



**Gambling motives and cognitive distortions mediate effects of personality on problem gambling in electronic gambling machine players.**

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## **Abstract**

A community sample of 273 people who play Electronic Gambling Machines frequently was collected from Brandon, Manitoba, Canada. Participants completed standard measures of problem gambling (Problem Gambling Severity Index; Ferris & Wynne, 2001), gambling motives (Gambling Motives Questionnaire; Stewart & Zack, 2008), cognitive distortions (Informational Biases Scale; Jefferson & Nicki, 2003), and personality (NEO PI-R; Costa & McCrae, 1992). Regression of problem gambling severity scores onto cognitive distortions, 4 gambling motives, and 4 personality traits found significant direct effects of cognitive distortion, Coping and Financial motives, and low Positive Emotions facet of Extraversion. Mediation analyses found that cognitive distortion mediated indirect effects of high scores on withdrawal-related facets of Neuroticism, and the Coping motive mediated effects of low scores on industriousness-related facets of Conscientiousness. Broad personality dispositions known to elevate risk of Problem Gambling may have their effects through mechanisms of escapist motivation for gambling and distorted beliefs about gambling.

## Introduction

Most people in Manitoba gamble, whether it be with lottery tickets, betting on sports, casino and card games, or slot machines and Video Lottery Terminals (VLTs). In the most recent 'Manitobans and Gambling' survey conducted for the Manitoba Gaming Control Commission (MGCC, 2010), 85.3% were identified as past-year gamblers (nongamblers were defined as those who reported 3 or fewer forms of gambling once in the past year). With such a large majority of the public participating in legal gambling, there comes a relatively small percentage whose gambling may become problematic. The most recent estimate of the prevalence of Problem Gambling (PG) in Manitoba comes from a 2006 survey conducted for the Addictions Foundation of Manitoba (Lemaire, Mackay & Patton, 2008), which found an overall participation rate of 85.6%, with moderate PG symptoms reported by 4.7% and severe symptoms reported by another 1.4% on the Problem Gambling Severity Index (PGSI; Ferris & Wynne, 2001). The rate of Pathological Gambling in Manitoba at that time was similar to the rate found internationally (Stucki & Rihs-Middel, 2007), although Manitoba's 6.1% rate of both moderate and severe PG combined is among the highest in Canada, with Saskatchewan coming a close second at 5.9%, and Prince Edward Island having the lowest rate at 1.6% (Harrigan, 2011). It should be remembered that the concept of PG is less extreme than the clinical syndrome of Gambling Disorder specified in the American Psychiatric Association's DSM-5 (APA, 2013). Nevertheless, a significant minority of Manitobans gamble excessively and report symptoms of PG. Some of them might be diagnosable as having Gambling Disorder, yet most gamble without difficulty and legal gambling is a normal recreational activity for most people. This presents an important question: what are the differences between people who gamble frequently and go on to develop into Problem Gamblers versus the majority of gamblers, some of whom may also gamble frequently but without PG? In this study, we explored personality, gambling cognitions, and gambling motives as a function of self-reported PG behaviors in a sample of Manitobans who play VLTs often.

### Literature review.

Participation in various forms of legal gambling is a normal feature of modern life in many industrialized countries, with a small percentage of people gambling excessively and problematically (Stucki & Rihs-Middel, 2007). The general pattern of widespread gambling participation by a majority of adults, with some playing frequently and a few experiencing adverse effects, draws concern about the potential risk for adverse effects in a subset of vulnerable players. Some forms of gambling may present higher risk of adverse effects than other forms, such as Electronic Gambling Machines (EGM) being more associated with Problem Gambling (Dowling, Smith & Thomas, 2005) than Bingo games (Moubarac, Shead & Derevensky, 2010) or ticket lotteries (Thege & Hodgins, 2014), and there are some forms of gambling associated with excessive risk-taking but that are less widely practiced (e.g. horse race betting). Likewise, some frequent gamblers may be more prone to experience adverse effects than others, and the characteristics of Problem Gamblers have been well characterized in terms of their demographic and social risk factors (Hodgins, Schopflocher, Martin, el-Guebaly, Casey, Currie, Smith & Williams, 2012), as well as individual characteristics of personality (MacLaren, Fugelsang, Harrigan & Dixon, 2011), motives for gambling (Stewart, Zack, Collins, Klein & Fragopoulos, 2008) and distorted beliefs and attitudes toward gambling (Goodie & Fortune, 2013).

The present study characterized frequent Electronic Gambling Machine (EGM) players in a small city located in Manitoba, a Canadian province where casino and bar patrons have easy access to EGMs and where there is a high prevalence of Problem Gambling compared to other Canadian provinces (Cox, Yu, Afifi & Ladouceur, 2005). Focusing on this population was intended to provide a window into the personality, motives, and thoughts of people who prefer this popular and particularly

risky form of gambling. Examining EGM players is important because there may be different subtypes of problem gamblers (Milosevic & Ledgerwood, 2010) who have different patterns of etiology (Blaszczynski & Nower, 2002), and risk of Problem Gambling might emerge out of an interaction of player characteristics that increase risk and the structural characteristics (Griffiths, 1993) of their preferred EGM games. For instance, one recent study found that people who play EGMs have lower scores on a personality trait of 'Reward Sensitivity' and are more motivated to gamble as a form of escapism than are gamblers who prefer betting on horse races (Balodis, Thomas & Moore, 2014). At the same time, another study concluded that the design of modern EGMs may increase players' illusory sense of being able to control the outcomes (Harrigan, MacLaren, Brown, Dixon & Livingstone, in press). Detailing the characteristics specific to problem and nonproblem EGM players, rather than problem and nonproblem gamblers more broadly, may contribute to an understanding of ways to reduce the potential harm that this form of gambling poses for the most vulnerable players who prefer it. Although many EGM players also participate in other less risky forms of gambling, the study did not include gamblers who prefer these other types of gambling to the exclusion of EGMs.

### *Personality and gambling.*

The personality characteristics that increase likelihood of PG have been described extensively in the psychological literature on problem gambling (MacLaren, Fugelsang, Harrigan & Dixon, 2011). Adult personality emerges from genetic variations in temperament interacting with life experience to shape enduring patterns of emotion, thought, and behavior. The most prominent theories of personality suggest that the number of discrete traits necessary to explain human variation may be two (Gray & McNaughton, 2000), three (Eysenck & Eysenck, 1976) or five (Costa & McCrae, 1992). Markon, Krueger and Watson (2005) integrated these models into a unified system with meta-analytic support for four domains corresponding to four of the factors in the widely accepted "five factor model" of Costa and McCrae. In the terminology of the five factor model, these domains are called Neuroticism, Extraversion, Agreeableness, and Conscientiousness. One important feature of the model is that each of the broad domains contains 6 "facets" that reflect an individual's typical behavior in specific situations.

Meta-analyses of these personality traits and psychopathology have found consistent support for the roles of the 4 personality domains in disorders of mood, anxiety, and substance use (Kotov, Gamez, Schmidt & Watson, 2010), as well as personality disorders (Samuel & Widiger, 2008), and pathological gambling (MacLaren et al., 2011). Interestingly, a pattern of high scores on measures of Neuroticism combined with low scores on Agreeableness and Conscientiousness, is associated with substance use disorders, antisocial and borderline personality disorders, and pathological gambling. Individuals with this combination of traits may be at higher risk for all of these disorders, which may partially explain comorbidity amongst these conditions. It also accounts for the well-known role of impulsivity in PG, since facets of impulsivity that fall within the Neuroticism and Conscientiousness domains have been found to differ between pathological gamblers and control groups across studies (MacLaren et al., 2011). This clinical psychology literature suggests that Problem Gambling might be one expression of a cluster of "externalizing" behaviors (e.g. aggression, poor self regulation, substance use and criminality) that is seen in individuals with deviant personality characteristics, perhaps in combination with demographic and social risk factors (e.g. being young, male, poor, uneducated and unmarried).

What is not known presently is the precise set of mechanisms through which personality traits may contribute to PG. For instance, one might speculate that people with high Neuroticism are more likely to use gambling as a means of escape from negative emotional states like boredom or hopelessness. Likewise, highly impulsive people with low scores on Conscientiousness might be less able to control their gambling behavior by rationally overriding false beliefs about gambling. Perhaps so-called "antisocial impulsivist" gamblers (Blaszczynski & Nower, 2002) with low Agreeableness

might gamble along with other reckless activities in order to enhance their pleasure-seeking without due regard for negative consequences for themselves or others. People with all three traits might be especially predisposed to PG. In the present study we predicted higher scores on Neuroticism, and lower scores on Agreeableness and Conscientiousness among frequent EGM players. Furthermore, we attempted to outline the cognitive and motivational mechanisms through which these broad personality domains might have their effects on PG behavior.

#### *Emotion-related motives and gambling.*

Several models have been proposed to explain gamblers' motivations (e.g. Binde, 2013; Lee, Lee, Bernhard, & Yoon, 2006, Thomas, Allen & James, 2009; Turner, Littman-Sharp, Toneatto, Liu & Ferentzy, 2013). Models such as these have emphasized motives like fun and excitement, winning money, affiliation, accessibility, and escape of negative emotional states. Some studies have attempted to measure gambling motives using single-item questions (e.g. Nower & Blaszczynski, 2010; Reid, Li, Lopez, Collard, Parhami, Karim & Fong, (2011), but most research on gambling motives (e.g. Ledgerwood & Milosevic, 2013; Quinlan, Goldstein & Stewart, 2013; Sztainert, Wohl, McManus & Stead, 2013) has used the Gambling Motives Questionnaire (GMQ; Stewart & Zack, 2008). The GMQ measures dysfunctional use of gambling as a way of escaping negative emotional states with its Coping scale, as well as fun and excitement with its Enhancement scale, and gambling as a way to affiliate with other people with its Social scale.

One criticism of the GMQ is that it was derived from a measure of alcohol abuse (Cooper, Russell, Skinner & Windle, 1992), so it may not capture the gambling-specific motive of potentially winning money (Hodgins, 2008). A set of 4 money motive questions was tested by Dechant and Ellery (2010) and they recommended the addition of a single money motive item to improve the fidelity of the Enhancement scale. More recently, Dechant (2013) reported factor analytic support for a 4 factor model of the GMQ including a Financial scale. Regardless, the Enhancement and Social scales appear to be less important than Coping in the etiology of PG among EGM players. MacLaren, Harrigan & Dixon (2012) replicated the results of Stewart and Zack (2008), in finding that the Coping motive was more strongly implicated in PG than Enhancement or Social motives in a large sample of EGM players. Thus, in the present study we predicted the Coping scale to be positively associated with severity of PG symptoms among frequent EGM players, and we explored the possibility that this motive might mediate indirect effects of more broad personality traits on PG. The similarity of content in the Coping scale and some Neuroticism items led us to expect a pattern among problem gamblers analogous to the situation in problem drinkers, where the drinking for Coping motive mediates Neuroticism's effect on excessive alcohol consumption (Stewart, Loughlin & Rhyno, 2001).

#### *Cognition and gambling.*

Cognitive theories of PG rest upon the idea that people control their behavior rationally, but their reliance on heuristics may lead to errors in judgment and decision making that maintain maladaptive gambling behaviors. The phenomenon of cognitive distortions among problem gamblers has been strongly supported (Goodie & Fortune, 2013). The availability and representativeness heuristics of Kahneman and Tversky (1974) may be the basis of many cognitive distortions that are commonly seen in PG, such as illusory correlations, memory biases, overconfidence, the gambler's fallacy and the hot hand fallacy (Fortune & Goodie, 2012). It is also possible that problem gamblers may have an accurate understanding of the games they play when they are not playing them, but that they may switch into an emotionally 'hot' mode of heuristic judgment that misguides their gambling behavior when they are engrossed in playing a game (Sevigny & Ladouceur, 2003). This is consistent with the finding that irrational thinking style mediates the effect of trait Reward Sensitivity on

symptoms of PG among frequent slot machine players (MacLaren, Fugelsang, Harrigan & Dixon, 2012). In the present study, we predicted higher scores on a measure of cognitive distortions about EGMs to be positively associated with severity of PG symptoms among frequent EGM players, and we explored the possibility that cognitive distortion might mediate indirect effects of more broad personality traits on PG.

### Research questions

This project had two main research questions as its focus. The first question concerned the differences between EGM players at low, moderate and high levels of problem gambling severity. It was predicted that participants identified as being at high risk of being problem gamblers would have higher scores on measures of cognitive distortions, Coping and Enhancement gambling motives, and higher Neuroticism but lower Conscientiousness personality traits. The second question concerned the relative contributions of these variables to predicting severity of problem gambling, and the possible mechanisms through which personality traits might increase problem gambling. It was predicted that gambling motives and cognitive distortions would be stronger predictors of problem gambling scores, but that they would mediate indirect effects of personality traits. High Neuroticism and Conscientiousness were predicted to increase scores on measures of cognitive distortions and Coping motive, which in turn were predicted to increase self-reported symptoms of PG.

### Significance

The significance of this research is to understand the factors that increase likelihood of problem gambling and what characteristics may make some EGM players more vulnerable to experiencing problems than others. It was predicted that gambling motives and cognitive distortions would be proximate causes of problem gambling symptoms but that these might mediate distal or indirect effects of broad personality traits like Neuroticism and Conscientiousness. If results support these predictions it would give a clearer picture of the mechanisms through which individual characteristics of some players may place them at greater risk. Likewise, it would increase our understanding of what personal characteristics may be preventive and reduce risk. This knowledge could help guide treatment and prevention by giving service providers insight into why some players are at higher risk and how problem gambling might be avoided or reduced by considering individual differences.

## **Method**

### Ethics review

This study was approved by the research ethics committees at Brandon University and University of Manitoba before any of the data were collected. All procedures were consistent with Canadian tri-council policy on ethical conduct for research involving humans (CIHR, NSERC, and SSHRC, 2010).

### Participants

Three hundred respondents were recruited using an advertisement on a popular community internet site (www.eBrandon.ca). The ad offered \$50 giftcards redeemable at stores in a local shopping mall for volunteers who were at least 18 years old, who were not in any form of treatment for Problem Gambling, and who “played VLTs at least twice a month for the past year”. The participants completed the questionnaires anonymously after signing an informed consent form, in group testing sessions with less than 40 participating at any time. Data from 11 participants were dropped from the sample because they failed to complete the NEO PI-R, 4 were dropped because they did not do the PGSI, and 2 were dropped because although they consented to participate in the study they refused to answer any of

the items on any of the questionnaires. One participant was dropped because he completed the questionnaires in less than 30 minutes and gave obviously random responses. Finally, 9 were dropped because although the study requested EGM players, on the CPGI they indicated that they did not play either VLTs or casino slot machines. The final sample of 273 participants was aged 18-68 years ( $M=34.0$ ,  $SD=11.2$ ), including 146 women, 123 men, and 4 who did not disclose their sex and 5 who did not disclose their age.

### Test instruments.

*Canadian Problem Gambling Inventory* (CPGI; Ferris & Wynne, 2001). The CPGI is a standard instrument developed for screening symptoms of Problem Gambling in face to face interviews, telephone interviews, or in paper and pencil questionnaire format. We used the CPGI in questionnaire form to measure the extent of self-reported gambling behaviors, with 4 subsections comprising the questionnaire. The first subsection gave a list of popular types of legal gambling and respondents checked off which of these they took part in within the previous year. The second subsection covered a variety of topics with single questions about age, sex, frequency of gambling, typical amount spent gambling per month, largest amount spent gambling in a single day, drinking while gambling, and gambling alone. The third subsection was the 9 item Problem Gambling Severity Index (PGSI), which is the most common indicator of Problem Gambling used in population prevalence studies in Canada. Scores on the PGSI correlate with DSM-IV (APA, 2000) criteria for Pathological Gambling at  $r=.83$  (Ferris & Wynne, 2001). PGSI items were answered with a 4 point Likert scale (never, sometimes, most of the time, always or almost always) and were scored from 0 to 3 to give a total score that could range from 0 to 27. We analyzed continuous PGSI scores in correlational analyses and also subdivided the sample into 3 categories representing the likelihood that each participant was a problem gambler judging from their self-reported PGSI symptoms. These categories were formed using the original cutoffs of Low Risk (0 to 2), Moderate Risk (3 to 7), and High Risk (8 and higher), but scores of 0 were included in the Low Risk group because all participants were frequent gamblers and this inherently poses some degree of risk for PG. We included PGSI scores for 4 participants who only answered 8 questions and classified 1 of these as Low Risk, 1 as Moderate Risk, and 2 as High Risk on the basis of the 8 items that they answered. Inter-item reliability in the present sample was Cronbach's  $\alpha=.91$ . The last subsection of the CPGI was the 5 item Population Harm supplement (Bagby, Quilty & Watson, 2012) used to measure respondents' perceptions of the impacts of their gambling on their partner, family, neighborhood, friends and coworkers. Items were scored from 0 to 3 and total scores were calculated by averaging the ratings across items. Inter-item reliability in the present sample was Cronbach's  $\alpha=.79$ .

*Revised Neuroticism, Extraversion and Openness Personality Inventory* (NEO PI-R; Costa & McCrae, 1992). The NEO PI-R is the most widely used and internationally validated instrument that measures five factors of adult personality: Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness. Each of these five domains contains 6 facets, which can be grouped into 'aspects' that lie at a level of detail between facets and domains (DeYoung, Quilty & Peterson, 2007). The test consists of 240 items on a 5-point Likert scale (strongly disagree, disagree, neutral, agree, strongly agree) to measure the participant's agreement with statements about his or her typical behaviors, thoughts and feelings across many situations. Scores on each facet may range from 0 to 32 and domain scores can range from 0 to 192. Following the standard scoring rules for the NEO PI-R, facet scores were only included if at least 6 of the 8 items were answered, and no scores were included if a respondent failed to answer at least 180 of the 240 items. The NEO PI-R developers report that its subscales are internally consistent, with Cronbach's  $\alpha$  estimates ranging from .70 to .82 (Costa & McCrae, 1992). Scores on the Openness domain were not analyzed because meta-analytic evidence

has rejected the validity of that domain as a correlate of relevant clinical syndromes (Kotov, Gamez, Schmidt & Watson, 2010; Samuel & Widiger, 2008), and because it taps general intelligence rather than being purely a dimension of personality (DeYoung, Quilty, Peterson & Gray, 2014).

*Gambling Motives Questionnaire* (GMQ; Stewart & Zack, 2008). The GMQ is a 15-item measure that assesses the frequency of gambling for each motive on a 4 point Likert scale (never or almost never, sometimes, often, almost always or always). The GMQ has three 5-item subscales measuring Social, Enhancement and Coping motives for gambling. We included an additional set of 9 financial questions that were also used in a population gambling study in Manitoba (MGCC, 2010) at the end of the GMQ for exploratory purposes. Dechant (2013) recently reported a factor analyses of the GMQ including these same financial motive items and found support for a 4-item Financial scale. We scored the 3 original 5-item GMQ scales and the Financial scale by averaging the ratings across items. Inter-item reliability in the present sample was Cronbach's  $\alpha$  = .83, .81, .73, and .79 for the Coping, Enhancement, Social and Financial scales respectively.

*Informational Biases Scale* (IBS; Jefferson & Nicki, 2003). The IBS was designed to measure gambler's cognitive distortions, particularly about VLTs, and it is comprised of 25 self-report items scored on a 7 point Likert scale anchored with "Don't agree at all", "Partially agree" and "Strongly agree". Total scores were calculated by averaging the ratings across items. Inter-item reliability in the present sample was Cronbach's  $\alpha$  = .93.

### Statistical approach

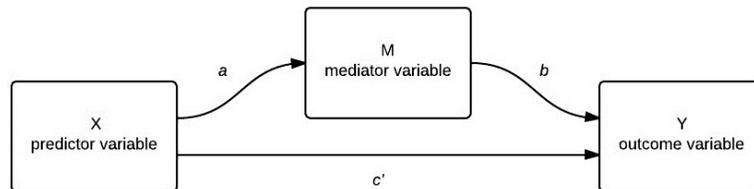
Data analysis was conducted in two phases to test the two major hypotheses of the study. The first phase tested the idea that personality, gambling motives and cognitive distortions may differ as a function of problem gambling severity. The sample was divided into groups labeled as Low Risk, Moderate Risk and High Risk according to PGSI scores. The NEO PI-R, GMQ and IBS scores of the three groups were compared using analysis of variance, with planned contrasts between the Moderate and High Risk groups versus the Low Risk group.

The second phase of analysis used multiple regression to quantify the relative contributions of personality traits, gambling motives and gambling beliefs as predictors of continuous problem gambling scores. To minimize the number of predictor variables sharing common variance with PGSI scores, only variables were included that showed significant differences between the Low Risk and High Risk groups in the first phase of analysis. To further reduce the number of predictors, aspect scores (DeYoung, Quilty & Peterson, 2007) were used instead of facet scores to represent the components of Neuroticism and Conscientiousness that differed between the Low Risk and High Risk groups. Aspect scores were felt to better represent the contributions of these traits than domain scores, which would include components that did not differ significantly between the groups. To statistically control for the potential confounding of demographics and personality, age and sex were also included as covariates.

We also tested the possibility that gambling motives and cognitive distortions may be proximate contributors to problem gambling severity that mediate more general tendencies related to personality. Personality traits were considered as more distal contributors to problem gambling because personality has a large heritable component and adult personality is generally established by the age when young adults first encounter legal opportunities to gamble. Personality development must therefore precede access to gambling and the formation of any gambling motives and cognitive distortions that may contribute to problem gambling. The PROCESS macro (Hayes, 2013) was used to quantify indirect effects of personality. The statistic of interest in these analyses was the product of the regression coefficients obtained when the mediator variables (i.e. GMQ and IBS scores) were regressed onto trait predictors (designated as effect *a* in Figure 1), multiplied by the regression coefficients obtained when

problem gambling outcome was regressed onto the mediators (effect  $b$ ). The product of these coefficients yielded path coefficients (effect  $ab$ ) independent of any direct effect of the personality predictor on the problem gambling outcome (effect  $c'$ ). In order to test for an indirect effect, an iterative bootstrapping procedure was used to draw random samples *with replacement* from the original data set, with the  $N$  of each resample equal to the number of cases in the original data set. This resampling was used to estimate a population-level sampling distribution of the  $ab$  path coefficient. For each of the 100,000 resamples that were drawn, separate regression analyses were run for each of the personality aspects that were treated as predictors. In each case the trait of interest was specified as the predictor, the 4 GMQ motives and IBS were specified as potential mediators, and age and sex were treated as covariates along with the remaining traits. Percentile bootstrap tests were run using the same seed (i.e. 5235) to ensure that the same set of 100,000 pseudorandom resamples was used in each mediation test. To enable nondirectional tests for significance of indirect effects, 95% confidence intervals were constructed by rank ordering the  $ab$  effects in all resamples, and identifying the values that constrained the middle 95% of estimates. Statistically significant indirect effects were identified when the 95% confidence intervals did not include a value of 0.

Figure 1.  
Conceptual model of direct and indirect effects.



### Study limitations

The findings of this study should be interpreted with the recognition that the data were collected from a small and potentially nonrepresentative convenience sample using self reports in a cross-sectional design. Any results from a correlational study like this one need to be replicated by research using more rigorous experimental or longitudinal methods if strong conclusions are to be made on the basis of converging evidence.

## Results

### Characteristics of Low, Moderate and High Risk EGM players

*CPGI group comparisons.* To examine the features of EGM players who were judged as being at Low, Moderate or High Risk of being Problem Gamblers on the basis of their self reports, the sample was divided into 3 groups according to the severity of symptoms indicated on the PGSI. There were 64 Low Risk gamblers (35 women, 29 men, Mean age = 31.6 years, SD = 11.2), 103 Moderate Risk gamblers (48 women, 53 men, Mean age = 32.7, SD=11.2) and 106 Problem Gamblers (63 women, 41 men, Mean age = 36.7, SD = 10.8).

Two questions on the CPGI asked about how much money participants spend on gambling. When participants were asked, “In the past year, about how much money did you spend out of pocket on all gambling activities in a *typical month*, not including any winnings that you re-gambled?”, the Low Risk group gave lower amounts ( $M=\$159.08$ ,  $SD=395.69$ ), than the Moderate Risk group ( $M=\$373.59$ ,  $SD=659.58$ ) or the High Risk group ( $M=\$1010.85$ ,  $SD=2753.65$ ). This did not include 2 High Risk participants who gave implausible answers (i.e. \$10,000 and \$25,000). The overall effect of

group on reported monthly expenditure was significant ( $F_{2,257} = 5.30, p=.006$ ). Dunnett's  $t$  test found the High Risk group's estimates to be significantly higher than those of the Low Risk group ( $p=.003$ ), but the Moderate Risk group did not differ from the Low Risk group ( $p=.338$ ).

When participants were asked, "In the past year, what is the *largest* amount of money you spent out of pocket on gambling in any *one day*, not including any winnings that you re-gambled?", increasing amounts were given by the Low Risk ( $M=\$106.50, SD=189.90$ ), Moderate Risk ( $M=\$205.73, SD=297.48$ ) and High Risk groups ( $M=\$402.55, SD=595.80$ ). The overall effect was significant ( $F_{2,258} = 10.41, p<.001$ ). Dunnett's  $t$  test found significantly higher estimates in the High Risk group than the Low Risk group ( $p<.001$ ), but the Moderate Risk group did not differ from the Low Risk group ( $p=.125$ ).

High Risk gamblers reported causing more harm to others due to their gambling. There was a significant effect of group on the CPGI population harm scale ( $F_{2, 270} = 74.6, p<.001$ ). The High Risk group had higher scores (Mean=.83,  $SD=.66$ ) than the Moderate Risk group (Mean=.19,  $SD=.24$ ) and the Low Risk group (Mean=.09,  $SD=.23$ ). Dunnett's  $t$  test showed a significant difference between the High and Low Risk groups ( $p<.001$ ) but not between the Moderate and Low Risk groups ( $p=.140$ ).

*Group comparisons on gambling motives, cognitive distortions and personality.* As shown in Table 1, there were large significant effects of group on the GMQ and IBS scales. The High Risk group had higher scores than the Low Risk group on the IBS and all four GMQ scales. The Moderate Risk group also scored higher than the Low Risk group on IBS and the GMQ Coping Enhancement and Financial scales. Pearson correlations with continuous PGSI scores are given in Table 1 as indicators of effect size.

The High Risk group had higher scores than the Low Risk group on Neuroticism and its facets of Depression, Self-consciousness and Vulnerability, with the Anxiety facet also closely approaching significance. There were nonsignificant group effects on Angry Hostility and Impulsiveness. The overlap of the four facets has been noted in a factor analytic study (DeYoung, Quilty & Peterson, 2007), which identified these four as possible markers for a sub-domain of Neuroticism called the *Withdrawal* aspect. The pattern of having significant results with these particular four facets corresponds well with the Withdrawal concept. When the four facets were summed together to form a Withdrawal score, it was found to differ significantly across the 3 severity groups ( $F_{2,264} = 8.04, p<.001$ ) and Dunnett's  $t$  test found that the high Risk group had significantly higher scores than the Low Risk group ( $p<.001$ ).

The High Risk group had lower scores than the Low Risk group on Conscientiousness and its facets of Competence, Dutifulness, Achievement Striving and Self-discipline. There were nonsignificant effects on Order and Deliberation. DeYoung et al., identified the 4 facets as possible markers for an aspect of Conscientiousness called *Industriousness* and the pattern of significant results for these four Conscientiousness facets maps neatly onto the Industriousness concept. Industriousness scores formed by summing the four facets were found to differ significantly across the 3 severity groups ( $F_{2,260} = 6.64, p=.002$ ) and Dunnett's  $t$  test found that the High Risk group had significantly lower scores than the Low Risk group ( $p=.001$ ).

There were also significant effects of Extraversion and its facets of Excitement Seeking and Positive Emotions, but only the Positive Emotions facet showed significant differences between the High Risk group and the Low Risk group. There was also an effect of the trust facet of Agreeableness, with higher scores in the High Risk group than the Low Risk group.

Table 1.

*Personality traits, Gambling Motives, and Gambling Beliefs among Low, Moderate and High PGSI groups.*

Trait	Low Risk	Moderate Risk	High Risk	Combined	<i>F</i>	<i>p</i>	<i>r</i>
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)			
Neuroticism	92.0 (20.62)	95.6 (17.65)	103.2 (21.03)*	97.8 (20.17)	7.17	.001	.30
N1 Anxiety	16.6 (4.51)	17.0 (4.59)	18.2 (4.77)	17.3 (4.68)	2.92	.056	.17
N2 Angry hostility	15.9 (4.96)	15.5 (4.39)	16.8 (4.74)	16.1 (4.68)	1.87	.156	.17
N3 Depression	15.2 (5.56)	16.8 (4.84)	17.9 (5.48)*	16.9 (5.35)	5.28	.006	.24
N4 Self-consciousness	15.6 (4.49)	16.4 (3.81)	17.2 (4.11)*	16.5 (4.13)	3.38	.036	.22
N5 Impulsiveness	17.2 (4.08)	17.8 (4.25)	18.7 (4.46)	18.0 (4.32)	2.50	.084	.18
N6 Vulnerability	11.5 (4.77)	12.3 (4.70)	14.1 (4.89)*	12.8 (4.89)	6.93	.001	.28
Extraversion	111.0 (19.60)	111.7 (16.70)	104.8 (19.23)	108.8 (18.61)	4.20	.016	-.19
E1 Warmth	21.6 (5.93)	21.3 (4.64)	20.0 (4.85)	20.8 (5.07)	2.73	.067	-.18
E2 Gregariousness	16.6 (5.08)	17.1 (4.95)	16.1 (5.18)	16.6 (5.07)	1.06	.347	-.09
E3 Assertiveness	15.6 (4.68)	16.3 (4.23)	15.7 (4.42)	15.9 (4.40)	0.60	.550	-.04
E4 Activity	17.4 (3.95)	17.5 (3.45)	16.4 (3.81)	17.1 (3.74)	2.59	.077	-.10
E5 Excitement seeking	19.0 (5.15)	19.9 (4.99)	18.1 (4.99)	19.0 (5.07)	3.49	.032	-.11
E6 Positive emotions	20.4 (4.53)	19.7 (4.17)	18.5 (4.50)*	19.4 (4.44)	4.40	.013	-.26
Agreeableness	109.6 (17.27)	109.5 (15.36)	108.3 (15.73)	109.1 (15.90)	0.20	.818	-.09
A1 Trust	17.1 (3.78)	16.0 (4.44)	15.4 (4.41)*	16.0 (4.32)	3.28	.039	-.18
A2 Straightforwardness	18.2 (4.41)	17.8 (4.78)	17.9 (4.63)	17.9 (4.62)	0.11	.897	-.09
A3 Altruism	21.9 (5.19)	21.6 (4.37)	20.8 (4.62)	21.3 (4.68)	1.50	.224	-.12
A4 Compliance	15.5 (4.82)	15.5 (4.10)	16.0 (4.51)	15.7 (4.43)	0.51	.602	.02
A5 Modesty	17.7 (4.17)	18.5 (4.17)	18.6 (3.87)	18.3 (4.06)	1.04	.354	.08
A6 Tender-mindedness	19.3 (3.65)	20.2 (3.79)	19.7 (4.18)	19.8 (3.92)	1.20	.304	-.02
Conscientiousness	111.7 (20.37)	108.8 (18.12)	103.0 (18.24)*	107.2 (18.95)	4.68	.010	-.29
C1 Competence	19.7 (4.39)	19.0 (4.00)	17.8 (4.30)*	18.7 (4.26)	4.17	.017	-.25
C2 Order	17.4 (4.23)	17.8 (4.01)	17.3 (3.83)	17.5 (3.98)	0.53	.589	-.09
C3 Dutifulness	20.3 (5.00)	19.5 (4.31)	18.3 (4.22)*	19.2 (4.50)	4.46	.012	-.24
C4 Achievement striving	18.5 (4.14)	18.2 (3.96)	16.9 (4.43)*	17.7 (4.23)	3.49	.032	-.23
C5 Self-discipline	19.5 (4.87)	18.0 (4.75)	17.4 (4.58)*	18.1 (4.76)	3.93	.021	-.22
C6 Deliberation	16.1 (4.40)	16.3 (4.73)	15.4 (4.37)	15.9 (4.52)	1.20	.302	-.18
GMQ Coping	0.30 (0.36)	0.54 (0.49)*	1.12 (0.71)*	0.71 (0.66)	49.54	<.001	.61
GMQ Enhancement	0.83 (0.54)	1.23 (0.66)*	1.52 (0.69)*	1.25 (0.70)	22.58	<.001	.47
GMQ Social	0.76 (0.47)	0.93 (0.55)	1.19 (0.66)*	0.99 (0.60)	12.14	<.001	.35
GMQ Financial	1.22 (0.74)	1.63 (0.80)*	2.00 (0.81)*	1.68 (0.84)	20.12	<.001	.41
IBS	3.10 (0.98)	3.97 (1.02)*	4.61 (1.15)*	4.01 (1.21)	40.47	<.001	.54

*Note:* \*significantly different from Low Risk group using Dunnett's *t* test with  $p < .05$ , 1 tail. All Pearson *r* correlations  $\geq .10$  between traits and PGSI are  $p < .05$ , 1 tail.

Contributions of gambling motives, cognitive distortions and personality to Problem Gambling.

*Correlations with PGSI.* As shown in Table 2, there were robust positive correlations between PGSI scores and the GMQ Coping, Enhancement, Social, and Financial motives, as well as the IBS measure of cognitive distortions. There was also a positive correlation with the Withdrawal aspect of Neuroticism and a negative correlation with the Industriousness aspect of Conscientiousness. PGSI scores also correlated negatively with the Positive Emotions facet of Extraversion and the Trust facet of Agreeableness.

Table 2.

*Pearson correlations among personality traits, gambling motives and beliefs.*

	1	2	3	4	5	6	7	8	9	10
1. PGSI		267	271	271	263	273	273	273	273	273
2. Withdrawal (N)	.30**		266	266	261	267	267	267	267	267
3. Positive Emotions (E)	-.26**	-.31**		270	263	271	271	271	271	271
4. Trust (A)	-.18**	-.35**	.39**		263	271	271	271	271	271
5. Industriousness (C)	-.30**	-.59**	.45**	.35**		263	263	263	263	263
6. GMQ Coping	.61**	.17**	-.04	.02	-.20**		273	273	273	273
7. GMQ Enhancement	.47**	.09	.01	-.03	-.17**	.62**		273	273	273
8. GMQ Social	.35**	.01	.10	.00	-.08	.54**	.50**		273	273
9. GMQ Financial	.41**	.14*	-.03	-.08	-.13*	.38**	.49**	.41**		273
10. IBS	.54**	.24**	-.13*	-.15*	-.19**	.43**	.48**	.33**	.56**	

Note: \*\*  $p < .01$ ; \*  $p < .05$ ; numbers of participants in each pairwise correlation are given above the diagonal.

*Direct effects on PGSI.* Continuous PGSI scores were regressed onto age and sex, followed by 4 GMQ motives and IBS, then 4 personality traits. As shown in Table 2, there were substantial correlations among these predictor variables. The overall regression equation was significant ( $F_{11,245} = 29.61, p < .001, R = .76$ ). There were significant effects for GMQ Coping ( $\beta = .34, t = 5.54, p < .001$ ), IBS ( $\beta = .25, t = 4.35, p < .001$ ), age ( $\beta = .20, t = 4.48, p < .001$ ), Positive Emotions ( $\beta = -.16, t = -3.26, p = .001$ ), GMQ Financial ( $\beta = .11, t = 2.04, p = .042$ ), and male sex ( $\beta = -.10, t = -2.13, p = .035$ ). There were nonsignificant effects for GMQ Enhancement ( $\beta = .06, t = 1.04, p = .301$ ), Industriousness ( $\beta = -.06, t = -1.03, p = .306$ ), Withdrawal ( $\beta = .04, t = 0.72, p = .473$ ), Trust ( $\beta = -.04, t = -.78, p = .436$ ), and GMQ Social ( $\beta = .02, t = 0.33, p = .745$ ). The same variables were identified as significant predictors when the regression was repeated with simultaneous entry.

*Indirect effects.* Mediation tests were conducted for the Industriousness and Withdrawal aspects and for the Positive Emotions and Trust facets. The possible indirect effects of these traits were examined because they correlated significantly with PGSI scores and they differed significantly between the High Risk and Low Risk groups. In each of these mediation tests the IBS and 4 GMQ scales were treated as potential mediators, and the remaining 3 personality traits were covariates along with age and sex. The point estimates and confidence intervals for these mediation tests are shown in Table 3. There was a significant indirect effect of low Industriousness on PGSI mediated through high GMQ Coping, and this effect was confirmed when domain scores for Conscientiousness and Neuroticism were used instead of aspects ( $ab = -.019$ ; 95% CI:  $-.0376$  to  $-.004$ ). The effect of Withdrawal mediated through IBS was also marginally significant, with the lower bound of its 95%

confidence interval slightly above 0. However, this result should be interpreted with caution because the confidence interval included a few values below 0 when Neuroticism and Conscientiousness domain scores were used instead of aspects ( $ab=.011$ ; 95% CI: -.000 to .026).

Table 3.  
*Indirect effects of NEO PI-R personality domains and facets on PGSI problem gambling scores.*

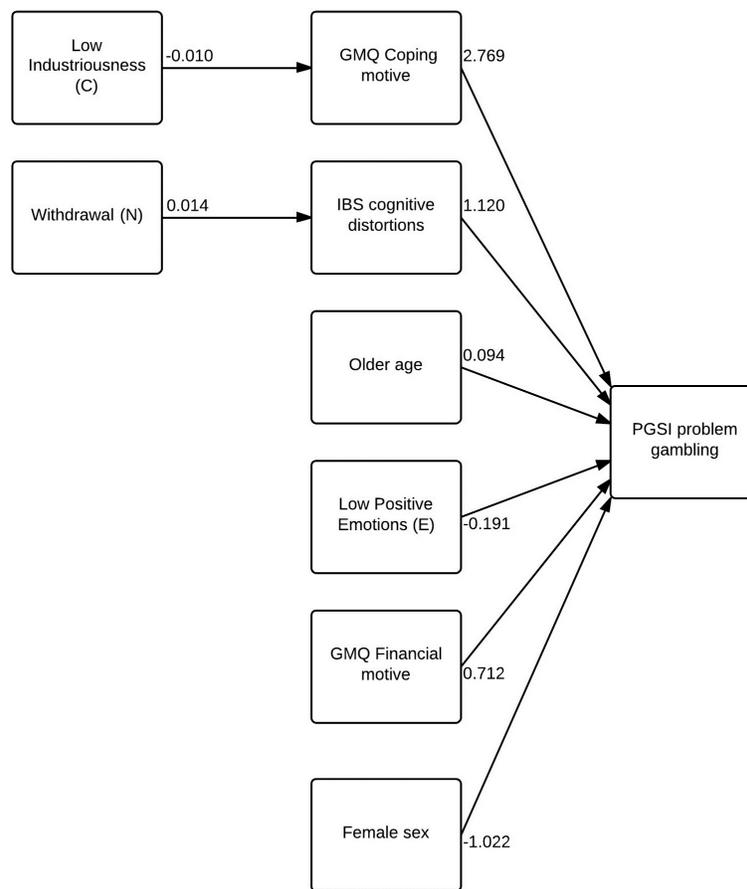
Predictor	<u>Mediators</u>				
	<u>GMO Coping</u>	<u>GMO Enhance</u>	<u>GMO Social</u>	<u>GMO Finance</u>	<u>IBS</u>
	<i>ab</i> (95%CI)	<i>ab</i> (95%CI)	<i>ab</i> (95%CI)	<i>ab</i> (95%CI)	<i>ab</i> (95%CI)
Withdrawal (N)	.008 (-.011; .031)	-.000 (-.006; .006)	-.000 (-.006; .005)	.005 (-.002; .015)	<b>.015 (.000; .036)</b>
Positive Emotions (E)	.004 (-.055; .062)	.007 (-.009; .030)	.003 (-.245; .030)	.007 (-.011; .032)	-.004 (-.045; .037)
Trust (A)	.046 (-.018; .118)	-.001 (-.017; .017)	-.001 (-.015; .014)	-.010 (-.038; .009)	-.022 (-.073; .021)
Industriousness (C)	<b>-.027 (-.053; -.006)</b>	-.005 (-.019; .004)	-.001 (-.011; .010)	-.002 (-.012; .005)	-.006 (-.024; .010)

*Note:* significant indirect effects are boldfaced.

Figure 2 depicts all of the significant direct and indirect effects on PGSI. Nonstandardized regression coefficients are given in the figure and the constant was .985. The model accounted for 57% of the variance in PGSI scores ( $R^2=.57$ ).

Figure 2.

*Model of direct and indirect effects on problem gambling severity.*



## Discussion

Past research into the antecedents of PG has consistently supported three characteristics of players that differ between problem and nonproblem gamblers, namely gambling motives, distorted beliefs about gambling, and personality traits such as high Neuroticism, low Conscientiousness, and impulsivity. The present study integrates these three characteristics into a unified model whereby the Coping motive and cognitive distortions mediate indirect effects of personality traits that increase vulnerability to PG. This model applies to EGM players and it is not yet known whether this model would accurately represent the pattern among other types of gamblers.

### Characteristics of EGM players at Low, Moderate and High Risk of problem gambling.

The players we identified as High Risk for PG on the basis of their PGSI scores reported spending more money per month, and gambling with larger maximum amounts in a single sitting than

those at lower risk. They also reported more perceived harmful effects of their gambling on other people. These self-reports corroborate their assignment to a higher risk category on the basis of the PGSI screen.

There were potent effects of PG group on gambling motives, cognitive distortions, and personality traits. The High Risk group had significantly higher scores on cognitive distortions measured by the IBS, as well as the Coping, Enhancement, Financial and Social scales of the GMQ. They also had lower scores on the Industriousness-related facets of Conscientiousness and higher scores on the Withdrawal-related facets of Neuroticism, as well as lower scores on the Positive Emotions and Trust facets. These findings strongly support our hypothesis that problem EGM players differ markedly from nonproblem players in terms of personality, motives for gambling and distorted beliefs and attitudes about gambling. The High Risk group may represent a distinct type of EGM player.

#### *What 'type' of gambler is a typical problem EGM player?*

Blaszczynski & Nower's (2002) 'pathways model of Problem and Pathological Gambling' claims the existence of 3 distinct subtypes of problem gambler. According to that theory, 'behaviorally conditioned' gamblers acquire the habit of excessive gambling through operant conditioning without individual characteristics that predispose them toward addictive behavior. The 'antisocial impulsivist' subtype gambles excessively due to an unusual combination of personality characteristics that might overlap with antisocial or borderline features such as substance use, aggression, criminality and risk taking. The third subtype, 'emotionally vulnerable', appears to most closely match the typical High Risk player in our sample. This subtype is believed to gamble because of emotional instability and a tendency toward negative emotional states that are avoided by the distraction of gambling. The EGM players in our sample who were at High Risk for being problem gamblers differed from the Low Risk players on exactly the kinds of personality traits the emotionally vulnerable prototype would seem likely to have. They had higher scores on the Withdrawal family of Neuroticism facets, and lower scores on the Positive Emotions facet of Extraversion. They also had lower scores on the Industriousness group of Conscientiousness facets. This combination of characteristics closely matches the 'demoralized' problem gamblers described by Vachon and Bagby (2009), and maps well onto Blaszczynski & Nower's emotionally vulnerable prototype. Further, High Risk players differed from the Low Risk players on only one of the four NEO PI-R facets (i.e. Self-discipline) that reflect forms of impulsivity (Whiteside & Lynam, 2001), and they scored low on just one facet of Agreeableness. This lack of antagonistic and impulsive traits suggests that they are not the antisocial-impulsivist type, and the mere presence of significant personality effects also rules out their being characterized as the behaviorally conditioned type. It is possible that there might be some behaviorally conditioned or antisocial-impulsivist players in our sample, but the overall pattern of findings supports an interpretation that our sample best fits the emotionally vulnerable subtype described in the pathways model.

#### Contributions of gambling motives, cognitive distortions and personality to Problem Gambling.

Using regression techniques, we found that most of the variability in continuous PGSI scores was predicted by a weighted combination of GMQ Coping, IBS cognitive distortion, age, low Positive Emotions, GMQ Financial motive, and sex. The effect of being female runs counter to the generally higher likelihood of PG among men, but the effect was not great (54.6% of Low Risk were female versus 60.6% of High Risk) and our results are consistent with the pattern of older age being a predictor among women (Afifi, Cox, Martens, Sareen & Enns, 2010). The predicted relationships between PG symptoms and gambling motives and cognitive distortions were found to be quite robust,

and there was a significant effect of low Positive Emotions. As predicted, there were no direct effects of Neuroticism or Conscientiousness but we found support for aspects of these traits having indirect effects on PGSI that were mediated through their influence on the Coping motive and cognitive distortions. These mediated effects suggest mechanisms through which personality traits of Withdrawal and low Industriousness may increase likelihood of PG.

There are 4 facets of Conscientiousness that comprise the Industriousness aspect, and all 4 of these were significantly lower in players with higher PGSI scores. The remaining 2 Conscientiousness facets both had null effects. The Industriousness aspect did not have a significant direct effect on PGSI scores but it did have a significant indirect effect that was mediated through a contribution to lower scores on the GMQ Coping motive. One explanation for this result might be that EGM players with low Industriousness may have poor capacity for self-regulation that makes it more difficult for them to control their gambling behavior even in the face of recurring losses. Such players might continue to gamble as a temporary escape from perceived problems rather than seek a more proactive solution. Indeed, their lack of ability to self-manage their gambling could feedback positively into growing financial problems that promote further need to escape through gambling. Another more sociological explanation for this result is that we live in an era when many people place great value on material wealth but little value on earning money through work. The promise of effortless windfalls through nonstrategic EGM gambling might appeal strongly to the least Industrious people, particularly when they are motivated to cope with the anxiety that can result from financial pressures. Again, the temporary solution is to use gambling as a familiar escape. One practical implication of these explanations is that public awareness campaigns and player limit setting schemes that promote willful self-restraint as a solution to PG are likely to have little positive impact on the class of players who have the least capacity to adhere to self-imposed limits and who are most likely to experience gambling problems.

We also found that cognitive distortions measured by the IBS mediated an indirect effect of the Withdrawal aspect of Neuroticism. Three of the 4 Withdrawal facets had significant group differences, the fourth came very close to significance, and the remaining 2 Neuroticism facets were not significant. The name 'withdrawal' is rather telling, as it comes out of a school of thought in personality psychology that has long emphasized the role of individual tendencies to respond more or less strongly to signals of reward and/or punishment. This theory is known as Reinforcement Sensitivity Theory (e.g. Corr, DeYoung & McNaughton, 2013) and the Withdrawal aspect of Neuroticism is considered to be an indicator of the tendency for one's behavior to be affected strongly by signals of punishment or nonreward. The mediation of an effect of Neuroticism through IBS was not expected; rather we predicted that it would be mediated through Coping. However, this finding is not difficult to reconcile when we consider that these emotionally vulnerable gamblers might imagine winning money as a solution to their financial concerns, but be acutely sensitive to disappointment and suffer emotional upset when faced with recurring losses. Losses are quite likely to accrue with extended participation in any gambling game that has a house edge, such as EGMs with a payback percentage well below parity (Harrigan & Dixon, 2009). Cognitive distortions like the gambler's fallacy, illusions of control and faith in superstitions might reflect a desperate attempt to attribute these sad outcomes to forces that can be understood and perhaps controlled. Somewhat paradoxically, these punishment-sensitive players might impulsively "chase" losses (Breen & Zuckerman, 2007) with renewed effort in order to escape the reality of having lost large sums of money by winning it back. This speculation explains how the punishment sensitivity of Neuroticism, combined with the experience of unpredictable and often negative outcomes, might lead to cognitive distortions that sustain further gambling. However, this effect was only significant with the Withdrawal aspect and not the full Neuroticism domain, so we offer only tentative support for this contention.

### *Why do they prefer EGMs?*

One question that follows from our explanations of these results concerns why EGM players are so strongly represented by emotionally vulnerable types, with their low Industriousness and Coping, and their high Withdrawal and cognitive distortion. One possibility is that these player characteristics might interact with the structural characteristics of the games they play to encourage continued play that leads to financial and social problems. Modern multiline EGMs create anticipation of potential reward in the form of large wins and 'bonus rounds', but they may be played in such a way as to create a high frequency of small wins and long 'time on device' before the player's funds are exhausted (Harrigan, Dixon, MacLaren, Collins & Fugelsang, 2012). The low volatility of these games may reassure the player that long losing streaks can be avoided, and invite continued gambling by giving the impression that risk can be minimized by the predictability of outcomes (Harrigan, MacLaren, Brown, Dixon & Livingstone, in press). Of course, EGMs are games of chance and their outcomes are not really predictable, but these games are carefully designed to create a sustained and continual experience of anticipated reward with minimal attention to losses (Dow Schull, 2012). These game elements might have a disproportionate effect on some players who are most prone to PG.

### Conclusions and future directions.

Problem EGM players differ from nonproblem players in terms of their motives for gambling, their cognitive distortions about gambling, and personality traits. Responsible gambling initiatives aimed at preventing or treating PG should take into account the differences between the majority of players who do not have a predisposition toward excessive gambling versus the minority who do have characteristics that increase risk. Another area for future study may be the nature of the interactions between players' characteristics and design features of modern EGMs that may unfortunately promote PG among the most vulnerable players. Ultimately this line of research could inform game designers and policy makers who regulate the gaming industry to ensure that the games that are provided under legal authority of government are ones that provide good entertainment value for the majority of nonproblem players, while minimizing the risk of harm to those who may be the most prone to PG.

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