Published in final edited form as:
Addict Behav. 2014 August ; 39(8): 1272–1277. doi:10.1016/j.addbeh.2014.04.005.

Identifying the facets of impulsivity that explain the relation between ADHD symptoms and substance use in a nonclinical sample

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Abstract

Adults with attention-deficit/hyperactivity disorder (ADHD) are at higher risk to use substances than their nonclinical peers. Increased levels of impulsivity are generally thought to contribute to their increased levels of risk. Impulsivity is a multifaceted construct, however, and little research to date has attempted to identify which facets of impulsivity contribute to the increased rates of substance abuse among individuals with ADHD. The current study examined the relation among ADHD symptom clusters (i.e., hyperactivity/impulsivity and inattention), substance use rates (i.e., alcohol use, nicotine use, and marijuana use), and personality processes associated with impulsive behavior in a group of young adults. Participants were 361 undergraduate students. Both symptom clusters were positively associated with rates of substance use. Specifically, hyperactive/impulsive symptoms were associated with alcohol and nicotine use, and inattentive symptoms were associated with alcohol use. Several pathways from hyperactive/impulsive symptoms to alcohol, nicotine, and marijuana use via specific facets of impulsivity were identified. These findings have implications for understanding the relation between ADHD symptoms and substance use, as well

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Author Disclosures
Statement 1: This research was supported by the National Institute on Drug Abuse grants DA005312 and DA035200 and National Institute on Alcohol Abuse and Alcoholism grant AA018274 both of the National Institutes of Health. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.
Statement 2: Richard Milich and Donald R. Lynam designed the study and wrote the protocol. Walter Roberts, Jessica R. Peters, and Zachary W. Adams conducted literature searches and wrote the manuscript. Jessica R. Peters conducted the statistical analyses. All authors contributed to and have approved the final manuscript.
Statement 3: All authors declare that they have no conflicts of interest.

as clinical implications for preventing and treating substance use problems in individuals with symptoms of ADHD.

Keywords

ADHD; impulsivity; alcohol; nicotine; marijuana

1. Introduction

Adults with ADHD use alcohol and other drugs at higher rates than those in the general population (Derefinko & Pelham, in press; Lee et al., 2011). Indeed, an estimated 15.2% of adults with ADHD meet criteria for a substance use disorder, a rate that is almost three times greater than adults without ADHD (Kessler et al., 2006). Although the link between ADHD symptoms and heightened rates of substance use is well established, relatively little is known about the factors that explain this risk. ADHD is a complex disorder with numerous associated cognitive impairments (Seidman, 2006), personality traits (Martel et al., 2010), and comorbidities (Kessler et al., 2006), any of which may contribute to increased rates of substance use.

Attempts to explain the elevated rates of substance use among adults with ADHD focus on traits observed in both people with ADHD and substance users in the general population. One such shared trait is heightened impulsivity. Impulsivity, defined as a tendency towards rash action (Dick et al., 2010), is a core component of the ADHD phenotype as well as a correlate of substance use (Verdejo-Garcia, Lawrence, & Clark, 2008). This trait overlap supports arguments that impulsivity explains the heightened rates of substance abuse in individuals with ADHD (Iacono et al., 2008). Although these conceptual models predict that shared traits of impulsivity explain the relation between ADHD symptoms and heightened substance use, this notion has received surprisingly little empirical support. In the current study, we examined the relations among these variables in a group of college-aged young adults.

Relatively few studies to date have attempted to identify the factors that place individuals with ADHD at high risk for substance misuse. For example, in a study on adults diagnosed with ADHD and nonclinical controls, three dimensions of impulsivity (i.e., attentional inhibition, response inhibition, sensation seeking) were assessed using behavioral and self-report measures and used to predict self-reported alcohol use (Weafer et al., 2011). Attentional inhibition predicted alcohol consumption only in the ADHD group, suggesting that specific types of behavioral disinhibition may contribute to elevated rates of substance use among individuals with ADHD. In a related study, impulsivity, as measured by the Sensation Seeking Scale—V (Zuckerman, 1994), accounted for heightened rates of alcohol use among college students diagnosed with ADHD (Rooney et al., 2012).

Although these studies provide evidence that specific facets of impulsivity contribute to substance use among those with ADHD symptoms, there are limitations to their measurement of impulsivity. Neither study used a comprehensive model of impulsivity to identify which aspects of personality contribute to the ADHD symptom/substance use

relation. Impulsivity is a complex and multi-faceted construct (Nigg, 2001), and dysfunction in many different personality processes and cognitive mechanisms can lead to impulsive action (Whiteside & Lynam, 2003). The development of personality-based models of impulsivity has focused on identifying dispositional pathways that can lead to rash or unplanned action (Dick et al., 2010). The UPPS-P Impulsive Behavior Scale (Lynam et al., 2006) measures five distinct traits associated with impulsive behavior, including negative and positive urgency (i.e., tendency to act impulsively under strong negative and positive affective experiences, respectively), (lack of) premeditation (i.e., tendency to act on the spur of the moment without regard for the consequences), (lack of) perseverance (i.e., difficulty with focusing on a task that may be boring or difficult), and sensation seeking (i.e., tendency to enjoy activities that are exciting or novel). Compared to other measures, the UPPS-P provides a more comprehensive assessment of personality traits that can lead to impulsive action. This model of impulsivity has been used to examine how specific personality processes contribute to impulsivity in psychological disorders characterized by rash action (Anestis, Selby, & Joiner, 2007).

Considering the variety of characteristics that lead to impulsive action, it is important to identify which facets of impulsivity contribute to risk for substance use in adults with ADHD symptoms. Several impulsivity-related traits are present in adults with ADHD and those with SUD (see Derefinko & Pelham, in press, for a review), such as poor inhibitory control (Roberts, Fillmore, & Milich, 2011), heightened sensation seeking (Kotov et al., 2010), and a tendency to act impulsively following strong emotion (Verdejo-Garcia et al., 2007). Although these studies demonstrate that specific traits of impulsivity occur in both groups, they do not compare how these traits contribute to the relation between heightened substance use and ADHD symptoms.

The current research examined associations among substance use, impulsivity, and ADHD symptom clusters, specifically testing which dimensions of impulsive behavior accounted for relations between ADHD symptoms and rates of alcohol, tobacco, and marijuana use. Facets of impulsivity were measured using the UPPS-P five-factor model described above, which provided specific information about the personality processes contributing to substance use among individuals with ADHD symptoms. This multi-faceted assessment strategy extends prior research using assessments that measure impulsivity as a unitary construct (Rooney et al., 2012).

We measured ADHD symptoms in a sample of undergraduate students using a dimensional assessment of symptoms rather than diagnostic categorization, which is appropriate given the dimensional structure of the ADHD symptom clusters (Hinshaw, 1994). Further, even among “subthreshold” individuals who do not meet full criteria for the disorder, symptoms of ADHD are associated with functional impairment (Bussing et al., 2010). This approach allowed us to examine separately the inattentive and hyperactive/impulsive symptom dimensions, which demonstrate differential relations with substance abuse in nonclinical samples (Glass & Flory, 2012).

2. Method

2.1 Participants

Participants included 361 undergraduate students recruited from introductory psychology courses as part of a longitudinal project examining correlates of substance use and abuse among young adults. Participants were in their second (64 %) or third (36 %) year of college and completed the study during the same academic year. The sample included participants who identified as White (82.8%), African American (12.4%), Latino/a (1.3%), Asian American (2.0%), Native American (0.2%), and Biracial (1.3%). Additional demographic information is reported in Table 1.

2.2. Measures

2. 2. 1.UPPS-P Impulsive Behavior Scale—The UPPS-P Impulsive Behavior Scale (Lynam et al., 2006) is a 59-item inventory designed to measure five personality traits linked to impulsive behavior: negative urgency (NU), lack of premeditation (PRE), lack of perseverance (PERS), sensation seeking (SS), and positive urgency (PU). Each item is rated on a 4-point Likert scale from *Strongly Agree* to *Strongly Disagree*. Average scores were calculated for each scale. All scales demonstrated good internal consistency in the present sample (α = .87-.93).

2.2.2.Conner' Adult ADHD Rating Scale—The 66-item Conners Adult ADHD Rating Scale—Self-Report: Long version (CAARS--S:L; Conners, Erhardt, and Sparrow, 1999) was used to measure ADHD *DSM-IV Inattentive Symptoms* (CAARS IA) and the *DSM-IV*

Hyperactive-Impulsive Symptoms (CAARS HI). These subscales measure ADHD symptomatology according to the well-established *DSM-IV* symptoms as they present in adulthood. Each item is rated on a 4-point Likert scale ranging from *Not at All, Never* to *Very Much, Very Frequently*. The CAARS-IA demonstrated good internal consistency (α = .86) and CAARS-HI demonstrated adequate internal consistency (α = .79) in the present sample. Scores from each subscale are reported in raw form and possible scores ranged from 9 to 36. We also report the number of participants who scored in the clinical range on each *DSM-IV* subscale of the CAARS. For men, scores greater than 11 and 13 fell in the clinical range for CAARS-IA and CAARS-HI symptoms, respectively. For women, scores greater than 14 (CAARS-IA) and 16 (CAARS-HI) fell in the clinical range.

2.2.3 Substance Use—Participants reported on their patterns of substance use over the past year using a life history calendar (LHC), a retrospective method for collecting data on a wide range of life events and behaviors (Caspi et al., 1996). Information obtained includes occurrence of substance use, frequency of substance use, average amount of use, and highest amount of use during one sitting. In the current study, data on use of alcohol, tobacco, and marijuana was collected. The strong reliability and validity of the LHC have been documented in previous studies relating LHC data to personality and psychopathology (e.g., Flory et al., 2004).

The present study used the average number of drinks per week as an indicator of typical alcohol consumption. Participants reported average drinks per sitting and frequency of

drinking alcohol for each month covered by the LHC. These values were multiplied to produce an Average Weekly Drinks score. Relatively few participants endorsed tobacco or marijuana use resulting in limited variability in the amount and frequency values, so dichotomous variables representing use (1) or abstention (0) were computed for these substances.

The Alcohol Use Disorder Identification Test (AUDIT; Saunders et al., 1993) measured problematic alcohol use. The AUDIT consists of 10 questions designed to assess frequency and psychosocial consequences of alcohol use (e.g., injury to self or others because of drinking). Internal consistency was good in the present sample ($\alpha = .81$). Although we used the AUDIT as a continuous measure in our data analyses, we report the number of participants who met criteria for problem drinking in Table 1. Problem drinking was defined as scores of 6 or higher for women and 8 or higher for men (Reinert & Allen, 2002).

2.3. Procedure

Participants attended a 2.5-hour session in a laboratory setting. All questionnaires were administered on a computer using the MediaLab software program. The LHC was administered as a computer-assisted structured interview. Participants were debriefed at the end of the study and paid $50 for participation.

2.4. Data Screening and Planned Analyses

Data were analyzed using SPSS 20 and Mplus 6.11. Three participants were identified as outliers due to their scores on the UPPS-P or the CAARS and excluded from analyses. The data were checked for violations of normality, and the UPPS-P and CAARS scores were within accepted limits for skew and kurtosis (Tabachnick & Fidell, 2000). The AUDIT and LHC alcohol use variables both demonstrated positive skew and potential zero-inflation. Residuals of normal regression models predicting these variables were examined; the models predicting AUDIT scores produced normal residuals. Accordingly, the AUDIT was estimated using normal regression procedures.

The models predicting LHC alcohol use produced non-normal residuals, so a zero-inflated poisson (ZIP) regression model was used to predict LHC alcohol use. ZIP models simultaneously estimate a dependent variable using a Poisson distribution and an inflation variable accounting for the extent to which the variable is zero-inflated (in this case, abstention from alcohol use). In the present study, both components of the ZIP model were regressed onto all potential predictors. Exponentiated regression coefficients (ExpB) are presented for the Poisson component of the model; the ExpB equals the factor by which the mean of the dependent variable is multiplied when the value of the corresponding independent variable is increased by one unit and the other independent variables and the inflation component are held constant. The ExpBs, or Odds Ratios, are also presented for the zero-inflated components of the models; these estimates can be understood as the change in the odds of the model containing excess zeros (non-substance users) with a one-unit increase in the independent variable. If the ExpB is less than 1, an increase in the independent variable reduces the zero-inflated characteristic of the dependent variable, or, in other words, results in fewer people reporting no substance use.

LHC tobacco and marijuana use were assessed as dichotomous values; accordingly, these outcomes were estimated using logistic regression. The ExpBs, or Odds Ratios, presented for these models can be understood as the change in likelihood of use with a one-unit increase in the independent variable.

For all regression analyses, each substance use variable was regressed onto CAARS IA and HI. Next, NU, SS, PRE, and PERS were added to the model to determine significance of predictors in the first step after controlling for impulsivity. For all models, PU was excluded from regression models to minimize multicollinearity given its large correlation with NU (i.e., $r = .76$). Potential indirect effects of CAARS IA and HI on substance use variables via UPPS impulsivity facets were simultaneously estimated using bootstrap analyses (Hayes, 2012).

3. Results

3.1 Descriptive Statistics and Zero-Order Correlations

Correlations and descriptive statistics for study measures are presented in Tables 1 and 2. CAARS IA was correlated with all of the UPPS-P dimensions except for SS. CAARS HI also was significantly correlated with all of the UPPS-P dimensions. The substance use variables were significantly correlated with most of the UPPS-P and CAARS scores, with the exception of the CAARS IA with marijuana frequency and PERS with both weekly alcohol use and marijuana frequency. Sex was significantly correlated with SS, PU, weekly alcohol use, and marijuana use frequency, with male sex predicting higher values, but sex was uncorrelated with both CAARS clusters. Correlations between CAARS clusters and other study variables did not differ significantly by sex (*p values* > .05), so sex was excluded from subsequent analyses.

3.2. LHC

3.2.1. Alcohol Use—Results of the ZIP regression analyses of past year alcohol use are presented in Table 3. In the initial model, CAARS HI, but not IA, was associated with reductions in zero-inflation, compared to a non-inflated Poisson model. This association was fully attenuated when UPPS scores were added during the second step. SS was the only predictor of zero-inflation.

Higher scores on both CAARS symptom clusters were associated with increased weekly alcohol use for individuals who endorsed drinking; a one-standard deviation increase in CAARS HI was associated with an estimated 19% increase in drinks per week, and a one-standard deviation increase in CAARS IA was associated with an estimated 9% increase in drinks per week. When UPPS scores were added to the model, the association between CAARS IA and alcohol use remained significant, whereas the association between CAARS HI and alcohol use was fully attenuated. NU, SENS, and PRE scores all predicted increased alcohol use. A one standard deviation increase in PRE, NU, and SS was associated with an estimated 27, 12, and 7% increase in alcohol use, respectively.

A significant indirect effect was observed via PRE (95% bootstrap confidence interval of . 0557 - .3468), accounting for 52% of the total relation between CAARS HI and alcohol use;

however, no significant effects were observed via NU (95% bootstrap confidence interval of -.0220 - .1573) or SS (95% bootstrap confidence interval of -.0363 - .1631).

3.2.2. Tobacco Use—Results of logistic regression analyses on past year smoking status are summarized in Table 4. In the initial model, the addition of CAARS symptoms as predictors significantly improved fit over the null model. CAARS IA had no significant effect on risk of tobacco use, but CAARS HI symptoms increased risk, such that a one-standard deviation increase in CAARS HI was associated with approximately 1.7 times greater likelihood of smoking tobacco. This association was fully attenuated in the second model, in which UPPS NU was the only significant predictor of smoking risk. A one-standard deviation increase in NU was associated with an approximately two-fold increase in the likelihood of smoking tobacco.

A significant indirect effect of CAARS HI on tobacco use via NU was observed (95% bootstrap confidence interval of .0165 - .0822), accounting for 37% of the total effect of CAARS HI on tobacco use.

3.2.3. Marijuana Use—Results of the logistic regression analyses predicting risk of marijuana use status are summarized in Table 5. In the initial model, the addition of CAARS symptoms as predictors significantly improved fit over the null model. CAARS IA had no significant effect on marijuana use, but CAARS HI increased risk of use, such that a one-standard deviation increase in CAARS HI was associated with an estimated one-and-a-half times greater likelihood of using marijuana. This association was fully attenuated in the second model, in which NU was a significant predictor of marijuana use. A one-standard deviation increase in NU was associated with an estimated 1.8 times greater likelihood of being a marijuana user.

Analyses revealed a significant indirect effect of CAARS HI on the likelihood of using marijuana via NU (95% bootstrapped confidence interval of .0090 - .0615), accounting for 52% of the total effect of CAARS HI on marijuana user status.

3.3. AUDIT

A hierarchical linear regression models was fit predicting the AUDIT from CAARS, and UPPS scores (Table 6). In Step 1, CAARS HI was a significant predictor of AUDIT scores but CAARS IA was not; together, these symptom clusters accounted for 10% of the variance in AUDIT scores. When added to the model, UPPS dimensions predicted significant additional variance, with NU, PRE, and SS all significantly predicting higher AUDIT scores. The relationship between CAARS HI and the AUDIT was fully attenuated in this second step.

Parallel indirect effects of CAARS HI on the AUDIT were estimated via NU, PRE, and SS, while controlling for PERS and CAARS IA. Significant indirect effects were observed via NU (95% bootstrap confidence interval of .0414 - .1761), PRE (95% bootstrap confidence interval of .0397 - .2165) and SS (95% bootstrap confidence interval of .0518 - .1755). Together, the paths accounted for 93% of total association of CAARS HI scores with

AUDIT scores, with NU, SS, and PRE accounting for 30%, 30%, and 33% of the effect, respectively.

4. Discussion

The current study examined the role of impulsivity-related personality traits in relations between ADHD symptoms and substance use. Several facets of impulsivity appear to differentially contribute to these relations. While SS accounted for the effect of HI symptoms in reducing the occurrence of abstainers from alcohol use, PRE accounted for the relation between HI symptoms and weekly alcohol use among current drinkers. The PRE facet describes the tendency to act without forethought or regard for the consequences of one's actions, and of the UPPS facets it is the most conceptually similar to the HI symptom cluster of ADHD. This finding suggests that the lack of foresight and poor planning that characterize individuals with ADHD may contribute to their heightened rates of alcohol use. A broad impulsivity pathway may exist from HI symptoms to alcohol-related problems, given that NU, SS, and PRE independently accounted for variance the relation between HI symptoms and problematic drinking.

With regards to tobacco and marijuana, NU accounted for the relation between HI symptoms and risk of use. This finding is consistent with prior research showing that NU predicts cue-induced tobacco craving (Billieux, Van der Linden, & Ceschi, 2007). NU is conceptualized as a failure to inhibit strong impulses while experiencing strong negative emotion, so this pathway from ADHD HI symptoms to nicotine use via negative urgency may suggest that individuals high in ADHD HI symptoms use nicotine to cope with negative emotions. The important role of NU in substance use is becoming increasingly clear as an expanding literature shows that urgency predicts rates of substance use and substance-related problems (Whiteside & Lynam, 2003). This finding is particularly interesting given that urgency is not generally considered to be part of the ADHD phenotype. The results of the current study suggest that urgency-related behaviors may explain some of the functional impairment associated with ADHD symptoms.

Although ADHD IA symptoms were associated with substance use variables, the UPPS impulsivity facets did not account for these relations. The lack of findings for PER in particular suggests that the impulsivity-related component of IA symptoms may not be important for understanding how these symptoms contribute to substance use. Instead, ADHD IA may increase risk of substance use through a non-impulsivity pathway. For example, ADHD IA symptoms are associated with poor academic achievement, and this underachievement can lead to affiliation with deviant peers thereby increasing risk for substance use (Molina et al., 2012). Another possibility is that individuals with ADHD symptoms self-medicate using nicotine to compensate for their cognitive deficits, which is consistent with findings that an acute dose of nicotine improves cognitive functioning in adults with ADHD (Levin et al., 1996). These results also suggest that IA and HI symptoms may lead to substance use through separate pathways, highlighting the importance of separately considering each symptom cluster in research on the link between ADHD and substance use.

Findings that specific impulsivity pathways may contribute to substance use among young adults with ADHD symptoms may aid targeted intervention efforts. Because adolescents with ADHD are at increased risk to use and abuse substances, a common goal for treatment in this population is reducing harmful substance use (Wilens, 2004). Results of the current study identify specific personality processes related to impulsivity that may act as potential treatment targets for adults with ADHD and comorbid substance abuse problems. These types of personality-targeted intervention strategies have reduced initiation and frequency of substance use among adolescents (Conrod et al, 2011; 2010), and the current findings could guide substance use interventions specifically for individuals with ADHD. For example, considering the role of premeditation described above, interventions aimed at improving forethought may be useful for decreasing alcohol consumption in this group. However, given the cross-sectional, correlational nature of this data, causal conclusions cannot be drawn. For example, prior research has shown that high rates of substance use in college students can predict increases in impulsivity over time (Quinn, Stappenbeck, & Fromme, 2011). As such, additional research using longitudinal or experimental designs will be necessary to better establish causal pathways to be targeted for intervention.

Although the current study provides important information about the relations among ADHD symptoms, impulsivity, and substance use, results should be interpreted in light of some limitations. We measured ADHD symptom dimensions rather than diagnostic status. Although this approach allowed us to examine the unique relations among the HI and IA symptoms clusters and substance use variables, it is unclear whether our findings would be similar had we used a categorical diagnostic approach. Also the base rate of tobacco and marijuana users in our sample was low, which may have limited our power to find associations involving these substances. Future research on these constructs in clinical samples of people with ADHD and substance use disorders may clarify the nature of these associations at more extreme levels of symptoms and substance use.

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Highlights

- We examined the relation among ADHD symptoms, impulsivity, and substance use.
- Participants with more ADHD symptoms reported higher rates of substance use.
- Specific facets of impulsivity accounted for the relation between ADHD symptoms and substance use.

Table 1

Descriptive statistics and demographic information

	Mean	SD	Range
Demographic			
Age (years)	21.4	0.7	20-25
Sex (% female)	50.8		
ADHD symptoms			
CAARS HI	18.45	4.36	9-35
CAARS HI Categorical (%)	12.5		
CAARS IA	17.78	4.58	9-34
CAARS IA Categorical (%)	18.4		
Impulsivity			
UPPS NU	2.27	0.55	1.0-4.0
UPPS PU	1.95	0.58	1.0-4.0
UPPS PRE	2.05	0.47	1.0-4.0
UPPS PER	1.94	0.48	1.0-4.0
UPPS SS	2.98	0.58	1.0-4.0
Substance Use			
AUDIT	8.08	6.14	0-27
AUDIT Categorical (%)	49.3		
Weekly alcohol use (LHC)	6.49	7.74	0-32
Marijuana user (%) (LHC)	23.3		
Tobacco user (%) (LHC)	20.4		

Note: CAARS= Conners Adult ADHD Rating Scale; IA = Inattentive; HI = Hyperactive; IA and HI (Categorical) is whether participant endorsed six or more ADHD symptoms in that symptom cluster; UPPS = Urgency Premediation Perserverance Sensation-seeking; NU = Negative Urgency; PU = Positive Urgency; PRE = (lack of) Premeditation; PER = (lack of) Perseverence; SS = Sensation-seeking; AUDIT = Alcohol Use Disorders Identification Test; AUDIT Categorical (%) is whether participant was classified as a high-risk drinker based on AUDIT score; LHC = Life History Calendar; Marijuana user (%) = percentage of sample that reported any marijuana use; Tobacco user (%) = percentage of sample that reported any tobacco use. Range column describes range of observed scores when applicable.

Table 2

Intercorrelations of Study Variables (n = 361)

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. CAARS IA	—											
2. CAARS HI	.63***	—										
3. UPPS NU	.54***	.52***	—									
4 UPPS PU	.48***	.53***	.76***	—								
5. UPPS PRE	.41***	.42***	.53***	.55***	—							
6. UPPS PER	.62***	.24***	.43***	.38***	.52***	—						
7. UPPS SS	.09	.32***	.21***	.29***	.29***	−.05	—					
8. AUDIT	.28***	.30***	.37***	.40***	.36***	.14**	.30***	—				
9. LHC Alc	.21***	.28***	.26***	.34***	.33***	.07	.27***	.79***	—			
10. LHC Tob	.12*	.20***	.30***	.22***	.19**	.14*	.09	.32***	.35***	—		
11. LHC MJ	.10	.17**	.25***	.21**	.18**	.08	.13*	.27***	.36***	.45***	—	
12. Female	−.03	−.05	.00	−.12*	−.01	.05	−.34***	−.10	−.25***	−.06	−.22***	—

Note: CAARS= Conners Adult ADHD Rating Scale; IA = Inattentive; HI = Hyperactive; UPPS = Urgency Premediation Perserverance Sensation-seeking; NU = Negative Urgency; PU = Positive Urgency; PRE = (lack of) Premeditation; PER = (lack of) Perseverence; SS = Sensation-seeking; AUDIT = Alcohol Use Disorders Identification Test; LHC = Life History Calendar; LHC Alc = weekly alcohol intake; LHC Tob = tobacco user status; LHC MJ = marijuana use status.

* $p < .05$

** $p < .01$

*** $p < .001$

Table 3

Zero-inflated Poisson Regression Models Predicting Average Number of Drinks per Week from ADHD Symptoms and UPPS Impulsivity Dimensions.

Independent Variable (Standardized)	Model 1 ExpB (95% CI)	Model 2 ExpB (95% CI)
CAARS Inattentive (zero inflation)	0.96 (0.68-1.35)	0.98 (0.61-1.56)
CAARS Hyperactive (zero inflation)	1.82*** (1.28-2.58)	1.32 (0.87-1.99)
UPPS Negative Urgency (zero inflation)		1.02 (0.72-1.47)
UPPS Sensation Seeking (zero inflation)		1.56** (1.15-2.09)
UPPS (lack of) Premeditation (zero inflation)		1.43 (0.97-1.97)
UPPS (lack of) Perseverance (zero inflation)		1.02 (0.66-1.55)
CAARS Inattentive	1.09*** (1.03-1.13)	1.15*** (1.07-1.23)
CAARS Hyperactive	1.19*** (1.13-1.25)	1.02 (0.95-1.08)
UPPS Negative Urgency		1.12*** (1.05-1.19)
UPPS Sensation Seeking		1.07** (1.02-1.12)
UPPS (lack of) Premeditation		1.27*** (1.21-1.33)
UPPS (lack of) Perseverance		0.84*** (0.79-0.89)

*$p < .05$

Note. CAARS = Conners Adult ADHD Rating Scale; UPPS = Urgency Premeditation Perseverance Sensation Seeking Scale. Effect sizes comparable to R^2 are not available in zero-inflated poisson regression; however, estimated percent change is described in the text for each significant predictor. Parenthetical values are 95% confidence intervals.

**$p < .01$

***$p < .001$

Table 4

Logistic Regression Models Predicting Tobacco Use From ADHD Symptoms and UPPS Impulsivity Dimensions.

	Model 1	Model 2
Likelihood Ratio Test Chi-Square	12.79**	32.38***
Nagelkerke's Pseudo R^2	0.06	0.15
Independent Variable (Standardized)	ExpB (95% CI)	ExpB (95% CI)
CAARS Inattentive	0.99 (0.70-1.49)	0.66 (0.41-1.08)
CAARS Hyperactive	1.66** (1.17-2.36)	1.43 (0.93-2.20)
UPPS Negative Urgency		2.13*** (1.44-3.17)
UPPS Sensation Seeking		1.10 (0.78-1.54)
UPPS (lack of) Premeditation		0.98 (0.66-1.45)
UPPS (lack of) Perseverance		1.34 (0.85-2.09)

*$p < .05$

Note. CAARS = Conners Adult ADHD Rating Scale; UPPS = Urgency Premeditation Perseverance Sensation Seeking Scale. Estimated percent change is described in the text for each significant predictor. Parenthetical values are 95% confidence intervals.

**$p < .01$

***$p < .001$

Table 5

Logistic Regression Models Predicting Marijuana Use From ADHD Symptoms and UPPS Impulsivity Dimensions.

	Model 1	Model 2
Likelihood Ratio Test Chi-Square	9.86**	26.73***
Nagelkerke's Pseudo R^2	0.04	0.12
Independent Variable (Standardized)	ExpB (95% CI)	ExpB (95% CI)
CAARS Inattentive	0.97 (0.71-1.34)	0.80 (0.51-1.25)
CAARS Hyperactive	1.52** (1.10-2.10)	1.13 (0.76-1.67)
UPPS Negative Urgency		1.78** (1.24-2.57)
UPPS Sensation Seeking		1.17 (0.85-1.61)
UPPS (lack of) Premeditation		1.22 (0.86-1.75)
UPPS (lack of) Perseverance		1.06 (0.70-1.60)

*$p < .05$

Note. CAARS = Conners Adult ADHD Rating Scale; UPPS = Urgency Premeditation Perseverance Sensation Seeking Scale. Estimated percent change is described in the text for each significant predictor. Parenthetical values are 95% confidence intervals.

**$p < .01$

***$p < .001$

Table 6

Hierarchical regression model predicting AUDIT scores from ADHD symptoms and impulsivity dimensions.

Step	Predictor(s)	change in R^2	total R^2	β (95% CI)
1	CAARS IA		.10***	.10 (−.21 – 1.37
	CAARS HI			.24*** (.67 – 2.26)
2	CAARS IA	.12***	.22***	.07 (−.57 – 1.37)
	CAARS HI			.02 (−.75 – .97)
	UPPS NU			.22*** (.58 – 2.11)
	UPPS PRE			.21*** (.53 – 2.11)
	UPPS PERS			−.08 (−1.37 – .38)
	UPPS SS			.18*** (.46 – 1.76)

*$p < .05$

**$p < .01$

Note. CAARS = Conners Adult ADHD Rating Scale; UPPS = Urgency Premeditation Perseverance Sensation Seeking Scale.

*** $p < .001$