THE DETERMINANTS OF RISKY DECISION-MAKING AND GAMBLING: THE EFFECTS OF NEED AND RELATIVE DEPRIVATION

Sandeep Mishra[1], Martin Lalumière[2], Robert Williams[2], & Martin Daly[3]

[1] *University of Guelph*
[2] *University of Lethbridge*
[3] *McMaster University*

Final research report submitted to the
Ontario Problem Gambling Research Centre
July 2012

GENERAL SUMMARY

Previous research has shown that various forms of risky behavior (e.g., aggression, property and violent crimes, sexual promiscuity, reckless driving, substance use, and gambling, among others) tend to co-occur among individuals. Furthermore, similar correlates have been associated with both gambling and other forms of risky behavior (e.g., such personality traits as sensation-seeking, impulsivity, low self-control; low social support; being male; poor academic performance). As a consequence, it is possible that gambling and other risky behaviors share common determinants. We examined whether factors that have been previously shown to predict risk-taking similarly predict engagement in gambling and problem gambling behavior. Specifically, we apply the framework of risk-sensitivity theory, which predicts a preference for high-risk options in situations of high need, where low-risk options are unable to meet one's need (where need describes disparity between a present and a desired/goal state). Overall, we found that conditions of need significantly predicted both risk-taking and gambling tendencies. Given that conditions of need appear to lead to predictable risk-taking and gambling behavior, it is therefore likely that gambling may be in part a product of a decision-making psychology sensitive to conditions of relative deprivation (i.e., sensitivity to disparity between one's present and desired states, usually ascertained through social comparison). These results have some important implications. Specifically, reductions in problem gambling may be observed by changing gamblers' situations of need (e.g., through access to health care, education, employment, or other opportunities), thereby altering the immediate cost-benefit structure of risk-taking and gambling. This approach would give consideration to reducing conditions of relative deprivation that favor risky decision-making.

ACKNOWLEDGMENTS

We sincerely thank the Ontario Problem Gambling Research Centre for their generous support of this research. We are also grateful for additional financial support in the form of scholarships to SM from the Alberta Gaming Research Institute, the Government of Alberta, and the Social Sciences and Humanities Research Council of Canada.

We also wish to thank our dedicated and talented research assistants and students: Mackenzie Becker, Sarah Dada, Thomas Fox, Christine Michell, Lindsay Kleiner, Alix Shriner, and Sara Kafashan. These students put in countless hours of work in order to facilitate the completion of this study.

Finally, it is absolutely necessary to thank the people who took the time and effort to participate in this study. It was a pleasure to be able to interact with some of the kindest people who sincerely wanted to be a part of finding solutions to gambling addiction.

INTRODUCTION

The Generality of Risk

Various forms of risky behavior, including substance use, dangerous driving, promiscuous sex, and antisocial behavior co-occur within individuals (reviewed in Mishra & Lalumière, 2008, 2009, 2011; Mishra, Lalumière, Morgan, & Williams, 2011). Gambling may be part of this general pattern of risk-acceptance. Gambling has been associated with various forms of risky behavior (e.g., Martins, Tavares, da Silva Lobo, Galetti, & Gentil, 2004; Powell, Hardoon, Derevensky, & Gupta, 1999; reviewed in Van Brunschot, 2009), and shares correlates associated with general risky behavior (reviewed in Stinchfield, 2004). Specifically, gambling and problem gambling have been associated with risky personality, risky decision-making, and pro-risk attitudes.

Such personality traits as sensation-seeking, impulsivity, and low self-control have been associated with risky behavior in various domains (reviewed in Zuckerman, 2007). Sensation-seeking describes a preference for varied, stimulating experiences and a willingness to engage in risk-taking in order to obtain such experiences (Zuckerman, 1994). Impulsivity refers to a tendency to prefer short-term rewards, without planning or forethought, with the potential for immediate or future costs (Eysenck, Pearson, Easting, & Allsop, 1985). Low self-control, like impulsivity, is associated with a tendency to focus on temptations of the moment, ignoring long-term consequences (Marcus, 2003).

Impulsivity has been consistently associated with problem and pathological gambling (Blaszczynski, Steel, & McConaghy, 1997; Clarke, 2004; Langewisch & Frisch, 1998; Franken, van Strien, Nijs, & Muris, 2008; Myrseth, Pallesen, Molde, Johnsen, & Lorvik, 2009; Vitaro, Arsenault, & Tremblay, 1999). Sensation-seeking has been less consistently associated with gambling, with some studies suggesting problem gamblers exhibit higher levels of sensation-seeking (e.g., Cloninger, 1987), and others suggesting the opposite (e.g., Powell et al., 1999; reviewed in Hammelstein, 2004). The relationship of low self-control and gambling has not received much attention so far; one study found that a self-control scale differentiated problem and non-problem gamblers, with problem gamblers exhibiting lower self-control (Corless & Dickerson, 1989). Factors implicated in temporary reduction of self-control (e.g., alcohol consumption, frustration) have also been associated with increases in gambling and risk-taking behavior (Baron & Dickerson, 1999; Corless & Dickerson, 1989; Freeman & Muraven, 2010).

Risk-Taking and Gambling

Problem gambling is significantly more prevalent in forensic populations than in the general population (Ferris, Wynne, & Single, 1999; Williams, Royston, & Hagen, 2005). Although some previous work suggests that gambling and antisocial behavior are related, the extent and nature of this relationship is unclear. Both gambling and antisocial behavior are forms of risk-taking, and may therefore share common determinants. In two recent studies, we examined the degree to which risk-taking and gambling were associated.

In the first study, we examined the relationship between gambling and antisocial behavior (Mishra, Lalumière, Morgan, & Williams, 2011). We examined whether individual differences in antisocial tendencies (namely, primary and secondary psychopathy, aggression, and early indicators of psychopathy), and personality traits associated with risk-taking predicted gambling and antisocial behavior. Results indicated that all forms of gambling and antisocial behavior were significantly correlated. Furthermore, personality traits associated with risk-acceptance (low self-control, impulsivity, sensation-seeking) explained a significant portion of the variance in problem gambling, general gambling involvement, and all forms of antisocial behavior. Interestingly, when controlling for personality traits associated with risk-acceptance, the correlation between gambling and antisocial behavior was significantly reduced, and in most cases, eliminated. These findings suggest that gambling and antisocial behavior are associated in part because they are different manifestations of similar preferences for risk.

In the second study, we investigated whether self-reported personality traits, laboratory-based behavioral measures of risk-taking, and self-reported attitudes toward risk in various domains were associated with general gambling involvement and problem gambling behavior, using an extreme-groups design (Mishra, Lalumière, & Williams, 2010). Risky personality traits such as impulsivity, sensation-seeking, and low self-control were significantly associated with problem gambling and general gambling involvement. Furthermore, positive attitudes toward risk-taking in a variety of domains were also significantly associated with gambling behavior. A confirmatory factor analysis indicated that both problem gambling and general gambling involvement loaded on single factors along with measures of personality traits associated with risk, behavioral measures of risk, and attitudes toward risk-taking. Together, our results suggest that gambling represents one expression of a general propensity for risk-taking, and may benefit from being examined within a more general framework of risk-taking.

Towards a Broader Understanding of Gambling and Risk-Taking

Many scientists have converged on a definition of risk as preference for high outcome variance, where the riskier of two options with the same mean expected value is that with higher outcome variability (Daly & Wilson, 2001). This definition of risk is clearly relevant to gambling behavior: Heavy gamblers often expose their resources to high variance outcomes in the hopes of a large reward. Some of our work has provided preliminary evidence suggesting that preference for high variance outcomes is associated with more frequent gambling (Mishra, Lalumière, Williams, & Morgan, 2008; Mishra, Lalumière, & Williams, 2009). Although growing research suggests that gambling is a form of risk-taking, most of this research has been conducted on undergraduate populations. Furthermore, little attention has been paid to the relationship of gambling with behavioral measures of risk-taking (specifically, measures of general variance preference). Finally, most of these studies tend to ignore the situational and environmental conditions in which risk-taking, including gambling, takes place. A consideration of conditions of need and relative deprivation in biopsychosocial context may be beneficial (e.g., Griffiths & Delfabbro, 2001; Toneatto & Nguyen, 2008).

Need and Risky Decision-Making

Risky behavior is often considered irrational, pathological, and against an individual's best interests. By treating risk simply as preference for high outcome variance, however, it is possible to re-frame risk-taking as an expected behavior in certain circumstances. Specifically, it may be advantageous to engage in risky behavior under certain conditions, such as when there is a need or aspiration to be fulfilled, or under conditions of relative deprivation. Relative deprivation refers to the perception that one is being deprived of a deserved outcome relative to others (Callan, Ellard, Shead, & Hodgins, 2008).

Mishra and Lalumière (2008) reviewed several correlates of risky behavior. Although these correlates span several domains, one pattern emerges: When individuals have a need to be met, or are in conditions of relative deprivation, risky options with highly variable outcomes are more likely to be favored. The theoretical framework of risk-sensitive decision-making, taken from behavioral ecology, provides a clear understanding of the role of need in decision-making (Stephens, 1981). This theory posits that people do not seek to maximize certain outcomes, but rather, seek to minimize the probability of outcomes that fail to meet one's needs (Rode, Cosmides, Hell, & Tooby, 1999). For example, if someone has a pressing debt of $5,000, they may prefer a gamble with a 10% of receiving $5,000 over a certain $500. Although both options have the same expected value, only the risky option offers a chance for someone to meet their need.

Can risk-sensitivity theory account for patterns of decision-making under risk? In a recent study, we examined whether need explained risky choice in a decision-making task (Mishra & Lalumière, 2010). People chose high-risk options more frequently when placed in a situation of high need, where a low-risk option was unlikely to meet their need. Conversely, people who experienced conditions of low need preferred low-risk options that were sure to meet their need. These results were obtained both when people were explicitly aware of the parameters of decision options (i.e., mean and variance), and when

they implicitly (i.e., unconsciously) learned the parameters of decision options through experience. These results were also obtained both with and without controlling for sex and individual differences in personality, suggesting that this pattern of results is robust. These findings have been replicated and extended in subsequent studies (Mishra & Fiddick, 2012; Mishra, Gregson, & Lalumière, 2012), suggesting that need is an important motivator of risky behavior. Together, our results suggest that (1) level of need is an important factor in risk-related decision making, and (2) humans are able to make risk-sensitive decisions based on implicit learning; that is, people are sensitive to the mean and variance of decision options even when not explicitly given the actual numbers. These results may have important implications for understanding gambling behavior.

Relative Deprivation and Need in Biopsychosocial Context

The etiology of problem gambling is complex. There are numerous demographic, personality, biological, and environmental/cultural variables that contribute to gambling behavior. Several important individual instigative factors have been associated with problem gambling, including being male (e.g., Nower, Derevensky, & Gupta, 2004), being younger (e.g., Shaffer, Hall, & Vander Bilt, 1999), possessing low socioeconomic status (e.g., Welte, Barnes, Wieczorek, Tidwell, & Parker, 2001), high impulsivity (e.g., Blaszczynski, Steel, & McConaghy, 1997), and having experienced childhood abuse (e.g., Kausch, Rugle, & Rowland, 2006), among others (reviewed in Toneatto & Nguyen, 2008). Although these instigative factors are reliable correlates of problem gambling, little is known about the mechanisms that associate these factors with problem gambling behavior. It has been suggested that an investigation of relevant biopsychosocial variables is necessary in order to understand these mechanisms (Toneatto & Nguyen, 2008).

The biopsychosocial approach to understanding addiction is a useful and widely-used framework for guiding research into the causes of problem gambling. Personal factors can increase an individual's susceptibility to engaging in gambling behavior (Williams, West, & Simpson, 2008) and risky behavior in general (Mishra & Lalumière, 2008). Some of these personal factors include low self-control, impulsivity, vulnerability to stress, and poor intellectual skills. These factors interact with social factors to produce conditions that may facilitate engaging in gambling and risky behavior. Available resources, social and familial support, proximity to gambling opportunities, and degree of equality in the availability of resources are important conditions of the environment in which an individual lives, and are all associated with problem gambling (Toneatto & Nguyen, 2008; Williams et al., 2008).

Personal and environmental factors may modulate risk-taking and gambling behavior by affecting the degree to which someone perceives they can compete with others for important resources. An individual who does not experience relative deprivation (e.g., by possessing many skills, plentiful resources, or high status) may derive less benefit from engaging in risky behavior, because the costs of engaging in such behavior far outweigh any advantages. Someone experiencing relative deprivation, however, may be unlikely to meet his or her interpersonal, social, romantic, or economic needs through low-risk options, and thus may have much to gain and little to lose from engaging in risky conduct. Relative deprivation can shift the cost-benefit ratio of risky behaviors, making such behaviors more favorable options in some circumstances.

Measures of relative deprivation have been associated with various forms of risky behavior, including aggression (Wilson & Daly, 1997), property and violent crimes (Kawachi, Kennedy, & Wilkinson, 1999), and teenage pregnancies (Wilson & Daly, 1997). In situations of high interpersonal competition, where effects of relative deprivation are amplified, risky and criminal behaviors tend to escalate (Wilson & Daly, 1985; Mishra & Lalumière, 2008). In the gambling domain, Callan et al. (2008) found that self-reports of relative deprivation predicted problem gambling and gambling urges. Furthermore, when Callan et al. manipulated perceptions of relative deprivation in a laboratory setting, they found that participants experiencing higher relative deprivation were more likely to opt to gamble. These results are consistent with our recent research described above. Together, these findings indicate that relative deprivation may play an important role in facilitating risky and gambling behavior, a role that has, to date, received little

attention in the gambling literature.

In this study, we (1) examined whether inducing transitory conditions of relative deprivation and "high need" in a laboratory setting led to increased gambling and risky behavior, (2) explored the role of stable personality traits on risk-taking, along with their interaction with need, and (3) examined how real-world conditions of need (i.e., relative deprivation) and individual differences in personality affect individuals who have experienced instigative factors for gambling (e.g., mental illness, parental divorce, low social support), compared to individuals who have not. We recruited participants who have experienced a variety of both personal and environmental vulnerability factors that are associated with relative deprivation and high need. This methodology allowed us to investigate several questions in a population of individuals who varied widely on their risk-taking tendencies, gambling problems, personal and social resources, and decision-making tendencies.

This study extends previous research in three important ways. First, we examine the relationship between relative deprivation, risk-taking, and gambling related outcomes in a diverse, non-exclusively student sample. Second, we examine the relationship of need and relative deprivation with not only gambling outcomes, but with risk-taking more generally. Finally, this study represents the first test of risk-sensitivity in a diverse, real-world sample.

RESEARCH QUESTION AND HYPOTHESES

Are relative deprivation and conditions of need associated with increased gambling and risky behavior?

Risk-sensitivity theory suggests that people make risky decisions based on their level of need (e.g., Mishra & Lalumière, 2010). If gambling behavior is closely associated with other forms of risky behavior, and risky behavior is well predicted by relative deprivation, a form of need, it follows that certain forms of gambling may be products of risk-sensitive decisions in response to motivations associated with relative deprivation and high need. Alternatively, it is possible that some individuals belong to populations that exhibit high levels of risky or gambling behavior simply because they possess a stable risk-accepting personality. That is, an individual's developmental and social environment may have facilitated a "fixed" pattern of risk-preference in all domains, including gambling.

In this study we tested these two possibilities, both of which have important theoretical and practical implications. Gambling and risky behavior may represent responses to situations presenting cues of relative deprivation and high need. If this hypothesis is supported, it would suggest that reductions in problem gambling might be observed by changing gamblers' situations of need, thereby altering the cost-benefit structure of gambling behavior. Alternatively, it is possible that problem gamblers have experienced early instigative factors for risky and gambling behavior that have facilitated the development of risky "personalities" that lead them to consistently prefer high-risk outcomes. If this hypothesis is supported, it would suggest that targeting early instigative factors for problem gambling would be an effective way of reducing later problem gambling behavior. It is also possible that both hypotheses are confirmed; situational cues and personality traits may combine, or interact, to instigate and maintain problem gambling behavior. Regardless of which of our hypotheses are supported, results will provide a more complete understanding of the causes of problem gambling as well as alternative approaches to the treatment of gambling problems.

STUDY DESIGN AND METHODOLOGY

Participants

Participants age 18 and older were recruited from various sources using public advertisements (i.e., posters and notices), and comprised university students, college students, the homeless, gambling and drug addicts, and ex-convicts. Advertisements were posted at the University of Lethbridge, Lethbridge

College, downtown Lethbridge, employment offices, the Lethbridge Homeless Shelter, drug addiction rehabilitation facilities, and the Lethbridge Food Bank. We sought to recruit a wide array of participants to maximize variance on key measures, including relative deprivation, degree of gambling addiction, mental health, income and socioeconomic status, antisocial tendencies, and social support.

Method

Participants were recruited using public poster advertisements in various locations, including downtown Lethbridge near central bus stops, local business in downtown Lethbridge, the Lethbridge Homeless Shelter, Lethbridge Immigrant Services, drug rehabilitation clinics, and the University of Lethbridge, among other locations.[1] We recruited from such sources in attempt to maximize variance on key measures (e.g., relative deprivation, problem gambling tendencies).

Participants came either to a psychology laboratory at the University of Lethbridge, or a downtown office space that was rented for study participation. All participants were given a thorough introduction to the study, including a description of all possible risks involved, and signed a consent form before the study began. Participants then completed the dependent measures, involving a biographic questionnaire, behavioral measures of risk-taking, early developmental environment measures, and personality and individual differences measures. All measures were presented on a computer in fully randomized order. Participants received $30 for their participation, in addition to keeping all of the earnings from the behavioral decision-making tasks (described below). Average earnings were $63.27 (*SD*: $21.91).

Measures

Biographic Questionnaire

The biographic questionnaire consisted of several demographic, experiential, and diagnostic variables. These variables included age, sex, relationship status, length of relationship, children, ethnicity, education, family structure, employment, earnings (household and personal in the last year), diagnosis of mental illness, and present debt.

Behavioral Measures of Risk-Taking

Balloon Analogue Risk Task (BART). Participants saw a computer screen with a deflated balloon and a "PUMP" button. Each pump of the balloon increased participants' earnings by one cent, and increased the degree to which the balloon was inflated. The balloon was set to pop randomly, with 65 pumps required on average before popping. If the balloon popped, participants lost all money gained for that trial. Participants could end a trial at any time by clicking on a "COLLECT" button. Thirty trials were presented. The first five trials were excluded from analysis as training. The average number of pumps for all trials where the balloon did not pop was computed (Lejuez et al., 2002). Because the balloon was set to pop randomly, number of pops are not as indicative as the adjusted average (i.e., a balloon could pop at trial 1, providing little useful information on risk-acceptance).

Choice Task (CT). Participants made six decisions, each between two monetary options (adapted from Fessler et al., 2004; Mishra & Lalumière, 2010). Both options had equal expected values but differed in variance (e.g., "Would you rather choose [A] $3 guaranteed, or [B] a 30% chance of earning $10?"). After task completion, participants rolled a die and received the value of one of the six choices they made (corresponding to the number on the die). A total score of number of risky choices was computed.

[1] We did not specifically note how participants were recruited in this study (i.e., where each individual participant saw a relevant advertisement for the study). However, we note that participants exhibited a substantial variability in demographic, personality, and behavior measures, as intended, suggesting that recruiting took place from diverse locations, and from diverse populations.

Ecological Decision-Making Task (ECO). The ECO was developed to approximate a real-world, ecologically relevant risk-sensitive decision in a foraging context. The ECO consisted of two parts. Part A was the training session. Participants saw 50 cartoon trees of four different colors, randomly presented one at a time on a computer screen. Clicking on each tree revealed some non-zero number of apples shown in the foliage of the tree. Each tree color produced a specific mean and variance of return, approximating a real-world foraging situation of learning the yield characteristics of patches by experience. The four tree colors and four yield characteristics were paired randomly between participants. Two trees had different mean outcomes, but the same variance in outcome (Tree 1: $M_{yield/day}$ = 7.3; $SD_{yield/day}$ = 2.5; Tree 2: $M_{yield/day}$ = 4.7, $SD_{yield/day}$ = 2.5). The other two trees had the same mean outcome, but different variance in outcome (Tree 3: $M_{yield/day}$ = 8.0, $SD_{yield/day}$ = 6.0; Tree 4: $M_{yield/day}$ = 8.0, $SD_{yield/day}$ = 0.9).

Part B was the decision-making phase. There were seven trials per block (described to participants as seven days). Ten blocks were presented to each participant. The participants' goal was to survive the week by obtaining 50 apples (and earning $2). For each trial, participants were told to "Click to see what trees [were] available within a day's walking distance." The first five trials in each block presented a single tree, such that participants were fixed to be in one of two conditions by the sixth trial: low need (Tree 1 presented for trials 1-5, resulting in an apple total close to the survival threshold, M = 36.5), or high need (Tree 2 presented for trials 1-5, resulting in an apple total far from the survival threshold, M = 23.5). The only parameter that varied between the two conditions was the mean yield of the tree presented; trees 1 and 2 both had the same variance in yield (see above). On trials six and seven, participants decided between two trees with the same mean yield, but different variance, one risky (high variance; Tree 3) and the other non-risky (low variance; Tree 4).

Trial six introduced participants to the decision-making task but was not used as a dependent measure. Trial seven represented a risk-sensitive decision based on an immediate situation of low or high need. The dependent measure was the proportion of risky choices on trial seven. Blocks where participants were able to meet their need with certainty by trial seven (by obtaining 49 or more apples) were eliminated from analysis (56 blocks). Trial seven was used as the dependent measure because participants' choices on this trial were directly relevant to the end outcome (whereas trial six was distal from the end outcome).

Gambling Decision-Making Task (GDT). The GDT was identical to the ECO as above, except that instead of clicking on trees, participants clicked on different colored decks of cards. Each card was assigned a certain level of points. Numbered cards were worth their face value (e.g., a five of clubs was worth five points). Jacks were worth 11 points, queens were worth 16 points, kings were worth 17 points, and aces were worth 1 point. These cards were distributed in the different decks such that the mean and variance of the four decks corresponded to those in the ECO above. Two decks had different mean outcomes, but the same variance in outcome (Deck 1: $M_{yield/day}$ = 7.3; $SD_{yield/day}$ = 2.5; Deck 2: $M_{yield/day}$ = 4.7, $SD_{yield/day}$ = 2.5). The other two decks had the same mean outcome, but different variance in outcome (Deck 3: $M_{yield/day}$ = 8.0, $SD_{yield/day}$ = 6.0; Deck 4: $M_{yield/day}$ = 8.0, $SD_{yield/day}$ = 0.9). The rest of the GDT was identical as in the ECO above.

Variance Preference Under Need Task (VPN). Participants made twenty decisions between a certain option, consisting of one of four fixed ratios of black to white beads totaling 100 (30:70, 50:50, 60:40, 70:30), and a risky option, consisting of a randomly determined combination of black and white beads totaling 100 (Rode et al., 1999). For each decision, participants drew ten beads with replacement. In order to earn any money, participants had to draw a specific number of black beads (i.e., meet a need requirement). Five need requirements were constructed. This need requirement was either one or two beads above, one or two beads below, or equal to the expected value of the certain option (abbreviated +1EV, +2EV, –1EV, –2EV, and 0EV, respectively).

Each level of need was presented for each of the different certain option ratios, leading to twenty decisions (4 certain option ratios × 5 need requirements). For example, "You are required to draw *seven* black beads out of ten. Would you rather draw from a cup containing (A) 50 black beads and 50 white

beads, or (B) a randomly determined combination of black and white beads totaling 100". In this example, option (A) is the certain option, (B) is the risky option, and the level of need is seven (which is equal to two above the expected value of the certain option).

At the end of the task, participants drew one of 20 numbered ping-pong balls and played out their decision in the scenario corresponding to the number drawn. Participants earned $20 if they met their need. The dependent measure was the proportion of risky choices made under each of the five need conditions.

Future Discounting (FD). Participants were presented with a series of 27 choices between an amount of money available today, and an amount of money available in the future (Kirby et al., 1999). Choices were either for small, medium, or large amounts of money (seven in each category). At the end of this task, participants picked one of 27 ping-pong balls labeled from 1 to 27, and earned the amount of their choice in the form of cheque (either immediately cashable, or post-dated to the relevant date in the future). The dependent measure consisted of a discounting parameter (k) for each of small (FD_S), medium (FD_M), or large rewards (FD_L), calculated as described in Kirby et al. (1999). Higher discounting parameters indicated a greater preference for immediate rewards over later rewards.

Early Developmental Environment

Retrospective Family Unpredictability Scale (RFUS). The RFUS (Ross & Hill, 2000) is a measure of consistency in family behaviors and regulatory systems during childhood development. The measure consisted of 28 statements involving uncertainty regarding meals (e.g., "Monday through Friday, the same people sat down and ate dinner together"), money (e.g., "Some months we had plenty of money to spend, other months we were quite poor"), parental nurturance (e.g., "When I got my feelings hurt, I went to my mom [dad] for comfort"), and discipline (e.g., "Sometimes my dad [mom] yelled at me without thinking about what he [she] was saying"). Agreement for each statement was rated on a scale from 1 (*not at all*) to 5 (*extremely*). Participants indicated if any individual statement did not apply to them.

Gambling Tendencies

General Gambling Involvement (GGI). Self-reports of (1) total number of different gambling activities engaged in, and (2) monthly frequency of gambling (both over the past year) were obtained (Williams & Connolly, 2006).

Canadian Problem Gambling Index (CPGI). The CPGI (Ferris & Wynne, 2001) is a 28 item self-report measure of problem and pathological gambling behavior. It consists of items assessing degree of problem gambling (the Problem Gambling Severity Index, PGSI; e.g., "How often have you bet more than you could really afford to lose?"), gambling fallacies (e.g, "After losing many times in a row, you are more likely to win"), and instigative (or risk) factors associated with engagement in problem gambling (e.g., "Has anyone in your family ever had a gambling problem?"). Items involving degree of problem gambling were scored on a scale of 1 (*never*) to 4 (*almost always*). Items involving gambling fallacies and instigative factors involved yes/no responses.

Personality and Individual Differences

Intelligence (IQW). The IQW is a brief intelligence measure consisting of a 10-word vocabulary test requiring participants to identify a target word's synonym for a set of five present word options. The IQW is used in the General Social Survey in the United States (called the Wordsum task), and it has been highly associated with longer, established IQ measures.

Domain Specific Risk-Taking Scale (DOS). The DOS (Weber et al., 2002) is a self-report measure of the likelihood of engaging in risky behavior in five domains: financial (investing and gambling; e.g., "Betting a day's income at a high stake poker game"), health/safety (e.g., "Not wearing a helmet when riding

a motorcycle"), recreational (e.g., "Going whitewater rafting during rapid water flows in the spring"), ethical ("Having an affair with a married man or woman"), and social risky behaviors (e.g., "Arguing with a friend about an issue on which he or she has a very different opinion"). Participants rated the likelihood of engagement in each behavior from a scale of 1 (*extremely unlikely*) to 5 (*extremely likely*).

Retrospective Behavioral Self-Control Scale (RBS). The RBS (Marcus, 2003) measures behaviors across the lifespan that are associated with low self-control. It consists of 67 items, measuring the frequency of behaviors associated with low self-control in childhood (e.g., "I copied homework from classmates"), adolescence ("I have been late for school or work because I stayed out too late the night before"), and adulthood (e.g., "I have been caught in a speed trap"). Behaviors were rated on a scale from 1 (never) to 7 (always). A total self-control score was obtained by summing ratings of frequency of engagement in risky behaviors; a higher score indicated lower self-control.

Eysenck's Impulsivity Scale (EIS). The EIS (Eysenck et al., 1985) consists of 19 yes/no statements about impulsive behaviors (e.g., "Do you often buy things on impulse?"). A total impulsivity score was obtained by summing the number of "yes" answers.

Zuckerman's Sensation Seeking Scale (SSS). The Sensation Seeking Scale, Version 5 consists of 40 choices between pairs of statements regarding preferences for varied, stimulating experiences and disinhibited behavior (e.g., "A sensible person avoids activities that are dangerous" versus, "I sometimes like to do things that are a little frightening"; Zuckerman 1994). A total sensation seeking score was obtained by summing the number of high sensation seeking choices.

Justice Sensitivity Scale (JSS). The JSS (Schmitt, Gollwitzer, Maes, & Arbach, 2005) measures sensitivity to justice issues and fairness (e.g., "It bothers me when others receive something that ought to be mine"). Items were rated on a scale from 1 (*strongly disagree*) to 5 (*strongly agree*). A total score was obtained by summing the responses to all of the items.

Personal Relative Deprivation Scale (PRDS). The PRDS (Callan et al., 2008) measures the degree to which people feel deprived relative to others (e.g., "I feel resentful when I see how prosperous other people seem to be"). Four items were rated on a scale from -3 (*strongly disagree*) to +3 (*strongly agree*). A total score was obtained by summing the responses to all of the items. The PRDS has been previously associated with gambling tendencies (Callan et al., 2008).

Mental Health Inventory (MHI-5). The MHI-5 (Berwick, Murphy, Goldman, Ware, Barsky, & Weinstein, 1991) is a brief measure of mental health used to detect affective and anxiety disorders. Participants indicated the amount of time in the last month where they experienced feelings associated with mood disorders (e.g., "Felt downhearted and blue") or anxiety disorders (e.g., "Been a very nervous person"). Items were rated on a scale of 1 (*none of the time*) to 6 (*all of the time*).

Multi-Dimensional Scale of Perceived Social Support (MSPSS). The MSPSS (Zimet, Dahlem, Zimet, & Farley, 1988) is a self-report measure of subjectively addressed social support, involving family, friends, and significant other. Participants indicated the degree to which they agreed or disagreed to 12 statements involving social support from family (e.g., "I get the emotional help and support I need from my family"), friends (e.g., "I can count on my friends when things go wrong"), and a significant other (e.g., "There is a special person who is almost always around me"). Items were rated on a scale of 1 (*very strongly disagree*) to 7 (*very strongly agree*).

Self-Report Early Delinquency Instrument (SRED). Antisocial behavior was measured using the Self-Report Early Delinquency Instrument (SRED; modified from Moffitt & Silva, 1988). The modified SRED consisted of a list of 36 delinquent behaviors (e.g., "Carried a weapon", 0 = *never*, 1 = *once*, 2 = *more than once*). The rating scale was modified to assess past year frequency in addition to lifetime frequency to better capture present tendencies for antisocial behavior. Items were divided into three categories of antisocial behavior: minor (e.g., "Trespassing", "Taking a car without permission"), moderate (e.g.,

"Stealing over $10", "Getting suspended or expelled from school"), and severe (e.g., "Struggling with a police officer", "Hitting a person to seriously hurt them"). Minor, moderate, and severe antisocial behavior scores were calculated by summing the relevant items for each subscale.

RESULTS AND DISCUSSION

A total of 328 participants (165 male, 160 female; 3 declined to provide their gender) were recruited (age: M = 31.0, SD = 12.5, Range = 18 to 73). Approximately half of the sample comprised college or university students; the other half consisted of community members. Participants recruited were from a wide range of socioeconomic backgrounds (Table 1). Most participants were not employed full-time (Table 2). Participants also exhibited a wide range of problem gambling tendencies; based on PGSI scores, 50.0% of participants were non-problem gamblers, 27.1% were low-risk gamblers, 13.1% were moderate gamblers, and 9.8% were problem/pathological gamblers.

Participants exhibited varied antisocial and criminal histories. Twenty-nine percent of participants indicated that they had been arrested once, 27.1% were charged with a crime, 25.9% were convicted of a crime, and 17.4% had been incarcerated at least once.

Although 82.0% of participants did not report experiencing a mental illness, 9.1% reported a current mental illness diagnosis (the majority of which was depression or anxiety disorders), and 7.3% reported a previous (but not necessarily current) diagnosis of a mental disorder.

A wide array of scores on the personal relative deprivation scale was also observed, suggesting robust variability to test hypotheses regarding the association of the perception of relative deprivation with risk-taking and gambling outcomes (Figure 1). Descriptive statistics for other key measures of interest are provided in Table 3.

Together, these demographic and frequency data suggest that our recruitment techniques were successful in maximizing variance on key measures, including relative deprivation, justice sensitivity, degree of problem gambling, mental health, income and socioeconomic status, and antisocial/criminal tendencies.

An Examination of the Generality of Risk

Previous research has suggested that people who tend to engage in one type of risk-taking (e.g., gambling), also tend to engage in other types of risk-taking (e.g., antisocial conduct). Theories have been derived suggesting the existence of what has been called the "generality of deviance" describing the phenomenon of general engagement in risky behavior across domains. Here, we examine the degree to which various measures of risk-taking were associated among individuals in our study population.

Data Simplification and Reduction

The two measures of general gambling involvement (number of gambling activities in the past 12 months, and monthly frequency of gambling) were significantly correlated, r = .409, p < .001. As a consequence, we created a composite variable, which we call *general gambling involvement (GGI)*, by summing the z-scores of the two gambling involvement measures.

Measures of antisocial behavior in the past year (minor, moderate, and major), were also highly intercorrelated (all rs > .433, ps < .001). Similarly, measures of antisocial behavior over the lifespan (minor, moderate, and major), were highly intercorrelated (all rs > .68, ps < .001). As a consequence, we summed the z-scores of the three antisocial behavior measures to create composite *antisocial behavior in the last year* (ABY) and *antisocial behavior over the* lifespan (ABL) measures.

The three future discounting variables were highly correlated (all Spearman's *rho*s > .81). A principal

components analysis showed that a single factor, future discounting (FD) accounted for 61.8% of the variance (all loadings > .66).

The Generality of Risk

Variables associated with gambling, risky personality, delinquency, and behavioral preference for risk were intercorrelated (Table 4). The results indicated that various manifestations and correlates of risk were highly intercorrelated with each other; 68% of correlations were statistically significant, and many that weren't significant were in the expected direction. These results suggest that various components of risk-taking are highly associated, supporting the generality of risk hypothesis.

Are Problem Gamblers Risk-Sensitive Decision-Makers?

Previous research conducted among undergraduate students has demonstrated that people are acutely sensitive to conditions of need, where need is defined as disparity between one's present and desired (or goal) states. This research has shown that people placed into situations of high need tend to prefer high-risk options in situations of high need, where low-risk options are unable to meet their needs (Mishra & Fiddick, 2012; Mishra & Lalumière, 2010; Mishra, Gregson, & Lalumière, 2012). People also tend to prefer low-risk options in situations of low need, where needs can be met without having to resort to potentially costly risky choice.

These results suggest that risk-sensitive decision-making is highly contingent on environmental conditions of need. Here, we examine whether people who appear to exhibit persistent levels of high-risk behaviors are also sensitive to environmental conditions of need, or whether such people engage in persistent risk-taking because they are "fixed" into such a pattern of behavior due to stable personality traits. We attempt to answer this question using three different measures (described above): (1) the VPN, an explicit measure of decision-making under need (Rode et al., 1999), (2) the ECO, which measures risk-sensitive decision-making in a foraging analogue (reflecting higher ecological validity through implicit learning of decision options; Mishra & Lalumière, 2010), and (3) the GDT, a measure of risk-sensitive decision-making identical to the ECO, except contextualized in the gambling domain.

We analyzed data for each of these three measures using mixed ANCOVAs, with sex, problem gambling status, and task condition as independent variables, and variance preference and risky personality as covariates. Variance preference and risky personality were treated as covariates because they have been previously shown not to influence decision making in conditions of need (except under very limited conditions; Mishra & Lalumière, 2010). However, they were included in the ANCOVA models to demonstrate the robustness of the results. We note that the pattern of results reported below remained significant even when covariates were not included in the models.

Data Simplification and Reduction

Because the personality traits associated with risk-taking used in this study – impulsivity (EIS), sensation-seeking (SSS), low self-control (RBS), and domain-specific risk-taking (DOS) – were highly correlated and previously shown to measure a similar construct of risky personality (Mishra & Lalumière, 2011), we sought to simplify subsequent analyses by reducing these variables using principal components analysis (PCA). PCA indicated that 60.0% percent of variance among these measures of personality associated with risk-taking was explained by a single component, which we call *risky personality*. All variables loaded highly and positively (all loadings > .664).

Similarly, the two behavioral measures of risk-taking used in this study – the Balloon Analogue Risk Task (BART) and the Choice Task (CT) were also significantly correlated, and have been previously identified as sub-components of a "variance preference" factor (Mishra et al., 2010). As a consequence, we again sought to simplify subsequent analyses by creating a composite measure of *variance preference* by summing the z-scores of the CT and BART.

We note that as in previous studies, *variance preference* was significantly correlated with *risky personality*, $r = .241$, $p < .001$, indicating that a general preference for variable outcomes is associated with risky personality traits. This provides further evidence for the generality of risk hypothesis.

Decision-Making under Need: VPN

A sex (male, female) × need (-2EV, -1EV, 0EV, +1EV, +2EV) × PGSI group (non-problem, low-risk, moderate, problem gambling) mixed ANCOVA was conducted on proportion of risky decisions made in the VPN. Covariates were the *risky personality* factor, and the *variance preference* composite measure. A main of effect of need on the proportion of risky decisions made in the VPN was obtained, $F(4, 1252) = 13.59$, $p < .001$, $\eta^2 = .041$ ($M_{-2EV} = .31$, $M_{-1EV} = .34$, $M_{0EV} = .33$, $M_{+1EV} = .37$, $M_{+2EV} = .43$), indicating that participants made a significantly higher proportion of risky decisions in conditions of higher need, *linear contrast*, $F(1,313) = 27.32$, $p < .001$, $\eta^2 = .081$. No significant main effects of sex, $F(1, 313) = .17$, $p = .68$, $\eta^2 < .001$, or PGSI category, $F(3, 313) = .1.46$, $p = .23$, $\eta^2 = .013$, were observed. All two and three-way interactions were tested, with none significant (all Fs < 2.40, ps > .19). None of the covariates were significant. The results are summarized in Figure 2.

Together, these results provide further evidence suggesting that people make risk-sensitive decisions independent of individual differences in personality traits associated with risk, general variance preference. The results indicate that people appear to make risk-sensitive decisions largely based on the perception of immediate environmental cues of need, and not based on stable individual differences in patterns of behavior.

Decision-Making Under Need: ECO

A sex (male, female) × need (high, low) × PGSI group (non-problem, low-risk, moderate, problem gambling) mixed ANCOVA was conducted on proportion of risky decisions made in the ECO. Covariates were the *risky personality* factor, and the *variance preference* composite measure. A main effect of need was obtained for proportion of risky decisions made in the ECO, $F(1, 313) = 29.51$, $p < .001$, $\eta^2 = .09$. A significantly higher proportion of risky choices were made in the high need condition compared to the low need condition, $M_{high} = .53$, $M_{low} = .39$. A significant main effect of sex was observed, $F(1, 313) = 5.97$, $p = .02$, $M_{men} = .44$, $M_{women} = .52$. Oddly, women were more likely than men to prefer high-risk options across both need conditions, running contrary to previous findings. No main effect of PGSI group was observed, $F(3, 313) = 1.82$, $p = .14$. All two and three-way interactions were tested, with none significant (all Fs < 2.06, ps > .11). None of the covariates were significant. These results are summarized in Figure 3.

Together, these results suggest that in the ECO, participants made adaptive, risk-sensitive decisions independent of personality traits associated with risk-taking, and general variance preference. These results are quite significant, in that they indicate that risk-sensitive decision-making in the ECO is largely contingent on perception and response to environmental cues of need, and not on stable individual differences.

Decision-Making under Need: GDT

The GDT was constructed identically to the ECO, with one difference: Instead of making decisions about foraging from trees regarding hypothetical survival, the GDT involved drawing from different decks of cards and making decisions based on a point threshold that resulted in a payout. All decisions were mathematically identical. As a consequence, the only thing that differed between the ECO and the GDT was contextualization in terms of gambling.

A sex (male, female) × need (high, low) × PGSI group (non-problem, low-risk, moderate, problem gam-

bling) mixed ANCOVA was conducted on proportion of risky decisions made in the GDT. Covariates were the *risky personality* factor, and the *variance preference* composite measure. A main effect of need was obtained for proportion of risky decisions made in the GDT, $F(1, 311) = 7.57$, $p = .006$, $\eta^2 = .023$. A significantly higher proportion of risky choices were made in the high need condition compared to the low need condition, $M_{high} = .55$, $M_{low} = .43$. No significant main effects were observed for sex, $F(1, 311) = 2.19$, $p = .14$, or PGSI category, $F(3, 311) = .485$, $p = .69$. None of the covariates were significant.

Only one of the two and three-way interactions was significant: A significant interaction between PGSI category and need was observed, $F(3, 311) = 3.57$, $p = .02$. Follow up repeated measures *t*-tests indicated that a significant difference in proportion of risky choices made in the GDT was only found in the non-problem gambler category, $t(163) = 6.05$, $p < .001$, $r = .43$, $M_{high} = .56$, $M_{low} = .39$. Among low-risk gamblers, moderate gamblers, and problem gamblers, however, no significant differences in risky choice were observed across need conditions; low-risk gamblers: $t(86) = 1.30$, $p = .20$, $r = .14$, $M_{high} = .54$, $M_{low} = .49$, moderate gamblers: $t(41) = 1.67$, $p = .10$, $r = .25$, $M_{high} = .55$, $M_{low} = .47$, problem gamblers: $t(31) = .443$, $p = .66$, $r = .08$, $M_{high} = .49$, $M_{low} = .47$. These results are summarized in Figure 4.

It is particularly interesting to note that the smallest effect size of need was observed among the problem gamblers. These results suggest that people with gambling experience, or at-risk for gambling problems, are less risk-sensitive than non-gamblers, but only in a gambling context. This interaction was not observed in the ECO or the VPN, suggesting that something about the contextualization of gambling leads to risk-*in*sensitivity among gamblers. It is possible that in a gambling context, gamblers are more driven by the possibility of reward, therefore leading them to consistently prefer high-risk options regardless of need condition. It is important to note, however, that even in gambling populations, the trend toward choosing risky options in high-need conditions across different tasks was observed, suggesting that risk-sensitivity theory is still able to account for risky choice under conditions of need, even in diverse populations. Future research will examine whether gamblers are disproportionately reward-seeking in gambling contexts compared to non-gambling contexts.

Is Relative Deprivation Associated with Gambling and Antisocial Behavior?

The results involving decision-making under conditions of need (described above) to some degree involve manipulating a perception of relative deprivation. Relative deprivation refers to the perception that one is being deprived of a deserved outcome relative to others (Callan et al., 2008). Thus, relative deprivation is a form of inequality. Need describes a condition of inequality, in that people in a condition of high need are at distance from a desired or goal state. As a consequence, the manipulations above involved inducing conditions of relative deprivation and inequality in a lab setting, with the outcome of measuring risk sensitivity.

However, a problem with this approach is its lack of external validity: Relative deprivation manifests through many different mechanisms in the real-world. As a consequence, in the following set of analyses, we examine the degree to which indicators of relative deprivation (e.g., debt level, income level, family income level) and the perception of relative deprivation (i.e., the measurement of the degree to which people perceive themselves to be relatively deprived) are associated with gambling, problem gambling, and risky behavior (here, operationalized as antisocial behavior).

Inter-correlations between measures of relative deprivation (PRDS, presence/absence of personal debt), sensitivity to justice, and measures of problem gambling (PGSI), general gambling involvement (GGI), antisocial behavior in the last year (ABY), antisocial behavior over the lifetime (ABL), and reports of having been arrested, charged, convicted, or incarcerated are shown in Table 5.

As predicted, measures of relative deprivation were significantly associated with general gambling involvement, problem gambling, and antisocial behavior. Somewhat puzzlingly, justice sensitivity was not associated with any of the measures of gambling or antisocial behavior, suggesting that it may measure a construct separate from relative deprivation.

Previous research has suggested that individual differences in personality–namely, impulsivity, sensation-seeking, and self-control–explain a large portion of the variance in general gambling involvement and problem gambling. Does the perception of relative deprivation explain engagement in general gambling or problem gambling above and beyond personal traits associated with risk-taking? To examine this possibility, measures of problem gambling (PGSI), general gambling involvement (GGI), and antisocial behavior in the last year (ABY) and over the lifetime (ABL) were regressed on two blocks of variables: (1) personality traits associated with risk-acceptance (SSS, EIS, RBS), and (2) perceptions of relative deprivation.

Problem gambling. Personality traits associated with risk-acceptance significantly predicted problem gambling as measured by the PGSI, adjusted R^2 = .230, p < .001 (significant predictors: impulsivity, β = .145, p = .013; low self-control, β = .428, p < .001). Personal relative deprivation significantly added to the variance explained, R^2 *change* = .008, p = .05 (PRDS, β = .276, p = .06). These results provide some evidence suggesting that the perception of relative deprivation explains problem gambling tendencies beyond personality traits associated with risk-taking.

General gambling involvement. Personality traits associated with risk-acceptance significantly predicted general gambling involvement as measured by the PGSI, adjusted R^2 = .099, p < .001 (significant predictors: impulsivity, β = .159, p = .012; low self-control, β = .144, p < .03). Personal relative deprivation did not significantly add to the variance explained (PRDS, β = .042, p = .45).

Antisocial behavior in the last year. Personality traits associated with risk-acceptance significantly predicted antisocial behavior in the last year, adjusted R^2 = .317, p < .001 (significant predictors: sensation-seeking, β = .323, p < .001; low self-control, β = .354, p < .001). Personal relative deprivation did not significantly add to the variance explained (PRDS, β = .028, p = .56).

Antisocial behavior over the lifetime. Personality traits associated with risk-acceptance significantly predicted antisocial behavior over the lifetime, adjusted R^2 = .671, p < .001 (significant predictors: sensation-seeking, β = .223, p < .001; low self-control, β = .733, p < .001). Personal relative deprivation did not significantly add to the variance explained (PRDS, β = -1.20, p = .23).

Together, the results suggest that although the perception of relative deprivation is significantly correlated with all forms of gambling and antisocial behavior, it only explains unique variance in problem gambling above and beyond established risky personality correlates. Perceived relative deprivation and risky personality were significantly correlated, r = .241, p < .001, however, hinting that the perception of relative deprivation and possessing risky personality traits may be consequences of similar developmental or environmental processes. To examine this possibility, in the next section, we examine the degree to which early instigative and protective factors (e.g., social support, parental stability, childhood unpredictability, mental illness, intelligence, etc.) are associated with gambling, risk-taking, and the perception of relative deprivation.

Are Instigative and Protective Factors Associated with Risky Personality, Gambling, and the Perception of Relative Deprivation?

The analyses in the previous section suggested that gambling tendencies and problem gambling may not necessarily be a consequence of the experience of relative deprivation. Rather, it is possible that both gambling tendencies and the perception of relative deprivation are analogous outcomes of similar developmental and environmental processes. Similarly, personality traits that have been consistently associated with gambling behavior (impulsivity, sensation-seeking, low self-control) may also be products of similar developmental and environmental processes. To test this possibility, we examined the degree to which common developmental and environmental risk factors explain variance in gambling, the perception of relative deprivation, and risky personality.

Inter-correlations between gambling (GGI, PGSI), the perception of relative deprivation (PRDS), risky personality, and various developmental instigative and protective factors associated with gambling (mental illness, parental divorce, familial unpredictability during childhood, intelligence, social support) were conducted (Table 6). Correlations are presented between these instigative/protective factors measured individually, and as measured by the CPGI risk factor subscale. The results clearly indicate that various developmental risk factors are associated with not only gambling and problem gambling, but also risky personality and personal relative deprivation, providing some preliminary evidence that these developmental/environmental factors similarly facilitate gambling and risk-taking outcomes, as well as the perception of relative deprivation.

To examine the degree to which individual risk factors predict problem gambling, general gambling involvement, and perceived personal relative deprivation, these variables were regressed on the individual instigative factors: mental illness diagnosis, mental health inventory, parental divorce, family unpredictability, social support, and intelligence.

Problem gambling. Overall, individual instigative factors were significantly predictive of problem gambling, adjusted R^2 = .142, p < .001. Mental illness diagnosis, β = .297, p < .001, and intelligence, β = -.199, p < .001, were significant individual predictors.

General gambling involvement. Overall, individual instigative factors were significantly predictive of general gambling involvement, adjusted R^2 = .032, p = .01. No individual predictors were significant, but intelligence, β = -.104, p = .06, and parental divorce, β = .103, p = .07, were marginally significant.

Personal relative deprivation. Overall, individual instigative factors were significantly predictive of self-reported personal relative deprivation, adjusted R^2 = .273, p < .001. Mental illness diagnosis, β = .109, p = .04, the mental health inventory, β = .227, p < .001, social support, β = -.235, p < .001, intelligence, β = -.164, p = .001, and parental divorce, β = .096, p = .05, were all significant predictors.

Risky personality. Overall, individual instigative factors were significantly predictive of risky personality, adjusted R^2 = .056, p = .001. Family unpredictability was a significant individual predictor, β = .136, p -= .03. Parental divorce, β = .106, p = .06, and the mental health inventory, β = -.101, p = .09, were marginally significant predictors.

Together, these results suggest that gambling and problem gambling, relative deprivation, and risky personality share some common developmental and environmental determinants. Personal relative deprivation was robustly predicted by a wide array of instigative developmental variables, whereas and problem gambling, general gambling involvement, and risky personality had more specific predictors. Further research is required to examine the etiological pathway and interrelationships between these variables. However, it is clear that similar developmental/environmental instigative factors similarly facilitate the perception of relative deprivation, gambling, and risky personality.

LIMITATIONS

One of the most interesting findings of this study is the fact that problem gambling had little effect on participants' decision-making under conditions of need (except in the gambling-specific GDT). Risk-sensitivity theory suggests that people are adaptive decision-makers, favoring risky options in situations of high need. Need constraints should necessarily motivate people to be risk-sensitive; it would be costly to be unnecessarily risk-prone, for example, or unnecessarily risk-averse. In this sense, gamblers are "rational" decision-makers in conditions of need, except in gambling-specific contexts (where problem gamblers have a specific deficit or pathology). This result suggests that problem gamblers may have a specific impairment for risk-sensitivity only in the gambling domain, and not more generally. It is somewhat surprising that problem gambling did not have more of an effect on decision-making, but it is

consistent with risk-sensitivity theory that all people, including gamblers, are sensitive to conditions of need.

Bivariate correlations showed that feelings of relative deprivation were associated with both problem gambling and general gambling involvement. However, regression analyses showed that above and beyond individual differences in risky personality (impulsivity, sensation-seeking, low self-control), relative deprivation explained significant variance only in problem gambling tendencies. These results suggest that relative deprivation may be more important in facilitating problem gambling behavior than for gambling more generally. Alternatively, it is possible that problem gamblers experience instigative factors (both personal and situational) that are likely to give rise to greater feelings of personal relative deprivation. Yet another explanation is that problem gambling gives rise of greater feelings of relative deprivation, perhaps because of repeated loss of money and greater levels of debt. Our results cannot distinguish the direction of causality between relative deprivation and gambling behavior. Future experimental research is necessary to examine the causal direction between these two variables; it is likely that the causal relationship occurs in both directions.

Although the results of this study suggest that risk-sensitive decision-making in a gambling context is impaired among gamblers, it is unclear what specifically it is about gambling that causes this effect. It is possible that gambling cues change the degree to which gamblers are sensitive to rewards and costs. Gambling contexts may promote reward sensitivity among experience gamblers. Gambling may also change participants' perception of the distribution of possible outcomes, shifting them towards risk-proneness (e.g., if memories of past gains loom large). Alternatively, gambling cues may deplete self-control, leading to risk-taking behavior. Future research should examine what cognitive mechanisms give rise to this impairment of risk-sensitivity in gambling contexts.

SUMMARY AND IMPLICATIONS

This study broadly sought to examine the degree to which relative deprivation and conditions of need were associated with elevated gambling and risky behavior. The first portion of this study demonstrated that general gambling involvement and problem gambling tendencies are significantly associated with behavioral measures of risk preference, as well as antisocial behavior and personality traits associated with risk. These findings replicate previous research indicating that gambling is a form of risk-taking (e.g., Kassinove, 1998; Martins, et al., 2004; Mishra et al., 2010; Powell et al., 1999; Vitaro, Brendgen, Ladouceur, & Tremblay, 2001).

Because gambling is a form of risk-taking, the predictions of risk-sensitivity theory—that is, people should prefer high-risk options in situations of need, where low-risk options are not sufficient—should hold when explaining patterns of engagement in gambling behavior. Previous research has shown that problem gamblers tend to engage in persistent risk-accepting behavior in various domains (reviewed in Mishra, Lalumière, & Williams, 2011; Mishra, Lalumière, Morgan, & Williams, 2011). Some have characterized this pattern of persistent risk-acceptance as a consequence of stable personality traits such as impulsivity, sensation-seeking, or low self-control. An alternative explanation is that problem gamblers and other persistent risk-takers are consistently exposed to environments and cues of high need, leading to engagement in risk-taking behavior. If this latter characterization is true, then conditions of need induced in a laboratory environment should facilitate elevated risk-taking behavior. Furthermore, the perception of relative deprivation, or need, should predict engagement in gambling, problem gambling, and other forms of risk-taking.

In this study, we found compelling support for the latter hypothesis. In two different lab-based decision-making scenarios reflecting both explicit (VPN) and implicit decision-making (ECO), all participants, including problem gamblers, exhibited significantly higher risk-acceptance in situations of high need, and lower risk-acceptance in low need conditions, consistent with risk-sensitivity theory. This finding is very important, in that it demonstrates that risk-sensitive decision-making is not "broken" among participants with problem gambling tendencies. However, a notable exception to this pattern of results was

observed in a third decision-making task that was presented in a gambling context (the gambling decision task; GDT). The GDT was mathematically and structurally identical to the implicit ECO decision-making task, except that it required participants to learn and make decisions involving drawing from hypothetical decks of cards (instead of trees providing a certain number of apples, as in the ECO foraging analogue).

In this explicit gambling context, only non-problem gamblers exhibited risk preferences consistent with risk-sensitivity theory. Gamblers showed risk-*in*sensitive decision-making in the GDT, with no statistical difference observed in their preference for risky outcomes, regardless of induced condition of need. This result suggests that contextualizing decision-making under need in the gambling domain leads to patterns of risk-acceptance that are no longer risk-sensitive. These findings have some significant implications.

Previous research has shown that teaching gamblers about the mathematics of gambling does not lead to changes in gambling behavior (Williams & Connolly, 2006). Other evidence indicates that pathological gamblers do not have poorer knowledge of gambling odds, or limited numerical ability (Lambos & Delfabbro, 2007). Decision-making in the VPN and the ECO in the present study similarly suggest that gamblers do not have a general decision-making impairment, in that they were just as risk-sensitive as non-gambling participants. Engaging in a gambling task, however, may cognitively impair mathematical reasoning, at least temporarily, perhaps through greater sensitivity to rewards (and diminished sensitivity to punishment). It is possible that gamblers are driven by the possibility of reward, ignoring the potential costs of risky behavior in specific environments of low need. We will be conducting further research on this topic to examine the degree to which reward-sensitivity drives risk-acceptance in gambling contexts.

In addition to experimentally manipulating the perception of need, this study also examined the degree to which natural variation in the perception of relative deprivation is associated with gambling and antisocial behavior. Results indicated that relative deprivation is robustly associated with general gambling involvement, as well antisocial behavior measured in several ways (antisocial behavior in the last year, over the lifetime, and history of arrests, criminal charges, convictions, and incarceration). Subsequent regression analyses indicated that perceived relative deprivation explained a significant amount of variance in problem gambling above and beyond personality traits associated with risk-acceptance. Perceived relative deprivation did not significantly predict engagement in general gambling or antisocial behavior above and beyond known personality correlates, suggesting that personal relative deprivation may play a unique role in facilitating problem gambling. Future interventions for problem gambling may benefit from targeting environmental conditions associated with personal relative deprivation. It should be noted, however, that perceived deprivation may also be a consequence of problem gambling.

Finally, we examined the degree to which gambling tendencies, the perception of relative deprivation, and personality traits associated with risk-taking are analogous outcomes of similar developmental and environmental processes. The results of several multiple regressions suggested that personal relative deprivation was predicted by a wide array of instigative developmental and personal variables (e.g., mental illness diagnosis, parental divorce, family unpredictability during childhood, social support, and intelligence). Gambling, problem gambling, and risky personality were less robustly predicted by a wide array of factors. Future research is required to more closely examine the specific environmental and developmental pathways of gambling, problem gambling, and correlated behaviors and risk-factors associated with gambling behavior.

Together, the results of this study support the hypothesis that gambling and risky behavior are immediate or current responses to situations presenting cues of relative deprivation and high need. This finding suggests that reductions in problem gambling would likely be observed by changing gamblers' situations of need, thereby altering the cost-benefit structure of risky behavior and gambling. This study further suggests some of the variables that contribute to the perception of need, namely instigative developmental and environmental factors such as mental illness diagnosis, general mental health, social

support, intelligence, and parental divorce. Aiming to (1) preventatively target early instigative factors associated with need and personal relative deprivation, and (2) change immediate social and environmental conditions facilitating the perception of need, may have some important implications for reducing engagement in gambling, problem gambling, and risky behavior more generally.

TABLES

Table 1. Participant distribution by personal and household income in the last year.

Personal Income (Last Year)	Proportion	Household Income (Last Year)	Proportion
< $10,000	39.6%	< $10,000	16.5%
$10,001 - $20,000	29.6%	$10,001 - $20,000	15.5%
$20,001 - $30,000	13.2%	$20,001 - $30,000	11.4%
$30,001 - $40,000	6.9%	$30,001 - $40,000	7.6%
$40,001 - $50,000	3.8%	$40,001 - $50,000	5.7%
$50,001 - $75,000	4.1%	$50,001 - $75,000	13.9%
$75,001 - $100,000	1.3%	$75,001 - $100,000	13.3%
$100,000+	1.6%	$100,000+	16.1%

Table 2. Participant employment status.

Employment Status	Proportion
Full-Time	15.5%
Part-Time	31.4%
Unemployed	23.2%
Homemaker	3.0%
Retired	4.9%
Student	21.0%

Table 3. Descriptive statistics for key measures.

	Mean	Std. Dev.
PGSI	2.28	4.42
GGI	0.00	1.68
EIS	8.25	4.85
SSS	20.95	6.76
RBS	368.37	62.18
DOS	107.42	21.34
ABY	0.00	2.42
ABL	0.00	2.72
CT	2.45	1.81
BART	41.10	16.40
FD	.00	1.00
PRDS	12.13	4.90
JSS	32.09	7.65
MHI5	13.93	4.56
RFUS	2.46	0.69
MSPSS	62.52	15.16
IQ	6.66	1.81

Note: PGSI = problem gambling; GGI = general gambling involvement (summed z-scores); EIS = impulsivity; SSS = sensation-seeking; RBS = low self-control; DOS = domain-specific risk-taking; ABY = antisocial behavior in last year (summed z-scores); ABL = antisocial behavior over the lifetime (summed z-scores); CT = choice task; BART = balloon analogue risk taking; FD = future discounting component; PRDS = personal relative deprivation scale; JSS = justice sensitivity scale; MHI5 = mental health inventory; RFUS = retrospective family unpredictability; MSPSS = social support; IQ = intelligence.

Table 4. Intercorrelations between risk measures.

	GGI	EIS	SSS	RBS	DOS	ABY	ABL	CT	BART	FD
PGSI	**.463**	**.351**	**.107**	**.463**	**.207**	**.308**	**.296**	**.192**	-.081	**.209**
	(.00)	**(.00)**	**(.05)**	**(.00)**	**(.00)**	**(.00)**	**(.00)**	**(.00)**	(.14)	**(.00)**
GGI		**.270**	**.211**	**.279**	**.295**	**.294**	**.237**	**.205**	-.009	**.196**
		(.00)	**(.00)**	**(.00)**	**(.00)**	**(.00)**	**(.00)**	**(.00)**	(.88)	**(.00)**
EIS			**.283**	**.551**	**.320**	**.282**	**.412**	**.189**	-.078	**.176**
			(.00)	**(.00)**	**(.00)**	**(.00)**	**(.00)**	**(.00)**	(.16)	**(.00)**
SSS				**.417**	**.710**	**.471**	**.515**	**.146**	**.231**	.084
				(.00)	**(.00)**	**(.00)**	**(.00)**	**(.01)**	**(.00)**	(.16)
RBS					**.496**	**.487**	**.795**	**.148**	.040	**.161**
					(.00)	**(.00)**	**(.00)**	**(.01)**	(.47)	**(.01)**
DOS						**.537**	**.544**	**.212**	**.209**	.091
						(.00)	**(.00)**	**(.00)**	**(.00)**	(.12)
ABY							**.584**	**.205**	.047	**.187**
							(.00)	**(.00)**	(.40)	**(.00)**
ABL								**.165**	.132	**.139**
								(.00)	(.02)	**(.02)**
CT									**.129**	.061
									(.02)	(.30)
BART										**-.142**
										(.02)

Note: Correlations in bold are significant at p < .05. P-values are provided in brackets (.00 indicates *p <* .01*). PGSI = problem gambling; GGI = general gambling involvement; EIS = impulsivity; SSS = sensation-seeking; RBS = low self-control; DOS = domain-specific risk-taking; ABY = antisocial behavior in last year; ABL = antisocial behavior over the lifetime; CT = choice task; BART = balloon analogue risk taking; FD = future discounting component .*

Table 5. Intercorrelations between gambling, antisocial behavior, and relative deprivation.

	GGI	PRDS	JSS	Debt	ABY	ABL	Arrest	Charge	Convicted	Incarcerated
PGSI	**.463**	**.253**	.074	**.134**	**.308**	**.296**	**.335**	**.360**	**.316**	**.280**
	(.00)	**(.00)**	(.18)	**(.02)**	**(.00)**	**(.00)**	**(.00)**	**(.00)**	**(.00)**	**(.00)**
GGI		**.143**	.004	.063	**.294**	**.237**	**.131**	**.159**	**.135**	**.174**
		(.01)	(.94)	(.26)	**(.00)**	**(.00)**	**(.02)**	**(.00)**	**(.02)**	**(.00)**
PRDS			**.289**	**.204**	**.156**	**.184**	**.214**	**.200**	**.204**	**.207**
			(.00)	**(.00)**	**(.01)**	**(.00)**	**(.00)**	**(.00)**	**(.00)**	**(.00)**
JSS				.080	.082	.065	-.037	-.031	-.038	-.008
				(.15)	(.14)	(.24)	(.51)	(.57)	(.50)	(.89)
Debt					**.135**	**.158**	.083	.075	.080	.066
					(.02)	**(.01)**	(.14)	(.18)	(.15)	(.24)
ABY						**.584**	**.279**	**.250**	**.263**	**.313**
						(.00)	**(.00)**	**(.00)**	**(.00)**	**(.00)**
ABL							**.608**	**.585**	**.564**	**.527**
							(.00)	**(.00)**	**(.00)**	**(.00)**
Arrested								**.910**	**.880**	**.717**
								(.00)	**(.00)**	**(.00)**
Charged									**.906**	**.751**
									(.00)	**(.00)**
Convicted										**.775**
										(.00)

Note: Correlations in bold are significant at p < .05. P-values are provided in brackets (.00 indicates *p <* .01*). PGSI = problem gambling; GGI = general gambling involvement; JSS = justice sensitivity; Debt = personal debt (yes/no); ABY = antisocial behavior in the last year; ABL = antisocial behavior over the life-time; Arrest (ever been arrested? Yes/no); Charge (ever been charged with a crime? Yes/no); Convicted (ever been convicted of a crime? Yes/no); Incarcerated (ever been incarcerated for a crime? Yes/no).*

Table 6. Intercorrelations between gambling, problem gambling, relative deprivation, and instigative factors.

	GGI	RP	PRDS	MID	MHI5	PD	RFUS	MSPSS	IQ	CPGI-R
PGSI	**.463**	**.359**	**.253**	**.324**	**.161**	.039	.047	**-.169**	**-.200**	**.540**
	(.00)	**(.00)**	**(.00)**	**(.00)**	**(.00)**	(.48)	(.40)	**(.00)**	**(.00)**	**(.00)**
GGI		**.341**	**.143**	.079	**.109**	**.132**	.095	**-.147**	**-.109**	**.366**
		(.00)	**(.01)**	(.16)	**(.05)**	**(.02)**	(.09)	**(.01)**	**(.05)**	**(.00)**
RP			**.117**	**.117**	**.158**	**.163**	**.198**	**-.166**	-.048	**.530**
			(.04)	**(.04)**	**(.00)**	**(.00)**	**(.00)**	**(.00)**	(.38)	**(.00)**
PRDS				**.267**	**.375**	**.187**	**.274**	**-.404**	**-.189**	**.352**
				(.00)	**(.00)**	**(.00)**	**(.00)**	**(.00)**	**(.00)**	**(.00)**
MID					**.276**	**.195**	**.127**	**-.279**	-.009	**.345**
					(.00)	**(.00)**	**(.02)**	**(.00)**	(.87)	**(.00)**
MHI5						.086	**.172**	**-.338**	-.060	**.256**
						(.12)	**(.00)**	**(.00)**	(.28)	**(.00)**
PD							**.200**	**-.156**	-.032	**.272**
							(.00)	**(.01)**	(.57)	**(.00)**
RFUS								**-.440**	-.052	**.265**
								(.00)	(.35)	**(.00)**
MSPSS									.029	**-.350**
									(.60)	**(.00)**
IQ										**-.135**
										(.01)

Note: Correlations in bold are significant at p < .05. P-values are provided in brackets (.00 indicates *p* < .01*). PGSI = problem gambling; GGI = general gambling involvement; RP = risky personality; PRDS = perceived personal relative deprivation; MID = mental illness diagnosis (never/past/current); MHI-5 = mental health inventory; PD = parental divorce; RFUS = retrospective family unpredictability; MSPSS = perceived social support; IQ = intelligence; CPGI-R = CPGI risk-factors subscale.*

FIGURES

Figure 1. Distribution of personal relative deprivation scores.

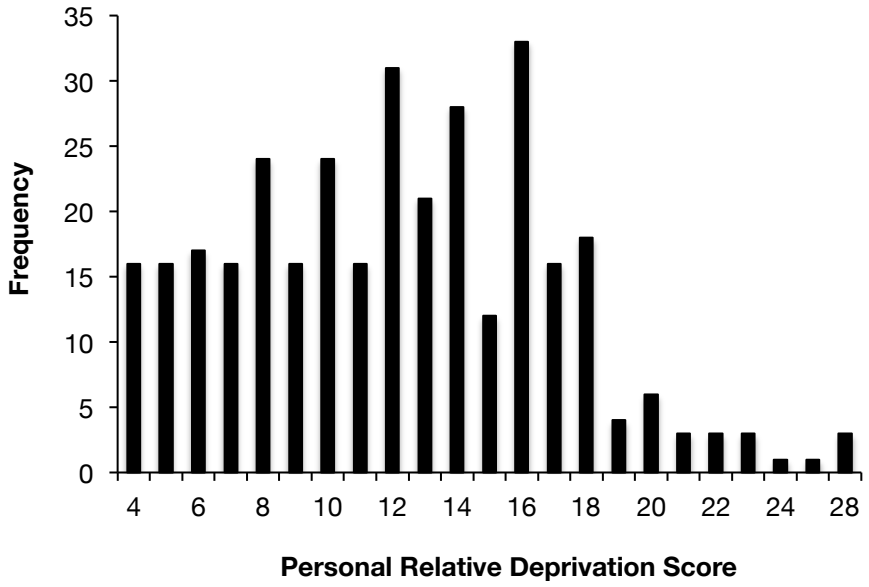


Figure 2. Interaction between need condition and problem gambling category in the VPN. All data are unadjusted for covariates.

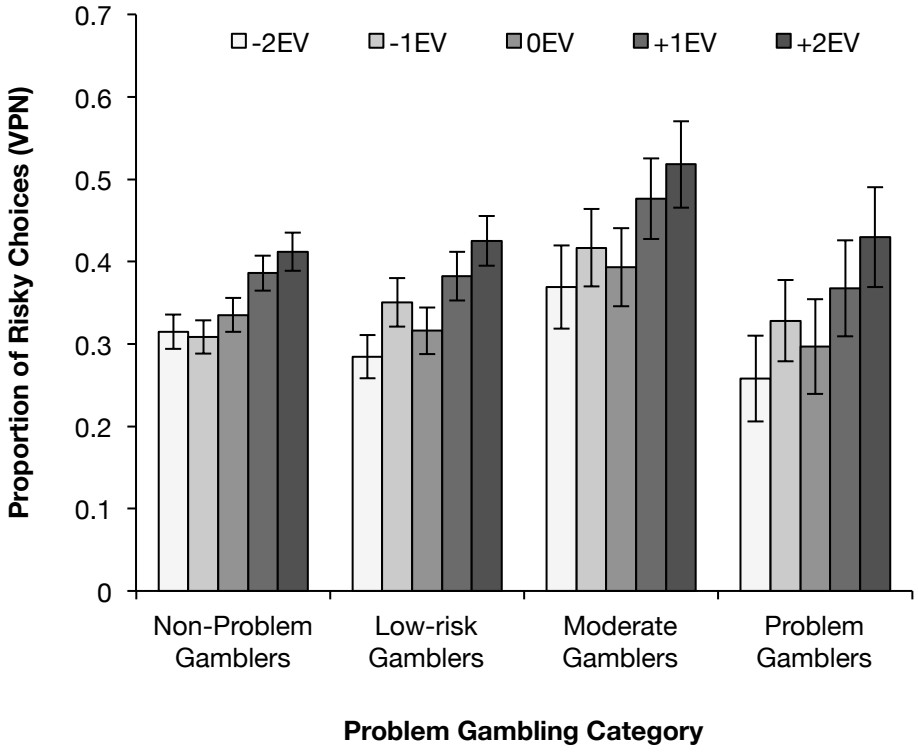


Figure 3. Interaction between need condition and problem gambling category in the ECO. All data are unadjusted for covariates.

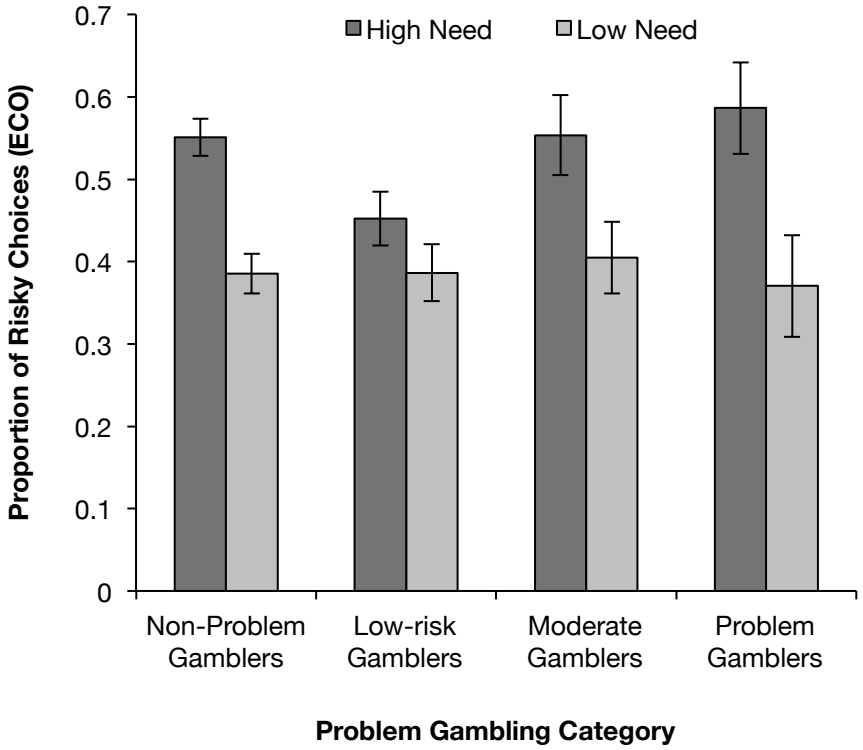
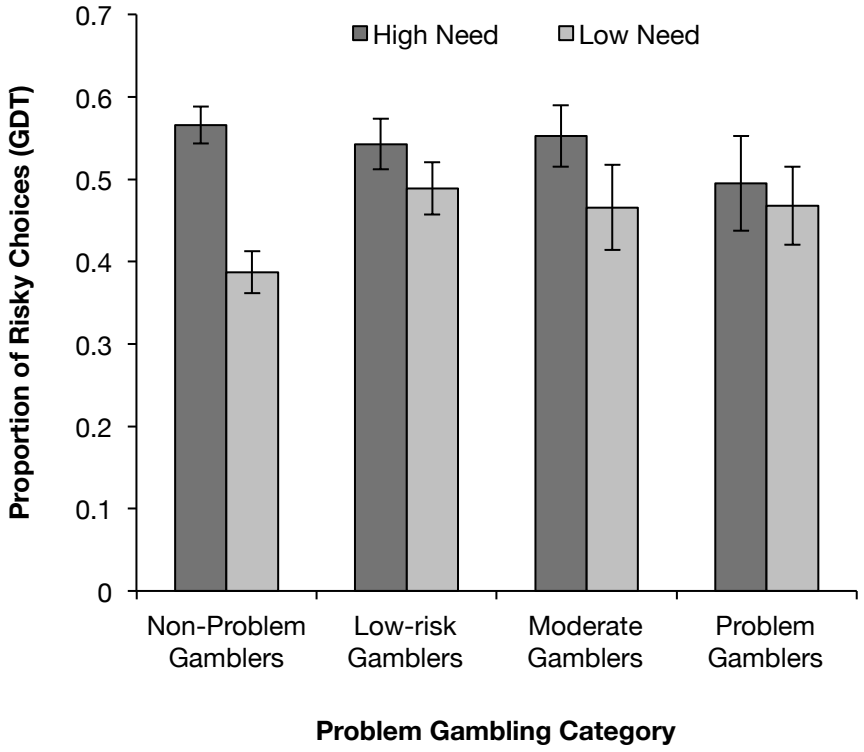


Figure 4. Interaction between need condition and problem gambling category in the GDT. All data are unadjusted for covariates.



REFERENCES

Baron, E., & Dickerson, M. (1999). Alcohol consumption and self–control of gambling behaviour. *Journal of Gambling Studies*, *15*, 3–15.

Blaszczynski, A., Steel, Z., & McConaghy, N. (1997). Impulsivity in pathological gambling: The antisocial impulsivist. *Addiction, 92,* 75-87.

Berwick, D. M., Murphy, J. M., Goldman, P. A., Ware, J. E., Barsky, A. J., & Weinstein, M. C. (1991). Performance of a five-item mental health screening test.

Callan, M. J., Ellard, J. H., Shead, N. W., & Hodgins, D. C. (2008). Gambling as a search for justice: Examining the role of personal relative deprivation in gambling urges and gambling behaviour. *Social Psychology and Personality Bulletin*, *34*, 1514-1529.

Clarke, D. (2004). Impulsivity, locus of control, motivation, and problem gambling. *Journal of Gambling Studies*, *4*, 319–345.

Cloninger, C. R. (1987). A systematic method for clinical description and classification of personality variants. *Archives of General Psychiatry*, *44*, 573–588.

Corless, T., & Dickerson, M. (1989). Gamblers' self–perceptions of the determinants of impaired control. *British Journal of Addiction*, *84*, 1527–1537.

Daly, M., & Wilson, M. (2001). Risk taking, intrasexual competition, and homicide. *Nebraska Symposium on Motivation, 47,* 1–36.

Eysenck, S. B. G., Pearson, P. R., Easting, G., & Allsopp, J. F. (1985). Age norms for impulsiveness, venturesomeness and empathy in adults. *Personality and Individual Differences*, *6*, 613–619.

Ferris, J., Wynne, H., & Single, E. (1999). *Measuring problem gambling in Canada: Final report* (Submitted to the Canadian Centre on Substance Use). Ottawa, Ontario: Canadian

Ferris, J., & Wynne, H. (2001). *The Canadian Problem Gambling Index: Final Report* (Submitted to the Canadian Centre on Substance Abuse). Ottawa, Ontario: Canadian Centre on Substance Abuse.

Fessler, D. M. T., Pillsworth, E. G., & Flamson, T. J. (2004). Angry men and disgusted women: An evolutionary approach to the influence of emotions on risk–taking. *Organizational Behaviour and Human Decision Processes*, *95*, 107–123.

Franken, I. H. A., van Strien, J. W., Nijs, I., & Muris, P. (2008). Impulsivity is associated with behavioral decision–making deficits. *Psychiatry Research*, *158*, 155–163.

Freeman, N., & Muraven, M. (2010). Self–control depletion leads to increased risk taking. *Social Psychological and Personality Science*, *1*, 175–181.

Griffiths, M., & Delfabbro, P. (2001). The biopsychosocial approach to gambling: Contextual factors in research and clinical interventions. *Journal of Gambling Issues*, *5*.

Hammelstein, P. (2004). Faites vos jeux! Another look at sensation seeking and pathological gambling. *Personality and Individual Differences*, *37*, 917–931.

Kassinove, J. (1998). Development of the gambling attitude scales: Preliminary findings. *Journal of Clinical Psychology, 54*, 763-771.

Kausch, O., Rugle, L., & Rowland, D. Y. (2006). Lifetime histories of trauma among pathological gamblers. *American Journal on Addictions*, *15*, 35-43.

Kirby, K. N., Petry, N. M., & Bickel, W. K. (1999). Heroin addicts have higher discount rates for delayed rewards than non–drug–using controls. *Journal of Experimental Psychology: General*, *128*, 78–87.

Lambos, C., & Delfabbro, P. (2007). Numerical reasoning ability and irrational beliefs in problem gambling. *International Gambling Studies*, *7*, 157-171.

Langewisch, M. W. J., & Frisch, G. R. (1998). Gambling behaviour and pathology in relation to impulsivity, sensation seeking, and risky behaviour in male college students. *Journal of Gambling Studies, 14*, 245–262.

Lejuez, C. W., Read, J. P., Wahler, C. W., Richards, J. B., Ramsey, S. E., Stuart, G. L., et al. (2002). Evaluation of a behavioral measure of risk–taking: The Balloon Analogue Risk Task (BART). *Journal of Experimental Psychology: Applied*, *8*, 75–84.

Marcus, B. (2003). An empirical examination of the construct validity of two alternative self-control measures. *Educational and Psychological Measurement, 63,* 674-706.

Martins, S. S., Tavares, H., da Silva Lobo, D. S., Galetti, A. M., & Gentil, V. (2004). Pathological gambling, gender, and risk-taking behaviors. *Addictive Behaviors, 29,* 1231-1235.

Mishra, S., & Fiddick, L. (2012). Beyond gains and losses: The effect of need on risky choice in framed decisions*. Journal of Personality and Social Psychology*, *102*, 1136-1147*.*

Mishra, S., Gregson, M., & Lalumière, M. L. (2012). Framing effects and risk-sensitive decision-making*. British Journal of Psychology*, *103*, 83-97.

Mishra, S., & Lalumière, M. L. (2008). Risk taking, antisocial behavior, and life histories. In J. Duntley & T. K. Shackelford (Eds.), *Evolutionary forensic psychology: Darwinian foundations of crime and law* (pp. 176–197). New York: Oxford University Press.

Mishra, S., & Lalumière, M. L. (2009). Is the crime drop of the 1990s in Canada and the USA associated with a general decline in risky and health-related behaviors? *Social Science and Medicine*, *68*, 39–48.

Mishra, S., & Lalumière, M. L. (2010). You can't always get what you want: The motivational effect of need on risk-sensitive decision-making. *Journal of Experimental Social Psychology*, *46*, 605–611.

Mishra, S., & Lalumière, M. L. (2011). Individual differences in risk-propensity: Associations between personality and behavioral measures of risk. *Personality and Individual Differences*, *50*, 869–873.

Mishra, S., Lalumière, M. L., Morgan, M., & Williams, R. J. (2011). An examination of the relationship between gambling and antisocial behavior. *Journal of Gambling Studies*, *27*, 409–426*.*

Mishra, S., Lalumière, M. L., & Williams, R. J. (2010). Gambling as a form of risk-taking: Individual differences in personality, behavioral preferences for risk, and risk-accepting attitudes. *Personality and Individual Differences*, *49*, 616–621.

Moffitt, T. E., & Silva, P. A. (1988). Self-reported delinquency: Results from an instrument for New Zealand. *Australia and New Zealand Journal of Criminology*, *21*, 227-240.

Myrseth, H., Pallesen, S., Molde, H., Johnsen, B. H., & Lorvik, I. M. (2009). Personality factors as predictors of pathological gambling. *Personality and Individual Differences*, *47*, 933–937.

Nower, L., Derevensky, J. L., & Gupta, R. (2004). The relationship of impulsivity, sensation-seeking, coping and substance use in youth gamblers. *Psychology of Addictive Behaviours*, *18*, 49-55.

Powell, J., Hardoon, K., Derevensky, J. L., & Gupta, R. (1999). Gambling and risk-taking behavior among university students. *Substance Use & Misuse, 34,* 1167-1184.

Rode, C., Cosmides, L., Hell, W., & Tooby, J. (1999). When and why do people avoid unknown probabilities in decisions under uncertainty? Testing some predictions from optimal foraging theory. *Cognition*, *72*, 269-304.

Ross, L. T., & Hill, E. M. (2000). The family unpredictability scale: Reliability and validity. *Journal of Marriage and Family*, *62*, 549-562.

Schmitt, M., Gollwitzer, M., Maes, J., & Arbach, D. (2005). Justice sensitivity: Assessment and location in the personality space. *European Journal of Psychological Assessment*, *21*, 202–211.

Shaffer, H. J., Hall, M. N., & Vander Bilt, J. (1999). Estimating the prevalence of disordered gambling behaviour in the United States and Canada: A research synthesis. *American Journal of Public Health*, *89*, 1369-1376.

Stephens, D. W. (1981). The logic of risk-sensitive foraging preferences. *Animal Behaviour*, *29*, 628-629.

Stinchfield, R. (2004). Demographic, psychosocial, and behavioural factors associated with youth gambling and problem gambling. In Derevensky, J. L. & Gupta, R. (Eds.), *Gambling problems in youth: Theoretical and applied perspectives*. New York: Kluwer.

Toneatto, T., & Nguyen, L. (2007). Individual characteristics and problem gambling behaviour. In G. Smith, D. C. Hodgins, & R. J. Williams (Eds.), *Research and Measurement Issues in Gambling Studies*, pp. 279-303. Amsterdam: Elsevier.

Van Brunschot (2009). Gambling and risk behaviour: A literature review. *Report prepared for the Alberta Gaming Research Institute.*

Vitaro, F., Arsenault, L., & Tremblay, R. E. (1999). Impulsivity predicts problem gambling in low SES adolescent males. *Addiction, 94,* 565–575.

Vitaro, F., Brendgen, M., Ladouceur, R., & Tremblay, R. E. (2001). Gambling, delinquency, and drug use during adolescence: Mutual influences and common risk factors. *Journal of Gambling Studies, 17,* 171-190.

Weber, E. U., Blais, A. R., & Betz, N. E. (2002). A domain–specific risk–attitude scale: Measuring risk perceptions and risk behaviors. *Journal of Behavioral Decision Making, 15*, 263–290.

Welte, J. W., Barnes, G. M., Wieczorek, W. F., Tidwell, M.-C. O., & Parker, J. C. (2001). Alcohol and gambling pathology among U.S. adults: Prevalence, demographic patterns, and comborbidity. *Journal of Studies on Alcohol*, *62*, 706-712.

Williams, R. J., & Connolly, D. (2006). Does learning about the mathematics of gambling change gambling behavior? *Psychology of Addictive Behaviors*, *20*, 62–68.

Williams, R. J., Royston, J., Hagen, B. F. (2005). Gambling and problem gambling within forensic popula-

tions: A review of literature. *Criminal Justice and Behavior*, *32*, 665-689.

Williams, R. J., West, B. L., & Simpson, R. I. (2008). Prevention of problem and pathological gambling: A comprehensive review of the evidence. *Report prepared for the Ontario Problem Gambling Research Centre*.

Wilson, M., & Daly, M. (1985). Competitiveness, risk-taking, and violence: The young male syndrome. *Ethology and Sociobiology, 6*, 59–73.

Wilson, M., & Daly, M. (1997). Life expectancy, economic inequality, homicide and reproductive timing in Chicago neighbourhoods. *British Medical Journal, 314*, 1271–1274.

Zimet, G. D., Dahlem, S. G., & Farley, G. K. (1988). The multidimensional scale of perceived social support. *Journal of Personality Assessment*, *52*, 30-41.

Zuckerman, M. (1994). *Behavioural expressions and biosocial bases of sensation seeking*. Cambridge: Cambridge University Press.

Zuckerman, M. (2007). *Sensation seeking and risky behavior.* Washington, DC: American Psychological Association.