ORIGINAL PAPER

CrossMark

Commonalities in the Association of Behavioral Activation and Behavioral Inhibition with Problem Gambling and Alcohol Use in Young Adult College Students

John Atkinson[1]

Abstract

In a previous study of young adult college students (age 18–25), we found an association among 157 past year gamblers between gambling severity as measured by the Problem Gambling Severity Index and negative affect as measured by the total score on the 21-item Depression Anxiety and Depression Scales. An inverse association between the behavioral activation system reward responsiveness scale and gambling severity was found, as was an inverse association between reward and negative affect. In addition, an association between the behavioral inhibition system scale and negative affect was observed. Theoretical models such as Shaffer's Syndrome Addiction model posit that problem behaviors are expressions of a common underlying etiology. In the current paper, we present results from the previous database regarding the severity of alcohol use among 286 past year drinkers as measured by the Alcohol Use Disorders Identification Test. As with gambling severity, reward responsiveness was inversely associated with alcohol use severity both directly and indirectly through negative affect. Severity was also directly associated with the BAS fun seeking scale. As previously found, negative affect was associated with inhibition. Among 125 students engaging in each behavior, scores for each severity index were also correlated. These findings suggest that a reward oriented coping approach may be protective against both more severe gambling and alcohol use problems. An inhibitory or escapist approach may lead to more severe problems. They also suggest that behaviors are co-occurring in a significant number of students, and levels of severity in one behavior are associated with levels in the other. It is hoped these results can inform future research and interventions.

Keywords College students · Gambling · Alcohol use · Behavioral inhibition · Behavioral activation · Negative affect

✉ John Atkinson
John.S.Atkinson@uth.tmc.edu

1   Center for Health Promotion and Prevention Research, University of Texas School of Public Health, 7000 Fannin #2512, Houston, TX 77030, USA

Introduction

Young-adult college students represent a sizable, at-risk population in the United States. In 2013, there were 12.2 million college students under the age of 25 (National Center for Education Statistics 2015). These students are in the developmental period that Arnett refers to as "emerging adulthood," a period of independence and exploration that may include engaging in several types of risky behavior (Arnett 2000).

One activity of increasing importance is gambling. Studies among college students have reported a past-school year gambling rate of 42% as well as a prevalence of pathological gambling of 11% (LaBrie et al. 2003; Nowak and Aloe 2014). 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).

Another, more established, activity is alcohol use. According to the National Institute on Drug Abuse's 2014 *Monitoring the Future Survey*, 63% of college students less than 5 years out of high school had used alcohol in the past 30 days (Johnston et al. 2015). Research involving college students has found a prevalence of alcohol dependence of 6% (Knight et al. 2002; Califano 2007; Dierker et al. 2007).

Conceptually, alcohol use represents a substance based behavior while gambling represents a non-substance based or "process" behavior. Substance use and non-substance use behaviors exhibit similar reward mechanisms and common characteristics including craving, tolerance, and withdrawal (Alavi et al. 2012). Behaviors are often co-occurring or one behavior may be initiated when another is ended, a phenomenon known as "addiction hopping" (Shaffer et al. 2004) when, for instance, alcohol use is replaced by gambling. Models such as s Shaffer's Syndrome Addiction Model treat problematic behaviors as manifestations of a common etiology (Shaffer et al. 2004; Odegaard et al. 2005). The DSM-5 treats gambling disorder as a behavioral addictive disorder similar to substance use addiction (American Psychiatric Association 2013). The identification of specific underlying components of the syndrome is still a subject of inquiry. In particular, there has been a call to identify personality factors that may underlie behaviors (Lang 1983).

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 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 activation system (BAS) acts to initiate behavior that may result in reward. In contrast, the behavioral inhibition system (BIS) acts to inhibit behavior that may result in punishment.

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. They contend that greater BIS sensitivity should be reflected in a greater proneness to anxiety in the face of proper cues and that BAS sensitivity is reflected in positive feelings, expressed in our previous study described below as decreased negative affect. Kasch et al. (2002) found their sample of clinically depressed participants to have lower scores on each BAS scale and higher scores on the BIS scale than did nondepressed participants. More specifically, the authors note that BIS and BAS may serve as risk factors for

persistent depression. Those with an underactive BAS may be less likely to pursue reward-ing activities and be less likely to respond to positive stimuli. As a result, they may be less likely seek or engage in pleasurable activities.

These findings suggest a mechanism by which more severe behavior is less motivated by the prospect of reward than by a desire to avoid negative affect. Within this framework, a coping strategy based on a desire to avoid punishment leads to increased feelings of depression, anxiety, and stress. The behavior may become a maladaptive coping strategy in which the behavior continues in the face of increasing harms since it offers an escape from these feelings.

In a previous paper (Atkinson et al. 2012), we examined gambling severity in a sam-ple 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 Prob-lem Gambling Index and the Problem Gambling Severity Index. Reward processing was measured with the BIS/BAS scales. Negative affect was assessed with the 21-item version of the Depression, Anxiety, and Stress Scales. 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 nega-tive 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 structural equation models, the associa-tion between reward responsiveness and gambling severity was mediated by negative affect among males but not among females.

In the current paper, we extend our previous work to examine associations between reward processing, negative affect, and alcohol use severity among past year drinkers using data from the previous study. The research questions of interest were whether these factors would exhibit associations similar to those observed for gambling severity; the co-presence of gambling and alcohol use; and the correlation between gambling severity and alcohol use severity.

Methods

Sample

As described in the previous paper, study data were collected during the fall 2010 semes-ter from psychology class students attending an urban public university. Approval for the study was obtained from the proper Institutional Review Boards. A total of 784 students enrolled in the study. Of these students, 666 were between the ages of 18–25.

Measures

Gambling behavior in the past year was assessed by the Canadian Problem Gambling Index (CPGI) (Wynne 2003). Students were asked how often they had gambled in the past year, including online gambling. The overall frequency of gambling was measured on a six-point scale ranging from never to daily. Specific gambling activities in the previous year (e.g. lottery or scratch-off tickets; poker; casino games; sporting events; etc.) were also speci-fied and were recorded by a set of no/yes questions. 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 ('Thinking about the past 12 months, how often have you bet more than you could afford to lose?'').

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 (''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 (''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 (''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 (''When I'm doing well at something, I love to keep at it.''). Items were reversed scored as necessary so that a higher score indicated greater presence of a construct. Scale scores were computed as the sum of scale items. 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.

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.

For the current study, the severity of alcohol use among past year drinkers was measured by the Alcohol Use Disorders Identification Test (AUDIT) (Babor et al. 2001). The AUDIT consists of 10 questions related to alcohol use in the previous year (''How often do you have a drink containing alcohol?) and the consequences of drinking (''How often during the last year have you failed to do what was normally expected from you because of drinking?). Each item was measured on a scale of 0–4, although specific response options differed by item. Scores could range from 0 to 40 with higher scores indicating more severe problems related to use.

Analyses

Frequencies were computed for categorical variables such as race/ethnicity, and descriptive statistics were computed for age and the continuous scale scores. We assessed associations of past year behaviors and severity of behaviors with gender and race/ethnicity. Among those engaging in a specific behavior, bivariate correlations between BIS/BAS scale scores, severity score, and negative affect were computed. Significant correlations were included as paths and covariances in structural equation models (SEM). Based on the literature and our previous results, BIS/BAS scales were designated as exogenous

variables, severity scores were designated as endogenous variables, and severity scores were designated as endogenous variables. Negative affect was designated as a mediating variable.

In contrast to the previous study, cases for males and females were analyzed together in the current study. A significance level of $p < .05$, two-tailed, was used for all analyses. Analyses were conducted using SPSS and Mplus. Goodness of fit for the SEM models was assessed with the model Chi square, with non-significant values indicating a good fit and the comparative fit index (CFI), with values of .95 or better indicating a good fit. Model fit was also assessed using the Root Mean Square Error (RMSEA) and the Standardized Rood Mean Square Residual (SRMR). Values below .06 or .07 for the RMSEA indicate good fit, while values less than .05 for the SRMR do so (Hooper et al. 2008). Prior to analyses, continuous variables were assessed for normality and nonparametric and bootstrapping methods were employed as described below.

Results

After completion of data collection, it was discovered that students were able to report specific gambling activities even if they reported no past year gambling or, conversely, report no specific gambling activity even though they answered affirmatively to past year gambling. A total of 218 cases were excluded, resulting in a final study sample of 448 young adult students with complete and consistent gambling information. As noted, this sample consisted of 352 females (78.6) and 96 males (21.4%). The sample contained 133 Caucasians (29.7%), 103 Asians (23.0%), 96 Hispanics/Latinos (21.4%), 83 African-American/Blacks (18.5), 1 Native American (.2%), and 32 Other (7.1%). For analyses, Native American was recoded as Other. The mean age of the sample was 21.1 (SD = 1.8).

Table 1 Normality of continuous variables scale scores by gender

	N	Possible range	Observed range	Mean	Skewness	SE	Kurtosis	SE	p^*
Age	448	18–25	18–25	21.2	.220	.115	− .630	.230	**< .001**
BAS reward responsiveness	445	0–20.0	9.0–20.0	17.5	− .912	.116	.659	.231	**< .001**
BAS Fun Seeking	446	0–16.0	5.0–16.0	11.7	− .221	.116	− .417	.231	**< .001**
BAS Drive	442	0–16.0	5.0–16.0	11.2	− .164	.116	− .220	.232	**< .001**
BIS	440	0–28.0	10.0–28.0	20.6	− .267	.116	− .320	.232	**< .001**
DASS-21 Total Score	441	0–126.0	0–116.0	25.8	1.006	.116	.680	.232	**< .001**
PGSI	157	0–27.0	0–27.0	3.0	2.147	.194	5.050	.385	**< .001**
AUDIT	286	0–40.0	1.0–27.0	6.3	1.502	.144	2.050	.287	**< .001**

Bold indicates $p < .05$

*Kolmogorov–Smirnov test

Retention of cases for this study did not vary by gender or race/ethnicity. As shown in Table 1, based on the *p* values of the Kolmogorov–Smirnov tests, continuous variables could not be assumed to be normally distributed.

Gambling and Gambling Severity

One-third (35.0%) of students reported past year gambling. As shown in Table 2, a greater proportion of males than of females gambled in the past year. As shown in Table 3, past-year gambling was not associated with or race/ethnicity. Among the past year gamblers, Chronbach's α for the PGSI was .92. Mean PGSI scores for past year gamblers did not differ by gender. However, PGSI score was associated with race/ethnicity.

Based on PGSI scores, 45.2% of past year gamblers were non-problem gamblers (score of 0). By definition, these gamblers would not have experienced any gambling related problems in the past year. Nearly one-quarter (22.9%) were low-risk gamblers, experiencing one or two minor gambling related problems (score of 1 or 2). Seventeen percent (17.2%) were moderate-risk gamblers, already experiencing problems as a result of their gambling (score of 3–7). The remaining gamblers (14.6%) were high-risk gamblers, experiencing substantial gambling related problems and possibly gambling dependent (score of 8–27) (Centre for Addiction and Mental Health, Problem Gambling Institute of Ontario 2013). More specific details regarding students' gambling behaviors are presented in our previous article.

Alcohol Use and Severity

Data for past year alcohol use and alcohol severity were available from 426 students. Of these, 286 (69.2%) had drunk alcohol in the previous year. Alpha for the AUDIT among the past year drinkers was .84. As shown in Tables 2 and 3, past year drinking was not associated with gender but was associated with race/ethnicity. AUDIT scores among past year drinkers were not independent of gender or race/ethnicity.

Based on AUDIT scores, 68.9% of past year drinkers had scores indicating a low level of alcohol related problems (indicated by a score of less than 8). One-quarter (23.1%) had scores (8–15) indicating a level of alcohol related problems for which advice on reducing hazardous drinking would be appropriate. Four percent (3.5%) had scores (16–19) suggesting a need for brief counseling and continued monitoring. The remaining drinkers (4.5%) showed a need for diagnostic evaluation for alcohol dependence (scores of 20–40) (Babor et al. 2001).

One quarter (23.4%) of drinkers reported drinking two or more times a week in the last year. One-quarter (22.7%) consumed five or more drinks when drinking, and 9.1% consumed six or more drinks on one occasion weekly or more often. One-tenth (9.1%) were unable to stop drinking once started on at least a monthly basis. Severn percent (7.1%) failed to do what was normally expected of them at least monthly. Eight students (2.8%) reported needing a drink after a heavy drinking session at least monthly. Eight percent (8.0%) felt guilt or remorse after drinking on at least monthly. One-tenth (9.8%) had failed to remember what happened the night before due to drinking on at least a monthly basis. Nine (3.1%) past year drinkers stated they had injured themselves or someone in the last year due to their drinking, and 20 (7.0%) reported someone had expressed concern about their drinking in the past year or suggested they cut down.

Table 2 Study items by gender

	Male		Female		All participants		$p*$
	N	Percent	N	Percent	N	Percent	
Past year gambling							**.044**
No	54	56.3	237	67.3	291	65.0	
Yes	42	43.8	115	32.7	157	35.0	
All participants	96	100.1	352	100.0	448	100.0	
Past year drinking							.596
No	31	35.2	109	32.2	140	32.9	
Yes	57	64.8	229	67.8	286	67.1	
All participants	88	100.0	338	100.0	426	100.0	
	N	Percent	Possible range	Observed range	Mean	SD	$p**$
BAS reward responsiveness			0–20.0				**.011**
Male	95	21.3		11.0–20.0	17.1	2.1	
Female	350	78.7		9.0–20.0	17.7	2.1	
All participants	445	100.0		9.0–20.0	17.5	2.1	
BAS Fun Seeking			0–16.0				.155
Male	95	21.3		7.0–16.0	12.1	2.1	
Female	351	78.7		5.0–16.0	11.7	2.4	
All participants	446	100.0		5.0–16.0	11.7	2.3	
BAS Drive			0–16.0				.181
Male	94	21.3		6.0–16.0	11.5	2.4	
Female	348	78.7		5.0–16.0	11.2	2.3	
All participants	442	100.0		5.0–16.0	11.2	2.3	
BIS			0–28.0				**< .001**
Male	93	21.1		10.0–27.0	18.8	3.9	
Female	347	78.9		10.0–28.0	21.1	3.6	
All participants	440	100.0		10.0–28.0	20.6	3.8	
DASS-21 Total Score			0–126.0				.745
Male	94	21.3		0–100.0	29.4	24.7	
Female	347	84.8		0–116.0	24.8	20.8	
All participants	441	100.1		0–116.0	25.8	21.7	
PGSI			0–27.0				.067
Male	42	26.8		0–16.0	3.8	4.7	
Female	115	73.2		0–27.0	2.7	4.8	
All participants	157	100.0		0–27.0	3.0	4.7	
AUDIT			1.0–40.0				**.040**
Male	57	19.9		1.0–23.0	7.3	5.3	
Female	229	80.1		1.0–27.0	6.1	5.5	
All participants	286	100.0		1.0–27.0	6.3	5.5	

*Pearson Chi square test

**Mann–Whitney U test

Table 3 Study items by race/ethnicity

	Caucasian		Asian		Hispanic/Latino		African-American/Black		Other		All participants		p*
	N	Percent	N	Percent	N	Percent	N	Percent	N	Percent	N	Percent	
Past year gambling													.566
No	87	65.4	69	67.0	58	60.4	52	62.7	25	75.8	291	65.0	
Yes	46	34.6	34	33.0	38	39.6	31	37.3	8	24.2	157	35.0	
All participants	133	100.0	103	100.0	96	100.0	83	100.0	33	100.0	448	100.0	
Past year drinking													**<.001**
No	27	20.9	46	46.9	25	27.5	26	33.8	16	51.6	140	32.9	
Yes	102	79.1	52	53.1	66	72.5	51	66.2	15	48.4	286	67.1	
All participants	129	100.0	98	100.0	91	100.0	77	100.0	31	100.0	426	100.0	

	N	Percent	Possible range	Observed range	Mean	SD	p**
BAS reward responsiveness			0–20.0				.362
Caucasian	132	29.7		11.0–20.0	17.6	2.1	
Asian	103	23.1		9.0–20.0	17.5	2.2	
Hispanic/Latino	96	21.6		13.0–20.0	17.6	2.0	
African-American/Black	81	18.2		11.0–20.0	17.8	2.0	
Other	33	7.4		10.0–20.0	16.8	2.5	
All participants	445	100.0					
BAS fun seeking			0–16.0				.658
Caucasian	133	29.8		5.0–16.0	11.7	2.3	
Asian	103	23.1		7.0–16.0	11.6	2.1	
Hispanic/Latino	96	21.5		6.0–16.0	12.0	2.4	
African-American/Black	81	18.2		6.0–16.0	11.8	2.5	
Other	33	7.4		7.0–16.0	11.6	2.4	

Table 3 (continued)

	N	Percent	Possible range	Observed range	Mean	SD	p**
All participants	446	100.0					.713
BAS Drive			0–16.0				
Caucasian	131	29.6		7.0–16.0	11.1	2.1	
Asian	103	23.3		5.0–16.0	11.1	2.4	
Hispanic/Latino	95	21.5		5.0–16.0	11.2	2.5	
African-American/Black	82	18.6		5.0–16.0	11.5	2.4	
Other	31	7.0		6.0–16.0	11.5	2.3	
All participants	442	100.0					.007
BIS			0–28.0				
Caucasian	133	30.2		10.0–28.0	21.1	4.0	
Asian	101	23.0		11.0–28.0	21.2	3.5	
Hispanic/Latino	93	21.1		14.0–27.0	20.7	3.5	
African-American/Black	80	18.2		10.0–27.0	19.2	3.8	
Other	33	7.5		13.0–28.0	20.6	3.9	
All participants	440	100.0					.013
DASS-21 total score			0–126.0				
Caucasian	132	29.9		0–100.0	26.7	22.0	
Asian	102	23.1		0–98.0	29.8	22.2	
Hispanic/Latino	92	20.9		0–88.0	21.4	20.7	
African-American/Black	82	18.6		0–70.0	22.0	18.7	
Other	33	7.5		2.0–116.0	31.5	26.3	
All participants	441	100.0					.036
PGSI			0–27.0				
Caucasian	46	29.3		0–19.0	2.2	4.4	
Asian	34	21.7		0–16.0	5.6	5.4	

Table 3 (continued)

	N	Percent	Possible range	Observed range	Mean	SD	p**
Hispanic/Latino	38	24.2		0–15.0	1.8	2.9	
African-American/Black	31	19.7		0–27.0	2.7	5.6	
Other	8	5.1		0–12.0	2.9	4.2	
All participants	157						
AUDIT			1.0–40.0				<.001
Caucasian	102	35.7		1.0–24.0	7.4	5.7	
Asian	52	18.2		1.0–22.0	6.2	5.6	
Hispanic/Latino	66	23.1		1.0–26.0	5.9	5.0	
African-American/Black	51	17.8		1.0–27.0	3.8	4.3	
Other	15	5.2		2.0–20.0	9.7	6.0	
All participants	286	100.0		1.0–27.0	6.3	5.5	

*Pearson Chi square test

**Kruskal–Wallis test

Negative Affect

Alpha for the composite measure consisting of the three DASS scales was .88. Mean total DASS-21 scores were not associated with gender. Mean scores were associated with race/ ethnicity (Tables 2, 3). Based on DASS-21 scores, 24.2% of students had a moderate, severe, or extremely severe level of depression (score of 14 or higher out of a possible 42); 30.9% had a moderate, severe, or extremely severe level of anxiety (10 or higher); and 18.7% had a moderate, severe, or extremely severe level of stress (19 or higher) (psytoolkit. org 2017). Two-fifths (38.6%) of students had at least a moderate level of depression, anxiety, or stress.

BIS/BAS Scales

Chronbach's α for the BAS reward responsiveness scale was .69. Alpha was .68 for BAS fun seeking and .73 for BAS drive. Alpha for the BIS scale was .77. Mean BAS reward responsiveness scores and mean BIS scores were both higher among females. BAS fun seeking and drive scores were not associated with gender. The BAS scales were not associated with race ethnicity. Mean BIS scores were associated with race/ethnicity (Tables 2, 3).

Correlates of Gambling and Alcohol Use Severity

As shown in Table 4A, among the past year gamblers, gambling severity scores were correlated with negative affect and inversely correlated with reward responsiveness. Negative affect was also inversely associated with reward responsiveness and correlated with behavioral inhibition. Each of the behavioral activation scales was correlated with the others. Inhibition was correlated with reward responsiveness.

Past year drinkers showed similarities to the past year gamblers (Table 4B). Alcohol use severity was associated with negative affect and inversely associated with reward responsiveness. Negative affect was inversely associated with reward responsiveness and correlated with inhibition. In contrast to the past year gamblers, there was also an association between and fun seeking and an inverse association between negative affect and drive. Each of the activation scales was correlated with the others. Inhibition was correlated was correlated with reward responsiveness and was inversely correlated with drive.

SEM Results

Due to the non-normality of the modeled variables, a bootstrapping procedure was used, with 500 iterations. The model for gambling severity, with standardized coefficients, is shown in Fig. 1. Each of the specified paths and covariances was significant. Chi square for the model was 5.21 with seven degrees of freedom and a p value of .634. The CFI was 1.00. The RMSEA was < .001, and the SRMR was .034. These values indicated an acceptable goodness of fit.

For alcohol use severity, the Chi square value for this model based on the observed correlations was 5.03 with four degrees of freedom and a p value of .284. The RMSEA was .030, and the SRMR was .025. While these values indicated a well-fitting model, the hypothesized path between drive and negative affect was not significant ($p = .281$). A

Table 4 Bivariate correlations

	Gambling severity (PGSI)	Nega-tive affect (DASS-21)	BAS reward responsive-ness	BAS drive	BAS fun seeking	BIS
A. Past year gamblers (N = 157)						
Gambling severity	1.00 N = 157					
Negative affect	.371 N = 155 **p < .001***	1.00 (N = 155)				
BAS reward responsive-ness	− .205 N = 157 **p = .010**	− .276 N = 155 **p = .001**	1.00 N = 157			
BAS drive	.052 N = 156 p = .522	− .091 N = 154 p = .263	.297 N = 156 **p < .001**	1.00 N = 156		
BAS fun seek-ing	.045 N = 157 p = .580	− .001 N = 155 p = .993	.300 N = 157 **p < .001**	.567 N = 156 **p < .001**	1.00 N = 157	
BIS	− .032 N = 157 p = .690	.309 N = 155 **p < .001**	.199 N = 157 **p = .012**	− .130 N = 156 p = .105	− .035 N = 157 p = .664	1.00 N = 157
	Alcohol use severity (AUDIT)	Nega-tive affect (DASS-21)	BAS reward responsive-ness	BAS drive	BAS fun seeking	BIS
B. Past year drinkers (N = 286)						
Alcohol use severity	1.00 N = 286					
Negative affect	.261 N = 284 **p < .001***	1.00 N = 284				
BAS reward responsive-ness	− .133 N = 285 p = .024	− .197 N = 284 **p = .001**	1.00 N = 285			
BAS drive	.038 N = 283 p = .525	− .128 N = 283 **p = .031**	.358 N = 283 **p < .001**	1.00 N = 283		
BAS fun seek-ing	.183 N = 285 p = .002	− .041 N = 284 p = .494	.308 N = 285 **p < .001**	.536 N = 283 **p < .001**	1.00 N = 285	
BIS	− .003 N = 281 p = .957	.368 N = 280 **p < .001**	.185 N = 281 **p = .002**	− .210 N = 279 **p < .001**	− .092 N = 281 p = .123	1.00 N = 281

*Spearman's Rho

second model was run in which this path was removed. As shown in Fig. 2, each path and covariance in this second model was significant. Model Chi square was 6.39 with five degrees of freedom and a p value of .270. The CFI was .99. The RMSEA was .031, and the SRMR was .029. Each specified path and covariance was significant. These values indicated an adequate fit. In addition, 125 (27.9%) students reported both past year gambling
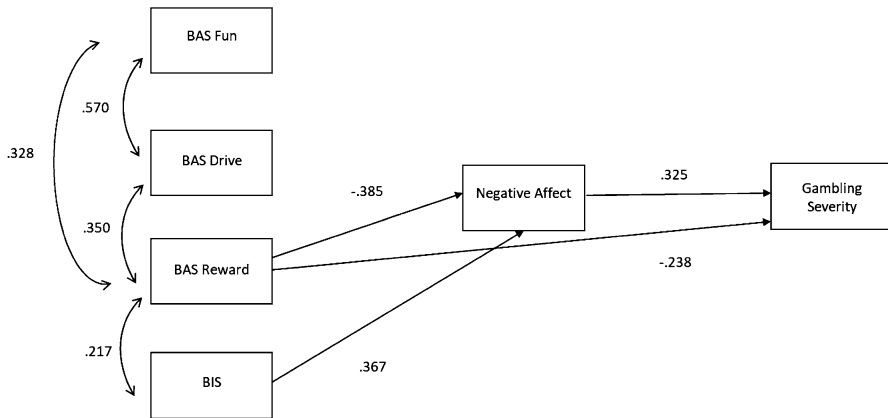
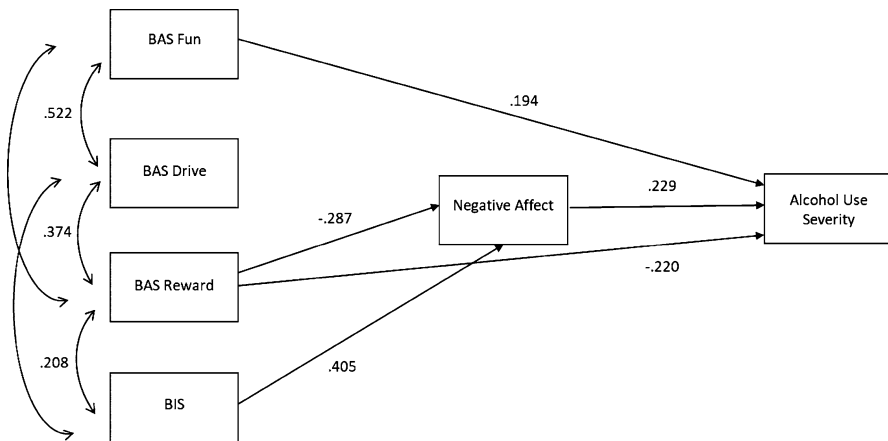**Fig. 1** SEM model gambling severity

Fig. 2 SEM model alcohol use severity

and past year alcohol use. Among these students, the Spearman's rho correlation between PGSI and AUDIT scores was .408 ($p < .001$).

Discussion

This study extends findings from a previous study of gambling severity among young adult college students by examining alcohol use severity within the same sample. Given the number of college students and the prevalence rates of problematic gambling and alcohol use, these problematic behaviors may affect hundreds of thousands of young people each year. As noted, substance use and non-substance use, or process, behaviors exhibit common characteristics. Behaviors are often co-occurring, or an individual may "hop" from one behavior to another. Theoretical models such as Shaffer's Syndrome Addiction Model posit that problematic behaviors may be manifestations of a common syndrome. This is

reflected by the DSM-5's classification of gambling disorder as a behavioral addictive disorder similar to substance use addiction. The identification of components of this syndrome remains an important topic of research.

Within our sample of young adult college students, one-third had gambled in the previous year, and two-thirds had drunk alcohol. One-quarter had engaged in both behaviors, and the correlation between PGSI and AUDIT scores was strong. Overall, 50 students (11.2%) had severity scores indicating moderate or high-risk gambling, and 89 (19.9%) had severity scores indicating a medium or high level of alcohol use related problems. Two-fifths of students had at least a moderate level of depression, anxiety, or stress.

Males were more likely to have engaged in past year gambling. Mean reward responsiveness and BIS scores were higher in females. Mean AUDIT scores were higher in males. Past year drinking was not independent of race/ethnicity. Mean BIS, DASS-21, PGSI, and AUDIT scores were each associated with race/ethnicity.

Within each behavior, severity was associated with negative affect and inversely associated with reward responsiveness. In turn, negative affect was associated with inhibition and inversely associated with reward responsiveness. Thus, both direct and indirect effects of reward responsiveness on severity were observed. In both groups, there were positive covariances among each of the BAS scales as well as a positive covariance between reward responsiveness and inhibition. Among past year drinkers, an association of fun seeking with alcohol use severity was also observed, as was a negative covariance between drive and inhibition. The results for alcohol use severity agree with our findings for gambling severity with regard to the associations between reward responsiveness and BIS with negative affect.

A reward or goal-oriented coping approach may lead to decreased negative affect. Reward responsiveness may also have an effect on the severity of gambling and alcohol use separate from its effect of negative affect. The association of fun seeking with alcohol use severity may, in part, be a reflection of impulsivity ("I often act on the spur on the moment."). Why this association was not observed for gambling is a question for further research. It may be a function of the availability of alcohol in comparison to gambling venues.

These findings are in contrast to those of Franken and Muris (2006) from their study of Dutch undergraduate psychology students. While they found an association between fun seeking and measures of alcohol use (number of glasses consumed when drinking and frequency of binge drinking), they found an inverse association between BIS and these measures. However, their study did not include measures of severity of use or affect. It may be that for some, higher levels of alcohol use can still be a rewarding activity.

While it is important to address specific emotional and behavioral problems a student may be experiencing or engaging in, it is also important to realize these may be manifestation of underlying characteristics. It is equally important to realize that characteristics may underlie different behaviors. Students may thus benefit from interventions designed to promote a reward or goal oriented coping approach and reduce an inhibition based approach. While there do not appear to be interventions which address behavioral activation and intervention directly, Yan et al. (2012) detail messaging approaches which take BAS and BIS orientation into consideration.

There were limitations to this study. This study was based on a cross sectional sample of students. Thus, causal statements regarding the associations among the study variables cannot be made. While concurrent past year gambling and alcohol use could be assessed, we could not determine the extent to which one behavior preceded or supplanted another. Longitudinal studies are needed to determine if BIS and BAS measures are predictive of

negative affect and behavioral severity. The study collected self-reports regarding potentially sensitive information. However, the anonymity and confidentiality of participants' responses were stressed.

Our study only included a measure of negative affect and did not include a measure of positive affect. While our study included assessment of illicit substance use and tobacco use, the number of cases available for analysis was low. The study was conducted with one particular at risk group, young adult college students, in one location. The study sample consisted primarily of females. Thus, generalizability to other populations and settings is not certain. While several study variables were found to differ by gender and race/ethnicity, these latter variables were not included as explicit moderators in the SEM models. Neither were formal mediation analyses conducted to assess the precise mediating effect of negative affect.

Strengths of the study included a sample size of over 400 students. While the sample was restricted with regard to gender, it was diverse with regard to ethnic identity. The study assessed the severity of both a substance based and a non-substance based behavior and their association with measures of behavioral activation and inhibition as well as a measure of negative affect.

It is hoped the limitations can be addressed in future studies. In addition to behaviors such as smoking and illicit drug use, process behaviors such as electronic device and Internet use should also be considered. The DSM-5 lists Internet use as a behavior deserving more study. As did Carver and White (1994), we also found a positive correlation between BIS and reward responsiveness. This association deserves further attention. Future research should also assess the effect of interventions in preventing the initiation of behaviors among currently abstinence students as well as reducing the severity of behaviors, or achieving abstinence, in those who are active. Baseline differences in abstinent and non-abstinent students should also be studied to identify other characteristics which may be protective.

In conclusion, these results show that some students may be engaging in activities beyond the point at which they are rewarding. These students may benefit from efforts to identify academic and other stressors in their lives, to address affective disturbances such as depression, anxiety, and stress, and to change motivation from seeking escape from these disturbances to seeking beneficial rewards.

Compliance with Ethical Standards

Conflict of interest The author declares that he has no conflict of interest related to the research reported in this manuscript.

Ethical Approval This study was approved by the Institutional Review Boards of the University of Houston and the University of Texas Health Science Center at Houston.

Human and Animal Rights All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed Consent This study was conducted on line and was granted a waiver of signed informed consent. Participants signified consent by selected the appropriate online button.

References

Alavi, S. A., Ferdosi, M., Jannatifard, F., Eslami, M., Alaghemandan, H., & Setare, M. (2012). Behavioral addiction versus substance addiction: Correspondence of psychiatric and psychological views. *International Journal of Preventive Medicine, 3*(4), 290–294.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.

Anthony, M. M., Bieling, P. J., Cox, B. J., Enns, M. W., & Swinson, R. P. (1998). Psychometric properties of the 42-item and 21-item versions of the Depression Anxiety Stress Scales (DASS) in clinical groups and a community sample. *Psychological Assessment, 10,* 176–181.

Arnett, J. J. (2000). Emerging adulthood: Theory of development from the late teens through the twenties. *American Psychologist, 55*(5), 469–480.

Atkinson, J., Sharp, C., Schmitz, J., & Yaroslavsky, I. (2012). Behavioral activation and inhibition, negative affect, and gambling severity in a sample of young adult college students. *Journal of Gambling Studies, 28,* 437–449.

Babor, T. F., Higgins-Biddle, J. C., Saunders, J. B., & Monteiro, M. G. (2001). *AUDIT: The alcohol use disorders identification test, guidelines for use in primary care* (2nd ed.). Geneva: Department of Mental Health and Substance Dependence, World Health Organization.

Cacioppo, J. T., & Berntson, G. G. (1994). The affect system: Architecture and operating characteristics. *Current Directions in Psychological Science, 8*(5), 133–137.

Califano, J. A. (2007). *Wasting the best and the brightest: Alcohol and drug abuse on college campuses.* America, May 2007. http://americamagazine.org/issue/616/article/wasting-best-and-brightest. Accessed January 22, 2018.

Carver, S., & White, T. L. (1994). Behavioral inhibition, behavioral activation, and affective responses to impending reward and punishment: The BIS/BAS scales. *Journal of Personality and Social Psychology, 67*(2), 319–333.

Centre for Addiction and Mental Health, Problem Gambling Institute of Ontario. (2013). *Gambling quiz.* https://learn.problemgambling.ca/PDF%20library/assessment-pgsi-en.pdf. Accessed January 22, 2018.

Custer, R. L. (1984). Profile of the pathological gambler. *Journal of Clinical Psychiatry, 45*(12, Sect 2), 35–38.

Dierker, L. C., Donny, E., Tiffany, S., Colby, S. M., Perrine, N., Clayton, E. R., et al. (2007). The association between cigarette smoking and DSM-IV nicotine dependence among first year college students. *Drug and Alcohol Dependence, 86,* 106–114.

Franken, I. H. A., & Muris, P. (2006). BIS/BAS personality characteristics and college students' substance use. *Personality and Individual Differences, 40*(7), 1497–1503.

Gray, J. A. (1987). *The psychology of fear and stress.* Cambridge: Cambridge University Press.

Hooper, D., Coughlan, J., & Mullen, M. R. (2008). Structural equation modelling: Guidelines for determining model fit. *The Electronic Journal of Business Research Methods, 6*(1), 53–60. www.ejbrm.com/issue/download.html?idArticle=183. Accessed January 24, 2018.

Johnston, L. D., O'Malley, P. M., Bachman, J. G., Schulenberg, J. E., & Miech, R. A. (2015). *Monitoring the future national survey results on drug use, 1975–2014: Volume 2, College students and Adults Ages 19–55.* Ann Arbor, MI: Institute for Social Research, The University of Michigan.

Kasch, K. L., Rottenberg, J., Arnow, B. A., & Gotlib, I. H. (2002). Behavioral activation and inhibition systems and the severity and course of depression. *Journal of Abnormal Psychology, 111*(4), 589–597.

Knight, J. R., Wechsler, H., Kuo, M., Seibring, M., Weitzman, E. R., & Schuckit, M. A. (2002). Alcohol abuse and dependence among U.S. college students. *Journal of Studies on Alcohol, 63,* 263–270.

LaBrie, R. A., Shaffer, H. J., LaPlante, D. A., & Wechsler, H. (2003). Correlates of college student gambling in the United States. *Journal of American College Health, 52*(2), 53–62.

Lang, A. R. (1983). Addictive personality: A viable construct? In P. K. Levinson, D. R. Gerstein, & D. R. Maloff (Eds.), *Commonalities in substance abuse and habitual behavior.* Lanham, MD: Lexington Books.

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (1998). Emotion and motivation: Measuring affective perception. *Journal of Clinical Neurophysiology, 15*(5), 397–408.

Lesieur, H. R., & Custer, R. L. (1984). Pathological gambling: Roots, phases, and treatment. *Annals of the American Academy of Political and Social Science, 474,* 146–156.

National Center for Education Statistics. (2015). *Fast facts: Back to school statistics*. http://nces.ed.gov/fastfacts/display.asp?id=372. Accessed January 22, 2018.

Nowak, D. E., & Aloe, A. M. (2014). The prevalence of pathological gambling among college students: A meta-analytic synthesis, 2005–2013. *Journal of Gambling Studies, 20,* 819–843.

Odegaard, B. A., Peller, A., & Shaffer, H. J. (2005). Addiction as syndrome. *Paradigm, Fall 2005*(12–13), 22.

Psytoolkit.org (2017). *Depression Anxiety Stress Scales (DASS)*. https://www.psytoolkit.org/survey-library/depression-anxiety-stress-dass.html. Accessed January 22, 2018.

Shaffer, H. J., LaPlante, D. A., LaBrie, R. A., Kidman, R. C., Donato, A. N., & Stanton, M. V. (2004). Toward a syndrome model of addiction: Multiple expressions, common etiology. *Harvard Review of Psychiatry, 12*(6), 367–374.

Wynne, H. J. (2003). *Introducing the Canadian Problem Gambling Index*. Edmonton: Wynne Associates.

Yan, C., Dillard, J. P., & Shen, F. (2012). Emotion, motivation, and the persuasive effects of message framing. *Journal of Communication*, *62*, 682–700.