot machines
j.	_____	_____	_____	played VLT machines
k.	_____	_____	_____	bowled, shot pool, played golf or some other game of skill for money
l.	_____	_____	_____	pull tabs or "paper" games other than lotteries
m.	_____	_____	_____	some form of gambling not listed above (please specify)_____

2. What is the largest amount of money you have ever gambled with on any one day?

_____ never have gambled
_____ $1 or less
_____ more than $1 up to $10
_____ more than $10 up to $100
_____ more than $100 up to $1,000
_____ more than $1,000 up to $10,000
_____ more than $10,000

3. Check which of the following people in your life has (or had) a gambling problem.

_____ father
_____ mother
_____ brother or sister
_____ grandparent
_____ my spouse/partner
_____ my child(ren)
_____ another relative
_____ a friend or someone else important in my life

4. When you gamble, how often do you go back another day to win back money you lost?

_____ never
_____ some of the time (less than half the time I lost)
_____ most of the time I lost
_____ every time I lost

5. Have you ever claimed to be winning money gambling but weren't really? In fact, you lost?

_____ never (or never gamble)
_____ yes, less than half the time I lost
_____ yes, most of the time

6. Do you feel you have ever had a problem with betting money or gambling?
_____ no
_____ yes, in the past but not now
_____ yes

7. Did you ever gamble more than you intend to? _____ yes _____ no

8. Have people criticised your betting or told you that you had a gambling problem, regardless of whether or not you thought it was true? _____ yes _____ no

9. Have you ever felt guilty about the way you gamble or what happens when you gamble? _____ yes _____ no

10. Have you ever felt like you would like to stop betting money or gambling but didn't think you could? _____ yes _____ no

11. Have you ever hidden betting slips, lottery tickets, gambling money, I.O.U.s or other signs of betting or gambling from your spouse, children, or other important people in your life? _____ yes _____ no

12. Have you ever argued with people you live with over how you handle money? _____ yes _____ no

13. (If you answered yes to question 12): Have money arguments ever centred on your gambling? _____ yes _____ no

14. Have you ever borrowed from someone and not paid them back as a result of your gambling? _____ yes _____ no

15. Have you ever lost time from work (or school) due to betting money or gambling? _____ yes _____ no

16. If you borrowed money to gamble or to pay gambling debts, who or where did you borrow from? (check "yes" or "no" for each)

	no	*yes*
a. from household money	( )	( )
b. from your spouse	( )	( )
c. from other relatives or in-laws	( )	( )
d. from banks, loan companies or credit unions	( )	( )

e. from credit cards	( )	( )
f. from loan sharks	( )	( )
g. you cashed in stocks, bonds or other securities	( )	( )
h. you sold personal or family property	( )	( )
i. you borrowed on your checking account	( )	( )
j. you have (had) a credit line with a bookie	( )	( )
k. you have (had) a credit line with a casino	( )	( )