COGNITIVE DISTORTIONS AND PATHOLOGICAL GAMBLING: ARE EDUCATIONAL ANIMATIONS EFFECTIVE IN REDUCING COGNITIVE DISTORTIONS, CHALLENGE APPRAISALS AND GAMBLING PERSISTENCE AMONG SLOTS PLAYERS?

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Abstract

Cognitive distortions, including illusions of control and misperception of odds, have been implicated in the development of gambling problems. It is unknown, however, if these cognitions encourage individuals to appraise gambling as a challenge and thus persist with play, and if these cognitions can be corrected to reduce gambling behaviour. The present study assessed the efficacy of an educational animation in correcting cognitive distortions and reducing problematic play among slots players ($N = 393$). Cognitive distortions and challenge appraisals significantly predicted gambling, and challenge appraisals mediated the relationship between misunderstanding odds and exceeding financial limits. Although the educational animation did not significantly reduce cognitive distortions, frequency of slot machine play was diminished over 30 days. Recreational gamblers were less likely to exceed financial limits after viewing the animation, although this effect dissipated over time. This research partially supports the use of educational animations to reduce problematic behaviours among slots players.

Keywords: Cognitive Distortions, Illusion of Control, Misperception of Gambling Odds, Pathological Gambling, Slots, Challenge Appraisals, Educational Animation

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Imagine you are sitting at a slot machine. You drop a quarter into the machine and pull the lever. The reels spin amidst changing sounds and colours, and eventually stop on three different symbols. You have lost your 25 cent investment. Now ask yourself, what would motivate you to continue playing at this point? Perhaps you enjoy the moment before the reels stop spinning, and the feeling of excitement as you wait to see if you're the next big jackpot winner. Perhaps you feel that you are bound to win eventually, if you just play long enough. Or perhaps you're curious and feel like testing your luck. You know there is a possibility that the next play could result in a jackpot win, but the only way to know for sure is to continue playing.

Many individuals enjoy gambling from time to time, and have likely considered what it would be like to win a large sum of money. Among most individuals, these activities offer a temporary distraction from daily events, excitement, or an opportunity to spend social time with friends and family. For others, however, the hope of a big win and the question of "what if?" may become overwhelming, contributing to greater persistence and increasing investments of time and money. Given these divergent experiences, what separates those slots players who are able to walk away from the machine from those who aren't? A growing body of research indicates that gambling-related cognitive distortions, in particular the tendency to misunderstand one's odds of winning and to develop feelings of control over chance outcomes, might encourage persistence and herald the development of gambling problems (e.g., Frank & Smith, 1989; Langer, 1975; Toneatto, Blitz-Miller, Calderwood, Dragonetti & Tsanos, 1997). Despite this contention, however, there remains debate regarding *how* these cognitions influence behaviour, and whether these cognitions can be corrected among individuals to reduce problematic play.

On one side of this debate, Ferland, Ladouceur and Vitaro (2002) found that cognitive distortions were reduced among recreational slots players following a cognitive therapy program, and concluded that it is possible to correct cognitions among individuals who are not yet experiencing advanced gambling problems. Others, however, have argued that cognitive distortions are stable and resistant to change among individuals at varying levels of gambling pathology, and have failed to find significant reductions in these cognitions following cognitive or educational programs (e.g., Delfabbro, Lahn & Grabosky, 2006). Given these conflicting findings, it is unclear if gambling-related cognitive distortions can be corrected among slots players, if these changes can be parlayed into meaningful reductions in gambling behaviour, and what strategies might be most effective to elicit behavioural change among slots players at different levels of gambling involvement.

Furthermore, the processes that underlie or explain the relationship between cognitive distortions and problem gambling are not well known. One possibility is that cognitive distortions, particularly those regarding false perceptions of control and the tendency to overestimate one's odds of winning, might encourage slots players to evaluate playing as a challenge or a test of their ability to win. This view has received some recent empirical support. Indeed, Lem (2007) found that the tendency to view gambling as a challenge was associated with persistence and increased frequency of play. It is not clear, however, if cognitive distortions are instrumental in promoting this challenge orientation and subsequent behaviours, and this process has yet to be empirically examined within the context of slot machine play.

To clarify and address these outstanding questions, the present study examined two specific cognitive distortions commonly held by slots players, illusion of control over winning and misperception of odds, and tested the efficacy of a slots-specific educational animation in reducing these cognitive distortions and problematic behaviours over time. The present study also examined individual's appraisals of gambling in order to ascertain whether these appraisals constitute a mechanism through which cognitive distortions exert their influence on gambling persistence and behaviours. Through examination of these processes, this research may shed light not only on a potential mechanism underlying the relationship between cognitions and behaviours, but also on the utility of educational animations in correcting cognitive distortions and curbing problematic play among slots players.

Slots and Pathological Gambling

Across all types of gambling, slot machine players appear to be at an especially high risk for developing serious gambling problems. Indeed, slots players tend to exhibit higher rates of pathology (e.g., Breen & Zimmerman, 2002; Griffiths & Delfabbro, 2001; Walker, 1992), and progress from recreational to problematic behaviours faster than other types of gamblers (Wiebe, Mun & Kauffman, 2006). Although a minority of gamblers in Ontario report a preference for playing slots over other forms of gambling (Wiebe et al., 2006), almost 15% of these individuals demonstrate moderate to severe gambling problems, and may contribute as much as 60% of the province's total slots revenue (Williams & Wood, 2003). There is growing consensus that slot machines constitute one of the most addictive forms of gambling currently available in Canada. In fact, slots have recently been described as the "crack-cocaine" of gambling due to the high prevalence of

problem gambling symptoms observed among slots players (Dowling, Smith & Thomas, 2005). Supporting this, a recent Canadian survey identified slot machine play as a primary risk factor for high-risk and problem gambling. Indeed, a staggering one out of every four gamblers who reported playing slots as a part of their gaming repertoire were classified as high-risk or problem gamblers: a proportion much higher than those observed for other forms of gambling, including card games, sports betting and lottery ticket purchases (Statistics Canada, 2003).

Why is pathological gambling so prevalent among slot machine players, and why does this type of gambling appear to be so "addictive?" According to recent research, slots might be reinforcing to gamblers on a number of dimensions. From a practical perspective, slots may be appealing because the cost of each play is minimal (typically between $0.01 and $5.00), because the rules of play are simple (MacLin, Dixon & Hayes, 1999), and because there is a very short delay between each play and the discovery of its outcome (Griffiths, 1999). Unlike card games or lotteries, where one may have to wait to learn the outcome of their wager for a period of hours, days, or even weeks, slots provide individuals with immediate gratification and instant feedback on the outcome of their bet (while minimizing any time to reflect upon their actions).

From a cognitive perspective, another reason that slot machines may be particularly habit-forming relative to other types of games might involve the pace and sequence in which wins and losses are experienced. Slot machines operate on a variable reinforcement schedule, whereby losses are unpredictably interspersed with small to moderate wins (e.g., Carroll & Huxley, 1994). Consistent with behavioural conditioning and learning theories (e.g., Bandura, 1977), these small wins are highly reinforcing to

gamblers, and may renew interest in playing. These wins might promote continued play by both supplementing the number of tokens that individuals have available for play, and by reminding slots players that the machines will pay out and wins are possible (e.g., Cote, Caron, Aubert, Desrochers & Ladouceur, 2003; Giroux & Ladouceur, 2006). Similarly, "near wins" (i.e., losses in which a player is only one symbol away from a winning combination) appear to have reinforcing properties, and to encourage persistence and continued play among slots players. Indeed, Cote and colleagues (2003) found that slots players in a "near win" condition continued playing 33% *longer* than individuals in a random control condition, indicating that individuals may be motivated to extend their play when they perceive that they are "close" to a win.

Some additional insight into individuals' motivations for playing slots may be gleaned from animal research. In an influential series of experiments, Bindra (1968, 1974) examined the behaviour of rats in order to identify factors related to initiating and continuing behaviour. This research distinguished between *drive motivation* and reinforcement-linked *incentive motivation*. According to Bindra (1968), drive motivation is largely determined by biological states (e.g., hunger) which motivate animals to work for a specific reward (e.g., food). When rats are deprived of food or water, for instance, they will display increased activity (e.g., lever pressing) in order to obtain a reward of food or water (Robbins & Everitt, 1996).

Incentive motivation, on the other hand, refers to a process through which external stimuli become directly associated with a reinforcement. Instead of learning to associate an action (e.g., lever pressing) with a specific reward (e.g., food) due to repeated and reliable pairings of the two events, incentive motivation involves a learned

association between an *external stimulus* (e.g., an environmental cue or event) and a salient reward. Bindra (1968) hypothesized that under these learned environment-response contingencies, animals might learn to expect a certain outcome when they are merely *exposed* to an environment that has previously been associated with a positive outcome, regardless of whether this outcome is likely, or any action has been taken to elicit this reward. Supporting the distinction between these motivations, Bindra (1968) and Baum and Bindra (1968) found that when rats were deprived of food, they readily performed learned tasks in order to acquire food (exemplifying a drive motivation). Interestingly, however, if these rats were fed and then placed in an environment previously associated with food, they continued to exhibit exploratory behaviours including sniffing and searching. These exploratory behaviours have been likened to anticipatory excitement in humans, or the apparent expectation that a given action or scenario will produce a certain response, even in the absence of physiological need. These paradigms may carry important implications in terms of human gambling behavior, and slots in particular. Although playing slots is not guaranteed (or even likely) to result in a win, individuals may be tempted to continue playing, or even learn to *expect* an eventual win because of prior positive experiences or salient characteristics of the gaming environment.

Taken together, these factors may help to explain or promote the "addictive" properties of slot machines. Although the odds of winning a jackpot are slim, they are not impossible. That is, there is always a chance that the next play will result in a win. Since the investment for a single play is relatively small, every play offers the (slim) chance of a win, and players receive almost immediate feedback on the outcome of their wager,

individuals may be tempted to continue playing "just one more time." Because of this, slot machine play may represent a form of gambling with a unique potential for addiction (Dowling, Smith & Thomas, 2005; Turner & Horbay, 2004). Furthermore, the variable reinforcement schedule that characterizes slot machine outcomes may promote persistence and heightened expectations of winning.

Gambling-Related Cognitive Distortions

It is widely acknowledged that cognitive distortions are instrumental in gambling persistence and loss of control over gambling (e.g., Delfabbro & Winefield, 1999; Toneatto, Blitz-Miller, Calderwood, Dragonetti & Tsanos, 1997). Specifically, there is a tendency for many gamblers to misunderstand the rules of probability, and to mistakenly attribute chance outcomes (e.g., wins or losses) to causal factors such as personal skill or environmental influences (e.g., Benhsain, Taillefer & Ladouceur, 2004; Kahneman & Tversky, 1972; Toneatto et al., 1997). Furthermore, a significant portion of gamblers may develop irrational beliefs about their ability to exert control over gaming outcomes, and subsequently misjudge their odds of success (Langer, 1975; May, Whelan, Meyers & Steenbergh, 2005; Wohl & Enzle, 2002). Based upon these findings, a growing body of research has examined the role of gambling-related cognitive distortions in decision making and problem gambling symptomatology (e.g., Hirsch & O'Donnell, 2001; Kahneman and Tversky, 1982; Tversky & Kahneman, 1992). This research largely indicates that slots players misjudge probabilities when playing games of chance, and tend to adopt a number of faulty cognitions, including false (i.e., inflated) perceptions of personal control and odds of winning.

Illusion of Control

The belief that games of chance can somehow be influenced or controlled through skill or concerted actions is a recurrent theme throughout the gambling literature. In fact, illusory control is widely considered to be one of the most prevalent and detrimental cognitive distortions endorsed by problem gamblers in general (Burger, 1986; Moore & Ohtsuka, 1999; Toneatto, Blitz-Miller, Calderwood, Dragonetti & Tsanos, 1997), and slot machine players in particular (Delfabbro & Winefield, 2000; Moodie, 2007). Illusion of control is formally defined as, "an expectancy of a personal success probability (which is) inappropriately higher than the objective probability would warrant" (Langer, 1975, p.313). In effect, illusion of control might refer to the belief that one can influence those events in their lives that, objectively, are beyond control.

In a series of experiments, Langer (1975) found that individuals perceived greater control over chance events when these events were judged as familiar (e.g., when individuals had prior knowledge or experience with the event or with a similar task), when the perceived outcome of the task was favourable, and when there was an element of choice inherent in the event or task at hand. Participants who were permitted to select a lottery ticket, for instance, were more likely to believe they had a "good" ticket, and were more confident that they would win compared to those who had a lottery ticket assigned to them by a researcher. Since slot machine players are able to choose not only when and where they wish to play, but also the machine they wish to use, the number of lines played, and the amount bet on each spin, it is possible that characteristics of slot machines in particular may encourage illusory control among gamblers (Delfabbro, 2004; Griffiths, 1990).

Interestingly, feelings of control or mastery are adaptive in many contexts. Among individuals who have suffered trauma or stress, for instance, the perception that events are personally controllable may serve as a buffer against depression, anxiety and negative affect (e.g., Delfabbro, 2004; Lyons, 1991). In terms of gambling, however, feelings of control (and particularly feelings of control over one's ability to win) may fuel a dangerous cycle of spending beyond financial limits, minimizing the importance of losses, and returning to gamble on future occasions in order to recoup previous losses (Breen & Zuckerman, 1999). The precise role or function of illusory control has been debated in the gambling literature. Keonig, Clements and Alloy (1992) have argued that illusions of control over winning may be reported by gamblers as a means of justifying past gambling behaviours (e.g., exceeding limits), maintaining positive self-esteem, and rationalizing poor decision making while gambling (e.g., persisting with play or betting increasing amounts of money). If money is lost, for instance, but one remains confident that this loss is temporary and correctible through future play, the importance of the loss is diminished and the gambler's decision to persist with play is justified. Others have argued that illusory of control simply represents wishful thinking, the desire to achieve a favorable outcome, or a manifestation of superstitious beliefs within a gaming context (Rudski, 2004).

In an interesting extension of this research on illusory control, Sevigny and Ladouceur (2003) found that while many gamblers endorsed appropriate attitudes and beliefs prior to gambling, these same individuals frequently demonstrated overconfidence in their ability to win while they were engaged in play. This *double switching* phenomenon suggests that individuals may not be inherently irrational: instead,

perceptions of control may be encouraged by the act of gambling. In fact, although many gamblers appeared to have reasonable perceptions and expectations of games of chance prior to engaging in play, the number of (false) perceptions of control reported by these individuals increased as play continued, and appeared to be situation-specific (i.e., were selectively elicited through the process of gambling). Since illusions of control have been strongly associated with problem gambling symptoms, and it appears that slot machine play might elicit false perceptions of control *even among otherwise rational individuals*, correcting these control beliefs may constitute a critical step in reducing problematic gambling behaviours among slots players.

Misperception of Odds

Why do some gamblers continue to make poor decisions, betting larger sums of money and persevering or returning to gamble despite losses? Kahneman and Tversky (1972) proposed a model of cognitive processing that might explain the tendency of gamblers to engage in faulty decision-making processes. An important component of this model states that gamblers may employ heuristic strategies, whereby small or unlikely events (e.g., wins) are seized upon and extended to broader contexts. Specifically, many gamblers tend to overestimate the likelihood of low-frequency events, including wins or perceived "streaks of luck," and to believe that these relatively rare events will be representative of future experiences. Kahneman and Tversky (1972) hypothesized that this may occur because wins, although rare, are very salient and reinforcing to gamblers, and as such may be recalled more readily or vividly than losses. If these positive events are called to mind with greater ease than negative events, gamblers might tend to minimize the frequency or importance of their losses, and expect to win more often than

probability would dictate. This expectation may further encourage feelings of control over gaming outcomes and extended play within a given session.

In addition to promoting play within a gambling session, these cognitive distortions may influence gamblers' judgments of future probabilities of success (e.g., Ayton & Fischer, 2004). When asked to predict the outcome of binary chance events (e.g., win or loss), for example, problem gamblers tend to either predict the same outcome as previously observed (e.g., a continuation of wins), or to predict the opposite outcome (e.g., a win following a string of losses). The former tendency, the *hot hand fallacy*, reflects the common belief of gamblers that they are "on a roll," or that a previously observed string of events (i.e. wins) are likely to continue with successive plays (Ayton & Fischer, 2004). The latter tendency, the *gambler's fallacy*, refers to the belief that a win is bound to occur following a string of losses. Although seemingly in opposition to each other, both the hot hand and gamblers' fallacies originate from the use of representative heuristics. Specifically, both strategies involve using previous experiences to impose patterns on chance events, and fail to acknowledge that each outcome is random and independent of the last. Supporting the relationship between odds-related misperceptions and gambling persistence, Burns and Corpus (2004) found that gamblers were more likely to believe that they would win if they perceived games of chance to be non-random or amenable to skill. Slot machine players who fail to acknowledge that outcomes are random and independent of one another, therefore, may be vulnerable to developing heightened expectations of winning and increased confidence in their ability to win, and these factors might in turn promote persistence and the development of problem gambling.

Taken together, illusions of control and the tendency to misunderstand gambling-related odds might influence the way that slots players perceive the characteristics of the game they are playing and subsequently evaluate their odds of winning. These appraisals, in turn, may be instrumental in determining how frequently individuals choose to play, whether they adhere to financial limits, and how much money they choose to wager.

Appraisal Processes and Gambling

Individuals' perceptions or appraisals of a given event may be influenced by a number of situational and dispositional factors, including personality variables, environmental cues, and prior knowledge or experience (e.g., Roesch, Weiner & Vaughn, 2002). A great deal of research has focused on appraisal processes in order to determine how these evaluations contribute to subjective feelings of stress and subsequent behavioural choices and psychological outcomes across individuals.

The appraisal process is twofold, consisting of a primary and secondary evaluation (Lazarus & Folkman, 1984). In a primary appraisal, individuals first assess the personal relevance of a given situation in terms of potential harm or benefit, and the degree of threat the situation poses. The secondary appraisal then involves an evaluation of one's personal resources and ability to cope with the event at hand (Folkman, Lazarus, Gruen, & DeLongis, 1986). At this secondary stage, individuals may consider available options for minimizing or escaping a threatening event (i.e., turning to others for help, removing themselves from the situation). Alternatively, they may draw upon personal coping resources in order to minimize the importance of an event (i.e., cognitive restructuring) or to control, act upon or resolve the source of threat (i.e., problem solving). Following from these dynamic processes, situations are typically perceived as

stressful when they are evaluated as being threatening, uncontrollable, and beyond the range of one's resources or coping attempts (e.g., Matheson & Anisman, 2003).

Within a gambling context, an individual's appraisals of the gaming environment may shape their decisions and behaviours during the gambling session. Although appraisals have received relatively little attention in the gambling literature (for exceptions see Daniel & Barry, 1990; Suzuki, Hirota, Takasawa & Shigemasu, 2003), situation appraisals may reflect an important mechanism through which gamblers make choices and act upon events in the gaming environment. Specifically, individuals who appraise gambling as uncontrollable or threatening (as may be the case particularly with slots or other chance-based games) may be inclined to view gambling as stressful, and therefore may be less likely to persist and wager beyond their means. Conversely, those who appraise gambling as a challenge may be more confident in their ability to rebound from losses, and may persevere in their belief that the challenge can be met. Challenge-oriented appraisals, therefore, may represent a risk factor for gambling persistence, and may contribute to the development of pathology and reticence to seek treatment among gamblers (e.g., Wohl, Anisman, Matheson & Young, 2006).

Despite research suggesting that challenge appraisals might influence gambling-related choices and behaviours (e.g., Lem, 2007; Wohl et al., 2006) it is not known if cognitive distortions encourage these appraisals. Since feelings of control and personal ability have been associated with the tendency to view events as challenging (Lazarus & Folkman, 1984), it is possible that a parallel process occurs in terms of gambling. Specifically, if individuals endorse illusions of control or heightened expectations of winning, they may be more likely to appraise gambling as a challenge and to persist with

play. As such, these appraisals may constitute an important mechanism through which cognitions influence subsequent behaviours across individuals. Although cognitive distortions and, to a lesser degree, challenge appraisals have been associated with gambling persistence, it is not clear if these cognitions can be corrected among slots players through the use of cognitive or educational strategies. Furthermore, the permanence and net impact of these cognitive changes on gambling behaviour have yet to be determined.

Prevention of Pathological Gambling: Approaches and Limitations

Traditional treatment programs for pathological gambling (i.e., Gamblers Anonymous) typically employ 12-step programs based on an addiction model. These models emphasize the importance of admitting loss of control, replacing negative behaviours with positive goals and activities, and promoting abstinence from gambling (Moos, 2007). Although these programs may be beneficial, they target those individuals who have *already developed* gambling problems or are experiencing negative consequences as a result of their behaviours. Furthermore, because these programs are voluntary, they reach only those individuals who are willing to acknowledge loss of control and seek treatment for gambling. Compounding this problem, it is currently estimated that that only 18.8% of individuals who meet criteria for pathological gambling self-identify as problem gamblers, suggesting that many underestimate the nature or severity of their behaviours, and consequently fail to acknowledge and seek treatment for gambling problems (Hardoon, Derevensky & Gupta, 2003). The challenge for researchers and policy makers, therefore, is to build more effective strategies to prevent pathological gambling among general and at-risk populations (Williams, West & Simpson, 2007).

Several approaches have been taken in recent years to prevent or slow the progression of gambling problems among individuals. These strategies have included policy-based, educational and cognitive approaches, each of which present unique strengths and weaknesses.

Policy Initiatives

Various regulatory policies have been introduced in Ontario to decrease the prevalence of problem gambling. These strategies have included restricting availability of gaming venues (e.g., number and location of casinos, hours of operation, etc.) and enforcing legal age requirements (Williams, West & Simpson, 2007). The intention of these policies is to make gambling less accessible or convenient in order to reduce the length of time or amount of money individuals spend gambling. Voluntary self-exclusion programs have also been introduced in many casinos. Under this policy, individuals who feel they have developed gambling problems may identify themselves to casino staff and formally request that they be banned from gaming venues for a contractually agreed period of time (OLG, 2007). Similar to restricting gaming availability, the purpose of this policy is to reduce problem gambling by limiting venue access to self identified at-risk or problem gamblers.

Policy initiatives are not without limitations. With respect to self-exclusion contracts in particular, it is understandable that these may be difficult to enforce, as identification is not always checked for outstanding self-exclusion agreements upon entry to casinos, and casino employees may not be adequately trained to identify or refuse access to patrons. One recent study indicated that a significant portion of problem gamblers with self-exclusion contracts were able to violate these contracts and enter

casinos without being identified by staff (O'Neil, Whetton, Doman, Herbert, Giannopolous, O'Neil & Wordley, 2003). Moreover, self-identified gamblers with restricted access to a particular venue may find alternate outlets or opportunities to gamble (e.g., internet casinos). Although one longitudinal study revealed that self-exclusion contracts were effective in reducing problem gambling (Ladouceur, Sylvain & Gosselin, 2006), these results were obtained from pathological gamblers who successfully fulfilled the terms of their contracts. Unfortunately, these findings may reflect a sampling bias, as they do not describe the behaviours or experiences of the large portion of individuals who violate self-exclusion contracts or relapse following periods of exclusion.

Educational Initiatives

Several educationally based strategies have been implemented to make individuals aware of both the personal risks (e.g., financial loss, negative health outcomes) and social costs of gambling (e.g., lost relationships or employment opportunities) (e.g., Broffman, 2005; Derevensky, Gupta & Dickson, 2004). The purpose of these programs is to inform the general public about issues such as gambling odds, symptoms of problem gambling, and options for treatment. It is hoped that these strategies will increase general knowledge and foster positive attitudes about responsible gambling, and that these factors will translate into reductions in problem gambling (Williams & Wood, 2004). Frequently, these programs are disseminated through information campaigns (e.g., in schools, online) and public advertising (e.g., television, radio) in order to reach a wide audience and make the potential risks and consequences of gambling visible to consumers.

Although educational initiatives have shown some promise for increasing gambling awareness and reducing problematic behaviour, these programs have several limitations. First, although information campaigns may improve knowledge about gambling odds, this acute knowledge may not improve actual behaviours or reduce frequency of gambling (Byrne, Dickson, Derevensky, Gupta & Lussier, 2005; Delfabbro, Lahn & Grabosky, 2006). Furthermore, public surveys indicate that many individuals do not process or retain information from advertising campaigns, unless they are specifically asked to attend to these messages in advance (Williams & Wood, 2004). In fact, only a minority of individuals in Ontario (34%) were able to recall gambling-related advertisements or information when surveyed following a province-wide information campaign (Turner, Wiebe, Falkowski-Ham, Kelly & Skinner, 2005). These strategies, therefore, may be effective only among a small portion of individuals who are sufficiently interested or motivated to retain and act upon these messages.

Cognitive Initiatives

Given the pervasiveness of cognitive distortions among pathological gamblers, a logical aim of treatment has been to reduce or correct these cognitions in order to minimize problematic behaviours (Ladouceur & Lachance, 2007). One of the most common strategies, cognitive-behavioural therapy (CBT), focuses on reducing feelings of control over gambling and other cognitive errors, and replacing gambling with more positive and adaptive activities. A primary strength of cognitive initiatives is that they draw upon a wide range of therapeutic resources and strategies, including cognitive restructuring, problem solving, skills development, and training in mathematics and probability in order to encourage widespread attitudinal, behavioural and cognitive

change (Petry & Armentano, 1999). Wulfert, Blanchard, Freidenberg and Martell (2006) found that cognitive treatments may be effective as an intervention strategy with problem gamblers, provided that these individuals consent to treatment and remain committed to the course of therapy. Furthermore, there is limited research indicating that components of CBT (including cognitive restructuring and probability training) may improve individual's attitudes and knowledge about gambling, and that this knowledge may have preventative effects among gamblers who are not yet experiencing loss of control or gambling problems (Ferland, Ladouceur & Vitaro, 2002).

Although several cognitive and education-based prevention strategies have sought to correct faulty cognitions among gamblers, these beliefs have proven resistant to change. MacDonald, Turner and Somerset (2004), for instance, found that training in probability and statistics was insufficient to elicit behavioural change and adaptive decision-making among problem gamblers. Extending this research to non-problem gamblers, Pelletier and Ladouceur (2007) found that students trained in mathematics and probability did not differ from a control group (with no background in mathematics) in terms of the number of irrational perceptions and behaviours they demonstrated while gambling. In fact, there was a tendency for individuals with greater mathematical knowledge to report a *greater number* of cognitive distortions relative to control participants. Although training in mathematics and probability might improve declarative knowledge about odds of winning (e.g., Williams & Connolly, 2006), therefore, these strategies have largely failed to translate into adaptive cognitive and behavioural changes among slots players.

These results are discouraging from a prevention and treatment perspective, as they suggest that improvements in stated knowledge generally do not predict behavioural change. This might not necessarily mean that interventions aimed at correcting faulty cognitions are futile. According to Hogarth (1975), formal training in statistics and probability may be ineffective not because individuals fail to understand these principles, but because they have difficulty applying abstract rules and information to real-life situations. Following from this, Hogarth (1975) proposed that *cognitively simple, task-specific* strategies may promote change more effectively than theory or mathematically based training programs. In a gambling context, therefore, it may be especially beneficial to present probabilistic education strategies with personally relevant (e.g., game-specific) examples, explanations and feedback.

Educational Animations

One specific medium that has been proposed to simplify scientific and mathematical information is through the use of educational animations (Mayer & Moreno, 2002). Indeed, it appears that re-casting complex information in the form of a cognitively simple, task-specific and relevant animation may provide an effective communication tool for disseminating mathematical, scientific and probabilistic knowledge (Lowe, 1999). Supporting this, Epstein and McGaha (1999) found that viewing a series of short, cognitively simple computerized animations significantly improved reported knowledge and attitudes about substance abuse and treatment options in the general public. Given this finding, educational animations may hold promise for disseminating information to gamblers as well. In particular, since understanding the nature of slot machine outcomes requires some (arguably complex) knowledge of odds

and randomness, a cognitively simple explanation of odds and probabilities may be especially impactful among slots players.

In addition to simplifying mathematical information on a cognitive level, the visual and auditory nature of educational animations may also provide an engaging learning medium for slots players, and further facilitate knowledge transfer and the modification of beliefs. James, Reichelt, Freeston and Barton (2007) suggest that cognitive distortions are based, in part, on previous experiences and memories of events. Following this reasoning, beliefs may be complex, involving not only declarative knowledge (e.g., knowledge of odds and probability), but also visual memories, sounds and contextual sensory cues. In order to address and alter these cognitions effectively, it may be necessary not only to impart correct knowledge, but also to replace maladaptive sensory memories with more appropriate ones (James et al., 2007). By embedding correct information in a contextually relevant visual and auditory format, animations may help to improve both declarative knowledge and internal (e.g., memory or experience-based) representations of slot machine operation. To this end, the present study examined the efficacy of a slots-specific educational animation in correcting cognitive distortions regarding slot machine operation and reducing problematic play among slots players. Specifically, the educational animation emphasized that slot machine wins are random, unpredictable and beyond personal control by explaining and deconstructing two cognitive metaphors: the *conveyor belt* metaphor and the *bag of marbles* metaphor.

Conveyor belt metaphor. This cognitive metaphor is based on the misconception that individual outcomes on a slot machine are predetermined and arranged in a fixed sequence (Dowling, Smith & Thomas, 2005). Based on this representation, individuals

may visualize a long, linear string of losses interspersed with occasional wins. Similar to a conveyor belt, the order of these wins and losses do not change with each play; instead, each spin or outcome in a given session moves the entire conveyor belt forward and brings the next win one step closer. Using this reasoning, individuals may view each losing play as an 'investment' towards a big win, and may be reluctant to terminate play or step away from their machine for fear that the next player will benefit from their investment.

Anecdotal evidence suggests that this reasoning is common among slot machine players. In some slots venues, for instance, clients may request a "hold" on a specific machine while they take a short break to visit an ATM or break for meals (OLG, 2007). The demand for these policies illustrates the reticence of many slots players to step away from the game, or to leave their chosen machine unattended for a period of time. Logically, if individuals acknowledge that their odds of winning are the same on each machine and on each play, they would not be expected to show loyalty or preference for one machine over another, or to believe that one machine would be "luckier" than the next. The demonstration of such preferences suggests that these individuals may view factors such as persistence as viable strategies for winning. Adherence to the conveyor belt model may also be reflected through depictions of "the lurker" (i.e., an individual who is known to circulate through slots venues in search of machines that have not paid out for a long time). The underlying motivation of "the lurker" is to capitalize on another player's investment of time and money in order to increase their chances of winning a jackpot. Again, this behaviour aligns with the conveyor belt model, and the notion that odds of winning become more and more likely with each loss. This pattern of thinking

may carry important implications for individuals at all stages of gambling involvement, and may promote problematic play. In particular, individuals who misunderstand their odds of winning and view slot machines as a "conveyor belt" (believing that each loss brings them one step closer to a big win) may be tempted to play for extended periods of time, to spend more money than originally planned, and to downplay the significance of their losses, believing that money spent is an investment to be recouped with the next and imminent win.

Bag of marbles metaphor. The second misconception of slot machine operation targeted in the educational animation is that one's odds of winning improve as a function of previous losses (e.g., Dowling, Smith & Thomas, 2005; Harrigan, 2007). This misconception rests on the assumption that there are a fixed number of wins and losses possible throughout the course of play in a given session, and that each loss an individual experiences improves the remaining odds ratio of wins to losses. For example, if an individual has lost money on 10 consecutive trials, he or she may believe they have "removed" 10 of the possible losses, leaving a higher concentration of wins in the machine. Each loss, therefore, improves the likelihood of a win on the next play, as each loss removes one negative outcome from the fixed pool of wins and losses. This is illustrated as a bag of marbles, containing several white marbles (representing losses) and a few red marbles (representing wins). Each time an individual reaches into the bag and removes a white marble, the ratio of white to red marbles remaining in the bag decreases, such that the odds of drawing a red marble (a win) will improve the next time a selection is made. Again, gamblers employing this reasoning may feel as though persistence is the key to winning, and that each loss carries with it a hidden benefit (i.e., that each loss

improves one's odds of winning on future spins). Similar to the conveyor belt analogy, this metaphor fails to take in to account the independence of outcomes and the replacement feature of slot machines, and as such may promote unrealistically high expectations of winning and excessive play.

The Present Study

Although an emergent body of research has demonstrated a relationship between gambling-related cognitive distortions and problem gambling, the flexibility of these cognitions and the process through which these beliefs influence behaviour among individuals is not clear. Specifically, it is not known if gambling-related cognitive distortions influence gamblers' appraisals of the gaming environment, in turn leading to poor decision making and behavioural tendencies (e.g., exceeding financial limits). Since situations are generally perceived favourably when they are appraised as challenging and controllable, gamblers who have high illusions of control over winning may be more likely to evaluate chance events (i.e., slots) in a positive light, and may therefore persist in gambling and spending beyond their financial limits.

In order to examine whether cognitive distortions can be corrected through the use of an educational animation, and to further assess the relationship between gambling-related cognitive distortions, appraisals of gambling, and problem gambling behaviours (e.g., gambling persistence and frequency) over time, this research assessed cognitions and appraisals of gambling among slot players both before and 30 days following a game-specific educational manipulation (a cognitively simple, interactive computer animation). The purpose of this intervention was to target gamblers' misunderstanding of

probability in a gambling-specific context, and to replace these cognitions with more accurate knowledge about odds of winning and the replacement feature of slot machines.

Specifically, through deconstructing the "conveyor belt" and "bag of marbles" metaphors endorsed by many slots players, the animation educated gamblers about the independence of slot machine outcomes (e.g., that outcomes are random and independent, and as such, a win or loss on one play has no effect on subsequent plays), and explained that slot machines sample with replacement (e.g., that the odds of winning "reload" or reset with each play: a mechanism akin to drawing a winning or losing marble from a bag, and replacing the marble in the bag before the next draw takes place). As such, outcomes are random and not amenable to skill or control, and extending play within a given session will not improve the odds of a large win.

Following recommendations by James, Reichelt, Freeston and Barton (2007), the visual and auditory format of this animation provided positive sensory cues in order to reinforce the educational content of the video and establish more adaptive cognitive schemas of gambling. By imparting correct information about odds of winning and the mechanics of slot machine operation, this educational animation was expected to reduce cognitive errors associated with odds of winning, and to promote responsible gambling by encouraging appropriate, realistic appraisals of risk and adherence to financial limits. The following specific hypotheses were assessed to examine and quantify these relationships:

1. Illusions of control over winning and misperception of odds will predict greater gambling symptoms and behavioural persistence among slots players, assessed by self-reported frequency of slot machine play and exceeding financial limits.
2. Illusions of control over winning and misperception of odds will predict challenge-oriented appraisals of gambling among slots players.
3. Challenge-oriented appraisals of gambling will predict greater gambling symptoms and behavioural persistence among slots players, assessed by self-reported frequency of slot machine play and exceeding financial limits.
4. Challenge-oriented appraisals of gambling will mediate the relationship between cognitive distortions and exceeding financial limits among slots players.
5. Viewing a slots-specific educational animation will reduce gambling-related cognitive distortions among slots players, including illusions of control over winning and misunderstanding of odds, and this effect will persist over a 30 day period.
6. Viewing a slots-specific educational animation will promote a) reductions in challenge-oriented appraisals of gambling, b) reductions in gambling frequency and c) improved adherence to financial limits over a 30 day period.

Method

Participants

A sample of 393 community slot machine players (n = 203 male; n = 185 female; n = 5 unreported) was recruited from Rideau Carleton Raceway and Slots in Ottawa, Ontario, Canada. Individuals were randomly approached upon entry to the slots venue, and asked to participate in a 30-45 minute study on gambling attitudes, perceptions and experiences. Participants were compensated $30 CAD for their time and debriefed at the end of the experimental session.

Following the initial session, 146 participants (n = 72 male; n = 72 female; n = 2 unreported) were identified as recreational or non-problem gamblers based on a score of 0 (i.e., no problem gambling symptoms) on the Canadian Problem Gambling Index (CPGI; Ferris & Wynne, 2001). A further 101 participants (n = 58 male; n = 42 female, n = 1 unreported) were classified as "low-risk" gamblers, and 146 participants (n = 73 male; n = 71 female, n = 2 unreported) were classified as "moderate-risk/problem" gamblers. Participants represented mixed ethnic and racial backgrounds, including Caucasian/European (n = 252), Asian (n = 13), African Canadian/American (n = 20), Middle Eastern (n = 7), Hispanic/South American (n = 6), Native Canadian/American (n = 58), Other (n = 26) and unreported (n = 11). Participants were 19 to 89 years of age, with a mean age of 46.59 years (SD = 15.99 years). A majority 91.9% of respondents (n = 361) were residents of Ontario. Participants were married (n = 175), Single/never married (n = 114), living with a common-law partner (n = 36), Divorced (n = 33), Separated (n = 14) and Widowed (n = 15). The majority of participants (n = 214) were employed full-time. Remaining participants reported working part-time (n = 40), being retired (n = 79),

and working on a seasonal or contract basis (n = 18). Approximately 8% of participants (n = 31) were unemployed at the time of their involvement in the study, and an additional 10 participants declined to report their employment status. Almost 60% of participants had obtained post-secondary education, with 30.5% (n = 120) reporting completion of a college program, 18.8% (n = 74) completing a University undergraduate degree, and an additional 9.2% (n = 36) completing a graduate/advanced University degree. The remaining participants reported completing Elementary School (n = 15) or High School (n = 141).

In terms of gambling involvement, 76.8% of participants (n = 302) reported that they had gambled *at least once* in the 3 months prior to the study. Of these individuals, 93.7% (n = 283) reported playing slots within this time period. An overwhelming 83.4% of participants (n = 328) reported setting financial limits for themselves (at least to some extent) prior to gambling. Specifically, 58.5% (n = 192) reported that they "always" set a spending limit prior to gambling, 30.8% (n = 101) reported setting financial limits "most times", and 6.1% (n = 20) reported that they "sometimes" or occasionally set a financial limit prior to gambling. Interestingly, 39.3% of these individuals (n = 129) admitted to exceeding their financial limits at least once in their lifetime, and 20.7% (n = 68) reported that they had exceeded their financial limits while gambling *at least once* in the 3 months prior to completing this study.

Procedure

Slot machine players who agreed to participate in this study were brought to a designated conference room at Rideau Carleton Raceway and Slots. The room was equipped with a number of personal laptop computers and headphones. Upon reading and

agreeing to an online informed consent form (Appendix A), participants were seated individually in front of a computer and asked to complete a battery of online questionnaires.

In the first phase of the study, participants were asked to provide demographic information and to complete a number of questionnaires assessing gambling frequency, beliefs about gambling and appraisals of gambling. Additionally, questionnaires were administered to assess participants' understanding of how slot machines operate, and to assess their knowledge of gambling odds and probability, including principles of randomness and sampling with replacement (see Appendix B for questionnaire package).

Following completion of these initial questionnaires, participants were assigned to either an educational animation condition or a control video condition. A total of 214 participants (110 men and 104 women) watched the five minute computerized animation (see Appendix C for animation script). The educational animation described both the "conveyor belt" and "bag of marbles" conceptualizations of slot machine operation, and broke these cognitive metaphors down to explain principles of randomness and sampling with replacement. Specifically, this animation explained that each play is independent of the last, and that a loss on any given play does not increase the probability of success on subsequent plays. The animation further emphasized that the odds of a significant win on a slot machine are extremely small (around 90,000 to 1), and that these odds never improve, regardless of how long one has played.

A control comparison group of 174 participants (93 men and 81 women) watched a neutral 5 minute video that discussed general facts about the lines of business managed by the Ontario Lottery and Gaming Corporation (see Appendix D for control video

content). Three primary lines of business were described: lottery (e.g., annual revenues derived from lottery products, lottery-based games offered in Ontario, etc.), Casino Services (e.g., the location of various Casinos in Ontario, the services and amenities provided, etc.), and Corporate Services (e.g., the location of corporate offices across Ontario, responsibilities of corporate services, etc.).

After viewing either the animation or control video, participants completed additional online questionnaires to determine the efficacy of the animation, the extent to which they endorsed the conveyor belt and bag of marbles models of slot machine operation, and the extent to which their endorsement of these models changed following presentation of the animation. Additionally, a number of the initial measures were repeated to determine whether participant's knowledge about odds of winning and understanding of slot machines improved following presentation of the video. Finally, all participants were asked for permission to be contacted for future research and fully debriefed as to the purpose of the study (see Appendix E for debriefing).

Upon leaving the study session, participants were provided with a link to an online 24 hour follow-up survey. This brief, 8 item questionnaire was used to confirm whether participants indeed set a financial limit for their visit to the slots venue on the day of the study session, whether they exceeded their financial limit after participating in the study, and whether they felt the video influenced their play or helped them to stay within financial limits. Additional feedback questions were included to assess whether participants found the video to be interesting and informative, and whether the length of the video was appropriate. This feedback may be used to evaluate the efficacy of the animation, and to modify or redesign the animation for future use.

Participants who consented to future contact were contacted via email or postal mail (as requested) one month following the initial test session, and asked to participate in a follow-up session. This follow-up session involved completing the initial questionnaire package, and was used to assess any changes in gambling frequency, tendency to exceed financial limits, illusory control and appraisals of gambling over time. Participants who completed this 30 day follow-up study and provided valid responses were compensated $50.00 CAD. A total of 191 participants (n = 109 animation condition; n = 82 control condition) completed measures at both time periods and are available for comparison.

Measures

Manipulation check. Following the presentation of each animated metaphor, participants were asked to answer the following question; *"How accurately does this explanation represent your understanding of how slot machines operate?"* Responses were measured on a 7 point Likert scale, with 1 representing *'Not at all accurate'* and 7 representing *'Very accurate'*. These questions were included as a manipulation check to assess the ecological validity and salience of the "conveyor belt" and "bag of marbles" cognitive metaphors, as well as the efficacy of the animation among slot machine players.

Demographics. The demographic questionnaire was used for descriptive purposes to assess variables such as participants' age, gender, annual household income, marital and employment status, ethnic background and highest level of education achieved. Additionally, participants were asked to indicate whether they are currently seeking professional help for gambling problems, or whether they have ever participated in treatment or counseling programs for dealing with gambling problems.

Gambling history. The 90-day retrospective gambling history questionnaire was used to assess self-reported frequency of gambling and setting financial limits among slots players over the past 3 month period, as well as self-reported frequency of exceeding financial limits while gambling, and extent of over-spending when limits are exceeded.

Problem gambling symptoms. The 9-item Canadian Problem Gambling Index (CPGI-9; Ferris & Wynne, 2001) was used to assess the presence and severity of gambling problems among participants. The CPGI-9 contains five items that assess problem gambling behaviour (e.g., "Have you bet more than you could really afford to lose?") and four items addressing the consequences of gambling (e.g., "Has gambling caused you any health problems, including stress or anxiety?"). Items are rated on a 4-point Likert scale, with 1 representing *'Never'* and 4 representing *'Almost Always'*. Items are then re-calibrated on a 0 to 3 scale, and summed to yield a composite score of gambling pathology. Composite scores range from 0 to 27. Based upon this score, individuals are classified in to one of three levels of gambling involvement. Participants with a total score of 0 were classified as 'non-problem' gamblers, those with a total score ranging from 1 to 2 were classified as 'low-risk' gamblers, and participants with a total score above 3 were classified as 'moderate-risk/problem' gamblers. As in previous research (e.g., Ferris & Wynne, 2001), the CPGI-9 demonstrated high internal consistency reliability in the present sample (Cronbach's $\alpha = .88$).

Misperception of odds. The 25-item Informational Biases Scale (IBS; Jefferson & Nicki, 2003) was used to assess the extent of cognitive distortions among slots players related to the nature of chance events, randomness, and independence of game outcomes.

Initial scale development work supports a single factor model of the IBS, with scale items loading on a single factor, described as "misconception of the nature of randomness" (Jefferson & Nicki, 2003). Items (e.g., "The longer a slot machine has gone without paying out a large sum of money, the more likely it is to pay out in the very near future") were rated on a 7-point Likert scale, with 1 representing *'Don't agree at all'* and 7 representing *'Strongly agree'*. Responses were summed and a mean score calculated, with higher scores representing greater misperceptions of randomness, odds and sampling with replacement. Previous research involving community video lottery players (Jefferson & Nicki, 2003) has demonstrated high content validity and internal consistency of the IBS. Internal consistency reliability was high in the present sample (Cronbach's $\alpha = .92$).

Illusion of control over winning. The 10-item illusion of control subscale of the Gamblers' Beliefs Questionnaire (GBQ; Steenbergh, Meyers, May & Whelan, 2002) was used to assess participant's perceptions of personal skill and control over gaming outcomes. Items (e.g. "My choices or actions affect the outcome of the game on which I am betting") were rated on a 5-point Likert scale, with 1 representing *'Strongly Disagree'* and 5 representing *'Strongly Agree'*. Responses were summed and a mean score was calculated, with higher scores representing greater illusions of control over winning. No items were reverse scored. Subscale items yielded high internal consistency reliability in the current sample (Cronbach's $\alpha = .87$).

Appraisals of gambling. The 37-item Stress Appraisal Measure (SAM; adapted from Peacock & Wong, 1990) was used to assess primary appraisals of Challenge (e.g., "Is my gambling going to have a positive impact on me?"), Threat (e.g., "How

threatening is my gambling behaviour?"), and Control (e.g., "Do I have what it takes to do well when I gamble?") in response to gambling. Items were rated on a 5 point Likert scale, with 1 representing *'Not at All'* and 5 representing *'Extremely / Very Much'*. Responses were summed and a mean score calculated for each subscale, with higher scores representing greater endorsement of the given appraisal. All SAM subscales demonstrated adequate reliability and internal consistency in the present study (Challenge $\alpha = .62$; Threat $\alpha = .92$; Control $\alpha = .81$).

Results

Preliminary Analyses

Gender differences. In order to identify any gender differences among participants in terms of gambling frequency, appraisals of gambling, illusions of control over winning or misunderstanding of odds, a series of one-way ANOVA's were conducted using each variable in turn as a dependent measure. These analyses indicated that males and females did not differ significantly on measures of illusory control ($p = .12$, *ns*), overall gambling frequency ($p = .75$, *ns*), frequency of slot machine play ($p = .33$, *ns*), frequency of exceeding financial limits ($p = .50$, *ns*), or appraisals of gambling, either as a threat ($p = .38$, *ns*) or challenge ($p = .40$, *ns*). Although there was a trend towards greater misunderstanding of odds among women ($M = 3.83$) compared to men ($M = 3.62$), this effect failed to reach statistical significance ($p = .06$, *ns*). As the main effect of gender was non-significant for all dependent variables, participant gender was collapsed across for all subsequent analyses.

Group/Condition differences. In order to confirm random assignment and the equivalency of groups by experimental condition, a series of one-way ANOVA's were conducted to determine whether there were any systematic pre-existing differences in gambling frequency, appraisals or cognitive distortions among participants assigned to the animation vs. the control condition. These analyses indicated that participants in the two conditions did not differ significantly on Time 1 measures of illusory control ($p = .55$, *ns*), misunderstanding of odds ($p = .31$, *ns*), overall gambling frequency ($p = .69$, *ns*), frequency of slot machine play ($p = .30$, *ns*), frequency of exceeding financial limits ($p = .66$, *ns*), or challenge-oriented appraisals of gambling ($p = .22$, *ns*). As the main effect of

condition was non-significant across all Time 1 measures, it was deemed that any differences observed between groups following the animation may be attributed to the effect of the manipulation, and not to pre-existing or systematic differences between groups.

Manipulation check. A fundamental assumption of the present study is that slots players do, in fact, endorse the cognitive metaphors targeted in the educational animation. In order to establish whether slots players adhered to the "conveyor belt" and "bag of marbles" metaphors of slot machine operation (and thus to determine whether the animation constitutes a potentially effective manipulation), manipulation check items were analyzed following the presentation of each animated metaphor.

Immediately following presentation of the animated "conveyor belt" analogy, participants were asked to rate the extent to which this explanation represented their understanding of slot machine operation on a 7 point scale. To assess participants' adherence to the conveyor belt model over the course of the educational animation, a repeated measures ANOVA was performed in which participants' *initial* ratings were compared against subsequent ratings (collected at the end of the animation, following a full explanation of both cognitive metaphors). This analysis revealed a significant difference in participants' ratings over time, $F(1,187) = 28.14$, $p < .01$, $\eta_p^2 = .13$. Specifically, participants were *less likely* to endorse the conveyor belt metaphor of slot machine operation after they listened to appropriate information dispelling this myth ($M = 2.74$, $SD = 2.11$), compared to initial ratings they made *prior* to receiving this information ($M = 3.62$, $SD = 2.33$). This finding suggests that the animation was indeed

effective in breaking down the conveyor belt metaphor of slot machine operation, and in reducing adherence to this metaphor among participants.

The second segment of the educational animation described principles of randomness and sampling with replacement using a "bag of marbles" analogy. Following presentation of this analogy, participants were once again asked to rate on a 7 point scale how well this metaphor described their understanding of slot machine operation. Again, a repeated measures ANOVA was used to assess adherence to this metaphor over time. In this analysis, participants' ratings of the "bag of marbles" metaphor were compared against a rating of their continued compliance with the "conveyor belt" analogy following explication of both cognitive metaphors. A significant main effect was observed, $F(1,187) = 153.21$, $p < .01$, $\eta_p^2 = .45$. Participants were significantly *more likely* to endorse the "bag of marbles" metaphor (encompassing principles of randomness and sampling with replacement) after listening to the educational animation ($M = 5.54$, $SD = 1.90$) than they were to endorse the conveyor belt metaphor ($M = 2.74$, $SD = 2.11$). In other words, it appears that the animated "bag of marbles" metaphor (which explained that slot machines are random and sample with replacement) resonated with participants.

Main Analyses of Variables Prior to Manipulation

Prior to assessing the effects of the educational animation on cognitive distortions and gambling behaviours, a series of analyses were performed to support the nature and direction of the hypothesized relationships between cognitive distortions, challenge appraisals, gambling symptomatology, and behavioural indices of gambling persistence (reported frequency of slot machine play and exceeding financial limits). A summary of bivariate correlations between these study variables is presented in Table 1.

Table 1

Bivariate Correlations Between Misperception of Odds, Illusion of Control, Challenge Appraisals, Gambling Frequency, Exceeding Financial Limits and Gambling Symptoms (CPGI) Among Slots Players (N = 393)

	1	2	3	4	5	6	7
1. Misperception of Odds	-	.32**	.17**	.02	.16**	.21**	.34**
2. Illusion of Control		-	.16**	.14**	.03	.11	.25**
3. Challenge Appraisals			-	-.03	.08	.22**	.27**
4. Gambling Frequency (Overall)				-	.26**	.17*	.11*
5. Gambling Frequency (Slots)					-	.17*	.35**
6. Extent of Exceeding Limits						-	.62**
7. Gambling Symptoms (CPGI)							-

*$p < .05$, **$p < .01$

Cognitive distortions and problem gambling symptoms. Building upon previous research, it was hypothesized that gambling-related cognitive distortions, including illusions of control over winning and misunderstanding of odds, would predict greater overall problem gambling symptoms among slots players. To assess this hypothesis, a stepwise linear regression analysis was performed. A preliminary analysis of residual scatterplots revealed adequate normality and homoscedasticity of study variables. Absence of multicollinearity and singularity between independent variables was additionally supported by relatively small standard errors and tolerance values close to 1 (Tabachnick & Fidell, 2007).

Misperception of odds was entered into the model first, given its stronger zero-order correlation with gambling (CPGI) scores ($r = .34$, $p < .01$). Consistent with previous research, misperception of odds uniquely predicted problem gambling symptoms among slots players, $F(1, 391) = 50.45$, $p < .01$, $SEE = 4.04$, $R^2 = .112$. In the second stage of the analysis, illusions of control scores were entered into the model. Illusions of control significantly predicted problem gambling symptoms in the present sample, holding misperceptions constant, $F(2, 390) = 30.94$, $p < .01$, $SEE = 3.99$. Illusion of control uniquely accounted for 2.3% of the variance in CPGI scores, over and above odds-related misperceptions ($\beta = .16$, $sr^2 = .023$). The 95% confidence interval was computed for each regression coefficient, and these confidence intervals did not contain zero, suggesting a true population effect of cognitive distortions on problem gambling symptoms. Participants' misperceptions of odds had the greatest relative influence on problem gambling symptoms ($\beta = .29$, $sr^2 = .075$), and the final model accounted for 13.3% of the variance in problem gambling scores. These parameters and their confidence intervals are summarized in Table 2.

Table 2

Summary of Stepwise Multiple Regression Analysis for Variables Predicting Problem Gambling Symptoms (CPGI Total Score) (N = 393)

Variable	Step	ΔR^2	Model R^2	Adjusted Model R^2	B	SE B	β	95% Confidence Interval Lower	Upper
Misperception of Odds	1	.114	.114	.112	1.12	.19	.29	.74	1.49
Illusion of Control	2	.023	.137	.133	.90	.28	.16	.35	1.46

Cognitive distortions and gambling behaviours. In addition to overall problem gambling symptomotology, it was hypothesized that cognitive distortions would predict gambling persistence, assessed by self-reported frequency of slot machine play and exceeding financial limits. In regards to gambling frequency, multiple linear regression revealed that misperception of odds was a significant predictor of slot machine play among participants, $F(2, 378) = 4.81$, $p = .01$, $SEE = 10.91$, $R^2 = .022$. Illusion of control, however, did *not* significantly predict frequency of slot machine play in the present study ($p = .61$, *ns*).

Two separate regression procedures were used to explore the relationship between cognitive distortions and exceeding financial limits among participants. To first assess whether cognitive distortions predicted exceeding financial limits, a standard logistic regression analysis was performed. Responses to the question, "In the past 3 months, have you ever *exceeded* your spending limit while playing slots?" (Yes / No) were used as a dichotomous dependent variable, and illusion of control and misperception of odds scores were examined as predictors of an affirmative response.

Misperception of odds significantly predicted the probability of exceeding financial limits in the present study, B = .65, *SE* = .12, Wald χ^2 (1) = 31.25, $p < .01$, with an odds ratio of 1.92 (*CI* = 1.53, 2.41). This odds ratio indicates that for each unit increase in misperception of odds, participants were approximately 2 times more likely to have reported exceeding their financial limits. As in the previous analysis, illusion of control scores did not significantly predict the odds of exceeding financial limits ($p = .27$, *ns*). This analysis is summarized in Table 3.

Table 3

Summary of Logistic Regression Analysis for Exceeding Financial Limits as a Function of Misperception of Odds and Illusion of Control

Variable	B	SE B	Wald χ^2	Odds Ratio	95% Confidence Interval for Odds Ratio	
					Lower	Upper
Misperception of Odds	.65	.12	31.25	1.92	1.53	2.41
Illusion of Control	-.17	.15	1.20	.85	.63	1.14

Standard linear regression was next used to assess whether cognitive distortions predicted the *extent* to which participants exceeded their financial limits while gambling (i.e., the amount of money spent above pre-set limits). This analysis revealed that misperception of odds significantly predicted the amount that participants spent above their financial limit, $F(1, 170) = 7.99$, $p = .01$, $R^2 = .039$, such that greater misperceptions were associated with more excessive spending. Again, illusion of control scores did not

significantly predict the extent to which participants exceeded their financial limits in the present study ($p = .64$, *ns*).

Cognitive distortions and challenge appraisals. Given that individual's cognitions might influence their subjective evaluations of events, it was hypothesized that gambling-related cognitive distortions, including misperceptions of odds and illusions of control over winning, would be associated with greater challenge-oriented appraisals of gambling among slots players. To test this hypothesis, a stepwise multiple linear regression analysis was performed. Misperception of odds was entered into the model first, given its stronger zero-order correlation with challenge appraisal scores ($r = .17$, $p < .01$). As expected, misunderstanding of odds significantly predicted challenge-oriented appraisals of gambling in the present sample, $F(1, 391) = 12.25$, $p = .001$, $SEE = .86$, such that greater misperceptions were positively associated with the tendency to evaluate gambling as a challenge. Misunderstanding of odds uniquely accounted for 2.8% of the variance in challenge-oriented appraisals of gambling. In the second stage of the analysis, illusion of control was entered in to the model. Illusion of control uniquely predicted challenge-oriented appraisals of gambling among slots players, holding misperceptions of odds constant, $F(2, 390) = 8.60$, $p < .01$, $SEE = .86$. Illusions of control accounted for an additional 1.2% of the variance in challenge-oriented appraisals of gambling, over and above the effect of odds-related misperceptions ($sr^2 = .012$). Results of this analysis are summarized in Table 4.

Table 4

Summary of Stepwise Multiple Regression Analysis for Variables Predicting Challenge-Oriented Appraisals of Gambling (N = 393)

Variable	Step	ΔR^2	Model R^2	Adjusted Model R^2	B	SE B	β	95% Confidence Interval Lower	Upper
Misperception of Odds	1	.030	.030	.028	.14	.04	.17	.06	.22
Illusion of Control	2	.012	.042	.037	.13	.06	.12	.01	.25

Challenge appraisals and gambling behaviours. In order to support and extend previous research, we hypothesized that challenge-oriented appraisals of gambling would predict gambling persistence, assessed by self-reported frequency of slot machine play and exceeding financial limits. Linear regression revealed that challenge-oriented appraisals of gambling did *not* predict overall frequency of slot machine play in the present sample, $F(1, 379) = 2.66$, $p = .10$, *ns*. Logistic regression, however, indicated that challenge-oriented appraisals of gambling significantly predicted the probability of exceeding financial limits in the present study, B = .26, *SE.* = .12, Wald χ^2 (1) = 4.73, p = .03, with an odds ratio of 1.30 (*CI* = 1.03, 1.64). This odds ratio indicates that for each unit increase in challenge appraisals, participants were approximately 1.6 times more likely to have exceeded their financial limits. Challenge appraisals were also significantly associated with the *extent* to which participants exceeded their financial limits in the present study, $F(1, 170) = 8.30$, $p < .01$, such that the tendency to appraise slots as a challenge was associated with greater overspending. These appraisals accounted for 4.1%

of the variance in exceeding financial limits. Although this represents a modest effect, this finding nonetheless supports the contention that perceiving slot machine play as a test of personal skill or ability might encourage extended play and spending beyond financial limits.

Mediation analysis. It was hypothesized that challenge appraisals would mediate the relationship between misunderstanding of odds and extent of exceeding financial limits (i.e., the amount of money spent *above* pre-set limits) among slots players. To test this hypothesis, mediation analyses were conducted using linear regression procedures as outlined by Baron and Kenny (1986). In the first step of the analysis, misperception of odds significantly predicted challenge appraisals, $F(1, 391) = 12.25$, $p = .001$, $R^2 = .03$, $\beta = .14$, thereby supporting a relationship between the independent variable and the proposed mediator. In the second step of the analysis, misperception of odds was regressed on extent of exceeding financial limits. Again, this relationship was statistically significant, $F(1, 170) = 4.12$, $p = .04$, $R^2 = .024$, $\beta = .15$, indicating that misperceptions exert a direct influence on the extent of exceeding financial limits among slots players. In the third step of the analysis, both misperceptions and challenge appraisal scores were included as predictor variables and regressed on exceeding financial limits. Although challenge appraisals remained a significant predictor of exceeding financial limits at this stage of the analysis ($\beta = .19$, $t(170) = 2.51$, $p = .01$), the direct relationship between misperception of odds and exceeding financial limits was rendered non-significant when controlling for appraisals ($\beta = .11$, $t(169) = 1.49$, $p = .14$). These results support mediation as identified by Baron and Kenny (1986).

Following recommendations by Preacher and Hayes (2004) for small samples, a bootstrapping technique was used to determine the significance of the indirect (e.g., mediated) effect, using 1000 iterations. The obtained 95% confidence interval did not contain zero (*CI* = .49, 13.43), indicating that the indirect effect was indeed significant. This mediated model is illustrated in Figure 1.

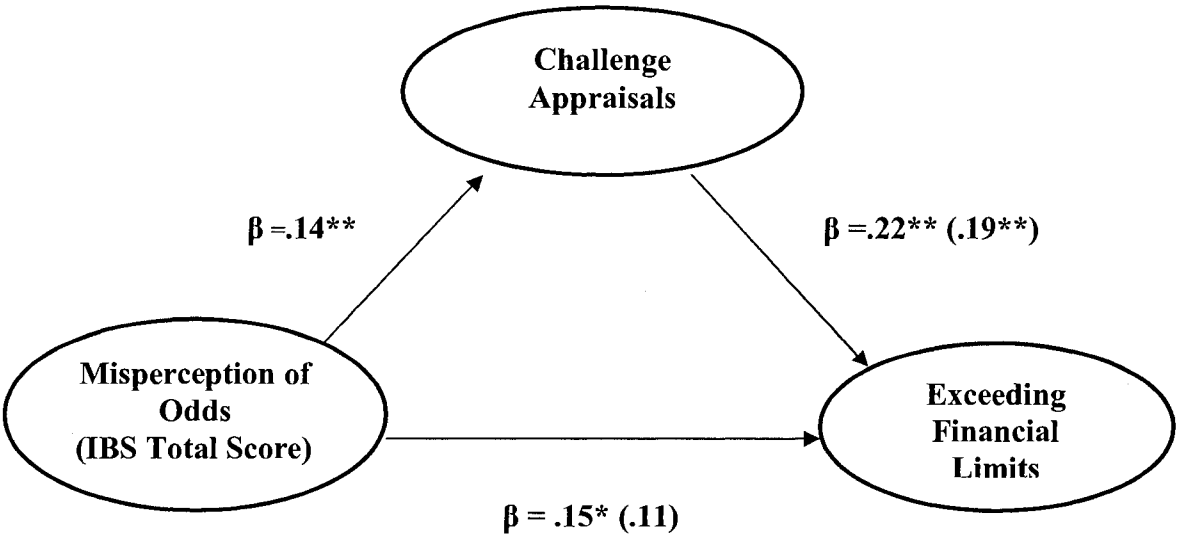

Figure 1. Mediational analysis examining the effect of misperception of odds on exceeding financial limits, with challenge appraisals as a mediator. Coefficients with an asterisk denote significant standardized beta weights ($^{*}p < .05$, $^{**}p < .01$). Coefficients in parentheses indicate the effect of each predictor on extent of exceeding financial limits, controlling for the other predictor.

Results of this analysis support the hypothesis that misunderstanding gambling-related odds predict challenge-oriented appraisals of gambling, and that these appraisals in turn might predict the extent to which slots players exceed their financial limits while gambling. Although illusions of control were weakly correlated with overall gambling frequency ($r = .15, p = .01$), the relationship between illusions of control and exceeding financial limits was non-significant in the present study ($r = .11, p = .17$). As such, the required conditions for testing mediation (as outlined by Baron & Kenny, 1986) were not satisfied in the present investigation and a test of the model including illusion of control as a predictor was not pursued.

Main Analyses of Variables Post-Animation

To assess whether the educational animation was effective in decreasing cognitive distortions among slots players at varying levels of pathology over time, a series of mixed-repeated measures ANOVAs were conducted. Cognitions were assessed at two time points: in the initial session prior to viewing the animation, and again 30 days later. Scores from the first test session (collected prior to presentation of the animation or control video) were used as a baseline measure, and these scores were compared against measures collected 30 days following the initial test session. A total of 191 participants ($n = 109$ animation condition; $n = 82$ control condition) completed measures at both time periods and were available for comparison.

Illusion of control over winning. In order to examine changes in illusions of control over time, a mixed-repeated measures ANOVA was performed, using 2 between subjects factors (condition: animation vs. control and level of pathology: non-problem vs. low-risk vs. moderate-risk/problem gambling), and 1 within subjects factor (illusion of

control scores: initial session vs. 30 day follow-up). Means and standard deviations for these factors are reported in Table 5.

Table 5

Illusion of Control over Winning (M ± SD) at Baseline and 30 Days, by Condition and Level of Gambling Pathology (N = 191)

Condition	CPGI	Baseline Mean	Baseline SD	30 Day Mean	30 Day SD
Animation	Non-Problem	1.60	.67	1.42	.44
	Low-Risk	1.94	.75	1.79	.67
	Moderate-Risk /Problem	2.13	.74	2.02	.70
Control	Non-Problem	1.68	.65	1.63	.64
	Low-Risk	1.96	.92	1.98	.89
	Moderate-Risk /Problem	2.07	.76	2.03	.80

Results of this analysis revealed a marginally significant within-subjects main effect of time of assessment, $F(1, 185) = 3.50$, $p = .06$, $\eta_p^2 = .019$. Specifically, illusions of control over winning tended to *decrease* among participants between the initial session ($M = 1.86$, $SD = .75$) and the 30 day follow-up session ($M = 1.76$, $SD = .70$). A significant main effect of gambling pathology was also observed, averaged over participant condition, $F(2, 185) = 10.37$, $p < .01$, $\eta_p^2 = .101$. Post-hoc tests (Tukey's HSD) revealed that non-problem gamblers differed significantly from both low-risk gamblers ($MD = -.33$, $p = .01$) and moderate-risk/problem gamblers ($MD = -.49$, $p < .01$), such that non-problem gamblers reported fewer illusions of control than participants

classified as either higher-risk or problem gamblers. The main effect of condition was not significant in the present sample, $F(1, 185) = .60, p = .44$, indicating that illusion of control scores did *not* vary as a function of participant condition. Although the observed decrease in illusions of control over 30 days tended to be more pronounced among participants in the educational animation condition ($MD = -.15$), relative to those in the control condition ($MD = -.03$), the interaction between time and participant condition failed to reach statistical significance, $F(1, 185) = 1.80, p = .18$, *ns*. The remaining interactions between participant condition, gambling pathology and illusions of control were non-significant in the present study.

Misperception of odds. In order to examine changes in participants' misunderstanding of odds over time, a mixed-repeated measures ANOVA was performed. As in the previous analysis, participant condition and level of gambling pathology were examined as between-subjects factors, and misunderstanding of odds (IBS Total Score) was treated as a within-subjects factor assessed at baseline and 30 days. Means and standard deviations of these factors are reported in Table 6.

Table 6

Misperception of Odds (M ± SD) at Baseline and 30 Days, by Condition and Level of Gambling Pathology (N = 191)

Condition	CPGI	Baseline Mean	Baseline SD	30 Day Mean	30 Day SD
Animation	Non-Problem	3.27	1.21	2.67	.97
	Low-Risk	3.35	.92	2.91	1.03
	Moderate-Risk /Problem	4.02	1.00	3.63	.90
Control	Non-Problem	3.23	1.23	2.91	1.24
	Low-Risk	3.75	1.01	3.13	.90
	Moderate-Risk /Problem	4.10	.95	3.85	1.14

Results of this analysis revealed a significant within-subjects effect of time of assessment, $F(1, 185) = 49.28$, $p < .01$, $\eta_p^2 = .210$, such that misperceptions decreased (i.e., knowledge of odds *improved*) among participants between the initial session ($M = 3.56$, $SD = 1.13$) and the 30 day follow-up session ($M = 3.13$, $SD = 1.12$). A significant main effect of gambling pathology was also observed, collapsed across participant condition, $F(1, 185) = 13.86$, $p < .01$, $\eta_p^2 = .130$. Tukey post-hoc tests indicated that non-problem gamblers reported significantly *fewer* odds-related misperceptions relative to moderate-risk/problem gamblers ($MD = -.89$, $p < .01$). Similarly, low-risk gamblers reported fewer odds-related misperceptions compared to moderate-risk/problem gamblers ($MD = -.65$, $p < .01$). Non-problem and low-risk slots players did not differ significantly from one another in terms of misperceptions of odds. As in the previous analysis, the main effect of participant condition was non-significant in the present sample, $F(1, 185)$

= 1.63, p = .20, *ns*, suggesting that misperceptions did not differ significantly as a function of assignment to the educational animation or control condition.

Interestingly, both the knowledge of odds x condition interaction, $F(1, 185) = .39$, $p = .53$, *ns*, and the knowledge of odds x level of gambling pathology interaction, $F(1, 185) = .88$, $p = .42$, *ns,* failed to reach statistical significance, indicating that knowledge of odds improved somewhat across all participants over time independent of their experimental condition or baseline level of problem gambling symptomatology.

Challenge appraisals. It was hypothesized that viewing the educational animation would weaken challenge-oriented appraisals of gambling, and would accordingly promote reductions in gambling frequency and the tendency to exceed financial limits among slots players. In order to assess whether challenge-oriented appraisals of gambling decreased over time as a function of participant condition and level of gambling pathology, a 2 between (condition: animation vs. control, level of gambling pathology), 1 within (challenge appraisal scores: initial session vs. 30 day follow-up) mixed-repeated measures ANOVA was calculated. Although a significant main effect of participant appraisals was observed, $F(1, 185) = 28.35$, $p < .01$, $\eta_p^2 = .133$, this effect was not in the hypothesized direction. Specifically, challenge-oriented appraisals of gambling *increased* slightly among participants between the initial session ($M = 2.12$, $SD = .85$) and the 30 day follow-up session ($M = 2.50$, $SD = .78$).

A marginally significant main effect of participant condition was also observed, $F(1, 185) = 3.50$, $p = .06$, $\eta_p^2 = .019$. Specifically, participants in the animation condition ($M = 2.02$, $SD = .86$) tended to endorse challenge appraisals to a lesser degree than did those in the control condition ($M = 2.26$, $SD = .85$), collapsed across level of gambling

pathology. The main effect of gambling pathology was non-significant, $F(2, 185) = 1.62$, $p = .20$, *ns*, indicating that challenge appraisals did not differ significantly among non-problem, low-risk and problem gamblers. Surprisingly, the interactions between challenge appraisals and video condition ($F(1, 185) = .24, p = .62$, *ns*), and between challenge appraisals and level of gambling pathology ($F(2, 185) = .17, p = .85$, *ns*) were non-significant in the present study, suggesting that appraisals did not vary over time as a function of experimental condition or overall gambling pathology.

Frequency of slot machine play. To determine whether the frequency of slot machine play decreased among participants over the 30 day assessment period, a 2 between (condition, level of gambling pathology), 1 within (reported frequency of slot machine play at the initial session *vs.* 30 day follow-up) ANOVA was performed. Means and standard deviations for these factors are presented in Table 7.

Table 7

Frequency of Slot Machine Play (M ± SD) at Baseline and 30 Days, by Condition and Level of Gambling Pathology (N = 106)

Condition	CPGI	Baseline Mean	Baseline SD	30 Day Mean	30 Day SD
Animation	Non-Problem	3.74	5.01	1.21	1.56
	Low-Risk	5.63	6.09	1.93	2.13
	Moderate-Risk /Problem	12.62	14.44	4.68	4.34
Control	Non-Problem	3.22	3.85	2.23	3.28
	Low-Risk	5.11	5.92	3.67	5.37
	Moderate-Risk /Problem	12.62	14.43	4.03	3.35

A significant main effect of time of assessment was observed, $F(1, 180) = 58.48$, $p < .01$, $\eta_p^2 = .245$. As expected, participants reported playing slots *less frequently* in the 30 days following the session ($M = 2.71$, $SD = 3.47$) compared to baseline ($M = 6.45$, $SD = 8.69$). The main effect of gambling pathology was also significant, $F(2, 180) = 17.86$, $p < .01$, $\eta_p^2 = .166$. Post hoc tests (Tukey) revealed that non-problem gamblers ($M = 2.59$, $SD = 3.51$) and low-risk gamblers ($M = 4.01$, $SD = 4.86$) played slots significantly less frequently than did moderate-risk/problem gamblers ($M = 7.99$, $SD = 8.12$) collapsed across time and condition. Non-problem and low-risk gamblers did not differ significantly from one another on overall frequency of slot machine play.

The main effect of participant condition was non-significant in the present study, $F(1, 180) = .05$, $p = .82$, *ns*, however, the condition x time of assessment interaction approached significance, $F(1, 180) = 3.06$, $p = .08$, $\eta_p^2 = .02$. As hypothesized, the reported frequency of slot machine play tended to diminish over time as a function of participant condition. Specifically, participants in the animation condition ($MD = -4.34$) reported playing slots *less frequently* in the 30 days following the experimental session than did those in the control condition ($MD = -2.94$) (see Figure 2). The 3-way interaction between condition, problem gambling symptomatology (CPGI) and frequency of slot machine play was non-significant in the present study, $F(2, 180) = .05$, $p = .95$, *ns*, suggesting that the pattern of changes observed in gambling frequency as a function of experimental condition did not differ significantly depending upon participants' overall level of gambling pathology.

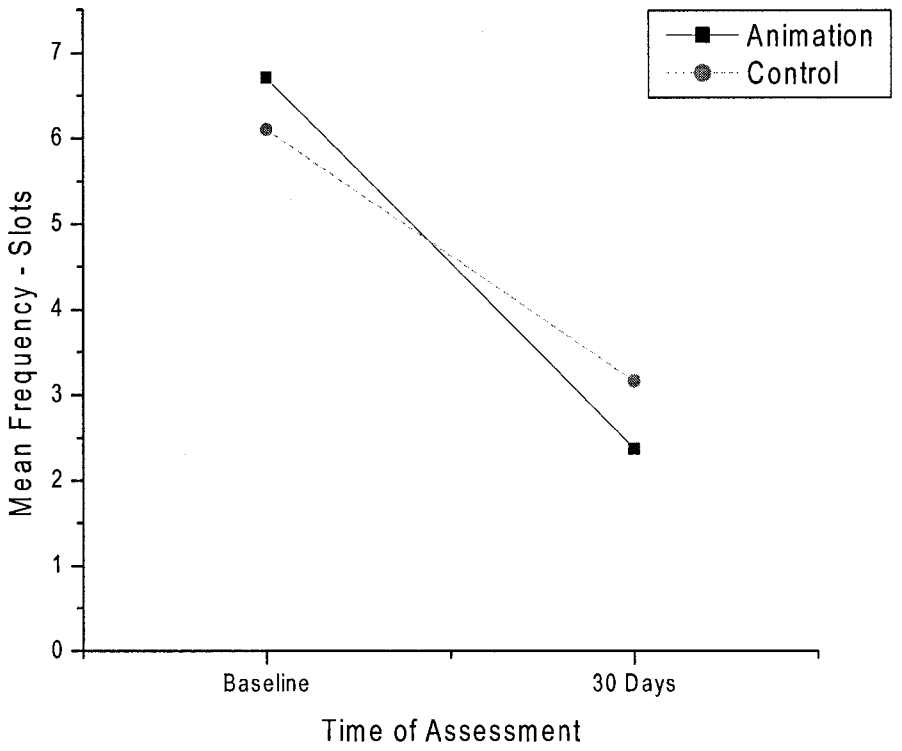

Figure 2. Reported Frequency of Slot Machine Play at Baseline and 30 Days Post-Video, by Condition.

Exceeding financial limits. In order to determine whether the educational animation effectively reduced participants' tendencies to exceed financial limits, participants were asked to complete a brief follow-up measure within 24 hours of leaving Rideau Carleton Raceway and Slots. A total of 200 participants (n = 105 animation, n = 95 control condition) completed this follow-up questionnaire and indicated whether they did or did not exceed their financial limits immediately following the session. Among recreational gamblers, a significant difference was observed in the tendency to exceed

financial limits following the experimental session. Specifically, only 4.88% of participants in the animation condition ($n = 2$) reported exceeding their financial limits within 24 hours of completing the initial session, compared to 24.24% of participants in the control condition ($n = 8$), χ^2 (1) = 5.87, $p = .02$. Interestingly, this effect did *not* hold among either at-risk gamblers (χ^2 (1) = 1.67, $p = .20$, *ns*) or moderate-risk/problem gamblers (χ^2 (1) = .031, $p = .86$, *ns*), indicating that participants with more advanced levels of gambling pathology or more severe gambling symptoms did *not* differ in their tendency to exceed financial limits, regardless of whether they had watched the educational animation or the control video. This finding suggests that viewing the educational animation may help slots players to stay within their short-term financial limits, but only among recreational slots players who have not yet developed impaired control over gambling. This effect is illustrated in Figure 3.

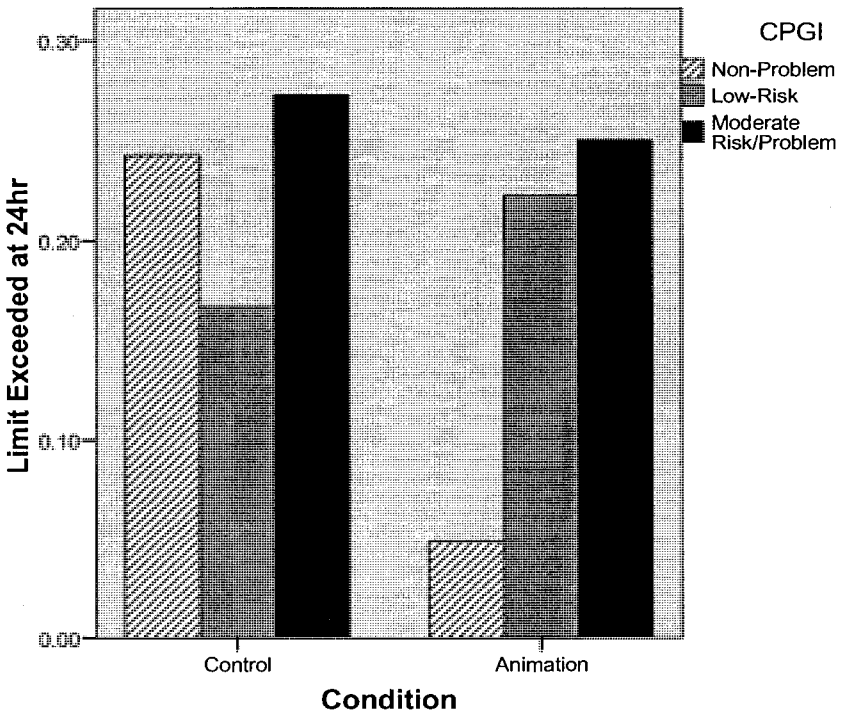

Figure 3. Proportion of Participants Exceeding Financial Limits at 24 Hours Post-Video, by Condition and Level of Gambling Pathology.

In order to determine whether this effect *persisted* among recreational slots players, these participants were again asked to report whether they had exceeded their financial limits 30 days following the initial session at Rideau Carleton Raceway and Slots. A total of 82 recreational slots players from the previous analysis responded at 30 days and are available for comparison.

A chi-square analysis was employed to assess group differences in exceeding financial limits 30 days following the initial session. Although a smaller percentage of participants in the animation condition (12.77%, $n = 6$) reported exceeding their financial

limits 30 days following the session compared to participants in the control condition (14.71%, $n = 5$), this effect failed to reach statistical significance, χ^2 (1) = .06, $p = .80$, *ns*. Slots players who had viewed the educational animation were not differentiated from those in the control group at the time of the follow-up assessment. As such, it appears that immediate effects of the educational animation in terms of encouraging adherence to financial limits dissipated over a 30 day period.

Discussion

The purpose of the present study was to investigate the relationship between cognitive distortions and gambling behaviour, and to determine if a game-specific educational animation was effective in correcting cognitive distortions and reducing problematic play among slots players. A further aim of this research was to determine if challenge-oriented appraisals of gambling constituted a mediator or a "process variable" that explained the relationship between cognitive distortions and problematic behaviours among slots players. Specifically, it was hypothesized that cognitive distortions including illusions of control over winning and misperception of odds would promote positive, challenge-oriented evaluations of gambling, and that these appraisals in turn would encourage gambling persistence (e.g., exceeding financial limits) among slots players.

Cognitive Distortions and Problem Gambling Symptoms

As expected, the presence of cognitive distortions was associated with greater problem gambling symptoms among slots players in the present study. Both illusions of control over winning and misunderstanding of odds significantly and independently predicted overall problem gambling symptoms. This finding is consistent with previous research that has demonstrated positive relationships between illusory control (Langer, 1975), misunderstanding of odds (e.g., Benhsain, Taillefer & Ladouceur, 2004; Toneatto, Blitz-Miller, Calderwood, Dragonetti & Tsanos, 1997) and the onset and development of problem gambling symptoms. In addition, misperception of odds significantly predicted reported frequency of slot machine play and the tendency of participants to exceed their financial limits in the present study. Again, this result aligns with previous research claims that odds-based cognitive distortions might influence gamblers to judge their

probabilities of success favourably (e.g., to overestimate their odds of winning), and therefore to persist or extend their play (e.g., Ayton & Fischer, 2004).

Cognitive Distortions and Challenge Appraisals

Extending research on the relationship between perceived control and challenge appraisals (e.g., Lazarus & Folkman, 1984), cognitive distortions including illusions of control and misperception of odds significantly predicted challenge–oriented appraisals of gambling among slots players in the present study. Moreover, challenge appraisals were significantly associated with the tendency for slots players to exceed their financial limits while gambling, and slots players who viewed gambling as a challenge tended to exceed their financial limits by a greater margin than those who did not endorse such appraisals.

This finding is in line with previous claims that challenge appraisals might influence decision making and behavioural persistence within a gambling context (e.g., Lem, 2007), and offers some empirical support for this position. Specifically, it appeared that as the number of cognitive distortions endorsed by slots players increased, the tendency to appraise gambling as a challenge increased in a linear fashion, and as this challenge orientation increased, participants were more likely to exceed their financial limits. This indicates that both misperceptions of odds and feelings of control over chance outcomes might independently and positively predict a challenge orientation among slots players, and that the tendency to appraise slot machine play as a challenge might indeed represent a risk factor for the development of problem gambling behaviours. This result is consistent with previous research that has demonstrated a relationship between perceptions of personal control and subsequent positive appraisals of gambling among

slots players (Wohl, Anisman, Matheson & Young, 2006), and further underscores the importance of examining appraisals and their influence on decision making processes and behaviours within a gambling context.

In addition to supporting research on cognitive distortions and problem gambling, the present study also examined the role of challenge appraisals in the relationship between cognitive distortions and gambling behaviours. Although individuals' cognitions might influence their appraisals of gambling in important ways, and the tendency to perceive gambling as a challenge has been hypothesized to encourage gambling persistence (e.g., Suzuki, Hirota, Takasawa & Shigemasu, 2003; Wohl, Anisman, Matheson & Young, 2006), this relationship has remained largely unexplored in the gambling literature. To address this and better understand the relationship between these variables, the present study examined challenge appraisals as a potential mediator in the relationship between cognitive distortions and gambling behaviours. Interestingly, it appeared that although misunderstanding (e.g., overestimating) one's odds of winning were related to the extent that participants exceeded their financial limits, this relationship was mediated by individuals' appraisals of the game. Specifically, slots players who misunderstood their odds of winning and the random nature of slot machine outcomes tended to evaluate gambling as a challenge, and these appraisals in turn predicted the extent to which participants exceeded their financial limits (e.g., the amount of money spent above pre-set limits).

This finding may have important implications for the prevention and treatment of gambling problems among slots players. Rather than anticipating direct links between one's cognitions and behaviours, for instance, it may be prudent to identify the processes

that underlie these relationships, and to target individuals' subjective appraisals of gambling in addition to improving their knowledge of gambling-related odds. One possible explanation for the observed failures of probability training with at-risk or problem gamblers (e.g., MacDonald, Turner & Somerset, 2004; Williams & Connelly, 2006) may be that these strategies tend to target knowledge in isolation, and do not aim to correct complex appraisals of gambling in a holistic way. Further research is needed to support this claim and to disentangle the relative contribution of odds-based knowledge, cognitions and appraisals within the context of gambling in general, and slot machine play in particular.

Effects of the Educational Animation

Changes in cognitive distortions. Despite some downward movement in participants' reported cognitive distortions over time, the effect of the educational animation on these cognitions was largely non-significant in the present study. Although a significant reduction was observed in odds-based misperceptions over the 30 day assessment period, for instance, it did not appear that this effect was attributable to the educational animation. In fact, reductions in these beliefs tended to emerge among *all* participants, regardless of whether they had viewed the educational animation or a neutral control video. Although this shift is in the predicted direction (e.g., indicating an overall *improvement* in knowledge of odds over time), the cause of this change is unclear. Interestingly, Echeburua, Fernandez-Montalvo and Baez (2000) noted a similar improvement in reported attitudes and behaviours among slots players over the course of a longitudinal (6 month) study, regardless of experimental or treatment condition. They

termed this phenomenon *natural recovery* or *spontaneous remission*, and posited that this gradual improvement may occur among slots players without intervention or treatment.

Alternatively, this finding might represent a *Hawthorne effect*. Initially described by Roethlisberger and Dickson (1939), the Hawthorne effect refers to the notion that individuals may alter their behaviour in a favourable direction when they know they are being observed. This phenomenon has been documented in social psychological and health research. O'Sullivan, Orbell, Rakow and Parker (2004), for instance, found that individuals were *more likely* to use health screening services after completing a questionnaire that assessed their attitudes and beliefs regarding the effectiveness of these screening procedures, relative to individuals in a non-questionnaire control group. It appears, therefore, that individuals were more likely to take positive action when their feedback was solicited by a research team, and when they were aware that their actions and responses were being observed. In the context of the present study, it is similarly possible that individuals were motivated to report fewer cognitive distortions over time because they were aware that their responses and potential progress (or regress) were being monitored by research personnel.

Another possible explanation for this observed change might be that participants' knowledge or reported attitudes towards gambling shifted as a function of practice effects, familiarity with the self-report materials, social desirability, or due to personal reflection on questionnaire items pertaining to problematic play. It is possible, for instance, that merely asking participants to respond to questions regarding their beliefs, gambling and spending behaviours increased self-awareness and reflection, and that this

awareness in turn (and not necessarily the animation in itself) may have promoted attitudinal and behavioural changes over the 30 day study period.

Surprisingly, illusions of control over winning decreased only marginally among slots players across the duration of the study. This effect may have emerged in part due to the content of the educational animation. It might be argued, for instance, that illusions of control *per se* were addressed less directly in the educational animation than were corrective points on the nature of randomness and odds of winning. Although the animation emphasized the point that slot machine outcomes are random and beyond skill or personal control, it is possible that participants applied or related this knowledge more to *external* characteristics of the game (i.e., the machines are unpredictable), and not to *internal* attributes (i.e., personal luck, skill or ability). If slots players believe they are inherently lucky or "due" to win, for instance, they may be unlikely to internalize information about randomness and apply it to their own experiences, beliefs or intuitions. This interpretation is in line with previous research (Wohl & Enzle, 2002), which has found that many gamblers tend to endorse beliefs in personal luck (and the ability of this luck to influence chance outcomes) *despite* knowledge about the nature of chance-based games. In this way, illusions of control may constitute a highly personal, internalized and change-resistant belief.

Changes in challenge appraisals. It was hypothesized that by improving knowledge about gambling odds, viewing the educational animation would promote reductions in challenge-oriented appraisals of gambling. Although slots players who viewed the animation tended to endorse challenge appraisals to a lesser degree than participants in the control condition, this effect was not statistically significant in the

present study. In fact, contrary to the hypothesized effect, it appeared that there was an overall tendency for challenge appraisals to *increase* among participants over the 30 day assessment period. Although the increase in challenge appraisals was small, the direction of this effect is nonetheless difficult to explain. Given that the educational animation focused on improving knowledge about gambling odds and probability, it is possible that merely listening to a discussion of these factors may have reinforced existing appraisals among participants who already tended to view slots as a challenge. Alternatively, it is possible that the improvement in cognitive distortions observed in the present study was not strong enough to shift participants' reported appraisals of gambling. To clarify this relationship, further research might assess gambling-related cognitions and appraisals over a longer period of time, after repeated viewings of the educational animation, or using a larger sample in order to obtain a stronger effect and maximize statistical power.

Changes in gambling behaviours. Although the effect of the educational animation on correcting cognitive distortions and challenge-oriented appraisals of gambling was largely non-significant, several interesting changes were observed with respect to gambling behaviours, including frequency of slot machine play and extent of exceeding financial limits while playing slots.

One notable finding was that participants who viewed the game-specific educational animation tended to report playing slots *less frequently* in the 30 days following the experimental session compared to participants in the control condition. Interestingly, this effect was observed across participants at varying levels of gambling pathology. This suggests that the animation may indeed be effective in curbing the tendency of slots players to engage in play and, perhaps more importantly, the influence

of this animation may extend beyond recreational gamblers to impact gambling frequency among higher risk or problem gamblers. Given the relatively poor success rates of many intervention programs and the high probability of relapse among pathological gamblers who complete treatment (e.g., Wulfert, Blanchard, Freidenberg & Martell, 2006), this finding is especially noteworthy, and suggests that game-relevant animations may hold some promise as psycho-educational tools to help problem gamblers regain control over gambling behaviours. Replication of this study is warranted to further investigate and support the nature of these intervention-level effects.

In addition to reductions in gambling frequency, a significant short-term effect was also observed among slots players in terms of exceeding financial limits. Slots players who viewed the educational animation were significantly *less likely* to exceed their financial limits within 24 hours of completing the study relative to participants in the control condition. It must be noted, however, that these reductions were only apparent among recreational gamblers who were not yet demonstrating loss of control over gambling. As such, the educational animation may influence spending behaviours only when those behaviours have not yet advanced to problematic levels.

In light of research on the double switching phenomenon (e.g., Sevigny & Ladouceur, 2003), one interpretation of this finding is that there may be a shift from rational to non-rational thinking among problem gamblers while they are engaged in play that overrides the effect of the educational animation. In particular, the educational animation was associated with an overall decrease in the frequency of slot machine play, but *not* with the tendency for problem gamblers to stay within financial limits while gambling. It is possible, therefore, that while the animation might generally deter

individuals from playing, problem gamblers still tend to revert back to previously held cognitive distortions (e.g., perceptions of control or heightened expectations of winning) once they are engaged in play, and thus exceed financial limits.

Alternately, it is possible that negative behaviours (including the tendency to exceed financial limits) might be more deeply ingrained or resistant to change among individuals with advancing levels of gambling pathology (Petry & Armentano, 1999). Indeed, the factors that motivate problem gamblers to continue playing might have little to do with their understanding (or misunderstanding) of how the game functions, and the threat of exceeding financial limits may have little influence on curbing self-destructive behaviours, particularly if these behaviours are already well established. At this stage of gambling involvement, more intensive interventions might be required to elicit behavioural change. The finding that *only* recreational gamblers were discouraged from exceeding their financial limits after viewing the educational animation further underscores this point, and suggests that it may be beneficial to target cognitive distortions early (e.g., prior to the onset of pathologies) in order to prevent problematic play and weaken gaming persistence.

Although the tendency to exceed financial limits was reduced among recreational slots players in the animation condition immediately following presentation of the video, this effect virtually disappeared at the 30 day follow-up assessment. Indeed, participants who had viewed the educational animation did not differ significantly from those in the control condition 30 days after viewing the video with regard to their tendencies to exceed financial limits. This decline in behavioural gains following gambling education programs is not uncommon: in fact, similar declines have been documented in studies of

gamblers in general (e.g., Turner, Wiebe, Falkowski-Ham, Kelly & Skinner, 2005), and slots players in particular (e.g., Echeburua, Fernandez-Montalvo & Baez, 2000).

The immediate tendency of recreational slots players to stay within financial limits following the animation is perhaps not surprising. At this point, the explanation of slot machine operation and corrective information regarding randomness and odds of winning presented in the video would be fresh in participants' minds. Furthermore, individuals might be motivated to act in a manner consistent with the goals of the educational animation given recent exposure to the material and interactions with research personnel (exemplifying a demand characteristic or Hawthorne effect). As time passes and this experience fades, however, it appears that individuals tend to revert back to previous patterns of spending. Based on these findings, it appears that the educational animation may have immediate benefits in curbing overspending among recreational slots players, but that these returns disintegrate rapidly over time. Following from this, the animation may hold only limited effectiveness if administered as a one-time session. Instead, it may be beneficial to refresh this information with slots players by offering repeated sessions or viewings of the animation (or a series of related animations), in order to promote retention and extend the "shelf-life" of the educational message.

It is interesting that while the educational animation was associated with reduced frequency of slot machine play over 30 days, this reduction did not hold to the same extent in terms of reported frequency of exceeding financial limits. One interpretation of this finding is that although the animation may help to improve knowledge among slots players, which in turn reduces the likelihood of engaging in play or seeking out opportunities to gamble, this knowledge may not be sufficient to curb overspending once

play is initiated (particularly among those who have already developed some impaired control over gambling). In this way, the educational message presented in the animation may be sufficient to reduce the likelihood that individuals will commence play moving forward, but may *not* adequately motivate slots players to restrict their spending once they are engaged in play. Although the observed decrease in gambling frequency may be associated with the content of the educational animation, there also remains a possibility that this effect is attributable to a double-switching tendency among problem gamblers (Sevigny & Ladouceur, 2003), and not to the educational animation in itself. Further research may support this distinction by examining factors that promote extended play among problem and non-problem slots players, both between and within gambling sessions.

Limitations

Several limitations of the present study should be addressed. Gambling frequency and behaviours (e.g., prevalence of over-spending or exceeding financial limits) were assessed solely through the use of self-report measures. Although these measures demonstrate adequate reliability, they are retrospective in nature and require participants to recall past events and behaviours. This retrospection may be problematic, in that individuals may not objectively recall their own actions or past behaviours, particularly regarding sensitive issues such as overspending, personal beliefs and potentially self-damaging behaviours. Furthermore, even if individuals *are* aware of such actions, many may be reluctant to admit to overspending, exceeding their financial limits, or engaging in frequent gambling behaviours due to embarrassment or fear of judgment from others (including research personnel). As such, these events may be downplayed or

underestimated in self-report questionnaires. This reporting bias may be of particular concern among slots players with more advanced levels of pathology, who might fail to acknowledge the full extent of their actions or to recognize behaviours as problematic within the context of their own experiences. To reduce the likelihood or impact of these self-report biases, convergent observational or behavioural measures should be included as additional controls.

As with many longitudinal designs, a further limitation concerns the attrition rate in this study. Despite efforts to retain participants through offering financial compensation and the option of completing questionnaires either online or by postal mail, only 49% of participants (n = 191) recruited in the original session completed subsequent follow-up measures 30 days later. Although no apparent patterns were observed in the attrition rates, there remains a possibility that those participants who completed the follow-up study differed from those that did not due to underlying personal characteristics or differences on another unmeasured variable. Additional measures should be considered to encourage participation and maximize retention rates.

Conclusion

In summary, the present study supported and extended previous research on gambling-related cognitive distortions, appraisals and problem gambling behaviours among slots players, and further evaluated the efficacy of a game-specific educational animation in reducing problem gambling symptoms. Interestingly, although cognitive distortions decreased among slots players in the present study, this effect could not be attributed specifically to the educational animation. It does appear, however, that gambling-specific educational animations may hold some promise as a preventative tool

among slots players in reducing negative behaviours (e.g., gambling frequency) and encouraging short-term adherence to financial limits. Further research is needed to support and replicate these findings, and to determine if these effects persist beyond 30 days.

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Appendix A: Informed Consent

The purpose of an informed consent is to ensure that you understand the purpose of the study and the nature of your involvement. The informed consent has to provide sufficient information such that you have the opportunity to determine whether you wish to participate in the study.

Study Title: Gambling Beliefs and Behaviours among Slot Players

Study Personnel: Dr. Michael Wohl, Department of Psychology, Carleton University
Phone: (613) 520-2600 ext 2908
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If you have any ethical concerns about how this study was conducted, contact: **Dr. A. Parush, Chair of the Carleton University Ethics Committee for Psychological Research, (613) 520-2600, ext. 6026.**

If you have any other concerns about how this study was conducted, contact: **Dr. A. Bowker, Chair of the Department of Psychology, Carleton University, (613) 520-2600, ext. 8218.**

Purpose and Task Requirements: The purpose of this study is to assess perceptions about gambling, and to identify potential factors related to the development of problem-gambling and exceeding financial limits among slot machine players. We are asking you to fill out a number of questionnaires regarding your personal characteristics (e.g., how you cope with things in your life) and gambling (e.g., propensity to gamble and attitudes toward gambling). Further, we will ask you to view a short video and to complete additional questionnaires following the presentation of this video. The questionnaires will take about 30 - 45 minutes to complete. You will receive $30 for your participation in this study.

Potential Risk and Discomfort: There are no physical risks in this study. Some individuals may experience distress or anxiety when asked to respond to personal, sensitive questions involving frequency and consequences of gambling. As researchers, we are not qualified to offer any sort of counselling, but we will provide you with a list of resources that you can contact for support if you need or want it.

Anonymity/Confidentiality: All of the data collected in this study will be kept confidential. Because we will want to keep track of your answers in this questionnaire to match up with possible later measures, we will have to be able identify who you are on your questionnaire. We will do this by assigning you a personal code, and we will take special precautions to make sure that no one else will be able to identify you and what your responses were. Any identifying information associated with your code will be confined to a single page that will be separated from your questionnaire, and kept by the research investigators in a separate, secured and confidential file. At the end of this study, we will be asking you for permission to keep your contact information on file for one year in order to contact you to ask if you'd be willing to participate in follow-up studies.

Right to Withdraw: Your participation in this study is entirely voluntary. At any point during the study, you have the right to not complete certain questions or to withdraw from the study. If we

ask a question and you do not wish to provide an answer, please leave the question blank on the online survey (e.g., do not select a response). You may then go on to the next question. Please note that you will not be penalized if you choose to leave some questions blank. However, if you choose to withdraw from the study, you will not be eligible to receive $30 payment for participating in this study.

By clicking the "next" button you will be directed to the on-line questionnaire. If you proceed and complete the questionnaire, your may submit your responses by clicking the "submit" button. *The data collected will be used in research publications and/or for teaching purposes.*

When you click the "next" button and submit your data it will be assumed that you have read the above description of the study concerning gambling beliefs and behaviours and have granted consent. However, should you wish to withdraw your data after submission we will grant that request immediately.

NEXT

Appendix B: Questionnaire Package

Demographic and Background Information

Please fill out the following information about yourself and your background:

1. Age: _____

2. Gender (circle one): Male / Female

3. Marital Status (circle one):

Never Married / Married / Separated / Divorced / Widowed / Common-Law (living together)

1 2 3 4 5 6

4. Ethnicity (select from a-h below):

a) Caucasian/European origin

b) African-Canadian/American

c) East Asian (Chinese, Japanese, Korean)

d) South Asian (Indian, Pakistani, Sri Lankan, etc.)

e) Middle Eastern

f) Native Canadian/American

g) Hispanic and South American Origin

h) Other or multi-ethnic origin

5. Are you a resident of Ontario, Canada? (Circle one)

YES / NO

If NO, what country do you reside in?

1. Canada

2. U.S.A.

3.Other

6. What is your current employment status? (select # from 1-5 below):

1. Not employed
2. Part-time
3. Full-time
4. Seasonal/Temporary/Contract
5. Retired

7. What is your average annual household income? _____

8. What is the highest level of education you have completed? (please select one):

1. Elementary School
2. High School
3. College
4. University (undergraduate)
5. University (graduate)

9. Has anything bad ever happened to you as a result of your gambling? (circle one)

YES / NO (If NO, skip to question 10)

→ *If YES, please describe in one sentence*

_____

10. Do you ever think life would be better if you gambled less?

1. Never
2. Rarely
3. Sometimes
4. Often
5. Always/Most of the time

11. Are you currently involved in any efforts to change your gambling (this question excludes historical efforts)? (circle one)

YES / NO (If NO, skip to question #12)

→ *If YES, what kinds of efforts? (circle all that apply to you)*

a) formal treatment program
b) psychotherapy
c) Gamblers' Anonymous
d) Other gambling support group (not GA)
e) Self-help literature
f) Talking to friends, family members, significant others, parish priest, minister, other spiritual/community leader, etc.
g) cutting down on your own, without outside help
h) other efforts to change

12. In your lifetime, have you ever been to a meeting of gamblers Anonymous?

YES / NO (If NO, skip to question #13)

→ *If YES, how old were you when you first went?* _____ *years old*

13. In your lifetime, have you ever been to a professional counsellor (e.g. gambling specialist, social worker, psychologist, etc.) to help with your gambling?

YES / NO (If NO, skip to question #14)

→ If YES, how old were you when you first went? _____ years old

14. Have you ever smoked? (circle one) YES / NO (If No, skip to question 19)

15. Do you currently smoke? (circle one) YES / NO

16. Have you tried to quit smoking? (circle one) YES / NO (If No, skip to question 18)

17. How often have you tried to quit smoking _____

18. Has anything bad ever happened to you as a result of your smoking?

YES / NO (If NO, skip to question 19)

→ *If YES, please describe in one sentence*

_____

19. Have you ever consumed alcohol? (circle one)

YES / NO (If No, skip to next page)

20. Do you currently drink alcohol? (circle one)

YES / NO

21. Have you tried to cut down drinking alcohol? (circle one)

YES / NO (If No, skip to question #23)

22. How often have you tried to cut down drinking alcohol ? _____

23. Has anything bad ever happened to you as a result of your drinking?

YES / NO (If No, skip to next page)

→ *If YES, please describe in one sentence*

_____

Gambling History Questionnaire

Instructions: **THINK ABOUT THE LAST 3 MONTHS** and tell us, as truthfully as you can, about your gambling.

IN THE PAST 3 MONTHS, HOW MANY TIMES HAVE YOU...

1. Visited a slots venue? (casino, charity casino, slots-at-racetrack facility) _____

2. Gambled, either at a casino or elsewhere? _____

3. Played slot machines? _____

4. In the past 3 months, what is the largest amount of money you have gambled with when playing slots? $_____

5. Do you typically set a spending limit for yourself prior to playing slots?

YES NO (If No, please skip to question 6)

5.a IF YES, how often do you set a spending limit?

a) Sometimes
b) Most times
c) Always

5.b IF YES, what is the typical spending limit you allow yourself for a single day or gambling session?

$_____

6. Have you set a spending limit for your visit to the slots venue today?

YES NO (If No, please skip to question 7)

6.a IF YES, what is your spending limit for today? $_____

7. When you decide on a limit, do you consider this to be money you can afford to lose?

YES NO

8. In the past 3 months, have you ever exceeded your spending limit while playing slots? (e.g., spent more money than you planned?)

YES NO (If No, please skip to question 10)

8.a IF YES, how often have you exceeded your spending limit in the past 3 months?

a) Rarely
b) Some of the time
c) Often
d) Most/all of the time

9. On the occasions that you have exceeded your spending limit (identified in question #5), what is the greatest amount of money you have spent above your limit?

$_____

10. Have you ever visited an ATM (bank machine) while playing slots to withdraw extra money for gambling?

YES NO (If No, please skip to question 11)

10.a IF YES, how often have you withdrawn money at a casino ATM in the past 3 months?

a) Rarely
b) Some of the time
c) Often
d) Most/all of the time

11. Have you ever used a credit card at a slots venue to get money to gamble?

YES NO (If No, please skip to question 12)

11.a IF YES, how often have you used a credit card for gambling at a casino in the past 3 months?

a) Rarely
b) Some of the time
c) Often
d) Most/all of the time

12. Other than slots, what game do you usually prefer to play when you visit a casino? (Please select only one)

a) Betting on horse races
b) Sports betting
c) Card games (e.g. poker, blackjack)
d) Dice games (e.g. craps)
e) Roulette
f) Bingo

Canadian Problem Gambling Index – 9 (CPGI-9)

Instructions: THINK ABOUT THE LAST 12 MONTHS and tell us, as truthfully as you can, about your gambling. Some of the items may not seem to apply to you. In this case, please select 1 (for *'Never'*).

1. Have you bet more than you could really afford to lose?

1	2	3	4	5
Never	Sometimes	Most of the time	Almost always	Don't know

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?

1	2	3	4	5
Never	Sometimes	Most of the time	Almost always	Don't know

3. When you gambled, did you go back another day to try to win back the money you lost?

1	2	3	4	5
Never	Sometimes	Most of the time	Almost always	Don't know

4. Have you borrowed money or sold anything to get money to gamble?

1	2	3	4	5
Never	Sometimes	Most of the time	Almost always	Don't know

5. Have you felt that you might have a problem with gambling?

1	2	3	4	5
Never	Sometimes	Most of the time	Almost always	Don't know

6. Has gambling caused you any health problems, including stress or anxiety?

1	2	3	4	5
Never	Sometimes	Most of the time	Almost always	Don't know

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?

1	2	3	4	5
Never	Sometimes	Most of the time	Almost always	Don't know

8. Has your gambling caused any financial problems for you or your household?

1	2	3	4	5
Never	Sometimes	Most of the time	Almost always	Don't know

9. Have you felt guilty about the way you gamble or what happens when you gamble?

1	2	3	4	5
Never	Sometimes	Most of the time	Almost always	Don't know

Informational Biases Scale (IBS)

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

1	2	3	4	5	6	7
Don't agree			**Partially agree**			**Strongly agree**

1. I believe that sometimes, some machines keep me from winning because they are programmed to produce fewer wins than normal.....1 2 3 4 5 6 7

2. In some establishments, the slot machines are more likely to pay out than others.....1 2 3 4 5 6 7

3. I would rather use a slot machine that I am familiar with than one that I have never used before.....1 2 3 4 5 6 7

4. The longer a slot machine has gone without paying out a large sum of money, the more likely the chances are that it will pay out in the very near future.....1 2 3 4 5 6 7

5. I have purposely avoided playing on slot machines that have recently paid out a lot of money.....1 2 3 4 5 6 7

6. I know some slot machine users who are just plain lucky.....1 2 3 4 5 6 7

7. I have a favourite slot machine that I use.....1 2 3 4 5 6 7

8. Your chances of winning are better on a machine that has not paid out in a long time.....1 2 3 4 5 6 7

9. People win large amounts of money on slot machines on a fairly frequent basis.....1 2 3 4 5 6 7

10. Hearing about other people winning on slot machines encourages me to keep on playing.....1 2 3 4 5 6 7

11. When I see others winning on slot machines, I feel that my turn is coming, too.....1 2 3 4 5 6 7

11. There are certain strategies you can use with slot machines to help you win.....1 2 3 4 5 6 7

13. I get upset when I almost win on slot machines.....1 2 3 4 5 6 7

1	2	3	4	5	6	7
Don't agree			**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
15. After a long string of wins on a slot machine, the chances of losing become greater.....	1	2	3	4	5	6	7
16. If I experience a long string of losses on a slot machine, I feel a big win must be coming just around the corner.....	1	2	3	4	5	6	7
17. If I'm experiencing a losing streak, the hope that a win has to be coming soon keeps me gambling.....	1	2	3	4	5	6	7
18. I know some people who gamble who are just plain unlucky with slot machines.....	1	2	3	4	5	6	7
19. Thinking about times that I have won on slot machines encourages me to keep playing.....	1	2	3	4	5	6	7
20. I sometimes find myself trying to win back money that I have lost on slot machines.....	1	2	3	4	5	6	7
21. Winning on slots makes me feel skillful.....	1	2	3	4	5	6	7
22. Sometimes, I'll keep playing slots because I get a strong feeling that I'm about to win.....	1	2	3	4	5	6	7
23. I sometimes talk to the machine in order to make it do what I want.....	1	2	3	4	5	6	7
24. Winning on slot machines encourages me to keep playing.....	1	2	3	4	5	6	7
25. I tend to think more often about my wins than my losses on slot machines.....	1	2	3	4	5	6	7

Illusion of Control (ICW)

Instructions: Please indicate your agreement with each of the following statements by selecting the appropriate answer.

1	2	3	4	5
Strongly Disagree	**Disagree**	**Slightly agree**	**Somewhat agree**	**Strongly agree**

1. I think of gambling as a "challenge".....1 2 3 4 5
2. My knowledge and skill in gambling contribute to the likelihood that I will make money.....1 2 3 4 5
3. My choices or actions affect the outcome of the game on which I am betting.....1 2 3 4 5
4. I keep track of previous winning bets so that I can figure out how I should bet in the future.....1 2 3 4 5
5. Gambling is more than just luck.....1 2 3 4 5
6. My gambling wins are evidence that I have skill and knowledge related to gambling.....1 2 3 4 5
7. I have a "lucky" technique that I use when I gamble.....1 2 3 4 5
8. Even though I may be losing with my gambling strategy or plan, I maintain that strategy or plan because I know it will eventually come through for me.....1 2 3 4 5
9. I am pretty accurate at predicting when a win will occur.....1 2 3 4 5
10. I have more skill and knowledge related to gambling than most people who gamble.....1 2 3 4 5

Appraisals of Gambling (SAM)

Instructions: This questionnaire is concerned with your thoughts and perceptions about your gambling. Some of these questions are concerned with how people would view or deal with gambling problems. Even if you do not have a problem with gambling, please respond to these questions according to how you would feel if you were in this situation right now. Please answer ALL questions by selecting the most appropriate answer.

1 Not at all	**2** Slightly	**3** Moderately	**4** Considerably	**5** Extremely

1. Is my gambling totally hopeless?	1	2	3	4	5
2. Does my gambling create tension in me?	1	2	3	4	5
3. Is my gambling uncontrollable (by anyone)?	1	2	3	4	5
4. Is there someone or some agency I can turn to for help if I need it?	1	2	3	4	5
5. Does my gambling make me feel anxious?	1	2	3	4	5
6. Does my gambling have important consequences for me?	1	2	3	4	5
7. Is my gambling going to have a positive impact on me?	1	2	3	4	5
8. How eager am I to tackle problems arising from my gambling?	1	2	3	4	5
9. How much will I be affected by the outcome of my gambling?	1	2	3	4	5
10. To what extent can I become a stronger person if I confront my gambling problems?	1	2	3	4	5
11. Will the outcome of my gambling be negative?	1	2	3	4	5
12. Do I have the ability to do well when I gamble?	1	2	3	4	5
13. Does my gambling have serious implications for me?	1	2	3	4	5
14. Do I have what it takes to do well when I gamble?	1	2	3	4	5
15. Is there help available to me for dealing with any gambling problems?	1	2	3	4	5
16. Do problems caused by my gambling tax or exceed my coping resources?	1	2	3	4	5
17. Are there sufficient resources available to help me?	1	2	3	4	5
18. Is it beyond anyone's power to do anything about my gambling?	1	2	3	4	5

1 Not at all	**2** Slightly	**3** Moderately	**4** Considerably	**5** Extremely

19. To what extent am I excited thinking about the outcome of my gambling?	1	2	3	4	5
20. How threatening is my gambling?	1	2	3	4	5
21. Are problems arising from my gambling unresolvable (by anyone)?	1	2	3	4	5
22. Will I be able to overcome problems arising from my gambling?	1	2	3	4	5
23. Is there anyone who can help me manage problems arising from my gambling?	1	2	3	4	5
24. To what extent do I perceive my gambling as stressful?	1	2	3	4	5
25. Do I have the skills necessary to achieve a successful outcome to problems arising from my gambling?	1	2	3	4	5
26. To what extent does my gambling require coping efforts on my part?	1	2	3	4	5
27. Does my gambling have long-term consequences for me?	1	2	3	4	5
28. Is my gambling going to have a negative impact on me?	1	2	3	4	5

Appendix C: Animation Storyboard

Introduction (*with animation directions in italics*)

The introduction of the animation pans a room of slot machines while a voice-over begins.

1. Many people enjoy slot machines. They're attracted by the possibility of a big win, and prepared to spend some of their leisure budget on it. They know the chances of winning a jackpot are slim, but enjoy the playing, hoping, and anticipating. *A scale appears to the side of the slot machine, and as the voice-over makes the previous statement, the words "playing", "hoping", and "anticipating" appear and settle on the left side of the scale, causing it to tip in that direction. At the mention of "cost of their time", some coins and bills appear and settle on the right side of the scale, causing it to balance.* They may be disappointed when they don't win, but feel their losses match the enjoyment they have received.

2. On any session, most slot players have an idea of their limit – that is, the amount they intend to spend. This is also the amount they can afford to lose. *The coins and bills on the scale are highlighted in some way.* Betting with money you can afford to lose is the only way to avoid gambling problems.

3. Difficulties arise when people exceed their limits. To keep your play problem-free it is important to know how a slot machine does and does not work.

4. Two ways of understanding how a slot machine works are presented in the following illustrations. Watch each and see which best reflects your view.

Part 1: The Conveyer Belt (*with directions in Italics*)

The "camera" descends and centres on the front of a single slot machine.

5. Many people think a slot machine works like a conveyer belt.

The camera rises above the machine and a conveyor belt emerges from the back and extends to a distant horizon.

6. The outcomes for each play are placed along the conveyor belt. Despite the many pictures on the play line, a slot machine has only three outcomes: a loss, a small win, or a big win. The hoped-for big win, of course, is why you are playing.

As each outcome is introduced, a small ball appears beside the slot machine: white for a loss, blue for a small win, and red for a big win.

7. Most plays are losses, so the vast majority of outcomes are white. Even though a loss appears on the screen as a "near miss" or an "almost win", it is still a loss. Near misses are designed to keep you playing, but have no more meaning than a "complete miss". A loss is a loss.

The white ball transports itself onto the conveyor belt behind the slot machine, and replicates into a line of balls extending into the distant horizon.

8. A small win is far less likely than a loss. But, there are a few.

The blue ball moves onto the conveyor belt and is divided into six equally spaced positions, ranging from the near field to the distant-field. An arrow above each identifies where they are.

9. Small wins keep you interested in two ways. They award more plays, and they restore hope for a big win.

10. The odds of a big win are extremely small, and so appear very infrequently.

The red ball splits into two and each is positioned well along the belt, but equally spaced and an arrow points to each of them. Possibly, the camera goes back for a long shot that emphasizes the ratio of white to blue and red balls.

11. There are two other considerations. First, every outcome is random. So, instead of being nicely spaced, wins appear in an unpredictable manner. Randomness means there are no patterns and no one can correctly predict when a win will occur.

The coloured balls rearrange themselves from equally-disbursed intervals to less orderly arrangements to suggest random placement.

12. Second, the probability of a big win is extremely low.

One of the two red balls flies away, leaving only the most remote one. It is close to the horizon and barely visible. An arrow locates it for the viewer.

13. Now, in this view of how a slot machine works, each play moves the conveyer belt forward one step.

A coin goes into the machine and a white ball falls through the front, moving the entire line forward one notch. A "counter" on the front of the machine displays a 25 cent bet.

14. It also suggests that the next win, wherever it is, is one step closer.

Coins begin to go into the machine – each time a white ball comes out the front and the whole belt moves forward a notch. A money counter on the front of the machine displays

bets so far in 25 cent increments, and begins to mount, past a dollar, then continues on at a regular pace. This process continues through the text that follows, stopping at the $25 mark.

15. So, a player who had a $25 limit and lost it all might tend to think of this as an "investment" – on a 25 cent machine, it moved the next big win 100 steps closer.

16. At this point, a problem emerges: how do you know whether the very next play isn't a big win – the payoff for the investment made so far? *(A big question mark appears above the first ball behind the machine.)* The only way to know for sure is to play. *A white ball appears.* It turns out to be a loss. But, what about the next one? Another play and another loss. And so, the trap of playing beyond your limit takes hold.

The counter begins again, in line with the text, and then continues to keep running with the end of the last sentence. Each outcome is a loss.

17. This cycle can go on for a long time as the player pursues the jackpot. Of course, this almost never comes because, as you will recall, the odds are incredibly small. *(The arrow identifies the winning red ball, which is still in the far-off distance.)*

18. In the heat of the moment, some players will go to an ATM and take out extra money in their desire for a payoff on their "investment".

The "camera" swings up and to the left until it reveals an ATM against a nearby wall – it is lit up like an old juke box and has neon letters on top with the letters "ATM" flashing.

19. They spend the extra money because, in this understanding, the key to winning is *persistence* – hanging in until the big win arrives.

20. What's more, there is a nagging concern: if they leave now, the very next player could benefit from *their* investment and take *their* win. *A red ball comes out of the machine and it lights up with accompanying noises.* They've heard this happens, and would never forgive themselves for allowing it to happen to them.

Part 2: The Bag of Marbles (without directions)

21. Another way to understand how a slot machine works starts with a simple bag of marbles. To begin, we'll have 19 losing white marbles and a single red win.

22. In order to make the outcome random, the bag is given a good shake. Now, there is no way to predict where the red marble is.

23. On each play of the slot machine, your 25 cent investment allows you to reach into the bag and take out one marble. Since there are 20 in all, your odds of

winning are 20 to 1. You take out a marble and it's white – you have lost this time.

24. Now, stop and ask yourself what the odds are at this point. There are19 marbles left in the bag – 18 white and one red. So it would be natural to conclude the odds were 19 to 1.

25. But, before you are allowed to draw, you must first replace the losing marble in the bag. This, of course, brings the odds back to 20 to 1. Then, before you draw again, the bag gets shaken to mix up all the marbles – remember, every outcome is random.

26. So, now your second draw is exactly the same as the first – 20 to 1 odds in a freshly shaken bag. And, no matter how many times you draw, the odds remain exactly the same – they never get any better.

27. This fundamental truth results from the replacement or "reload" feature that applies to every play of every slot machine. The losing marble gets put back in the bag.

28. But, you say, at 20 to 1 odds, you will get the big win sooner or later, so it's not that bad a deal. Unfortunately, on a real slot machine, your odds of the jackpot are much higher – usually in the neighbourhood of 90,000 to 1.

29. So, instead of a bag, picture a large cylinder with a trap door you can open to draw a marble. To hold 90,000 marbles it would be 6 feet long and 3 feet wide. Buried among the 89,999 white marbles is the single red jackpot.

30. Before each play, the cylinder is turned so that the marbles get all mixed up. With each 25 cent bet, you get to reach in without looking and take out any marble. If you choose a white one, you must reload the game by replacing the marble before the cylinder is turned again. And, each time you play, you repeat this process with the randomly mixed 90,000 to 1 odds.

31. Within this understanding, there are three important questions:

    a) Is it possible to win the jackpot? Yes. Over the long term, the odds will establish themselves, and one in every 90,000 plays will win the jackpot. At 25 cents a play, this will require an average investment of $22,500 for each jackpot given out.

    b) Is it likely? No – the likelihood of any player winning over the normal course of play is extremely small. Remember, the machine reloads and randomizes for each play. Your bet is the cost of the entertainment gained from anticipating and finding out the outcome.

c) When you reach your financial limit, does it make any sense to start spending money you can't afford to lose? None whatsoever. You are likely to lose money that you can't afford to – it's as close to a guarantee as you'll get from gambling.

Part 3: What do we make of this?

32. There are four key lessons you need to take away in order to keep your slots play problem-free.

33. First, the conveyor belt example is critically flawed because it does not include the all-important reload feature. It wrongly implies that your chances get better the longer you play. And in so doing, it encourages you to play beyond your limit and increase your likelihood of harm.

34. Second, keeping the 90,000 marble cylinder in mind, it virtually impossible for the next player to choose exactly the same marble you would have. This person in no way benefits from your "investment" of money.

35. Third, persistence has nothing to do with winning the jackpot. The extremely remote odds stay exactly the same each time you play.

36. Finally, sticking to your limit is the only sensible option. Exceeding it almost certainly guarantees you will lose money you can't afford to.

Seven Habits for Problem-Free Gambling

As with any activity that involves the risk, there are habits you can adopt to protect yourself. Here are seven – we urge you to use them.

1. **Set your limit:** before heading out for the slots, set your limit – how much money you can afford and are you willing to lose?

2. **Avoid a cushion:** take only the cash you need with you – leave all extra money at home.

3. **Plan your departure:** think about how many hours it will take to play to your limit; use this number to identify the time you will leave the slots venue.

4. **Eliminate your access to cash:** if you have ever used an ATM for gambling money, leave all debit and credit cards at home.

5. **Avoid ATMs:** make an unbending rule that you will never withdraw extra cash at the slots venue for gambling;

6. **Cool down:** once you reach your limit, get out of the slots area; go to a lounge or refreshment area and cool down any thoughts or temptations to continue playing;

7. **Picture the cylinder:** if tempted to play beyond your limit, recall the drum with 90,000 marbles and the futility of betting money you can't afford to lose

Appendix D: Control Video Content

The Ontario Lottery and Gaming Corporation operates and oversees three main business areas: Lottery, Gaming, and Corporate Services.

Lottery:

OLG offers Ontario consumers a variety of Lottery products through its network of more than 10,000 individual retailers across the province. Products include:

- Lotto 6/49 - Super 7 - Lottario - Pick 3 - Pick 4 - LottoAdvance

- Ontario Pay Day - Ontario 49 - Daily Keno - Encore - Pro- Line -Instant

Lotteries have been available in Ontario since 1975. Over the past years, lottery sales have exceeded $2 billion dollars annually, with the popular Lotto 6/49 and Super 7 as OLG's flagship games. About 50% of lottery ticket sales are returned to players in the form of prizes.

Gaming:

OLG is now responsible for 27 Gaming sites throughout the province. It is directly responsible for managing and operating:

- 5 OLG Casinos: OLG Casino Brantford, OLG Casino Point Edward, OLG Casino Sault Ste. Marie, OLG Casino Thousand Islands, OLG Casino Thunder Bay, and;

- 17 OLG Slots facilities at Racetracks across Ontario: Ajax Downs, Clinton Raceway, Dresden Raceway, Flamboro Downs, Fort Erie Racetrack, Georgian Downs, Grand River Raceway, Hanover Raceway, Hiawartha Horse Park, Kawartha Downs, Mohawk Racetrack, Rideau Carleton Raceway, Sudbury Downs, Western Fair Raceway, Windsor Raceway, Woodbine Racetrack, and Woodstock Raceway.

In addition, OLG maintains authority over the slot operation at the Great Blue Heron Casino (an aboriginal casino owned by the Mississaugas of Scugog Island First Nation) and four Resort Casinos in Ontario – Casino Windsor, Casino Niagara, Casino Rama, and Niagara Fallsview Casino Resort. The day-to-day operations of these casinos are contracted to the private sector.

OLG contributes directly to the host communities of its gaming facilities. Municipalities that host charity and aboriginal casinos obtain five percent of the gross slot revenue, while host municipalities of slots at racetracks receive five per cent of the gross slot revenue for the first 450 slot machines, and two per cent from machines over that number.

Corporate Services:

Each day, employees in OLG Finance and Administration, Information Technology, Human Resources, Security, Legal, Compliance, Marketing and Public Affairs support Lottery and Gaming business areas in fulfilling the Corporation's mandate. Collectively referred to as corporate services or corporate staff, these employees work primarily out of corporate offices in Sault Ste. Marie and Toronto.

Appendix E: Debriefing

This information is designed to help you understand the nature of the research you have just completed. In this study, we have been interested in examining people's perceptions about how slot machines work, and in examining the relationship between these beliefs and other factors (e.g., reasons for gambling) that might be related to the development of gambling problems among slot machine players.

Previous research has shown that beliefs about luck and feelings of control while gambling may play an important role in the development of gambling problems. Furthermore, misunderstanding the odds of winning can encourage gamblers to play for longer periods of time, and might be associated with the development of gambling problems (e,g., Toneatto, Blitz-Miller, Calderwood, Dragonetti, & Tsanos, 1997). In particular, many gamblers believe that slot machines work like a "conveyor belt", where every loss brings the player one step closer to a big win. Instead, slot machines have a "reload" feature, meaning that the odds of winning a jackpot are the same on each play, and that your chances of winning never improve, no matter how long you have played or how many losses you have had. If players believe that they are getting closer and closer to a big win, they may be tempted to play longer and spend more money than they planned. The purpose of this study, therefore, is to examine beliefs that people have about the ways that slot machines work, and to examine whether educational animations may be useful for improving people's understanding of slot machines and odds of winning. It is hoped this knowledge will help slots players to stay within their financial limits while gambling, and to reduce gambling problems among slot machine players.

The symptoms of problem gambling include: borrowing money to gamble, inability to stop gambling, feeling irritable if you do not gamble for a period of time, going back to the casino to win back lost money, lost relationships due to gambling behaviour, spending a lot of time thinking about gambling, an needing to spend more and more money to get the same excitement out of gambling. Someone who has problems with gambling may experience a few of these symptoms, but not necessarily all of the above symptoms. The questionnaires you have just completed will help us to identify factors (e.g., gambling experience, knowledge about gambling and games of chance, coping styles, etc.) that might contribute to gambling frequency and persistence over time, and that might encourage slot machine players to spend beyond their financial limits. It is hoped that the results from this project will help us to identify factors that put slot machine players at risk for developing gambling problems, and will help us to evaluate whether educational animations are effective for a) improving knowledge about how slot machines work, and b) preventing gambling problems among slot machine players over time.

As researchers, we are not qualified to provide advice or treatment for gambling problems. However, **if you have a concern about your gambling or are feeling upset in any way after participating in this study, you may contact any of the following people to talk about your thoughts or experiences:**

- If you have any concerns about your gambling behaviour, you may wish to contact:
  - Gamblers Anonymous at: 613-567-3271
  - Ontario Problem Gambling helpline at: 1-888-230-3505; Web Site: http://www.opgh.on.ca
  - Addictions and Problem Gambling Services of Ottawa at: 613-789-8941; Web Site: http://www.apgso-stjpo.ca/find_eng.html

- If you have a family member who gambles, you may wish to contact:
  - Gam-Anon at: 613-567-3271

- If you are experiencing any sort of distress, it is suggested that you either contact your family physician, or one of the organizations listed below:
  - Ottawa & Region Distress Centre: 613-238-1089; Web Site: www.dcottawa.on.ca;
  - Amethyst Women's Addiction Centre (offering support for gambling, drug and alcohol problems): 613-563-0363; Web Site: http://www.amethyst-ottawa.org/

- It is not a good idea to allow problems to fester, as ruminating over these problems will typically not make them go away. Your family physician or counselor will usually be able to help you or to refer you to someone who can.

If you have any questions or comments about this research, please feel free to contact:

- Kelly Christie at: Email: klchrist@connect.carleton.ca; Phone: 613-520-2600 ext. 6312
- Dr. Michael Wohl at: Email: michael_wohl@carleton.ca; Phone: 613-520-2600 ext. 2908
- Dr. Hymie Anisman at: Email: hymie_anisman@carleton.ca; Phone: 613-520-2600 ext. 2699
- Dr. Kim Matheson at: Email: kim_matheson@carleton.ca; Phone: 613-520-2684
- Cara Donnelly at: Email: c_carad@hotmail.com; Phone: 613-520-2600 ext. 6312
- Daniel Afram at: Email: dafram@connect.carleton.ca); Phone: 613-520-2600 ext. 2683

If you have any ethical concerns about how this study was conducted, please contact:

☐ Dr. A. Parush, Chair of the Carleton University Ethics Committee for Psychological Research, (613) 520-2600, ext. 6026

If you have any other questions or comments about this research, please feel free to contact:

- Dr. A. Bowker, Chair of the Department of Psychology, Carleton University, (613) 520-2600, ext. 6026

We thank you very much for participating in this study. Your assistance will help us better understand gambling behaviour among slot machine players.