



Multidimensional Impulsive Personality Traits Mediate the Effect of Parent Substance Use Disorder on Adolescent Alcohol and Cannabis Use

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Abstract

Theory suggests that behavioral undercontrol mediates the effect of parental substance disorder on offspring substance use, but no studies have tested multidimensional impulsive personality traits as mechanisms of risk. Adolescents ($N = 392$; 48% female) from a multigenerational study of familial alcohol disorder self-reported impulsive personality traits via the UPPS-P ($M_{\text{age}} = 16.09$; Range = 13–19) and alcohol/cannabis frequency one year later. The UPPS-P assesses negative and positive urgency (i.e., rash action in a negative or positive mood state), lack of premeditation (i.e., lack of planning/forethought), lack of perseverance (i.e., inability to finish tedious/boring tasks), and sensation seeking (i.e., thrill seeking/risk taking). Parent substance disorder was assessed via diagnostic interviews. Two-part hurdle models tested predictors of any substance use (i.e., binary part) and frequency of use (i.e., continuous part). Parent substance disorder was indirectly associated with any alcohol/cannabis use (binary part) and higher cannabis frequency (continuous part) through negative urgency. Parental substance disorder was associated with higher alcohol frequency through a lack of premeditation. Sensation seeking was associated with any alcohol/cannabis use but unrelated to parental substance disorder. Despite indirect effects, strong effects of parental substance disorder on substance use remained. The findings are discussed in terms of theory and public health implications.

Keywords Family history · Impulsivity · Urgency · Sensation seeking · Substance use

Introduction

Adolescence, broadly defined as the period spanning the initiation of puberty to the beginning of adult social roles and identity development (Sawyer et al., 2018), is a period of heightened risk taking and experimentation, particularly substance use (Steinberg et al., 2008). Theory suggests that having a parental history of substance disorder is associated with adolescent substance use indirectly through behavioral undercontrol (e.g., Iacono et al., 2008; Sher, 1991). However, no studies to date have investigated whether specific, multidimensional impulsive personality traits mediate the effect of parental substance disorder on adolescent substance use. Therefore, the current study sought to test

whether five impulsive personality traits derived from the UPPS-P impulsivity measure (Urgency, Premeditation, Perseverance, Sensation Seeking-Positive Urgency Measure; Lynam et al., 2007) mediated the effect of parental substance disorder on adolescent alcohol and cannabis use.

Substance use during adolescence remains a serious and pervasive public health concern. Rates of adolescent alcohol use (i.e., any use) have remained steadily high over the past decade (Johnston et al., 2020), and rates of adolescent cannabis use have been rising since the early 2000s (NIDA, 2020). Although some adolescent experimentation is normative, adolescent substance use is also associated with a variety of deleterious acute and long-term negative outcomes, including lower academic achievement (Haller et al., 2010), worse cognitive functioning (Scott et al., 2018), and mental health comorbidities (Silins et al., 2017). Furthermore, earlier initiation of substance use (King & Chassin, 2007) and frequency of adolescent substance use (Blozis et al., 2007) are predictors of future problem use.

One risk factor for adolescent substance use is having a family history of parental substance disorder. Research

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consistently finds that offspring with parental substance disorder begin using substances earlier and are heavier alcohol users (Chassin et al., 2002; Elam et al., 2020), binge drinkers (e.g., Chassin et al., 2002) and heavier cannabis users (Rothenberg et al., 2020). Parental substance disorder places offspring at higher risk for developing a substance disorder during adolescence (e.g., Chassin et al., 1991; Hussong et al., 2012) and young adulthood (Sher et al., 1991), showing a 2.5 to 4.4-fold increase in risk for developing a substance disorder (Yoon et al., 2013). Furthermore, twin studies suggest that risk from a parental substance disorder is conferred via a combination of genetic and environmental characteristics (Agrawal & Lynskey, 2008).

One proposed mechanism explaining the effect of parental substance disorder on offspring substance use is behavioral undercontrol, broadly defined as the predisposition toward swift, disinhibited action with little self-awareness or self-control. Several theoretical models suggest this mediated pathway. For example, both the Deviance Proneness (Sher, 1991; Sher & Trull, 1994) and “externalizing pathway” (Iacono et al., 2008; Zucker et al., 2011) models suggest that distal factors such as parental substance disorder are linked to behavioral disinhibition/undercontrol, which predisposes individuals to substance use and externalizing behaviors, respectively. In support of these theories, genetically informed studies find that behavioral undercontrol accounts for a large amount of genetic risk conferred from parental substance disorder (Khemiri et al., 2016). Furthermore, one study found that, among college students, parental substance disorder was related to behavioral undercontrol, which then conferred both direct and indirect (through cognition) risk for alcohol involvement (Sher et al., 1991). In addition, several other studies have also found that parental substance disorder is associated with heightened behavioral undercontrol (Sanchez-Roige et al., 2016; Wasserman et al., 2020), and task-related impulsivity (Petry et al., 2002).

While behavioral undercontrol appears to be a consistent, promising mechanism of risk, one critique of the “behavioral undercontrol” construct is that it lacks specificity. Early studies defined behavioral undercontrol as a composite of hyperactivity, impulsivity, extraversion, aggressiveness, antisociality, and sensation seeking (Sher et al., 1991; Iacono et al., 2008). However, modern conceptualizations of behavioral undercontrol suggest that there are several lower-order facets of undercontrol. One modern conceptualization is the dual systems model (e.g., Steinberg et al., 2010), which suggests that there are two systems by which personality enacts risk for negative outcomes, a sensation seeking/reward seeking system and a top-down cognitive control system. However, studies using the dual systems model focus on sensation seeking and top-down

cognitive/behavioral control, and thus may ignore additional multidimensionality within “undercontrol”.

In terms of multidimensionality, the UPPS-P (Urgency, Premeditation, Perseverance, Sensation Seeking-Positive Urgency) model suggests there are five correlated, lower-order impulsive personality traits, including a lack of premeditation (i.e., lacking forethought/planning), lack of perseverance (i.e., inability to finish tedious/boring tasks), sensation seeking (i.e., thrill seeking/risk taking), and positive/negative urgency (i.e., rash action during a positive/negative mood state) (Cyders et al., 2007; Whiteside & Lynam, 2001). Although most often studied in young adults, UPPS-P facets are differentially related to substance use outcomes. A meta-analysis of 96 studies found that sensation seeking was strongly related to any alcohol use, whereas lack of premeditation and lack of perseverance were strongly related to heavier alcohol use, and positive/negative urgency was strongly related to alcohol problems (Coskunpinar et al., 2013). In addition, a meta-analysis of 38 studies found that relations between impulsive personality traits and cannabis use/problems were consistent with the alcohol literature (VanderVeen et al., 2016).

In line with the UPPS-P model, there may be specific impulsive personality traits that are particularly important predictors of substance use risk during adolescence. Considering that there is an increase in reward seeking and risk taking from childhood into adolescence (e.g., DeFoe et al., 2019), sensation seeking may influence adolescents to experiment with substance use during a time of heightened risk. Several studies also suggest that adolescence is a time of increased emotionality, particularly negative emotionality (e.g., Compas et al., 1995), as well as a time of increased emotional volatility (Larson & Richards, 1994). Thus, considering that cognitive control is still developing during the adolescent years, heightened emotions coupled with poor regulation may mean that negative and positive urgency may also influence adolescents to experiment with substance use.

Deviance Proneness and Externalizing Pathway models of risk from parental substance disorder typically do not differentiate among impulsive personality traits (other than sensation seeking), but rather consider impulsive personality traits to represent generalized behavioral undercontrol (e.g., Sher et al., 1991; King & Chassin, 2004). In one exception, using ABCD study data, a recent study tested whether a family history of parental alcohol use disorder was associated with UPPS-P facets in 9–10-year-olds (Watts et al., 2020). Parental alcohol disorder was assessed via the Family History Assessment Module Screener, and parents reported on their own (or biological parents if adopted) alcohol disorder symptoms. This study found that a family history of alcohol disorder was correlated with all UPPS-P facets in youth, but a family history was only uniquely associated with a lack of perseverance when considering all facets in a single

regression; all effect sizes were small (<0.10 ; Watts et al., 2020). In addition, another study separated sensation seeking from undercontrol but found no relations between parental substance disorder and sensation seeking (Wasserman et al., 2020). Thus, no studies to date have tested indirect effects of parental substance disorder on adolescent substance use through UPPS-P facets.

Current Study

The current study tested whether parental substance disorder conferred indirect risk for adolescent substance use through UPPS-P impulsive personality traits in a longitudinal, multigenerational study of familial alcohol disorder. The current study focused on adolescent alcohol and cannabis use, because adolescent alcohol and cannabis use are both common and remain significant public health concerns. It was hypothesized that parental substance disorder would be associated with all five UPPS-P facets, and that sensation seeking, negative urgency, and positive urgency would mediate the effect of parental substance disorder on any alcohol and cannabis use. It was also hypothesized that a lack of premeditation/perseverance would predict the continuous part of alcohol/cannabis frequency because adult data suggest that these facets are strong correlates of heavier alcohol and cannabis use.

Methods

Participants

Participants ($N = 392$) were from the third generation in a multigenerational longitudinal study of familial substance disorder (Chassin et al., 1992) recruited from the state of Arizona. The original target sample consisted of 454 adolescents (generation 2; “G2s”) and their parents (generation 1; “G1s”), of which 54.2% of G2s had at least one parent with an alcohol disorder. Families without a history of alcohol disorder were demographically matched to families with a history of alcohol disorder. Parents (G1s) and their children (G2s) were followed for six waves spanning 20 years. At Wave 4, G2s’ biological siblings, if within the same age range as the target G2, were added to the study. At Waves 5 and 6, G2’s spouses/partners and children were added to the study (generation 3; “G3s”). There were no inclusion criteria for G3s other than having a parent as a G2 in the study. If G2 families had several G3s, each G3 was recruited. After the initial interview, G3s were reassessed 1 year later (Wave 7), 1.5 years later (Wave 8), and then an additional 1 year later (Wave 9). The current study used G2 data from Waves 4–6 and G3 data from Wave 6 (T1;

$M_{\text{age}} = 12.61$), Wave 8 (T2; $M_{\text{age}} = 16.09$), and Wave 9 (T3; $M_{\text{age}} = 17.09$). G3 retention at T3 was high (86.7%). Going forward, G3s will be referred to as participants.

To capture adolescence, participants were included if they were age 13–19 at T2, in line with other studies of adolescent substance use from the sample (Hill et al., 2018; Sternberg et al., 2019). Thus, participants younger than 13 and older than 19 were excluded. Compared to excluded participants, included participants drank fewer drinks at T1 ($t = 2.72$, $p = 0.007$), but did not differ on any other study variables. Participants had a mean age of 16.09 ($SD = 1.97$) at T2, were 48% female, and were 58.4% non-Hispanic White, followed by 26% Hispanic/Latinx, 2% American Indian/Native, 1.8% Black/African American, 0.3% Asian, and 10.5% other.

Recruitment

Full information on study recruitment is available in Chassin et al. (1992). G1s with a history of alcohol disorder and their G2 children were recruited through health maintenance organization wellness questionnaires, court reports, and community telephone screenings. Eligibility criteria for parents were currently living in Arizona, reporting Hispanic/Latinx or non-Hispanic/Latinx ethnicity, being born between 1926–1960, and having at least one child age between the ages of 10.5 and 15.5. Once families with alcohol disorder were selected, families from the same neighborhood without a history of alcohol disorder were added and matched based upon demographic characteristics and family structure. Adult participants gave consent to participate, and adolescents under age 18 gave assent. All study procedures were approved by the Arizona State University Institutional Review Board (IRB).

Measures

Demographics

At T1, G3 participants reported on their sex (male vs. female), and race/ethnicity. Due to a lack of variability, race/ethnicity was dichotomized so that 1 = non-Hispanic/Latinx White vs. 2 = Ethnic/Racial minority. At T2, participants reported on their age. T2 age was used for the current study since this age was used to determine which participants were eligible.

Parent substance disorder

Although G1s were oversampled for alcohol disorder, the current study included both alcohol and cannabis use outcomes in G3s and thus considered both G2 alcohol and drug use disorders. At Waves 4–6, G2s were assessed for lifetime DSM-IV alcohol/drug dependence and alcohol/drug abuse

symptoms via the Diagnostic Interview Schedule (DSM-IV; Robins et al., 1981) or the Family History Research Diagnostic Criteria (FH-RDC; Andreasen et al., 1977). Both G2 target parents and their spouses completed DSM-IV/FH-RDC interviews. If either of the G3's parents met lifetime criteria for an alcohol or drug disorder, the G3 was given a code of 1 for having a history of parental substance disorder. In the current sample, 70.5 percent of G3s had a history of parental substance disorder.

Impulsive personality traits

G3 impulsive personality traits were assessed at T2 via the UPPS-R-C (Zapolski et al., 2010), an adapted version of the adult UPPS-P impulsivity scale that was modified for adolescents. The UPPS-R-C includes fewer items and simplified items for adolescents based upon sentence structure, number of syllables, and readability for children/adolescents. The UPPS-R-C included 8 items per facet, assessing negative urgency (e.g., "When I feel bad, I often do things I later regret in order to make myself feel better now"; $\alpha = 0.87$), positive urgency (e.g., "When I am very happy, I can't stop myself from going overboard"; $\alpha = 0.93$), sensation seeking (e.g., "I like new, thrilling things, even if they are a little scary"; $\alpha = 0.80$), a lack of premeditation (e.g., "I like to stop and think about something before I do it" [Reverse]; $\alpha = 0.81$) and a lack of perseverance (e.g., "I almost always finish projects that I start" [Reverse]; $\alpha = 0.72$). Items were averaged to create mean scores per facet. Items were assessed on a scale of 1 (Disagree Strongly) to 4 (Agree Strongly). All items for lack of perseverance and all items for lack of premeditation except "I tend to blurt out things without thinking" were reverse-scored so that higher scores were indicative of higher levels of impulsive personality traits.

Substance use

G3 substance use was assessed by asking participants how often they drank wine, wine coolers, and beer, as well as how often they used marijuana in the past year on a scale of 0 (Never) to 8 (Everyday). Average T3 levels of adolescent alcohol ($M = 0.79$, $SD = 1.48$) and cannabis ($M = 0.51$, $SD = 1.36$) were low. A total of 102 adolescents reported any alcohol use and 61 adolescents reported any cannabis use. Average levels of alcohol ($t = 8.97$, $p < 0.001$) and cannabis ($t = 5.35$, $p < 0.001$) increased from T1–T3.

Data Analytic Plan

Primary analyses consisted of two longitudinal path models analyzed in Mplus Version 8.5 using Robust Maximum Likelihood estimation (MLR). Alcohol and cannabis use were specified as outcomes in separate

models. Two-part hurdle models were estimated for each outcome, specifying predictors of both the binary (any use) and continuous (levels of use) parts of alcohol and cannabis use frequency, respectively. A hurdle modeling approach was used to more accurately represent zero-inflated substance use outcomes.

In each path model, parent substance disorder was specified as the distal predictor variable, which indirectly predicted alcohol and cannabis use via UPPS-P impulsivity traits in adolescence. UPPS-P traits were specified as correlated mediators, parsing apart the shared variance among UPPS-P traits. Participant sex, race/ethnicity, T1 alcohol/cannabis use and T2 age were covaried, and all exogenous variables were allowed to freely covary. The combination of hurdle modeling and the use of FIML for missing data required the use of Monte Carlo integration, and thus model fit indices were not available for models.

Indirect effects from parental substance disorder to alcohol and cannabis use were tested using 95% bias-corrected bootstrapped confidence intervals from 5000 bootstrapped samples (MacKinnon et al., 2007). Indirect effects for the binary part of each model were exponentiated into odds ratios in line with recommendations from Feingold et al. (2019). Since G3 adolescents were nested within G1-G2 families, the TYPE = Complex function in Mplus utilizing cluster-robust standard errors was used to adjust for a nested data structure. Descriptive statistics and bivariate correlations are shown in Table 1. All statistical analyses were considered confirmatory of theoretical hypotheses.

Full Information Maximum Likelihood (FIML) was used to estimate missing data. Missingness was present for T1 alcohol use (4 cases; 1.0%), T1 cannabis use (7 cases; 1.8%), T3 alcohol use (52 cases; 13.3%) and T3 cannabis use (53 cases; 13.5%). When comparing participants with missing data vs. non-missing data, the only difference that approached significance was T2 sensation seeking, such that those with missing data had lower levels of sensation seeking ($t = 1.985$, $p = 0.051$). Considering this, using FIML for missing data was deemed appropriate.

Results

Alcohol Use Frequency Two-Part Hurdle Model

Model parameters are shown in Table 2. Being an older adolescent was associated with lower levels of lack of premeditation, lower levels of lack of perseverance, a higher odds of reporting any alcohol use, and a higher frequency of alcohol use. Being female was associated with lower levels of sensation seeking, and being an ethnic/racial minority was associated with lower levels of lack of premeditation. T1 alcohol use was associated with the

Table 1 Descriptive statistics and bivariate correlations

	Mean (SD)	1	2	3	4	5	6	7	8
1. Parental Substance Disorder	70.5% SUD+	–	0.16**	0.13*	–0.01	0.10†	0.11*	0.17**	0.19**
2. T2 Negative Urgency	2.29 (0.66)		–	0.65**	0.13*	0.46**	0.25**	0.23**	0.19**
3. T2 Positive Urgency	2.13 (0.68)			–	0.22**	0.38**	0.21**	0.16**	0.05
4. T2 Sensation Seeking	2.90 (0.63)				–	0.19**	–0.11*	0.13*	0.15**
5. T2 Lack of Premeditation	1.90 (0.51)					–	0.49**	0.15**	0.15**
6. T2 Lack of Perseverance	1.81 (0.43)						–	0.02	0.08
7. T3 Alcohol Use	0.79 (1.48)							–	0.60**
8. T3 Cannabis Use	0.51 (1.36)								–

Note. SUD+= a family history of Substance Use Disorder; UPPS-P impulsive personality traits were measured on a scale of 1 (Disagree Strongly) to 4 (Agree Strongly); Alcohol and cannabis use frequency were measured on a scale of 0 (Never) to 8 (Everyday);

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.

continuous part of alcohol use frequency and with higher levels of sensation seeking.

Having a history of parental substance disorder was associated with higher levels of lack of premeditation, lack of perseverance, positive urgency, and negative urgency. However, having a history of parental substance disorder was unrelated to sensation seeking. Sensation seeking and negative urgency were associated with higher odds of reporting any alcohol use (binary outcome), and there was an indirect effect of parental substance disorder on higher odds of reporting any alcohol use through negative urgency (aOR = 1.28, SE = 0.17, 95%CI = [1.064, 1.700]). A lack of premeditation was associated with the continuous part of alcohol use frequency, and there was an indirect effect parental substance disorder on higher frequency alcohol use through a lack of premeditation ($b = 0.05$, SE = 0.03, 95%CI = [0.008, 0.123]). However, above and beyond impulsive personality traits and covariates, parental substance disorder was still associated with higher odds of using alcohol (see Fig. 1).

Cannabis Use Frequency Two-Part Hurdle Model

Model parameters are shown in Table 3. Covariate effects for age, sex, and ethnicity/race stayed consistent with the previous model, as did the significant effects of parental substance disorder on all impulsive personality traits except for sensation seeking. In addition, T1 cannabis use was associated with higher levels of sensation seeking, positive urgency, and negative urgency.

Sensation seeking and negative urgency were associated with higher odds of reporting any cannabis use, and there was an indirect effect of parental substance disorder on higher odds of reporting any cannabis use through negative urgency (aOR = 1.17, SE = 0.15, 95%CI = [1.001, 1.544]). Negative urgency was associated with

higher values on the continuous part of cannabis frequency, whereas positive urgency was associated with lower values on the continuous part of cannabis frequency. There was an indirect effect of parental substance disorder on the continuous part of cannabis frequency, such that parental substance disorder was associated with a higher levels of cannabis frequency through negative urgency ($b = 0.13$, SE = 0.08, 95%CI = [0.022, 0.327]) and lower levels of cannabis frequency through positive urgency ($b = -0.11$, SE = 0.06, 95%CI = [–0.249, –0.024]). However, above and beyond impulsive personality traits and covariates, parental substance disorder was still associated with higher odds of using cannabis (see Fig. 2)¹.

Sensitivity Analyses

Accounting for additional covariates

In addition to accounting for sex, age, and race/ethnicity, sensitivity analyses were conducted that also accounted for two social–ecological predictors of substance use and impulsive personality traits, parent–child separation (i.e., living with both parents or only one; 22% separated) and peer substance use (i.e., number of peers that use alcohol [or marijuana]).

¹ Theoretical (e.g., Cyders & Smith, 2016) and empirical (e.g., Waddell, Corbin, & Leeman, 2021) studies suggest unique prediction of substance use outcomes by both positive and negative urgency, which guided us to include both in the same model. However, models were also estimated with positive and negative urgency in separate models due to their high correlation. The direction of effects for each urgency facet was unchanged, however significant effects of negative and positive urgency in the cannabis model became nonsignificant when not accounting for the other urgency facet. Thus, when accounting for only one urgency facet and not the other, specificity of risk vs. protective urgency effects was lowered. Therefore, analyses were retained that included both in the same model.

Table 2 Alcohol Use Frequency Model Parameters

	aOR/ β	SE	<i>p</i> -value
<i>Alcohol use frequency</i> (Binary; aOR)			
Negative urgency	2.79	0.07	<0.001
Positive urgency	1.09	0.07	0.747
Sensation seeking	1.87	0.07	0.016
Lack of premeditation	1.56	0.06	0.153
Lack of perseverance	1.08	0.07	0.840
Parental substance disorder	3.06	0.07	0.004
Sex	1.12	0.06	0.700
Age	1.88	0.05	<0.001
Ethnicity/Race	1.43	0.06	0.259
T1 Use	1.24	0.05	0.459
<i>Alcohol use frequency</i> (Continuous; β)			
Negative urgency	-0.04	0.15	0.763
Positive urgency	0.02	0.12	0.877
Sensation seeking	-0.08	0.11	0.473
Lack of premeditation	0.28	0.11	0.011
Lack of perseverance	0.06	0.12	0.608
Parental substance disorder	-0.01	0.15	0.935
Sex	-0.10	0.10	0.285
Age	0.34	0.10	0.001
Ethnicity/Race	-0.14	0.09	0.135
T1 Use	0.16	0.06	0.007
<i>Negative urgency</i>			
Parental substance disorder	0.17	0.05	0.002
Sex	0.04	0.05	0.382
Age	-0.04	0.05	0.448
Ethnicity/Race	-0.07	0.06	0.206
T1 Use	0.05	0.07	0.496
<i>Positive urgency</i>			
Parental substance disorder	0.13	0.05	0.003
Sex	-0.03	0.05	0.538
Age	-0.08	0.05	0.133
Ethnicity/Race	-0.05	0.05	0.318
T1 Use	0.11	0.08	0.172
<i>Sensation seeking</i>			
Parental substance disorder	0.003	0.06	0.960
Sex	-0.24	0.05	<0.001
Age	-0.05	0.06	0.405
Ethnicity/Race	-0.10	0.06	0.065
T1 Use	0.16	0.06	0.005
<i>Lack of premeditation</i>			
Parental substance disorder	0.13	0.05	0.010
Sex	-0.02	0.05	0.639
Age	-0.20	0.05	<0.001
Ethnicity/Race	-0.12	0.06	0.030
T1 use	0.05	0.05	0.313
<i>Lack of perseverance</i>			
Parental substance disorder	0.14	0.05	0.011
Sex	0.06	0.05	0.285
Age	-0.25	0.05	<0.001
Ethnicity/Race	-0.07	0.05	0.195
T1 use	0.04	0.04	0.305

Note. Predictors of the binary part of alcohol use are odds ratios, whereas predictors of the continuous part are standardized betas; Sex is coded such that 0 = female, 1 = male, and Race/Ethnicity is coded such that 0 = non-Hispanic/Latinx White, 1 = Racial/Ethnic minority.

Although important, caution is warranted when accounting for these social–ecological as covariates could mask prediction to and from impulsive personality traits, considering evocative and self-selection effects of behavioral under-control on several life domains, including family functioning (e.g., Elam et al., 2016) and peer substance use (e.g., Barnow et al., 2004). However, inclusion of these covariates did not change the statistical significance of any effects.

Ordered categorical models

Due to potential concerns with estimating the continuous part of adolescent substance use with little variability, models were estimated with alcohol and cannabis use frequency as ordered categorical variables (0 = no use, 1 = less than monthly use, 2 = monthly use; see Appendix 1 for variable distributions) to ensure that findings were robust across different methods of handling zero-inflation. Model covariates and mediators were specified identically to primary models, and a Brant–Wald test was used to test for the proportional odds/parallel regression assumption in ordered categorical models (Agresti et al., 2002).

The Brant–Wald Test for proportional odds was non-significant in both the alcohol ($X^2(10) = 14.90, p = 0.14$) and cannabis ($X^2(10) = 12.59, p = 0.25$) models, suggesting that odds ratios could be interpreted across levels of both outcomes. In both models, covariate effects and the effect of parental substance disorder on impulsive personality traits were unchanged.

In the alcohol model, a lack of premeditation (aOR = 1.83, SE = 0.55, 95%CI = [1.02, 3.29]) and negative urgency (aOR = 2.30, SE = 0.63, 95%CI = [1.35, 3.93]) were associated with higher levels of alcohol use frequency, and there was still a direct effect of parental substance disorder on levels of alcohol use (aOR = 3.07, SE = 1.25, 95%CI = [1.39, 6.80]). In the cannabis model, sensation seeking (aOR = 2.34, SE = 0.71, $p = 0.005$, 95%CI = [1.29, 4.24]), a lack of perseverance (aOR = 2.05, SE = 0.73, $p = 0.044$, 95%CI = [1.02, 4.11]), and negative urgency (aOR = 2.12, SE = 0.69, $p = 0.021$, 95%CI = [1.12, 3.99]) were associated with higher levels of cannabis use, and positive urgency was associated with lower levels of cannabis use (aOR = 0.55, SE = 0.17, $p = 0.048$, 95%CI = [0.30, 0.99]). There was also a direct effect of parental substance disorder on levels of cannabis use (aOR = 6.54, SE = 4.25, $p = 0.004$, 95%CI = [1.83, 23.39]).

Latent variable model for heavier drinking

To test whether the pattern of findings changed when investigating indicators of heavier drinking, a model was estimated where the outcome was a latent variable of

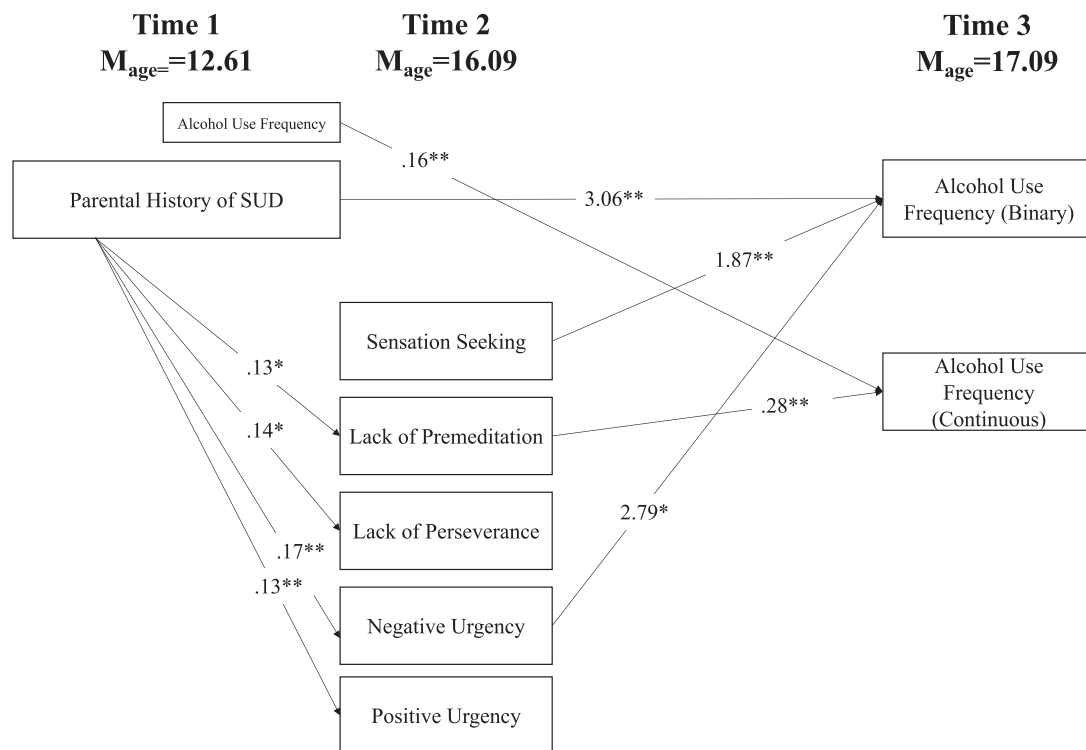


Fig. 1 Alcohol use model. *Note.* SUD substance use disorder; Predictors of the binary part are adjusted Odds Ratios whereas predictors of the continuous part are standardized betas; * $p < 0.05$, ** $p < 0.01$

drinking frequency (from the main alcohol model), typical drinking quantity, and binge drinking frequency. All three indicators loaded highly onto the latent variable ($bs = 0.89$ – 0.91). A lack of premeditation ($b = 0.13$, $SE = 0.06$, $p = 0.018$) and negative urgency ($b = 0.18$, $SE = 0.07$, $p = 0.016$) were related to heavier drinking, but no other UPPS-P facets were related to heavier drinking. In addition, parental substance disorder was directly related to heavier drinking ($b = 0.10$, $SE = 0.04$, $p = 0.017$).

Discussion

Theoretical (Iacono et al., 2008; Sher, 1991) and empirical (Wasserman et al., 2020) studies of intergenerational transmission suggest that behavioral undercontrol is a mechanism through which parental substance disorder confers risk for offspring substance use. However, the current study is the first to test whether specific, multidimensional impulsive personality traits served as mechanisms explaining the link between parental substance disorder and adolescent substance use. Using longitudinal, multigenerational data, this study found that parental substance disorder was associated with all UPPS-P facets except for sensation seeking. Furthermore, negative urgency mediated the effect of parental substance disorder on any adolescent alcohol *and* cannabis use (binary part), and negative urgency also mediated the effect of parental substance

disorder on frequency of cannabis use (continuous part). In addition, a lack of premeditation mediated the effect of parental substance disorder on frequency of adolescent alcohol use (continuous part). Findings are discussed in turn.

The current study found that, when all UPPS-P impulsive personality traits were accounted for, parental substance disorder was related to positive/negative urgency and lack of premeditation/perseverance. Considering decades of research linking parental substance disorder and behavioral undercontrol (e.g., Sher et al., 1991; Wasserman et al., 2020), it is unsurprising that most UPPS-P facets were related to parental substance disorder. However, only one other study, to our knowledge, has looked at differences in UPPS-P facets by a family history of alcohol disorder, finding that a lack of perseverance (but no other facet) was uniquely related to a family history of alcohol disorder when simultaneously tested alongside other UPPS-P facets (Watts et al., 2020). Although the significant unique relation between parental alcohol disorder and lack of perseverance was replicated, a unique effects of parental substance disorder on premeditation and both urgency facets above and beyond the effect on perseverance were also found. One explanation may be the larger effect sizes in the present analyses ($bs = 0.12$ – 0.17) compared to those in Watts et al. (2020; $bs = 0.04$ – 0.09). The current study may have also been better positioned to test effects of parental of substance disorder because over 70% of the sample had at least one

Table 3 Cannabis Use Frequency Model Parameters

	aOR/ β	SE	<i>p</i> -value
<i>Cannabis use frequency</i> (Binary; aOR)			
Negative urgency	1.91	0.09	0.041
Positive urgency	0.65	0.09	0.131
Sensation seeking	2.19	0.07	0.002
Lack of premeditation	1.39	0.08	0.370
Lack of perseverance	1.68	0.06	0.120
Parental substance disorder	6.44	0.11	<0.001
Sex	0.81	0.07	0.523
Age	1.33	0.07	0.001
Ethnicity/Race	1.10	0.08	0.800
T1 Use	1.12	0.06	0.596
<i>Cannabis use frequency</i> (Continuous; β)			
Negative urgency	0.47	0.14	0.001
Positive urgency	-0.47	0.13	<0.001
Sensation seeking	0.19	0.13	0.129
Lack of premeditation	-0.04	0.12	0.729
Lack of perseverance	0.23	0.14	0.083
Parental substance disorder	-0.25	0.18	0.157
Sex	0.21	0.09	0.020
Age	0.40	0.10	<0.001
Ethnicity/Race	-0.02	0.12	0.864
T1 Use	0.07	0.06	0.267
<i>Negative urgency</i>			
Parental substance disorder	0.16	0.05	0.004
Sex	0.04	0.05	0.451
Age	-0.06	0.06	0.317
Ethnicity/Race	-0.07	0.06	0.213
T1 Use	0.16	0.05	<0.001
<i>Positive urgency</i>			
Parental substance disorder	0.13	0.05	0.006
Sex	-0.03	0.05	0.508
Age	-0.07	0.05	0.161
Ethnicity/Race	-0.05	0.05	0.390
T1 Use	0.14	0.06	0.013
<i>Sensation seeking</i>			
Parental substance disorder	-0.008	0.06	0.900
Sex	-0.24	0.05	<0.001
Age	-0.03	0.05	0.537
Ethnicity/Race	-0.09	0.06	0.102
T1 Use	0.17	0.04	<0.001
<i>Lack of premeditation</i>			
Parental substance disorder	0.12	0.05	0.012
Sex	-0.02	0.05	0.634
Age	-0.19	0.05	<0.001
Ethnicity/Race	-0.12	0.06	0.035
T1 Use	0.05	0.05	0.329

Table 3 (continued)

	aOR/ β	SE	<i>p</i> -value
<i>Lack of perseverance</i>			
Parental substance disorder	0.14	0.05	0.010
Sex	0.06	0.05	0.264
Age	-0.24	0.05	<0.001
Ethnicity/Race	-0.07	0.05	0.225
T1 Use	-0.01	0.02	0.664

Note. Predictors of the binary part of cannabis use are odds ratios, whereas predictors of the continuous part are standardized betas; Sex is coded such that 0 = female, 1 = male, and Race/Ethnicity is coded such that 0 = non-Hispanic/Latinx White, 1 = Racial/Ethnic minority.

parent with a substance disorder. Finally, this study tested effects of parent substance disorder (alcohol and drug use disorder) rather than solely measuring parent alcohol disorder. Thus, the combination of parental alcohol and drug diagnoses rather than alcohol-only diagnoses may be more strongly related to offspring impulsive personality traits. In any case, the current findings suggest that parental substance disorder was associated with all UPPS-P facets representing top-down cognitive/behavioral control, with the largest effect sizes present for negative urgency ($b = 0.16/0.17$).

In contrast, there were no significant unique relations between parental substance disorder and offspring sensation seeking. Early studies supporting the Deviance Proneness and Externalizing Pathway models specified sensation seeking as an indicator of behavioral undercontrol (e.g., Sher et al., 1991; King & Chassin, 2004), whereas some newer studies have separated sensation seeking from behavioral undercontrol (e.g., Wasserman et al., 2020). Thus, in line with findings from newer studies (e.g., Wasserman et al., 2020; Watts et al., 2020), the current findings suggest that sensation seeking may be a distinct impulsive personality trait that is unrelated to parental substance disorder. Considering that items on the sensation seeking scale assess thrill seeking but not necessarily thrill seeking when dysregulated, one explanation may be that parental substance disorder only confers risk for personality traits that are indicative of poor regulation/top-down processing. Items for sensation seeking, such as “I would like to learn to fly an airplane”, and “I would like parachute jumping”, may be less about swift, ill-advised action and more about novelty/thrill seeking. For instance, a sensation seeker may be interested in parachute jumping, but may use a reputable and trustworthy company to do so (i.e., having forethought toward potential consequences). Thus, while facets of behavioral undercontrol and sensation seeking are two distinct pathways to adolescent substance use, the present findings suggest that the pathway from sensation seeking was not uniquely related to risk from parental substance disorder.

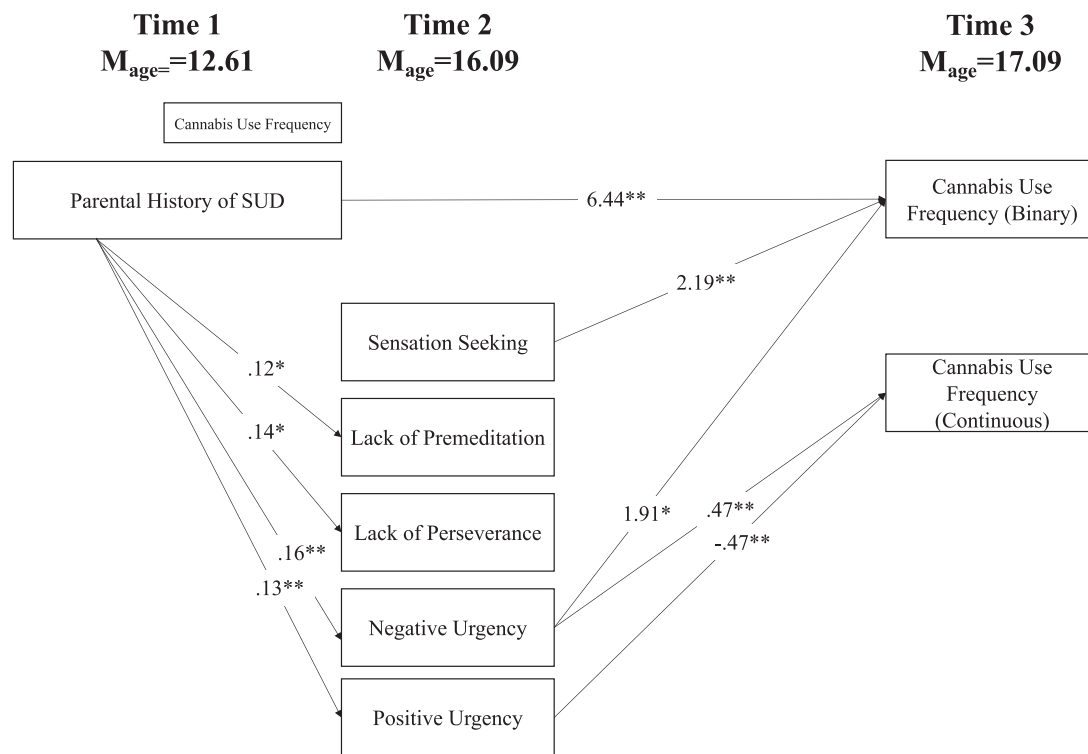


Fig. 2 Cannabis use model. *Note.* SUD substance use disorder; Predictors of the binary part are adjusted Odds Ratios whereas predictors of the continuous part are standardized betas; * $p < 0.05$, ** $p < 0.01$

The current study also found that negative urgency mediated the effect of parental substance disorder on higher odds of reporting any alcohol and cannabis use (binary part). Thus, having a history of parental substance disorder may lead adolescents to act rashly when in a negative mood state through both genetically and environmentally influenced pathways, and this predisposition may raise risk for adolescents to engage in substance use during a time of increased negative emotionality (e.g., Compas et al., 1995). Negative urgency also served as a mechanism of risk for more frequent cannabis use (continuous part), and thus may be related to both experimentation and continued use, particularly for cannabis. Given that adult data have linked negative urgency with substance use-related problems (Coskunpinar et al., 2013), negative urgency may represent a particularly high-risk pathway for children of parents with a substance disorder.

In addition, sensation seeking was associated with higher odds of reporting alcohol and cannabis use (binary part). However, considering that parental substance disorder was unrelated to sensation seeking, and that adolescence is a time of increased sensation-seeking, relations between sensation seeking and any substance use may be more indicative of age-typical risk taking/thrill seeking when reward seeking is at its highest (e.g., Steinberg et al., 2008). The association between sensation seeking and use (but not frequency) is consistent with data linking sensation seeking to initial

substance use experimentation rather than to later stages of substance use involvement (e.g., Malmberg et al., 2010).

In contrast to negative urgency and sensation seeking, a lack of premeditation served as a mechanism of risk for more frequent alcohol use (continuous part) but not any alcohol use (binary part). Studies in adults find that a lack of premeditation is most related to binge drinking/quantity of consumption (Coskunpinar et al., 2013), and thus more frequent alcohol use may be an indicator of “heavier” use during adolescence. In support, the effect of lack of premeditation on heavier use was also present in sensitivity analyses using a latent variable of “heavier use”. Therefore, one interpretation of findings may be that lacking planning/forethought for the future may not necessarily lead to substance use experimentation, but rather may lead to frequent, continued use, despite potential adverse consequences from substance use.

Despite having all UPPS-P facets in the model, parental substance disorder was still related to higher odds of reporting any alcohol and cannabis use. Deviance Proneness and Externalizing Pathway models suggest that behavioral undercontrol is an important mediator of parental substance disorder on offspring substance use (Sher et al., 1991). However, the current analyses suggest that there are other mechanisms worthy of study, considering odds ratios for the direct effect of parental substance disorder, accounting for UPPS-P facets, were still substantial (aORs = 3.06, 6.44).

The current findings may have implications for adolescent substance use interventions, as targeting high-risk children and equipping them with coping skills may prove effective at reducing adolescent substance use. Recent work has suggested that brief, skills-based interventions may be effective at reducing health risk behavior in adolescents high in negative urgency (e.g., Zapolski & Smith, 2017). Thus, considering consistent links between parental substance disorder and negative urgency, targeting offspring with parental substance disorder for these interventions could prevent from a developmental sequence toward problem use. In addition, the childhood combination of high anger reactivity and low effortful control is a developmental antecedent to negative urgency (Waddell et al., 2021), and thus targeting these individuals for such interventions may interrupt a developmental sequence toward adolescent substance use. Interventions targeting a lack of premeditation/planning in high-risk children, as well as sensation seeking in all children, may also be effective strategies. Personality-centered interventions have been shown to reduce adolescent alcohol misuse (e.g., Conrod et al., 2013), and thus future research should consider the multidimensional nature of impulsive personality traits in such interventions.

It is worth noting that the current study had relatively low levels of adolescent substance use, which could have blunted prediction of use frequency in the continuous part of the two-part hurdle models. However, when specifying the outcome as a three-level ordinal variable, findings were largely identical. Nonetheless, data from the Monitoring the Future study suggest that rates of 10th and 12th grade alcohol use (i.e., any use) are around 40% and 50%, respectively, and rates of 10th and 12th grade cannabis use are around 25% and 35%, respectively (Johnston et al., 2020). Thus, considering only 26% of the current sample reported past-year alcohol use and 16% past-year cannabis use, rates were substantially lower than national averages. One reason for this may have been age heterogeneity in the sample. Considering individuals age 13–19 were included, it is possible that younger adolescents have not begun experimenting with substances yet. This notion is supported by strong main effects of age in all models. Thus, replication in heavier using adolescent samples is needed.

Although the current study advances the literature on mechanisms of risk for adolescent substance use, findings must be interpreted alongside study limitations. First, adolescent impulsive personality traits were measured at one time point, and thus analyses do not represent prospective prediction of UPPS-P. However, this study's theoretical model was based upon adolescent levels of impulsive personality traits, not necessarily change in traits from childhood to adolescence. Future research is needed to test whether changes in UPPS-P facets mediate the effect of parental substance disorder on adolescent substance use outcomes. Second, this study focused on adolescent substance use, and future research is also needed

to test whether UPPS-P impulsive personality traits mediate the effects of parental substance disorder on alcohol and cannabis during ages when rates of problems/substance disorders are more prevalent (e.g., young adulthood). Third, the current study used self-report measures of substance use and impulsive personality traits, and future research using objective measures should be considered. Finally, parent substance use disorder diagnoses convey both genetic and environmental influence and the current study cannot distinguish between them. Future genetically-informed studies are needed to identify the processes of gene-environment interplay that are involved in the mediating effects of impulsive personality traits on adolescent substance use.

Conclusion

Although several studies suggest that behavioral undercontrol mediates the effect of parental substance disorder, no work has focused on multidimensional impulsive personality traits. Therefore, the current study tested whether parental substance disorder was indirectly related to adolescent alcohol and cannabis use via multidimensional impulsive personality traits, including positive urgency, negative urgency, sensation seeking, lack of premeditation, and lack of perseverance. Findings suggested that parental substance disorder was related to all UPPS-P facets except for sensation seeking, and that sensation seeking and negative urgency were associated with heightened risk for any alcohol/cannabis use (binary part), whereas negative urgency and a lack of premeditation were associated with heightened risk for frequency of use (continuous part). In addition, there were indirect effects of parent substance disorder on substance use through both lack of premeditation and urgency. Therefore, findings highlight the importance of studying multidimensional impulsive personality traits in models of developmental psychopathology. Findings may also be useful in determining personality-centered interventions in adolescence to interrupt a sequence toward continued heavy substance use into later periods of development.

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Authors' Contributions J.W. conceived of the study, participated in its design and coordination, performed the statistical analyses, and drafted the manuscript; L.C. participated in the design and coordination of the study, interpretation of the data, and edited all drafts of the manuscript; K.E. participated in the design and coordination of the study and edited all drafts of the manuscript. All authors read and approved the final manuscript.

Data Sharing and Declaration The datasets generated and/or analyzed during the current study are not publicly available but are available from Dr. Chassin upon reasonable request.

Compliance with Ethical Standards

Conflict of Interest The authors declare no competing interests.

Ethical Approval All study procedures were approved by the Arizona State University Institutional Review Board.

Informed Consent All human participants above the age of 18 provided informed consent and parents of those under the age of 18 provided assent.

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Appendix 1 Variable Distribution for Alcohol and Cannabis Use Frequency

	% of sample	3-level categories
<i>Past-year alcohol use frequency</i>		
Never	70%	Never: 70%
1–2 times	9.7%	Less than monthly: 19.7%
3–5 times	6.8%	
5+ times, but less than monthly	3.2%	
1–4 times a month	6.8%	Monthly + : 9.2%
1–2 times a week	2.1%	
3–5 times a week	1.2%	
Everyday	0.3%	
<i>Past-year cannabis use frequency</i>		
Never	82.0%	Never: 82%
1–2 times	2.1%	Less than monthly: 6.2%
3–5 times	1.2%	
5+ times, but less than monthly	2.9%	
1–4 times a month	2.1%	Monthly + : 4.2%
1–2 times a week	1.2%	
3–5 times a week	0.9%	

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