The role of temperament in alcohol use among college students

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ABSTRACT

Alcohol use and alcohol use disorder (AUD) among young adults are important public health concerns. The high prevalence and negative effects of alcohol use suggests that there is a need for improved understanding of the mechanisms underlying alcohol use. The current study utilizes the model of adult temperament proposed by Evans and Rothbart (2007) as the framework with which to examine the interplay among temperament domains and alcohol use. Specifically, we examined individual and interactive associations among self-report ratings of positive affect, negative affect, effortful control, orienting sensitivity and alcohol use patterns, among a large sample of college students. ANOVA and linear regression analyses indicated that positive affect was associated with engagement in hazardous alcohol use and binge drinking. Furthermore, effortful control was associated with reduced engagement in overall alcohol use. These results corroborate and extend previous work which suggests that positive affect and effortful control temperament domains are linked to alcohol use patterns in college-age young adults. These findings may serve as an important step for informed decision-making about prevention and intervention efforts related to problematic alcohol use in young adults.

1. Introduction

Numerous studies have documented the detrimental effects of alcohol use and alcohol use disorder (AUD) among young adults (Brown et al., 2009; White & Hingson, 2013). According to the 2018 National Survey on Drug Use and Health (NSDUH), 54.9% of full-time college students ages 18–22 years were current alcohol users (i.e., any use of alcohol in the past 30 days), 36.9% were binge alcohol users (i.e., drinking five or more drinks on the same occasion at least once in the past 30 days), 9.6% were heavy alcohol users (i.e., binge drinking on 5 or more days in the past 30 days; SAMHSA, 2018), while 20% of college students meet criteria for an AUD (NIAAA, 2020). The high prevalence and well-documented negative effects of alcohol use, including binge drinking and AUDs, suggests that there is a need for improved understanding of the mechanisms underlying harmful alcohol use in this population.

The World Health Organization (WHO) defines hazardous alcohol use as "a pattern of alcohol consumption that increases the risk of harmful consequences for the user or others and that results in consequences to physical and mental health", and alcohol use disorder as "a cluster of behavioral, cognitive, and physiological phenomena (i.e., a strong desire to consume alcohol, impaired control over its use, persistent drinking despite harmful consequences) that may develop after repeated alcohol use" (WHO, 2001).

In order to address who is at greatest risk for engaging in hazardous alcohol use, it is imperative to understand the factors that characterize these groups of alcohol users. One potential mechanism underlying hazardous alcohol use may be temperament, which has been previously linked to alcohol use (Cheetham, Allen, Yücel, & Lubman, 2010; Howard, Patrick, & Maggs, 2015). Herein, we utilize temperament to understand the individual differences that lead to alcohol use among college students.

1.1. Temperament domains

The current study utilizes the model of adult temperament proposed by Evans and Rothbart (2007) given its theory-driven approach to understanding individual differences in adult temperament. Rothbart's model is comprised of the following four subdomains: extraversion (i.e., positive affect), negative affect, effortful control, and orienting

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sensitivity. Extraversion, or herein positive affect, is the extent to which one experiences positive emotions and mood, while negative affect is the extent to which one experiences negative or aversive emotions and mood (Evans & Rothbart, 2007). Importantly, positive affect and negative affect are orthogonal constructs (Tellegen, Watson, & Clark, 1999). Effortful control is the ability to inhibit a dominant response in order to perform a subdominant response, while orienting sensitivity is automatic attention given to both external and internal sensory events (Evans & Rothbart, 2009; Rothbart & Rueda, 2005)

1.2. Temperament and substance use

Studies on the association between positive affect and alcohol use have produced mixed results (Cyders et al., 2007; Simons, Wills, & Neal, 2014). Elevated positive affect in college students has been associated with elevated quantity and frequency of alcohol consumption, as well as a greater number of heavy drinking days (Howard et al., 2015; Rankin & Maggs, 2006). Conversely, other studies have reported that positive affect is a protective factor against substance use. For example, Wills et al. (2001) found that positive emotionality was inversely associated with alcohol consumption, such that higher levels of positive emotionality were associated with lower levels of alcohol use. A review of the literature conducted by Lopez-Vergara, Spillane, Merrill, and Jackson (2016) found that while some studies establish a positive association between trait positive affect and college student drinking, other studies report no association or a negative association. Therefore, whether higher levels of positive affect are associated with an increase or decrease in alcohol use remains unclear.

To date, the work on the impact of negative affect on alcohol use has produced mixed results. Although there exists evidence supporting the positive correlation between levels of negative affect and substance use, some studies have noted no association between negative affect and alcohol use (Howard et al., 2015) while others have documented a negative association (Bresin & Fairbairn, 2019; Patrick, Yeomans-Maldonado, & Griffin, 2016). Further, individuals who experience higher levels of negative affect are at an elevated risk for using drugs or alcohol, perhaps as a coping mechanism to provide a distraction from unpleasant feelings (Cheetham et al., 2010). Among undergraduate students, those with higher levels of negative affect experience higher levels of solitary drinking and this, in turn, leads to an increase in harmful drinking behaviors (Bilevicius, Single, Rapinda, Bristow, & Keough, 2018; Gonzalez & Skewes, 2013). However, the authors note that the students were in their first semester and, as such, results may not generalize to future college years where the amount of drinking may likely increase. The current study population includes participants across a wide college student age-range, which serves to address this prior limitation. Of note, prior work suggests that college-age students with higher levels of negative affect are more likely to engage in drinking as a means to cope, which may consequently lead to higher problematic outcomes (Merrill, Wardell, & Read, 2013). The current study aims to provide clarity regarding this association through assessing levels of negative affect in a large sample of college students while differentiating among a range of alcohol severity levels.

There is considerable longitudinal evidence linking effortful control to problematic substance use (Chassin, Ritter, Trim, & King, 2003; Mun, Dishion, Tein, & Otten, 2018; Wills, Walker, & Resko, 2005). Specifically, lower self-regulation (one form of effortful control) appears to serve as a risk factor for experiencing negative alcohol-related consequences, and individuals with lower self-regulation show modest reductions in alcohol use over time compared to those with higher self-regulation (Hustad, Carey, Carey, & Maisto, 2008). In assessing the progression of alcohol use from adolescence to adulthood, higher levels of adolescent effortful control are associated with reduced rates of problematic substance use through early adulthood among at-risk youth (Mun et al., 2018). While previous studies utilizing longitudinal designs have linked effortful control to alcohol use, they have focused solely on

students with heavy drinking patterns. Thus, more work is needed on typical college-age populations with variability in their alcohol use patterns to allow for greater generalization of the results. The current study aims to address prior limitations in the literature by assessing associations between temperament and a range of alcohol use patterns among a large sample of typically developing college students.

Orienting sensitivity is an attention-linked temperament construct (Evans & Rothbart, 2007). It is the ability to be cognizant of a stimulus of low intensity in the environment (Greven et al., 2019; Wiltink, Vogelsang, & Beutel, 2006). To our knowledge, no prior work has been conducted on the link between orienting sensitivity and alcohol use. Until now, work on orienting sensitivity has focused primarily on the association with perceptual sensitivity, punishment and reward reactivity (Bolders, Tops, Band, & Stallen, 2017), and stress in response to negative environments (Greven et al., 2019; Soons, Brouwers, & Tomic, 2010). As such, we chose to include it in the model in an effort to perform sensitivity analysis.

Cheetham et al. (2010) note that most studies examining associations among temperament domains and substance use have focused on the domains individually, ignoring the interactions among temperament domains in predicting substance use. Few studies have examined the role of multiple temperament domains on substance use broadly (Cheetham et al., 2015; Rioux, Castellanos-Ryan, Parent, & Séguin, 2016), though these studies have focused on other substances, such as cigarettes, and solely on the adolescent population. Therefore, the specific role that interaction effects among temperament domains may play in alcohol use among young adults remains underexplored. Herein, we consider the interaction among these variables, specifically effortful control, and its effect in attenuating or exacerbating the association between affect and alcohol use. While the impact of effortful control on alcohol use has been established, its effect on positive and negative affect and alcohol use remains under question. Broadly, we address this gap by examining the individual and interactive associations among positive affect, negative affect, and effortful control, as well as alcohol use, within a large sample of typically developing college-age students.

1.3. The present study

In the present study, we sought to examine individual and interactive associations among self-report ratings of positive affect, negative affect, effortful control, orienting sensitivity and alcohol use patterns, including non-hazardous alcohol use, hazardous alcohol use, and binge drinking, among a large sample of college-age students. Based on previous literature, it was hypothesized that (1) higher levels of positive affect will be associated with an increase in hazardous alcohol use, (2) higher levels of negative affect will be associated with greater problematic alcohol use broadly, (3) higher levels of effortful control will be associated with lower levels of hazardous alcohol use and lower levels of binge drinking, (4) orienting sensitivity will not be associated with any form of alcohol use, and (5) effortful control will moderate the associations between positive and negative affect on alcohol use, such that lower levels of effortful control will exacerbate the association between positive affect and hazardous alcohol use, and higher levels of effortful control will attenuate the association between negative affect and alcohol use. Understanding the associations among these variables will provide a greater understanding of the potential risk factors for alcohol-related problems in young adults. The current study may provide additional insight and may be an important step for informed decision-making about prevention and intervention efforts related to problematic alcohol use in young adults.

2. Method

2.1. Participants

To examine associations among temperament domains and alcohol

use patterns, 696 undergraduate students were recruited from Florida International Univeristy in Miami, Florida. Participant demographic data is provided in Table 1. Of the 696 participants, 69.8% identified as female. Participants were between the ages of 18 and 25 years (M = 20.92, SD 1.91), and represented the following racial groups: 64.9% White, 12.1% Black/African American, 4.0% Asian/Asian American, 0.4% Hawaiian/Pacific Islander, 0.6% Native American/Alaskan Native, and 2.2% identified as multi-racial. The majority of the sample identified as Hispanic/Latinx (i.e., 73.2%). Race and ethnicity data for the sample are consistent with the demographics of the greater Miami metropolitan area.

Measures of current mood and depressive symptoms of participants (Beck Depression Inventory-II; Beck Anxiety Inventory) were assessed in non-hazardous and hazardous alcohol use groups (see Table 1). Additionally, other substance use including nicotine and marijuana were assessed, and proportions for each alcohol use group was included in Table 1. Binge drinking was assessed utilizing question 3 of the Alcohol Use Disorder Identification Test (AUDIT) given its reliability as a good indicator of episodes of binge drinking. Results are shown in Table 1.

2.2. Procedure

Self-report measures were completed via Qualtrics (www.qualtrics.com). Participants consisted of undergraduate students enrolled in courses offered through the Department of Psychology. Participants provided informed consent prior to completing surveys. They received extra credit as compensation. Participants between the ages of 18 and 25 years were included in the analysis. The Florida International University Institutional Review Board approved the study. All procedures conformed to the Ethical Principles of Psychologists and Code of Conduct (APA, 2010).

2.3. Measures

2.3.1. Alcohol Use Disorders Identification Test (AUDIT)

Participants completed the Alcohol Use Disorders Identification Test (AUDIT), a 10-item screening tool developed by the World Health Organization (WHO, 2001) that assesses alcohol consumption, drinking

behaviors, and alcohol-related problems. The self-report version includes questions such as: *How many drinks containing alcohol do you have on a typical day when you are drinking?* and *During the past year, how often have you had a feeling of guilt or remorse after drinking?* Participants are asked to respond to questions on a 5-point scale. AUDIT scores of 8 or more is considered to indicate hazardous or harmful alcohol use (WHO, 2001). Additionally, given the importance of binge drinking to prior outcomes within our age range, associations between binge drinking and temperament were also assessed. Question 3 of the AUDIT was used to assess binge drinking: *How often do you have six or more drinks on one occasion?* The AUDIT has demonstrated strong psychometric properties to detect alcohol use in college students (García Carretero, Novalbos Ruiz, Martínez Delgado, & O'Ferrall González, 2016) and demonstrated good internal validity within this sample (α = 0.71).

Herein, we utilize the AUDIT to identify alcohol use patterns and follow the developer's clinical cut-off scores and appropriate terminology. Therefore, we utilize the term "hazardous" (e.g., harmful) alcohol use to define any score with a clinical cut-off of 8 or more for both genders (WHO, 2001). We first intended to divide our sample into three separate groups (e.g., non-hazardous, hazardous, and potential AUD), although given the low membership in the AUD group in our sample (n = 30), we ultimately created two groups: non-hazardous (n = 562) and hazardous (n = 134).

2.3.2. Adult Temperament Questionnaire (ATQ)

To assess temperament, participants completed the short-form of the Adult Temperament Questionnaire (ATQ; Evans & Rothbart, 2007). The ATQ is a 77-item self-report measure, and was utilized given its advantage in distinguishing between motivational-emotional and attentional constructs, allowing for a more fine-grained conceptualization of how emotion and cognition might be distinct yet also interactive (Evans & Rothbart, 2007). The measure assesses the following temperament domains: negative affect, extraversion/surgency (i.e., positive affect), effortful control, and orienting sensitivity. The ATQ does not include affiliativeness as a domain and, therefore, was not included in this analyses. Participants responded to individual items using a 7-point scale, ranging from 1 (extremely untrue) to 7 (extremely true). The ATQ has good internal and external validity (Evans & Rothbart, 2007;

Table 1
Descriptive statistics for Non-hazardous Alcohol Use and Hazardous Alcohol Use groups.

Variable	Non-Hazardous ($n = 562$)	Hazardous ($n = 134$)	F/χ^2	p	$\eta p2$</Cramer's V<
Demographics					
Age, mean (*SD*)	20.91 (1.86)	21.16 (1.91)	2.049	0.153	0.119
Sex			4.103	0.043	0.077
% Female	77.20	68.70			
% Male	22.80	31.30			
Race			7.198	0.206	0.110
% Native American	0.6	0.9			
% Hawaiian or Pacific Islander	0.6	0.0			
% Asian/Asian American	5.2	2.7			
% Black/African American	14.6	7.2			
% Caucasian	76.7	85.6			
% Multiple	2.3	3.6			
Ethnicity			0.711	0.399	0.032
% Hispanic	75.7	79.2			
% Non-Hispanic	24.3	20.8			
Depression and Anxiety Symptoms					
BDI, mean (SD)	31.61 (10.49)	35.33 (11.29)	12.647	<0.001	0.019
BAI, mean (SD)	30.84 (10.24)	35.35 (12.68)	17.132	<0.001	0.026
Other Substance Use					
%Nicotine/Tobacco	22.80	59.0	67.779	<0.001	0.312
%Marijuana	40.90	82.10	73.377	<0.001	0.325
%Binge Drinking	10.90	73.90	242.780	<0.001	0.591

Note. % = percentage; *SD* = Standard Deviation; Non-Hazardous Alcohol Use: AUDIT score < 8; Hazardous Alcohol Use: AUDIT score > 8. Missing data handled via listwise deletion. BDI: Beck Depression Inventory. BAI: Beck Anxiety Inventory. Nicotine/Tobacco and Marijuana: "Ever tried, even just one time". Binge Drinking: item 3 of the AUDIT.

Gomez, Watson, & Gomez, 2016). All subscales demonstrated acceptable internal consistency: extraversion/surgency (α = 0.67), negative affect (α = 0.78), effortful control (α = 0.74) and orienting sensitivity (α = 0.73).

2.3.3. Mood symptom questionnaires

The Beck Depression Inventory (BDI-II) was utilized to assess for participant's current depressive symptoms. The BDI is a 21-item, self-report rating inventory that measures characteristic attitudes and symptoms of depression (Beck, Steer, & Brown, 1996). The BDI-II has high internal consistency (α = 0.90). The Beck Anxiety Inventory (BAI) is a 21-item self-report inventory for measuring the severity of anxiety in psychiatric populations, shows high internal consistency (α = 0.92), and was utilized in the current study (Beck, Epstein, Brown, & Steer, 1988).

2.4. Data analytic plan

ANOVA and linear regression with and without covariates were conducted using SPSS version 25 (SPSS Inc., Armonk, NY). Missing data was handled via listwise deletion. Variables ranged on missing data in 1.2–14.1% of cases. Amount of missing data across temperament variables did not differ according to levels of alcohol use (all $\chi^2 < 4.20$, all p > .16).

Following correlation analyses, it was noted that age, sex, race, and ethnicity were significantly associated with primary study variables (i. e., alcohol use groups, temperament groups) and were included as covariates (see Table 2).

In an exploratory third step, we separately probed interactions among positive affect and effortful control, and negative affect and effortful control, to identify the effect that these temperament domains have on the association among alcohol use and affect. To do so, we specified individual two-way interactions between effortful control with (1) positive affect and (2) negative affect to predict alcohol use. The

PROCESS macro (Hayes, 2017) was used to conduct moderation analyses in SPSS and examine the interaction of effortful control and positive and negative affect in predicting alcohol use. The PROCESS macro can perform a number of moderation analyses and provides conditional effects (www.processmacro.org).

2.5. Power analysis

G*Power (Faul, Erdrelder, Lang, & Buchner, 2007) revealed that with a sample size of 696, ANCOVA both with and without interaction terms with three groups would each have adequate power (b > 0.99, p < .05) to detect medium effects (*Cohen's d > 0.30*). This was also the case for linear regression analyses.

3. Results

3.1. Preliminary analyses

As presented in Table 1, non-hazardous alcohol users and hazardous alcohol users differed only marginally according to sex $\chi^2(2) = 4.103$, p = .043, though did not differ according to race $\chi^2(10) = 7.198$, p = .206, ethnicity $\chi^2(2) = 0.711$, p = .399, *Cramer's V* = 0.032, or age $\chi^2(20) = 2.049$, p = 153, *Cramer's V* = 0.119. Refer to Table 1 for further information.

3.2. Primary analyses

3.2.1. Positive affect

ANOVA revealed significant differences in positive affect according to alcohol use group, $F(1, 693) = 4.317$, p = .038, $\eta_p^2 < 0.006$. Specifically, participants in the hazardous group (M = 14.17, SD = 2.11) had significantly higher positive affect scores compared to the non-hazardous group (M = 13.73, SD = 2.19). Additionally, binge drinkers

Table 2
Correlations between Study Variables.

	1	2	3	4	5	6	7	8	9	10	11
1. Age											
2. Sex	0.022										
3. Race	−0.007	0.039									
4. Ethnicity	−0.050	0.004	−0.392**								
5. Continuous	0.115**	−0.048	0.087*	−0.079*							
6. Hazardous	0.054	−0.077*	0.084*	−0.032	0.790**						
7. Binge	0.075*	−0.015	0.038	−0.054	0.665**	0.591**					
8. PA	−0.021	0.009	0.067	−0.093*	0.110**	0.079*	0.143**				
9. NA	−0.121**	0.246**	−0.050	0.044	0.038	0.033	0.001	−0.270**			
10. EC	0.083*	−0.074*	−0.045	0.027	−0.173**	−0.162**	−0.093*	0.093**	−0.455**		
11. OS	−0.102**	0.030	−0.052	0.029	0.050	0.031	0.021	0.332**	0.122**	0.058	

Note. **p < .01, *p < .05. Continuous = Continuous scores on Alcohol Use Disorders Identification Test (AUDIT) score; Hazardous = Hazardous Alcohol Use, AUDIT score > 8; Binge: Binge Drinking, AUDIT item 3; PA = Positive Affect; NA = Negative Affect; EC = Effortful Control; OS = Orienting Sensitivity.

Table 3
One-Way Analysis of Variance of the association among temperament domains on Non-Hazardous, and Hazardous groups and among Non-Binge Drinkers and Binge Drinkers.

Variable (mean, SD)	Non-Hazardous (n = 562)	Hazardous (n = 104)	F (1, 693)	p	$\eta p^2 </$
Positive Affect	13.73 (2.19)	14.17 (2.11)	4.317	0.038	0.006
Negative Affect	15.67 (2.79)	15.90 (2.68)	0.748	0.387	0.001
Effortful Control	13.05 (2.24)	12.12 (2.19)	18.648	<0.001	0.026
Orienting Sensitivity	13.97 (2.39)	14.17 (2.33)	0.683	0.409	0.001
Variable (mean, SD)	**Non-Binge Drinking (n = 566)**	**Binge Drinking (n = 169)**	**F (1, 734)**	**p**	**$\eta p^2 </$**
Positive Affect	13.65 (2.16)	14.39 (2.18)	15.297	<0.001	0.020
Negative Affect	15.69 (2.77)	15.70 (2.72)	0.001	0.982	0.000
Effortful Control	13.00 (2.28)	12.51 (2.07)	6.360	0.012	0.009
Orienting Sensitivity	13.97 (2.38)	14.09 (2.30)	0.337	0.562	0.000

Table 4

Summary of Linear Regression Analysis and Moderation Analyses examining the association among temperament domains on Alcohol Use as a continuous measure.

Variable	F	B/b	p	R^2/t
Linear Regression Analysis	**F (1, 693)**	**B**	***p***	R^2
Positive Affect	8.549	0.227	<0.01	0.012
Negative Affect	1.017	0.062	0.314	0.001
Effortful Control	21.466	-0.345	<0.001	0.030
Orienting Sensitivity	1.706	0.092	0.192	0.001
Moderation Analysis 1	**F (7, 559)**	**b**	***p***	R^2
Overall model PA X EC	5.731		<0.001	0.067
Positive Affect		0.2566	<0.001	3.349(t)
Effortful Control		-0.3708	<0.001	−4.973(t)
EC (moderator)		0.0274	0.354	0.9276(t)
Moderation Analysis 2	**F (7, 558)**	**b**	***p***	R^2
Overall model NA X EC	4.258		<0.001	0.051
Negative Affect		-0.084	0.221	−1.226(t)
Effortful Control		-0.392	<0.001	−4.657(t)
EC (moderator)		0.012	0.604	0.519(t)

Note. % = percentage; *SD* = Standard Deviation; Missing data handled via listwise deletion. PA = Positive Affect; EC = Effortful Control; NA = Negative Affect. Age, sex, race, and ethnicity were included in the moderation analyses.

were found to have higher positive affect (M = 14.39, SD = 2.18) than non-binge drinkers (M = 13.65, SD = 2.16), $F(1, 734) = 15.297$, $p = $ <0.001 (Table 3).

The linear regression model examining the association between positive affect and alcohol use treated continuously revealed a significant, positive association, $F(4,563) = 3.34$, B = 0.212, $p = .010$, $R^2 = 0.023$. Results held when including age, sex, race, and ethnicity as covariates (Table 4).

3.2.2. Negative affect

No significant differences were found in negative affect scores among non-hazardous (M = 15.67, SD = 2.79) and hazardous (M = 15.90, SD = 2.68) drinkers, $F(1,693) = 0.748$, $p = .387$, $\eta_p^2 < 0.001$. No significant differences were found in negative affect among binge drinkers (M = 15.70, SD = 2.72) and non-binge drinkers (M = 15.69, SD = 2.77), $F(1, 734) = 0.001$, $p = .982$ (Table 3).

The linear regression model similarly indicated no significant association, $F(4,562) = 1.875$, B = 0.062, SE = 0.068, $p = .113$, $R^2 = 0.013$. Results held when including age, sex, race, and ethnicity as covariates (Table 4).

3.2.3. Effortful control

The ANOVA revealed significant differences in effortful control according to alcohol use group, $F(1,693) = 18.648$, $p < .001$, $\eta_p^2 < 0.026$. Specifically, participants in the non-hazardous group (M = 13.05, SD = 2.24) had significantly higher levels of effortful control compared to the hazardous group (M = 12.12, SD = 2.19). Additionally, non-binge drinkers were found to have higher effortful control (M = 13.00, SD = 2.28) than binge drinkers (M = 12.51, SD = 2.07), $F(1, 734) = 6.360$, $p = .012$ (Table 3).

The linear regression model revealed a significant, negative association, $F(4,562) = 4.742$, B = −0.279, SE = 0.080, $p = .001$, $R^2 = 0.033$ (Table 4).

3.2.4. Orienting sensitivity

No significant differences were found among non-hazardous (M = 13.97, SD = 2.39) and hazardous (M = 14.17, SD = 2.33) groups, $F(1, 693) = 0.683$, $p = .409$, $\eta_p^2 < 0.001$. Additionally, no significant differences were found in orienting sensitivity among binge drinkers (M =
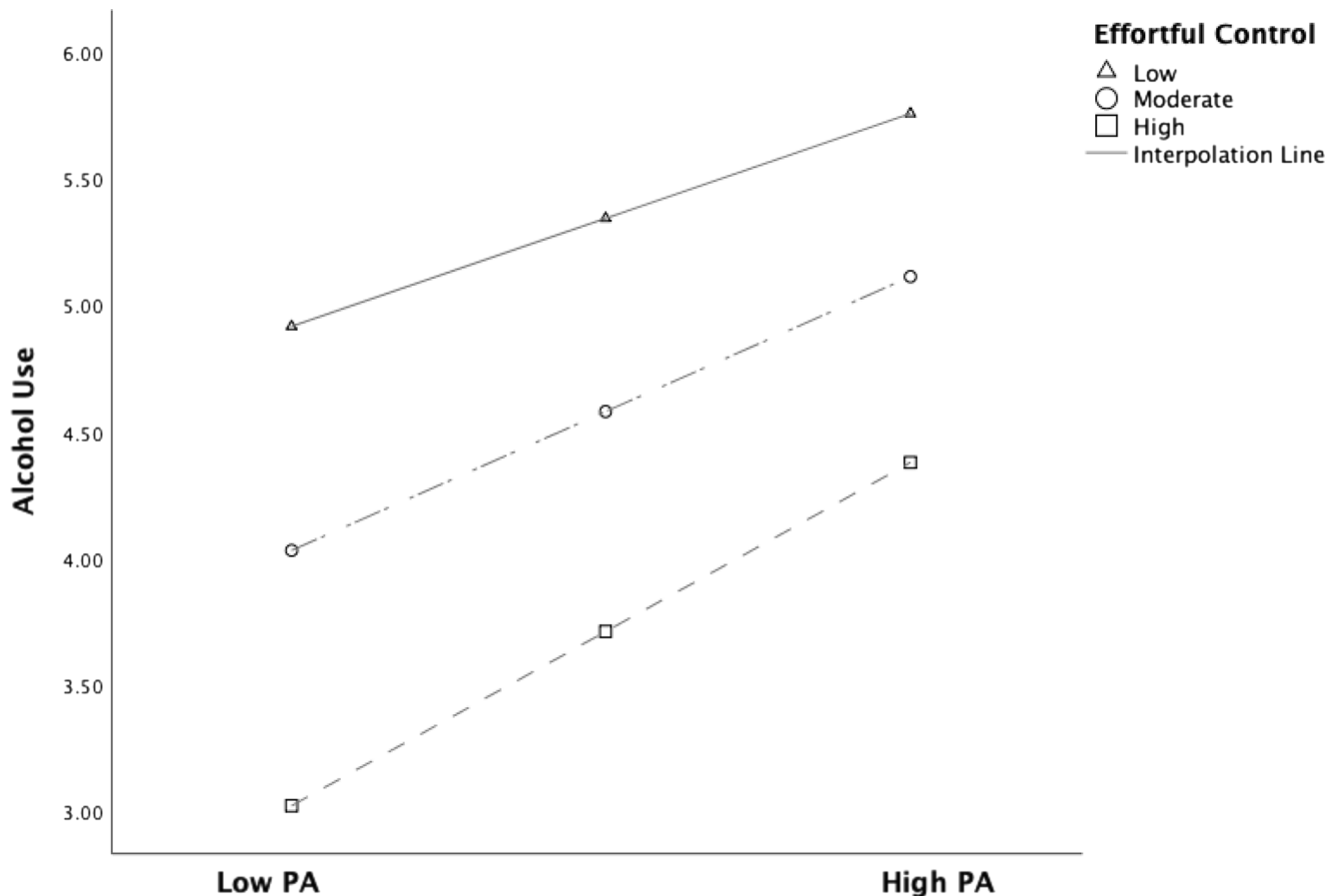

Fig. 1. Moderation analysis: the association between positive affect and alcohol use at low, moderate, and high levels of effortful control, p < .001. PA = Positive Affect.

14.09, SD = 2.30) and non-binge drinkers (M = 13.97, SD = 2.38), $F(1, 734) = 0.337$, $p = .562$ (Table 3).

Finally, the linear regression model indicated no significant association, $F(4, 561) = 2.100$, B = 0.097, SE = 0.078, $p = .079$, $R^2 = 0.015$. Results held when including age, sex, race, and ethnicity as covariates (Table 4).

3.3. Moderation analyses

A moderation analysis was conducted to examine the effects of effortful control on the association between positive affect and problematic alcohol use as a continuous measure. Herein, positive affect was included as the independent variable and AUDIT scores as the dependent variable, while effortful control was included as the moderator variable, and age, sex, race, and ethnicity were included as covariates. The overall model was significant $F(7, 559) = 5.731$, $p < .001$, $R^2 = 0.067$, as seen in Fig. 1. However, while both positive affect b = 0.2566, $t(690) = 3.349$, $p < .001$ and effortful control b = −0.3708, $t(690) = −4.973$, $p < .001$ were unique predictors of alcohol use, effortful control was not observed to moderate the association b = 0.0274, $t(690) = 0.9276$, $p = .354$ (Table 4).

A moderation analysis was conducted to examine the effects of effortful control on the association between negative affect and alcohol use. Herein, negative affect was included as the independent variable and AUDIT scores as the dependent variable, while effortful control was included as the moderator variable, and age, sex, race, and ethnicity were included as covariates. The overall model was significant, $F(7,558) = 4.258$, $p < .001$, $R^2 = 0.051$, as seen in Fig. 2. While negative affect b = −0.084, $t(689) = −1.226$, $p = .221$ was not a unique predictor of alcohol use, effortful control b = −0.392, $t(689) = −4.657$, $p < .001$ remained uniquely associated with drinking behavior among college students. Furthermore, effortful control was not observed to moderate

the association b = 0.012, $t(689) = 0.519$, $p = .604$ (see Table 4).

4. Discussion

The current study sought to examine the associations between positive affect, negative affect, effortful control, orienting sensitivity and specific alcohol use patterns, including non-hazardous, hazardous alcohol use, and binge-drinking in college-age students. In line with our hypotheses, results indicate that college students with higher levels of positive affect are more likely to engage in hazardous alcohol use and binge drinking. In contrast to our hypothesis, negative affect was not found to be associated with alcohol use broadly. More work is needed to understand this association and the role that negative affect plays in relation to problematic alcohol use. Furthermore, in line with our hypothesis, we found that students with higher levels of effortful control endorsed lower levels of overall alcohol use. Finally, as expected, no association was observed between orienting sensitivity and alcohol use in our population. Overall, when conceptualizing hazardous alcohol use on a continuum from low- to high- risk, our results indicate that higher levels of positive affect (e.g., positive emotions and mood) lead to a higher risk of engaging in alcohol use, while higher levels of effortful control, or the ability to inhibit a response, lead to lower levels of alcohol use.

When assessing the moderating effects of effortful control on the association between positive affect and problematic alcohol use, we found that effortful control did not moderate associations between positive affect and problematic alcohol use. Rather, positive affect and effortful control seem to be independent risk and protective factors (Kraemer, Stice, Kazdin, Offord, & Kupfer, 2001) for problematic alcohol use among college students.

The findings support and extend previous work on temperament domains and problematic alcohol use among a large and diverse sample
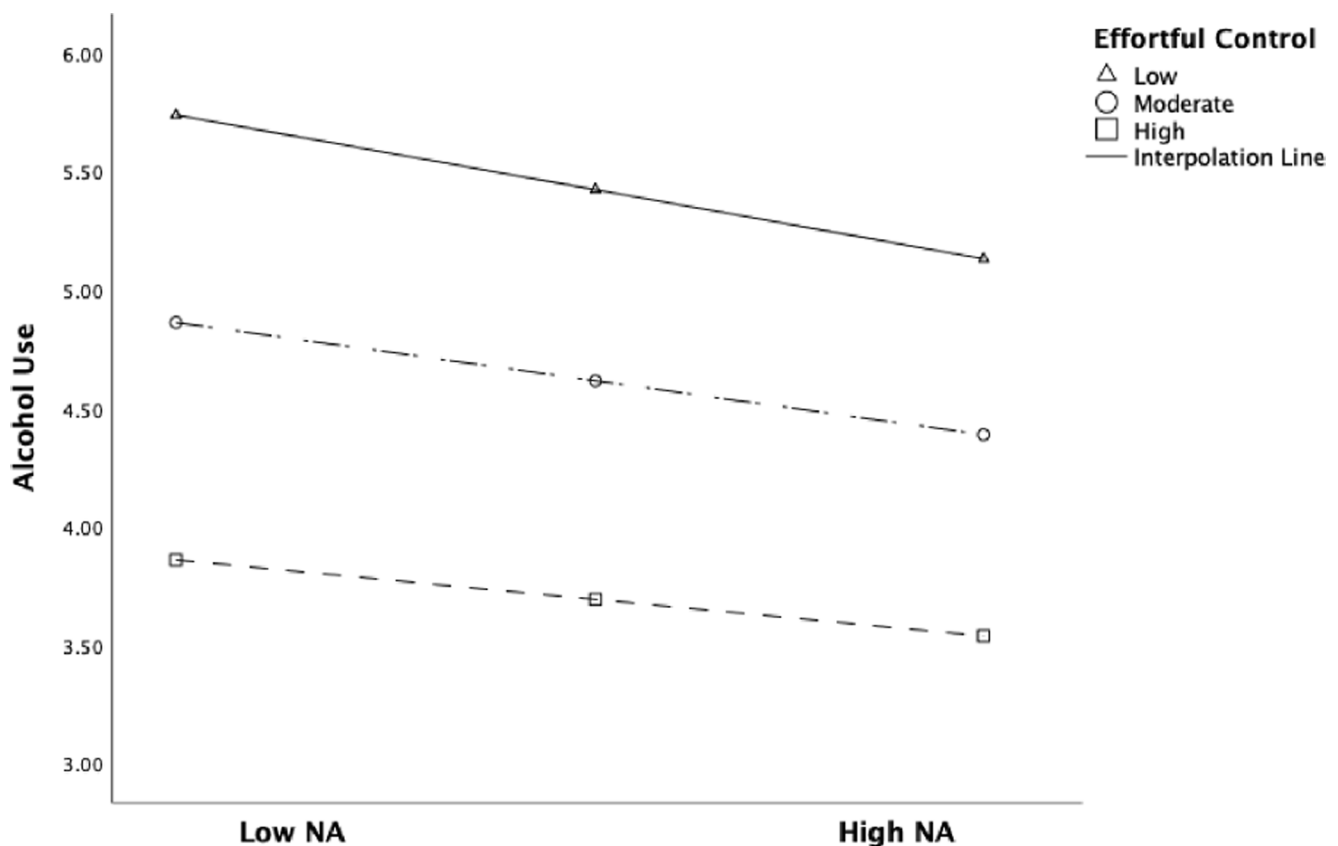

Fig. 2. Moderation analysis: the association between negative affect and alcohol use at low, moderate, and high levels of effortful control, p < .001. NA = Negative Affect.

of college-age young adults. Generally, our results corroborate previous findings (Howard et al., 2015; Hustad et al., 2008), indicating that positive affect and effortful control play a vital role in a young adult's alcohol use behavior. Additionally, the current study provides useful information surrounding the temperament characteristics that potentially underlie problematic alcohol use in young adults. The findings also shed light on the importance of addressing temperament variability to help prevent or diminish alcohol use engagement, especially given the high prevalence of alcohol use in college students and emerging adults (Bilevicius et al., 2018; SAMHSA, 2018) and to avoid the engagement of further substance use (Miller et al., 2016). For example, high levels of positive affect may serve as a risk factor for experiencing hazardous alcohol consumption and related consequences, while high levels of effortful control may serve as a protective factor. The findings of the present study may inform prevention, assessment, and intervention strategies for alcohol use among young adults by understanding the underlying temperament domains that may put college students at risk for problematic drinking behaviors. For instance, clinicians may benefit from targeting at-risk youth that are exhibiting high positive affect and low effortful control to reduce levels of hazardous alcohol use as they enter adulthood. Future research may benefit from these findings in the use of temperament domains (i.e., positive affect, effortful control) as either risk or protective factors when examining overall alcohol use and related consequences in college-aged youth, as well as in identifying treatment and prevention targets.

The results of this study should be considered in the context of several limitations. First, given the cross-sectional design of the study, we were not able to make causal inferences and future longitudinal work is needed. A second limitation of this study is the reliance on self-report measures where participants' responses may be influenced by their willingness and/or ability to accurately report on alcohol use and temperament. Future work would benefit from utilizing non-self-report (i.e., behavioral, diagnostic interviews, biological specimens, physiological) measures of alcohol use and temperament domains. Third, the current study did not exclude voluntary abstinent participants which may contribute to "noise" in the data. Future work may benefit from excluding participants who choose not to engage in alcohol use due to various reasons. Finally, the sample consisted of students attending college which may not generalize to other young adult populations (i.e., non-college attending individuals).

In conclusion, our findings corroborate and extend previous work which suggests that variations in temperament domains (i.e., positive affect, effortful control) are linked to alcohol use patterns (i.e., hazardous drinking) in college-age young adults. These findings provide an understanding of the underlying temperament domains in college students which may serve as an important step for informed decision-making about prevention, intervention, and treatment efforts for young adults engaging in problematic alcohol use.

5. Author agreement

All authors have seen and approved the final version of the manuscript. The current article is the authors' original work, hasn't received prior publication and isn't under consideration for publication elsewhere.

CRediT authorship contribution statement

Rosario Pintos Lobo: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Validation, Visualization, Writing - original draft, Writing - review & editing. **Stephanie M. Morris:** Formal analysis, Resources, Writing - review & editing. **Julio Yanes:** Conceptualization, Data curation, Investigation, Resources. **Rachel Tenenbaum:** Resources, Validation. **Kathleen Feeney:** Resources, Validation. **Erica D. Musser:** Conceptualization, Funding acquisition, Investigation, Methodology, Project administration, Supervision, Validation, Writing - review & editing.

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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