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Predictors of Problem Gambling for Sports and Non-sports Gamblers: A Stochastic Search Variable Selection Analysis

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Abstract
Differences in the psychological characteristics and gambling behaviors of sports bettors and non-sports bettors were examined with a view to identifying predictors of problem gambling severity. A survey was completed by 1,280 participants, 596 of whom had placed bets on a sporting event in the last year. We found that sports bettors are at greater risk of problem gambling due to differences in attitudes towards gambling, personality traits, thinking styles, erroneous cognitions, and gambling motivations. Moreover, our findings suggest that the difference between individuals who bet on sports and those who do not is more quantitative than qualitative. A stratified stochastic search variable selection analysis by type of bettor revealed similar important predictors of problem gambling for both sports bettors and non-sports bettors; however, the association between the predictors and problem gambling was stronger for sports bettors. Overall, the findings of this study suggest that preventative methods and interventions for problem gambling should be targeted as a function of whether individuals bet on sports.

Keywords Sports gambling · Motivation · Cognitions · Impulsivity · Bayesian analysis

Introduction

The widespread use of technology, changing societal attitudes, and the liberalization of government regulations has been accompanied by an increase in the general popularity of gambling including gambling on sports. Sports betting entails wagering on sporting activities other than horse and dog racing (Hing, 2016). Population prevalence estimates of sports betting are quite variable. In Australia, the estimates range from 6% (Gainsbury et al., 2015) to 13% (Hing et al., 2016). Gassman et al. (2017) reported that 11.1% of German citizens had bet on sporting events at least once and 3.4% had bet on sports in the last year. Winters and Derevensky (2019) cited a U.S. consumer survey indicating that 45% of respondents had bet on sports at least once in their lives, although 4% reported betting on sports regularly.

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A major contributor to the growth of sports betting is the availability of online outlets. Lopez-Gonzales et al. (2019) reported that online sports gambling accounts for 37% of the online gambling market in Europe. According to Winters and Derevensky (2019), sports wagering accounted for 45% of the amount wagered on online gambling worldwide in 2015. The next highest among online gambling options was online casino gambling at 24%. Brosowski et al. (2020) reported that in contrast to a decrease in the prevalence of offline sports betting in Iceland from 3.5% in 2007 to 2.8% in 2017, there was an increase in online sports betting on foreign websites from 0.2 to 5.3% across those time frames.

Patterns of gambling behavior have been linked to at-risk gambling (Hing et al., 2016). Gainsbury et al. (2019) found that the frequency of venue-based gambling for sports betting uniquely predicted problem gambling. However, the relationship between frequency of sports betting and problem gambling was mediated by the breadth of gambling involvement (the number of different forms of gambling activities). Brosowski et al. (2020) tested the mediating effects of expenditure, breadth of gambling involvement, and frequency of gambling within a specific activity on the relation between the activity and problem gambling. Across 15 types of gambling activities, most direct effects of specific gambling activities on problem gambling were statistically non-significant. However, some direct effects, including sports betting online on a foreign website, were statistically significant.

Beyond gambling behaviors, researchers have explored individual differences in personality, cognition and motivation as predictors of problem gambling. Slutske et al. (2005) revealed negative emotionality and lack of constraint to be trait-like personality factors of problem gamblers. That is, individuals who were problem gamblers were more likely to experience negative emotions (e.g., anxiety, anger) and be risk-takers relative to individuals who were not problem gamblers. In addition, Chiu and Storm (2010) characterized problem gamblers as being impulsive, believing in luck, and having more positive attitudes towards gambling. Impulsivity was the strongest predictor of problem gambling out of the risk factors examined (Chiu & Storm, 2010). A study of South Asian gamblers revealed that individuals who gambled frequently had poorer cognitive control and higher cognitive distortions related to criminal activity, namely notion of entitlement and insensitively to the impact of crime, relative to non-gamblers (Fatima et al., 2019). Moreover, prior research has additionally demonstrated particular erroneous cognitions, such as illusion of control and locus of control, to be risk factors of problem gambling (Moore & Ohtsuka, 1999).

Devos et al. (2020) identified clusters of gambler types differentiated by facets of impulsivity and cognitive distortion. For example, one cluster that was likely to seek treatment comprised impulsive gamblers with gambling-related cognitions who had high levels of sensation seeking and illusion of control. Hearn et al. (2020) distinguished three types of gamblers varying in gambling motivation: social gamblers are motivated by socialization; affect-regulation gamblers seek to control negative affective states; and, antisocial gamblers are motivated by excitement. That typology was linked to the propensity for problem gambling such that social gamblers were most protected from developing problems and antisocial gamblers were most likely to experience harms from gambling.

Purpose of the Present Study

The overarching goal of the present research was to examine differences between the psychological characteristics of non-sports gamblers and sports gamblers with a view to identifying the predictors of risk of gambling harms. Since we initiated our data

collection in the autumn of 2018, two reviews of at-risk sports bettor characteristics have been published. Winters and Derevensky (2019) listed the following factors as predictors of problem gambling among sports bettors: being young and male; being single; betting with friends; holding a self-perception of being skilled and knowledgeable; having a high likelihood of alcohol or illicit drug use while gambling. These sociodemographic predictors of problem gambling, however, are common among problem gamblers who are not sports bettors (Calado & Griffiths, 2016). Russell et al. (2019) conducted analyses to identify the most important predictors of gambling-related risk severity among sports gamblers regardless of whether collinearity was present among the large number of predictors tested. The model indicated that demographic factors and breadth of gambling involvement were not significant predictors of at-risk gambling among sports bettors. The significant predictors were a lack of self-control, being motivated by money, having a high urge for gambling, alcohol issues, and having erroneous cognitions. Those results suggest that the gambler's psychological relationship to sports betting contributes to potential harms from gambling on sports.

The present study differs from Russell et al. (2019) in the selection of critical measures and analyses. Russell et al. (2019) adapted the Problem Gambling Severity Index (PGSI) (Ferris & Wynne, 2001), the "gold standard" measure of problem gambling (Caler et al., 2016; Miller et al., 2013), to apply strictly to sports betting as their sample comprised sports bettors. They dichotomized the scores on the PGSI to identify groups as either non-risk or at-risk gamblers. The present study used the original PGSI to compare non-sports gamblers to sports gamblers, and we used the PGSI scores as a continuous variable as in Gainsbury et al. (2019) in order to assess the importance of the predictors. Whereas Russell et al. (2019) pooled across a 2-dimensional scale of erroneous cognitions (Steenbergh et al., 2002), we treated scores from each dimension as separate predictors. Similarly, whereas Russell et al. (2019) measured self-control with a single score, we measure five facets of impulsivity and used each as a separate predictor. Although Russell et al. (2019) and the current study considered several separate motivations as predictors, different scales and specific motivations were measured. In addition, we included a measure of thinking style and a measure of the centrality of gambling to one's persona.

The State of Regulated Sports Gambling in Ontario, Canada

The participants in the current study were residents of Ontario, Canada where sports betting is regulated as a lottery in a parlay format. Bettors must select the outcomes of at least three sporting events in order to place a bet. Although the betting events may be accessed online along with the payouts for a successful parlay bet, the actual placement of the bet must occur in a licenced retail facility. In fiscal year 2018–2019, proceeds from government regulated lotteries were 4.17 billion dollars of which 302.6 million dollars (7%) were from regulated sports betting (Ontario Lottery and Gaming Corporation, 2019). The government recognizes that sports gamblers may bet on offshore online sites and at out-of-country land-based facilities. There is discussion of recouping those lost revenues by offering single event bets and online betting, but to date those changes have not been implemented.

Method

Participants

A survey was distributed by Qualtrics to a panel of gamblers in Ontario, Canada. The survey was completed by 1,280 participants, 596 of whom had placed bets on a sporting event in the last 12 months. Of the sports bettors, 324 were men with a median age of 44 years, and 267 were women with a median age of 38 years. Of the 684 non-sports bettors, 247 were men with a median age of 56 years, and 436 were women with a median age of 48 years. One non-sports bettor elected not to indicate a gender.

Measures

The survey included several standardized scales used to measure participants' impulsivity, gambling motivations, erroneous cognitions, and problem gambling severity. In addition, the survey asked about the participants' demographics (e.g., age, gender, marital status), their gambling behaviors, and their attitudes towards betting on sports.

Problem Gambling Severity Index (PGSI) The PGSI (Ferris & Wynne, 2001) measures an individual's risk of being a problem gambler. The temporal context is the last 12 months and participants are asked to indicate the frequency (0=never, 1=sometimes; 2=most of the time; 3=almost always) with which four gambling behaviors and five adverse consequences have occurred. The behaviors are: betting more than one could really afford to lose; needing to gamble with larger amounts of money to get the same feeling of excitement; going back another day to try to win back lost money; and, borrowing money or selling anything to get money to gamble. The five adverse consequences are: feeling one might have a problem with gambling; perceiving that gambling has caused health problems, including stress or anxiety; being criticized by people for your betting or being told you had gambling problem, regardless of whether or not you thought it was true; attributing gambling as the cause of any financial problems for oneself or one's household; and, having felt guilty about the way one gambles or what happens when one gambles. The PGSI had a Cronbach's alpha of 0.95.

Four categories of severity are identified by the summed PGSI as follows: 0, non-problem gambler; 1–2, low risk gambler; 3–7, moderate risk gambler; and, 8 or higher, problem gambler. The percentage in each category for non-sports gamblers in the current study was 62%, 17%, 11%, and 10%, respectively. The percentage in each of the four categories of gambling severity for the sports gamblers was 34%, 24%, 20%, and 22%, respectively. That pattern showed that whereas non-sports gamblers were more likely than sports gamblers to have no problems, sports gamblers were more likely than non-sports gamblers to have higher risks of problem gambling, χ^2 (3)=104.61, $p<0.001$. Note that the percentage of problem gamblers among sports bettors in the current study was similar to the 27% reported by Russell et al. (2019).

Gamblers Beliefs Scale The gamblers beliefs scale (Steenbergh et al., 2002) consists of 22 items indexing two factors: Illusion of Control; and, Luck/Perseverance. Examples of the items on the scale include: "I think of gambling as a challenge" and "I have a "lucky" technique that I use when I gamble". Participants are asked to what extent they agree or disagree with each statement on a 7-point Likert scale (1=strongly agree, 7=strongly

disagree). The Illusion of Control subscale had a Cronbach's alpha of 0.92 and the Luck/Perseverance subscale had a Cronbach's alpha of 0.97.

Rational versus Experiential Scale The Rational versus Experiential scale (Pacini & Epstein, 1999) assesses a participant's tendency to process information rationally or intuitively. We adapted the context for decision-making by providing a scenario in which participants were asked to consider a hypothetical betting scenario in which they were to bet on the favorite or the underdog. The participants then responded to series of 20 items asking about the extent to which a decision-making method was used in their choices about the hypothetical betting scenario. An example of a rational item is, "I reasoned things out carefully", and an example of an experiential item is, "I used my gut feelings". Participants rated each item from 1 (definitely false) to 5 (definitely true). The rational subscale had a Cronbach's alpha of 0.93 and the experiential subscale had a Cronbach's alpha of 0.89.

Short UPPS-P Impulsive Behavior Scale The Short UPPS-P Impulsive Behavior Scale (Cyders et al., 2014) was developed to measure five facets of impulsive behavior: positive and negative urgency, premeditation, perseverance, and sensation seeking. Participants rate 20 items on a 4-point scale for the extent to which they agree or disagree with the statement. Examples of items from each subscale and the Cronbach's alphas are: "When I am upset, I often act without thinking" (negative urgency; 0.84); "I generally like to see things through to the end" (lack of perseverance, reverse scored; 0.67); "My thinking is usually careful and purposeful" (lack of premeditation, reverse scored; 0.79); "I quite enjoy taking risks" (sensation seeking; 0.73); and, "I tend to lose control when I am in a great mood" (positive urgency; 0.86).

Gambling Motivation Scale The Gambling Motivation Scale (Shinaprayoon et al., 2017) comprises 28 items that measure the extent to which an individual is motivated along six dimensions: intellectual challenge (e.g., "I enjoy improving my knowledge of the game"); excitement (e.g., "It is exciting to gamble"); socialization (e.g., "It is the best way to relax"); monetary gain (e.g., "I play for money"); social recognition (e.g., "It makes me feel important"); and, amotivation (e.g., "I play for money, but sometimes I ask myself what I get out of it)." Amotivation signals a lack of intention to act. Participants are asked to report the extent to which they agree or disagree with each item on a 7-point Likert scale (1 = strongly disagree to 7 = strongly agree). Cronbach alpha values ranged from 0.84 (monetary gain) to 0.94 (intellectual challenge).

Gambling Identity Scale The Gambling Identity Scale was a modified version of the Self-Concept and Smoking Cessation Scale (Shadel & Mermelstein, 1996). To modify the scale, the word "smoking" was replaced with "gambling" for each of the five statements on the scale. An example item is "Gambling is part of who I am." The Gambling Identity Scale had a Cronbach's alpha of 0.96.

Procedure

Participants were recruited by a research agency, Qualtrics. There were two waves of recruitment: one wave for gamblers of any kind and a second wave that targeted sports bettors. In the first wave, sports bettors comprised approximately 13% of respondents; therefore, purposive sampling was used in the second wave to select additional sports bettors. Participants were contacted by Qualtrics to notify them about a study on the "characteristics of sports gamblers." and were provided with a link to the study if they were interested in participating. Participants were compensated in line with Qualtrics' policy. Once

participants consented to continue, they were asked to confirm that they were 18 years of age or older, residents of Ontario, and that they had placed a bet in the past 12 months. Any participant who answered "no" to any of the inclusion criteria did not proceed with the survey.

Respondents completed an online survey developed to assess demographic variables, sports betting behaviors, attitudes towards gambling, impulsivity, beliefs, motivation, and problem gambling severity. The materials and procedures were approved by the Research Ethics Board at the researchers' home university. The materials included a consent form, a debriefing form, contact information for a problem gambling helpline, and contact information for the principal investigator. After completion of the survey, participants were sent to a second site where they were provided with contact information to receive their incentive. All responses to the survey were anonymous. The demographic variables were those assessed by Gainsbury et al. (2015): gender; year of birth; household size; current living arrangement; marital status; educational level; employment; country of birth; ethnic affiliation; and, language spoken at home.

The gambling behavior items asked respondents to indicate whether they had participated in the different activities during the last year. The activities included lottery tickets, instant scratch tickets, horse racing, electronic gaming machines, sports betting, casino table games, poker, and bingo. A sport-specific question asked about betting on NHL hockey, NFL football, college football, MLB baseball, NBA basketball, professional soccer, professional tennis, and professional golf. An "other" option was available to indicate any other activity and sport. For each activity and sport, participants were asked to indicate their typical monthly expenditure.

In addition, participants were presented with two hypothetical betting scenarios and asked whether they would vote on "the underdog" or "the favorite" in each game. The first hypothetical betting scenario was: "Imagine you were betting on the outcome of three sporting events. If you bet $2 on the underdog in each game and the underdog were to win each game, you would receive $33.60. If you bet $2 on the favorite in each game and the favorite were to win each game, you would receive $16.60. Which bet would you make?" The second hypothetical scenario was: "Imagine you were betting on the outcome of three sporting events. If you bet $10 on the underdog in each game and the underdog were to win each game, you would receive $168. If you bet $10 on the favorite in each game and the favourite were to win each game, you would receive $83.20. Which bet would you make?".

Participants were asked about their attitudes towards sports gambling. In particular, participants were asked which of the following expresses their belief about the harms versus benefits of betting on sports: the harms far outweigh the benefits; the harms slightly outweigh the benefits; the harms are equal to the benefits; the benefits slightly outweigh the harms; the benefits far outweigh the harms. Participants were then asked whether they believe that betting on sports is morally wrong. The impulsivity, cognition, and motivation scales described above followed the demographic and gambling behavior questions. Finally, participants completed the PGSI.

Overview of Statistical Analyses

Bivariate analyses were conducted to distinguish between sports bettors and non-sports bettors in terms of demographic factors, gambling behaviors, personality correlates, gambling motivations, thinking styles, erroneous cognitions, and problem gambling

severity. Chi-square analyses and parametric or non-parametric tests of independent groups were used to examine how sports bettors and non-sports bettors differed from one another on each factor. Non-parametric Mann-Whitney U tests were conducted rather than Welch's parametric t-tests when the outcome of interest was highly skewed.

Our main interest was to examine whether differences between sports and non-sports bettors in terms of their gambling behaviors, personality correlates, thinking styles, erroneous cognitions and gambling motivations influenced the relationship between type of bettor and problem gambling severity. To conduct that analysis, each factor on which sports bettors and non-sports bettors differed was considered for inclusion in an ordinary least squares (OLS) multiple linear regression model with the square-root transformation of PGSI score as the outcome. The square-root transformation of PGSI was used due to a violation of the assumption of normality in model residuals. The number of predictors of problem gambling is large. Howe et al. (2019) reported that 33 variables produced significant regression coefficients for PGSI. A statistical challenge is to identify the important predictors of any psychological construct as the number of models increases exponentially with the number of predictors. We used Stochastic Search Variable Selection (SSVS) to select the subset of the predictors which are most important in the prediction of PGSI for inclusion in the OLS regression model. SSVS is a Bayesian variable selection technique which "increases power and decrease false-positive results, compared with traditional approaches" (Bainter et al., 2020, p. 67). In particular Bainter et al. (2020) criticized step-wise regression which was used by Howe et al. (2019). See Bainter et al. (2020) for a discussion of the advantages of SSVS in psychological research.

In order to select the subset of most important variables, SSVS analyses sample a very large number of high probability Bayesian regression models made up of varying subsets of the candidate predictors using Markov-Chain Monte-Carlo (MCMC) estimation. The predictors which appear most often in the sample of high probability models are said to be the more important predictors. SSVS therefore estimates the *marginal inclusion probability* (MIP) for each predictor, which indicates the proportion of models the predictor was included in out of the thousands of models sampled. An MIP equal to or greater than 0.5 would indicate that the predictor was included in 50% or more of the model subsets, thereby suggesting that the predictor is a reliable predictor of the outcome (Bainter et al., 2020).

We conducted the SSVS analyses with the web application, SSVSforPsych, which is available at https://ssvsforpsych.shinyapps.io/ssvsforpsych/ and included the predictors with an MIP greater than 0.5 in our OLS regression models. This package uses default prior distributions for the Bayesian estimates of the intercept and regression coefficients. A prior inclusion probability of 0.5 was used so that each predictor had a 50% chance of being included in the Bayesian models originally. Finally, the first 5,000 iterations of the MCMC algorithm were not used in the estimation of the MIPs in order to allow the algorithm to converge prior to estimation. Convergence of results was evaluated by assessing the correlation between results when running each analysis twice.

To assess whether the predictors of problem gambling severity are dependent on the type of bettor, two separate OLS multiple linear regressions on the square-root of PGSI scores were conducted for sports bettors and non-sports bettors. Again, for each of these regression analyses, an SSVS analysis was conducted to determine which predictors to include in the OLS regression model. Percentage of income wagered was not included for consideration in any of the models given that there were missing data for 40% of the respondents and SSVS does not allow for observations with any missing values.

Results

Demographic Comparisons

Table 1 presents a summary of the gender, marital, employment, and education demographic data. Males were more likely than females to be sports bettors and the reverse was true for non-sports bettors, χ^2 (1) $=44.600$, $p<0.001$. The distribution of marital status differed between sports bettors and non-sports bettors $\chi^2(4)=24.910$, $p<0.001$, as did the distribution of employment status, χ^2 (6) $=131.766$, $p<0.001$, and highest level of education, χ^2 (4) $=30.413$, $p<0.001$. Those patterns showed that sports bettors were more likely to be single, employed full-time, and college educated than were non-sports bettors. Sports bettors were significantly younger ($M=43.332$, $SE=0.560$) than non-sports bettors ($M=49.842$, $SE=0.581$), $t(1273)=8.064$, $p<0.001$, Cohen's $d=0.451$. Only 69% of participants reported their income and the distribution of reported income was highly skewed in the positive direction, Shapiro-Wilk $=0.773$, $p<0.001$. A Mann–Whitney test indicated that sports bettors had a significantly higher income ($M=\$92,918.220$, $SE=3,514.196$) than non-sports bettors ($M=\$73,884.510$, $SE=2,421.690$), $U=77,035$, $p<0.001$, $\eta=0.176$. MANCOVAs and ANCOVAs were performed for the following t-tests and

Table 1 Demography data for sports bettors and non-sports gamblers

Demographic factor	Sports bettor		Non-sports bettor	
	N	%	N	%
Gender				
Male	324	54.8%	247	36.2%
Female	267	45.2%	436	63.8%
Marital status				
Never married	177	29.7%	159	23.2%
Married	287	48.2%	327	47.8%
Divorced	40	6.7%	92	13.5%
Widowed	14	2.3%	30	4.4%
Common law/Living with partner	77	12.9%	70	10.2%
Employment status				
Full-time	413	69.3%	273	39.9%
Part-time	54	9.1%	103	15.1%
Unemployed	13	2.2%	32	4.7%
Student	27	4.5%	16	2.3%
Retired	55	9.2%	153	22.4%
Homemaker	18	3.0%	47	6.9%
Sick, parental or disability leave or other	16	2.7%	57	8.4%
Highest level of education				
Some high school/Junior high	11	1.8%	34	5%
High School	71	11.9%	134	19.6%
Some college or University	105	17.6%	130	19.0%
College/University	329	55.2%	307	44.9%
Graduate or Professional school	79	13.3%	69	10.1%

Mann-Whitney U tests to confirm that differences shown between sports and non-sports bettors remained when controlling for demographic differences.

Comparison of Gambling Beliefs

Table 2 shows that sports bettors and non-sports betters differed in their beliefs about the harms versus benefits of gambling, $\chi^2(4) = 138.454$, $p < 0.001$. Post-hoc analyses demonstrated that, whereas sports bettors (20.6%) were more likely to believe that the benefits of gambling outweigh the harms to some degree compared to non-sports bettors (5.9%), $\chi^2(1) = 62.374$, $p < 0.001$, the reverse was true for the perception that the harms outweigh the benefits or are equal to the benefits. Complementing that pattern was the finding that although both groups were more likely to consider sports gambling as moral, the tendency was stronger for sports bettors (76.4%) than non-sports bettors (62.2%), $\chi^2(1) = 29.877$, $p < 0.001$.

Comparisons of Gambling Behaviors

Sports bettors bet on a significantly higher number of non-sport activities in a typical month ($M = 3.292$, $SE = 0.087$) than did non-sports bettors ($M = 1.599$, $SE = 0.051$), $t(975) = -16.863$, $p < 0.001$, Cohen's $d = 0.959$. The percentage of income wagered towards non-sports activities was positively skewed, Shapiro-Wilk $= 0.424$, $p < 0.001$. Sports bettors wagered a significantly higher percentage of their income toward non-sport activities in a typical month ($M = 3.794\%$, $SE = 0.386$) than did non-sports bettors ($M = 2.436\%$, $SE = 0.298$), $U = 55,399$ $p < 0.001$, $\eta = 0.200$. When presented with the first hypothetical betting scenario with lower risk and lower reward, the choice of betting on the favorite was not statistically different for sports bettors (46%) and non-sports bettors (41%), $\chi^2(1) = 3.653$, $p = 0.061$. However, when presented with a betting scenario carrying higher risk and higher reward, sports bettors were more likely to bet on the favorite (53%) than were non-sports bettors (46%), $\chi^2(1) = 6.481$, $p = 0.012$. Across the two scenarios, sports bettors appear to be more conservative in their choice.

Table 2 Gambling attitudes of sports and non-sports gamblers	Gambling attitude	Sports bettor		Non-sports bettor	
		N	%	N	%
	Harms versus benefits				
	Harms far outweigh the benefits	111	18.6%	311	45.6%
	Harms slightly greater than the benefits	159	26.7%	171	25.1%
	Harms equal to the benefits	203	34.1%	160	23.5%
	Benefits slightly greater than the harms	89	14.9%	25	3.7%
	Benefits far outweigh the harms	34	5.7%	15	2.2%
	Betting on sports is morally wrong				
	Yes	38	6.4%	65	9.5%
	Unsure/don't know	102	17.2%	193	28.3%
	No	453	76.4%	424	62.2%

Table 3 Means and standard errors of personality measures for sports and non-sports gamblers

Personality correlate	Sports bettor		Non-sports bettor		t-statistic	p-value	Cohen's d
	M	SE	M	SE			
Impulsivity							
Negative urgency	2.432	0.030	2.261	0.025	4.538	<0.001	0.255
Positive urgency	2.218	0.030	1.987	0.025	6.007	<0.001	0.338
Lack of premeditation	1.892	0.020	1.907	0.018	−0.459	0.647	0.026
Lack of perseverance	1.881	0.020	1.913	0.017	−1.296	0.195	0.073
Sensation seeking	2.590	0.026	2.265	0.026	9.228	<0.001	0.516
					U	p-value	η
Gambling identity	3.203	0.068	2.117	0.053	118.972	<0.001	0.239

Table 4 Mean (SE) Thinking Style and Cognition Scores for Sports bettors and Non-sports Gamblers

Personality correlate	Sports bettor		Non-sports bettor		t-statistic	p-value	Cohen's d
	M	SE	M	SE			
Thinking style							
Experiential	3.312	0.030	3.020	0.031	6.855	<0.001	0.383
Rational	3.732	0.028	3.459	0.032	6.437	<0.001	0.359
					U	p-value	η
Erroneous cognition							
Illusion of control	4.120	0.051	2.739	0.053	95.429	<0.001	0.458
Luck/Perseverance	3.576	0.057	2.424	0.052	110.030	<0.001	0.396

Comparisons of Impulsivity, Cognitions, and Motivations

Table 3 presents the summary and inferential statistics for each personality correlate subscale. In terms of impulsivity, sports bettors had significantly higher negative urgency, positive urgency, and sensation seeking scores than did non-sports bettors. However, the two types of bettors did not differ in lack of perseverance or lack of premeditation. In addition, gambling identity was compared across type of bettor. Gambling identity was positively skewed, Shapiro-Wilk = 0.883, $p < 0.001$. A Mann-Whitney test indicated that sports bettors were more likely to identify themselves as a gambler on the self-concept scale.

Table 4 presents summary and inferential statistics for thinking styles and erroneous cognitions. Sports bettors scored significantly higher than non-sports bettors on both the rational thinking style scale and the experiential thinking style scale. Both illusion of control and luck/perseverance beliefs were highly skewed; Shapiro-Wilk = 0.965, $p < 0.001$, and Shapiro-Wilk = 0.949, $p < 0.001$, respectively. Non-parametric tests showed that sports bettors had significantly higher illusion of control and luck/perseverance scores than did non-sports bettors.

Table 5 Mean (SE) and score on motivation subscales for sports and non-sports gamblers

Motivation	Sports bettor		Non-sports bettor		t-statistic	p-value	Cohen's d
	M	SE	M	SE			
Intellectual Challenge	4.539	0.047	3.189	0.057	18.252	<0.001	1.016
Excitement	4.793	0.049	3.395	0.061	17.870	<0.001	0.994
Socialization	3.987	0.058	2.793	0.056	14.781	<0.001	0.829
Monetary Gain	4.309	0.052	3.107	0.057	15.564	<0.001	0.869
Social Recognition	3.663	0.060	2.698	0.053	12.021	<0.001	0.676
Amotivation	4.083	0.059	3.329	0.063	8.732	<0.001	0.488

Table 5 shows that sports bettors had significantly higher scores on each type of gambling motivation compared to non-sports bettors. That is, sports bettors are more motivated through intellectual challenge, excitement, socialization, monetary gain, social recognition, and amotivation compared to non-sports bettors.

Is Sports Betting a Predictor of Problem Gambling?

PGSI scores were highly skewed in the positive direction due to few individuals reporting high problem gambling severity, Shapiro-Wilk $= 0.664$, $p < 0.001$. A Mann-Whitney test showed that the total PGSI score was higher for sports bettors ($M = 4.536$, $SE = 0.250$) than for non-sports bettors ($M = 2.096$, $SE = 0.165$), $U = 140,607.5$, $p < 0.001$, $\eta = 0.285$. Our goal was to test whether the higher problem gambling severity of sports bettors could be explained by the differences between the two types of bettors in terms of their gambling behaviors, personality correlates, motivations, thinking styles and erroneous cognitions. An ordinary least squares regression analysis with the square-root transformation of PGSI score as the outcome was conducted. The gambling behaviors, personality correlates, motivations, thinking styles and erroneous cognitions on which sports bettors differed significantly from non-sports bettors were considered for inclusion as predictors in the regression model. The predictors included in the model were those with an MIP greater than 0.5 in an SSVS analysis. The SSVS analysis selected the number of non-sport activities wagered on, positive urgency, gambling identity, luck/perseverance cognitions, amotivation, and social recognition to be included in the regression model (see Table 6 for MIPs of each predictor). Type of bettor was included in the model despite it having a low MIP in order to examine whether it would be a significant predictor of problem gambling severity when the other factors were included in the model.

As can be seen in Table 6, each predictor selected by the SSVS analysis was a significant predictor in the regression analysis. Type of bettor was not a significant predictor of problem gambling severity when the gambling behaviors, personality correlates, motivations and erroneous cognitions were accounted for in the model. The number of non-sport activities wagered on, positive urgency, gambling identity, luck/perseverance cognitions and amotivation each had a positive relationship with total PGSI score. In contrast, motivation for social recognition had a negative relationship with total PGSI.

Table 6 Linear Regression Coefficients on the Square-root Transformation of PGSI for Predictors with SSVS MIP > .50. $R^2 = 0.516$

	Beta	SE(Beta)	*p*-value	MIP
Type of bettor	0.020	0.063	0.745	0.03
Gambling behaviours				
Number of non-sport activities wagered on	0.056	0.017	0.001	1.00
Imaginative bet	–	–	–	0.01
Impulsivity				
Negative urgency	–	–	–	0.41
Positive urgency	0.557	0.046	<0.001	1.00
Sensation seeking	–	–	–	0.01
Gambling identity	0.242	0.029	<0.001	1.00
Erroneous cognitions				
Luck/Perseverance	0.181	0.035	<0.001	1.00
Illusion of control	–	–	–	0.01
Gambling motivations				
Amotivation	0.183	0.022	<0.001	1.00
Intellectual challenge	–	–	–	0.01
Socialization	–	–	–	0.41
Social recognition	−0.119	0.032	<0.001	0.72
Monetary gain	–	–	–	0.02
Excitement	–	–	–	0.00
Thinking style				
Rational	–	–	–	0.02
Experiential	–	–	–	0.01

Separate regression analyses were conducted for non-sports bettors and sports bettors to examine whether the predictors of problem gambling severity are consistent for each type of bettor (see Table 7). Again, the predictors considered for inclusion in the models were the gambling behaviors, personality correlates, motivations, and erroneous cognitions on which sports bettors and non-sports bettors differed. The predictors included in the regression models were those with MIPs greater than 0.5 in an SSVS analysis. The SSVS analyses selected three predictors to be included in each model. For both non-sports bettors and sports-bettors, gambling identity, and amotivation were identified by the SSVS analyses as important predictors of problem gambling severity. The regression analyses demonstrated that each of these predictors had a significant, positive relationship with the total PGSI score for both types of bettor. The important predictors of problem gambling severity for the two types of bettor differed in terms of impulsivity. The SSVS analysis selected positive urgency as an important predictor of problem gambling severity for sports bettors whereas negative urgency was selected as an important predictor for non-sports bettors.

Discussion

To our knowledge, few previous studies have focused on examining the characteristics that differentiate problem gambling risk among sports and non-sports bettors. Understanding risk factor differences between sports bettors and non-sports bettors is critical in

Table 7 Linear Regression Coefficients for Sports Bettors (SB) and Non-sports bettors (NSB). $R^2 = 0.499$ for Sports Bettors and $R^2 = 0.435$ for Non-sports Bettors

	Beta		SE(Beta)		p–value		MIP	
	SB	NSB	SB	NSB	SB	NSB	SB	NSB
Gambling behaviors								
Number of non-sport activities wagered on	–	–	–	–	–	–	0.12	0.06
Imaginative bet	–	–	–	–	–	–	0.05	0.01
Impulsivity								
Negative urgency	–	0.362	–	0.058	–	<0.001	0.06	0.67
Positive urgency	0.710	–	0.068	–	<0.001	–	1.00	0.45
Sensation seeking	–	–	–	–	–	–	0.03	0.02
Gambling identity	0.279	0.365	0.030	0.031	<0.001	<0.001	1.00	1.00
Erroneous cognitions								
Luck/Perseverance	–	–	–	–	–	–	0.19	0.26
Illusion of control	–	–	–	–	–	–	0.01	0.02
Gambling motivations								
Amotivation	0.243	0.159	0.033	0.025	<0.001	<0.001	1.00	0.97
Intellectual challenge	–	–	–	–	–	–	0.03	0.01
Socialization	–	–	–	–	–	–	0.06	0.01
Social recognition	–	–	–	–	–	–	0.01	0.24
Monetary gain	–	–	–	–	–	–	0.02	0.03
Excitement	–	–	–	–	–	–	0.01	0.02
Thinking style								
Rational	–	–	–	–	–	–	0.01	0.03
Experiential	–	–	–	–	–	–	0.07	0.02

determining whether preventative methods and interventions for problem gambling should be targeted as a function of whether individuals bet on sports.

The current study demonstrated that sports bettors and non-sports bettors may be distinguished by their demographics, gambling behaviors, attitudes towards gambling, personality traits, thinking styles, erroneous cognitions, and gambling motivations. In particular, sports bettors are more likely to be younger and male. Relative to non-sports gamblers, sports gamblers are more involved in gambling, have more positive attitudes towards gambling, and are more likely to identify themselves as a gambler. Sports gamblers are more likely to adhere to beliefs in illusion of control and luck/perseverance, and are more rational and experiential thinkers than are non-sports gamblers. Sports gamblers tend to act as a result of wanting to feel sensation or as a result of positive and negative emotions. Finally, sports gamblers have stronger motivations to gamble across all motivation domains (i.e. intellectual challenge; socialization; social recognition; excitement; monetary gain; lack of intention).

Given the culture of sports gambling, it is not surprising that sports bettors represent a unique cohort of gamblers. Individuals that participate in sports or who are fans of sports often believe that particular rituals can impact the outcome of a game (Wann et al., 2013). Moreover, sports bettors often have a loyalty to the game or the players and will often bet on sports to demonstrate their knowledge of the game and because of the connection that it

brings to others (Gordon et al., 2015). Therefore, it follows that sports bettors would have higher illusion of control, and/or luck and perseverance cognitions, as these cognitions align with "good luck" rituals. As for differences in gambling motivations, individuals who bet on sports could be satisfying motivations such as intellectual challenge, socialization, or social recognition through the ability to make bets based on statistics of the game and the feeling of connection to others that it brings. In addition, many advertisements targeting sports bettors focus on the reduced risk of sports gambling by offering money-back guarantees or free bets (Lopez-Gonzalez, Estévez, et al., 2018). The resulting reduction in perceived risk associated with sports gambling could be one potential explanation for why individuals who are motivated by monetary gain are more likely to bet on sports. Finally, the loyalty to the game or the players could result in sports bettors experiencing strong emotions as a result of wins or losses. Given that sports bettors were found to be more impulsive and more likely to act as a result of positive and negative emotions, the good or bad performance of a team could result in a sports bettor wagering money towards the game.

Given that the factors on which sports gamblers score higher than non-sports gamblers are predictive of problem gambling severity, it is not surprising that sports bettors had higher problem gambling severity scores than non-sports bettors. However, associations between problem gambling and specific types of gambling activities may be mediated by gambling involvement (Brosowski et al., 2020; LaPlante et al., 2011). A major focus of the present study was to explore whether the difference between sports bettors and non-sports bettors with respect to problem gambling could be explained by the differences in their gambling behaviors, personality traits, erroneous cognitions, thinking styles and gambling motivations.

Betting on sports was excluded as a predictor of problem gambling severity when gambling behaviors, personality traits, erroneous cognitions, thinking styles and gambling motivations were accounted for. Overall, this suggests that sports bettors are not at greater risk of problem gambling because they bet on sports. Rather, the heightened risk for problem gambling among sports bettors may be attributed to their being more likely to: bet on a wider range of activities; fail to control impulses in the face of positive emotions; believe in luck and perseverance; and, be uncertain as to whether gambling leads to financial gain. Each of these factors has been linked to problem gambling among gamblers in general (e.g. Clarke, 2004; Marmurek et al., 2014; Nelson et al., 2018; Steenbergh et al., 2002). However, given that motivation through social recognition is associated with a decrease in problem gambling severity, this may act as a protective factor against problem gambling for sports bettors. This finding replicates Hearn et al. (2020) who also showed that motivation through socialization is protective against problem gambling.

The pattern of important predictors of problem gambling was similar for sports bettors and non-sports bettors. There was one exception: whereas sports bettors who act on positive emotions may be at greater risk of problem gambling, non-sports bettors who act on negative emotions may be at greater risk. It might be conjectured that sports bettors are disposed to lose control following a run of successes; non-sports bettors may lose control when they attempt to recoup losses. Furthermore, the predictors in the model for sports bettors accounted for an additional 6.4% of the variability in PGSI scores compared to the model for non-sports bettors. That is, high levels of impulsivity, gambling identity, and amotivation may pose a greater risk to sports bettors than to non-sports bettors, further demonstrating the need to target interventions and preventative methods for problem gambling towards sports bettors.

Tolchard (2017) has suggested that interventions should adopt the favorable elements of both behavioral and cognitive approaches. The current study showed that the strength of one's identification as a gambler is an important predictor of problem gambling severity. Personalized feedback intervention (PFI) may offer a method of modifying that self-perception. PFI interventions (Marchica & Derevensky, 2016) promote a comparison of an individual's behaviors and attitudes to what is perceived to be normal. If there is a discrepancy between their behavior and the perceived norm, then the individual will be more motivated to change their behavior towards the norm. Increasing awareness of the behaviors and characteristics that put sports gamblers at risk may lead to more responsible gambling.

In addition, preventative methods can be put in place to help educate sports bettors on the potential harms of gambling. This study demonstrated that sports bettors were more likely to have a normalized and positive view of gambling and sports gambling compared to non-sports bettors. Given that sports bettors are at greater risk of problem gambling, it is important that they understand the potential harms of gambling on sports. Advertising which targets sports bettors has been found to reduce the stigma around sports betting (Lopez-Gonzalez, Guerrero-Sol, et al., 2018) and increase the perceived illusion of control (Lopez-Gonzalez et al., 2019). Policy makers should intervene to ensure that advertising does not normalize betting on sports compared to other forms of gambling to ensure that these individuals understand the associated risks.

Motivation is considered to be central to many accounts of the development of behavioral gambling problems (Dong & Potenza, 2014; Hearn et al., 2020). We found that sports gamblers report stronger motivations for gambling than do non-sports gamblers across all facets of motivation. The SSVS analysis identified amotivation as the most important of the motivations that predict problem gambling. Amotivation indicates that the gambler questions whether potential monetary gain is to be expected from continued gambling. Interventions may be designed to address that conflict. Robbins (2019), in the context of drug abusers, claimed that a frequent reply to the question of their motivation was "they don't know" (p. 93) and that attributions for craving were post-hoc rationalizations. The challenge in mitigating harms experienced by gamblers and sports gamblers in particular is to foster self-awareness of the supporting mechanisms along with prospects for successfully regulating them.

Data Availability Data will be made available to reviewers upon request.
Data will be stored in Open Science Framework once manuscript is accepted for publication.

Declarations

Conflicts of interest None.

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