A dissociation of impulsivity and gambling cognition pathways to gambling urges via motivation

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OBJECTIVES: The present study explored the associations among problem gambling severity, trait impulsivity, gambling cognitions, gambling motivations, and gambling urges. The central question was whether the pathway linking trait impulsivity and gambling urges could be dissociated from the pathway linking gambling cognitions and gambling urges. Differential mediation along those pathways via gambling motivation was assessed.

METHOD: The participants were 202 patrons of a slot machine gambling venue who completed standardized impulsivity and gambling related measurement scales in return for $30.

RESULTS: Gambling cognitions and motivation were more strongly correlated with problem gambling severity than was trait impulsivity. Mediation analyses showed that whereas the impulsivity to urge link was mediated by motivation, the cognition to urge link was not mediated by motivation.

CONCLUSION: Cognitive and motivational interventions for high-risk and/or addictive gamblers are expected to reduce the urge to gamble independently of a gambler's trait impulsivity level.

Key Words: *Gambling severity; Impulsivity; Gambling cognitions; Gambling urges; Gambling motivation*

A recent review (1) of gambling prevalence in 31 countries reported a range from 25.5% (Czech Republic) to 86% (New Zealand). The range of problem gambling prevalence varied depending on whether the temporal context was lifetime (0.7% to 6.5%) or past-year (0.12% to 5.8%). The variation in estimates of the gambling prevalence within each temporal frame reflects the diversity of measurement instruments, operational definitions, and cultural trends. Across countries, the socio-demographic factors predictive of problem gambling included the following: young, less educated, male, ethnic minority, single or divorced, and, unemployed or low income.

A study (2) of the gambling habits of Canadians reported that, aside from scratch tickets and lotteries, slots accounted for the highest participation rate (16.5%) and the highest percentage of gambling revenue (40%). The allure of slot machine play may derive from the short time interval between placing a bet and the outcome. Despite the popularity of slot machine games among gamblers, the relative risk of slot players being problem gamblers was reported to be 3.5 where relative risk was measured as the degree to which problem gamblers report having played a particular form of gambling relative to non-problem gamblers. The relative risk of slots players having gambling problems is about half the relative risk of internet (7.7) and casino (7.2) gamblers. A similar pattern was reported (3) for conversion rates across various gambling activities where the conversion rate was indexed by the likelihood of becoming a frequent (at least weekly) player of that activity given some participation in that activity. Whereas sports and internet betting had high conversion rates (23%; 20%), slots had a low conversion rate (2.76%).

The low prevalence rates of problem gambling among slots players suggest that individual differences moderate the effects of a gambling activity on problem gambling. Many personality and psychosocial characteristics have been associated with disordered gambling. Narcissism, psychopathy, and Machiavellianism have been linked to disordered gambling (4) as has personal relative deprivation (5). However, those studies did not include comparisons across a wide range of individual difference links to gambling. In a comprehensive analysis of 23 predictors of problem gambling severity (6), it was found that trait impulsivity was the strongest predictor. That result has been confirmed in reviews of the personality correlates of pathological gamblers (7,8).

Theoretical advances on the construct of impulsivity identify five distinct components of impulsivity (9): lack of planning involves a failure to plan ahead; lack of perseverance involves a failure to maintain vigilant attention on a task; sensation seeking is the tendency to pursue novel or thrilling experiences; negative urgency is the tendency to act rashly when upset; and,

positive urgency is the tendency to act rashly when experiencing an unusually positive mood. In a meta-analysis of impulsivity studies (7) that included several measures of those components (excluding positive urgency), only negative urgency and low premeditation differentiated problem gamblers and controls. The major contribution of the emotional components of impulsivity to problem gambling is confirmed in findings where the greatest differences between a clinical sample of pathological gamblers and healthy controls occurred on the negative and positive urgency components (10).

Problem gambling is also sustained by distorted gambling cognitions (11). The Gambling Related Cognition Scale (GRCS) identifies five cognitive factors related to gambling (12): expectancies (e.g., "gambling makes the future brighter"); illusion of control (e.g., "specific numbers and colors can help increase my chances of winning"); predictive control (e.g., "losses when gambling are bound to be followed by a series of wins"); inability to stop (e.g., "I can't function without gambling"); and, interpretive bias (e.g., "relating my losses to probability makes me continue gambling"). In a study (10) of the relationships among facets of impulsivity and gambling related cognitions, positive urgency and negative urgency were the strongest discriminators of pathological gamblers and healthy controls. Although both positive urgency and negative urgency were directly correlated with illusion of control, only positive urgency was significantly correlated with the overall gambling related cognition score. No other facets of impulsivity were significantly correlated with gambling related cognitions.

It should be noted that (10) focused on a small sample (n= 30) of treatment-seeking gamblers. The present study was designed to analyze whether impulsivity and gambling related cognitions provide alternate pathways to problem gambling in a broader spectrum of gamblers. The central question addressed was whether the contributions of impulsivity and gambling related cognitions to the urge to gamble (13) may be differentially related to the role of motivation on gambling (14,15). Participants were recruited at a gambling venue that offered primarily slot machine games (no table games). Participants completed measures of gambling severity, impulsivity, gambling related cognitions, gambling motivations, and urgency to gamble. Sub-scales of impulsivity, cognitions, and motivation that significantly separated low risk and high risk gamblers were pooled and entered into mediation analyses (16) that tested whether motivation had differential mediating effects for the pathway from impulsivity to gambling urge and the pathway from cognitions to gambling urge. Whereas impulsivity is a trait measured independently of the gambling context, gambling related cognitions are contextually specific to gambling. Therefore, it might be expected that impulsivity is linked to

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gambling urges via motivation for gambling and that gambling cognitions are directly linked to gambling urges.

METHODS

Participants

This research project received ethics approval from the Research Ethics Board at the author's university. The participants were 202 (97 males; 105 females) patrons at a racetrack-slots facility in Ontario Canada. A recruitment poster was placed adjacent to the entrance to the gambling area. The poster stated that a research team was on the premises to study "the characteristics of gamblers." The poster indicated that participants would be paid $30. Patrons who wished to participate were directed by a member of the research team to a room outside the gambling area where they completed a survey containing a series of standardized scales measuring problem gambling severity, trait impulsivity, gambling related cognitions, gambling motivation, and gambling urges. The survey was presented electronically or in paper format according to the preference of the participant.

Measurement instruments

The Problem Gambling Severity Index (PGSI) is a nine-item subset of the Canadian Problem Gambling Inventory (17). Respondents are asked to think about the past year and indicate the frequency for each item using a 4-point scale: 0=never; 1=sometimes; 2=most of the time; 3=almost always. The nine items are: How often have you bet more than you could really afford to lose? How often have you needed to gamble with larger amounts of money to get the same feeling of excitement? How often have you gone back another day to try to win back the money you lost? How often have you borrowed money or sold anything to get money to gamble? How often have you felt that you might have a problem with gambling? How often have people criticized your betting or told you that you had a gambling problem, regardless of whether or not you thought it was true? How often have you felt guilty about the way you gamble or what happens when you gamble? How often has your gambling caused you any health problems, including stress or anxiety? How often has your gambling caused any financial problems for you or your household?

The PGSI has been endorsed (18,19) as a reliable and valid index of the progression of gambling severity in non-clinical samples. In contrast to the South Oaks Gambling Screen (SOGS), the PGSI measure was developed explicitly for use with a general (rather than clinical) population. Factor analysis and the reliability analysis point to the existence of a single, underlying, problem gambling factor whereas the same analysis conducted on the SOGS items yielded multiple gambling factors. The original scoring of the PGSI classified four gambling subtypes on the basis of the sum of the responses across the nine items: 0=non-problem gambler; 1-2=low-risk gambler; 3-7=moderate-risk gambler; 8 or more=problem gambler. Non-problem and low-risk gamblers were described as not having experienced any adverse consequences from gambling. Revised cutoffs (20) of 1-4 and 5-7 provided better distinctiveness between the middle categories. The present study identified two gambler types, low-risk vs. high- risk using "5" as the cutoff. Cronbach's alpha for the PGSI was 0.80.

The Impulsivity scale (9) contains 59 items to which respondents indicate their level of agreement using a 4-point scale from 1=agree strongly to 4=disagree strongly. Five factors are identified: lack of deliberation; lack of persistence; sensation seeking; positive urgency; and, negative urgency. The Gambling Related Cognitions Scale (GRC) comprises 23 items (12). Participants indicate their level of agreement with each statement on a 7-point scale (1=strongly disagree; 7=strongly agree). The scale comprises five facets of gambling related cognitions: expectancies; illusion of control; predictive control; inability to stop; interpretive bias. Cronbach's alpha across the 23 items items was 0.93.

The Gambling Motivation Scale (21) asks respondents to indicate their level of agreement on 27 statements using a 5-point scale where 1=strongly disagree, 3=neutral, and 5=strongly agree. The scale identifies five separate factors: excitement; monetary; avoidance; socialization; and, amusement. A comparison of the two gambling subtypes on each of the factors yielded statistically significant differences on all factors but social (Table 2). The scores on the 21 items assessing the other four factors were summed to yield an overall motivation score. Cronbach's alpha for those items was .91.

The Gambling Urgency Scale (13) comprises the following six statements for which respondents indicate their level of agreement using a 7-point scale: All I want to do now is to gamble; It would be difficult to turn down a gamble this minute; Having a gamble now would make things seem just

perfect; I want to gamble so bad that I can almost feel it; Nothing would be better than having a gamble right now. I crave a gamble right now. The scores for each statement are summed to yield an overall score. In the present study, Cronbach's alpha across the six items was .92. A comparison for the two gambling subgroups (Table 2) showed that the high risk group has significantly higher gambling urge scores than did the low risk group.

RESULTS

PGSI Categories

Statistical analyses that focus on comparisons of gambling severity categories are typically based on defining a cut-off for pooling categories into two groups (22,23). The pooled low-risk and high-risk groups in the present study were based on the PGSI cut-off of 5 (20). There were 168 (90 female, 78 male) low-risk gamblers and 34 (15 female, 19 male) high-risk gamblers. The association between severity category and gender was not statistically significant, $\chi 2$ (1)=1.01, p=0.32. The difference in PGSI between the low-risk (M =1.14, SD=1.25) and the high-risk (M=8.35, SD=3.43) groups was statistically significant, t (200)=12.11, p<0.001, Cohen's d=2.79.

Group differences in impulsivity

The top portion of Table 1 presents the mean and standard deviation values on the total score of each subscale of impulsivity (9). A comparison of the low-risk and high-risk gamblers on each factor showed that high-risk gamblers had statistically significant higher scores on only positivity urgency and negative urgency. For the mediational analysis, the 23 positive and negative urgency scores were combined to yield an overall impulsivity score. Cronbach's alpha for those items was 0.95.

Group differences in gambling related cognitions (GRC)

The middle portion of Table 1 presents the mean and standard deviation values on the total score for each GRC subscale for the non-problem and problem gambling groups. A comparison of the two gambling severity subtype groups yielded statistically significant higher scores for the high-risk group on all five subscales. For the mediation analysis, the scores on the five facets were summed to yield an overall gambling cognitions score. Cronbach's alpha for the total scale was 0.93.

Group differences in motivations for gambling

The bottom portion of Table 1 presents the mean and standard deviation values on the total score for each Gambling Motivation subscale for the non-problem and problem gambling groups. A comparison of the two gambling severity subtype groups yielded statistically significant higher scores for the high-risk group on all subscales with the exception of social motivation. For the mediation analysis, the scores on the 21 items testing the significant four subscales were summed to yield an overall gambling motivation score. Cronbach's alpha for those items total scale was 0.91.

Group differences in gambling urgency

The scores on the six items of the gambling urgency were summed for each participant. The high-risk group (M=19.5, SD=9.02) had higher gambling urgency scores than did the low-risk group (M =10.47, SD=5.75), t (200)=7.49, p<0.001, Cohen's d=1.19.

Correlation and mediation analyses

The top portion of Table 2 presents the bivariate correlations among the measures entered into the mediation analysis along with PGSI. Note that for impulsivity, cognitions, and motivation the variable was defined as the sum score of the statistically significant subscales. All bivariate correlations (range from 0.30 to 0.65, df=200) were statistically significant. PGSI was more strongly correlated cognitions than with impulsivity, z=3.16, p=0.002, and PGSI was more strongly correlated with motivations than with impulsivity, z=2.54, p=0.01.

The central question guiding the present study was whether the path from impulsivity to urges and the path from cognitions to urges might be differentially mediated by motivations. Mediation analyses require the computation of the regression coefficient (a) between an independent variable and a mediating variable. Next the analysis requires a simultaneous regression of the independent variable and mediating variable on the dependent variable to determine the coefficient (b) for the effect of the mediating variable on the dependent variable independent of the effect of the independent variable on the dependent variable. The product of the coefficients (ab) signals an indirect effect of the independent variable on the dependent variable via the mediating variable.

TABLE 1

Means and standard deviations on impulsivity, gambling cognitions and gambling motivation.

Variables	Problem Gambling Severity Index (PGSI) Subtype					
Scale	Non-problem (n=168; PGSI=0 - 4)		Problem (N=34; PGSI >4)			
	M	SD	M	SD	t	Cohen's d
Impulsivity						
Negative Urgency	27.19	6.63	30.86	6.13	2.98*	0.57
Positive Urgency	26.39	7.74	31.85	9.32	3.61**	0.64
(Lack of) Planning	31.57	5.47	31.21	4.06	0.37	0.07
(Lack of) Perseverance	26.88	5.54	27.21	2.75	0.33	0.08
Sensation Seeking	32.42	8.22	31.97	7.01	0.3	0.06
Gambling Related Cognitions						
Expectancies	9.95	4.75	15.64	5.44	6.22**	1.12
Illusion of Control	7.39	4.38	10.44	4.85	3.63**	0.66
Predictive Control	13.96	6.39	18.94	7.57	4.01**	0.71
Inability to Stop	6.89	3.42	13.21	7.16	7.87**	1.13
Interpretive Bias	10.29	5.69	14.09	5.75	3.54**	0.66
Gambling Motivations						
Excitement	27.86	6.94	31.44	4.63	2.88*	0.61
Money	14.42	4.47	19.26	3.36	5.99**	1.22
Avoidance	12.68	4.84	17.36	6.33	4.87**	0.83
Social	9.98	2.75	10.5	3.02	0.94	0.18
Amusement	13.31	3.39	15.88	2.35	4.73**	0.88

* p<0.005; ** p<0.001

TABLE 2

Bivariate correlations and mediation (N=202).

| Correlations (all p<0.001)	PGSI	Impulsivity	Cognitions	Motivation	Urges	
PGSI		0.3	0.5	0.46	0.53	
Impulsivity			0.49	0.51	0.36	
Cognitions				0.65	0.65	
Motivation					0.49	
Mediation Analyses						
		B	SE	β	t	P
Impulsivity-Motivation-Urges	a	0.59	0.07	0.51	8.31	0.001
	b	0.19	0.03	0.41	5.81	0.001
	c	0.19	0.04	0.36	5.37	0.001
Indirect effect (c'): 95% CI: [0.07, 0.16], p=0.001						
		B	SE	β	t	P
	a	0.45	0.04	0.65	11.96	0.001
	b	0.05	0.03	0.12	1.66	0.1
	c	0.21	0.02	0.65	12.04	0
Indirect effect (c'): 95% CI: [-0.01, 0.05], p=0.10						
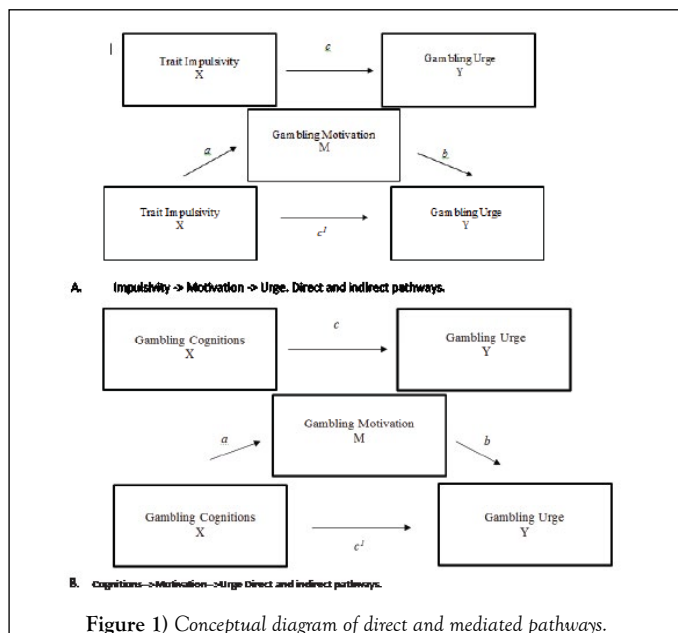
Figure 1) *Conceptual diagram of direct and mediated pathways.*

Figure 1 presents a conceptual diagram of the direct and mediated pathways.

Several approaches to testing the statistical significance have been proposed. The options reported here are the partial-posterior method for calculating the p value of an indirect effect, and the hierarchical Bayesian method for calculating the confidence interval (16). Table 2 summarizes the results of the mediation analyses. Both direct effects (c) for impulsivity->urges and cognitions>urges were statistically significant. In the impulsivity-motivation-urges pathways, impulsivity was directly related to motivation, motivation was independently related to urges, and the indirect pathway from impulsivity to urges was mediated by motivations. In contrast, for the cognition-motivation-urges pathways, cognition was directly related to motivation, motivation was not independently related to urges, and the indirect pathway from gambling cognitions to urges was not mediated by motivation.

DISCUSSION

The results of the present study confirmed that problem gambling severity among slot machine gamblers is associated with trait impulsivity, gambling related cognitions, gambling motivations, and gambling urges. However, trait impulsivity was the weakest predictor of problem gambling severity. Only two of the sub-scales of trait impulsivity (positive urgency; negative urgency) discriminated between low-risk and high-risk gamblers. Moreover, even when combining the two significant sub-scales as a predictor, trait impulsivity yielded the smallest effect among the correlates of problem gambling severity. The impulsivity traits of positive and negative urgency refer to the tendencies to act rashly when experiencing unusually positive

or negative emotions, respectively (24). The association between problem gambling severity and the urgency scales is consistent with the hypothesis that deficits in emotion regulation contribute to excessive gambling (25). A stronger association between impulsivity and problem gambling severity may result if, rather than indexing impulsivity with measures of trait impulsivity, measures of impulsive choice (discounting of delayed rewards) and/or measures of impulsive action (inhibition of a pre-potent response) were correlates (26). However, the relation of those correlates to problem gambling and trait impulsivity is inconsistent (10,27).

An original feature of the current study was the examination of the relation between predictors of gambling severity (impulsivity, cognitions, and motivations) and the urge to gamble. Gambling urge was selected as the dependent measure in the mediation analyses given that urges are common to addictions despite gender and neural differentiation among different addictions. For example, urges for cocaine and gambling are primed specifically by the context-specific videos that lead to activation in different neural structures (28). The mediation analyses demonstrated that whereas the link between trait impulsivity and urge to gamble was mediated by motivation, the link between gambling cognitions and urge to gambler was direct.

These results may have implications for the treatment of problem gambling. Pharmacological treatments may attempt to address urges directly (29). However, more common interventions involve cognitive and motivational restructuring with most successful outcomes for cognitive-behavioral interventions (30). That pattern is consistent with the finding of the current study that there is a direct link from gambling cognitions to the urge to gamble. Therefore, cognitive restructuring would be expected to lead to adjustments in the urge to gamble.

A critical limitation on generalizing from the present results to implications for intervention is that the PGSI is designed as a screen for problem gambling severity rather than as an assessment tool to diagnose gambling pathology. It would be a mischaracterization to categorize the high-risk gamblers in the present study as pathological or addictive (31). Nonetheless, slot machines provide the structure (high event frequency; continuous play; potential of immediate rewards) of gambling activities that may foster a gambling addiction. Considering recreational, problem, and addictive gambling as graduated points on a continuum warrants a careful analysis of how a gambler's underlying personality, cognitive and motivational determinants guide transitions along the continuum.

CONCLUSION

Cognitive and motivational interventions for high-risk and/or addictive gamblers are expected to reduce the urge to gamble independently of a gambler's trait impulsivity level.

CONFLICT OF INTEREST

ACKNOWLEDGEMENT

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