manitoba gambling research PROGRAM

Behavioural Indicators and Player Characteristics of Frequent VLT Players

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Abstract

Most of the revenues generated by legal gambling in Canada come from EGMs, and there is a stronger relationship between Problem and Pathological Gambling (PPG) and past year participation in EGM gambling than there is with other forms of gambling. This study was focused on the potential for a simple measure of excessive EGM gambling behavior to be used in predicting PPG and as a practical tool for monitoring the population prevalence of PPG. Self-reported frequency, duration and expenditure of EGM play were found to accurately predict the likelihood of PPG measured by the PGSI. A simple unweighted index formed by the sum of participants' numerical ratings of frequency, duration and expenditure allowed a high proportion of nonproblem and problem gamblers to be correctly identified. Hierarchical regression found that the index accounted for additional variance in self-reported harms from gambling, even when controlling for demographics, gambling motives, distorted gambling cognitions, personality, and problem gambling severity scores. Potential applications were discussed in terms of safe EGM gambling limits and the potential for population PPG prevalence to be monitored using behavioral data collected from player cards and internet gambling accounts.

Keywords: gambling; problem gambling; EGMs; VLTs; slot machines; safe limits

Behavioral indicators of excessive EGM play: Introduction

Legal gambling is a form of entertainment that is an important source of revenue for businesses, governments and charities. As in other countries with legalized gambling, most adults in Canada participate in some form of gambling, including lotteries, casino games, sports betting, Bingo, and Electronic Gambling Machines (EGMs). In a 2013 survey, a large majority (77.3%) of Manitobans reported some kind of gambling in the past year (Liquor and Gaming Authority of Manitoba, 2014), but most of this participation was in the form of relatively low-cost and low-risk activities such as weekly lotteries. A smaller group of Manitobans reported playing casino slots (35%) or VLTs in racetracks and bars (25%), yet the lion's share of gambling revenue came from EGMs. In that same 2012-13 fiscal year, Manitoba's gross revenue from EGMs, lotteries, casino games and Bingo totaled $672,785,000, with $540,283,000 (80.3%) coming from slots and VLTs (Canadian Partnership for Responsible Gambling, 2014). The remaining 19.7% came from lotteries (15.6%), non-slots casino games (3.7%), and Bingo (0.4%). Gambling revenues in Manitoba and across Canada peaked in the 1990s when EGMs were being widely introduced and have been slowly declining in recent years (Williams, Rehm & Stevens, 2011). There are many reasons why the rates of gambling participation may change over time, such as temporary increases due to greater accessibility and perceived novelty when new forms of gambling are introduced to a city or region (Jacques & Ladouceur, 2006), versus the rate of adaptation (LaPlante & Shaffer, 2007) as some players reduce or stop gambling due to loss of interest, attempts to reduce their gambling expenditures, or financial insufficiency.

Playing EGMs is more strongly associated with PPG than other forms of legal gambling in Canada.

The present study dealt with the gambling behaviour of problem versus nonproblem EGM players. The focus on EGM players was inspired by the widely acknowledged association between EGM play and addictive gambling behaviour (Dowling, Smith & Thomas, 2005; Smith & Schopflocher, 2014), and the disproportionately high share of revenue that may be drawn from a small percentage of problem gamblers who play EGMs excessively and lose large sums of money (Williams & Wood, 2004).

There is a stronger relationship between PPG and playing EGMs than there is between PPG and other forms of gambling. To show that this is true, I examined past year gambling participation rates of problem and nonproblem gamblers that were reported in 39 surveys that have been conducted in all 10 Canadian provinces. Table 1 summarizes these data converted into risk ratios, with random effects meta-analyses to give mean effect sizes and 95% confidence limits (Borenstein, Hedges, Higgins & Rothstein, 2009). These relative risks represent the degree to which problem gamblers are more likely to report having played each form of gambling within the past year relative to nonproblem gambers. For example, in the 2008 Manitoba survey there were 67 problem gamblers and 899 nonproblem gamblers who played VLTs in the previous year, so the percentage of VLT players that are problem gamblers is estimated at 67/(67+899), or 6.94%. This is compared to the percentage of nonplayers who are problem gamblers (18) and nonproblem gamblers (3261), which is 18/(18+3261), or 0.55%. The ratio of these two percentages gives the *relative risk*, which in this example is 6.94/0.55, or 12.6. Thus, we can see that VLT players in Manitoba are about 12.6 times as likely to be problem gamblers than VLT nonplayers.

It is no surprise that problem gamblers report more gambling participation than nonproblem gamblers, but something more interesting can be seen when the magnitude of these differences is compared across the different forms of gambling. The mean risk ratio for VLTs across studies is 12.5 with a 95% confidence interval of 8.0-19.6. This confidence interval overlaps those of internet gambling and casino table games, but not other common forms of gambling. Llooking at participation rates across the 39 provincial surveys, I have calculated that twice as many people play VLTs (10.8%,

+/- 4.7% 19 times out of 20) as play casino table games (5.4%, +/- 2.1 19 times out of 20), and only a few gamble on the internet (1.6%, +/- 1.2 19 times out of 20), so the *overall harm* from VLTs is likely to be much greater simply because more people play them, and those who play often may spend a lot of money on them. Sportselect, horse racing, Bingo, scratch or instant win tickets, and weekly lotteries all have mean odds ratios that are much smaller than VLTs and their confidence intervals do not overlap. Curiously, playing casino slots also has a low relative risk, but these figures probably include many people who do not play them regularly but merely visited a casino in the past year while on vacation or for a special occasion. A better indicator might be the relative risk of playing EGMs in the subset of surveys that reported *weekly* participation rather than at least once in the past year♠. These differences in effect size quantify a substantially stronger correlational relationship between problem gambling and past-year participation in VLT gambling than has been seen with other forms of legal gambling in Canada. Considered alongside the vastly greater revenues that are drawn from EGMs relative to other forms of gambling, it is clear that EGMs are central to the issue of problem gambling in Canada.

Table 1.
Relative risk of problem gambling among past-year participants in nine legal gambling activities compared to nonparticipants (citations are given in Appendix A).

Author	Province	Year	VLTs	Internet	Casino	Sport	Horses	Bingo	Slots	Scratch	Lottery
Afifi	National CCHS	2014	6.38	3.1	4.0	3.3	2.8	3.2	3.0	2.4	1.3
Williams	Alberta	2011	10.5	4.8	5.6		2.7	6.1	7.8	3.2	2.1
Smith	Alberta	2002	10.8	52.0	12.8	4.5	1.8	7.9	4.1	2.3	2.3
Wynne	Alberta	1998	8.4	1.0		2.8	5.1	5.3		2.5	1.4
Ipsos Reid	Brit Columbia	2008		1.8		4.9	1.8	6.9	2.4		1.4
Ipsos Reid	Brit Columbia	2003		0.1		7.5	4.0	1.2	6.2		15.7
Angus Reid	Brit Columbia	1996					2.3	3.2		1.7	0.8
Gemini	Brit Columbia	1994					3.6	7.1		2.6	2.6
LGAM	Manitoba	2014	37.9	1.3	6.3	2.0	6.0	3.3	10.6		
Lemaire	Manitoba	2008	12.6	5.6	13.4	5.6	2.2	3.6	5.4	4.6	4.1
Marketquest	New Brunswick	2010	62.0	12.9		2.2	11.4	2.8		2.0	1.4
Baseline	New Brunswick	1996	0.8					5.0		1.6	0.5
Marketquest	Newfoundland	2009	31.1	53.2		13.9	12.8	3.5		1.4	0.4
Marketquest	Newfoundland	2008	22.1	1.0		8.5		3.4		0.9	1.9
Marketquest	Newfoundland	2005	35.2	15.2		3.1	6.0	3.0		6.3	1.2
Focal	Nova Scotia	2008	12.2	11.6	6.0	4.0	4.6	1.2	2.7	1.1	1.0
Focal	Nova Scotia	2004	19.0	12.5	5.0	4.3	0.6	2.6	2.4	3.6	1.5
Baseline	Nova Scotia	1996	6.9		6.0			1.9	0.8	4.2	1.0
Omnifacts	Nova Scotia	1993	14.4				4.7	2.0	1.1		
Williams	Ontario	2013		6.6	6.9	5.4	1.6	2.9	3.2	3.1	0.9
Weibe	Ontario	2006		5.6	6.6	7.8	6.1	4.4	4.4	2.6	1.0
Weibe	Ontario	2001		1.9	10.4	6.1	7.1	5.5	3.5	2.2	1.9
Doiron	Pr Ed Island	2006	41.1				3.4	2.6	4.3	2.6	0.8
Doiron	Pr Ed Island	1999	6.9		4.6		2.4	2.9	3.1	2.8	0.9
Kairouz	Quebec	2010	1.44					3.1	1.2		0.4
Wynne	Saskatchewan	2002	19.0	13.7	6.1	5.0	6.6	2.8	9.2	9.0	4.2
Weighted Mean Relative Risk:			**12.5**	**7.7**	**7.2**	**5.4**	**3.7**	**3.7**	**3.5**	**2.5**	**1.2**
95%CI UL:			**19.6**	**12.8**	**9.1**	**6.3**	**4.7**	**4.4**	**5.0**	**3.2**	**1.6**
95%CI LL:			**8.0**	**4.6**	**5.7**	**4.6**	**2.9**	**3.0**	**2.5**	**2.0**	**0.9**

♠ Risk ratios for weekly play are 33.7 (95%CI=20.6-55.3, *k*=10) for VLTs and 22.1 (95%CI=10.0-44.8, *k*=8) for slots.

Population prevalence of PPG versus individual diagnosis of PPG.

The gambling participation rates in Table 1 are for the nonproblem and PPG subgroups within the populations of gamblers in each province. These survey results were obtained through a process of routine monitoring of participation and PPG. This is an important activity because gambling operations in Canada work under provincial mandate to oversee the conduct and management of legal gambling, which means they must work in the interest of the public good and must take reasonable steps to mitigate potential harm to consumers and citizens. In some jurisdictions there may also be legal liability if the authorities fail to take reasonable steps to ensure consumer safety that are based on current scientific understanding of the potential harmfulness of different gambling activities.

The first step in harm reduction is to measure and monitor impacts, yet this is very difficult to do on an individual basis. Gambling Disorder is a behavioural addiction in the DSM-5 (APA, 2014) and arriving at a differential diagnosis requires detailed psychological assessment of an individual. Directly measuring the population prevalence of Gambling Disorder with such a level of professional assessment for each individual in a representative sample would be cost-prohibitive and time consuming. Most prevalence studies have therefore resorted to a screening approach to detect the more broad construct of Problem and Pathological Gambling (PPG), which emphasizes risk of harm rather than discrete symptoms of a diagnosable addictive process. What makes this approach valid is that population prevalence is estimated at the population level of analysis rather than at an individual level of analysis. A reasonably accurate PPG screen like the Problem Gambling Severity Index (PGSI, Ferris & Wynne, 2001) may be used to estimate the population prevalence even if there are some inaccuracies in the scores given to particular individuals in the sample. It would not be valid to use such a screen to make any inferences about individual people because the likelihood of false positive and false negative error may be quite high when determinations are made on the basis of a standardized self-report questionnaire rather than an individualized psychological assessment. Notwithstanding the inaccuracy at an individual level of analysis, at the population level it is fairly reasonable to assume that the false positive errors in a sample may be countered to some extent by the false negative errors, and so the prevalence estimate is sufficiently unbiased for the purpose of monitoring gross impacts and changes over time. The utility in prevalence assessment may lie not so much in being able to identify the point prevalence of Gambling Disorder, but in specifying a *range* of estimates that likely contains the true rate of Gambling Disorder. In that sense a PPG estimate may be viewed as a ceiling analogous to the upper limit of a statistical confidence interval that ranges from zero up to that upper limit, with the true rate of Gambling Disorder falling somewhere within that range. Within any PPG estimate there will be included most of the people with Gambling Disorder (i.e. "pathological gamblers") as well those with subclinical adverse effects (i.e. "problem gamblers"), and some who do not have significant impacts from their gambling but who nevertheless overreport gambling problems (i.e. false positives). There will also be some people with Gambling Disorder who are not included in the PPG estimate because they underreport the adverse impacts of their gambling. Population prevalence may thus be reasonably estimated as long as the screening instrument is fairly accurate both in terms of positive predictive power (i.e. the proportion of people with test scores above the PPG cutoff who actually have Gambling Disorder) and negative predictive power (i.e. the proportion of scores below cutoff that are from people without Gambling Disorder). Gambling Disorder is socially and economically disruptive so screening instruments like PGSI should be somewhat biased toward overestimating the true prevalence of Gambling Disorder. As with any phenomenon with a low base rate of occurrence in a population, lowering the threshold for detection will tend to ensure that more true positives are captured within the prevalence estimate but at the expense of more false positives (Meehl & Rosen, 1955).

The population prevalence of PPG is rather low. According to Williams, Volberg and Stevens (2012), the standardized prevalence rates of PPG averaged 2.3% across national studies conducted

between 1991 and 2011, and ranged from 0.5% (Denmark) to 6.4% (South Africa). The rates in Canada (2.4%), the United States (2.2%), and Australia (2.0%) fell close to the middle of the international range despite great differences in gambling availability, regulation, and culture across the different countries. Although the rate of PPG in Canada has declined from a peak at 4.1% in 1996 down to 1.9% as of 2009, there remain intractable pockets of high PPG among players who are vulnerable because of demographic and social risk factors (e.g. being young, male, poor, uneducated and single; Hodgins, Schopflocher, Martin, el-Guebaly, Casey, Currie, Smith & Williams, 2012). The lifelong impact of past-year PPG may also accrue over time as transitory periods of problematic gambling involvement can have long lasting effects on individuals who experience bankruptcy, marital breakup, career disruption or suicide. There is high comorbidity of PPG with depression, substance use disorders and other mental health diagnoses (Lorains, Cowlishaw & Thomas, 2011), and it possible that psychological stress over financial insecurity may exacerbate or trigger these conditions. So although the annual incidence and lifelong prevalence of PPG may be low, the impacts on affected individuals and their families can be substantial.

Measuring excessive gambling behaviours.

Provincial authorities responsible for legal gambling have a dual mandate to maintain an industry that is safe for players, yet profitable enough to contribute to public sector finances while supporting private gambling venues and charities. This is why population surveys have periodically been done in each province to monitor impacts. Rather than relying on costly and time consuming surveys, another approach might be to directly observe excessive gambling behaviour using some form of player tracking. As is the case with surveys, it would be more important to use the population incidence of players gambling excessively to derive estimates of PPG prevalence across the population than to make any kind of individual diagnosis, so there would be no real need to violate individuals' right to privacy by collecting non-deidentified data that could be associated with individuals. Critical to this approach would be a definition of "excessive" gambling that allows the population estimate of PPG to be estimated.

Several attempts have been made to identify safe limits for gambling. These were based on cross-sectional population surveys, with Receiver Operating Curve (ROC) analyses used to select valid predictors of PPG and to set optimal cutoffs (Currie, Hodgins, Wang, El-Guebaly, Wynne & Chen, 2006; Currie, Hodgins, Wang, El-Guebaly, Wynne & Miller, 2008; Currie, Miller, Hodgins & Wang, 2009). Based on these findings, Currie, Hodgins, Casey, El-Guebaly, Smith, Williams, Schopflocher & Wood (2012) used safe gambling limits to define low risk and high risk behaviour in a longitudinal study of PPG. The safe limits were gambling no more than 3 times per month, spending no more than $1000 per year, and spending no more than 1% of gross income. Gambling above these safe limits was strongly related to PPG as measured by the PGSI. They also looked at factors that increase the likelihood of shifting from low risk gambling behaviour to high risk gambling 14 months later, and they found that among non-demographic variables, the significant predictors were having friends who also gamble, playing EGMs, and being a smoker (which may be interpreted as a marker for low socioeconomic class). Similar cutoffs for low risk gambling frequency, duration and expenditure have been independently found in a clinical sample (Weinstock, Ledgerwood & Petry, 2007) and a student sample (Weinstock, Whelan & Meyers, 2008)

Measuring excessive EGM play specifically.

Although the work of Currie and colleagues is encouraging in that it supports the feasibility of developing evidence-based limits for safe gambling, there are some pitfalls inherent to their approach. Because their safe gambling limits were developed out of population survey data that were not broken

out by gambling type, the limits that they derived are not specific to individual forms of gambling. EGMs are far more problematic than other popular types of gambling, so lumping EGM play in with less harmful gambling activities can only produce a nonspecific indicator of general gambling severity. It would be like defining a safe limit for using "drugs", but defining substance use to include alcohol and tobacco along with illegal drugs in a single index regardless of the very different patterns of addictive behaviour and harms that are associated with those drugs. A better approach would be to have separate safety cutoffs specifically for the different drugs and consider participation above the safety limit of any one of them as behaviour with a high risk of harm, since excessive smoking, drinking or using illegal drugs are all harmful in some way. Likewise, because not all gambling activities are equally associated with PPG, excessive participation in the different forms should be measured separately. Not doing so makes it difficult for gambling researchers to document the specific association between EGMs and PPG (but see Table 1).

As a model of how different addictive behaviours can be measured specifically and concurrently, consider the study by Nehlin, Gronbladh, Fredericksson & Jansson (2013). The goal of that study was to measure the prevalence and co-occurrence of addictive behaviours among a sample of 2160 Swedish psychiatric outpatients. Rather than use an omnibus measure of addictive behaviours (e.g. the Promis questionnaire by Christo, Jones, Haylett, Stephenson, Lefever & Lefever, 2003), they used 4 separate measures of gambling and the use of alcohol, tobacco, and illegal drugs. These measures were the Alcohol Use Disorders Identification Test (AUDIT; Saunders, Aasland, Babor, de la Fuente & Grant, 1993), the Drug Use Identification Test (Berman, Bergman, Palmstierna & Schlyter,2005), and *de novo* items about consumption of cigarettes and gambling participation. The frequency, amount and binge questions for these addictive behaviours are shown in Table 2. Note that each of these questions is given in a multiple choice or Likert style format. In the case of AUDIT and DUDIT these questions were scored numerically and contributed to the total scores indicating alcohol or other substance use disorders. Each of the four scales also had some questions about addiction symptoms and other harmful effects.

In contrast to the AUDIT and DUDIT, the amount and binge questions that are typically given in the CPGI are open-ended (i.e. "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?"; "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?"). Open-ended questions are notoriously difficult to quantify because respondents may give atypical answers (e.g. "I usually bet whatever I have on me"; "I spent my whole cheque once"). The CPGI frequency question is in a Likert format, but unfortunately it refers to all types of gambling combined (i.e. "In the past year, how often did you bet or spend money on gambling, including all the activities that you checked off in part I? Daily or nearly every day, 2 to 6 times per week, about once a week, 2 or 3 times per month, about once a month, between 6 and 11 times a year, between 1 and 5 times a year). Worse still, these questions are not actually used in calculating the PGSI score; but rather to decide whether the respondent is a "gambler" or "nongambler", and the nongamblers are not given the PGSI. These design flaws of the CPGI make it difficult to calculate the relative contributions of excessive participation in different gambling activities to PPG.

The issue of measuring excessive participation in different gambling activities was recently addressed by Quilty, Murati & Bagby (2013). They used CPGI survey data from a community sample and identified safe gambling limits for specific forms of gambling (i.e. lottery tickets, bingo, casino games, horse betting, sports betting, games of skill, investments). They quantified the responses and calculated ROC areas for frequency, duration, and monthly expenditures on different kinds of gambling. That study was conducted in the Toronto area, at a time when there were no casinos,

Charitable Gaming Centres or VLTs in the city. As a result, there were not enough regular EGM players to establish meaningful cutoffs for safe EGM play. They did manage to report ROC areas for high PGSI predicted by casino frequency (.76) and VLT frequency (.54) but these are hopelessly contaminated by low access to VLTs (i.e. a Toronto resident would have to leave Ontario to play VLTs), and the fact that Ontario casinos and slots at racetracks have table games and horserace gambling alongside EGMs. Nevertheless, their work is step in the right direction and they showed the value of measuring participation in different gambling activities separately.

Table 2.
Questions about frequency and intensity of gambling, smoking, alcohol, and illegal drugs in the study by Nehlin et al. (2013).

Frequency questions

Gambling: *"How often do you put money on lottery or gambling? Never, Once per month or less often, 2–4 times per month, 2–3 times per week, 4 times or more times a week"*

Smoking: *"How often do you smoke?" Never, Occasionally, Every day"*

Alcohol: *"How often do you have a drink containing alcohol? Never, Monthly or less, 2-4 times a month, 2-3 times a week, 4 or more times a week"*

Illegal drugs: *"How often do you use drugs other than alcohol? Never, Once a month or less often, 4 times a week, more often"* (A list of illegal drugs was given)

Amount questions

Gambling: none

Smoking: *"How many cigarettes do you smoke in a typical smoking day? 1–4 cigarettes, 5–20 cigarettes, ≥21 cigarettes"*

Alcohol: *"How many drinks containing alcohol do you have on a typical day when you are drinking? 1 or 2, 3 or 4, 5 or 6, 7 to 9, 10 or more"*

Illegal drugs: *"How many times do you take drugs on a typical day when you use drugs? 0, 1-2, 3-4, 5-6, 7 or more"*

Binge questions

Gambling: none

Smoking: none

Alcohol: *"How often do you have six or more drinks on one occasion? Never, Less than Monthly, Monthly, Weekly, Daily or almost daily"*

Illegal drugs: *"How often are you influenced heavily by drugs? Never, Less often than once a month,Every month, Every week, Daily or almost every day"*

Is it necessary to calculate proportions for time and money expenditure?

In the studies by Currie et al., they used indicators that were weighted by individual players' characteristics that might not be easily attainable if gambling behaviour were to be measured with some method other than a survey. A secondary goal of the present study was to learn whether there is any advantage to individually weighting indicators proportionally to players' characteristics. For instance, is it necessary to convert raw expenditure into the percentage of income that is spent gambling? Given the fact that most Canadians' incomes are distributed close to the median it would seem unnecessary. It is true that there are some very poor gamblers and some very wealthy ones, but if the goal is to measure population prevalence of PPG rather than to make individual diagnoses of Gambling Disorder, there should be no advantage at a population level of measurement. All that might be accomplished by converting from raw expenditures to percentages is to add error variance and thereby reduce the effectiveness of the predictions that can be made. Nevertheless I made an attempt to do this in terms of money and time spent gambling if only to disprove the idea that it is necessary.

Additional research questions.

The present study was done to test the idea that simple measures of gambling activity could be used to accurately predict PGSI problem gambling scores, and that they add to the ability of PGSI to predict problem associated with excessive gambling. A secondary purpose of the study was to corroborate past results that were obtained in the same population that was sampled in the present study (MacLaren, Ellery & Knoll, 2014). The previous project measured relationships between standard

measures of personality, gambling cognitions and gambling motives as predictors of problem gambling. In an attempt to replicate that earlier work, a different set of self-report scales were used to measure similar constructs in the new sample. Descriptive and simple correlational analyses were done with the measures, but there were no strong hypotheses made about relationships between these variables and self-reported gambling frequency, duration and expenditure.

Summary

The present study was focused on the EGM play behaviour of experienced nonproblem and problem gamblers. Most of the revenues generated by legal gambling in Canada come from EGMs. There is a stronger relationship between PPG and past year participation in EGM gambling than there is with other forms of gambling. Monitoring the population prevalence of PPG is important for harm minimization and this can be done using surveys, or potentially by monitoring excessive gambling behaviours that predict PPG. Monitoring excessive gambling behaviours should be done is a way that is specific to different gambling activities, particularly EGMs because they generate the most revenue and have the strongest association with PPG of any form of gambling. As a first step, the present study was done to test the idea that self-reported frequency, duration and intensity of EGM play can predict PPG measured by the PGSI.

Method

Ethics review

This study was approved by the research ethics committees at Brandon University 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 once a month for the past year". In Canada, the acronym 'VLT' refers to Video Lottery Terminals, which are government run Electronic Gambling Machines (EGMs) located in bars and licensed restaurants that are privately owned and operated. The participants completed the questionnaires anonymously after signing and returning an informed consent form, in group testing sessions with up to 30 participating at any time. Data from 7 participants were dropped from the sample because they failed to complete the questionnaires, and 1 was dropped because he completed the questionnaires in less than 20 minutes and gave obviously random responses. Two cases were dropped because they appeared intoxicated, 1 elderly case was dropped because she appeared confused and disoriented while doing the questionnaires, and 2 were dropped because they completed the questionnaires non-anonymously because they needed assistance due to illiteracy. Finally, 37 were dropped because they indicated playing VLTs and slot machines either "never" or "less than once a year". The final sample of 250 participants was aged 18-68 years (M=33.1, SD=11.7), including 135 women, 114 men, and 1 who did not disclose their sex and 2 who did not disclose their age. Of the 248 who disclosed their ethnic ancestry, most identified themselves as Aboriginal (77.2%), with smaller numbers identifying as Caucasian (18.0%), Latin American (2.4%), African American (0.8%), Asian (0.4%), or South Asian (0.4%). There were 244 individuals who answered a pair of questions asking about how many adults and children live at their address. There were 44 adults (18.0%) who reported living alone without children, 29 adults (11.9%) living with 1 or more children, and 171 (70.1%) living with at least one other adult and at least one child in the home. The participants reports of annual income and their past-year participation in various gambling activities are given in Table 3.

Table 3.
Past year gambling participation and annual incomes of Low, Moderate and High Risk participants, and the entire sample (N=250).

	Low	Moderate	High	Combined
Gambling activity				
Sports lotteries	16 (23.9%)	38 (38.4%)	37 (44.0%)	91 (36.4%)
Weekly or instant lottery	52 (77.6%)	85 (85.9%)	74 (88.1%)	211 (84.4%)
Charity raffles and instant tickets	26 (38.8%)	47 (47.5%)	48 (57.1%)	121 (48.4%)
Bingo	29 (43.3%)	51 (51.5%)	55 (65.5%)	135 (54.0%)
Casino slots	50 (74.6%)	83 (83.8%)	71 (84.5%)	204 (81.6%)
Casino table games	8 (11.9%)	23 (23.2%)	37 (44.0%)	68 (27.2%)
VLTs at bar or racetracks	58 (86.6%)	89 (89.9%)	76 (90.5%)	223 (89.2%)
Horse racing	1 (1.5%)	5 (5.1%)	4 (4.8%)	10 (4.0%)
Poker in bar or public place	8 (11.9%)	35 (35.4%)	31 (36.9%)	74 (29.6%)
Poker with friends or family	20 (29.9%)	45 (45.5%)	52 (61.69%)	117 (46.8%)
Other card games, boardgames, etc.	24 (35.8%)	49 (49.5%)	40 (47.6%)	113 (45.2%)
Internet	7 (10.4%)	20 (20.2%)	26 (31.0%)	53 (21.2%)
Annual Income				
<$5,000	13 (19.7%)	21 (21.6%)	21 (26.6%)	55 (22.7%)
$5,000 - $9,999	12 (18.2%)	12 (12.4%)	15 (19.0%)	39 (16.1%)
$10,000 - $14,999	7 (10.6%)	16 (16.5%)	11 (13.9%)	34 (14.0%)
$15,000 - $19,999	8 (12.1%)	13 (13.4%)	9 (11.4%)	30 (12.4%)
$20,000 - $29,999	10 (15.2%)	19 (19.6%)	12 (15.2%)	41 (16.9%)
$30,000 - $39,999	8 (12.1%)	6 (6.2%)	6 (7.6%)	20 (8.3%)
$40,000 - $49,999	3 (4.5%)	2 (2.1%)	2 (2.5%)	7 (2.9%)
$50,000 - $59,999	3 (4.5%)	4 (4.1%)	0 (0.0%)	4 (1.7%)
$50,000 - $79,999	1 (1.5%)	3 (3.1%)	0 (0.0%)	4 1.7%)
$80,000 - $99,999	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
>$100,000	1 (1.5%)	1 (1.0%)	3 (3.8%)	8 (2.1%)

Test instruments.

Samples of all materials are given in Appendix B.

Modified Canadian Problem Gambling Inventory.

The CPGI (Ferris & Wynne, 2001) 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. The CPGI was used in questionnaire form to measure the extent of self-reported gambling behaviours, with 6 subsections comprising this version of the questionnaire. The first subsection gave a list of 12 popular types of legal gambling and respondents indicated how often they participated in each activity within the past year. The second subsection covered a variety of topics with single questions about frequency of gambling, typical amount spent gambling per month, largest amount spent gambling in a single day, drinking while gambling, and gambling alone.

Problem Gambling Severity Index. The third subsection of the CPGI 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. Continuous PGSI scores were analyzed in correlational analyses and the sample was also subdivided into 3 categories representing the likelihood that each participant was a problem gambler judging from their self-report on the PGSI screen. 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. The PGSI scores for 5 participants who skipped 1 question were included and on the basis of the 8 remaining answers. One of these was classified as Low Risk, 1 as Moderate Risk, and 3 as High Risk. Inter-item reliability in the present sample was Cronbach's α=.91.

Population Harm. The fourth subsection of the CPGI was the 5 item Population Harm supplement (Bagby, Quilty & Watson, 2012) used to measure respondents' perceptions of the negative 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 α=.77.

Gambling Behaviours. The fifth section of the CPGI had 3 multiple-choice questions intended to measure specific patterns of VLT gambling in terms of frequency, duration and expenditure. The first of these was "Roughly how many times do you normally play VLTs in a typical month?", followed by 10 options (i.e. 'never or maybe once in a month', 'usually about one day each month', '2 days a month (about once every other week)', '4 days a month (about once per week)', '8 days a month (about twice per week)', '12 days a month (about 3 per week)', '16 days a month (about 4 per week)', '20 days a month (about 5 per week)', '24 days a month (about 6 per week)', '30 days a month (just about every day)'). These answers were scored from 1 to 10 and designated as the Frequency variable.

The second question was "On a typical day when you play VLTs, about how much time do you normally spend playing VLTs?", followed by 12 options (i.e. 'usually less than 30 minutes', 'between 30 minutes and 1 hour', 'between 1 to 2 hours', '2 to 3 hours', '3 to 4 hours', '4 to 5 hours', '5 to 6 hours', '6 to 7 hours', '7 to 8 hours', '8 to 9 hours', '9 to 10 hours', 'more than 10 hours'). These answers were scored from 1 to 12 and designated as the Time variable.

The third question was "On a typical day when you play VLTs, about how much money do you normally spend playing VLTs?", followed by 12 options (i.e. 'usually less than $50', 'between $50 and $100', 'between $100 to $200', '$200 to $300', '$300 to $400', '$400 to $500', '$500 to $600', '$600 to $700', '$700 to $800', '$800 to $900', '$900 to $1,000', 'more than $1,000'). These answers were scored from 1 to 12 and designated as the Spend variable.

Demographics, income and free time. The final section of the CPGI included demographic questions about age, sex, ancestry, and the number of adults and children living at the participant's address. There was also a pair of multiple choice questions about annual income and weekly disposable income, and an open-ended multiple response question about the time spent doing various weekly activities.

The question asking about Annual Income was "*How much was your total income in the past year? Please include income from all sources before taxes. Only include your own income and not that of a partner or spouse."*. This was followed by four options in $5000 increments from "under $5000 (less than $100/week before taxes)" up to "$15,000-19,999 (about $340/week before taxes), and then four options in $10,000 increments from "$20,000-29,999 (about $480/week before taxes) up to "$50,000-59,999 (about $1060/week before taxes). The remaining options were "$60,000-79,999 (about $1350/week before taxes)", "$80,000-99,999 (about $1730/week before taxes", and "over $100,000 (about $1900/week before taxes)".

The question about weekly Disposable Income was "*Approximately how much "disposable*

money" do you have each week? That is, how much do you have left to save or to spend on whatever you like after you have paid your taxes, housing costs, car payment, gas, credit cards, student loans and other debts, utility and phone bills, food, transportation and clothing?". This was followed by "My expenses are greater than my income so I borrow", "I have less than $50 a week left to spend", "I have between $50 and $100 a week left to spend", "I have between $100 and $150 a week left to spend", "I have between $150 and $250 a week left to spend", "I have between $250 and $500 week left to spend", and "I have more than $500 a week left to spend".

The open-ended question about time consuming activities was "*How much time do you spend per week doing each of the following activities? Please write in approximately how many hours each week you spend doing these things.*". This was followed by 9 spaces that each had a box where respondents could enter a value indicating how many hours they spend doing each activity. The items were "Paid work at a job outside the home", "Housework or paid work that you do at home", "Shopping or doing errands outside the home", "Volunteer work for community or church organizations", "Attending classes at high school, university or college", "Looking after your children or other's children", "Physical exercise (e.g. running, gym, sports)", "Taking children to organized activities (e.g. children's art or music lessons, hockey or soccer practice)", and "Other organized activities like church, art classes, music lessons, AA or NA meetings, political party activities, etc.".

Additional tests and measures.

Ancillary scales measuring personality, gambling motives and cognitions were given after the modified CPGI for the purposes of replicating earlier work (MacLaren, Ellery & Knoll, 2014) and for characterizing the present sample along these dimensions.

Gambling Motives. The Electronic Gambling Motives Questionnaire (EMGQ; Thomas, Allen & Phillips, 2009) is a 19 item questionnaire measuring Escape, Access, and Social motives for playing electronic gaming machines. The items were scored from 0 to 3 on a 4-point Likert scale (never or almost never, sometimes, often, almost always or always). The wording of one item of the Access scale was changed from "Call in when passing (a venue)" to "I stop in when passing a VLT venue" to reflect Canadian dialect. The Coping scale was of particular interest because scores on a similar scale from the Gambling Motives Questionnaire (Stewart & Zack, 2008) were highly correlated with PGSI in a previous sample from this population (MacLaren, Ellery & Knoll, 2014). Cronbach's alpha was .86, . 86, and .83 for the Coping, Availability and Social scales in this sample respectively.

Gambling Cognitions. Nineteen items from the The Gambling Related Cognitions Scale (GRCS; Raylu & Oei, 2004) were scored on a 7 point Likert scale from 1 (strongly disagree) to 7 (strongly agree). This scale was of interest because scores on a measure of distorted beliefs about electronic machine gambling, the Informational Biases Scale (IBS; Jefferson & Nicki, 2003), were highly correlated with PGSI in a previous sample from this population (MacLaren et al., 2014). Cronbach's alpha in the present sample was .95.

Personality. The Personality Inventory for DSM-5 (PID-5; American Psychological Association, 2013) is intended for clinical assessment of personality disordered traits according to the latest revision of the DSM. The questionnaire has 220 items that participants answer on a 4 point Likert scale (PID-5; http://www.psychiatry.org/practice/dsm/dsm5/online-assessment-measures#Personality accessed July 15, 2013). The traits measured by this instrument were of interest because they overlap conceptually with the Five Factor Model (Costa & McCrae, 1992), and aspects of low Conscientiousness and high Neuroticism were found to have effects on problem gambling in a previous sample drawn from this population (MacLaren et al., 2014). Each of the 25 facet scores were calculated by averaging item scores, and facet scores were not calculated if more than 25% of items were missing. In the present sample there were uniformly low scores that appear to be the result of

response bias and this bias appeared to be particularly acute in some participants' responses. Among the 51,000 ratings of the 204 positively keyed items, 5.3% were left blank, 43.3% were rated 0 (very false or often false), 24.7% were rated 1 (sometimes or somewhat false), 19.2% were rated 0 (sometimes or somewhat true), and 7.5% were rated 3 (very true or often true). Among the ratings of the 16 reverse keyed items, 5.3% were left blank, 25.0% were rated 0, 25.4% were rated 1, 25.3% were rated 2, and 19.0% were rated 3. To correct for the varying degrees of individual response bias, each participant's grand mean rating on all items was calculated (without reverse scoring the reverse-keyed items), and their grand mean was subtracted from each facet score.

Analytic strategy.

The first stage of the analysis was to test the idea that PGSI problem gambling scores could be predicted by self-reported electronic gambling behaviours. This was done in two ways. First, a series of multiple regression analyses was done with continuous PGSI scores as the criterion variable and Frequency, Time, and Spend as predictors, with age and sex entered first to control for these basic demographics. Additionally, the ability of Frequency, Time and Spend to detect problem gambling status was tested using signal detection analyses. Receiver Operating Characteristic (ROC) curves plotted the proportion of respondents having PGSI scores equal to or greater than 8, at each possible Frequency, Time or Spend score. The area under a ROC curve can vary from 0.00 to 1.00 and is a widely accepted index of the diagnostic efficiency of a test that is not biased by choice of cutoff scores. An ROC area of .50 is expected to occur when a test has no ability to discriminate, and confidence intervals may be used to compare a ROC area against this chance criterion. Mutually exclusive confidence intervals may also be interpreted as proof of a difference in discrimination between two different tests. The areas under the ROC curves and 95% confidence intervals were calculated using SPSS version 20.

The second phase of the analysis explored prediction of PGSI scores by a set of derived variables that estimated percentages of Free Time, Annual Income, and Monthly Disposable Income spent EGM gambling. Regression and ROC analyses were conducted using these variables as predictors of PGSI scores and severity levels.

The third phase tested two combinations of the Frequency, Time and Spend variables as predictors of PGSI continuous scores, and problem gambler classification. One combination was made by simply adding the Frequency, Time and Spend scores; the other was made using an optimal weighting derived from a regression analysis. The unweighted combined index was also examined in terms of its predictive power in the present study and what would be expected with a more extreme base rate typical of a population survey.

The fourth phase examined the incremental validity of the combined measure of Frequency, Time and Spend as a predictor of Population Harm. A hierarchical regression analysis was done to test the increment in variance accounted by the combined Frequency/Time/Spend measure, beyond the variance attributed to age, sex, personality traits that correlate with PGSI, as well as GRCS and Escape scores. A positive result of this analysis would support the usefulness of the combined Frequency/Time/Spend as an indicator beyond well established predictors of the harms associated with playing electronic gambling machines excessively.

Results

Predicting PGSI scores and severity levels from gambling behaviours

In a series of regression analyses, continuous PGSI scores were regressed onto age, sex, and one of the following self-reported gambling behaviour indicators: Frequency, Time, Spend, Percent Free Time, Percent Annual Income, and Percent Monthly Disposable Income. Correlations amongst these variables are given in Table 4 (Appendix A also gives these data broken out by gambling severity level). It may be worth noting that the standard deviations of the derived behavioural indicators (i.e. Percent Free Time, Percent Annual Income, and Percent Monthly Disposable Income) are all very high relative to their means, and that the standard deviations of the nonderived behavioural indicators show much less variability. ROC curves with area and 95% confidence intervals were generated, with each gambling behaviour testing classification of participants as High Risk according to the PGSI cutoff of 8.

Table 4.
Descriptive statistics and correlations among continuous PGSI scores and gambling behaviours.

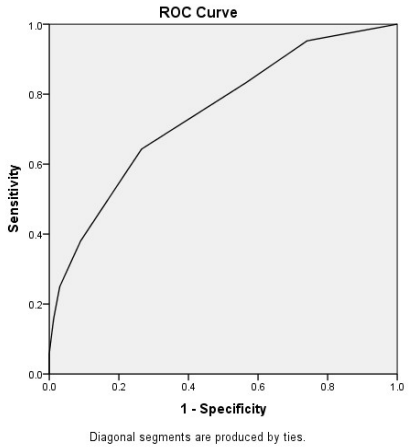
	Mean (SD)	1	2	3	4	5	6
1. PGSI	6.34 (5.27)						
2. Frequency	3.28 (1.85)	.54					
3. Time	2.68 (1.73)	.56	.56				
4. Spend	1.85 (1.42)	.49	.52	.70			
5. Percent Free Time	0.05 (0.30)	.26	.26	.33	.35		
6. Percent Annual Income	0.90 (3.04)	.48	.62	.62	.79	.45	
7. Percent Disposable Income	2.00 (5.74)	.38	.58	.43	.46	.23	.64

Note: all Pearson correlations $p<.01$

Frequency. Continuous PGSI scores were significantly predicted by a weighted combination of age, sex, and self-reported frequency of playing EGMs (F 3,243 = 38.44, $p<.001$, $R^2=.32$). There were significant effects for older Age ($\beta=.16$, $t=2.97$, $p=.003$), and Frequency ($\beta=.54$, $t=10.14$, $p<.001$).

The area under the ROC curve for Frequency was .75 and the confidence interval excluded .50, the value associated with a diagonal ROC line and estimation at chance level (95% CI: .68 to .81). Figure 1 shows the ROC curve for Frequency.

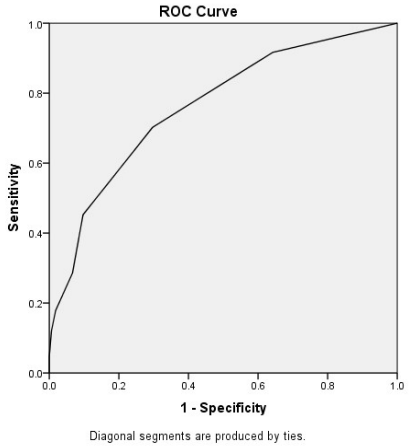
Figure 1.
Receiver Operating Characteristic curve for Frequency.



Time. Continuous PGSI scores were significantly predicted by a weighted combination of age, sex, and self-reported time spent playing EGMS per gambling session (F 3,242 = 37.96, p<.001, R^2=.52). The only significant predictor was Time (β=.55, t=10.07, p<.001).

The area under the ROC curve for Time was .76 and the confidence interval excluded .50, the value associated with a diagonal ROC line and estimation at chance level (95% CI: .70 to .83). Figure 2 shows the ROC curve for Time.

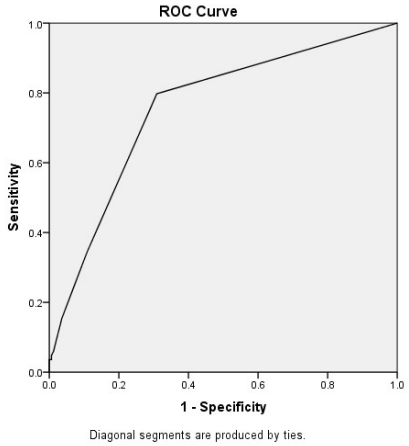
Figure 2.
Receiver Operating Characteristic curve for Time.



Spend. Continuous PGSI scores were significantly predicted by a weighted combination of age, sex, and self-reported expenditures on EGMs per gambling session (F 3,242 = 29.30, p<.001, R^2=.27). The only significant predictors were Age (β=.15, t=2.78, p=.006) and Spend (β=.49, t=8.74, p<.001).

The area under the ROC curve for Spend was .76 and the confidence interval excluded .50, the value associated with a diagonal ROC line and estimation at chance level (95% CI: .70 to .82). Figure 3 shows the ROC curve for Spend.

Figure 3.
Receiver Operating Characteristic curve for Spend.



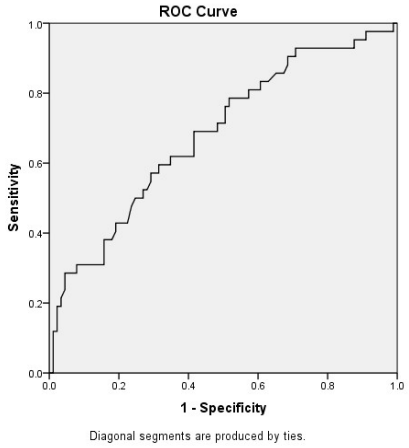
Predicting PGSI scores and severity levels from derived estimates of gambling behaviours.

Percentage of Free Time. One source of contamination in using the Time variable is the amount of free time available to players, so an exploratory analysis was done with an attempt to estimate participants' time spent playing EGMs as a percentage of their total available free time. The regression and ROC analyses were repeated, but with a predictor variable derived using the respondents' estimates of how often they play EGMs and the amount of time they have left after doing their weekly activities. To calculate this Percent Free Time variable, the estimated hours spent playing EGMs was calculated by multiplying the number of days by the number of hours per day to get a monthly time score. Frequency was converted into the number of days per month the participants claimed to play EGMs (the "never or maybe once a month" option was given a value of 0.5 days). Time was converted into hours spent per session (the "usually less than 30 minutes" option was given a value of .25 hours, the "more than 10 hours" option was given a value of 10.5 hours, and the midpoints were used for the other 10 ranges). This product gave an estimate of the total hours spent playing EGMs per month, and it was then divided by an estimate of the number of free hours available for each participant to give the Percent Free Time score. The total free hours was calculated starting with a value of 168 hours in a week, minus 70 hours for sleep, minus the total hours reported engaging in various activities in the open-ended question of CPGI section 6, and then multiplying this weekly estimate by 4.3 to make it a monthly estimate. Dividing the hours per month spent playing EGMs by the monthly free time yielded a Mean estimate of 5.2% (SD=.30), but scores could only be calculated for 131 participants due to missing data. Nevertheless, this variable did significantly predict PGSI scores (F 3,126 = 3.55, p<.017, R^2=.08), and only Percent Freetime was a significant predictor in the equation (β=.25, t=2.89, p=.005).

The area under the ROC curve was .68 and the confidence interval excluded .50, the value

associated with a diagonal ROC line and estimation at chance level (95% CI: .58 to .78). This variable is problematic because it is difficult for respondents to give accurate estimates of how they spend their time, and because time requirements for their activities may change. Figure 4 shows the ROC curve for Percent Free Time.

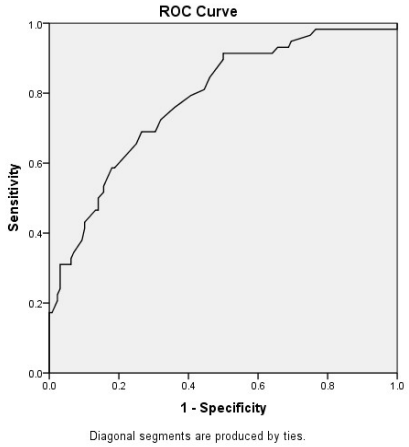
Figure 4.
Receiver Operating Characteristic curve for Percent Free Time.



Percentage of Annual Income. One source of contamination in the Spend variable is the total amount of income available to players. An exploratory analysis was done with an attempt to estimate participants' EGM expenditures as a percentage of their annual income. To calculate Percent Annual Income, the Frequency variable was converted into monthly sessions as was done for the Percent Free Time calculations above, and then multiplied by the Spend variable converted into dollar amounts per session (the option "usually less than $50" was given a value of $25, the option "more than $1,000" was given a value of $1,050, and the midpoints were used for the other 10 ranges). This Monthly Expenditure variable was multiplied by 12 and then divided by participants' estimated annual income (the option "Under $5000" was given a value of 2500, the option "Over 100,000" was given a value of 100,500, and the midpoints were used for the other 10 ranges). The Percent Annual Spend had a Mean of .09% (SD=3.04), but scores could only be calculated for 186 participants due to missing data. Nevertheless, this variable did significantly predict PGSI scores (F 3,180 = 19.80, p<.001, R^2=.25), with Age (β=.13, t=2.05, p=.042) and Percent Annual Income (β=.48, t=7.37, p<.001) as significant predictors.

The area under the ROC curve for Percent Annual Income was .78 and the confidence interval excluded .50, the value associated with a diagonal ROC line and estimation at chance level (95% CI: . 71 to .85). This variable is somewhat problematic because some people may not be able to report their income accurately or they have expenditures greater than their income by going into debt, so their percentage of annual income cannot be calculated without knowing how much credit they can access. Figure 5 shows the ROC curve for Percent Annual Income.

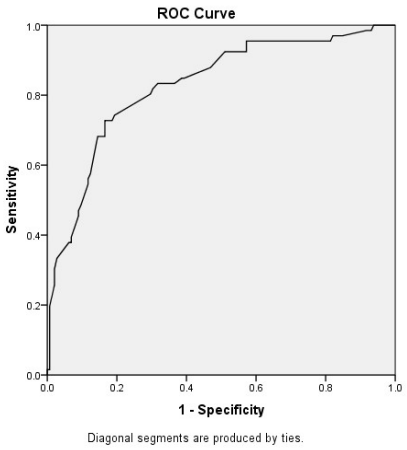
Figure 5.
Receiver Operating Characteristic curve for Percent Annual Income.



Percentage of Monthly Disposable Income. Another way to quantify the amount of money available to consumers is their disposable income after their fixed costs are paid. An exploratory analysis was done with an attempt to estimate participants' EGM expenditures as a percentage of their monthly disposable income. To calculate Percent Disposable Income, the Frequency variable was converted into monthly sessions as was done for the Percent Free Time calculations above, and then multiplied by the Spend variable converted into dollar amounts per session as was done for the Percent Annual Income calculations above. This product was divided by participants estimates of their weekly disposable income multiplied by 4.3 to make it a monthly index (the option "My expenses are greater than my income so I borrow" was given a value of 0, the option "more than $500" was given a value of 600, and the midpoints were used for the other 5 ranges). This Percent Monthly Disposable Income variable had a Mean of 2.00% (SD=5.74) and scores could be calculated for 211 participants. This variable significantly predicted PGSI scores (F 3,206 = 15.50, p<.001, R^2=.18), with Age (β=.19, t=3.07, p=.002) and Percent Monthly Disposable Income (β=.38, t=6.02, p<.001) as significant predictors.

The area under the ROC curve for Frequency was .83 and the confidence interval excluded .50, the value associated with a diagonal ROC line and estimation at chance level (95% CI: .77 to .89). This variable is somewhat problematic because people may misreport their income or expenditures, and it is possible for some people to have negative disposable income by going into debt and in such cases the percentage of disposable income cannot be calculated without knowing their use of credit. Figure 6 shows the ROC curve for Percent Monthly Disposable Income.

Figure 6.
Receiver Operating Characteristic curve for Percent Monthly Disposable Income.

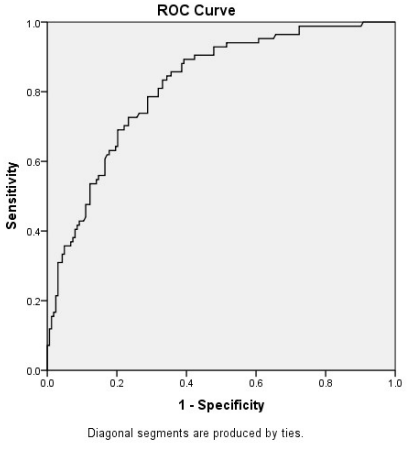


Predicting PGSI scores and severity from weighted and unweighted combinations of gambling behaviours.

Weighted combination of Frequency, Time, Spend and Age. These were tested as predictors of PGSI scores. To determine the optimal weightings, a regression analysis was done with age and sex, followed by Frequency, Time and Spend entered as predictors. The equation was significant (F 5,240 = 33.22, p<.001, R^2=.41), and the significant predictors were age (β=.11, t=2.07, p=.04), Frequency (β=.32, t=5.23, p<.001), Time (β=.26, t=3.48, p=.001), with Spend also closely approaching significance (β=.13, t=1.86, p=.064). The constant was 3.39 and the unstandardized coefficients were . 049, .922, .807, and .499 for Age, Frequency, Time and Spend respectively.

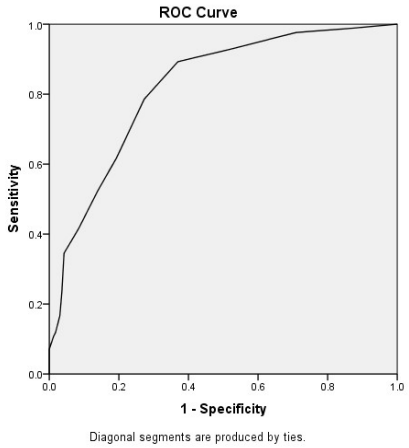
The ROC area for the optimally weighted combination of Age and the 3 behavioural indicators was .82 with a 95% confidence interval of .77 to .87. Figure 7 shows the ROC curve for the optimally weighted combination of age, Frequency, Time and Spend.

Figure 7.
Receiver Operating Characteristic curve with optimally weighted FTS scores.



Unweighted combination of Frequency, Time, Spend. The unweighted sum of Frequency, Time and Spend also had an ROC area of .82 with 95%CI of .77 to .87, exactly the same as the more complicated weighted index. The weighted and unweighted combinations had slight differences at the third decimal place but these combinations produced essentially identical results that were within rounding error of one another. Figure 8 shows the ROC curve for the unweighted FTS index.

Figure 8.
Receiver Operating Characteristic curve with unweighted FTS scores against PGSI.



Predicting risk of problem gambling from gambling behaviours with optimal cutoffs.

This analysis tested the ability of the Frequency, Time, Spend and combined FTS index to predict risk of problem gambling using optimal cutoffs. Among the 249 people with complete scores, there were 67 with PGSI scores in the Low Risk category (0, 1, or 2), 98 in the Moderate Risk category (3 to 7), and 84 in the High Risk category (8 or higher). There was also 1 Moderate Risk participant who did not answer the Time and Spend questions. The distributions of scores for the Low Risk and High Risk participants are given in Table 5.

Frequency. The cutoff score that resulted in the greatest number of correct classifications of the Low and High Risk participants was 4. Sixty of the 67 Low Risk participants (89.6%) indicated that they play VLTs or slots less than 4 days a month, and 54 of the 84 High Risk participants (64.3%) indicated that they play EGMs at least weekly. The average accuracy for Low Risk and High Risk groups was 77.0%. Thirty seven of the 99 Moderate Risk participants (37.4%) also indicated playing EGMs 4 or more days per month.

Time. The cutoff score that resulted in the greatest number of correct classifications of the Low and High Risk participants was 3. Fifty eight of the 67 Low Risk participants (86.6%) indicated that they played VLTs for less than 1 hour per session, and 59 of the 84 High Risk participants (70.2%) of the High Risk participants indicated that they usually play EGMs for an hour or longer. The average accuracy for Low Risk and High Risk groups was 78.4%. Forty of the 98 Moderate Risk participants (40.8%) also indicated playing EGMs 4 or more days per month.

Table 5.
Cross-tabulation of problem gambling severity and gambling behaviour indicators.

Score	Frequency (%)		Time (%)		Spend (%)		FTS (%)	
	Low	High Risk	Low	High Risk	Low	High Risk	Low	High Risk
1	**38.4**	4.8	**52.2**	8.3	**86.8**	20.2		
2	**17.9**	11.9	**34.3**	21.4	11.9	**45.2**		
3	**32.8**	19.0	9.0	**25.0**	1.5	**19.0**	**20.9**	1.2
4	7.5	**26.2**	0.0	**16.7**	0.0	**9.5**	**25.4**	1.2
5	3.0	**13.1**	4.5	**10.7**	0.0	**1.2**	**22.4**	4.8
6	0.0	**9.5**	0.0	**6.0**	0.0	**1.2**	**16.4**	3.6
7	0.0	**4.8**	0.0	**7.1**	0.0	**0.0**	7.5	**10.7**
8	0.0	**4.8**	0.0	**2.4**	0.0	**0.0**	1.5	**16.7**
9	0.0	**3.6**	0.0	**1.2**	0.0	**1.2**	1.5	**9.5**
10	0.0	**2.4**	0.0	**0.0**	0.0	**0.0**	0.0	**10.7**
11			0.0	**0.0**	0.0	**1.2**	3.0	**7.1**
12			0.0	**1.2**	0.0	**1.2**	1.5	**10.7**
13							0.0	**7.1**
14							0.0	**4.8**
15							0.0	**0.0**
16							0.0	**1.2**
17							0.0	**3.6**
18-33							0.0	**7.1**

Note: correct classifications using optimal cutoffs are boldfaced.

Spend. The cutoff score that resulted in the greatest number of correct classifications of the Low and High Risk participants was 2. Fifty eight of the 67 Low Risk participants (86.6%) indicated that they usually spend less than $50 per session playing EGMs, and 67 of the 84 High Risk participants (79.8%) indicated that they usually spend $50 or more. The average accuracy for Low Risk and High Risk groups was 83.2%. Forty two of the 98 Moderate Risk participants (42.9%) also indicated spending $50 or more per session.

Combined FTS index. The unweighted FTS index was simply the sum of the Frequency, Time and Spend scores for each participant. The cutoff score that resulted in the greatest number of correct classifications of the Low and High Risk participants was 7. Fifty seven of the 67 Low Risk participants (85.1%) had 6 or fewer points, and 75 of the 84 High Risk participants (89.3%) had 7 or more points. The average accuracy for Low Risk and High Risk groups was 87.2%. Fifty one of the 98 Moderate Risk participants (52.0%) also scored 7 or higher. The combined FTS index performed better in terms of average accuracy than its constituent Frequency, Time and Spend indicators.

Predictive power of the FTS index.

Predictive power refers to the proportions of correct positive and negative classifications that may be expected to occur in a population, using a test with known sensitivity and specificity and assuming a particular base rate of the phenomenon to be detected. The present sample contained a much greater proportion of cases reporting significant indications of problem gambling according to the PGSI than is typical of population surveys. Among the 85 Low Risk and High Risk participants with FTS scores of 7 or greater, 75 had PGSI scores indicating High Risk of being problem gamblers (positive predictive power = .882). Among the 66 with scores of 6 or less, 57 were Low Risk according to PGSI (negative predictive power = .863). The apparently high positive predictive power is

unlikely to generalize to other samples that typically have more polarized base rates of nonproblem and problem gamblers.

Assuming the estimates of sensitivity and specificity from the present sample may generalize beyond this sample, it is possible to estimate the predictive power in a population with a typical base rate of approximately 3% problem and pathological gamblers. In such a survey, one could expect to find FTS scores of 7 or greater from .893 of the 3% who are actual problem gamblers (true positives = 2.7%), as well as .149 (i.e. 1 - .841) of the 97% who are nonproblem gamblers (false positives = 14.5%). Among the total of 17.1% with positive FTS scores, only 15.8% of these would actually be problem gamblers (i.e. positive predictive power = .158). One could expect to find negative FTS outcomes from .851 of the 97% who are nonproblem gamblers (true negative = 82.5%), as well as .107 (i.e. 1 - .893) of the 3% who are problem gamblers (false negative = 0.3%). Among the total of 82.8% with negative FTS outcomes, 99.6% of these would be correct rejections (i.e. negative predictive power = .996). Thus a negative FTS outcome would be quite meaningful and might be used in a 'successive hurdles' approach to weed out those with negative scores and target those with positive FTS scores for evaluation with other diagnostic criteria that may be more invasive or expensive but that have greater predictive power such a PGSI screen or clinical diagnostic interview.

Incremental validity in predicting population harm.

This phase of the analysis was focused on the degree to which the self-reported behavioural indicators (i.e. unweighted FTS) add predictive power to the PGSI as an indicator of problem gambling severity. This analysis used the Population Harm measure to indicate negative sequelae of problem gambling conceived as a syndrome with contributions from individual vulnerability as well as behavioural, cognitive, and emotional components that may not be directly tapped by the PGSI. To this end, a hierarchical regression analysis was done in 4 steps. In the first step, Population Harm was regressed onto individual participant characteristics, namely age, sex and personality traits that correlate significantly with PGSI. In the second step, cognitive and emotional correlates of problem gambling were entered in the form of GRCS cognitive distortion and EGMQ escape motive scores. The EGMQ Access scale was not used because its content overlaps with the Escape scale, which is a closer conceptual match to the Coping scale of the Gambling Motives Questionnaire that has been validated as a correlate of problem gambling severity in this population (MacLaren et al., 2014). Likewise the Social scale was not used because it conceptually matches the GMQ social scale which correlates weakly with PGSI in this population. In the third step, PGSI scores were entered and at the fourth step the FTS scores were entered. The incremental validity of FTS would be supported if it explained variance in Population Harm above and beyond the portion accounted for by the individual characteristics, emotional and cognitive predictors, and PGSI. This increment would be indicated by a significant regression coefficient and change in R^2.

Step 1: Participant characteristics. Basic demographic features (i.e. age and sex), and personality traits like Neuroticism and impulsivity are consistently related to problem gambling (MacLaren, Fugelsang, Harrigan & Dixon, 2011). A previous study with this population by MacLaren et al. found that aspects of Neuroticism and Conscientiousness had indirect effects on PGSI scores that were mediated through the Coping motive of the Gambling Motives Questionnaire (Stewart & Zack, 2008) and cognitive distortions measured by the Information Biases Scale (Jefferson, & Nicki, 2003). In the present sample, an attempt was made to test the replicability of these findings using a different set of measures for the same or similar constructs. Correlations between the traits of the PID-5 and the 3 EGMQ motives and GRCS cognitive distortions are given in Table 6.

There were significant positive correlations between PGSI and low scores on Depressivity (e.g. “The future looks really hopeless to me”), Hostility (e.g. “I have a very short temper”), Impulsivity

(e.g. “I always do things on the spur of the moment”), and Irresponsibility (e.g. “I just skip meetings or appointments if I'm not in the mood”). There were significant negative correlations with Restricted affectivity (e.g. “I don't react much to things that seem to make others emotional), Rigid perfectionism (e.g. “It is important to me that things are done in a certain way”), and Risk taking (e.g. “I do what I want regardless of how unsafe it might be”). The content of the Impulsivity, Irresponsibility and (low) Rigid perfectionism facets correspond well with the Industriousness aspect of Conscientiousness (DeYoung, Quilty & Peterson, (2007). The content of the Depressivity and (low) Restricted affect facets also match the Withdrawal aspect of Neuroticism. The negative correlation between PGSI and scores on the Risk taking facet are puzzling except for the fact that many of the items appear to tap fearfulness rather than enjoyment of risk, which makes this facet also fit with the Withdrawal aspect. Finally, the Hostility aspect fits with low Agreeableness. Altogether, this collection of facets replicates the earlier finding that similar traits constituting the Withdrawal and Industriousness aspects are important in the etiology of problem gambling. This confirms the stability of earlier results from the previous study by MacLaren et al.

Population Harm scores were significantly predicted at step 1 by a combination of age, sex, and the 7 personality traits (F 9,217 = 6.89, p<.001, R^2=.47). The significant predictors were low Risk taking (β=-.31, t=4.56, p<.001), low Restricted affectivity (β=-.23, t=3.62, p<.001), male sex (β=.18, t=2.88, p=.004), and low Rigid perfectionism (β=-.17, t=2.44, p=.016).

Table 6.
Correlations between PID-5 traits and gambling severity, motives and cognitive distortions.

PID-5 Trait	Mean (SD)	Pop Harm	FTS	PGSI	Escape	GRCS
Anhedonia	.06 (.45)	-.05	-.05	.04	.03	-.06
Anxiousness	-.01 (.28)	.00	.09	-.01	-.09	-.06
Attention seeking	-.09 (.54)	-.07	-.07	-.12	-.21**	-.05
Callousness	-.29 (.36)	.04	.06*	.03	-.07	-.01
Deceiptfulness	-.17 (.36)	.03	.03	-.01	-.06	.06
Depressivity	-.20 (.36)	.20**	.18**	.30**	.25**	.17**
Distractibility	.06 (.36)	.03	.09	.01	.05	.02
Eccentricity	.01 (.43)	.05	-.02	.08	.04	.05
Emotional lability	.14 (.54)	.04	-.02	.10	.13*	.04
Grandiosity	-.24 (.43)	-.08	-.01	-.11	-.06	-.01
Hostility	.14 (.37)	.12	.13*	.15*	.03	.03
Impulsivity	.10 (.49)	.05	.09	.23**	.09	.10
Intimacy avoidance	-.22 (.55)	-.05	-.02	.01	-.01	-.07
Irresponsibility	-.08 (.39)	.05	.12	.16*	.06	.07
Manipulativeness	-.09 (.49)	.08	.10	.06	.03	.15*
Perceptual dysregulation	-.20 (.29)	.14	.00	.04	.06	.03
Perseveration	.06 (.33)	.12	.04	.05	.10	.08
Restricted affectivity	-.01 (.46)	-.21	-.10	-.17**	-.18**	-.17**
Rigid perfectionism	.17 (.51)	-.15*	-.15*	-.15*	.01	-.12
Risk taking	.40 (.51)	-.26**	-.21**	-.21**	-.19**	-.26**
Separation insecurity	-.01 (.56)	.06	-.04	.00	.05	.03
Submissiveness	.08 (.51)	-.03	-.07	.02	.04	.01
Suspiciousness	.33 (.40)	-.08	.04	-.03	.01	-.05
Unusual beliefs	-.14 (.40)	.10	-.01	-.03	-.08	.05
Withdrawal	.11 (.49)	.00	.02	.02	.04	.01

Note: * p<.05; ** p<.01

Step 2: Gambling motives and cognitive distortions. This step added the GRCS and Escape scores to the model predicting Population Harm. Table 7 gives descriptive statistics and correlations amongst these variables as well as PGSI and FTS. These data are also broken out by gambling severity level in Appendix A.

Population Harm scores were significantly predicted at step 2 by a combination of age, sex, the 7 personality traits, GRCS and Escape motive (F 11,215 = 11.51, p<.001, R^2=.61), and the change in R^2 was significant (p<.001). The significant predictors were GRCS (β=.30, t=4.26, p<.001), Escape (β=.19, t=2.69, p=.008), male sex (β=.18, t=3.19, p=.002), low Risk taking (β=-.18, t=2.72, p=.007), low Restricted affectivity (β=-.16, t=2.61, p=.010) and low Rigid perfectionism (β=-.15, t=2.32, p=.022).

Table 7.
Correlations among Population Harm, FTS, PGSI, Escape motive and GRCS scores.

	Mean (SD)	1	2	3	4
1. Population Harm	0.38 (.050)				
2. FTS unweighted	7.81 (4.27)	.57			
3. PGSI	6.34 (5.27)	.67	.63		
4. EGMQ Escape	.066 (0.59)	.42	.43	.53	
5. GRCS	2.45 (1.18)	.50	.55	.65	.57

Note: all Pearson correlations p<.01

Step 3: Problem gambling. The third step added PGSI scores to the model. Population Harm was significantly predicted at step 3 by a combination of age, sex, the 7 personality traits, GRCS, Escape motive, and PGSI (F 12,214 = 19.70, p<.001, R^2=.72), and the change in R^2 was significant (p<.001). The significant predictors were PGSI (β=.59, t=8.34, p<.001), low Restricted Affectivity (β=-.14, t=2.78, p=.006), male sex (β=.14, t=2.86, p=.005), and low Rigid Perfectionism (β=-.14, t=2.44, p=.016). Low Risk taking also approached significance as a predictor (β=-.11, t=1.88, p=.062). There were nonsignificant effects of Escape (β=-.14, t=2.44, p=.016) and GRCS (β=-.14, t=2.44, p=.016), which indicates that PGSI completely mediated their effects on Population Harm (Baron & Kenny, 1986).

Step 4: Behavioural indicators. The final step added FTS scores to the model. Population Harm was significantly predicted at step 4 by a combination of age, sex, the 7 personality traits, GRCS, Escape motive, PGSI, and FTS (F 13,213 = 19.66, p<.001, R^2=.74), and the change in R^2 was significant (p=.002). The significant predictors were PGSI (β=.51, t=6.77, p<.001), FTS (β=.19, t=3.11, p=.002), low Restricted Affectivity (β=-.15, t=2.89, p=.004), male sex (β=.14, t=2.89, p=.004), and low Rigid Perfectionism (β=-.12, t=2.13, p=.034). Low Risk taking also approached significance as a predictor (β=-.10, t=1.75, p=.081). This final step shows that FTS added significantly to the model as a predictor of Population Harm beyond the contributions of the other variables.

Discussion

The major hypothesis tested by this study was that self reported indicators of frequency and intensity of playing EGMs would be good predictors of PGSI scores and subsequent harms from problem gambling. Further, it was predicted that there would be no advantage to using proportional versions of the Time and Spend variables that were derived by calculating percentages of total available free time and money spent playing EGMs. Finally, a series of exploratory analyses was done to identify an optimal prediction index made from a combination of the Frequency, Time and Spend indicators, with cut points that would allow the most accurate identification of PPG measured by the PGSI. The incremental validity of this optimal index was tested for its ability to predict PGSI even when age, sex, personality, gambling motives and gambling cognitions were statistically controlled.

Self reported indicators of excessive EGM gambling are valid predictors of PGSI scores. Frequency, Time and Spend were all significantly correlated with continuous PGSI scores (r= .54, .56, and .49 respectively) and were substantially higher among High PPG Risk participants than Low PPG Risk participants (see Table 4 and Appendix A). Regression analyses confirmed that the measures could significantly predict continuous PGSI scores even when controlling for demographic variables. It should be noted that all of these variable were likely range restricted in the present sample because all participants were frequent EGM players, so the magnitude of effects is likely to underestimate the true effect sizes that would be observed in a sample representative of the whole population. As predictors of PGSI classification of participants as being Low or Moderate Risk versus being at High Risk for PPG (i.e. having a PGSI score of 8 or greater) across all possible cutoff scores, these behavioural indicators had large ROC areas of .75, .76, and .76 respectively. These results support the validity of using these measures as predictors of PPG.

Converting Time and Spend into proportional variables was counterproductive. Percentage of Free time did significantly predict PGSI (r=.26; ROC area=.68) but the effect was less robust than the simpler Time variable and there were a lot of missing data. Similarly disappointing results were found for Percent Annual Income (r=.48; ROC area= .78) and for Percent Monthly Disposable Income (r=.38; ROC area=.83), both of which performed reasonably well compared to the simpler Spend variable but produced far more missing data. As predicted, these proportional derived variables were vulnerable to inaccurate and incomplete responses from participants and are far less useful than simpler indicators of excessive EGM play without conversion into proportions.

Combining the simple Frequency, Time and Spend variables into a prediction index was done two ways. The first one was made using regression to arrive at an optimal classification scheme. This was run like the the previous regression analyses testing Frequency, Time and Spend and predictors of PGSI alongside the demographic variables of Age and Sex. The result was an optimally weighted FTS index. The second approach was to simply add the raw numerical scores for Frequency, Time and Spend together without the demographics or optimal weighting. As it turned out, the weighted and unweighted FTS indexes were equally good at predicting PGSI scores with ROC areas of .82, a value nominally higher than those obtained by its Frequency, Time and Spend constituents. The unweighted FTS index has the advantage of being simpler to observe and quantify than the weighted version.

The ability of the unweighted FTS index to predict PPG was examined using an optimally derived cutoff, and was compared to the Frequency, Time and Spend variables. As shown in Table 5, the unweighted FTS index with a cutoff of 7 points allowed 89.3% of the high PPG Risk participants to be correctly classified, which was substantially better than Frequency (64.3%), Time (70.2%) and Spend (79.8%) with their optimal cutoffs. However, the unweighted FTS correctly identified 85.1% of Low PPG Risk participants, which was not substantially different from Frequency (89.6%), Time (86.6%) and Spend (86.6%). Taking into account the low base rate of PPG in the general population, it

was estimated that the best use of the unweighted FTS index could be as a screening instrument capable of excluding most nonproblem gamblers and thereby allowing attention to be focused on EGM players who have a greater likelihood of being problem gamblers. Such a screening approach could be used in a way similar to the NODS-CLiP (Toce-Gerstein, Gerstein & Volberg, 2009), which has a full set of diagnostic questions derived from DSM-IV criteria of Pathological Gambling, but only 3 questions are needed to screen out nonproblem gamblers. Positive answers to those 3 questions elicit administering the full set of 17 questions. One intriguing possibility for the FTS index is that the 3 questions might be given as a precursor to another existing inventory such as the CPGI (Ferris & Wynne, 2001), PPGM (Williams, Belanger & Arthur, 2011) or FLAGS (Schellinck, Bliemel, Schellinck & Schrans, 2012) and used to screen out nonproblem gamblers. Such a strategy would approximate the way simple behavioral indicators of consumption levels may be used to screen out nonproblem drinkers in brief versions of the AUDIT (Bush, Kivlahan, McDonnell, Fihn & Bradley,1998), and would greatly improve the efficiency of surveys. Unlike other very brief screening self-reports like the Lie/Bet scale (Gotestam, Johansson, Wenzel & Simonsen, 2004), the FTS index could also be collected from player cards or other data sources without the need for any intrusive survey at all. This also introduces a more long-term benefit of allowing the full distributions of players' gambling behaviors to be described and compared at the population level against factors such as revenues, as was attempted in the study by Williams and Wood (2004) in their effort to derive the proportion of revenues that are extracted from problem gamblers. Thus, studies using self-report data and analyses of player card data could be compared because both would be using the same FTS index as a common metric for excessive gambling. The self-report studies would always have the disadvantage of relying on respondent perception and recall, but at least there would be some commonality in measurement across studies using these very different data sources, and so there could be at least the possibility of converging evidence.

The incremental validity of the unweighted FTS index as a predictor of harms associated with PPG was tested in a series of hierarchical regressions that statistically controlled for demographics, personality, gambling motives, gambling cognitions and PGSI scores. It was found that even with the variance associated all of these variables partialled out, and despite this sample being range restricted due to inclusion of only frequent EGM players, the unweighted FTS index did manage to explain a small amount of additional variance. On its own, unweighted FTS had a correlation of .57 with Population Harm. These results suggest that a behavioural index of excessive EGM play like FTS should be used alongside the PGSI, much as behavioural indicators are in the case of AUDIT and DUDIT (see Table 2). Future research might examine the value of FTS as a stand-alone measure that could serve as a proxy for PGSI, thus obviating the need for periodic surveys in favour of real-time analysis of player behaviour to estimate the population prevalence of EGM players who gamble excessively and are likely to be problem gamblers.

Knowledge Translation.

There are a few ways that knowing safe limits specific to EGM play might be applied. First, recall the dual mandate for regulators and operators of legal gambling in Canada, which is to have a gambling industry that generates much needed revenue for provincial governments, private businesses and charities, while also minimizing potential harm from problem gambling in a significant minority of patrons. The first way that safe EGM limits on the frequency, duration and cost of play could be used to help satisfy this mandate could be in responsible gambling awareness campaigns. For instance, advertising campaigns that use jingles like the Ontario Lottery and Gambling Corporation's “Know your limit, play within it” slogan might be augmented with evidence-based suggestions as to what those limits should be to reduce excessive gambling. This might have some impact on reducing the

likelihood of nonproblem gamblers progressing to excessive EGM play and problem gambling, but it is unlikely to have much impact on players who are already behaviorally addicted to playing EGMs. The very nature of addiction is that conscious and effortful self-regulation of the addictive behaviour breaks down and well ingrained emotionally driven habits are extremely difficult to alter wilfully. Nevertheless, giving consumers some guidance to judge the safety of their own behavior might help prevent excessive and unsafe practices, as has been shown by the effectiveness of recommendations for simple brief interventions to prevent excessive drinking (Moyer & Finney, 2015). Public awareness of what constitutes safe or unsafe gambling might similarly reduce the incidence of problem gambling.

The second way that safe EGM gambling limits might be used is to program EGMs with obstacles to players exceeding the safe limits. A good example of this approach is the way some EGMs in Manitoba have a time limit that starts counting down when players deposit money into them. Players can choose how long they want their session to last when they start playing. This may have some effect of nonproblem players choosing safe time limits, but a more forceful use of the safety limits might be to make the default time limit correspond to the value of '2' that was found to be a safety cutoff for duration in the present study (i.e. 1 hour). Similarly, limits on the amount that a player can deposit per session could also be easily implemented. The goal of this approach is to make it too inconvenient for nonproblem players to bother exceeding the safe limits. However, it does nothing to stop players from simply starting a new session on another machine or playing two EGMs simultaneously. Thus it might be expected to have some preventive effect on nonproblem players but seems unlikely to do much to reduce the excessive EGM play of problem gamblers. At the time of writing, I have seen time limits of this type on VLTs in Manitoba and New Brunswick, although it is unclear how the choice of time limit before interruption was decided upon, or whether it has any effect on excessive play or development of problem gambling.

In order to deter problem players exceeding safe limits, there would have to be some mechanism that motivates or prevents them from playing more sessions than the safe Frequency limit (i.e. 2 per month), or playing beyond the safe limits for Time (i.e. 1 hour) and Spend ($50) within a session. One way to achieve this could be the use of a player card or rewards points card that must be shown whenever a person plays EGMs, with some kind of valuable incentive for playing within the safe limits (e.g. casino comp points, or perhaps Airmiles or Aeroplan points awarded for playing no more than 2 times per month, for less than an hour each time, and spending no more than $50 each time). I am not advocating the unlimited rewarding of gambling with unlimited points; rather the points should be awarded only for compliance within the safety limits. This approach would give some motivation for players to voluntarily adhere to the safe gambling limits, but the rewards point bonus for doing so might have to be very large if it is to have any tangible effect on reducing problem gamblers excessive play. Again, it might have more of a preventive effect in terms of motivating nonproblem gamblers to not increase their EGM play beyond the safe limits. One advantage to a system that is based on a consumer loyalty card like Airmiles is that it might be possible to enact it on all forms of gambling so that a complete picture of individual gambling patterns can be assembled (as well as drinking since Airmiles points are awarded for buying alcohol in Manitoba's Liquormart outlets).

A third approach might be to implement a mandatory card system that requires players to swipe their card anytime they play, and to specify their EGM playing limits in advance. Safe EGM limits might be suggested as the default settings. This has been tried with the MyPlay system that was used in Nova Scotia until it was removed recently due to poor player compliance. The advantage of a system of this type is that it is more forceful in controlling players' behavior, but it has some serious disadvantages. First, requiring patrons to register and use a card may provide such an obstacle to casual players that it might reduce revenues from nonproblem players, unless the barriers to obtaining a card are made so lax that problem players can simply get more than one card, thus defeating the whole

purpose of the program. Second, public perception of government interference and coercion in their gambling behaviour is likely to breed resentment and less participation by nonproblem gamblers, as well as increased possibility for more involved gamblers moving away from legal gambling in favour of illegal venues. Thus, a card system of this type with enough 'teeth' to be effective in reducing problem gambling must be designed very carefully or it is likely to fail, as happened in Nova Scotia. For a more detailed discussion of issues surrounding programs of this type, the reader is referred to Schellinck and Schrans (2011).

Another use for safe EGM limits is at online gambling sites such as the new PlayNow site launched in Manitoba and British Columbia. Gambling at internet sites can easily be designed with either mandatory limits or voluntary safe limits with default settings, and they have the potential to award responsible play with points promotions. The downside to this approach is that internet play is still a tiny fraction of the gambling market and although slots games are available on these sites, people do not get to “go out” to a bar or casino to play them. Thus the vast majority of slots play is still done on physical VLTs and casino slot machines, and this does not appear likely to change anytime soon. The impact of any such intervention at internet sites is likely to be minimal, simply because of the small share of the gambling market that is captured at government run internet gaming sites.

There is one last possibility that may emerge in coming years as technology advances and smaller gambling operations develop contractual relationships with, or are merged or acquired by, larger organizations with the capacity to change the gambling landscape on a province-wide level (e.g. Ontario bingo halls rebranded as charitable gaming centres and coming under OLG oversight of conduct and management). Recall that VLTs are already networked, as are most casinos slots, and indeed most other forms of gambling. It should be possible at some point to integrate these networks with something like PlayNow as a common “front end” that players use to log in and gain access. Each player could have a registered account that they use whether playing on their computer or phone, on a VLT at a bar, on a video slot machine in a casino, or on a video instant ticket vending machine or play on demand bingo unit in a charitable gaming center. It could also be expanded to iclude lottery ticket purchases, and perhaps less prevalent gambling activities like Bingo and horse racing, all with the same familiar user interface making it convenient for players. Indeed, the common interface might have a positive effect on revenue generation by increasing access to all the different forms in one package. The advantage to this scheme would be that the totality of each player's gambling activity could be monitored, all the while promoting player acceptance of the system as a convenience rather than as government interference with their fun. Safe limits for all the different kinds of gambling could be calculated from records the behaviour of the entire population of players and these safe limits used as default settings with promotions to motivate adherence. Periodic screening with the PGSI could be done to estimate prevalence of PPG and cross tabulate with patterns of participation in each form of gambling captured within the purview of the system (e.g. one month each year all members get directed to a separate site one time to complete the PGSI anonymously and they must complete it before continuing back to the main site to login). A system like this could allow players to self-assess with a PGSI and provide a ready access point for Responsible Gambling information as well as contact information for mental health service providers or consumer credit counsellors. The comprehensiveness of such a system and the requirement to log in with a common account would also create a strong barrier to underage gamblers or self-excluded problem gamblers being able to do any kind of gambling. This system would allow gambling researchers to move away from periodic surveys based on self report and toward analysis of deidentified records linking PGSI scores with actual gambling behaviours monitored in real time. Finally, the incidence of excessive gambling behaviours could be monitored by operators and regulators and used to meet their mandate of ensuring adequate revenue generation while minimizing the potential for harmful impacts. However, there are huge

obstacles to implementation of such a scheme, both in terms of practicality and cost, as well as the ethical implications of how such 'Big Data' are collected, stored, used, and at some point destroyed.

Study Limitations

There are a number of technical and practical limitations to the present study which may suggest areas where interpretation should be tempered, or resolved by future research. The first of these comes from the use of PGSI as a proxy for PPG. The PGSI is properly interpreted only in terms of rates of likely problem gambling in a population rather than as a clinical tool for individual diagnosis. Nevertheless, most gambling research uses PGSI as the de facto standard. Future research into safe gambling limits should use a tool such as the NODS-CliP (Toce-Gerstein, Gerstein & Volberg, 2009), PPGM (Williams, Belanger & Arthur, 2011), or FLAGS (Schellinck, Bliemel, Schellinck & Schrans, 2012) to sort individual cases into PPG and nonPPG categories.

Another improvement over the present study might be a more fine grained selection of increments for the multiple choice alternatives. The need to capture these variables accurately must be balanced by the number of alternatives per question. For instance, for the Spend question, the items labelled 'usually less than $50' and 'between $50 and $100' might be replaced by 'usually $20 or less', 'between $20 and $50', 'between $50 and $80', etc. It should also be made explicit to players that what is meant by "spent" is all money they deposit into the machine minus any money they take out and that is not re-gambled.

One additional study limitation that should be acknowledged pertains to the conversion of categorical data to means for the purposes of regression analyses. Such conversions involve applying an estimated mean to all cases falling in a given category, so as to "upgrade" nominal level data to a ratio level. There is a risk that the estimates used may affect analysis outcomes, including potentially producing falsely significant indicators and masking important differences that may exist between cases in the same category. Where these estimates are multiplied together, such as in the case of percentage of annual income, the potential errors are also multiplied, leading to results that should be interpreted with a considerable degree of caution. However, giving respondents a set of income or expenditure ranges to select from, rather than open-ended questions, has the advantage of eliminating the possibility of unscorable responses which outweighs the disadvantage of a loss in fidelity.

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References

Afifi, T. O., Cox, B. J., Martens, P. J., Sareen, J., & Enns, M. W. (2010). Demographic and social variables associated with problem gambling among men and women in Canada. *Psychiatry research, 178,* 395-400.

American Psychiatric Association (2013). *Diagnostic and Statistical Manual of Mental Disorders: DSM-5.* Washington, DC: Author.

Bagby, R. M., Quilty, L. C., & Watson, C. (2012). *CPGI-Population Harm: A Supplement to the Canadian Problem Gambling Inventory.* Canadian Consortium of Gambling Research. Available online at http://www.ccgr.ca/canadian-problem-gambling-index-cpgi/ accessed January 17, 2014.

Balodis, S. R. S., Thomas, A. C., & Moore, S. M. (2014). Sensitivity to reward and punishment; horse race and EGM gamblers compared. *Personality and Individual Differences, 56,* 29-33.

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research – Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51,* 1173–1182.

Berman A.H., Bergman H., Palmstierna T., & Schlyter, F. (2005). Evaluation of the Drug Use Disorders Identification Test (DUDIT) in criminal justice and detoxification settings and in a Swedish population sample. *European Addiction Research, 11,* 22–31.

Binde, P. (2013). Why people gamble: A model with five motivational dimensions. *International Gambling Studies, 13,* 81-97.

Blaszczynski, A., & Nower, L. (2002). A pathways model of problem and pathological gambling. *Addiction, 97,* 487−499.

Borenstein, M., Hedhes, L. V., Higgins, J. P. T., & Rothstein, H. R. (2009). *Introduction to Meta-analysis.* Chichester West Sussex, UK; Wiley.

Breen, R. B., & Zuckerman, M. (1999). 'Chasing' in gambling behaviour: Personality and cognitive determinants. *Personality and Individual Differences, 27,* 1097-1111.

Bush, K., Kivlahan, D. R., McDonnell, M. B., Fihn, S. D., & Bradley, K. A. (1998). The AUDIT alcohol consumption questions (AUDIT-C): An effective brief screening test for problem drinking. *Archives of Internal Medicine, 158,* 1789–1795.

Canadian Partnership for Responsible Gambling (2014). *Canadian Gambling Digest 2012-13.* Report prepared by the Responsible Gambling council for the CPRG. Available online at http://cprg.ca/articles/Canadian%20Gambling%20Digest%202012-13.pdf

Christo, G., Jones, S. L., Haylett, S., Stephenson, G.M., Lefever, R.M. H., & Lefever, R. (2003). The shorter PROMIS questionnaire: Further validation of a tool for simultaneous assessment of multiple addictive behaviours. *Addictive Behaviours, 28,* 225−248.

CIHR, NSERC, and SSHRC (2010). *Tri-council Policy Statement: Ethical Conduct for Research Involving Humans.* Ottawa: Interagency Secretariat on Research Ethics, Government of Canada.

Cooper M. L., Russell M., Skinner J. B., Windle, M. (1992). Development and validation of a three-dimensional measure of drinking motives. *Psychological Assessment, 4,* 123–132.

Corr, P. J., DeYoung, C. G., & McNaughton, N. (2013). Motivation and personality: A neuropsychological perspective. *Social and Personality Psychology Compass, 7,* 158-175.

Costa, P. T., Jr., & McCrae, R. R. (1992). *NEO PI-R professional manual.* Odessa, FL: Psychological Assessment Resources.

Cox, B. J., Yu, N., Afifi, T. O., & Ladouceur, R. (2005). A national survey of gambling problems in Canada. Canadian Psychiatry, 50, 213-217.

Dechant. K. (2013). Show me the money: Incorporating financial motives into the Gambling Motives Questionnaire. *Journal of Gambling Studies.* Online first prepublication available online June 6, 2013 from http://link.springer.com/article/10.1007/s10899-013-9386-5

Dechant, K. & Ellery, M. (2011). The effect of including a monetary motive item on the Gambling Motives Questionnaire in a sample of moderate gamblers. *Journal of Gambling Studies, 27,* 331-344.

DeYoung, C. G., Quilty, L. C., & Peterson, J. B. (2007). Between facets and domains: 10aspects of the big five. *Journal of Personality and Social Psychology, 93,* 800-896.

DeYoung, C. G., Quilty, L. C., Peterson, J. B., & Gray, J. R. (2014). Openness to experience, intellect, and cognitive ability. *Journal of Personality Assessment, 96,* 46-52.

Doiron, J. (2006). Gambling and problem gambling in Prince Edward Island. Report submitted to the PEI Department of Health.

Dowling, N., Smith, D., & Thomas, T. (2005). Electronic gaming machines: Are they the 'crack cocaine' of gambling? *Addiction, 100,* 33-45.

Dow Schull, N. (2012). *Addiction by Design: Machine Gambling in Las Vegas.* Princeton, NJ: Princeton University Press.

Eysenck, H. J., & Eysenck, S. B. G. (1976). *Psychoticism as a dimension of personality.* New York: Crane, Russak & Company.

Ferris, J., & Wynne, H. J. (2001). *The Canadian Problem Gambling Index.* Ottawa: Canadian Centre on Substance Abuse.

Goodie, A. S., & Fortune, E. E. (2013). Measuring cognitive distortions in Pathological Gambling; Review and meta-analyses. *Psychology of Addictive Behaviours, 27,* 730-73.

Gotestam, K. G., Johansson, A., Wenzel, H. G., & Simonsen, I.-E. (2004). Validation of the lie/bet screen for pathological gambling on two normal population data sets. *Psychological Reports, 95,* 1009–1013.

Gray, J. A., & McNaughton, N. (2000). *The neuropsychology of anxiety: an enquiry into the functions of the septo-hippocampal system(2nd edition).* Oxford: Oxford University Press.

Griffiths, M. D. (1993). Fruit machine gambling: The importance of structural characteristics. *Journal of Gambling Studies, 92,* 101-120.

Harrigan (2011). *The House Rules: Gaming Regulations and Their Effects on Gambling and Problem Gambling Across Canada.* Report prepared for the Ontario Problem Gambling Research Center and the Ontario Ministry of Health and Long Term Care. Guelph, ON: OPGRC.

Harrigan, K. A., & Dixon, M. (2009). PAR sheets, probabilities, and slot machine play: Implications for problem and non-problem gambling. *Journal of Gambling Issues, 23,* 81-110.

Harrigan, K., Dixon, M., MacLaren, V., Collins, K., & Fugelsang, J. (2012). The maximum rewards at the minimum price: Reinforcement rates and payback percentages of multi-line slot machines. *Journal of Gambling Issues, 26,* 11-29.

Harrigan, K., MacLaren, V., Brown, D., Dixon, M., & Livingstone, C. (in press). Games of chance or masters of illusion: Multiline clots design may promote cognitive distortion. *International Gambling Studies*, manuscript accepted pending minor revision, Jan 31, 2014.

Hayes, A. H. (2013). *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-based Approach.* New York, NY: Guilford Press.

Hodgins, D. C. (2008). What we see depends mainly on what we look for (commentary). *Addiction, 103*, 1118-1119.

Hodgins, D. C., Schopflocher, D. P., Martin, C. R., el-Guebaly, N., Casey, D. M., Currie, S. R., Smith, G. J., & Williams, R. J. (2012). Disordered gambling among higher-frequency gamblers: Who is at risk? *Psychological medicine, 42,* 2433-2444.

Ipsos Reid Public Affairs (2008). British Columbia problem gambling prevalence study. Report submitted to the BC Gaming Policy and Enforcement Branch, Ministry of Public Safety and Solicitor General by Ipsos Reid Public Affairs and Gemini Research.

Jacques, C., & Ladouceur, R. (2006). A prospective study of the impact of opening a casino on gambling behaviours: 2- and 4-year follow-ups. *The Canadian Journal of Psychiatry, 51*, 764-773.

Jefferson, S., & Nicki, R. (2003). A new instrument to measure cognitive distortions in video lottery terminal users: The informational biases scale (IBS). *Journal of Gambling Studies, 19,* 387–402.

Kairouz, S., & Nadeau, L. (2010). Portrait du jeu au Québec: Prévalence, incidence et trajectoires sur quatre ans. Report prepared for Agence de la santé et des services sociaux de Montréal

Kotov, R., Gamez, W., Schmidt, F., & Watson, D. (2010). Linking "big" traits to anxiety, depressive, and substance use disorders: A meta-analysis. *Psychological Bulletin, 136,* 768−821.

LaPlante, D. A., & Shaffer, H. J. (2007). Understanding the influence of gambling opportunities: Expanding exposure models to include adaptation. *American Journal of Orthopsychiatry, 77,* 616-623.

Lee, H., Chae, P. K., Lee, H., & Kim, Y. (2007). The five-factor gambling motivation model. *Psychiatry Research, 150*, 21-32.

Ledgerwood, D. M., & Milosevic, A. (2013). Clinical and personality characteristics associated with Posttraumatic Stress Disorder in Problem and Pathological Gamblers recruited from the community. *Journal of Gambling Studies.* Online first prepublication available Nov 30, 2013 at http://link.springer.com/article/10.1007/s10899-013-9426-1 accessed Jan 22, 2014.

Lemaire, J., MacKay, T., & Patton, D. (2008). *Manitoba gambling and problem gambling 2006.* Winnipeg: Addictions Foundation of Manitoba.

Liquor and Gaming Authority of Manitoba (2014). *Liquor and Gambling in Manitoba.* Winnipeg, MB: Author.

Lorains, F. K., Cowlishaw, S. T., & Thomas, S. A. (2011). Prevalence of comorbid disorders in problem and pathological gambling: Systematic review and meta-analysis of population surveys. *Addiction, 106,* 490-498.

MacLaren, V. V., Ellery, M., & Knoll, T. (2014). Gambling motives and cognitive distortions mediate effects of personality on problem gambling in electronic gambling machine players. Report to the Manitoba Gambling Research Program.

MacLaren, V. V., Fugelsang, J., Harrigan, K. A., & Dixon, M. J. (2011). The personality of pathological gamblers: A meta-analysis. *Clinical Psychology Review, 31,* 1057-1067.

MacLaren, V. V., Harrigan, K. A., & Dixon, M. (2012). Gambling motives and symptoms of problem gambling in frequent slots players. *Journal of Gambling Issues, 27,* 1-13.

Manitoba gaming Control Commission (2010). *Manitobans and Gambling III.* Winnipeg, MB: Author.

Markon, K. E., Krueger, R. F., & Watson, D. (2005). Delineating the structure of normal and abnormal personality: An integrative hierarchical approach. *Journal of Personality and Social Psychology, 88,* 139−157.

Marketquest Research (2009). 2009 New Brunswick gambling prevalence study. Report prepared for NB Department of Health and NB Loteries and Gaming Corporation.

Marketquest Research (2009). Newfoundland and Labrador gambling prevalence study June 2009. Report prepared for NL Department of Health and Community Services.

Meehl, P. E., & Rosen, A. (1955). Antecedent probability and the efficiency of psychometric signs, patterns, or cutting scores. *Psychological Bulletin, 52,* 194-216.

Milosevic, A., & Ledgerwood, D. M. (2010). The subtyping of pathological gambling: A comprehensive review. *Clinical Psychology Review, 30,* 988−998.

Moubarac, J. C., Shead, N. W., & Derevensky, J. L. (2010). Bingo playing and problem gambling: A review of our current knowledge. *Journal of Gambling Issues, 24,* 164-184.

Moyer, A., & Finney, J. W. (2015). Brief interventions for alcohol misuse. *Canadian Medical Association Journal.* Available online prepublication at http://www.cmaj.ca/content/early/2015/03/02/cmaj.140254 March 2, 2015.

Nehlin, C., Gronbladh, L., Fredericksson, A., & Jansson, L. (2013). Alcohol and drug use, smoking, and gambling among psychiatric outpatients: A 1-year prevalence study. *Substance Abuse, 34,* 162-168.

Nower, L., & Blaszczynski, A. (2010). Gambling motivations, money-limiting strategies, and precommitment preferences of problem versus non-problem gamblers. *Journal of Gambling Studies, 26,* 361-372.

Quinlan, C. K., Goldstein, A. L., & Stewart, S. H. (2013). An investigation of the link between gambling motives and social context of gambling in young adults. *International Gambling Studies.* Online first prepublication available Nov 29, 2013 at http://www.tandfonline.com/doi/full/10.1080/14459795.2013.855252#.UuAD5rTnYkU accessed Jan 22, 2014.

Raylu, N., & Oei, T. P. S. (2004). The gambling related cognitions scale (GRCS): Development, confirmatory factor validation and psychometric properties. *Addiction, 99,* 757-769.

Reid, R. C., Li, D. S., Lopez, J., Collard, M., Parhami, I., Karim, R., & Fong, T. (2011). Exploring the facets of personality and escapism in pathological gamblers. *Journal of Social Work Practice in the Addictions, 11,* 60-74.

Samuel, D. B., & Widiger, T. A. (2008). A meta-analytic review of the relationships between the five factor model and DSM-IV-TR personality disorders: A facet level analysis. *Clinical Psychology Review, 28,* 1326−1342.

Saunders JB, Aasland OG, Babor TF, de la Fuente JR, Grant M. (1993). Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO Collaborative Project on Early Detection of Persons with Harmful Alcohol Consumption—II. *Addiction, 88,* 791–804.

Schellinck, H., Bliemel, M., Schellinck, T., & Schrans, T. (2012). Raising the FLAGs: A Pilot Study adapting FLAGS, a next- generation gambling risk assessment instrument, for use in identifying risk among general gambling populations. Ontario Problem Gambling research Centre. http://www.gamblingresearch.org/content/raising-flags-pilot-study-adapting-flags-next-generation-gambling-risk-assessment-instrument

Schrans & Schellinck (2008). 2007 adult gambling prevalence study. Report prepared for NS Department of Health Promotion and Protection by Focal Research Consultants.

Schellinck, T., & Schrans, T. (2011). Intelligent design: How to model gambler risk assessment by using loyalty tracking data. *Journal of Gambling Issues, 26,* 51-68.

Smith, G., & Schopflocher, D. (2014). *Are EGMs the most hazardous gambling format?* Paper presented at the Alberta Gambling Research Institute conference, Banff, AB.

Smith, G. J., & Wynne, H. J. (2002). Measuring gambling and problem gambling in Alberta using the Canadian Problem Gambling Inventory. Report prepared for the Alberta Gambling research Institute.

Stewart, S. H., Loughlin, H. L., & Rhyno, E. (2001). Internal drinking motives mediate personality domain - drinking relations in young adults. *Personality and Individual Differences, 30,* 271-286.

Stewart, S. H., & Zack, M. (2008). Development and psychometric evaluation of a three-dimensional gambling motives questionnaire. *Addiction*, *103*, 1110–1117.

Stewart, S. H., Zack, M., Collins, P., Klein, R. M., & Fragopoulos, F. (2008). Subtyping pathological gamblers on the basis of affective motivations for gambling: Relations to gambling problems, drinking problems, and affective motivations for drinking. *Psychology of Addictive Behaviours, 22,* 257-268.

Stucki, S., & Rihs-Middel, M. (2007). Prevalence of adult problem and pathological gambling between 2000 and 2005: An update. *Journal of Gambling Studies, 23,* 245-257.

Sztainert, T., Wohl, M. J. A., McManus, J. F., & Stead, J. D. H. (2013). On being attracted to the possibility of a win: Reward sensitivity (via gambling motives) undermines treatment seeking among pathological gamblers. *Journal of Gambling Studies.* Online first prepublication available June 6, 2013 at http://link.springer.com/article/10.1007/s10899-013-9394-5, accessed Jan 22, 2014.

Thege, B. K., & Hodgins, D. C. (2014). The 'light drugs' of gambling? Non-problematic gambling activities of pathological gamblers. *International Gambling Studies, 14,* 29-38.

Thomas, A. C., Allen, F. C., & James, P. (2009). Electronic gaming machine gambling: Measuring motivation. *Journal of Gambling Studies, 25,* 343-355.

Toce-Gerstein, M., Gerstein, D. R., & Volberg, R. A. (2009). The NODS-CLiP: A rapid screen for adult patholigical and problem gambling. *Journal of Gambling Studies, 25:* 541-555.

Turner, N. E., Littman-Sharp, N., Toneatto, T., Liu, E., & Ferentzy, P. (2013). Centre for Addiction and Mental Health Inventory of Gambling Situations: Evaluation of the factor structure, reliability, and external correlations. *International Journal of Mental Health and Addiction, 11,* 526-545.

Vachon, D. D., & Bagby, R. M. (2009). Pathological gambling subtypes. *Psychological Assessment, 4,* 608-615.

Weibe, J., Mun, P., & Kauffman, N. (2006). Gambling and problem gambling in Ontario 2005. Responsible Gambling Council

Whiteside, S. P., & Lynam, D. R. (2001). The five factor model and impulsivity: Using a structural model of personality to understand impulsivity. *Personality and Individual Differences, 30,* 669−689.

Williams, R.J., Belanger, Y.D., & Arthur, J.N. (2011). *Gambling in Alberta: History, Current Status, and Socioeconomic Impacts.* Final Report to the Alberta Gaming Research Institute. Edmonton, Alberta. April 2, 2011. http://hdl.handle.net/1880/48495 or http://research.uleth.ca/seiga/index.html

Williams, R.J., Rehm, J., & Stevens, R.M.G. (2011). *The Social and Economic Impacts of Gambling.* Final Report prepared for the Canadian Consortium for Gambling Research.

Williams, R.J., Volberg, R.A. & Stevens, R.M.G. (2012). *The Population Prevalence of Problem Gambling: Methodological Influences, Standardized Rates, Jurisdictional Differences, and Worldwide Trends.* Report prepared for the Ontario Problem Gambling Research Centre and the Ontario Ministry of Health and Long Term Care.

Williams, R. J., & Wood, R. T. (2004). The proportion of gaming revenue derived from problem gamblers: Examining the issues in a Canadian context. *Analyses of Social Issues and Public Policy, 4,* 33-45.

Wynne, H. J. (2002). Gambling and problem gambling in Saskatchewan. Canadian Centre on Substance Abuse, Ottawa.

Appendix A

Surveys used in the meta-analysis (see Table 1)

Afifi, T. O., LaPlante, D. A., Taillieu, T. L., Dowd, D., & Shaffer, H. J. (2014). Gambling involvement: Considering frequency of play and the moderating effects of gender and age. *International Journal of Mental Health and Addiction, 12,* 283-294.

Williams, R.J., Belanger, Y.D., & Arthur, J.N. (2011). *Gambling in Alberta: History, Current Status, and Socioeconomic Impacts.* Final Report to the Alberta Gaming Research Institute.

Smith, G. J., & Wynne, H. J. (2002). *Measuring Gambling and Problem gambling in Alberta using the Canadian Problem Gambling Index.* Edmonton: Prepared for the Alberta Gaming Research Institute.

Wynne Resources Ltd. (1998). *Adult Gambling and Problem Gambling in Alberta, 1998.* Edmonton: Report to the Alberta Alcohol and Drug Abuse Commission.

Ipsos-Reid & Gemini Research. (2008). *British Columbia Problem Gambling Prevalence Study.* Victoria, BC: Ministry of Public Safety and Solicitor General.

Ipsos-Reid & Gemini Research. (2003). *British Columbia Problem Gambling Prevalence Study.* Victoria, BC: Ministry of Public Safety and Solicitor General.

Angus Reid Group. (1996). *Problem Gambling Survey 1996: Final Report.* Submitted to the British Columbia Lottery Corporation. Vancouver, BC: Author.

Gemini Research & Angus Reid Group. (1994). *Social Gaming and Problem Gambling in British Columbia.* Report to the British Columbia Lottery Corporation. Roaring Spring, PA: Gemini Research.

LGAM Liquor and Gaming Authority of Manitoba (2014). *Liquor and Gambling in Manitoba*. Winnipeg, MB: Author.

Lemaire, J., MacKay, T., & Patton, D. (2008). *Manitoba Gambling and Problem Gambling 2006.* Winnipeg, MB: Addictions Foundation of Manitoba.

MarketQuest Research. (2010). *2009 New Brunswick Gambling Prevalence Study.* Prepared for Department of Health and New Brunswick Lotteries and Gaming Corporation, Government of New Brunswick. Fredericton, NB.

Baseline Market Research. (1996). *Final Report: Prevalence Study: Problem Gambling: Wave 2.* Prepared for Department of Finance. Fredericton: New Brunswick Department of Finance.

MarketQuest Research (2009). *2009 Newfoundland and Labrador Gambling Prevalence Study.* Prepared for Department of Health and Community Services, Government of Newfoundland and Labrador. St. John's, NL: Department of Health and Community Services.

MarketQuest Research (2008). *Newfoundland and Labrador Targeted Gambling Prevalence Study.* Prepared for Department of Health and Community Services, Government of Newfoundland and Labrador. St. John's, NL: Department of Health and Community Services.

MarketQuest Research (2005). *2005 Newfoundland and Labrador Gambling Prevalence Study.* Prepared for the Department of Health and Community Services, Government of Newfoundland and Labrador. St. John's, NL: Department of Health and Community Services.

Focal Research Consultants (2008). *2007 Adult Gambling Prevalence Study.* Halifax, NS: Nova Scotia Health Promotion and Protection.

Focal Research Consultants. (2004). *2003 Nova Scotia Gambling Prevalence Study.* Commissioned by the Nova Scotia Office of Health Promotion.

Baseline Market Research. (1996). *Final Report: 1996 Prevalence Study on Problem Gambling in Nova Scotia.* Prepared for Nova Scotia Department of Health. Halifax, NS: Author.

Omnifacts Research. (1993). *An Examination of the Prevalence of Gambling in Nova Scotia.* Halifax, NS: Nova Scotia Department of Health, Drug Dependency Services.
Williams, R. J., & Volberg, R. A. (2013). *Gambling and Problem Gambling in Ontario.* Report Prepared for the Ontario Problem Gambling Research Centre and the Ontario Ministry of Health and Long Term Care.
Wiebe, J., Mun, P., & Kauffman, N. (2006). *Gambling and Problem Gambling in Ontario 2005*. Toronto, ON: Responsible Gambling Council (Ontario).
Wiebe, J., Single, E., & Falkowski-Ham, A. (2001). *Measuring Gambling and Problem Gambling in Ontario.* Toronto, ON: Canadian Centre on Substance Abuse and Responsible Gambling Council (Ontario).
Doiron, J. (2006). *Gambling and Problem Gambling in Prince Edward Island.* Submitted to Prince Edward Island Department of Health.
Doiron, J., & Nicki, R.M. (1999). *The Prevalence of Problem Gambling in Prince Edward Island.* Fredericton: University of New Brunswick.
Kairouz, S., Nadeau, L., & Paradis, C. (2011). *Portrait of Gambling in Quebec: Prevalence, Incidence and Trajectories over Four Years.* Montreal, QC: Université Concordia.
Wynne, H. (2002). *Gambling and Problem Gambling in Saskatchewan: Final Report.* Ottawa, ON: Canadian Centre on Substance Abuse.

Appendix B

Group scores on all variables by gambling severity level.

Table A1 describes group scores on all of the variables used in this study, broken out by the 3 gambling severity levels. A correlational approach was used in all of the data analyses for this study, and no hypotheses were stated in terms of contrasts between severity levels. Nevertheless, the data are summarized here in 'binned' format for the sake of future comparisons with other samples or inclusion in meta-analysis. Means and standard deviations for the entire sample are available in Tables 1 and 3.

Table A1.
Descriptive statistics.

Variable	Low Risk	Moderate Risk	High Risk
Frequency	2.18 (1.13)	3.07 (1.46)	4.40 (2.11)
Time	1.70 (0.97)	2.42 (1.27)	3.76 (2.07)
Spend	1.15 (0.40)	1.71 (1.11)	2.57 (1.88)
Unweighted FTS	5.03 (1.95)	7.19 (3.05)	10.74 (5.03)
Weighted FTS	8.91 (1.79)	10.59 (2.43)	13.52 (3.85)
Percent Free Time	0.01 (0.03)	0.02 (0.37)	0.12 (0.32)
Percent Annual Income	0.75 (0.10)	0.34 (0.63)	2.39 (5.12)
Percent Disposable Income	0.22 (0.39)	1.17 (4.20)	4.73 (8.55)
Population Harm	0.08 (0.24)	0.25 (0.31)	0.79 (0.57)
GRCS	1.69 (0.74)	2.16 (0.84)	3.39 (1.21)
EGMQ Escape	0.32 (0.51)	0.56 (0.44)	1.06 (0.57)
EGMQ Access	0.51 (0.45)	0.81 (0.47)	1.29 (0.57)
EGMQ Social	0.26 (0.40)	0.37 (0.44)	0.66 (0.63)

Appendix C

Materials used in the study.

Canadian Problem Gambling Inventory

These questions are part of a standard measurement scale that was developed in Canada for use in gambling surveys similar to this one. For each question please base your answer on the past 12 months. Remember that all your answers are strictly confidential, so please do not write your name on this questionnaire.

Part I

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

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

Never	Less than once a year	1 to 5 times a year	6 to 11 times a year	About once a month	2 or 3 times a year	About once a week	2 to 6 times a week	Daily	I don't know	I refuse to answer

1.2 Buy other lottery, instant win or scratch tickets at lottery kiosks or through subscriptions?

Never	Less than once a year	1 to 5 times a year	6 to 11 times a year	About once a month	2 or 3 times a year	About once a week	2 to 6 times a week	Daily	I don't know	I refuse to answer

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

Never	Less than once a year	1 to 5 times a year	6 to 11 times a year	About once a month	2 or 3 times a year	About once a week	2 to 6 times a week	Daily	I don't know	I refuse to answer

1.4 Play bingo for money?

Never	Less than once a year	1 to 5 times a year	6 to 11 times a year	About once a month	2 or 3 times a year	About once a week	2 to 6 times a week	Daily	I don't know	I refuse to answer

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

Never	Less than once a year	1 to 5 times a year	6 to 11 times a year	About once a month	2 or 3 times a year	About once a week	2 to 6 times a week	Daily	I don't know	I refuse to answer

1.6 Play table games, such as blackjack and roulette, at a casino?

Never	Less than once a year	1 to 5 times a year	6 to 11 times a year	About once a month	2 or 3 times a year	About once a week	2 to 6 times a week	Daily	I don't know	I refuse to answer

1.7 Play VLTs at a bar, lounge or racetrack?

Never	Less than once a year	1 to 5 times a year	6 to 11 times a year	About once a month	2 or 3 times a year	About once a week	2 to 6 times a week	Daily	I don't know	I refuse to answer

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

Never	Less than once a year	1 to 5 times a year	6 to 11 times a year	About once a month	2 or 3 times a year	About once a week	2 to 6 times a week	Daily	I don't know	I refuse to answer

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

Never	Less than once a year	1 to 5 times a year	6 to 11 times a year	About once a month	2 or 3 times a year	About once a week	2 to 6 times a week	Daily	I don't know	I refuse to answer

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

Never	Less than once a year	1 to 5 times a year	6 to 11 times a year	About once a month	2 or 3 times a year	About once a week	2 to 6 times a week	Daily	I don't know	I refuse to answer

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

Never	Less than once a year	1 to 5 times a year	6 to 11 times a year	About once a month	2 or 3 times a year	About once a week	2 to 6 times a week	Daily	I don't know	I refuse to answer

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

Never	Less than once a year	1 to 5 times a year	6 to 11 times a year	About once a month	2 or 3 times a year	About once a week	2 to 6 times a week	Daily	I don't know	I refuse to answer

Part II

In this part, we would like you to tell us a little about yourself and your gambling. Please remember that your answers are confidential and to answer as accurately as possible.

2.3 In the past year, how often did you bet or spend money on gambling, including all the activities that you checked off in part I? Would you say….

[ ] daily or nearly every day
[ ] 2 to 6 times per week
[ ] about once a week
[ ] 2 or 3 times per month
[ ] about once a month
[ ] between 6 and 11 times a year
[ ] between 1 and 5 times a year

2.4 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? _____

2.5 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? _____

2.6 Of the times when you gambled in the past year, how often did you drink alcohol before or while you were gambling (circle one)?

Never or almost never	Sometimes	Always or almost always

2.7 In the past year, when you were gambling who did you normally participate with or go with?

[ ] alone
[ ] with spouse or partner
[ ] with other family members
[ ] with friends
[ ] with co-workers
[ ] with some other individual or group: _____

Part III

Some of these questions may not apply to you but please try to answer as accurately as possible.

Please circle the best answer for each question.

Thinking about the past 12 months.....

3.1 Have you bet more than you could really afford to lose?

Never Sometimes Most of the time Always or almost always

3.2 Have you needed to gamble with larger amounts of money to get the same feeling of excitement?

Never Sometimes Most of the time Always or almost always

3.3 Have you borrowed money or sold anything to get money to gamble?

Never Sometimes Most of the time Always or almost always

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

Never Sometimes Most of the time Always or almost always

3.5 Have you felt that you might have a problem with gambling?

Never Sometimes Most of the time Always or almost always

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

Never Sometimes Most of the time Always or almost always

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

Never Sometimes Most of the time Always or almost always

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

Never Sometimes Most of the time Always or almost always

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

Never Sometimes Most of the time Always or almost always

Part IV

Some of the next questions may not apply to you, but please try to answer as accurately as possible. Please circle the best answer for each question.

Thinking about the past 12 months.....

4.1 Has your gambling made things more difficult for your partner?

Not at all / Disagree | Mildly agree | Moderately agree | Strongly agree

4.2 Has your gambling caused problems for your family?

Not at all / Disagree | Mildly agree | Moderately agree | Strongly agree

4.3 Has your gambling had a negative impact on your neighborhood?

Not at all / Disagree | Mildly agree | Moderately agree | Strongly agree

4.4 Has your gambling caused problems for your friends?

Not at all / Disagree | Mildly agree | Moderately agree | Strongly agree

4.5 Has your gambling in any way negatively affected people at work?

Not at all / Disagree | Mildly agree | Moderately agree | Strongly agree

Part V

These questions are about your VLT or Casino slots playing. When you answer these questions, please remember that we are asking about how you play VLTs or slots, and **not** about any other kind of gambling that you may do.

Thinking about your VLT or slots playing the last 12 months.....

5.1 Roughly how many times do you go out to play VLTs or slots in a typical month?

[ ] never or maybe once in a month
[ ] usually about one day each month
[ ] 2 days a month (about once every other week)
[ ] 4 days a month (about once per week)
[ ] 8 days a month (about twice per week)
[ ] 12 days a month (about 3 per week)
[ ] 16 days a month (about 4 per week)
[ ] 20 days a month (about 5 per week)
[ ] 24 days a month (about 6 per week)
[ ] 30 days a month (just about every day)

5.2 On a typical day when you play VLTs or slots, about how much time do you spend playing them?

[ ] usually less than 30 minutes
[ ] between 30 minutes and 1 hour
[ ] between 1 to 2 hours
[ ] 2 to 3 hours
[ ] 3 to 4 hours
[ ] 4 to 5 hours
[ ] 5 to 6 hours
[ ] 6 to 7 hours
[ ] 7 to 8 hours
[ ] 8 to 9 hours
[ ] 9 to 10 hours
[ ] more than 10 hours

5.3 On a typical day when you play VLTs or slots, about how much money do you spend playing them?

[ ] usually less than $50
[ ] between $50 and $100
[ ] between $100 to $200
[ ] $200 to $300
[ ] $300 to $400
[ ] $400 to $500
[ ] $500 to $600
[ ] $600 to $700
[ ] $700 to $800
[ ] $800 to $900
[ ] $900 to $1,000
[ ] more than $1,000

Part VI. Questions all about you.

These question are meant to give us some idea of who you are and your lifestyle. Please try to answer them as honestly and completely as you can, and remember that all of your answers will be kept private.

6.1 Are you male or female? Male [ ] Female [ ]

6.2 How old are you? _____

6.3 What is your ethnicity? Please select which of the following groups you most strongly identify yourself as belonging to.

Caucasian (e.g. English, Irish, French, German, Italian, Russian, etc.) [ ]
Aboriginal (e.g. First nations, Metis, Inuit, etc.) [ ]
Latin American (e.g. Mexican, Salvadoran, Central or South American, etc.) [ ]
Asian or Southeast Asian (e.g. Chinese, Japanese, Korean, Filipino, Vietnamese, etc.) [ ]
African American (e.g. Black, African or Caribbean, etc.) [ ]
South Asian (e.g. India, Pakistan, Bangladesh, Sri Lanka, etc.) [ ]
West Asian (e.g. Arab, Persian, etc.) [ ]

6.4 How much was your total income in the past year? Please include income from all sources before taxes. Only include your own income and not that of a partner or spouse.

Under $5000 (less than $100/week before taxes) [ ]
$5000 - $9,999 (about $150/week before taxes) [ ]
$10,000 - $14,999 (about $240/week before taxes) [ ]
$15,000 - $19,999 (about $340/week before taxes) [ ]
$20,000 - $29,999 (about $480/week before taxes) [ ]
$30,000 - $39,999 (about $680/week before taxes) [ ]
$40,000 - $49,999 (about $860/week before taxes) [ ]
$50,000 - $59,999 (about $1060/week before taxes) [ ]
$60,000 - $79,999 (about $1350/week before taxes) [ ]
$80,000 - $99,999 (about $1730/week before taxes) [ ]
Over $100,000 (more than $1900/week before taxes) [ ]

6.5 Including you, how many adults over age 18 live at your address? _____

6.6 How many children under age 18 live at your address? _____

6.7 Approximately how much "disposable money" do you have each week? That is, how much do you have left to save or to spend on whatever you like after you have paid your taxes, housing costs, car payment, gas, credit cards, student loans and other debts, utility and phone bills, food, transportation and clothing?

My expenses are greater than my income so I borrow	[ ]
I have less than $50 a week left to spend	[ ]
I have between $50 and $100 a week left to spend	[ ]
I have between $100 and $150 a week left to spend	[ ]
I have between $150 and $250 a week left to spend	[ ]
I have between $250 and $500 week left to spend	[ ]
I have more than $500 a week left to spend	[ ]

6.8 How much time do you spend per week doing each of the following activities? Please write in approximately how many hours each week you spend doing these things.

Activity	**Hours per week**
Paid work at a job outside the home	
Housework or paid work that you do at home	
Shopping or doing errands outside the home	
Volunteer work for community or church organizations	
Attending classes at high school, university or college	
Looking after your children or other's children	
Physical exercise (e.g. running, gym, sports)	
Taking children to organized activities (e.g. children's art or music lessons, hockey or soccer practice)	
Other organized activities like church, art classes, music lessons, AA or NA meetings, political party activities, etc.	

Electronic Gambling Motives Questionnaire

People have many reasons for playing VLTs. Here is a list of reasons that other people sometimes give for gambling on VLTs and we would like to know if any of these are reasons that apply to you. Remember that there are no right or wrong answers. We just want to know about the reasons why you play VLTs. Please rate each statement in terms of how much it applies to you by putting a check mark (√) in a box next to each item.

Thinking of all the times you've played VLTs in the past year, **how often do you play them**.....

	Never or almost never	Sometimes	Often	Always or almost always
1. To stop thinking about problems				
2. It provides a break from worrying				
3. The machines provide a focal point				
4. Somewhere to escape alone				
5. No one knows I'm there				
6. Somewhere to go alone				
7. Somewhere to go when there's nothing to do				
8. It's somewhere to go when you need it				
9. I go when I've got time to spare				
10. It's somewhere to go with something to do				
11. VLT venues are open long hours				
12. VLT venues are close by				
13. I stop in when passing a VLT venue				
14. Playing VLTs reduces boredom				
15. I play to be around people				
16. I play to meet new people				
17. You can talk to someone				
18. It's a welcoming atmosphere				
19. It's somewhere to go and feel safe				

Source:
Thomas, A. C., Allen, F. C., & Phillips, J. (2009). Electronic Gaming Machine Gambling: Measuring motivation. *Journal of Gambling Studies, 25,* 343-355.

Gambling Related Cognitions Scale

The following is a list of statements about playing VLTs. Please read each statement carefully and indicate how much you agree or disagree with it by circling the right number underneath it.

1 Gambling makes me happier.

1	2	3	4	5	6	7
strongly disagree	moderately disagree	mildly disagree	neither agree nor disagree	mildly agree	moderately agree	strongly agree

2 I can't function without gambling.

1	2	3	4	5	6	7
strongly disagree	moderately disagree	mildly disagree	neither agree nor disagree	mildly agree	moderately agree	strongly agree

3 Praying helps me win.

1	2	3	4	5	6	7
strongly disagree	moderately disagree	mildly disagree	neither agree nor disagree	mildly agree	moderately agree	strongly agree

4 Losses when gambling are bound to be followed by a series of wins.

1	2	3	4	5	6	7
strongly disagree	moderately disagree	mildly disagree	neither agree nor disagree	mildly agree	moderately agree	strongly agree

5 Relating my winnings to my skill and ability makes me continue gambling.

1	2	3	4	5	6	7
strongly disagree	moderately disagree	mildly disagree	neither agree nor disagree	mildly agree	moderately agree	strongly agree

6 Gambling makes things seem better.

1	2	3	4	5	6	7
strongly disagree	moderately disagree	mildly disagree	neither agree nor disagree	mildly agree	moderately agree	strongly agree

7 It is difficult to stop gambling as I am so out of control.

1	2	3	4	5	6	7
strongly disagree	moderately disagree	mildly disagree	neither agree nor disagree	mildly agree	moderately agree	strongly agree

8 Specific numbers and colours can help increase my chances of winning.

1	2	3	4	5	6	7
strongly disagree	moderately disagree	mildly disagree	neither agree nor disagree	mildly agree	moderately agree	strongly agree

9 A series of losses will provide me with a learning experience that will help me win later.

1	2	3	4	5	6	7
strongly disagree	moderately disagree	mildly disagree	neither agree nor disagree	mildly agree	moderately agree	strongly agree

continued.....

10 Relating my losses to bad luck and bad circumstances makes me continue gambling.

1	2	3	4	5	6	7
strongly disagree	moderately disagree	mildly disagree	neither agree nor disagree	mildly agree	moderately agree	strongly agree

11 Gambling makes the future brighter.

1	2	3	4	5	6	7
strongly disagree	moderately disagree	mildly disagree	neither agree nor disagree	mildly agree	moderately agree	strongly agree

12 My desire to gamble is so overpowering.

1	2	3	4	5	6	7
strongly disagree	moderately disagree	mildly disagree	neither agree nor disagree	mildly agree	moderately agree	strongly agree

13 I collect specific objects that help increase my chances of winning.

1	2	3	4	5	6	7
strongly disagree	moderately disagree	mildly disagree	neither agree nor disagree	mildly agree	moderately agree	strongly agree

14 When I have a win once, I will definitely win again.

1	2	3	4	5	6	7
strongly disagree	moderately disagree	mildly disagree	neither agree nor disagree	mildly agree	moderately agree	strongly agree

15 Relating my losses to probability makes me continue gambling.

1	2	3	4	5	6	7
strongly disagree	moderately disagree	mildly disagree	neither agree nor disagree	mildly agree	moderately agree	strongly agree

16 Having a gamble helps reduce tension and stress.

1	2	3	4	5	6	7
strongly disagree	moderately disagree	mildly disagree	neither agree nor disagree	mildly agree	moderately agree	strongly agree

17 I'm not strong enough to stop gambling.

1	2	3	4	5	6	7
strongly disagree	moderately disagree	mildly disagree	neither agree nor disagree	mildly agree	moderately agree	strongly agree

18 I have specific rituals and behaviours that increase my chances of winning.

1	2	3	4	5	6	7
strongly disagree	moderately disagree	mildly disagree	neither agree nor disagree	mildly agree	moderately agree	strongly agree

19 There are times that I feel lucky and so I only gamble those times.

1	2	3	4	5	6	7
strongly disagree	moderately disagree	mildly disagree	neither agree nor disagree	mildly agree	moderately agree	strongly agree

Source:

Raylu, N., & Oei, T. P. S. (2004). The gambling related cognitions scale (GRCS): Development, confirmatory factor validation and psychometric properties. *Addiction, 99,* 757-769.