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Behavioral Activation and Inhibition, Negative Affect, and Gambling Severity in a Sample of Young Adult College Students

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Abstract The prevalence of pathological gambling among college students is increasing. Few studies have directly examined the relation between reward processing and gambling severity while concurrently examining the effects of co-occurring negative affect in this at risk population. This study used Structural Equation Modeling (SEM) techniques to analyze results from an online survey of 352 female and 96 male students age 18–25. Participants completed measures of past year gambling behavior and severity of gambling problems using the Canadian Problem Gambling Index and the Problem Gambling Severity Index. Negative affect and reward processing were measured by the 21-item version of the Depression, Anxiety, and Stress Scales and the Behavioral Inhibition System and Behavioral Activation System (BIS/BAS) scales, respectively. Thirty-five percent of participants reported gambling in the previous 12 months, and 11% had gambling severity scores indicative of "moderate-risk" or "problem gambling." Gambling severity was associated with negative affect. Negative affect, in turn, was correlated with the unitary BIS scale and inversely associated with the BAS reward responsiveness scale. Reward responsiveness was also inversely associated with gambling severity. In the SEM models, the association between reward responsiveness and gambling severity was mediated by negative affect among males but not among females. Potential explanations for these findings and their implications for addressing problem gambling are discussed.

Keywords Behavioral inhibition system/behavioral activation system (BIS/BAS) · Gambling · Negative affect · Young adults

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Introduction

The ages of 18–25, or young adulthood, is a time when many persons are developing their self-identity and sense of independence (Arnett 2000). It is a period of assuming the responsibilities of adulthood, including those related to relationships, employment, and, for many, entry into college. Young adulthood is also a time when many engage in potentially risky behaviors related to sex and alcohol and drug use (Volberg 2003). An activity among college students receiving increasing attention is gambling. While gambling is a legal and entertaining diversion for most who engage in it, individuals can progress from social gambling to pathological gambling (Custer 1984; Lesieur and Custer 1984). In addition to financial consequences, pathological gambling can lead to loss of friends and family. Students may risk loss of academic standing. Extreme cases may involve imprisonment or attempted suicide. These problems may become more common as legal gambling venues, including the Internet, increase (Volberg 2003).

LaBrie et al. (2003) reported findings from a national survey of college students' gambling behavior. Forty-two percent of students had gambled in the previous school year. Weekly or more frequent gambling was reported by 2.6%. Blinn-Pike et al. (2007) reviewed 15 studies of what they termed "disordered gambling," defined as a score of 5 or more on the South Oaks Gambling Screen, in college students. The estimated prevalence of disordered gambling across the studies was 7.9% (95% confidence interval of 5.4–10.4%). The authors note this rate represented an increase in disordered gambling among college students from the earlier review conducted by Shaffer et al. (1999) which reported a rate of 5.1%.

Pathological gambling has been associated with the presence of mood disorders (Quilty et al. 2011). In studying emotion-based correlates of pathological gambling, a useful theoretical framework is Gray's (1987) Reinforcement Sensitivity Theory (RST). According to this theory two motivational systems—appetitive/approach and defensive/withdrawal—are present in the brain and guide emotional responses. Differential activation of either or both systems (appetitive and defensive) is driven by motivated attention during emotional experience, which then leads to either approach or withdrawal from the stimuli (Cacioppo and Berntson 1994; Lang et al. 1998). Accordingly, the behavioral inhibition system (BIS) acts to inhibit behavior that may result in punishment. In contrast, the behavioral activation system (BAS) acts to initiate behavior that may result in reward. Carver and White (1994) extended this work by identifying three components of behavioral activation—fun seeking, drive, and reward responsiveness. The authors note that these scales are designed to be anticipatory, not experiential. That is, they are designed to measure the reaction to an expectation of reward or punishment, not reaction to specific events. These scales are described in greater detail in the "Methods" section below.

Studies support the importance of BIS/BAS in various psychological problems or disorders. Individuals with depression appear to have decreased activity and sensitivity of the appetitive system and increased activity and sensitivity of the defensive system (Clark and Watson 1991; Klein et al. 2008). BAS reward responsiveness and drive have been found to be inversely associated with depression (McFarland et al. 2006). In contrast, lifetime drug abuse and dependence were associated with greater BAS fun seeking in a community sample of young adults age 19–21 (Johnson et al. 2003). In this study, higher BIS scores were associated with current depression and anxiety. In a study of BIS/BAS and substance use among college students (Franken and Muris 2006), BIS was inversely associated with the quantity of drinking and binge drinking. BAS drive was associated with the number of illegal substances used, and BAS fun seeking was correlated with the number of

substances, drinking quantity, and binge drinking. A stronger association between fun seeking and substance use than between drive and drug use was found.

Clearly, from this perspective, disorders that are characterized by negative affect like depression as well as substance dependence may be seen as reward pathologies. Indeed, fMRI work in both disorders has confirmed anomalies in reward responses (Sinha et al. 2005; Nestler and Carlezon 2006), which are governed by pathways that underlie appetitive approach and withdrawal tendencies (Cools 2008). In substance dependence, it is easy to understand such anomalies because exogenous chemicals have been shown to disrupt the striatum signal in the domapinergic system correlating with drug specific cravings (Sinha et al. 2005) and potentially increasing urges for risk-seeking behaviour (Potenza and Winters 2003). In parallel to substance dependence, disrupted dopamine processing along the striatal pathway in depression results in impaired reward-based decision making (see Treadway and Zald 2011). This form of impairment leads to biased expectancies for future hedonic and punishing outcomes, which may reduce depressed persons' capacity to evaluate gambling related risk (Cella et al. 2010). In light of its role in reward processing, it is not surprising that the dopamine system has taken the forefront in the gambling literature. For instance, Ross et al. (2008) proposed the presence of similar developmental pathways between pathological gambling and substance dependence in which behavioral and environmental contingencies disrupt the striatal signal (coined by Ross and colleagues as 'midbrain mutiny'), resulting in the relentless pursuit of reliable cues for surprise (i.e., additive targets—in this case gambling). Together, these studies suggest the presence of common neurological processes in substance use, depression, and gambling behaviors that affect appraisal and processing of reward and punishment.

Despite implied relations from self-report and neuroimaging studies, few have directly examined the links between reward processing and co-occurring gambling problems and negative affect Examining these questions in young adults is particularly important since these individuals seem to be especially susceptible to pathologies, including a wide range of risky behavior, of the reward system (Kelley et al. 2004). The aims of this study were twofold. The first was to assess the prevalence and severity of gambling in a sample of college students aged 18–25. The second was to employ structural equation modeling (SEM) to examine the relations between gambling severity, negative affect, and behavioral inhibition and activation among those who gambled. We hypothesized that gambling severity would be a function of negative affect and that negative affect would, in turn, be associated with BIS and inversely associated with the BAS scales. We further hypothesized that BIS would be associated with gambling severity and that BAS would be inversely associated with gambling severity and that these associations would by negative affect.

Methods

Participants

Participants for this study were college students recruited from psychology classes at a public university. The study was publicized through classroom and online announcements and flyers. Students were informed they could complete an on-line survey about emotions and gambling for additional class credit. Students were informed about the purpose of the study and told declining to participate would not affect their grades. They were also told they could refuse to answer any question. An informed consent form was presented on-line. A waiver of signed consent was obtained, and students signaled their consent by selecting

the appropriate onscreen button. All materials were presented in English. All study protocols and forms were approved by the appropriate Institutional Review Boards. No personal identifiers were collected. Although the focus of this article is on young adults, there was no age requirement to participate in the survey.

Measures

Demographic Information

Personal characteristics measured were gender, age, and class (freshman through graduate student).

Gambling Behavior and Severity

Gambling behavior and the severity of gambling problems in the past year were assessed by the Canadian Problem Gambling Index (CPGI) (Wynne 2003). Students were asked how often they had gambled in the past year. The overall frequency of gambling was measured on a six-point scale ranging from never to daily. Specific gambling activities in the previous year were recorded by a set of no/yes questions. These included lottery or scratch-off tickets; raffle tickets; bingo; poker; games such as blackjack, craps, roulette, slot machines, or eight-liners; horse or dog racing; a sporting event; or any other activity. Participants were also asked if they had gambled in a casino or gambled online.

Gambling severity was measured by the Problem Gambling Severity Index (PGSI), which comprised nine items from the CPGI measured on a four-point scale from 0 = never to 3 = almost always. A sample item was, "thinking about the past 12 months, how often have you bet more than you could afford to lose?" PGSI score was computed as the sum of the nine items and could range from 0 to 27. The reliability and validity of the PGSI have been presented in Ferris and Wynne (2001), with a recent IRT study confirming internal validity (Sharp et al. 2011).

The CPGI also contained other items which, although not included in the PGSI score, provided further information related to participants' gambling. Two items were recorded on a four-point scale from 1 = strongly disagree to 4 = strongly agree and were related to gambling beliefs. For example, "After losing many times in a row, you are more likely to win." Other items asked for a no or yes response and measured the correlates of lifetime gambling ("Do you remember a big win when you first started gambling?") and past year gambling ("Thinking about the past 12 months, have you used alcohol or drugs while gambling?"). A set of open ended questions asked how much time and money were typically spent gambling.

Behavioral Inhibition and Activation

Participants completed the Behavioral Inhibition and Behavioral Activation Scales (BIS/BAS) developed by Carver and White (1994). Items were measured on a four-point scale with 1 = very true for me and 4 = very false for me. The BIS subscale consisted of seven items assessing concerns regarding the possible occurrence of negative events and the sensitivity to such events when they do occur (e.g., "Even if something bad is about to happen to me, I rarely experience fear or nervousness."). The BAS drive scale contained four items pertaining to the persistent pursuit of desired goals (e.g., "I go out of my way to get things I want."). The BAS fun seeking scale consisted of four items. reflecting both a

desire for new rewards and a willingness to approach a potentially rewarding event on the spur of the moment (e.g., "I'm always willing to try something new if I think it will be fun."). The BAS reward responsiveness scale comprised five items that focus on positive responses to the occurrence or anticipation of reward (e.g., "When I'm doing well at something, I love to keep at it.").

Items were reversed scored as necessary. Scale scores were computed as the sum of scale items. A higher score indicated greater presence of a construct. BIS scores could range from 7 to 28. BAS drive and BAS fun seeking scales could range from 4 to 16. BAS reward scales could range from 5 to 20. Chronbach's α for the BIS scale was .77. Alpha was .73 for BAS drive, .68 for BAS fun seeking, and .69 for BAS reward.

Negative Affect

Negative affect was measured by the 21-item version of the Depression, Anxiety, and Stress Scale (DASS-21) (Anthony et al. 1998). The DASS-21 is a self-report measure in which participants rate the frequency and severity of experiencing negative emotions over the previous week. Responses were measured on a four-point scale ranging from 0, "does not apply to me at all", to 3, "applies to me very much or most of the time." Three seven-item subscales were computed, depression ("I couldn't seem to experience any positive feeling at all."); anxiety ("I was aware of dryness in my mouth."); and stress ("I tended to over-react to situations."). The 21-item version of the instrument was used to reduce the testing burden on participants. Scale scores were computed by summing across items. In accordance with scoring instructions for the DASS-21, scores were then doubled to have a comparable range as the 42-item version of the DASS. For this study, a composite DASS measure was computed as the sum of the subscales and could range from 0 to 126. Alpha for the composite measure consisting of the three DASS scales was .88.

Data Analyses

Frequencies were computed for categorical study variables, and descriptive statistics were computed for continuous ones. Differences in mean scale scores by gender were assessed with independent samples *t*-tests. Differences by ethnicity and school year were assessed with one-way analysis of variance (ANOVA). A significance level of $P \leq .05$, two-tailed, was used. Bivariate correlations among the scale scores were computed. As described below, significant correlations were then included in a structural equation model (SEM). Three measures of goodness of fit were used to assess the SEM model—model χ^2, the comparative fit index (CFI), and the root mean square error of approximation (RMSEA). A non-significant χ^2 value, CFI values $\geq .95$, and RMSEA values $\leq .05$ are generally accepted as indicating a well-fitting model. Analyses were conducted with SPSS and AMOS software. Reported percentages were based on nonmissing cases.

Results

Descriptive Analyses

A total of 784 students agreed to take the on-line survey. Of these, past year gambling behaviors (as indicated by the CPGI items) and gambling severity scores (as indicated by the PGSI) were available from a total of 448 students between the ages of 18 and 25.

This sample consisted of 352 females (79%) and 96 males (21%). The sample contained 133 Caucasians (30%), 103 Asians (23%), 96 Hispanics/Latinos (21%), 83 African-American/Blacks (19%), 1 Native American (<1%), and 32 "Others" (7%). The sample contained 48 freshmen (11%), 92 sophomores (21%), 182 juniors (41%), 122 seniors (27%), and four graduate students (1%). The mean age of the sample was 21.2 years (SD = 1.8).

Past Year Gambling

Among these students, 157 (35%) had gambled at least one time in the 12 months preceding their survey. Whether a participant had gambled or not in the past year was independent of negative affect and BIS/BAS. Gambling was not independent of gender. Forty-four percent of males had gambled compared to 33% of females ($\chi^2 = 4.07$; $df = 1$; $P = .04$). Twenty-one percent of freshmen had gambled compared to 25% of sophomores, 37% of juniors, and 45% of seniors and graduate students ($\chi^2 = 14.34$; $df = 3$; $P = .002$). Gamblers had a mean age of 21.0 (SD = 1.9) years compared to a mean age for non-gamblers of 21.5 years (SD = 1.7) ($t = 2.68$; $df = 446$; $P = .01$). Having gambled in the past year was independent of race/ethnicity.

Seventy-three percent of those who had gambled had gambled between one and five times in the previous 12 months. Seventeen percent had gambled 6–11 times. Six percent had gambled "about once a week." Three percent had gambled between two and six times a week, and 1% had gambled daily. The most popular activities were lottery or scratch-off tickets (67%) and games such as blackjack, craps, roulette, and slot machines and 8-liners (62%). Approximately one-third had played poker (38%), bought a raffle ticked (37%), or bet on a sporting event (33%). One-quarter (24%) had played bingo, and 8% had bet on horse or dog racing. Seven in ten (69%) had gambled in a casino, and one in seven (14%) had gambled online. The mean time of each gambling episode was 5.5 h (SD = 14.4). The mean amount spent per month on gambling was \$146.03 (SD = \$192.09).

Gambling Severity

Problem Gambling Severity Index scores among gamblers ranged from 0 to the possible maximum of 27. The mean score was 3.0 (SD = 4.7, median = 1.0). Forty-five percent of gamblers had a score of 0, indicative of non-problematic gambling (Wynne 2003). Scores of 1–2 were reported by 23%, indicating low-risk gambling. Seventeen percent 17% had a score of 3–7, defined as moderate-risk gambling. Fifteen percent 15% had scores above 7, indicative of problem gambling.

When asked how often in the past year they bet more than they could afford to lose, 32% of gamblers said they did so at least sometimes. Twenty-five percent reported they needed to gamble with larger amounts of money to maintain the same level of excitement. Forty-three percent reported gambling to win back money they had lost. Eighteen percent had borrowed money or sold something to finance their gambling. Eighteen percent had had other people criticize their gambling or been told they had a gambling problem, and 19% had felt they might have a problem with gambling. Twenty-four percent felt guilty about their gambling. Fifteen percent stated gambling had caused health problems, including stress and anxiety. Fifteen percent reported gambling had caused financial problems for themselves or their household.

A difference in mean gambling severity scores was found by ethnicity. The mean score of Asians (5.6, SD = 5.4) was higher than that for Caucasians (2.2, SD = 4.4) and for

Hispanic/Latinos (1.8, SD = 2.9) ($F = 3.81$; $df = 4, 152$; $P = .01$). There were no differences in means by gender or school year. Age was not correlated with score.

Correlates of Gambling

With regard to the correlates of gambling as measured by the Canadian Problem Gambling Index Likert scale items, 48% of gamblers reported they had spent more money on gambling in the past year than they wanted to at least sometimes. Fifteen percent had lied about their gambling. Sixteen percent stated they would like to stop gambling but did not believe they could. One-third (31%) agreed or strongly agreed that winning was more likely after a series of loses, and 51% that wininng was more likely if they used a system. In responding to the dichotomous CPGI items, one-half of those who gambled reported using drugs or alcohol while gambling in the past year, and nearly one-third (30%) reported gambling while drunk or high. More participants reported an urge to drink (40%) or to use drugs or medication (25%) if something painful happened than reported an urge to gamble (9%). Fourteen percent felt they might have an alcohol or drug problem. Over one-quarter (28%) reported being depressed for 2 or more weeks in the previous year. One-half remembered a big win when they first started gambling, and 48% remembered a big loss. One-fifth (22%) reported a family member who had ever had a gambling problem, and the majority (51%) reported a family member with an alcohol or drug problem. Seven students (5% of those responding) reported seriously thinking about suicide in the past year as a result of their gambling. Mean DASS-21 score was higher in those who reported past year depression (42.7, SD = 17.2) than in those who did not (21.3, SD = 17.2; $t = 6.85$, $df = 153$, $P < .001$).

BIS/BAS and Negative Affect

BIS scores ranged from 10 to 27 with a mean score of 20.5 (SD = 3.7). The mean BAS reward responsiveness score was 17.7 (SD = 2.1), ranging from 10 to 20. BAS drive ranged from 5 to 16 with a mean score of 11.2 (SD = 2.2). BAS fun seeking ranged from 5 to 16 with a mean of 11.9 (SD = 2.3). Females had a higher mean BIS score (21.1, SD = 3.7) than did males (19.0, SD = 3.4) ($t = 3.13$, $df = 155$, $P = .002$). Mean BAS reward responsiveness score was also higher in females (17.9, SD = 2.2) than in males (17.0, SD = 2.0) ($t = 2.22$; $df = 155$; $P = .03$). Mean scores did not differ by ethnicity or school year. Scores were not associated with age.

Total negative affect scores ranged from 0 to 84 with a mean score of 27.2 (SD = 19.9). Mean scores did not differ by gender, ethnicity, or school year. Scores were not correlated with age.

The Relation Between Gambling, Negative Affect and BIS/BAS

Bivariate correlations between the scale scores are shown in Table 1. Due to the unexpected preponderance of females in the sample, correlations were computed separately by gender. Due to the relatively low number of male participants, a significance level of .10, two-tailed was employed. Among females, gambling severity was associated with negative affect and inversely associated with BAS reward. Negative affect, in turn, was associated with BIS and inversely correlated with BAS reward. Each of the BAS measures was intercorrelated, but of these, only BAS reward and BAS fun seeking were correlated with BIS. BAS drive and BAS fun seeking scores were not associated with gambling severity, nor

Table 1 Bivariate correlations

	Gambling severity	Negative affect	BIS	BAS reward	BAS drive	BAS fun seeking
Females						
Gambling severity	1.00					
Negative affect	**.35**	1.00				
BIS	.05	**.37**	1.00			
BAS reward responsiveness	**−.34**	**−.25**	**.21**	1.00		
BAS drive	−.02	−.02	−.07	**.34**	1.00	
BAS fun seeking	−.05	.02	**.16**	**.33**	**.58**	1.00
Males						
Gambling severity	1.00					
Negative affect	**.53**	1.00				
BIS	.02	**.30**	1.00			
BAS reward responsiveness	**−.29**	**−.44**	< .001	1.00		
BAS drive	−.18	**−.28**	−.14	**.35**	1.00	
BAS fun seeking	**−.27**	−.25	**−.45**	**.46**	**.57**	1.00

$P \leq .10$

with negative affect. Among males, these correlations, with the exception of that between BIS and BAS reward, were also significant among. In addition, there were significant inverse correlations between BAS fun seeking and gambling severity and between BAS drive and negative affect among males.

Results of the SEM model for females are shown in Fig. 1. The figure shows the correlations between the BIS and BAS scales, the standardized regression coefficients for the model, and the r^2 values for negative affect and gambling severity. Each correlation and path was significant at the .05 level. The model χ^2 was 4.40 ($df = 6$; $P = .62$). The CFI for the model was 1.00, and the RMSEA was <.001. These values indicate a well fitting model. The model accounted for 23% of the variance in negative affect and 19% of the variance in gambling severity. Results for the males are shown in Fig. 2. The model χ^2 was 6.92 ($df = 5$; $P = .23$). The CFI for the model was .97, and the RMSEA was .10. These values indicate a less well fitting model. The model accounted for 28% of the variance in negative affect and 30% of the variance in gambling severity. In this model, the hypothesized links between BAS drive and negative affect, BAS reward and gambling severity, and BAS fun and gambling severity were not significant.

Discussion

This exploratory study examined gambling behaviors in a sample of 18–25 year old college students. The purpose of the study was to assess the prevalence of pathological gambling in this sample and to use SEM to examine associations between behavioral inhibition and activation with gambling severity and whether these associations were mediated by negative affect. Strengths of the study were its large and ethnically diverse

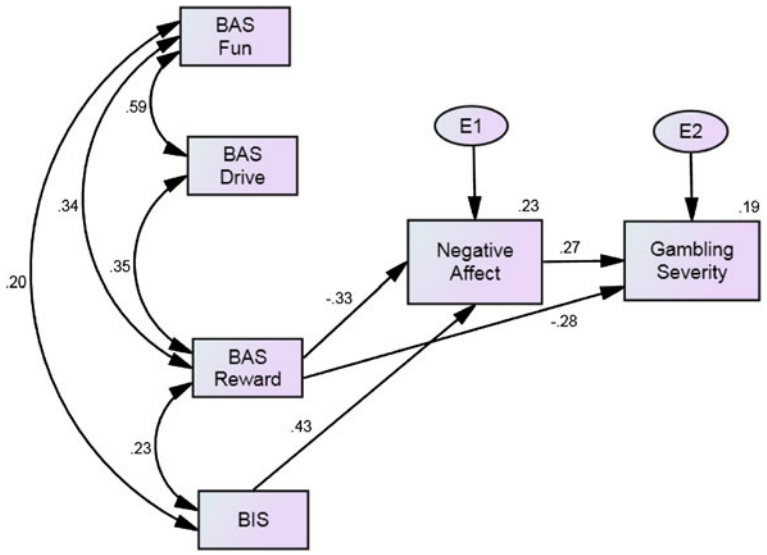

Fig. 1 SEM model females

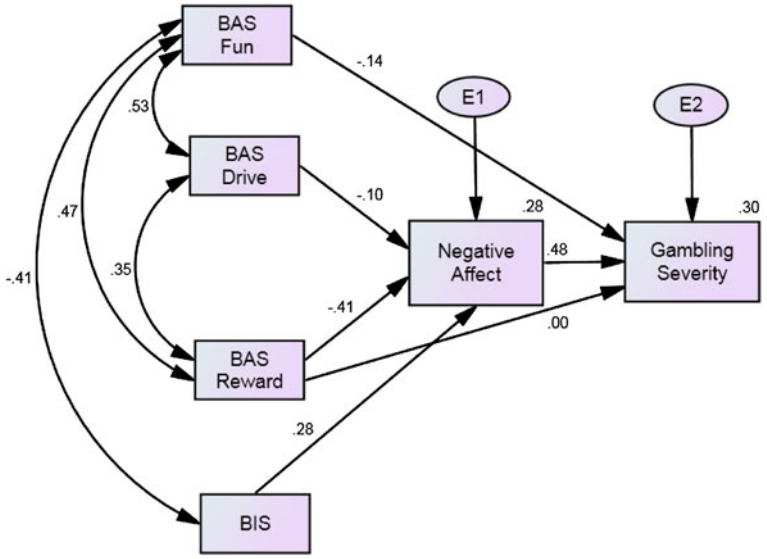

Fig. 2 SEM model males. *Note*: Paths between BAS fun and gambling severity; BAS drive and negative affect; and BAS reward and gambling severity NS at the .05 level

sample and its use of structural equation modeling to assess associations among the study variables.

Overall, 35% of students surveyed had gambled in the year preceding their survey. This is slightly lower than the rate of 42% reported by LaBrie et al. (2003) in their national study of college student gambling, although probably not significantly so. The rate of

weekly gambling observed in our sample, 3%, is the same as that reported in their study. The percentage of past year gamblers in the current sample, 32%, with scores indicating moderate-risk or problem gambling is similar to the rate reported by King et al. (2010), 34%, in students reporting 3-month gambling (using the Canadian Adolescent Gambling Index). Given the total number of young adult college students, these figures represent a substantial number of individuals, and provide further evidence for the importance of studying gambling behaviors in young adults.

A key finding of the current study is that reward responsiveness may be protective of gambling problems. Our finding of an inverse relationship between BAS and gambling is in contrast to the previously cited studies which have found an association between behavioral activation and risky behaviors (Johnson et al. 2003; Franken and Muris 2006). The finding of an inverse association between behavioral activation and risky behaviors is, however, not unique. Voigt et al. (2009) studied seven risky behaviors (related to sex, substance use, safety, inactivity, and diet) in a sample of undergraduates. BIS was associated with several risky behaviors including ones related to diet and exercise and drug use. Fun seeking was associated with all but two of the behaviors. In contrast, reward responsiveness was found to be protective of five of the behaviors studied. Braddock et al. (2011) found dual pathways through which BAS predicted risky health behaviors in the form of substance use (i.e., tobacco, alcohol, and drugs), vehicular safety, and sexual practices. While BAS increased the likelihood of risky behaviors through its relation with impulsivity, it also served as a direct protective factor against these risky behaviors.

These studies did not include gambling behaviors, though. Additionally, the reward responsiveness items were context neutral, that is, they were worded without regard to specific rewards. It may be important to consider reward responsiveness in the context of specific goals and rewards; that students who are focused on their studies and a successful academic career may report high reward responsiveness but not engage in gambling to the extent it becomes pathological. Custer (1984) noted that social gamblers, in contrast to pathological gamblers, experienced other aspects in their lives that were more important and rewarding than gambling.

Given that reward responsiveness reflects obtaining pleasure from the anticipation or receipt of reward, it seems natural that it is a protective factor. One can argue that reward responsiveness counters the effects of negative affect, which then reduces risk for gambling.

Among females, the protective effect of reward responsiveness was observed through an inverse association with negative affect and an inverse association with gambling severity not mediated by affect. Among males, the bivariate inverse association between reward responsiveness and gambling was mediated by negative affect. One explanation for this finding may lie in different goals behind gambling for men and women. For instance, one large study of internet gamblers found that women were more likely than men to gamble for mood regulation purposes (Lloyd et al. 2010). In light of observations by Lloyd et al. (2010) and the robust relation between propensity to experience hedonic feelings and reward responsiveness (Carver and White 1994; Hasler et al. 2010), our findings may suggest that women who are not anhedonic may have less of a need to gamble for mood elevation purposes. This possibility deserves further study.

It is also important to consider reward responsiveness in the context of other factors which may motivate gambling and which may be of more immediate concern to pathological gamblers. Wood and Griffiths (2007) conducted qualitative interviews with 50 "problem gamblers" in the United Kingdom. Gambling was seen as a means to avoid

responsibilities and as a means to achieve ego gratification. Many gamblers spoke of a "fantasy world" built around their gambling.

Based on interviews with Gamblers Anonymous members, Rockloff and Dyer (2005) identified four traits of pathological gamblers. These traits, which they deemed the "Four Es," were escape ("Running away from my problems may be the only solution."), (low) esteem ("I feel completely worthless."), excess ("I usually get into trouble because I don't stop to think."), and excitement ("I get very anxious when there is nothing to do."). Items related to each trait were found to be correlated with Problem Gambling Severity Index scores. Excess was found to be predictive of 1-year increases in gambling problems (Rockloff and Dyer 2007) among those with a current gambling or alcohol/substance problem and among others. These motivations and those identified by Wood and Griffiths (2007) appear to reflect those put forward in the Gamblers Anonymous "Combo Book" (Gamblers Anonymous International Service organization 2010). There is a need to consider how these traits may interact with BIS/BAS and negative affect in relation to pathological gambling.

Although this study was conducted with a large, ethnically diverse sample using established instruments, there were limitations. The sample was not a random one. Participants were students completing the survey in exchange for class credit. The generalizability of the findings presented here will be limited to the extent that these students differed from non-participants with regard to the study variables. The study was conducted at one site. Again, generalizability will be limited to the extent that participants differ from students at other schools with regard to relevant measures. The study was conducted online and was not monitored. While efforts were made to ensure students that their responses were confidential, some may have been reluctant to disclose potentially sensitive information. An unanticipated result was the preponderance of females in the sample which may have reduced the power to detect gender differences. This may have been due to the gender composition of the psychology classes from which participants were drawn. Future research will attempt to recruit more balanced samples with regard to gender.

The study was a crossectional one. Thus, causal inferences could not be made. Recollection of past-year activities may have resulted in recall bias. Assessing participants' gambling behaviors at only one point missed the fact that the gambling careers of pathological gamblers are dynamic. As Lesieur and Custer (1984) have detailed, gambling for these individuals appears to progress through phases, including the winning, losing, and desperation phases. It may have been the case that some of the gamblers in this study were in the early phases of their gambling careers and may develop more serious problems in the future.

While a number of gambling locations were measured, we did not take these environmental settings into consideration in our analyses. This was in no small part due to the low frequency of participants gambling in non-casino environments. Infrequent endorsements of other gambling contexts precluded our ability to test our structural model across gambling settings. It is well recognized that gambling venues (i.e., casino vs. online), gambling activities therein (i.e. machines vs. "traditional" forms of gambling), and their physical features, are related to gamblers' affective experience (Finlay et al. 2006), sensitivity to reward and punishment (van Holst et al. 2010), gambling frequency, severity, and latency to pathological gambling (Breen and Zimmerman 2002; Goudriaan et al. 2009; Franco et al. 2011), and substance use (Franco et al. 2011; Goudriaan et al. 2009). Future investigations should consider these elements in testing our proposed models.

Future research should address developing means to identify those young adult students who may be at risk of progressing to pathological gambling. This should include assessing

students' specific goals and ambitions regarding their academic career and motivations for gambling. Like the BIS/BAS scales, the Four Es are explicitly worded without reference to gambling and may be of use in identifying those who may be vulnerable to pathological gambling before overt signs are manifested.

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