RESEARCH REPORT

Gambling and Risk-Taking:

Individual Differences in Risk-Acceptance, and the Impact of Situational Factors

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This report represents a summary of the results from two Alberta Gaming Research Institute funded pilot studies. The first investigated the impact of individual differences and situational factors on gambling tendencies and risky behavior (Mishra, Lalumière, & Williams, 2006). The second looked at the relationship between delinquency and gambling behavior (Lalumière, Williams, & Morgan, 2005). This report is organized into two sections based on these two studies; under each section, several questions are addressed. Each question represents a set of results that will be submitted for publication in a peer-reviewed journal. Question four from Part I and Question one from Part II overlap in their addressing the relationship between gambling behavior and delinquent/antisocial behavior.

A portion of the work summarized here was presented at the Banff Annual Seminar in Cognitive Science (2008), and the University of Lethbridge Psychology Symposium (2008).

GENERAL SUMMARY

Part I

Gambling and Risk-Taking: Individual Differences in Risk-Acceptance and Variance Preference

The relationship of gambling and risky behavior was evaluated in a population of male and female undergraduate students. The study was conducted in two phases: the first measured risk as personality, and the second measured gambling tendencies, and risk as variance preference.

(a) Risk as conceptualized as a personality trait (e.g., impulsivity) was positively and significantly correlated with risk conceptualized as variance preference. Individuals who exhibited high scores on personality measures assessing attraction to risk tended to also exhibit high scores on measures that measured risk as variance preference.
(b) In both explicit and implicit risky decision making tasks, participants tended to make the 'rational' decision under conditions of need.
(c) In a task that evaluated rational decision making (i.e., choosing a risky option when it made sense to do so) risky decisions were not significantly predicted by gender, or risk-as-personality measures. Risk-as-variance measures were marginally predictive of rational decision making. The single best predictor of rational risk-sensitive decision making, however, was condition of need: Individuals in situations of high need preferred high risk options that were statistically more likely to meet their need.
(d) Risk-as-personality was significantly correlated with a measure of problem gambling (the Canadian Problem Gambling Index), and other gambling behavior (measured using the Gambling Behavior Scale). This finding suggests that risk as conceptualized as a personality trait is significantly associated with gambling tendencies and problems.
(e) Problem gambling scores showed no significant relationship with any measures of risk as variance preference, although the relationships were all in the expected positive direction.
(f) Higher levels of (non-problem) gambling behavior were associated with riskier decision making in risk-as-variance tasks.

(g) Gambling tendencies do not predict risky decision making under conditions of needs. Most participants make rational risk-sensitive decisions based on level of need, not based on risk-as-personality (which is highly associated with gambling behavior).
(h) Traits associated with antisociality and delinquency (early antisociality, low self-control) were significantly associated with both problem and non-problem gambling.

Part II

Delinquency and Gambling: A Pilot Study of their Inter-Relationship and Common Determinants

Delinquency and gambling behavior were measured for a population of male undergraduates that reported engaging in gambling behavior in the past. An experiment involving a mood manipulation (happy/neutral/sad) and a peer observer (no observer/one male/one female) was conducted to investigate the role of situational factors on gambling on a video lottery terminal.

(a) Students interested in a gambling study show a high level of gambling activities. Forty of the students met the criteria for "moderate" or "at-risk gamblers" and twelve for "severe gamblers".
(b) A simple manipulation of mood had the expected effect on mood but no effect on gambling behavior in the laboratory.
(c) The presence of a peer observer had some effect on gambling in the laboratory. Participants won more money when in the presence of a female observer than in the presence of a male or no observer (amount of money won was directly related to betting safely). Also, participants in the no observer condition played longer.
(d) Gambling behaviour reported outside of the laboratory had little connection to gambling behaviour in the laboratory. Interestingly, however, half of the problem gamblers lost all of their allocated money on the VLT; the corresponding values for non-gamblers, low-risk gamblers, and moderate gamblers were 24%, 34%, and 41%.
(e) As predicted, problem gambling is related to certain personality measures: higher impulsivity, lower self-control in childhood and adolescence, higher disinhibition, and lower thrill and adventure seeking. These personality measures had less consistent relationship with measures of gambling in the laboratory.

(f) As predicted, problem gambling is related to measures of delinquency and antisocial tendencies (psychopathy and anger).

(g) More specifically, gambling was predicted by personality measures of impulsivity and risk-taking, and antisocial tendencies did not add to this prediction. Serious delinquency in the last year was also predicted by measures of impulsivity and risk-taking, but antisocial tendencies did add significantly to the prediction.

(h) In sum, gambling and delinquency have common personality determinants, perhaps explaining why gambling problems are prevalent in forensic populations. Serious problem gamblers, however, are no more likely to engage in serious crime, unless they also possess serious antisocial tendencies.

PART I

GAMBLING AND RISK-TAKING: INDIVIDUAL DIFFERENCES IN RISK-ACCEPTANCE AND VARIANCE PREFERENCE

INTRODUCTION

Risk-taking is of great interest to researchers in several fields, including psychology, health sciences, biology, and economics. Researchers in these fields have converged on a definition of risk as outcome variance, where the riskier of two options with the same mean expected outcome is that with higher outcome variance. Gambling involves an important element of risk, in that gamblers experience highly variable returns. Therefore, to better understand gambling, one must better understand risk-taking behavior.

Several measures of individual differences in risky behavior, including sensation seeking and impulsivity, have been studied in association with gambling behavior, but the results have been mixed and inconclusive. It is presently unknown whether risky behavior is a stable personality trait, consistent across situations and contexts, or whether risky behavior varies as a function of situational and environmental factors, or a combination of both. Various conceptualizations of risk have been utilized in past research, yet no evidence exists suggesting that these different conceptualizations actually address the same risk construct. Therefore, the unclear relationship between gambling and risk-taking may be due to the fact that risk-taking itself is not clearly understood.

The theoretical framework of risk sensitive decision making, taken from behavioural ecology, provides an illuminating view of the role of variance in risky decision making. This theory posits that individuals do not seek to maximize expected utility (a positive outcome), but rather, to minimize the probability of an unfavorable outcome that fails to meet one's needs (Rode, Cosmides, Hell, & Tooby, 1999). The example of foraging decisions in birds illustrates this theoretical framework well, and has been empirically demonstrated (Charnov, 1976; Pyke, Pulliam, & Charnov, 1977). If a bird requires 1000 calories per day to survive, the bird would be risk-accepting up to that caloric consumption level because any less consumption would be fatal. If two resource patches had the same mean payoff amount (e.g., an average of 700 calories per visit), but differing payoff variance, the riskier of the two options is that with *higher variance*. Patch one's payoff may range from 600 to 800 calories (low variance), and patch two's payoff

may range from 200 to 1200 calories (high variance). The bird should choose to forage at the low variance patch by default, because it is "safe", provided that the mean amount is sufficient. If, however, the payoff needed to survive is higher than the mean (as is the case in this example), the high variance patch would be chosen. The low variance patch would not provide enough calories anyways (based on its mean), and the high variance patch at least allows for a *chance* for enough calories to be obtained. This high variance option is a "riskier" option, in that its outcome is less certain. Thus, organisms should only prefer high variance options (or be risk-accepting), when there is a *need* or an *aspiration* to be fulfilled, that cannot be fulfilled from low variance (less risky) options.

Rode et al. (1999) investigated the influence of need on risk-taking in humans using the framework of risk-sensitive decision making. In a series of experiments, they demonstrated that when presented with two options, one with high variance, and the other with low variance, people systematically choose the lower variance option, even if that option is ambiguous. This tendency was reversed, however, when participants needed to satisfy a "need" (i.e., analogous to a bird requiring a number of calories to survive) that exceeded the mean expected value of the safe, low variance option. In this case, participants chose the high variance option because of its potential high reward.

We tested two alternative theories that may explain the relationship between risk measured as a stable personality trait, risk measured as variance preference, and gambling. It may be the case that participants who score highly on personality traits that are said to be related to risk-taking, such as impulsivity, are also more likely to prefer high variance options. Alternatively, the type of risk-taking that traditional instruments measure may instead reflect a different underlying personality trait, such as extroversion, and not risk preference; in this case, we expected that risk personality traits will be unrelated to variance preference, and shifts in variance preference will only be observed when there is a clear need to be met (e.g., Rode et al., 1999). For example, a preference for "risky" activities such as bungee jumping may not actually be "risky" in the sense that there is little variance in outcome; the likelihood of an uncertain outcome is very low. Such a preference may rather reflect a personality tendency for excitement, or extroversion, independent of risk propensity in terms of high variance preference. We sought to investigate whether traditional measures of risk are truly measures of risk propensity in the variance accepting sense, or rather, a different underlying variable such as extroversion, and

whether different gambling tendencies related to risk are better conceptualized as a personality trait, or as variance preference.

METHODS

Participants

The experiment consisted of two phases. In phase I, 119 males and 121 females were recruited from psychology classes at the University of Lethbridge. Fifty-eight males and fifty-seven female participants from phase I returned to participate in phase II of the study, following an "extreme design". Those that scored highest, medium, and lowest on traditional personality-based measures of risk-taking completed measures of gambling frequency and propensity, as well as behavioural measures of risk as variance preference. Problem gamblers were not targeted, because we were interested in the natural variation of risk propensity and gambling tendencies.

Measures

Phase I

Zuckerman's Sensation Seeking Scale (SSS). The SSS is a widely used individual difference measure, measuring tendencies toward stimulating experiences and disinhibited behaviour (Zuckerman, 1994).

Eysenck Impulsiveness Scale. (EIS). The EIS is the most widely used measure of impulsivity in psychological research (Eysenck, Person, Easting, & Allsopp, 1985).

Retrospective Behavioural Self-Control Scale (RBS). Low self-control has been commonly cited as a cause of risk-taking, and gambling behaviour (Gottfredson & Hirschi, 1990). The RBS is an instrument that looks at prior behaviour across one's lifespan that can result in negative short- and long-term consequences (Marcus, 2003).

Domain-Specific Risk-Taking Scale (DOSPERT). The DOSPERT measures risk-taking in five content domains: financial (investing and gambling), health/safety, recreational, ethical and social decisions, and participants rate the likelihood of engaging in these behaviours (Weber, Blais, & Betz, 2002).

Neuroticism-Extroversion-Openness Five-Factor Inventory. The well-validated NEO-FFI assesses participants' personality traits in the factor domains of Neuroticism, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness (Costa & McCrae, 1992).

Child and Adolescent Taxon Scale (CATS-SR). The CATS-SR measures early indicators of antisocial tendencies (Lalumière, Chalmers, Quinsey, & Seto, 1996).

Phase II

Measures of Gambling Behaviour

Canadian Problem Gambling Inventory (CPGI). A short version of the CPGI was included to evaluate degree of problem gambling (Ferris & Wynne, 2001).

Gambling Behaviour Scale (GBS). The GBS measures gambling in the last month and in the last year with questions reporting gambling frequency, time, and expenditures.

Behavioural Measures of Risk and Variance Preference

The following behavioural measures of risk were presented in random order. After each task, the participant called for the experimenter, and the experimenter provided poker chips in the amount of money earned for each task (rounded up to the nearest dollar). At the end of the experiment, participants exchanged their chips for a cheque in the amount earned (from $10.50 to $106.50, with an average of $44.38).

Choice task. Adapted from Fessler, Pillsworth, & Flamson (2004) and Daly & Wilson (2001). Participants were given a series of six choices between two monetary options, one with a guaranteed smaller payout, and another with a lesser probability of receiving a greater payout. Each option had the same expected value over time. For example, would you rather choose $3.00 guaranteed, or an 10% probability of receiving $30.00?

Balloon Analogue Risk Task (BART). From Hunt, Hopko, Bare, Lejuez, & Robinson (2005). The BART is related to real-work risky behaviour, in that participants were rewarded for taking risks up to a particular point, and after this, risk-taking could result in a negative outcome. Participants pumped a computerized balloon, receiving money for each pump. If the balloon popped, participants lost all accumulated money. Participants could stop the trial at any time, receiving the amount of money earned so far. The balloon popped randomly, with an average of 65 pumps required before the balloon popped.

Variance Preference Task (VP). From Rode, Cosmides, Hell, & Tooby (1999). Participants chose between two options, both with the same expected value, but one with very high variance outcome (high risk), and one with lower variance (less risky).

Variance preference under conditions of need task (VPN). From Rode et al., (1999). This task measured participants' variance preference under conditions of need. There were two stages

to the task, and participants had to successfully meet the "need" requirements of Stage 1 in order to continue onto Stage 2, where money could be earned. Participants were given a choice between two boxes. Each choice specified the exact distribution of black and white beads in one box (low variance), but left the distribution in the second box unknown (high variance). In addition, participants were told that they needed a certain number of black beads in order to move to Stage 2. A total of 20 decision scenarios were presented. We thus tested participants' variance preference when a "need" requirement had to be met.

Ecological Variance Preference Task (ECOTASK). A "survival" scenario was constructed for this experiment. Participants imagined they were in a situation where a certain amount of resources (apples) had to be acquired within one week to survive, where a single week constituted a block of seven trials. Each week survived earned the participant $2. To acquire resources, participants had to choose between two foraging patches for each day, one with high variance in outcome, and one with low variance in outcome. This task introduces "need" requirements that are ecologically relevant, and measures variance preference under these conditions of "need".

Procedure

Phase I

Phase 1 of the experiment was administered in groups. Upon arrival at the designated classroom, participants were given a thorough oral introduction to the study, and were assured of complete confidentiality and the right to withdraw at any time. After signing a consent form, participants were provided with an envelope containing a consent form and questionnaire package. Participants were instructed to fill out the questionnaire and return it to the experimenter in a sealed envelope, with the consent form returned separately. This guaranteed the participants' anonymity. If participants were interested in participating in phase 2, they were provided with an opportunity to provide a method of contact at the end of the questionnaire. A randomized, secret code was used to link participant data from phase I and phase II.

Phase II

Sixty male and sixty female participants from phase 1 of the experiment were invited to participate in phase 2. Those that scored highest, medium and lowest on a composite measure of the most important traditional measures of risk (impulsivity, sensation seeking, self-control, and extraversion) were invited to participate in phase 2, which utilized more comprehensive

measures of risk-taking as variance and under conditions of "need". Participants of both sexes were selected by percentile rank; those in the 25th or lower percentile, 75th or higher percentile, and approximately 40th-60th percentile were selected as the three groups. Subjects were not told why they were called back.

Participants in phase II were run one at a time. Upon arrival, the participant was given a thorough oral introduction to the study, and was assured of complete confidentiality and the right to withdraw at any time. After signing a consent form, the participant was taken to a private room, and was asked to complete the tasks described. After each task, the participant called for the experimenter, and the experimenter provided poker chips in the amount of money earned for each task (rounded up to the nearest dollar). Participants exchanged their chips for a cheque in the amount earned at the end of the experiment.

Results

Question 1: Is risk conceptualized as personality related to risk conceptualized as variance preference?

A principal components analysis on the risk-as-personality measures Domain-specific isk-taking scale, Eysenck impulsiveness scale, and Zuckerman's sensation seeking scale was conducted. We found that one normally distributed factor explained a large portion of the variance (37%) in the measures of risk propensity as a stable personality trait. We also found that this "risk as personality" factor significantly correlated with other aspects of personality traits measured using the *NEO-FFI*, in expected directions: risk and openness to experience[1] correlated positively, and risk and agreeableness[2] correlated negatively, as did risk and conscientiousness[3].

Using this factor score, we separated our phase I participants into three groups: high, medium, and low risk takers. Participants that scored most representatively in those three groups participated in Phase II (20 males and 20 females from each group).

[1] An individual's degree of willingness to consider, explore, or tolerate new or unknown experiences, feelings, or ideas.
[2] A tendency to accommodate, cooperate, and empathize with others.
[3] The degree to which an individual completes tasks on time, organizes well, and meets goals.

Table 1. Factor loadings for measures of risk-as-personality, males and females.

Component	Loading
Sensation seeking, thrill and adventure seeking	.472
Sensation seeking, experience seeking	.604
Sensation seeking, disinhibition	.693
Sensation seeking, boredom susceptibility	.679
Impulsivity	.582
DOSPERT, investment	.383
DOSPERT, gambling	.545
DOSPERT, health	.759
DOSPERT, recreational	.661
DOSPERT, ethical	.724
DOSPERT, social	.425

Relationships were found between the risk-as-personality variables; most were significantly intercorrelated with each other in the expected directions. An expected sex difference was observed in level of risk-as-personality factor, with males possessing significantly higher risk-propensity, $t(235) = 6.56$, $p < .001$, Cohen's $d = 0.85$.

We also conducted a principal components analysis on all behavioral measures of risk-taking that involved variance preference. The BART, variance preference task, and the choice task all loaded highly on one factor, representing a preference for risk-as-variance.

Table 2. Factor loadings for measures of risk-as-variance preference, males and females.

Component	Loading
BART	.791
Variance Preference (VP)	.445
Choice Task (CT)	.654

A sex difference was also observed for variance preference. Males preferred riskier options significantly more often than females, $t(113) = 2.17$, $p = .03$, Cohen's $d = .41$.

The relationship between risk-as-personality and risk-as-variance was measured using one-tailed Pearson correlations. All variables were normally distributed. The variance preference tasks were mostly significantly inter-correlated. The risk-as-personality factor was not significantly related to any of the three measures of risk-as-variance, although all correlations

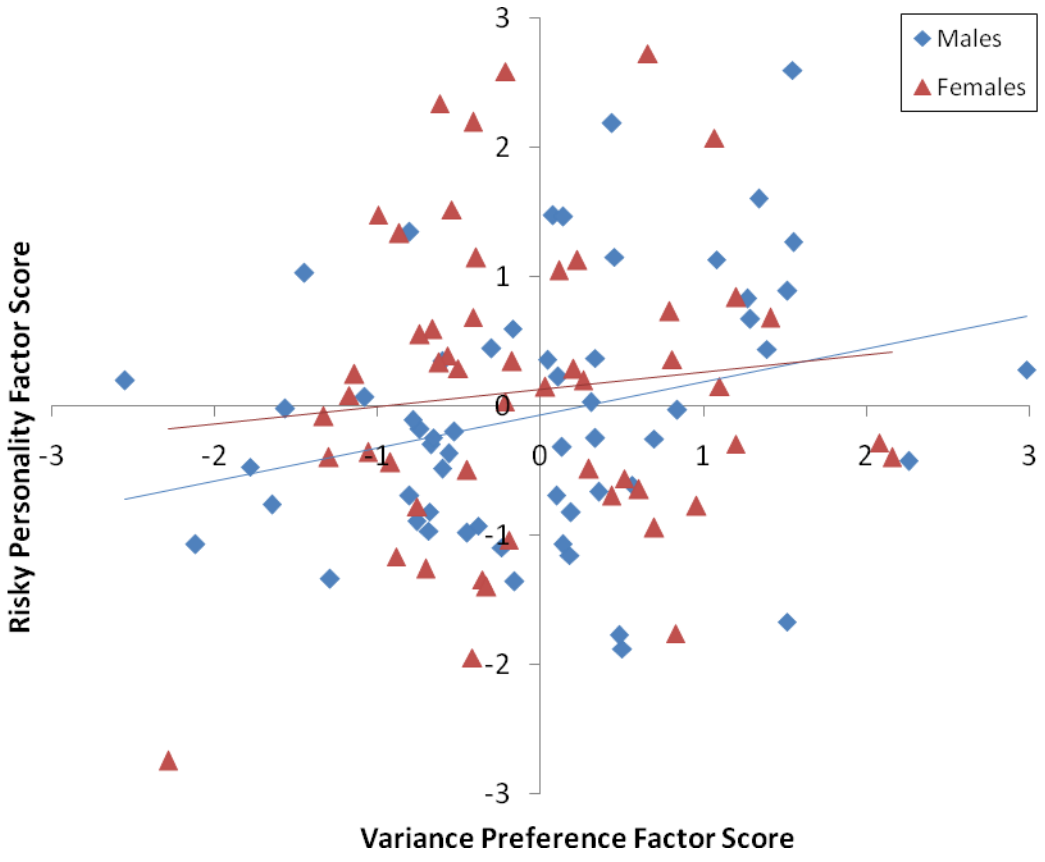
were in the expected direction. When the risk-as-variance factor was correlated with the risk-as-personality factor, however, a signicant relationship emerges, r = .211, p = .01. This finding suggests that there is a relationship between the latent factor of risky personality, and the latent factor of variance preference.

Table 3. Correlation matrix for risk-as-personality factor, risk-as-variance factor, and three behavioral measures of variance preference.

	Variance Preference Factor	**BART**	**CT**	**VP**
Risk as Personality Factor	.211*	. 121	.140	.092

Notes: * p < .05.

Figure 1. The relationship of risk-as-personality and risk-as-variance preference, separated by gender.



In sum, risk conceptualized as a personality trait is significantly related to risk conceptualized as variance preference, but only when factor solutions were developed for each type of risk.

Question 2: What effect does "need" have on risky decision making?

The *variance preference under conditions of need* (VPN) task was an explicit task used to measure the influence of imposed need on risky decision (Rode et al., 1999). That is, participants were provided with options that were explicitly defined, and then asked to choose between high and low variance options in an attempt to meet their need.

For example, this decision was one of the scenarios presented to participants. The text in parentheses was not included:

*You are required to draw **seven** black beads out of ten. Indicate which option you would like to draw from:*

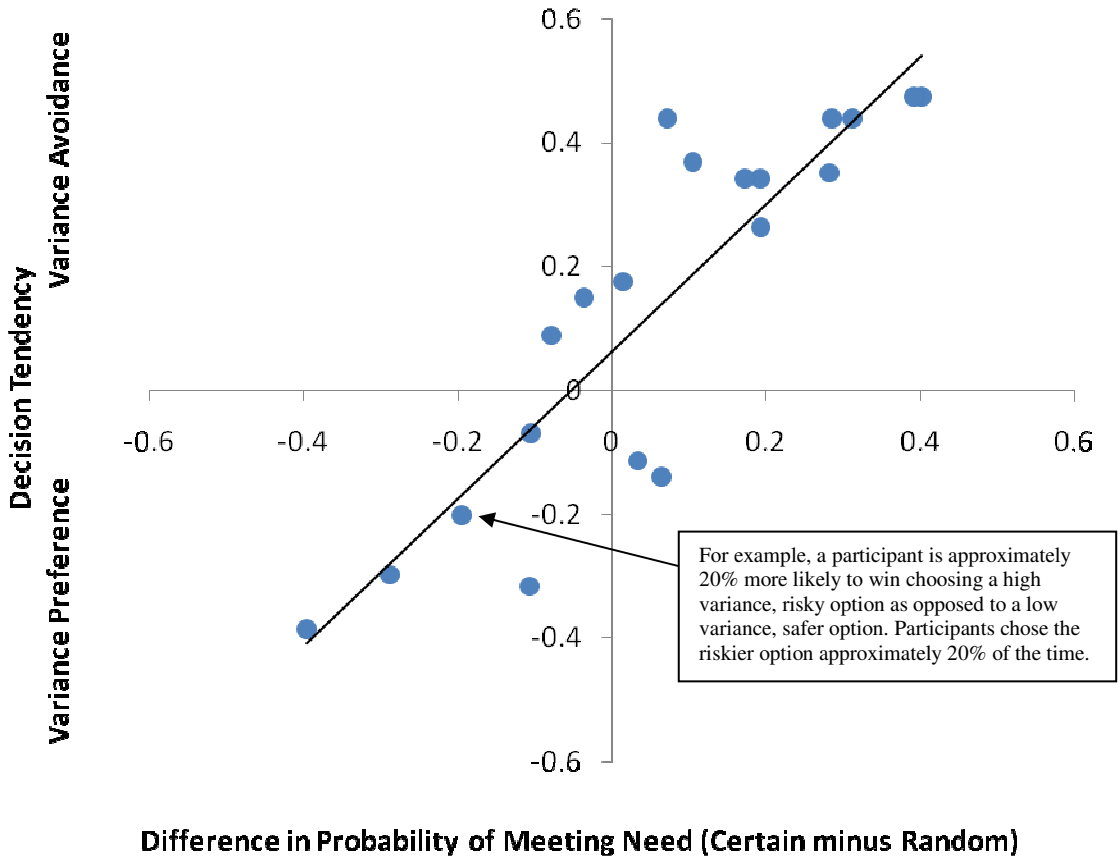
(1) A cup containing 50 white beads and 50 black beads [certain, low risk option]

(2) A cup containing a randomly determined distribution of 100 black and white beads. [variable, risky option]

All the choices presented were similar to the one above. The need requirement was varied (number of black beads required), as was the ratio of the first option. Twenty choices in total were presented. For each choice, the need level was varied relative to the expected value of the certain option. In the choice above, the expected value of the certain option is 5 black beads, and the need level is 7 black beads, two above the expected value of the certain option. We expected, based on risk-sensitive decision making theory, that as need level increased above the expected value of the certain, non-risky option, participants would prefer the risky decision option. If the need level was below the expected value of the certain, non-risky option, participants would prefer the certain option.

For each choice, the probability of meeting one's need with the certain option and with the risky option was calculated, and correlated with participant's actual decisions. A similar pattern of results was observed for both men and women, so data were collapsed across sex. Participants' risk preference was highly correlated with the probability of meeting a need with a higher risk option, Pearson $r = .88$, $p < .001$.

Figure 2. Probability of meeting one's need with a risky option is associated with more risky decision making in an explicit decision making task.



The effect of need on risky decision making was also measured using an implicit task. The key difference between the implicit task (ECOTASK) and the explicit task (VPN) above is that participants learned the mean and variance of several foraging patches through experience, instead of through explicit instructions. Therefore, participants' choices on this task refer to implicitly learned yields. In some ways, this task is similar to real-life situations (including games of chance) in which the payoff parameters are not explicitly known.

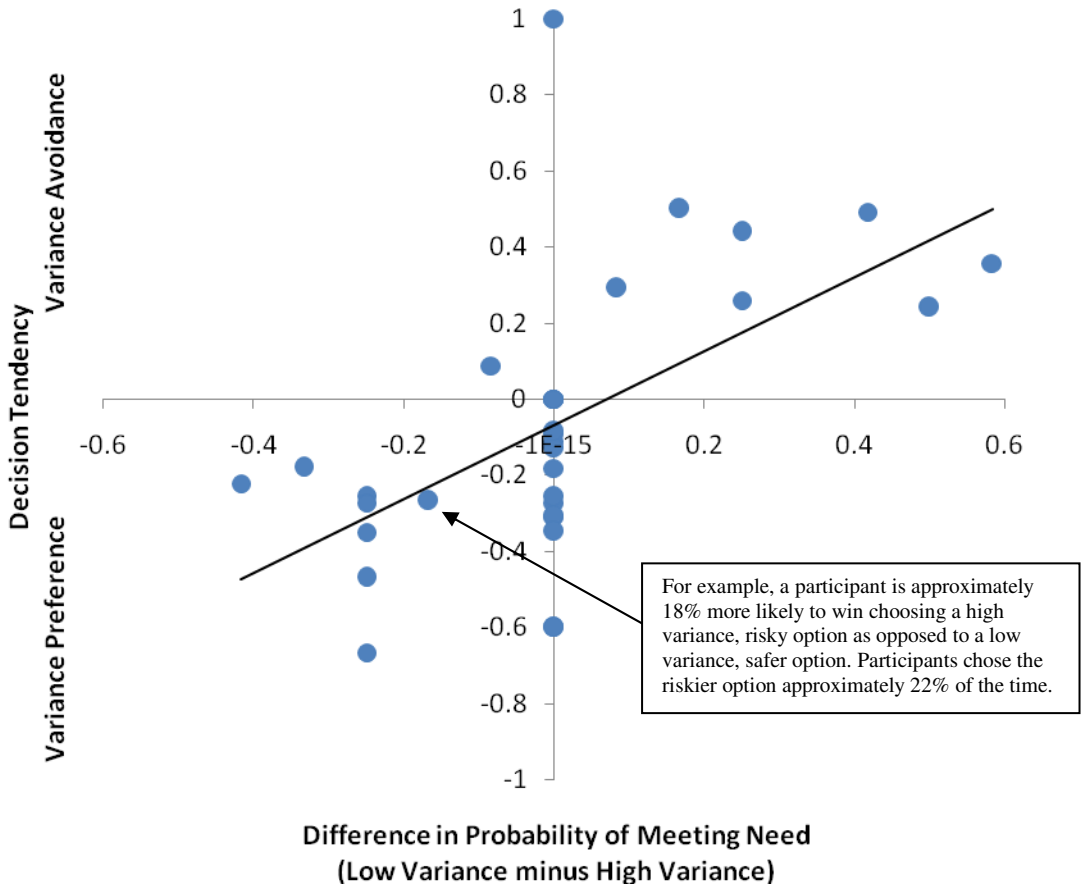
Participants played a hypothetical computerized survival scenario, where they were required to survive a "week" (seven trials) by obtaining a certain number of apples from clickable foraging trees (50 were needed to survive). Before making any decisions, participants "sampled" four different colored trees by clicking on them. One hundred trees were presented, in random order. Each colored tree provided a different number of apples on each click, determined

by a programmed level of mean and variance for each tree. Participants presumably learned the "yield" of each tree by having interacted with them.

After the training period, participants played the actual survival scenario. There were seven trials per block, and each trial represented a hypothetical day. The first five trials were fixed to meet one of two conditions: (1) low need, where one's need was likely to be met by picking a low variance, non-risky option, and (2) high need, where one's need was *not* likely to be met by picking a low variance, non-risky option, and so a risky, high variance option should be preferred. On the sixth and seventh trials, participants had to choose between a low variance, low-risk tree, or a high variance, high-risk tree in order to try and meet their need and survive the week. We expected that in the high need condition, participants would prefer high variance, risky options, and in the low need condition, participants would prefer lower variance, less risky options.

Results were calculated as in the VPN task above; the probability of meeting one's need in each trial by picking the risky, high variance option and the non-risky low variance option were calculated, and correlated with participants' actual choices. As with the VPN, we found that participant's risky choices were highly correlated with the probability of winning with a risky option, Pearson $r = .59$, $p < .001$; participants preferred risky options when they were more likely to meet their need.

Figure 3. Probability of meeting one's need with a risky option is associated with risky decision making in an implicit risk-sensitive decision making task.



To determine what factors were most important in predicting risky decision making, two regression analyses were performed, one for the VPN, and one for the ECOTASK. The independent variables were the risk-as-personality factor, risk-as-variance factor, need condition (high or low need), and sex. The dependent measure for the first regression was risk preference in the VPN, and for the second regression, risk preference in the ECOTASK.

For the VPN regression, we found that the only significant predictors of risky decision making was need condition (highly significant and predictive), and risk-as-variance preference. There was a trend toward significance for risk-as-personality.

Table 4. Regression predicting VPN decisions.

	Regression coefficients (B)	*Standardized regression coefficients (β)*
Sex	.009	.040
Risk as Variance Preference Factor	.013*	.123
Risk as Personality Factor	.011	.106
Need Condition	.124**	.569
CONSTANT	.692**	

R = .587; adjusted R^2 = .344; * p < .01, **p < .001

For the ECOTASK regression, we found that the only significant predictor of risky decision making was need condition (also highly significant and predictive, as in the VPN regression). Risk-as-variance preference showed a trend toward significance.

Table 5. Regression predicting ECOTASK decisions.

	Regression coefficients (B)	*Standardized regression coefficients (β)*
Sex	-.044	-.068
Risk as Variance Preference Factor	.034	.106
Risk as Personality Factor	.011	.038
Need Condition	.236**	.368
CONSTANT	.246*	

R = .400; adjusted R^2 = .160; * p < .01, **p < .001

Together, these results indicate that regardless of sex or personality, participants tended to make the most "rational" decision under conditions of need. Individual differences in variance preference, however, played a role in whether participants chose risky options or not, above and beyond the role of need.

Question 3: How does gambling relate to risk-as-personality, risk-as-variance, and how do gambling tendencies predict rational decision-making?

The Canadian Problem Gambling Index (CPGI) and the Gambling Behavior Scale (GBS) were used to measure gambling behaviors. The CPGI and GBS measures were highly intercorrelated with each other.

Table 6. Intercorrelations between the GBS and the CPGI.

	GBS: # Gambling Activities Last 12 mo.	GBS: Monthly Spending on Gambling	GBS: Days/month gambled
CPGI	.406***	.135	.391***

Notes: * p < .05, ** p < .01, *** p < .001. All tests two-tailed.

Gambling and Personality

A principal components analysis was conducted on all personality measures of risky behavior, excluding the gambling subscale of the domain-specific risk-taking scale. The factor loadings were remarkably similar to the first factor analysis of personality-related risk that included the DOSPERT gambling factor.

Table 7. Factor loadings for measures of risk-as-personality, males and females.

Component	Loading
Sensation seeking, thrill and adventure seeking	.493
Sensation seeking, experience seeking	.622
Sensation seeking, disinhibition	.690
Sensation seeking, boredom susceptibility	.680
Impulsivity	.588
DOSPERT, investment	.376
DOSPERT, health	.754
DOSPERT, recreational	.682
DOSPERT, ethical	.699
DOSPERT, social	.466

This risk-as-personality factor was significantly correlated with all measures of gambling behavior, including the CPGI (r = .297, p < .01), and the GBS (number of activities in last 12 months: r = .324, p < .001; monthly spending on gambling: r = .191, p = .04; days per month reported gambling: r = .392, p < .001). These results strongly suggest that risk as personality trait is significantly associated with gambling tendencies and problems.

Previous studies showing a positive relationship between gambling behavior and sensation seeking and impulsivity were also replicated. Sensation seeking was significantly correlated with the CPGI (r = .205, p = .02), and the GBS (number of activities in last 12

months: $r = .260$, $p < .01$; monthly spending on gambling: $r = .177$, $p = .03$; days per month reported gambling: $r = .300$, $p < .001$). Impulsivity was also significantly correlated with the CPGI ($r = .210$, $p = .02$), and the GBS (number of activities in last 12 months: $r = .303$, $p < .001$; monthly spending on gambling: $r = .234$, $p < .01$; days per month reported gambling: $r = .313$, $p < .001$). The Domain Specific Risk Taking Scale (DOSPERT), excluding the gambling subscale, was also significantly correlated with the CPGI ($r = .296$, $p < .01$), and the GBS (number of activities in last 12 months: $r = .293$, $p < .01$; days per month reported gambling: $r = .386$, $p < .001$). Monthly spending on gambling was marginally related to the DOSPERT, $r = .122$, $p = .20$).

A gambling factor was obtained by exposing all of the measures of gambling behavior to principal components analysis. This normally distributed factor explained 54% of the variance in gambling measures used (Table 7).

Table 8. Loadings of the GBS and CPGI on a gambling factor.

Component	Loading
GBS: Number of gambling activities in last year	.909
GBS: Days per month reported gambling	.911
GBS: Monthly spending on gambling	.203
CPGI Score	.675

The gambling factor was then correlated with measures of risk-as-personality, to determine if there was an underlying latent aspect of gambling behavior related with risk-as-personality. The gambling factor was significantly and highly correlated with the risk-as-personality factor ($r = .396$, $p < .001$), as well as individual measures of risk-as-personality (SSS: $r = .291$, $p < .001$, EIS: $r = .324$, $p < .001$, DOSPERT (excluding gambling): $r = .384$, $p < .001$).

Gambling and Variance Preference

Gambling measures were correlated with measures of risk-as-variance to investigate whether gambling behavior is associated with higher variance preference. CPGI scores showed no significant relationship with any measures of variance preference. The GBS, however, showed a significant relationship with the variance preference task (VP), a one-shot task that measured preference for either a high risk or low risk option, both with the same expected mean

outcome. The number of gambling activities reported in the last 12 months (r = .154, p = .05) and the average number of days per month spent gambling (r = .263, p < .001) were both significantly correlated with higher risk-preferring scores on the VP task.

The choice task, another measure of risk-as-variance preference, was significantly correlated with the number of gambling activities reported in the last 12 months, suggesting that higher risk preference is associated with higher number of gambling behaviors (r = .157, p = .05). The risk-as-variance factor obtained from principal components analysis (see Table 2) showed a significant relationship with average number of days per month spent gambling (r = .172, p = .04), suggesting that higher variance preference is association with more gambling behavior.

All relationships between variance preference and gambling behavior were positive, and thus in the expected direction. A larger sample of individuals exhibiting more variance in gambling behavior would be useful in demonstrating conclusively that variance preference is associated with gambling behavior.

Gambling and Rational Risk-Sensitive Decision Making

Do individuals with higher gambling tendencies make rational risk-sensitive decisions under conditions of need, or are gamblers more likely to choose high variance options regardless of need? We investigated the relationship between indicators of gambling behavior and risk-sensitive decision making options under conditions of need to answer this question.

Irrational risk choices in the VPN and ECOTASK refer here to participants choosing high-risk, high-variance options when a certain, low-risk option was *more* likely to meet one's need. Conversely, rational risk choices in the VPN and ECOTASK refer to participants choosing high-risk, high-variance options when a certain, low-risk option was *less* likely to meet one's need. The indifferent risk choice in the VPN refers to choosing a high-risk, high-variance option when both the risky and non-risky options were equally likely to satisfy one's need.

Table 9. Correlations between gambling indicators and risk-sensitive decision making choices under conditions of need.

	Gambling Factor	CPGI	GBS: # Gambling Activities Last 12 mo.	GBS: Monthly Spending on Gambling	GBS: Days/month gambled
Irrational risk choice (VPN)	.172^{+}	.065	.166^{+}	.080	.197*
Rational risk choice (VPN)	.100	.141	.080	-.005	.054
Indifferent risk choice (VPN)	.072	-.011	.134	-.072	.234*
Irrational risk choice (ECO)	.121	-.039	-.157	.160^{+}	-.166^{+}
Rational risk choice (ECO)	-.154^{+}	.121	.130	.100	.023

Notes: $^{+}$ p < .10, * p < .05, ** p < .01, *** p < .001. All tests two-tailed.

Only two significant correlations were obtained: Individuals who gambled more days per month made significantly more irrational risk choices in the VPN, and showed higher risk preference in the indifferent risk choice in the VPN. Similar trends were seen for the gambling factor, and the number of gambling activities in the last 12 months, suggesting that greater gambling tendencies may be associated with higher risk preference, independent of levels of need. The correlations, however, were small.

To clarify the influence of gambling tendencies on risky decision making, two regressions were performed with the risk-as-personality factor, risk-as-variance factor, gambling factor, and need condition as the independent variables, and risk choice in the VPN and risk choice in the ECO task as the dependent variables. For both regressions, need condition was highly significant, and the most important predictor of risk preference. In both, the risk-as-variance factor was also significant. The gambling factor and risk-as-personality factors were not significant in either regression.

These results suggest that gambling tendencies do not predict risky decision making under conditions of need, and that most participants make the "rational" risk-sensitive choice based on their need condition, not based on risk-as-personality (which is highly associated with gambling behavior). It appears that individual differences in risk-as-variance preference, however, are important in predicting risky decision making.

Question 4: Is gambling associated with delinquency?

This question is answered more in-depth in part II. In part I, however, we collected some preliminary data that can shed light on the relationship between gambling behavior and delinquent or antisocial behavior. The Retrospective Behavioral Self-Control Scale (RBS) was used to assess delinquent or antisocial behaviors indicative of low self-control at three developmental stages (childhood, adolescence, and adulthood). The Child and Adolescent Taxon Scale (CATS-SR) was used to measure early indicators of antisocial behavior.

Our results suggest that higher gambling tendencies are significantly associated with more frequent delinquent and antisocial behaviors. Scores on the CPGI were significantly correlated with all four scores on the RBS and the CATS-SR. Scores on the GBS were also significantly correlated with indicators of low self-control and antisocial behavior. Gambling factor scores were also highly correlated with the CATS-SR and the RBS.

Table 10. Correlations between indicators of low self-control, antisociality and gambling behaviors.

	CATS-SR	RBS Childhood	RBS Adolescence	RBS Adulthood	RBS Total
Gambling Factor	.277**	.326**	.311**	.356***	.323***
CPGI	.231*	.276**	.233*	.307**	.369***
GBS: # Gambling Activities Last 12 mo.	.201*	.225*	.242*	.292**	.208*
GBS: Monthly Spending on Gambling	.225*	.141	.124	.184	.062
GBS: Days/month gambled	.339***	.263**	.313***	.221*	.307***

Notes: * $p < .05$, ** $p < .01$, *** $p < .001$. All tests two-tailed.

It appears that there is a robust and strong relationship between measures of low self-control, early antisociality, and gambling behavior. These results suggest that some aspects of antisocial and delinquent behavior, including low self-control, are associated with gambling tendencies.

PART II

DELINQUENCY AND GAMBLING: A PILOT STUDY OF THEIR INTER-RELATIONSHIP AND COMMON DETERMINANTS

INTRODUCTION

There is a significant association between problem gambling and crime. Less clear is the nature of this relationship. Because both gambling and crime involve elements of risk, there may well be individual characteristics associated with risk-taking tendencies that are common to both. Thus, the first purpose of the present study was to explore the extent to which risk-taking and impulsivity, as well as sensation-seeking and antisocial personality, predicted both gambling and delinquency in 180 male university students.

In a review of 27 studies, Williams, Royston, and Hagen (2005) found that approximately 30% of prison inmate samples met criteria for problem and/or pathological gambling, the highest rate yet found in any population. Similarly, among gamblers, there are frequent reports of criminal activity. For example, Blaszczynski, Steel, and McGonaghy (1997) reported that 58% of a sample of 115 problem gamblers had committed a gambling-related offense, and 21% had committed other criminal offenses. Similar high rates of delinquent activity have been found to be associated with both adolescent gambling (e.g., Barnes, Welte, Hoffman, & Dintcheff, 1999) and adolescent problem gambling (e.g., Hardoon & Derevensky, 2002; Vitaro, Ladouceur, & Bujold, 1996).

The second purpose of the present study is to explore the effect of mood and peer observation in a laboratory setting to examine their impact on actual video lottery terminal (VLT) play. Mood and peer influences are known to have a significant impact on delinquent behaviour but their influence on gambling behaviour is less well established. Understanding their impact has the potential to better inform prevention and treatment initiatives for problem gambling.

METHODS

Participants

One hundred and eighty male volunteers were recruited from psychology classes at the University of Lethbridge. Problem gamblers were not targeted, but it was expected that individuals would be recruited that exhibited a full range of gambling habits (from none to recreational to problematic), because the recruitment advertisement specified that this was a study on gambling.

Measures

A comprehensive assessment of personality was undertaken by administration of the NEO Personality Inventory, a well-validated measure of personality. This test also provided specific subscale measures of Impulsivity, Depression, and Excitement Seeking (Costa & McCrae, 1992).

Delinquency and antisocial behaviour was measured with the Childhood and Adolescent Indicators of Psychopathy Scale (CATS-SR; Lalumière, Chalmers, Quinsey, & Seto, 1996), the Levenson Psychopathy Scale (LPS; Levenson, Kiehl, & Fitzpatrick, 1995), and the Self-Report Early Delinquency Instrument (SRED; Charles & Egan, 2004), three well-validated self-report measures. The rating scale for the last measure was slightly modified in order to determine lifetime frequency, past year frequency, and onset of each delinquent activity. Impulsivity was measured as a subscale of the NEO Personality Inventory.

The measure of risk-taking was the Retrospective Behavioural Self-Control scale (RBS) (Marcus, 2003). This measure consisted of 67 items, which assessed the frequency of prior risk-taking behaviour from childhood to adulthood. This test has satisfactory reliability in terms of both internal and test-retest stability. Risky personality was also measured using Zuckerman's Sensation Seeking Scale (SSS), a well-validated measure of risky behavior (Zuckerman, 1994).

Different aspects of current mood state were assessed immediately after the mood manipulation and immediately after the gambling task using an in-house self-report measure designed for this study. For example, the statement "Right now I feel anger" was rated by participants on a scale of one to seven (1 = not at all, and 7 = extremely).

Three measures of gambling were used. The first two, the Gambling Behavior Scale (GBS) and the Canadian Problem Gambling Index (CPGI), are described in Part I. The third measure was actual gambling behavior on a Video Lottery Terminal (VLT) machine. The

playing behavior of the participant with regard to whether they chose to gamble, how long they gambled for, and their net win/loss after gambling was recorded. Each participant was given $20 worth of credit, and was allowed to play for a maximum of 15 minutes.

Procedure

Participants were recruited on a volunteer basis among undergraduate students at the University of Lethbridge. Upon arrival at the laboratory the study was described and participants were assured of complete confidentiality. After signing a consent form, participants were taken to a private room and asked to fill out the self-report measures described above. Participants were run individually.

Participants were then shown to an adjacent room in which they sat in a comfortable chair and listened to one of three mood-inducing songs for a period of eight minutes. They were instructed to think about something upsetting (negative mood), or something happy (positive mood), or what they did yesterday (neutral mood) while listening to the music. They were also instructed to write down a few sentences at the end of the song about what they thought about during the song. Following the mood manipulation participants were asked to complete the in-house mood measure.

The participant was then taken to another room and offered the opportunity to gamble using on a VLT for a period of up to fifteen minutes. The VLT was the same as those found in commercial establishments in Alberta, and the laboratory was decorated to approximate an actual VLT location. Participants were informed that they had $20 worth of credit to play with, and that they were allowed to cash out at any time. They were not informed of the length of the gambling session. Instead, at the end of 15 minutes (or after they cashed out) they were asked how long they thought they played. They were also instructed that the amount of credit they cash out would be given to them, up to a maximum of $50. Any dollar amount exceeding $50 was converted one-to-one into raffle tickets for a $200 prize drawn at the end of the study. This gave an incentive to continue playing for those few participants who won a large amount of credits early. A $5 movie coupon was given to anyone who lost all of their credits.

Participants were observed by a female or male peer (a same age student at the same university who was a research assistant), or by no one. The peer had a notepad and pencil and appeared to be making observations of the person's play. He/she did not speak or offer advice, except to answer questions related to the procedure.

Question 1: Is there a relationship between problem gambling and personality traits?

Students interested in a gambling study showed a high level of gambling activities. Forty out of 180 met the criteria for "moderate" or "at-risk gamblers" and twelve for "severe gamblers". A risk-as-personality factor was computed using principal components analysis, similar to Part I. A single factor solution explained 37% of the variance. We note that this risk-as-factor cannot be directly compared to that of Part I, because slightly different measures were used.

Table 11. Factor loadings for measures of risk-as-personality.

Component	Loading
Sensation seeking, thrill and adventure seeking	.195
Sensation seeking, experience seeking	.271
Sensation seeking, disinhibition	.626
Sensation seeking, boredom susceptibility	.477
Impulsivity	.600
RBS, Childhood	.724
RBS, Adolescence	.845
RBS, Adulthood	.798

Similar to part I, problem gambling was related to certain personality measures: higher impulsivity, lower self-control in childhood and adolescence, higher disinhibition, and higher boredom susceptibility. The risk-as-personality factor was strongly correlated with all measures of gambling, except for monthly spending on gambling-related expenses.

Table 12. Correlations between gambling behaviors and risk-as-personality measures.

	CPGI	GBS: # Gambling Activities Last 12 mo.	GBS: Monthly Spending on Gambling	GBS: Days/month gambled
EIS	.284***	.084	.154*	.141
SSS, Total	.050	.235***	-.071	.161*
SSS, Thrill and Adventure Seeking	-.093	.031	-.095	-.034
SSS, Experience Seeking	-.075	-.014	-.038	.093
SSS, Disinhibition	.181*	.341***	.024	.183*
SSS, Boredom Susceptibility	.075	.165*	-.073	.147*
RBS, Childhood	.093	.118	.039	.072
RBS, Adolescence	.203**	.169*	.049	.255***
RBS, Adulthood	.360***	.249***	.061	.295***
Risk-as-personality Factor	.222**	.263***	.055	.268***

Notes: * p < .05, ** p < .01, *** p < .001. All tests two-tailed.

These personality measures had less consistent relationship with measures of gambling in the laboratory (using a VLT).

Table 13. Correlations between measures of gambling in the lab on a Video Lottery Terminal, and measures of risk as personality.

	Money won	Time played	Total # of Spins	Min bet %	Deviation from $20
EIS	-.097	.020	.091	.028	.123
SSS, Total	.067	-.135	-.128	-.030	-.006
SSS, Thrill and Adventure Seeking	.032	-.076	.029	-.042	-.029
SSS, Experience Seeking	-.086	-.090	-.089	.103	-.027
SSS, Disinhibition	.120	-.127	-.156	-.102	.061
SSS, Boredom Susceptibility	.070	-.033	-.122	.029	-.044
RBS, Childhood	-.047	-.053	-.046	.018	-.007
RBS, Adolescence	-.052	-.201**	-.119	-.131	-.020
RBS, Adulthood	-.023	-.104	-.025	-.074	.125
Risk-as-Personality Factor	-.020	-.136	-.091	-.062	.053

Notes: * p < .05, ** p < .01, *** p < .001. Min bet % = percentage of time participant bet the minimum amount on the VLT; Deviation from $20 = amount that the participant deviated from the starting amount on the VLT ($20). Note that safe betting is indicated by playing for a shorter amount, engaging in fewer spings, betting the minimum amount, and winning more money (because the VLT has a negative expected value).

Gambling behaviour reported outside of the laboratory had little connection to gambling behaviour in the laboratory. One relationship, however, was indicative: the risk-as-personality factor was negatively correlated with the length of time played on the VLT, r = -.136, p = .07. This finding suggests that individuals with more of a 'taste for risk' tended to spend less time on the VLT, possibly because they lost their money more quickly.

Interestingly, however, half of the problem gamblers lost all of their allocated money on the VLT; the corresponding values for non-gamblers, low-risk gamblers, and moderate gamblers were 24%, 34%, and 41%, respectively.

Question 2: Is there a relationship between problem gambling and delinquency/antisocial behavior?

Gamblers were separated into three groups based on their CPGI scores (no gambling problem, low risk, and moderate/severe). An ANOVA analysis showed no significant group differences on any of the measures of delinquent or antisocial behavior, suggesting that problem gambling is not associated with delinquent behavior.

Non-problem gambling behavior as measured by the GBS showed some significant relationships with delinquent behavior. These data suggest that delinquent behavior is associated with higher frequency of gambling, and more variety in reported gambling activities.

Table 14. Correlations between indicators of gambling behavior and delinquency in the last year and in the lifespan.

	CPGI	GBS: # Gambling Activities Last 12 mo.	GBS: Monthly Spending on Gambling	GBS: Days/month gambled
Minor ever	.137	.257***	.012	.215**
Moderate ever	.060	.083	.103	.092
Serious ever	.112	.120	-.094	.145*
Minor last year	.186*	.353***	.010	.291***
Moderate last year	.186*	.102	.068	.209**
Serious last year	.113	.115	.070	.177*

Notes: * p < .05, ** p < .01, *** p < .001. Delinquency categories refer to minor, moderate, and severe delinquent acts reportedly performed in the lifespan, or last year.

Significant relationships were also observed between indicators of gambling behavior and antisociality, as measured by the Self-Report Delinquency Scale, suggesting that antisociality is associated with indicators of real-world gambling behavior, as well as problem gambling.

Table 15. Correlations between indicators of gambling behavior and measures of antisocial tendencies.

	CPGI	GBS: # Gambling Activities Last 12 mo.	GBS: Monthly Spending on Gambling	GBS: Days/month gambled
AQ Anger	.186*	.079	.000	.208**
AQ Hostility	.197**	.038	.007	.112
Levenson Primary	.231**	.252***	-.032	.254***
Levenson Secondary	.252***	.116	-.032	.218**

To further investigate whether antisociality and delinquency are associated with gambling, regression analyses were conducted on a gambling factor obtained from principal components analysis on the CPGI and the three sub-measures of the GBS. This factor explained 47% of the observed variance in the gambling measures.

Table 16. Loadings of the CPGI and GBS for a gambling factor.

Component	Loading
CPGI	.739
GBS: # Gambling Activities Last 12 mo	.783
GBS: Monthly Spending on Gambling	.126
GBS: Days/month gambled	.844

The gambling factor was regressed on three blocks of variables. The first block included personality variables associated with gambling (EIS, SSS, RBS), the second block included antisociality variables (primary and secondary psychopathy, anger, hostility). The dependent measure was the gambling factor. The first block accounted for 21% of the variance in the gambling factor. The second block (R change = .014, p = .58) did not significantly add to the variance explained.

To investigate whether the same variables predicted delinquency, the same two blocks of variables were regressed on the dependent variable of total delinquency in the past year. Once again, antisocial variables did not significantly add to the variance explained (R change = .010, p = .61).

To investigate whether the same variables predicted serious delinquency in the past year, the dependent variable of serious delinquency in the last year was used. Antisociality significantly added to the variance explained, over and above the variance explained by personality variables (R change = .053, p = .02). This result suggests that antisociality is only relevant to the production of serious delinquent behavior, but not gambling behavior. For both delinquent and gambling behavior, personality characteristics such as impulsivity, sensation seeking, and low self-control are important, perhaps explaining why gambling problems are prevalent in forensic populations. Problem gamblers, however, are no more likely to engage in serious crime, unless they also possess serious antisocial tendencies.

Question 3: Do peer influences and negative mood affect gambling behavior in the laboratory?

A simple manipulation of mood had the expected effect on mood but no effect on gambling behavior in the laboratory.

A 3x3 analysis of variance with two between-subjects factors (Mood: happy, sad, neutral; Observer: male, female, none) was conducted on each of the VLT dependent variables. A near significant main effect of observer on the total amount of money won was observed $F(2, 171) = 2.85$, $p = .06$. An examination of means and 95% confidence intervals indicated that participants won more money when in the presence of a female observer than in the presence of a male or no observer (winning more money is associated with betting safely). In addition, a main effect of observer was found on the total time spent playing the VLT, $F(2,171) = 5.38$, $p < .01$, suggesting that participants in the no observer condition played longer.

We suggest continuing to investigate the influence of mood and peer observer on gambling behavior using a more realistic gambling setting (e.g., unlimited playing time, outside of the laboratory).

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