



Published in final edited form as:

Am J Drug Alcohol Abuse. 2019 ; 45(4): 400–409. doi:10.1080/00952990.2019.1601200.

Personality traits and negative consequences associated with binge drinking and marijuana use in college students

Daniel S. O'Leary, PhD¹, Douglas R. Langbehn, MD PhD^{1,2}, John R. Kramer, PhD¹, Samuel Kuperman, MD¹, Lindsey A. Fuhrmeister, BA¹, Jatin G. Vaidya, PhD¹

¹University of Iowa Carver College of Medicine, Department of Psychiatry, Iowa City, IA, United States

²University of Iowa College of Public Health, Department of Biostatistics, Iowa City, IA, United States

Abstract

Background.—Binge drinking is common in college students, and many youth drink in quantities greater than the standard definition of bingeing. The use of additional substances, particularly marijuana, is also common.

Objectives.—Increased Impulsivity and Sensation Seeking are risk factors for binge drinking, and this study was designed to characterize the association of Impulsivity and Sensation Seeking with more extreme compared to standard bingeing, as well as with combined bingeing and marijuana use. The negative consequences of these patterns of substance use were also investigated.

Methods.—Self-report personality measures and a measure of the negative consequences of alcohol use were given to a sample of 221 college students (109 F) sorted into 5 groups based upon their patterns of bingeing and marijuana use. Narrowly defined, non-overlapping measures of Impulsivity and Sensation Seeking were initially analyzed, followed by a broader set of personality traits to determine the best predictors of substance-use patterns and negative consequences of bingeing.

Results.—Both standard and extreme bingers had significantly higher Impulsivity and Sensation Seeking scores than the non-bingeing control group, but only Sensation Seeking significantly differentiated the two binge groups. A Disinhibition scale was a highly significant predictor of substance use group, along with Impulsivity and Sensation Seeking. Personality traits significantly predicted substance use patterns as well as specific negative consequences of bingeing.

Conclusions.—Impulsivity and Sensation Seeking are significant predictors of substance use patterns and the negative consequences of use in college students, as is Disinhibition and to a lesser extent, other personality traits.

Corresponding Author Daniel O'Leary, Ph.D., University of Iowa Carver College of Medicine, Department of Psychiatry, 200 Hawkins Dr., W278GH, Iowa City, IA 52242, Daniel-oleary@uiowa.edu.

Disclosure Page

Personality traits and negative consequences associated with binge drinking and marijuana use in college students.

The authors report no relevant financial conflicts.

Keywords

Alcohol; Binge; Marijuana; Impulsivity; Consequences; Sensation Seeking

Introduction

Alcohol use typically begins in adolescence and is highly prevalent by late adolescence and young adulthood (1). Risky alcohol use in this age range has been shown to be associated with problems such as decreased executive function (2), structural brain abnormalities (3), and increased risk of adult substance use problems (4). Some patterns of alcohol use are riskier than others. There is evidence for example that binge drinking may be more damaging than moderate regular use (5). The majority of studies of problematic alcohol use in adolescence have assessed the effects of standard bingeing defined as 4/5 or more standard drinks within a two-hour drinking session for females/males (6). However, many youth drink in quantities much greater than the standard definition of bingeing (7–9). Drinking 8+ (females) or 10+ drinks (males) on one occasion has been called “extreme bingeing” or “high intensity drinking” (10, 11) and is relatively frequent in adolescents (8).

The effects of extreme bingeing compared to standard bingeing have not yet been widely studied, but there is initial evidence that it is associated with more negative consequences, such as higher rates of alcohol use disorder (AUD) and blackouts, than is standard bingeing (7, 10). Factors other than the amount of alcohol consumed per session may also increase negative consequences. For example, a large percentage of youth who regularly use alcohol also use other substances, particularly marijuana (12, 13). Among high-school seniors reporting any past 12-month marijuana use, 62% reported simultaneous alcohol and marijuana use (14). The effects of co-use of marijuana in binge drinkers has also received relatively little research attention. This study assessed the personality traits of college students who are standard versus extreme bingers and who do not regularly use marijuana, as well as the personality traits of those who binge drink and also regularly use marijuana. Other goals of the study were to assess the negative consequences associated with differing patterns of alcohol and marijuana use (e.g., poor academic performance, low self-esteem), and to identify personality traits related to negative consequences of substance use.

Adan et al (15) performed a systematic review of the personality traits related to binge drinking in adolescents and young adults and found that Impulsivity and Sensation Seeking were the two characteristics most strongly associated with regular binge drinking. High levels of Impulsivity have been shown to be particularly associated with substance use problems in adolescence (15–17). Impulsivity reflects a tendency to behave in an under- (versus over-) controlled manner and is associated with poor behavioral inhibition (18). One common approach is to measure Impulsivity with self-report trait inventories, such as the UPPS-P Impulsive Behavior Scale (19), and the Barratt Impulsiveness Scale (20). Stautz and Cooper (17) performed a meta-analysis to assess the degree to which the UPPS-P measures of Impulsivity were associated with alcohol consumption use in adolescents. They found that two components of Impulsivity, Positive Urgency and Sensation Seeking, were positively associated with excessive alcohol consumption.

Sensation Seeking, the second personality trait commonly associated with binge drinking, refers to the propensity to search for unusual experiences that are novel, intense, and frequently entail some risk (21). It is often measured using self-report measures such as the Zuckerman Sensation Seeking Scale (22). Sensation Seeking can be conceptualized as a facet of IMP, as it is in the UPPS-P, or as an independent but related feature of Impulsivity, as in the Zuckerman scale (15).

Impulsivity and Sensation Seeking can be viewed in the context of neurobehavioral mechanisms underlying the peak in risky behaviors that occurs during mid-adolescence. Research into these mechanisms has been influenced by the 'dual systems' (18, 23) or 'maturational imbalance' (24) models of adolescent risk taking. These models describe adolescence as a period of developmental asynchrony between: a) an easily aroused ventral forebrain reward system, which results in heightened sensation seeking, and b) a still maturing prefrontal self-regulatory system. This imbalance limits the adolescent's ability to resist inclinations, resulting in impulsive decisions and risky behavior. Following the approach used in Steinberg et al (18), self-report measures of Impulsivity and Sensation Seeking were utilized that were non-overlapping in order to emphasize their possible independent associations with problematic substance use.

The decision to use specific, non-overlapping measures of Impulsivity and Sensation Seeking was based upon a desire for conceptually distinct, unidimensional measures, rather than using multi-dimensional, overlapping measures of these personality traits (e.g. the UPPS-P and Zuckerman's SSS). Our measure of Impulsivity was a subscale of the BIS-11 (Nonplanning), and the Sensation Seeking measure was a subscale from the Zuckerman SSS (Thrill and Adventure Seeking scale) that had a near zero-order correlation with Impulsivity. After assessing the association of Impulsivity and Sensation Seeking with different patterns of bingeing and marijuana use and with negative consequences of bingeing, exploratory analyses were carried out to determine if other commonly used personality scales explained additional variability in these measures.

We administered the instruments from which the Impulsivity and Sensation Seeking measures were drawn (BIS-11, SSS) as well as the UPPS-P to a sample (n = 221) of freshman and sophomore college students selected based upon differing patterns of binge drinking and marijuana use. We assessed the negative consequences of alcohol use with the Young Adult Alcohol Consequences Questionnaire (YAACQ) (25), and explored the inter-relationship of poor outcomes to substance use patterns and personality traits (there is now a scale that assesses the negative consequences of marijuana use (26), but we were not aware of it when we began our study). We hypothesized that Impulsivity and Sensation Seeking would be independently associated with variability in alcohol and marijuana use in our sample. Given the heterogeneity of the Impulsivity and Sensation Seeking constructs, we carried out additional analyses of the association between substance use patterns and consequences of use with each subscale of the BIS-11, SSS, and the UPPS-P.

Methods

Subjects:

Subjects were college freshmen and sophomores who took part in a larger study examining the association between brain, behavioral, and personality measures, with different forms of alcohol and marijuana use. The original sample consisted of students who did not binge drink, standard binge drinkers, and extreme-bingers, none of whom regularly used marijuana or other recreational drugs. To examine the effects of the co-use of alcohol and marijuana, two additional groups were recruited; students who were standard or extreme bingers and also used marijuana regularly. We excluded subjects if they used street drugs or abused prescription drugs more than 15 times in their life. Age and gender distribution were not significantly different across groups. As can be seen in Table 1, the marijuana use groups not only use marijuana more frequently than the other groups, they also engage in higher levels of binge drinking.

The local Institutional Review Board (IRB) approved all measures and procedures used in this study. Subjects were recruited by advertising in local newspapers, websites, mass e-mails, and flyers on campus buses and in public locations to target subjects who had specific substance use patterns. The criteria for the number of binge drinking episodes and the number of occasions of marijuana use in each group were developed based upon a review of the literature as well as upon practical constraints resulting from the distribution of bingeing and marijuana use in our sample. Subjects were recruited with the following criteria:

- a. Controls: (n = 40, 20 females; mean age = 18.70, SD = 0.61). No current or past marijuana use, standard or extreme bingeing; and no more than 3 non-binge drinking occasions per month.
- b. sBinge: (n = 62, 29 females; mean age = 18.65, SD = 0.68). Two or more standard binge episodes in past 30 days or 2+ standard binge episodes since the semester began and use of marijuana 3 times or less in the last month, with no more than 30 occasions of use lifetime.
- c. eBinge: (n = 59, 30 females; mean age = 18.78, SD = 0.72). Two or more eBinge episodes in past 30 days OR 2+ eBinge episodes since the semester began and marijuana 3 times or less in the last month, with no more than 30 occasions of lifetime Marijuana use.
- d. Marijuana + sBinge: (n = 35, females = 16; mean age = 18.60, SD = 0.60). Marijuana use on at least 4 occasions in past 30 days and meet sBinge criteria for alcohol use.
- e. Marijuana + eBinge: (n = 25, 14 females, mean age = 18.72; SD = 0.68). Marijuana use on at least 4 occasions in past 30 days and meet eBinge criteria for alcohol use.

After reviewing and signing an informed consent document, subjects were screened through a review of medical history to exclude a history of seizure disorders, head injury, neurologic, metabolic, or cardiovascular disease, or cerebrovascular events. Subjects then received a computerized version of the MINI International Neuropsychiatric Interview (27) to exclude

individuals who met DSM-IV criteria for substance use disorders other than alcohol and marijuana. A urine test for substances of abuse (the U-Cup CLIA Waived Marijuana Test Cup 12 Panel™) was administered as well as using a breathalyzer. Testing positive for marijuana was not an exclusion because it is lipid soluble and detectable for long periods of time, but participants were asked to refrain from marijuana on the day of the MRI scan. Subjects testing positive on alcohol and/or other drug screens were rescheduled for one further assessment and dropped from the study if they failed a 2nd time.

Personality measures and individual characteristics

The Barratt Impulsiveness Scale, Version 11 (BIS-11) is a self-report measure with 6 first-order factors that can be grouped into 3 second-order factors (attention, motor, and non-planning). The Zuckerman Sensation Seeking Scale (SSS) incorporates 4 sub-domains: thrill and adventure seeking, experience seeking, disinhibition, and boredom susceptibility. The UPPS-P Impulsive Behavior Scale (UPPS-P) was also administered to better characterize personality traits associated with different patterns of marijuana and alcohol use in subsidiary analyses. It consists of 5 distinct sub-scales (negative urgency, (lack of) premeditation, (lack of) perseverance, sensation seeking, positive urgency) and has demonstrated validity in predicting different forms of impulsive behaviors.

The non-planning scale from the BIS-11 was utilized as our primary measure of Impulsivity. It is similar to the measure utilized by Steinberg and colleagues (18), and is most strongly associated with our conceptualization of this construct. The thrill and adventure seeking subscale on the Zuckerman SSS was used as a measure of Sensation Seeking. Consistent with previous evidence that these measures are orthogonal, the correlation between non-planning and thrill and adventure seeking was nearly zero ($r = .007$). The negative consequences of alcohol use were assessed with the Young Adult Alcohol Consequences Questionnaire (YAACQ) (25).

Statistical Methods

We hypothesized that Impulsivity and Sensation Seeking would both be related to the magnitude of binge drinking and marijuana use. Group differences were analyzed by analysis of variance (ANOVA), and the statistical significance of the overall model fit is reported. For comparisons among the groups, the Tukey-Kramer method (28) was used to adjust for multiple comparisons. Potential sex effects in these analyses were assessed by two-way ANOVA models with sex-by-binge group interactions. Subjects were administered the entire BIS-11, and the SSS, as well as the UPPS-P to more broadly characterize the personality traits that are associated with different substance use patterns. To determine if any of the subscales differed significantly between substance use groups, exploratory analyses on all of the scales from the BIS-11, the SSS, and the UPPS-P were carried out using the same ANOVA design as with Impulsivity and Sensation Seeking. Both the SSS Disinhibition scale and the SSS Experience seeking scale have items that assess substance use patterns. Because our 5 groups were based upon the subjects' patterns of use, we computed scores for the SSS Disinhibition and Experience Seeking scores deleting items assessing substance use.

We modeled the joint prediction of binge group by all personality measures via nominal logistic regression (29) with binge group as the outcome. The multivariate relationship of personality measures and binge group membership to negative consequences (YAACQ) was assessed by multivariate linear regression. Controls were excluded from YAACQ analyses due to their paucity of non-zero scores. Analyses were performed using SAS/STAT software (30).

Results

Impulsivity (BIS Nonplanning)

There was a highly significant overall difference among the 5 binge groups ($F = 6.16$, $df = 4$, 216 , $p = .0001$). The eBinge, Marijuana + sBinge and Marijuana + eBinge groups differed significantly from controls after adjustment for multiple comparisons. However, as can be seen in Figure 1, none of the binge groups differed significantly from each other. See Table 2 for means and standard deviations of all personality scales.

Sensation Seeking (SSS Thrill Adventure Seeking)

There was a highly significant overall difference among the 5 binge groups ($F = 5.05$, $df = 4$, 216 , $p = .0002$). As can be seen in Figure 2, the eBinge group had higher scores than controls and sBingers. The difference between marijuana + sBinge and controls was not quite significant at the .05 level ($p < .06$).

To determine if any of the scales from the BIS-11, the SSS, or the UPPS-P differed significantly between substance use groups, we carried out exploratory analyses on scales from these instruments using the same ANOVA design as with the Impulsivity and Sensation Seeking measures. Table 2 shows the results of the separate ANOVAs carried out on these scales.

As can be seen, the five binge groups differ significantly on most of the personality scales. However, it is well-established that these scales are inter-related. To identify which of these scales, when considered together, provided independent information that best distinguished the groups, we modelled the joint prediction of binge group by all of the UPPS, BIS-11, and SSS personality measures via nominal logistic regression (29), with binge group as the outcome.

Both the Impulsivity and Sensation Seeking scales contributed notable unique information for predicting substance use group membership. However, the Disinhibition measure was far and away the strongest predictor of group membership. For this reason, the same ANOVA analysis was carried out on this variable as with Impulsivity and Sensation Seeking.

There were no Sex main effect or interactions for the Disinhibition score. There was a highly significant overall difference among the 5 binge groups ($F = 17.21$, $df = 4$, 216 , $p < .0001$). All binge groups had significantly higher mean scores than controls. As can be seen in Figure 3, the marijuana + sBinge and marijuana + eBinge groups had higher mean scores than the sBinge only group, and the difference between the marijuana + sBinge and eBinge

groups had an adjusted p value of .051, with the marijuana + sBinge group having higher values.

Group differences in negative consequences of alcohol use

The multivariate relationship of personality measures and binge group membership on YAACQ outcomes was assessed by multivariate linear regression. Controls were excluded from YAACQ analyses due to their paucity of non-zero scores. As can be seen in Tables 4 and 5, the personality measures were strong independent predictors of negative consequences assessed by the YAACQ. Personality traits were significant at the .05 or higher level for seven of the YAACQ scores and significant at the .08 level for the Academic-Occupational measure. Disinhibition had the strongest association with negative consequences, predicting 5 of the 8 YAACQ scores.

The binge group that an individual was classified into was a less robust predictor of negative consequences than personality traits but explained significant variability in 4 of the 8 YAACQ scales. The binge drinkers who also used marijuana had more negative consequences than the binge only group as detailed in the last column of Table 5. Gender was associated with two YAACQ scores with females having more self-control and less alcohol dependence (as defined by the YAACQ) than men.

Discussion

This study assessed the relationship of personality measures to patterns of binge drinking and marijuana use, as well as the interrelationships between personality traits, substance use patterns, and the negative consequences of alcohol use. As noted above, the initial intent was to determine if *extreme* binge drinkers who did not use marijuana or other substances differed on personality traits and the magnitude of negative consequences from *standard* binge drinkers with no regular marijuana use. The effects of regular marijuana use in conjunction with bingeing were then explored. Consistent with the dual systems model of risky adolescent behavior (18), specific, non-overlapping measures of Impulsivity and Sensation Seeking were initially used as conceptually clear, unidimensional measures of these traits. Multivariate modeling was then used to determine which of all of the BIS-11, SSS, and UPPS-P subscales were the best predictors of an individual's substance-use group classification. Finally, the negative consequences of alcohol use in each group was assessed to identify the personality traits associated with negative consequences on the YAACQ.

Personality correlates of standard versus extreme bingeing

White et al (9), were the first to note that a surprisingly large percentage of college students drink at levels well beyond the traditional binge threshold of 4/5 or more standard drinks within a two-hour drinking session for females/males. Read et al (31) found that this pattern of extreme bingeing (but not standard bingeing) was associated with more frequent alcohol use and more negative consequences on the YAACQ than non-binge drinking in college youth. Recent studies have addressed the prevalence of extreme bingeing at different ages (8, 10, 11) and its consequences (7, 32). Although prior work implicated multiple facets of Impulsivity in binge drinking behavior (33), no study, to our knowledge, has assessed

differences in personality traits that are associated with standard versus extreme bingeing patterns.

Our data indicate that both Impulsivity and Sensation Seeking robustly predicted whether subjects were bingers or controls. However, only Sensation Seeking differentiated standard from extreme bingers. The eBinge group had significantly higher scores on Sensation Seeking than sBingers, indicating that individuals who frequently binge drink at very high levels of consumption had a greater predilection for participating in highly stimulating activities such as mountain climbing and sky diving than standard bingers. These results suggest that Impulsivity plays less of a role in extreme binge drinking than does Sensation Seeking or Disinhibition.

The dual systems model (18) posits that Sensation Seeking is mediated by a socioemotional arousal system with a developmental course that follows an inverted-U shaped function, with responsiveness to reward increasing in early adolescence and declining in early adulthood (23). The conceptually similar maturational imbalance model (24) also posits that emotional arousal peaks in mid-adolescence, but this model holds that Sensation Seeking then plateaus, remaining at this level into adulthood. Both models hold that Impulsivity is mediated by a cognitive control system that has a linear developmental function and matures in late adolescence.

Our data on Sensation Seeking appear to be more in line with Casey et al's (24) maturational imbalance theory than Steinberg's dual systems model (18), at least for youth who extreme binge. The 18 – 20-year-old eBingers had very high levels of Sensation Seeking at an age at which the dual-system model posits that Sensation Seeking should be decreasing. Shulman et al (23) suggest that some forms of real-world risky behavior peak at a later age than predicted by the dual-systems model because of differential opportunities for risk-taking in late adolescence rather than because of neurobiological factors. However, in our sample it seems unlikely that eBingers had greater access to alcohol than sBingers. It seems possible that there are individual differences in the developmental course of Sensation Seeking (34), and that youth who extreme binge have a responsiveness to reward that continues to increase into early adulthood.

All of the personality subscales of the SSS, BIS-11 and the UPPS-P were significantly different at the $p < .05$ level or higher in the two binge groups than in controls (with the exception of BIS-11 Attentional Score). Logistic regression of the subscales indicated that while both Impulsivity and Sensation Seeking contributed unique information for predicting group membership, the Disinhibition scale was the strongest predictor. However, sBinge and eBinge groups again did not differ significantly from each other on Disinhibition (see Figure 3).

In summary, our data indicate that standard bingers who did not use marijuana or other drugs regularly were not significantly different from controls on Impulsivity or Sensation Seeking. Both standard and extreme bingers were significantly higher than controls on Disinhibition, which is a general index of an externalizing spectrum (35), but Sensation Seeking was the only trait that was significantly higher in extreme than in standard bingers.

This may indicate that the socioemotional arousal system matures later in extreme bingers than in standard bingers or controls, and additionally implicates Sensation Seeking as opposed to Impulsivity or Disinhibition as risk factor for extreme binge drinking. Personality targeted interventions have been shown to be effective in modifying alcohol consumption, and this effect appears to be particularly strong in individuals who score high in Sensation Seeking (36). It will be important for future research to examine personality targeted interventions specifically focused on extreme binge drinking in college students.

Personality correlates of Marijuana use and Bingeing

Alcohol and marijuana are the two mostly frequently used substances among college students (37), and the co-use of both substances is common (12, 13). There have been a few studies suggesting that marijuana use could have a protective effect in binge drinkers (38, 39), but the majority of studies indicate that co-use of marijuana and alcohol is associated with additive cognitive impairment, increased consumption levels, and more negative consequences (40). There are few studies that have assessed the personality traits associated with bingeing along with marijuana use (41), but such information could be helpful in identifying youth at risk for substance use disorders and for targeted interventions.

Our results indicate that both standard and extreme binge drinkers who also regularly smoked marijuana were significantly higher than controls on Impulsivity and Disinhibition, but surprisingly not on Sensation Seeking. Neither Sensation Seeking nor Impulsivity or Disinhibition differentiated the marijuana + sBinge and marijuana + eBinge groups. Disinhibition was the only trait that was significantly different in the marijuana use groups than in the non-marijuana use binge groups. In general, youth who used marijuana regularly as well as binge drank did not have robust personality differences from bingers who did not use marijuana. The finding that Disinhibition is an important factor in the use of multiple substances is consistent with an earlier study that also implicates Disinhibition (41) and is consistent both with the content of the scale and with the notion of deviance proneness.

Group differences in negative consequences of alcohol use

The personality scales were a strong predictor of negative consequences related to alcohol use. As a group they significantly predicted seven of the eight YAACQ scales at the $p < .05$ level or better (see Table 4). The Social/Interpersonal scale had the highest F value and was predicted most strongly by the UPPS Negative Urgency scale and SSS Disinhibition and Experience Seeking scales (see Table 5). Physiological Dependence was the next most highly associated score and was best predicted by the UPPS Lack of Premeditation and the Disinhibition scales. The YAACQ Physiological Dependence scale is not the same as DSM-IV criteria of alcohol dependence. Blackout drinking was predicted most strongly by the Disinhibition score. It is likely to have particularly negative neurobiological consequence in adolescents and young adults (42, 43). In all, Disinhibition was a significant predictor of five of the 8 YAACQ scales.

The substance use group that a student was classified into was a significant predictor of 4 of the YAACQ scales. Bingeing and co-use of marijuana led to more negative consequences than binge drinking alone. A similar conclusion was reached by Haas et al (44) who

identified 4 patterns of either marijuana and/or alcohol use in entering college freshmen using latent profile analysis. The 4 patterns were composed of light or moderate drinkers who either had used marijuana recently (past 30 days) or had no recent use. Among moderate drinkers, recent marijuana users were more likely to drink more than intended, drink to get drunk, and have more problems including higher rates of blackouts, physical injury, and drunk driving relative to peers who did not use marijuana recently (44).

Bingeing and marijuana use can either be simultaneous, which can produce additive/synergistic euphoric effects; or concurrent, which may be used to alleviate the negative consequences of one or the other substance. We did not assess whether bingeing and marijuana use were simultaneous or concurrent in our sample. But a secondary analysis of the 2005 and 2010 National Alcohol Survey (N = 4,522 females, 4,104 males), found that simultaneous use of alcohol and marijuana has twice the prevalence of concurrent use and approximately doubles the odds of drunk driving, social consequences, and harm to self, compared to using only alcohol (13). Simultaneous use of alcohol and marijuana may also be associated with cumulative deficits, including higher consumption levels and increased negative consequences (40). These data are consistent with our findings that marijuana use plus bingeing was characterized by a higher frequency of binge drinking, greater Disinhibition scores, and more negative consequences than bingeing alone.

The items in the SSS Disinhibition scale tap into both the substance use and anti-social content of two broad externalizing sub-factors (35). Even with the substance use items removed, the Disinhibition score predicted patterns of bingeing and Marijuana use (i.e., binge group membership) as well as negative consequences of alcohol use to a much greater extent than IMP, SS, or any other personality trait. Our data indicate that the presence of externalizing factors indexed by the Disinhibition score may intensify the magnitude of binge drinking and marijuana use and increase the negative consequences of these behaviors.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

This study was supported by NIAAA/NIDA under Grant 5R01AA021165.

References

1. Johnston LD MR, O'Mally PM, Bachman JG, Schuenbrg JE & Patrick ME. Monitoring the Future national survey results on drug use: 1975–2017: Overview, Key Findings on Adolescent Drug Use. Ann Arbor, MI: Institute for Social Research, The University of Michigan; 2018.
2. Gil-Hernandez S, Mateos P, Porras C, Garcia-Gomez R, Navarro E, Garcia-Moreno LM. Alcohol Binge Drinking and Executive Functioning during Adolescent Brain Development. *Front Psychol.* 2017;8:1638. [PubMed: 29046650]
3. Wilson S, Malone SM, Thomas KM, Iacono WG. Adolescent drinking and brain morphometry: A co-twin control analysis. *Dev Cogn Neurosci.* 2015;16:130–8. [PubMed: 26278682]
4. Irons DE, Iacono WG, McGue M. Tests of the effects of adolescent early alcohol exposures on adult outcomes. *Addiction.* 2015;110(2):269–78. [PubMed: 25251778]

5. Witt ED. Research on alcohol and adolescent brain development: opportunities and future directions. *Alcohol*. 2010;44(1):119–24. [PubMed: 20113880]
6. NIAAA Council approves definition of binge drinking. *NIAAA Newsletter*. 2004(3).
7. Patrick ME, Cronce JM, Fairlie AM, Atkins DC, Lee CM. Day-to-day variations in high-intensity drinking, expectancies, and positive and negative alcohol-related consequences. *Addict Behav*. 2016;58:110–6. [PubMed: 26922158]
8. Patrick ME, Terry-McElrath YM. High-intensity drinking by underage young adults in the United States. *Addiction*. 2017;112(1):82–93.
9. White AM, Kraus CL, Swartzwelder H. Many college freshmen drink at levels far beyond the binge threshold. *Alcohol Clin Exp Res*. 2006;30(6):1006–10. [PubMed: 16737459]
10. Linden-Carmichael AN, Vasilenko SA, Lanza ST, Maggs JL. High-Intensity Drinking Versus Heavy Episodic Drinking: Prevalence Rates and Relative Odds of Alcohol Use Disorder Across Adulthood. *Alcohol Clin Exp Res*. 2017;41(10):1754–9. [PubMed: 28800154]
11. Terry-McElrath YM, Patrick ME. Intoxication and binge and high-intensity drinking among US young adults in their mid-20s. *Subst Abus*. 2016;37(4):597–605. [PubMed: 27092592]
12. Pampati S, Buu A, Hu YH, Mendes de Leon CF, Lin HC. Effects of alcohol and cigarette use on the initiation, reinitiation, and persistence of cannabis use from adolescence to emerging adulthood. *Addict Behav*. 2018;79:144–50. [PubMed: 29289854]
13. Subbaraman MS, Kerr WC. Simultaneous versus concurrent use of alcohol and cannabis in the National Alcohol Survey. *Alcohol Clin Exp Res*. 2015;39(5):872–9. [PubMed: 25872596]
14. Terry-McElrath YM, O'Malley PM, Johnston LD. Simultaneous alcohol and marijuana use among U.S. high school seniors from 1976 to 2011: trends, reasons, and situations. *Drug Alcohol Depend*. 2013;133(1):71–9. [PubMed: 23806871]
15. Adan A, Forero DA, Navarro JF. Personality Traits Related to Binge Drinking: A Systematic Review. *Front Psychiatry*. 2017;8:134. [PubMed: 28804465]
16. Jones KA, Chryssanthakis A, Groom MJ. Impulsivity and drinking motives predict problem behaviours relating to alcohol use in university students. *Addict Behav*. 2014;39(1):289–96. [PubMed: 24176824]
17. Stautz K, Cooper A. Impulsivity-related personality traits and adolescent alcohol use: a meta-analytic review. *Clin Psychol Rev*. 2013;33(4):574–92. [PubMed: 23563081]
18. Steinberg L, Albert D, Cauffman E, Banich M, Graham S, Woolard J. Age differences in sensation seeking and impulsivity as indexed by behavior and self-report: evidence for a dual systems model. *Dev Psychol*. 2008;44(6):1764–78. [PubMed: 18999337]
19. Whiteside SP, Lynam DR. The Five Factor Model and impulsivity: using a structural model of personality to understand impulsivity. *Personality and Individual Differences*. 2001;30(4):669–89.
20. Patton JH, Stanford MS, Barratt ES. Factor structure of the Barratt impulsiveness scale. *J Clin Psychol*. 1995;51(6):768–74. [PubMed: 8778124]
21. M Z. *Sensation Seeking: Beyond the Optimal Level of Arousal*. Hillsdale, NJ: Psychology Press; 1979.
22. Zuckerman M KE, Price L, Zoob I. Development of a sensation-seeking scale. *Journal of Consulting Psychology*. 1964;28(6):477–82. [PubMed: 14242306]
23. Shulman EP, Smith AR, Silva K, Icenogle G, Duell N, Chein J, et al. The dual systems model: Review, reappraisal, and reaffirmation. *Dev Cogn Neurosci*. 2016;17:103–17. [PubMed: 26774291]
24. Casey BJ, Getz S, Galvan A. The adolescent brain. *Dev Rev*. 2008;28(1):62–77. [PubMed: 18688292]
25. Read JP, Kahler CW, Strong DR, Colder CR. Development and preliminary validation of the young adult alcohol consequences questionnaire. *J Stud Alcohol*. 2006;67(1):169–77. [PubMed: 16536141]
26. Simons JS, Dvorak RD, Merrill JE, Read JP. Dimensions and severity of marijuana consequences: development and validation of the Marijuana Consequences Questionnaire (MACQ). *Addict Behav*. 2012;37(5):613–21. [PubMed: 22305645]

27. Sheehan DV, Lecrubier Y, Sheehan KH, Amorim P, Janavs J, Weiller E, et al. The Mini-International Neuropsychiatric Interview (M.I.N.I.): the development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *J Clin Psychiatry*. 1998;59 Suppl 20:22–33;quiz 4–57.
28. Kramer CY. Extension of Multiple Range Tests to Group Means With Unequal Numbers of Replications. *Biometrics*. 1956;12(3):4.
29. Agresti A. *Categorical Data Analysis*, second edition New York: Wiley; 2002.
30. Inc. SI. SAS/STAT software. 14.1 ed Cary, NC, USA2002-2012.
31. Read JP, Beattie M, Chamberlain R, Merrill JE. Beyond the “Binge” threshold: heavy drinking patterns and their association with alcohol involvement indices in college students. *Addict Behav*. 2008;33(2):225–34. [PubMed: 17997047]
32. Hingson RW, Zha W, White AM. Drinking Beyond the Binge Threshold: Predictors, Consequences, and Changes in the U.S. *Am J Prev Med*. 2017;52(6):717–27. [PubMed: 28526355]
33. Coskunpinar A, Dir AL, Cyders MA. Multidimensionality in impulsivity and alcohol use: a meta-analysis using the UPPS model of impulsivity. *Alcohol Clin Exp Res*. 2013;37(9):1441–50. [PubMed: 23578176]
34. Harden KP, Tucker-Drob EM. Individual differences in the development of sensation seeking and impulsivity during adolescence: further evidence for a dual systems model. *Dev Psychol*. 2011;47(3):739–46. [PubMed: 21534657]
35. Krueger RF, Markon KE, Patrick CJ, Benning SD, Kramer MD. Linking antisocial behavior, substance use, and personality: an integrative quantitative model of the adult externalizing spectrum. *J Abnorm Psychol*. 2007;116(4):645–66. [PubMed: 18020714]
36. Conrod PJ, Castellanos N, Mackie C. Personality-targeted interventions delay the growth of adolescent drinking and binge drinking. *J Child Psychol Psychiatry*. 2008;49(2):181–90. [PubMed: 18211277]
37. The National College Health Assessment Summary, University of Iowa. <https://studenthealth.uiowa.edu/news/national-college-health-assessment-data/>: The University of Iowa; Spring 2017.
38. Becker MP, Collins PF, Luciana M. Neurocognition in college-aged daily marijuana users. *J Clin Exp Neuropsychol*. 2014;36(4):379–98. [PubMed: 24620756]
39. Jacobus J, McQueeney T, Bava S, Schweinsburg BC, Frank LR, Yang TT, et al. White matter integrity in adolescents with histories of marijuana use and binge drinking. *Neurotoxicol Teratol*. 2009;31(6):349–55. [PubMed: 19631736]
40. Yurasek AM AE. Co-Use of Alcohol and cannabis: A Review. *Current Addiction Reports*. 2017;4(2):184–93. [PubMed: 32670740]
41. Conway KP, Kane RJ, Ball SA, Poling JC, Rounsaville BJ. Personality, substance of choice, and polysubstance involvement among substance dependent patients. *Drug Alcohol Depend*. 2003;71(1):65–75. [PubMed: 12821207]
42. Hermens DF, Lagopoulos J. Binge Drinking and the Young Brain: A Mini Review of the Neurobiological Underpinnings of Alcohol-Induced Blackout. *Front Psychol*. 2018;9:12. [PubMed: 29403418]
43. Schuckit MA, Smith TL, Heron J, Hickman M, Macleod J, Munafo MR, et al. Latent trajectory classes for alcohol-related blackouts from age 15 to 19 in ALSPAC. *Alcohol Clin Exp Res*. 2015;39(1):108–16. [PubMed: 25516068]
44. Haas AL, Wickham R, Macia K, Shields M, Macher R, Schulte T. Identifying classes of conjoint alcohol and marijuana use in entering freshmen. *Psychol Addict Behav*. 2015;29(3):620–6. [PubMed: 26168228]

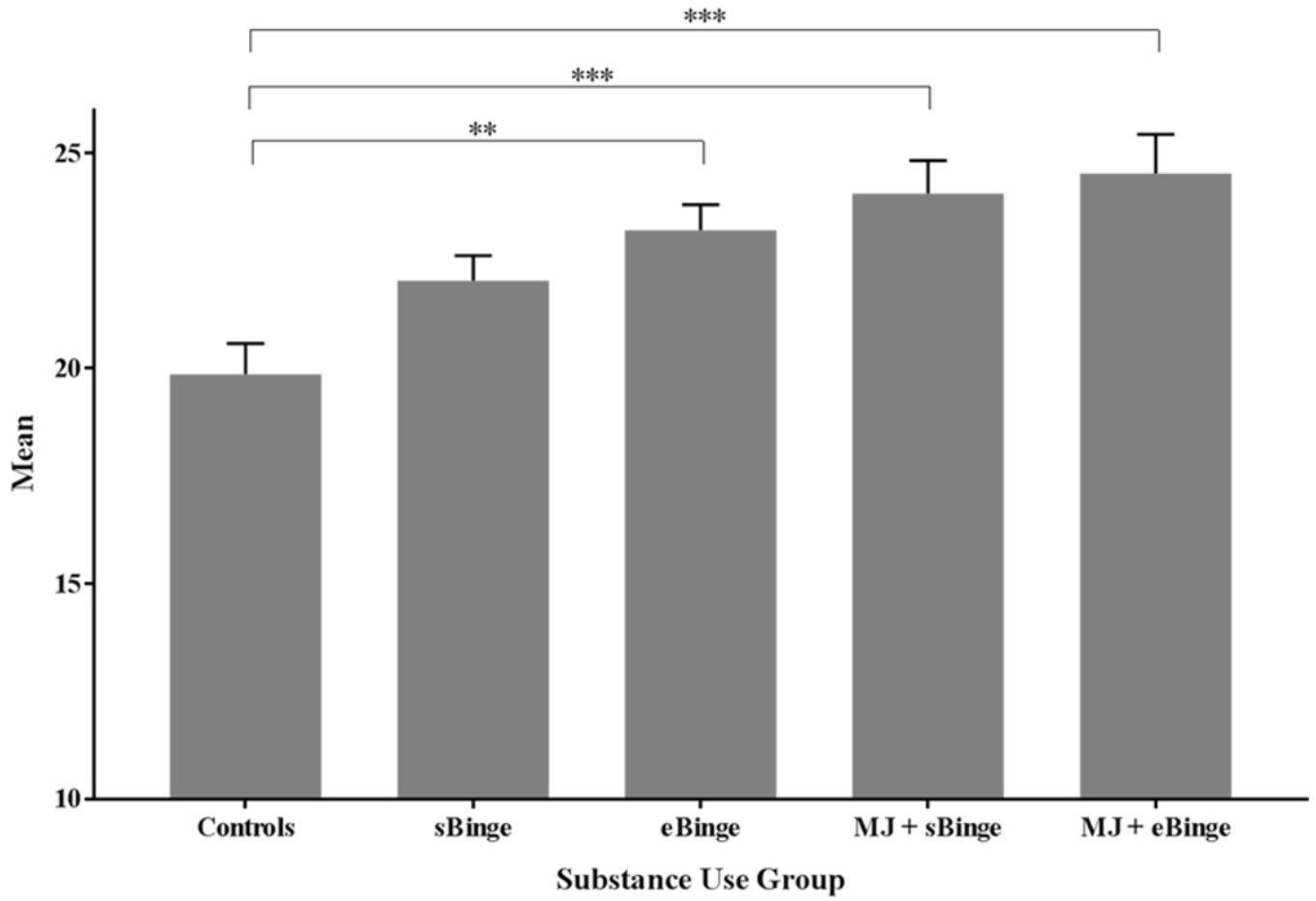


Figure 1.
BIS-11 Nonplanning.

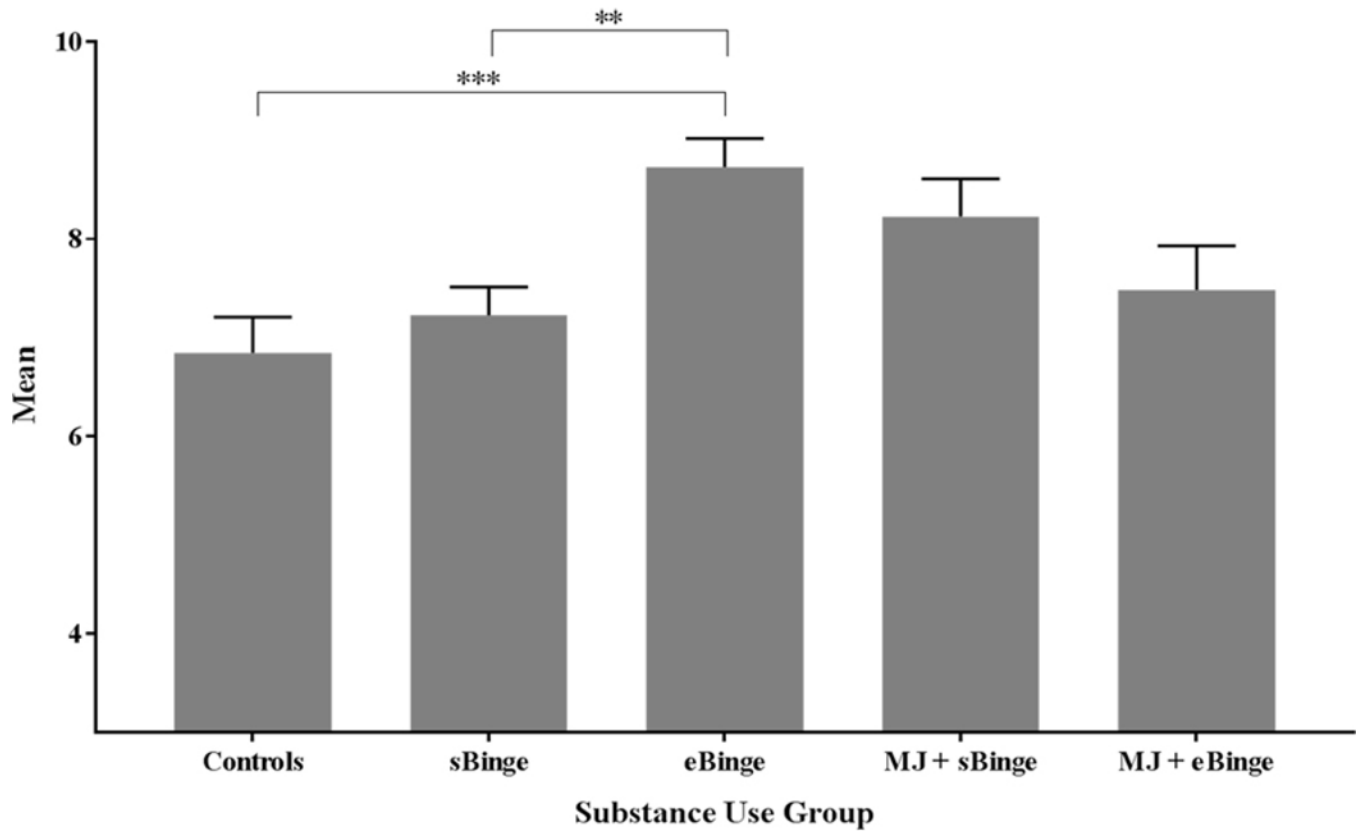


Figure 2.
SSS Thrill & Adventure Seeking.

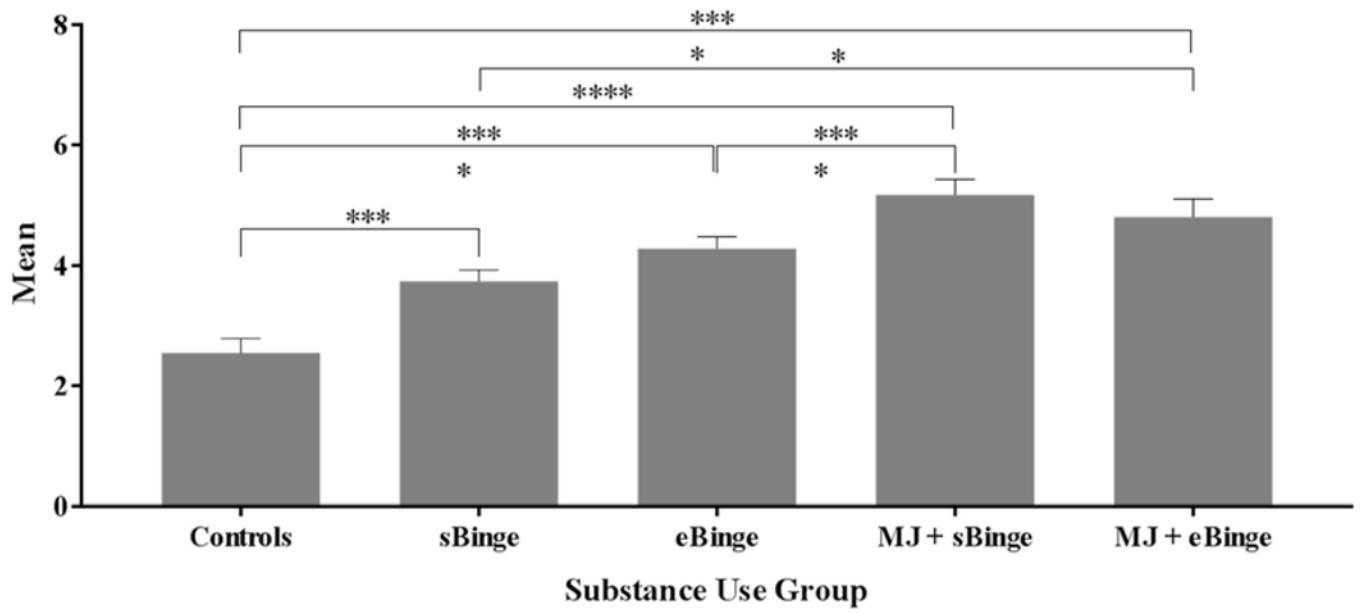


Figure 3.
SSS Disinhibition.

Table 1

Average Monthly Substance Use Since Beginning Current Academic Year

Type of Substance Use	Study Group				
	Control n = 40	sBinge n = 62	eBinge n = 59	MJ+sBinge n = 35	MJ+eBinge n = 25
sBinge	0.0	2.4 (2.5)	3.6 (3.7)	3.74 (2.78)	4.81 (4.82)
eBinge	0.0	0.3 (0.7)	2.0 (2.4)	0.77 (1.31)	3.55 (4.48)
Marijuana	0.0	0.3 (0.6)	0.4 (0.6)	8.68 (5.29)	10.78 (8.35)

Note: MJ = Marijuana. sBinge = Standard Binge. eBinge = Extreme Binge

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 2

Personality Subscale Differences

	<i>F</i>	<i>p</i>	<u>Control</u>	<u>sBinge</u>	<u>eBinge</u>	<u>MJ+sBinge</u>	<u>MJ+eBinge</u>
			<i>M (SD)</i>				
IMP	6.16	0.000	19.9 (3.97)	22.0 (4.31)	23.2 (4.69)	24.1 (5.13)	24.5 (4.81)
SS	5.74	0.000	6.85 (2.68)	7.23 (2.32)	8.73 (1.81)	8.23 (1.91)	7.48 (2.65)

Note: MJ = Marijuana. sBinge = Standard Binge. eBinge = Extreme Binge.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 3

Logistic Regression Predicting Substance-Use Group

	Wald Chi-Square	Pr > Chi-Square
IMP	15.159	0.004
SS	13.398	0.0095
Disinhibition ¹	33.47	0.0001

Note:

¹ Substance use items removed. Disinhibition was included as a predictor in an exploratory analysis that included all of the subscales of the Barratt Impulsiveness Scale and the Zuckerman Sensation Seeking Scale.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 4

Youth Adult Alcohol Consequences Questionnaire (YAACQ) Subscale Variance

YAACQ Subscale	R^2	R^2 (adj.)	<u>Personality</u> ¹		<u>Binge Group</u> ²		<u>Gender</u> ³	
			<i>F</i>	<i>P</i>	<i>F</i>	<i>P</i>	<i>F</i>	<i>P</i>
Social/Interpersonal	0.133	0.103	5.98	0.001	0.46	0.708	0.00	0.978
Impaired Control	0.105	0.074	5.14	0.002	1.05	0.371	0.39	0.534
Self-Perception	0.037	0.004	0.55	0.649	0.91	0.436	0.26	0.613
Self-Care	0.058	0.026	0.88	0.451	0.58	0.626	3.97	0.048
Risk Taking	0.172	0.144	5.79	0.001	2.57	0.056	0.00	0.987
Academic/ Occupational	0.114	0.084	2.13	0.098	3.05	0.029	0.02	0.893
Physiological Dependence	0.141	0.112	3.55	0.0157	4.97	0.002	1.33	0.250
Blackout Drinking	0.146	0.11	4.55	0.004	2.70	0.047	0.56	0.455

Note: Denominator degrees of freedom are 169 for all *F* values in the table.

¹Personality hypothesis tests have 2 numerator degrees of freedom (num df).

²Binge Group hypothesis tests have 3 num df.

³Gender hypothesis tests 1 num df.

Table 5

Youth Adult Alcohol Consequences Questionnaire (YAACQ) Correlations

<u>YAACQ Correlations</u>				
YAACQ Subscale	Does Personality Predict YAACQ Score?	The Significant Personality Does Scale(s)	Group Predict YAACQ Score?	The Significant Group(s)
Social/ Interpersonal	Yes	BIS-11 Nonplanning SSS Disinhibition	No	None
Impaired Control	Yes	SSS Disinhibition	No	None
Self Perception	No	—	No	None
Self-Care ¹	No		No	None
Risk Taking	Yes	BIS-11 Nonplanning SSS Disinhibition	No ²	None
Academic/ Occupational	No	—	Yes	MJ + eBinge > sBinge and eBinge
Physiological Dependence	Yes	SSS Disinhibition	Yes	MJ + eBinge > sBinge, eBinge and MJ + sBinge
Blackout Drinking	Yes	SSS Disinhibition	Yes	MJ + eBinge > sBinge, eBinge

Note: MJ = Marijuana. sBinge = Standard Binge. eBinge = Extreme Binge. BIS-11 = Barratt Impulsiveness Scale 11. SSS = Sensation Seeking Scale

¹Gender is significant ($F = 3.97, p < .04$).

²Group $F = 2.57, p < .056$

Table 6

Correlations Between Lifetime Incidence of Binge Drinking, Marijuana Use, Personality and Negative Consequences Measures

Measure	# of Lifetime sBinge Episodes	# of Lifetime eBinge Episodes	Lifetime Marijuana Use
<u>Personality</u>			
BIS-11 Impulsivity	0.124	0.009	-0.011
SSS Sensation Seeking	0.152 *	0.142	0.043
SSS Disinhibition	0.230 **	0.029	0.243 **
<u>YAACQ</u>			
Social/Interpersonal	0.345 **	0.230 **	0.125
Impaired Control	0.171 *	0.170 *	-0.023
Self-Perception	0.157 *	0.074	0.166
Self-Care	0.242 **	0.195 *	0.097
Risk Taking	0.445 **	0.223 **	0.225 *
Academic/ Occupational	0.123	0.156	0.227 *
Physiological Dependence	0.301 **	0.311 **	0.177 *
Blackout Drinking	0.363 **	0.308 **	0.045

Note: BIS-11 = Barratt Impulsiveness Scale 11. SSS = Sensation Seeking Scale. YAACQ = Youth Adult Alcohol Consequences Questionnaire. sBinge = standard binge. eBinge = extreme binge. Lifetime binge and marijuana use variables were first subjected to a log transform.

Data reported in this table includes only non-control subjects who reported at least a single episode of a sBinge, eBinge, or marijuana use (lifetime). Therefore sample sizes vary somewhat for each column: N = 179 (sBinge), N = 151 (eBinge), and N = 121 (Marijuana.).

*
 $p < .05$

**
 $p < .001$