

**Drinking Motives Mediate the Association between Personality and High-Intensity
Drinking in a Sample of Underage Drinkers**

Agnes Zhou

Department of Psychology, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA,
15213, USA

Abstract

Researchers have long been interested in identifying risk factors for binge drinking behavior (4+/5+ drinks/occasion for females/males), but many studies have demonstrated that a substantial proportion of young adults are drinking at levels far beyond (often 2-3 times) the standard binge threshold (Patrick et al., 2017). The consumption of such large quantities of alcohol, typically referred to as high-intensity drinking (HID), can cause severe alcohol-related problems, such as blackouts, unintended sexual experiences, and even death (Hingson et al., 2017). This study is the first to investigate whether drinking motives mediate the relationship between personality and HID in a large ($N=999$) sample of underage drinkers. We hypothesized that coping motives will mediate the positive association between neuroticism and HID and that social and enhancement motives will mediate the positive association between extraversion and HID. To investigate these hypotheses, we used two archival datasets that recruited current underage (18-20 year old) adult drinkers residing in the United States from online panel services. Results showed that coping motives partially mediated the positive association between neuroticism and HID. In addition, social and enhancement motives fully mediated the positive association between extraversion and HID. These findings provide an initial step toward examining the interplay between drinking motives and personality traits in predicting heavy drinking in underage drinkers and point to the potential clinical utility of prevention and intervention programs targeting drinking motives for these at-risk populations who are high in neuroticism and/or extraversion.

Keywords: High-intensity drinking, drinking motives, personality, emerging adulthood

Drinking Motives Mediate the Association between Personality and High-Intensity Drinking in a Sample of Underage Drinkers

Binge drinking, sometimes referred to as “heavy episodic drinking”, is defined as consuming 4+/5+ drinks/occasion for females/males (NIAAA, 2004), and peaks in young adulthood with approximately 35-40% of 18 to 21 year-olds in the US reporting at least one episode of binge drinking in the past two weeks (Patrick et al., 2019). Binge drinking contributes to a substantial proportion of alcohol-related deaths, including suicide, in addition to a host of other negative outcomes such as alcohol poisoning, unintentional injuries, vehicular accidents, and increased risk of developing alcohol use disorder (Chikritzhs et al., 2001; Creswell et al., 2020; Rehm et al., 2010; Spillane et al., 2020). The probability that negative alcohol-related consequences will occur greatly increases with more frequent binge drinking episodes and when individuals consume larger quantities of alcohol during a particular drinking episode (Miller et al., 2007; Jackson, 2008; Read et al., 2008).

Importantly, a substantial proportion of young adults drink at levels far beyond the standard binge threshold, typically referred to as high-intensity drinking (HID; Hingson et al., 2017; Patrick et al., 2017; White et al., 2006). For example, White and colleagues (2006) found that approximately 43% of college student drinkers endorsed drinking at levels twice the standard binge cut-off (i.e., 8/10+ drinks for females/males) in a single sitting. In a nationally representative sample of US high school seniors (modal age 18), Patrick & Terry-McElrath (2017) found that approximately 25% consumed 5+ alcoholic drinks, 10% consumed 10+ drinks, and 5% consumed 15+ drinks in a single setting at least once in the last 2 weeks. Young adults who engage in HID are particularly vulnerable to severe alcohol-related harms, including blackouts and death (Hingson et al., 2013; White et al., 2006). Identifying young adults who are

at risk of engaging in HID, and understanding why these individuals are at increased risk, is a research priority (e.g., Patrick, 2016; NIAAA High-Intensity Drinking Working Group Meeting), yet very few prior studies have examined these questions.

Personality is one such construct that has been identified as important in predicting unhealthy alcohol use. Specific personality traits, including neuroticism and extraversion, have been linked to binge drinking as traditionally defined (see Adan et al., 2017 and Malouff et al., 2007 for reviews). These traits may also help to explain who is at increased risk of engaging in HID, but we are aware of only two papers on this topic. The first study (Ramchandani et al., 2019) investigated impulsivity and aggression in a non-treatment seeking sample classified into 4 groups: Level 0 (no binges), Level 1 (4-7/5-9 drinks for females/males), Level 2 (8-11/10-14 drinks for females/males) and Level 3 (12+/15+ drinks for females/males). They found significant differences in impulsivity and aggression between high-intensity drinkers (Levels 2 and 3) and binge/non-drinkers (Levels 0 and 1), such that high levels of trait impulsivity and aggression indicated higher likelihood of HID. The second study examined the relationship between the Big 5 personality traits and HID in a sample of midlife adults (Lee & Sibley, 2020), using data from the 2014 to 2016 New Zealand Attitudes Values Study. Results suggested that extraversion and neuroticism positively correlated with HID and there was no relationship between conscientiousness and HID. Interestingly, they also found that high neuroticism was linked with coping motives and that high extraversion was linked with social and enhancement motives, but they did not investigate whether motives mediated the personality to HID links.

A substantial portion of the research on predictors of HID has focused on motivations or reasons for drinking (Patrick et al., 2016, 2017, 2021; White et al., 2016), as this information will likely be useful in identifying alternative reinforcement options to target in treatment and

prevention programs (Creswell et al., 2020). Several theories propose that drinking motives are the most proximal predictors of alcohol use that all other distal determinants (e.g., personality traits) operate through (Cooper, 1994; Cox & Klinger, 1988; Kuntsche et al., 2005). Four possible drinking motives have been identified based on the perceived valence and locus of the outcomes, including social (positive-external; drinking to obtain/facilitate social gains), conformity (negative-external; drinking to feel included/avoid social rejection), enhancement (positive-internal; drinking to enhance a positive mood), and coping (negative-internal; drinking to avoid/regulate negative feelings) (Cooper, 1994; Cox & Klinger, 1988).

A large body of research has accumulated showing that drinking motives predict alcohol use and alcohol-related consequences, including binge drinking (Cooper et al., 2016). Further, many studies have shown that motives mediate the relationship between personality traits and alcohol consumption (e.g., Kuntsche et al., 2008; Stewart & Devine, 2000; Stewart et al., 2001). Although several studies have investigated whether drinking motives predict HID, no prior studies, to our knowledge, have tested whether drinking motives might mediate the link between personality and HID. For example, White and colleagues (2016) found that, over six months, increases in social and enhancement motives were larger among college students who transitioned from non-binge drinking to HID. In a large national sample of young adult drinkers, Patrick and colleagues (2017) investigated longitudinal self-report data on HID (10+ drinks) collected from the national Monitoring the Future study in 2005-2014 from 2,664 participants ages 18–26. They found stable associations over time between HID and the following four reasons for drinking: drinking to get away from problems, to feel good or get high, to relax or relieve tension, and to get to sleep. Finally, in a clinical sample of adolescents with alcohol-related problems, Creswell and colleagues (2020) studied 432 adolescents (aged 12–18 years)

followed into young adulthood (aged 19–25 years). They found that the maintenance of relatively high endorsement of enhancement and social motives over time was associated with HID in young adulthood, and that decreases in coping motives were associated with less risky drinking (i.e., standard threshold binge drinking) in young adulthood. Taken together, drinking motives seem to be a promising avenue to pursue in better understanding the emergence of HID in young adults. This will be the first study to investigate whether drinking motives mediate the link between personality traits and HID. Results from such a study would provide information about who is at risk of engaging in this type of unhealthy alcohol use, as well as why they are at increased risk, which could aid in more targeted intervention programs.

The current study extends prior research on the associations between personality traits, motives, and HID in three important ways. First, while prior studies have tended to focus on midlife (e.g., mean age of around 50 years; Lee & Sibley, 2020) and wide age ranges of emerging adults mostly of legal drinking age (e.g., 18 to 29/30 year olds; Patrick et al., 2017), we focus on a large sample of underage drinkers who have been shown to be most at-risk for engaging in HID (Patrick et al., 2017). Indeed, HID increases sharply across late adolescence, peaks during the early 20s, and then decreases through adulthood (Patrick & McElrath, 2019). Second, prior studies have tended to define binge drinking similarly across males and females (i.e., consuming 5+ drinks per occasion; Patrick et al., 2017, 2021), which does not accurately account for the fact that blood alcohol concentration (BAC) raises to 0.08 percent at lower drinking levels in the average adult woman as compared to the average adult man. Our study aimed to rectify this by defining binge drinking in accordance with national recommendations (see Methods below). Third, our study is the first to determine whether drinking motives mediate the association between personality (i.e., neuroticism, extraversion) and HID. A better

understanding of whether drinking motives explain the relationship between personality and HID in underage young adults will lend evidence towards interventions incorporating motivational theory for this at-risk group.

As discussed above in more detail, the present study focuses specifically on the personality traits of neuroticism and extraversion due to prior research findings linking these traits consistently with both with HID (Lee & Sibley, 2020) and unhealthy alcohol use in general (Adan et al., 2017; Malouff et al., 2007). Consistent with prior research examining alcohol consumption and related problems as outcome variables (Cooper, 1994; Loose et al., 2018; Mezquita et al., 2010), we predicted the following: 1) the positive association between trait neuroticism and HID would be mediated by greater drinking to cope motives, and 2) the positive association between trait extraversion and HID would be mediated by greater enhancement and social motives.

Methods

Participants

Two archival datasets based on two separate studies were used for this project ($N=1237$). Both studies recruited current underage (18-20 year old) adult drinkers residing in the United States from online panel services (i.e., Amazon TurkPrime and Qualtrics). Reliable and valid substance use data has been obtained through such online samples (e.g., Arditte et al., 2016; Kim & Hodgins, 2017). The first sample was recruited through an Amazon TurkPrime panel (see Skrzynski et al., 2018 for additional details), and 727 eligible individuals (i.e., those who were 18–20 years old, current alcohol drinkers, and residing in the United States) were included in the current analyses. The second sample was recruited through a Qualtrics panel, and 510 eligible individuals (i.e., current alcohol drinkers between 18-20 years old who were residing in the United States) were included in the current analyses. Manipulation checks were used during data

collection to assess whether participants were paying attention or answering items at random, which led to the removal of 238 participants. The final sample size was 999.

Measures

Demographics. Participant characteristics were assessed with age, sex, race, education, and parent education. Sex was examined as a binary categorical variable (0=female and 1=male). Participants were asked to then identify their race (White, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, American Indian/Alaska Native, and Multiracial) and education level (response options ranged from 8th grade or less through 4+ years of graduate school). Finally, parental education was assessed and categorized as follows: completed grade school or less, attended some high school, completed high school, attended some college, completed college, and attended graduate or professional school post-college.

Alcohol Consumption. Past month frequency of binge drinking was assessed with the following question, “During the past month, how often did you have 4 (for females)/5 (for males) or more drinks containing any kind of alcohol within a two-hour period?” (NIAAA, 2004). Responses were marked on a 7-point scale (1=*every day*, 2=*5 to 6 times a week*, 3=*3 to 4 times a week*, 4=*twice a week*, 5=*once a week*, 6=*2 to 3 times in the past month*, 7=*once in the past month*). Past month HID was assessed with two questions asking about frequency of drinking 8+/10+ (for females and males, respectively) and 12+/15+ drinks (for females and males, respectively) within a two-hour period (Patrick, 2016). Response options were the same as those used for the standard binge drinking question. Participants were then categorized into an overall HID variable based on responses to these questions: 0=never binge drank, 1=endorsed binge drinking at least once, but never engaging in HID, or 2=endorsed engaging in HID (i.e.,

drank 8+/10+ drinks or more) at least once in the past month. This three-level HID variable was the primary outcome variable in multivariate models.

Drinking Motives. Reasons for drinking were assessed with the well-validated (e.g., Kuntsche et al., 2005) Drinking Motives Questionnaire-Revised (DMQ-R; Cooper, 1994), a 20-item measure that assesses why individuals might be motivated to drink alcohol. The DMQ-R contains four subscales measuring four facets of reasons for drinking: coping (e.g., “because it helps you when you feel depressed or nervous”), social (e.g., “because it is part of a drinking game”), enhancement (e.g., “because you like the feeling”), and conformity (e.g., “because people at work will not like you if you do not drink”). Items are rated on a 5-point Likert scale (*almost never/never, some of the time, half of the time, most of the time, almost always/always*) and averaged to create each subscale. Based on study hypotheses, we used the following three subscale scores in the proposed analyses: coping ($\alpha=0.86$), social ($\alpha=0.91$), and enhancement ($\alpha=0.86$).

Personality Traits. Two domains of adult personality, neuroticism ($\alpha=0.79$) and extraversion ($\alpha=0.79$), were assessed using the abbreviated 60-item version of the NEO Five-Factor Inventory (NEO-FFI; Costa & McCrae, 1992). The NEO-FFI asks participants to rate how well statements describe them (e.g., “I am not a worrier”) on a 5-point scale from 1-5 (*Disagree strongly, Disagree a little, Neither agree or disagree, Agree a little, Agree strongly*). Items were then summed to create neuroticism and extraversion scale scores.

Data Analyses

For the descriptive results, we calculated means, standard deviations, percentages, F statistics (for continuous variables) or chi-squared statistics (for categorical variables), effect

sizes, and bivariate correlations using IBM SPSS Statistics for Windows, version 27 (IBM Corp., Armonk, N.Y., USA).

To investigate the mediating role of drinking motives in the association between personality and HID, we calculated both the direct and indirect effects via three path analyses using Mplus, version 8 (Muthén & Muthén, 2017). Three models were conducted with drinking motives (coping, social, enhancement) as the mediator, personality traits (neuroticism, extraversion) and covariates (age, sex, study, parent education) as the independent variables, and HID as the categorical dependent variable (0=never binge drank, 1=binge drank, 2=engaged in HID). Specifically, we examined whether 1) higher trait neuroticism predicted high intensity drinking and whether higher levels of coping motives mediated this relationship (model 1), and 2) higher trait extraversion predicted high intensity drinking and whether higher levels of social (model 2) and/or enhancement motives (model 3) mediated this relationship. Significant indirect effects indicated mediation.

Results

Descriptive Analyses

Missing Data. There were no missing data on the DMQ-R or on items assessing HID status and less than 1% missing data on personality variables ($n = 78$). Due to low rates of missingness, listwise deletion was used in models including personality traits.

Descriptive Statistics. Table 1 presents the means, standard deviations, percentages, F-values/chi-squared values, significance, and effect sizes for all study variables of interest. Participants ($N=999$, $M_{\text{age}}=19.1$, $SD_{\text{age}}=0.8$) mostly identified as female (70.0%) and White (73.6%), but a substantial proportion identified as more than one race (11.0%) or Black (9.2%). The remaining participants identified as Asian (3.9%), American Indian/Alaska Native (1.5%),

or Native Hawaiian or other Pacific Islander (0.7%). In regards to the participants' education levels, the majority had completed one year of college, with 57.6% of the sample completing at least high school. Regarding parental education (a socioeconomic status proxy), the parents of most participants completed some college, with 90.2% of these parents completing at least high school.

Binge drinking and HID were relatively common in the current sample. More than half ($n=575$; 57.6%) of participants met the cutoff for drinking at least 4 (female) or 5 (male) drinks per occasion at least once in the past month. In addition, 30.3% of participants fell into the highest HID category - drinking at least 8/10 or 12/15 (female/male, respectively) drinks per occasion at least once in the past month. Results revealed that drinkers typically drank two to three times in the past month and 39.8% of the sample drank at least once a week.

Bivariate Correlations. Table 2 presents the bivariate associations among study variables. HID was significantly positively correlated with coping, social, and enhancement motives, (p -values <0.01), but was not significantly related to neuroticism or extraversion. As expected, neuroticism was significantly positively correlated with coping motives, and extraversion was positively correlated with social and enhancement motives.

Mediation Models

Results of all three models, including standardized path coefficients, can be found in Figure 1. Model 1 indicated that the total effect of neuroticism predicting HID was nonsignificant ($\beta = -0.01$, $SE=0.04$, 95% C.I.=-0.09-0.07, $p=0.79$). However, the indirect effect for neuroticism predicting HID through coping motives was significant ($\beta=0.12$, $SE=0.02$, 95% C.I.=0.09-0.16, $p<0.01$); see Figure 1). The direct effect of neuroticism on HID was also significant, but negative in direction ($\beta= -0.13$, $SE=0.04$, $p<0.01$).

Model 2 indicated that the total effect of extraversion on HID was nonsignificant ($\beta=0.05$, $SE=0.04$, 95% C.I.=-0.02-0.12, $p=0.18$). However, the indirect effect was significant ($\beta=0.04$, $SE=0.01$, 95% C.I.=0.02-0.05, $p<0.01$) indicating that higher extraversion was associated with higher social motives, which in turn was associated with HID. In addition, the direct effect between extraversion and HID was nonsignificant ($\beta=0.02$, $SE=0.04$, $p=0.68$), indicating a full mediation effect.

Lastly, Model 3 revealed that when we instead examined enhancement motives as the mediator, the indirect effect from extraversion to HID was significant ($\beta=0.03$, $SE=0.01$, 95% C.I.=0.01-0.05, $p<0.01$) such that higher extraversion was associated with higher enhancement motives, which in turn was associated with HID. In addition, the direct effect from extraversion to HID was not significant ($\beta=0.02$, $SE=0.04$, $p=0.58$) lending evidence for a full mediation effect.

Table 1. Participant characteristics and descriptive statistics for the Drinking Motives Questionnaire-Revised (DMQ-R) NEO Five-Factor Inventory (NEO-FFI) across drinking groups

	Total (N=999)	Study 1 (N=489)	Study 2 (N=510)			
Variable	<i>M (SD)/ %</i>			F/ χ^2	<i>p</i> -value	η^2/ϕ
<i>Demographics</i>						
Age	19.1 (0.8)	19.2 (0.8)	18.9 (0.9)	44.4	<.001	.04
Female Gender	70.0%	90.8%	50%	197.7	<.001	.45
Education	6.0 (1.6)	6.2 (1.5)	5.8 (1.6)	16.7	<.001	.02
Parent Education	4.1 (1.2)	4.3 (1.2)	4.0 (1.2)	9.4	.002	.01
Non-Caucasian Race	26.4%	29.0%	23.5%	3.4	.07	.06
<i>NEO-FFI</i>						
Neuroticism	40.4 (10.2)	41.1 (9.9)	39.9 (10.4)	3.2	.07	.003
Extraversion	37.9 (8.7)	37.7 (8.6)	38.0 (8.7)	0.2	.65	<.001
<i>DMQ-R</i>						
Social	3.0 (1.1)	3.0 (1.1)	3.1 (1.0)	1.0	.33	.001
Coping	2.3 (1.1)	2.3 (1.1)	2.3 (1.0)	0.2	.70	<.001
Enhancement	2.8 (1.0)	2.8 (1.1)	2.8 (1.0)	0.0	.99	<.001
<i>Drinking Group</i>						
Never binge drank	42.4%	42.9%	42.0%	1.9	.39	.04
Binge drinking	27.2%	28.6%	25.9%			
High-intensity drinking	30.3%	28.4%	32.2%			

Note: Never binge drank = under 4/5 drinks for females/males per occasion in the past month. Binge drinking = 4+/5+ drinks per occasion in the past month. High-intensity drinking = 8+/10+ drinks per occasion in the past month.

Table 2. Correlations for study variables

Variable	<i>n</i>	1	2	3	4	5	6
1. DMQ-R Social	999	—					
2. DMQ-R Coping	999	.39**	—				
3. DMQ-R Enhancement	999	.63**	.42**	—			
4. NEO Neuroticism	921	.001	.37**	.06	—		
5. NEO Extraversion	921	.13**	-.23**	.09**	-.52**	—	
6. HID total ^a	999	.26**	.24**	.29**	-.03	.05	—

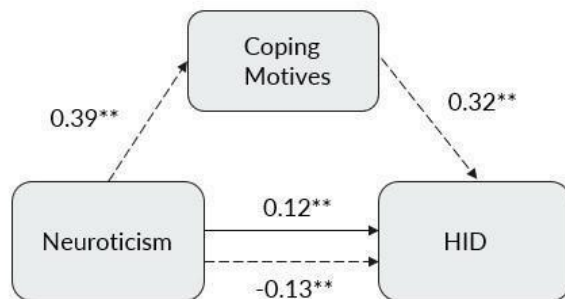
^a 0 = never binge drank, 1 = binge drinking, 2 = high-intensity drinking.

Note: All correlation coefficients are Pearson's *r*.

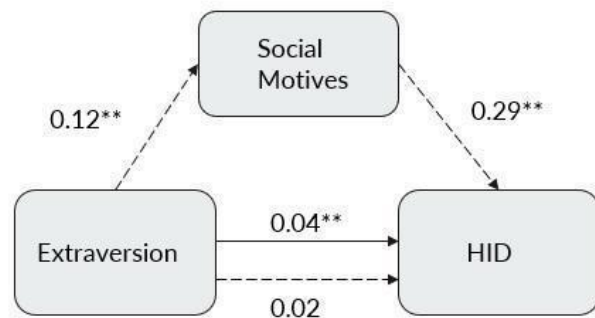
** Correlation is significant at the 0.01 level (2-tailed).

Figure 1. Direct and Indirect Effects models looking at the relationship between personality, drinking motives and high-intensity drinking.

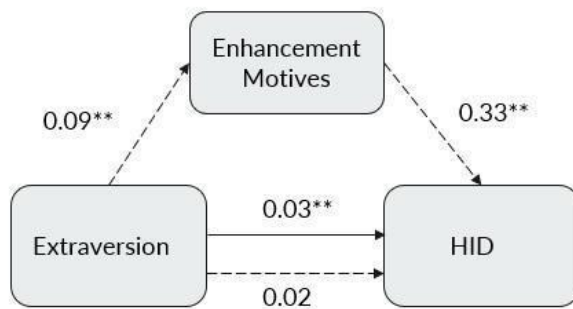
Model 1



Model 2



Model 3



Note: Dotted lines signify direct effects and solid lines signify indirect effects.

Discussion

Almost half of college student drinkers report drinking at levels twice the standard binge threshold in a single sitting (White et al., 2006), and young adults who engage in HID are especially vulnerable to severe alcohol-related consequences, including blackouts and death (Hingson et al., 2003). It is therefore a research priority to identify predictors of HID in these at-risk populations. Personality traits (i.e., neuroticism and extraversion; Lee & Sibley, 2020) and drinking motives (i.e., coping, enhancement, and social; White et al., 2016; Creswell et al., 2020) have been shown to be associated with high-risk drinking in prior studies, but the current study is the first to investigate whether drinking motives mediate the link between personality traits and HID in underage drinkers who are most at-risk for engaging in this behavior (Patrick et al., 2017). We hypothesized that the positive association between trait neuroticism and HID would be mediated by greater drinking to cope motives, and that the positive association between trait extraversion and HID would be mediated by greater enhancement and social motives.

Bivariate correlations showed that HID was significantly and positively associated with coping, social, and enhancement motives. These findings are consistent with previous research investigating associations between drinking motives and binge drinking (Cooper et al., 2016) and HID (White et al., 2016; Creswell et al., 2020). In addition, neuroticism was significantly

positively correlated with coping motives, and extraversion was positively correlated with social and enhancement motives, which is consistent with much prior research on alcohol consumption (e.g., Kuntsche et al., 2008; Stewart & Devine, 2000; Stewart et al., 2001; Lee & Sibley, 2020). Contrary to expectations, neuroticism and extraversion were not significantly correlated with HID, which contrasts with the findings of Lee & Sibley (2020), the only other study that examined the Big 5 personality traits as predictors of HID. It is possible that our findings differed since we investigated underage drinkers in the U.S. while Lee & Sibley looked at findings in a sample of New Zealand residents with a mean age of 50 years old. In addition, the present study used a cross-sectional design and Lee & Sibley examined findings longitudinally. Finally, their study measured HID in a more open-ended manner as the quantity of drinks containing alcohol consumed on a typical day when drinking (i.e., 1 to 2, 3 to 4,...10 or more), whereas we assessed HID with two questions asking about frequency of drinking 8+/10+ (for females and males, respectively) and 12+/15+ drinks (for females and males, respectively) within a two-hour period.

As hypothesized, our first mediation model showed a mediating effect for coping motives in the association between neuroticism and HID. However, only a partial mediation effect was observed, such that both the indirect and direct effects were significant. In addition, the indirect effect was positive while the direct effect was negative. Thus, the null total effect was obscuring an indirect effect that was positive and a direct effect that was negative. Results suggest that higher neuroticism was associated with higher coping motives, which in turn was associated with increased frequency of HID. However, after controlling for coping motives, we found a negative direct effect, such that holding constant coping motives revealed that higher neuroticism was associated with less HID. Although Lee & Sibley (2020) found a significant positive association

between neuroticism and HID, this may only hold true when examining personality as an individual predictor, and it is possible that our results indicate a suppression effect. Because the role of coping motives surpasses the true relationship between neuroticism and HID, it must be accounted for in order to reveal the indirect relationship between neuroticism and HID.

Consistent with our other hypothesis, our latter two mediation models showed that enhancement and social motives fully mediated the positive association between extraversion and HID. Given that extraversion did not have a significant direct effect with HID, these results suggest that modeling drinking motives (specifically enhancement and social motives) in this relationship helps us understand why certain underage individuals engage in HID. Thus, examining personality or motives in isolation will not provide a nuanced understanding as to why someone drinks at these high levels.

Furthermore, findings may help clinicians personalize and hone effective intervention and prevention strategies for populations engaging in or at-risk for HID. Treatment research focused on unhealthy alcohol use has long purported that substance use treatment is not a “one size fits all” and that tailoring treatment (or prevention work) to fit the person’s symptom severity, social situation, sociodemographics, and goals is often necessary for treatment to be effective (e.g., Dietrich et al., 2015; Edokpolo et al., 2010; Koch & Rubin, 1997). For example, based on the present findings, if an individual high in neuroticism was engaging in HID, it may be helpful to discuss how and why that individual is using alcohol to cope with negative emotions and introduce and reinforce healthier ways to cope with negative mood. Conversely, an individual higher in extraversion who engages in HID may need help identifying healthier activities that lead to joy as well as aid in identifying social networks that do not engage in HID.

Like most, our study has limitations that should be acknowledged. Although we were able to recruit a large sample of underage drinkers ($N=999$), the racial diversity could have been more representative of the U.S. population, as only about a quarter of our sample was non-White. In addition, approximately 70% of our sample was female. Future studies using more diverse and nationally representative samples are indicated. Another limitation was the cross-sectional design of our study, which precludes us from making claims about the directionality of the associations between personality traits, drinking motives, and HID. Further, we specifically focused on trait neuroticism and extraversion and only on coping, social, and enhancement motives in the present study. We used these particular personality traits and drinking motives based on previous binge drinking research, but a more in-depth analysis could include the remaining traits (i.e., conscientiousness, agreeableness, openness) and other drinking motives (e.g., conformity). Finally, although underage individuals who engage in HID represent a clinically relevant population, our findings should be replicated with different populations in order to determine their generalizability.

In summary, this study provides evidence that drinking motives can act as mediators in the associations between personality traits and HID. More specifically, higher endorsement of drinking to cope can explain why higher neuroticism predicts HID. In addition, higher levels of social and enhancement motives may explain why higher extraversion predicts HID. These findings provide an initial step toward examining the interplay between drinking motives and personality traits in predicting heavy drinking in underage drinkers, and future research should aim to confirm these results using longitudinal designs. The results of this study point to the potential clinical utility of prevention and intervention programs targeting drinking motives (e.g.,

developing coping skills, engaging in healthier social lives, etc.) for heavy-drinking underage populations who are high in neuroticism and/or extraversion.

References

- Adan, A., Forero, D. A., & Navarro, J. F. (2017). Personality traits related to binge drinking: a systematic review. *Frontiers in Psychiatry*, 8, 134.
- Arditte, K. A., Çek, D., Shaw, A. M., & Timpano, K. R. (2016). The importance of assessing clinical phenomena in Mechanical Turk research. *Psychological assessment*, 28(6), 684.
- Chikritzhs, T. N., Stockwell, T. R., Jonas, H. A., Heale, P. F., & Dietze, P. M. (2001). Mortality and life-years lost due to alcohol: a comparison of acute and chronic causes. *Medical Journal of Australia*, 174(6), 281-284.
- Cooper, M. L. (1994). Motivations for alcohol use among adolescents: Development and validation of a four-factor model. *Psychological assessment*, 6(2), 117.
- Cooper, M. L., Kuntsche, E., Levitt, A., Barber, L. L., & Wolf, S. (2016). Motivational models of substance use: A review of theory and research on motives for using alcohol, marijuana, and tobacco.
- Costa, P. T., & McCrae, R. R. (1992). Normal personality assessment in clinical practice: The NEO Personality Inventory. *Psychological assessment*, 4(1), 5.
- Cox, W. M., & Klinger, E. (1988). A motivational model of alcohol use. *Journal of abnormal psychology*, 97(2), 168.
- Creswell, K. G. (2020). Drinking Together and Drinking Alone: A Social-Contextual Framework for Examining Risk for Alcohol Use Disorder. *Current Directions in Psychological Science*, 0963721420969406.

- Creswell, K. G., Chung, T., Skrzynski, C. J., Bachrach, R. L., Jackson, K. M., Clark, D. B., & Martin, C. S. (2020). Drinking beyond the binge threshold in a clinical sample of adolescents. *Addiction, 115*(8), 1472-1481.
- Dietrich, T., Rundle-Thiele, S., Leo, C., & Connor, J. (2015). One size (never) fits all: Segment differences observed following a school-based alcohol social marketing program. *Journal of School Health, 85*(4), 251-259.
- Edokpolo, O., James, P., Kearns, C., Campbell, A., & Smyth, B. P. (2010). Gender differences in psychiatric symptomatology in adolescents attending a community drug and alcohol treatment program. *Journal of Psychoactive Drugs, 42*(1), 31-36.
- High Intensity Drinking Working Group Meeting | National Institute on Alcohol Abuse and Alcoholism (NIAAA) n.d. Available at: <https://www.niaaa.nih.gov/news-events/meetings-events-exhibits/high-intensity-drinking-working-groupmeeting-test> (accessed 30 May 2019).
- Hingson, R. W., Zha, W., & White, A. M. (2017). Drinking beyond the binge threshold: predictors, consequences, and changes in the US. *American journal of preventive medicine, 52*(6), 717-727.
- Jackson, K. M. (2008). Heavy episodic drinking: determining the predictive utility of five or more drinks. *Psychology of addictive behaviors, 22*(1), 68.
- Kim, H. S., & Hodgins, D. C. (2017). Reliability and validity of data obtained from alcohol, cannabis, and gambling populations on Amazon's Mechanical Turk. *Psychology of addictive behaviors, 31*(1), 85.
- Koch, D. S., & Rubin, S. E. (1997). Challenges faced by rehabilitation counselors working with alcohol and other drug abuse in a "one size fits all" treatment tradition. *Journal of*

- Applied Rehabilitation Counseling, 28(1), 31-35.
- Kuntsche, E., Knibbe, R., Gmel, G., & Engels, R. (2005). Why do young people drink? A review of drinking motives. *Clinical Psychology Review*, 25(7), 841-861.
- Kuntsche, E., von Fischer, M., & Gmel, G. (2008). Personality factors and alcohol use: A mediator analysis of drinking motives. *Personality and Individual Differences*, 45(8), 796-800.
- Lee, C. H., & Sibley, C. G. (2020). Correlates of New Zealanders' drinking status, frequency and intensity: Evidence from the New Zealand Attitudes and Values Study. *New Zealand Journal of Psychology (Online)*, 49(2), 46-58.
- Loose, T., Acier, D., & El-Baalbaki, G. (2018). Drinking motives as mediators between personality traits and alcohol use among young French people. *Personality and Individual Differences*, 134, 268-274.
- Malouff, J. M., Thorsteinsson, E. B., Rooke, S. E., & Schutte, N. S. (2007). Alcohol involvement and the five-factor model of personality: A meta-analysis. *Journal of drug education*, 37(3), 277-294.
- Maples-Keller, J. L., Williamson, R. L., Sleep, C. E., Carter, N. T., Campbell, W. K., & Miller, J. D. (2019). Using item response theory to develop a 60-item representation of the NEO PI-R using the International Personality Item Pool: Development of the IPIP-NEO-60. *Journal of Personality Assessment*, 101(1), 4-15.
- Mezquita, L., Stewart, S. H., & Ruipérez, M. Á. (2010). Big-five personality domains predict internal drinking motives in young adults. *Personality and Individual Differences*, 49(3), 240-245.
- Miller, J. W., Naimi, T. S., Brewer, R. D., & Jones, S. E. (2007). Binge drinking and associated

health risk behaviors among high school students. *Pediatrics*, 119(1), 76-85.

National Institute on Alcohol Abuse and Alcoholism (NIAAA). Task force on recommended questions of the national council on alcohol abuse and alcoholism: Recommended sets of alcohol consumption questions. Retrieved from <https://www.niaaa.nih.gov/research/guidelines-and-resources/recommended-alcohol-questions>.

Patrick, M. E. (2016). A call for research on high-intensity alcohol use. *Alcoholism, clinical and experimental research*, 40(2), 256.

Patrick, M. E., Crouce, J. M., Fairlie, A. M., Atkins, D. C., & Lee, C. M. (2016). Day-to-day variations in high-intensity drinking, expectancies, and positive and negative alcohol-related consequences. *Addictive behaviors*, 58, 110-116.

Patrick, M. E., Evans-Polce, R., Kloska, D. D., Maggs, J. L., & Lanza, S. T. (2017). Age-related changes in associations between reasons for alcohol use and high-intensity drinking across young adulthood. *Journal of studies on alcohol and drugs*, 78(4), 558-570.

Patrick, M. E., Terry-McElrath, Y. M., Miech, R. A., Schulenberg, J. E., O'Malley, P. M., & Johnston, L. D. (2017). Age-specific prevalence of binge and high-intensity drinking among US young adults: Changes from 2005 to 2015. *Alcoholism: Clinical and Experimental Research*, 41(7), 1319-1328.

Patrick, M. E., & Terry-McElrath, Y. M. (2017). High-intensity drinking by underage young adults in the United States. *Addiction*, 112(1), 82-93.

Patrick, M. E., Terry-McElrath, Y. M., Schulenberg, J. E., & Bray, B. C. (2017). Patterns of high-intensity drinking among young adults in the United States: A repeated measures latent class analysis. *Addictive behaviors*, 74, 134-139.

- Patrick, M. E., Terry-McElrath, Y. M., Lanza, S. T., Jager, J., Schulenberg, J. E., & O'Malley, P. M. (2019). Shifting age of peak binge drinking prevalence: historical changes in normative trajectories among young adults aged 18 to 30. *Alcoholism: Clinical and Experimental Research*, 43(2), 287-298.
- Patrick, M. E., & Terry-McElrath, Y. M. (2019). Prevalence of High-Intensity Drinking from Adolescence through Young Adulthood: National Data from 2016-2017. *Substance Abuse: Research and Treatment*.
- Patrick, M. E., Terry-McElrath, Y. M., & Bonar, E. E. (2021). Patterns and predictors of high-intensity drinking and implications for intervention. *Psychology of Addictive Behaviors*.
- Ramchandani, V., Morris, J., Swan, J., Gowin, J., Stangl, B., Schwandt, M., ... & Diazgranados, N. (2019). S205. "Super Bingers": Traits and Consumption Patterns Associated With High-Intensity Drinking. *Biological Psychiatry*, 85(10), S376-S377.
- Read, J. P., Beattie, M., Chamberlain, R., & Merrill, J. E. (2008). Beyond the "binge" threshold: Heavy drinking patterns and their association with alcohol involvement indices in college students. *Addictive behaviors*, 33(2), 225-234.
- Rehm, J., Mathers, C., Popova, S., Thavorncharoensap, M., Teerawattananon, Y., & Patra, J. (2009). Global burden of disease and injury and economic cost attributable to alcohol use and alcohol-use disorders. *The lancet*, 373(9682), 2223-2233.
- Rehm, J., Baliunas, D., Borges, G. L., Graham, K., Irving, H., Kehoe, T., ... & Taylor, B. (2010). The relation between different dimensions of alcohol consumption and burden of disease: an overview. *Addiction*, 105(5), 817-843.
- Skrzynski, C., Creswell, K. G., Bachrach, R. L., & Chung, T. (2018). Social discomfort

- moderates the relationship between drinking in response to negative affect and solitary drinking in underage drinkers. *Addictive behaviors*, 78, 124-130.
- Spillane, S., Shiels, M. S., Best, A. F., Haozous, E. A., Withrow, D. R., Chen, Y., ... & Freedman, N. D. (2020). Trends in alcohol-induced deaths in the United States, 2000-2016. *JAMA network open*, 3(2), e1921451-e1921451.
- Stewart, S. H., & Devine, H. (2000). Relations between personality and drinking motives in young adults. *Personality and individual differences*, 29(3), 495-511.
- Stewart, S. H., Loughlin, H. L., & Rhyno, E. (2001). Internal drinking motives mediate personality domain—drinking relations in young adults. *Personality and individual differences*, 30(2), 271-286.
- White, A. M., Kraus, C. L., & Swartzwelder, H. S. (2006). Many college freshmen drink at levels far beyond the binge threshold. *Alcoholism: Clinical and experimental research*, 30(6), 1006-1010.
- White, H. R., Anderson, K. G., Ray, A. E., & Mun, E. Y. (2016). Do drinking motives distinguish extreme drinking college students from their peers?. *Addictive behaviors*, 60, 213-218.