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Abstract

The dual process theory proposes two forms of cognitive processing: implicit and explicit. The goal of the current study is to further investigate the dual process model of risky drinking, exploring the roles of executive functioning, implicit attitudes, and stress. 98 students from the University of Richmond participated in this study. After reading a stressful vignette, significant changes in Implicit Association Test (IAT) scores indicated that stress does heighten implicit "approach" associations for alcohol. Interestingly, when separated into low and high self-restraint groups, only participants with high self-restraint were significantly affected by the vignette. After testing for interaction effects, our study partially supported the dual process theory, indicating that self-restraint and implicit alcohol approach associations predict unique variance in heavy weekend drinking. Executive functioning—specifically self-restraint—most strongly predicted risky drinking across all measures.

A Dual Process Model of Stress Effects on Alcohol Consumption

Excessive drinking, or consuming large quantities of alcohol in one sitting, is the most significant health risk among college students. Officially defined as four or more alcoholic beverages in a sitting for women and five for men, binge drinking is not only acceptable, but often expected during college years. (Young, Morales, McCabe, Boyd, & D'Arcy, 2005). Across college campuses, virtually all aspects of daily functioning are affected by or involved in "heavy alcohol consumption" (Young et al., 2005). With drinking so prevalent in this population, unearthing the reasoning for excessive consumption is a vital question plaguing educators, parents, and researchers alike.

One prevailing reason for drinking, in both college students and adults, is stress. College students are catapulted into an unfamiliar, alcohol-soaked environment while simultaneously plagued by an immense amount of stress. Intensive course work, new living situations, and lack of an immediate social support system are only a few examples. Drinking, to cope or escape this stress, has been correlated with higher levels of alcohol consumption and problem drinking, which can lead to alcohol dependence (Park & Levenson, 2002; Grunberg, Moore, Anderson-Connolly, & Greenberg, 1999; Carrigan, Ham, Thomas, & Randol, 2008). While heavy drinking is so prevalent, the reasoning behind students' attraction to alcohol is still widely debated.

Modern day college students are not the first to turn towards alcohol to deal with stressful situations. From Grecian poets to Shakespeare, alcohol consumption has long been cited as a stress reduction mechanism (Sayette, 2000). The tension- reduction hypothesis asserts that drinking reduces stress and furthermore, in times of distress, people will be especially motivated to consume alcohol. Individual differences, such as deficits in controlling behavior and low

cognitive performance (difficulty organizing new information), account for the increased amounts of stress reduction when consuming alcohol (Sayette, 2000).

While many cite stress as a motivation for alcohol consumption, behavior is controlled by more than conscious decision-making; unconscious cognitive processes drive behavior as well. The Dual Process Theory asserts that two distinct but interdependent cognitive systems exist; a controlled system that focuses on conscious decision-making and logical processes, and an automatic system that utilizes unconscious, reflexive processes (Evans & Coventry, 2006). It can be conceptualized as two general processes: one that is motivated by rational problem solving, and another that is undirected and based on subconscious associations (Evans & Coventry, 2006).

The pros and cons of a situation are not always reflected upon before a decision is made: automatic cognitive processes influence attention, memory, and feelings (De Houwer, 2002). These processes can affect the creation and maintenance of addictive behaviors by manifesting attentional biases, memory associations, and a tendency to approach a substance (Stacy & Weirs, 2010). Several studies have shown that these instinctive processes predict risky drinking behavior and negative problems associated with alcohol consumption (Houben & Weirs, 2006; Ostafin & Palfai, 2006). Specifically, Greenwald et al. (1998) demonstrated the effect of automatic associations on memory: the more strongly associated certain concepts are, the quicker they will be triggered and acted upon when faced with a decision.

Research has indicated that the Implicit Associations Test (IAT) is an effective measure of these automatic attitudes and beliefs about drinking (Greenwald et al, 1998). A study using hazardous drinkers (those who scored 8 or higher on the Alcohol Use Disorders Identification Test) found that IAT scores correlated with binge drinking frequency and explicit measures of

drinking motivations (Ostafin & Palfai, 2006). This study was a replication of Palfai & Ostafin's (2003) study, which suggested that alcohol-related stimuli automatically elicit the approach response in heavy drinkers. In a study by Lindgren, Neighbors, Kaysen, Zvorsky, & Westgate (2011), the tendency to approach alcohol was not only more pronounced in heavy drinkers, but enhanced under stress. As participants were stressed, by reading a vignette, they had a stronger mental association with alcohol and approach. These studies provide support for the IAT as a valid measure of both attitudes concerning alcohol and actual alcohol consumption.

The IAT reveals the automatic associations with drinking; however, it cannot account for the controlled and reflective decisions related to alcohol consumption. In order to investigate the other half of the Dual Process Theory, this study will explore executive functioning. Though an array of definitions exists for executive functioning (EF), we will use a concise explanation: cognitive processes that organize behavior to achieve future goals (Barkley & Murphy, 2010).

To highlight the impact of EF, it is important to look at disorders that fall under its control. For example, Attention-Deficit Hyperactivity Disorder (ADHD) is often described as an EF disorder with poor response inhibition as its central shortcoming (Barkley & Murphy, 2010; King, Barkley, & Barrett, 1998). In a recent study of subclinical levels of ADHD, Overbey, Snell, & Callis (2011) found that higher levels of ADHD symptoms predicted maladaptive coping strategies and negative reactions to stress. These participants were also likely to report disengaging from problems, denying the issue at hand, and resorting to alcohol or drug use (Overbey et al., 2011).

Problems with EF, as outlined in Barkley's Deficits in Executive Functioning Scale (Barkley, 2011), highlight issues with self-restraint and impulsivity, emotional regulation, and problem solving. Studies have indicated that people who exhibit difficulty controlling their

behavior and organizing new information may be more likely to utilize alcohol to cope with stress (Sayette, 2000; Carrigan, Ham, Thomas, & Randal, 2008). Stress has been found to increase the attentional bias towards alcohol for those that consume to cope (Field & Powell, 2007). If someone already displays deficits in EF, they may react negatively to a stressful event, and prone to utilize alcohol as a means of escape. This attentional bias would reinforce the coping mechanism, further increasing the risk for alcohol dependence. Deficits in executive functioning may therefore play an integral role in predicting risky drinking in tandem with the IAT, supporting the Dual Process Theory. Interestingly, little to no ecological validity has been found outside of clinical settings for executive functioning laboratory tests (Barkley & Murphy, 2010). We would like to investigate if the BDEFS can accurately predict actual alcohol consumption.

The current study is designed to further explore the dual process model of explicit and implicit cognitive process for alcohol consumption in an attempt to clarify the roles of executive functioning and implicit associations in relation to stress. Specifically, three research questions are investigated: does stress affect implicit attitudes towards alcohol (can we replicate the Lindgren et al. (2011) results)? Does the effect of stress on IATs depend on levels of Executive Functioning? Do EF and IATs predict risky drinking and, if so, independently or is there an interaction effect?

Method

Participants

Ninety-eight University of Richmond Students (77 females and 21 males) ranging from ages 18-25, with an average age of 19, participated in this study. 50% of this sample were freshman, 33% sophomores, 11% juniors, & 6% seniors or above. Our sample was

predominantly Caucasian, 80.6%, followed by 5.1% Asian, 5.1% Hispanic/ Latino, 5.1% other, and 4.1% African American.

Measures

Barkley Deficits in Executive Functioning Scale (BDEFS). The BDEFS (Barkley, 2011) is an 89 item questionnaire, which measures aspects of executive functioning across five subscales: self-management to time, self-organization/ problem solving, self-restraint, self-motivation, and self-regulation of emotions. Participants answered questions within each subscale using a 4-point Likert Scale, 1= Never or Rarely, 2= Sometimes, 3= Often, and 4= Very Often. Summary scores are calculated for each subscale, corresponding to percentile rankings for Executive Function symptoms, with higher scores corresponding to higher levels of deficit in that area. Overall the internal consistency of the BDEFS was strong ($\alpha = 0.97$) Internal consistency for the individual subscales was also very good (α range 0.89 to 0.94).

Implicit Association Test (IAT). A total of four IATs were included in this study. The IAT is a computerized task in which the stimuli are two target concepts (e.g., alcoholic beverage, non-alcoholic beverage) and two attributes (approach, avoid). Participants must pair the two attributes with each concept during different stages of this task. Designated keys are assigned to categorize a word or picture that is associated with the attribute into one of the two targets. If a concept and an attribute are highly associated, the response times during the IAT will be faster than if the two are not highly associated (Greenwald et al., 1998). For example, in this study, the two concepts will be alcohol and non-alcohol, while the attributes will be “approach” and “avoid” for one IAT and “cope” and “ignore” for the other.

We wanted to investigate whether stimuli presentation affected IAT scores, so both types of IATs (Approach and Cope) used word and picture stimuli. If a participant received the

approach IAT with words prior to the vignette, they then received the picture IAT post vignette. Word stimuli used for alcoholic beverages were: alcohol, beer, tequila, vodka, and rum. For non-alcoholic beverages, water, juice, milk, coffee, and Gatorade, were used. Picture stimuli consisted of these words in picture form, sized and formatted. All trials were counterbalanced according to task order and stimuli presentation.

Drinks Per Drinking Day (DPDD). The DPDD Chart (CASAA, 1995) allows participants to enter in the amount of drinks they typically consume for each day of the week. Each day is separated into morning, afternoon, and evening. Summary scores were calculated, separating weekdays from weekends (including Thursday).

Alcohol Use Disorder Identification Test (AUDIT). The AUDIT (Saunders, Aasland, Babor, De la Fuente, & Grant, 1993) contains 10 questions pertaining to risky drinking and negative consequences. Any summary score above an 8 is associated with hazardous drinking, while a score of 13 or more in women, and 15 or more in men, is likely to indicate alcohol dependence. Internal consistency for the AUDIT was robust ($\alpha = 1.00$).

Procedure

All procedures were reviewed and approved by the University's Institutional Review Board. Subjects were recruited using two different processes. University of Richmond Introduction to Psychology students had the option to sign up for the study via SONA, an online experiment management system, for one hour of course credit. The study was also advertised in the school's daily e-bulletin, Spiderbytes, sent to all undergraduates. Students who volunteered via Spiderbytes were compensated $10 for their time.

Upon arriving at the lab, all participants received an identification number used to link data within their record. Participants were aware that all of the information was completely anonymous in order to ensure their sense of security and honesty in responding to potentially sensitive questions. They were presented with the consent form and an opportunity to ask questions. Signatures were not collected in order to protect the anonymity of the participants; therefore, consent was in the form of checking a box, indicating they had read and agreed to the form.

After instructions about the computer tasks were provided, up to 6 people were led to the designated testing area; each assigned their own workstation with a privacy screen on the monitor. All tasks were completed within Medialab, starting with demographic questions including: gender, age, race, ethnicity, Greek life affiliation (binomial), intention of going Greek, and GPA. If students were first years in their first semester, they were asked to use their high school GPA. After demographics, the multiple-choice Religious Beliefs question (CASAA, 1994) was presented with 5 categories: Atheist, Agnostic, Unsure, Spiritual, and Religious, with explanations for each choice. Religious denomination was recorded, with the participants typing their own responses.

Upon completion of demographics, the next battery of self-report questionnaires included the Barkley Deficits in Executive Functioning Scale (BDEFS) (Barkley, 2011) and the Big Five Questionnaire (Goldberg, 1990). The Big Five, not included in the analyses of this paper, consists of 5 subscales regarding personality traits: Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism.

The first set of IATs was presented before reading a vignette, one targeting approach associations and the other targeting cope associations with alcohol. After completing the first two

IATs, participants were randomly assigned to read a stressful story about a typical college day at UR or a neutral story. Both vignettes were approximately the same word length and contained the same scenarios (see Appendix A). For the stressful vignette, issues such as tardiness, forgetting about important assignments, disapproval from teachers, and relationship problems were included. As a manipulation check, the Subjective Units of Distress Scale followed the vignettes, with participants rating their current stress on a scale of 1-100. Next, the second round of IATs was presented. As previously mentioned, if participants received one type of stimuli (picture or word) for the first presentation of IAT type, they then received the other stimuli post-vignette.

For the remaining self-report questionnaires, a drink conversion information sheet was provided to ensure response accuracy (see Appendix B). The Drinks Per Drinking Day (DPDD) Chart (CASAA, 1995) was presented, followed by the Drinking Motives Questionnaire – Revised (Cooper, 1994), which was not included in the analyses here. The DMQ is a 20-question measure containing 4 different subscales pertaining to various reasons for drinking, including Drinking to Cope, Drinking for Enhancement, Drinking for Social Motives, and Drinking as a result of Conformity. Finally, the participants responded to the AUDIT questionnaire. The DPDD and AUDIT were used to assess risky drinking habits to investigate the predictive powers of the BDEFS and IATs.

After all of the tasks were finished, the screen instructed the participants to go back to the original room to inform the experimenter of their completion. The experimenter then debriefed the participants, explaining the full purpose of the study. A handout was provided with on and off campus resources for questions and concerns about drinking habits.

Plan of Analysis

First, we examined the variables pertaining to IAT stimuli presentation (picture vs. word) for both Approach and Cope IATs. A paired-samples t-test was conducted to compare IAT sores using picture and word stimuli. No significant difference was found for both Approach and Cope ($t(97)= .233$, $p= 0.82$; $t(97)= -1.15$, $p= 0.25$, respectively), so the variable was not considered further.

Next, we investigated the effect of order within the IAT, whether Alcohol was paired with Approach or Avoid first, as well as, Cope or Ignore. We discovered that in an attempt to counterbalance for stress vs. neutral vignettes, order was directly confounded with stress condition. All participants in the stress condition were presented with the "Alcohol" and "Avoid" pairing first, as well as, "Alcohol" and "Ignore". Therefore, only the pre-vignette scores were utilized for regression analyses involving the full sample. For analyses of the effects of stress, only data from the stress condition were used.

IATs were then examined, using only the stress condition, to explore the effect of reading the vignette on the D score. The D score is a difference score between pairings of attributes and concepts (i.e. approach and alcohol vs. avoid and alcohol), addressing number of errors and latency for the different pairings. A positive D score indicates a strong association between alcohol and avoid or ignore, and a negative score indicating an association with approach or cope. A paired samples T-test was conducted with the stress group to examine the effect of the vignette for the Cope and Approach IATs.

To investigate the impact of executive functioning on the effect of stress on IAT scores, a 2x2 repeated measures ANOVA was conducted with time (pre- or post-vignette) and self-

restraint score (above or below the 50th percentile for the scale) as the independent variables. This analysis was conducted for both Cope and Approach IAT scores as the dependent variable.

A series of hierarchical multiple regressions was conducted to test the prediction of risky drinking behavior, as measured by the AUDIT and DPDD, by BDEFS and IAT scores. We first entered both BDEFS and IAT at Step 1 and then added their interaction term at Step 2. We examined significance and R^2 for the overall model, followed by an examination of the semi-partial r^2 for each factor as an indicator of unique variance predicted in risky drinking. Analyses were conducted separately for DPDD and AUDIT as the criterion, and Cope or Approach IAT as a predictor, resulting in four separate regression analyses.

Results

Effect of Stress Manipulation on IAT Scores

For this analysis, only data from the participants who read the stressful vignette were analyzed (n=42). First, however, we compared the SUDS ratings of participants who read the stressful vs. neutral vignette. We found that reading the stressful vignette was associated with higher stress ratings (M= 80.45, SD= 14.40) as compared to the neutral vignette (M= 29.38, SD= 20.66). For participants who read the stressful vignette, the cope/ignore mean IAT D scores decreased significantly from pre (M= 0.43, SD= 0.50) to post vignette (M=0.22, SD= 0.45), ($t(41) = 2.63$; p= 0.012). While not significant ($t(41) = 1.80$; p= 0.079), the approach/avoid IAT followed the same trend, with D-scores decreasing from pre (M=0.32, SD= 0.42) to post-vignette (M=0.17, SD= 0.40). For both IAT types, reading the stressful vignette resulted in lowered D scores, indicating a stronger association between alcohol and the approach and cope attributes. Although we did not directly compare these results with the neutral vignette due to possible confounding of order effects, it should be noted that D-scores for participants who read the

neutral vignette did not change significantly from pre (*M*= 0.08, *SD*= 0.42) to post vignette (*M*= 0.12, *SD*= 0.37) for the Cope IAT (*t*(55)= -0.82, *p*= 0.42), or the Approach IAT pre (*M*= -0.08, *SD*= 0.41) to post vignette (*M*=-0.05, *SD*= 0.35), (*t*(55)= -0.52, *p*= 0.60).

Interaction of Stress Effects with Self-Restraint

Preliminary data analysis of correlations between the 5 subscales of the BDEFS and risky drinking habits, as measured by the DPDD (weekend scores) and AUDIT, revealed that Self-Restraint was the only significant scale within the BDEFS (*p*= 0.01) (see Table 1). Therefore, only Self-Restraint from this measure was used as a predictor in subsequent analyses.

Participants were then divided into two sub-groups based on their self-restraint score, high self-restraint (i.e. low self-restraint deficit score) and low self-restraint. Any score below the 50th percentile on this normed scale (a score of 27), was considered high self-restraint. To investigate the interaction of stress and self-restraint on the approach IAT, a 2x2 repeated measures ANOVA with self-restraint (high vs. low) and Approach IAT scores (pre- and post-vignette) was conducted. A significant main effect for time was found, *F*(1,40)=5.67, *p*=.022, that was qualified by a significant interaction effect *F*(1,40)=4.22, *p*=.047. Although participants with higher self-restraint showed less of an inclination to approach alcohol before the vignette, their approach tendencies became similar to the low self-restraint group after reading the stressful vignette (see Figure 1). Participants with low self-restraint did not appear to show a vignette-related change in Approach IAT.

A 2x2 repeated measures ANOVA was also conducted using the Cope IAT to test the interaction between self-restraint and reading the stressful vignette. A significant main effect for time was found *F*(1,40)= 5.12, *p*= 0.03; however, the interaction effect was not significant

$F(1,40)= 0.76$, $p= 0.39$. Different levels of self-restraint did not appear to impact Cope IAT scores before and after the vignette (see Figure 2).

IAT and BDEF Predicting AUDIT and DPDD

Models Using Approach/Avoid IAT. In predicting the AUDIT, linear regression results indicated that the overall model including Self-Restraint and the Approach IAT was significant ($R^2= 0.10$, $p= 0.01$), predicting 10% of the variance in AUDIT score; however, only the Self-Restraint scale was a significant individual predictor (β=0.28, $r_{sp}^2= 0.08$, $p = 0.01$) while the Approach IAT was not (β= -1.40, $r_{sp}^2= 0.02$, $p = 0.17$). When the interaction term was added to the model, it was not significant (β= 0.36, $r_{sp}^2= 0.01$, $p = 0.45$) in predicting the AUDIT (see Table 2).

For DPDD, the overall model was significant ($R^2= 0.09$, $p= 0.01$), predicting 9% of the variance in weekend drinking. Both the Self-Restraint and the Approach IAT were significant predictors (β= 0.20, $r_{sp}^2= 0.04$, $p = 0.049$; β= -0.20, $r_{sp}^2= 0.04$, $p = 0.048$, respectively). Each predictor uniquely accounted for 4% of the variance in DPDD. The interaction term was not significant (β= -0.12, $r_{sp}^2= 0.00$, $p = 0.81$).

Models Using Cope/Ignore IAT. Again in predicting the AUDIT, a trend similar to the Approach IAT is found for the Cope IAT and Self-Restraint. The overall model was significant ($R^2= 0.11$, $p= 0.01$), predicting 11% of variance, with Self-Restraint being the only significant individual predictor (β= 0.28, $r_{sp}^2= 0.08$, $p = 0.01$). The Cope IAT yielded non-significant results (β= -0.16, $r_{sp}^2= 0.03$, $p = 0.12$). The addition of the interaction term was not significant (β= 0.369, $r_{sp}^2= 0.01$, $p = 0.41$)(see Table 4).

Finally for DPDD, the model was significant ($R^2= 0.71$, $p= 0.04$), predicting 4% of variance, and driven by the predictive power of the Self Restraint Scale (β= 0.21, $r_{sp}^2= 0.04$, $p =$

0.04). The Cope IAT did not provide significant predictive value (β= -0.15, r_{sp}^2= 0.02, p = 0.16). The interaction term was not significant (β= 0.2,1 r_{sp}^2= 0.00, p = 0.67) (see Table 5).

Discussion

In addressing our first research question, stress does appear to activate implicit attitudes towards alcohol. Scores on the Cope IAT significantly changed from pre-to post the stressful vignette, indicating a stronger association between cope and alcohol. While the results for the Approach IAT were not significant, a similar trend was observed. These findings not only replicated previous results found in Lindgren et al., 2011, but also support the study by Field & Powell (2007), indicating that stress increases the attentional bias towards alcohol as a coping mechanism. Our vignette attempted to capture the variety of potential stressors in a typical student's life including both academics and relationships. Reading a short story written in the second person appeared to generate feelings of discomfort as evidence by increased SUDS scores, triggering automatic associations of alcohol as a coping mechanism.

Interestingly, the levels of self-restraint did interact with the effects of stress on implicit associations; however, this interaction was in the opposite direction of what one might expect. People with high self-restraint were more affected by the stressful vignette, with their change in IAT scores toward alcohol being more dramatic than the low-restraint group. Those generally "in control" of their lives, exhibiting little impulsivity, were more likely to approach alcohol when stressed. These participants may be unaccustomed to the chaotic type of day presented in the vignette and may have been uncomfortable with their lack of control over the situation they read. The stressors in the vignette, such as waking up late and forgetting about assignments, may be uncharacteristic of the high self-restraint individuals; thus, the story may have created extreme

anxiety. Further investigation into potential causes for this increase in apprehension needs to be explored.

Our final question concerning the ability of IATs and EF to predict actual drinking behavior presents the most provocative results of our study. For all of our regression analyses, the Self-Restraint scale drove the predictive relationship with risky drinking (AUDIT) and drinking amount and frequency (DPDD). All of the models, except for the DPDD for the Approach IAT, indicated that Self-Restraint was the only significant predictor. For DPDD, both Self-Restraint and the Approach IAT each significantly predicted approximately 4% of the unique variance of DPDD scores. When both IAT and self-restraint predict drinking, they did so independently. The Dual Process Model is partially supported in our findings, indicating that two different categories of cognitive processes may affect the frequency of heavy drinking.

Our study had several limitations, with the most prominent issue pertaining to the confounding order effects with the stress condition. Due to a programming error, the stress condition (whether participants received the stress or neutral vignette) was matched with order of IAT presentation. For example, those that received the stress condition were always presented with directions to pair the concept of alcohol and avoid first. Due to this issue, only the stress condition was included in the analyses focusing on the effect of stress on IAT and only the "pre" vignette IATs were used for the regression analyses. This reduction in sample size may have reduced power, decreasing the likelihood of detecting smaller effects in our analyses. Running the study again, removing the programming error, would provide more data for the utilization of the "activated" IAT scores. The post vignette scores may have more predictive strength after the participants are stressed and their coping mechanism for consuming alcohol is triggered.

Other limitations include the nature of our sample, being primarily Caucasian females, exclusively attending a private school. A more gender, ethnicity, and socio-economic balanced study may draw different conclusions than the results found here. Furthermore, 50% of our sample was freshman and drinking habits may change throughout college years, so a study containing a more diverse age range may also yield different results. Considering that half of our participants were freshman and the average age was 19, some may refrain from responding openly to questions pertaining to alcohol, as it is illegal to consume under the age of 21. We attempted to evade this issue by ensuring the anonymity of their responses; however, overall comfort level may be a good manipulation check for future studies (i.e. a self-report question asking how truthful they were and whether they felt comfortable divulging this information).

Our findings appear to indicate the Self-Restraint is a more powerful predictor of risky drinking than automatic associations, insinuating that explicit measures are more useful for substance abuse intervention strategies and treatment. These findings support a growing literature that suggests that rating scale measures of executive functioning possess ecological and predictive validity (Barkley & Murphy, 2010; Barkley, 2011), as they accurately encompass self-restraint deficits that lead to alcohol consumption. However, the effect of implicit associations may not have been properly detected due to the previously mentioned programming error. While the predictive power of implicit associations is not conclusive in our study, it is evident that self-restraint deficits do have an impact on actual drinking habits. Our results support previous findings that impulsivity is a strong predictor of risky drinking (Henges & Marczinski, 2012; Papachristou, Nederkoom, Havermans, Van der Horst, & Jansen, 2012). Our results also suggest that impulsivity leads to utilizing alcohol to cope, as found in Sayette, (2000) and Carrigan et al., (2008).

Despite our inconclusive results pertaining to IATs, our findings are in line with current research by Christiansen, Cole, Goudie, & Field (2012), indicating that automatic associations and measures of impulsivity are unique predictors of variance in risky drinking measures. While we used different methods of measuring the predictors, their study also utilized the AUDIT in assessing risky drinking behavior and another self-report method similar to DPDD for amount of alcohol consumption. Continuing to investigate the effect of impulsivity and automatic associations on alcohol consumption is essential to aid in the identification of those at risk for alcohol dependence. We will continue to work with the data collected to investigate other questions such as the potential impact of religion and Greek life affiliation in predicting heavy drinking. We will also continue to investigate our self-restraint measure and its possible correlations with GPA, the Big 5 personality traits, and drinking motivations (as measured by the DMQ). Future research should continue to investigate the potential use of measuring executive functioning deficits in order to predict those who may be at-risk for developing dangerous drinking habits and potential dependence. In order to implement prevention strategies for binge drinking on college campuses, the motivations and tendencies of risky drinking need to be properly identified.

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Table 1

BDEF subscales and correlations with AUDIT and DPDD

BDEF Scale	Self-Management to Time	Self-Organization/ Problem-Solving	Self-Restraint	Self-Motivation	Self-Regulation of Emotions
AUDIT	0.19	0.11	0.29**	0.17	0.14
DPDD	0.09	-0.01	0.22*	0.06	-0.07

Note: * $p < 0.05$, ** $p \leq 0.01$. BDEF= Barkley Deficits in Executive Functioning Scale.

AUDIT= Alcohol Use Disorder Identification Test. DPDD= Drinks per Drinking Day Chart.

Table 2

Predicting Audit Scores with Self-Restraint and the Approach IAT

	Unstandardized		Standardized			
Predictor	B	Standard Error	β	Significance	r_{sp}	r_{sp}^2
Model 1						
Approach IAT	-1.97	1.42	-1.40	0.17	-0.14	0.02
Self Restraint	0.22	0.08	0.28	0.01	0.28	0.08
Model 2						
Approach IAT	-6.90	6.71	-0.49	0.31	-.10	0.01
Self Restraint	0.21	0.08	0.27	0.01	0.26	0.07
App*SR	0.16	0.22	0.36	0.45	0.08	0.01

Note : Model 1: R^2= 0.10, *p*= 0.01, Model 2: R^2= 0.11, *p*= 0.02. R^2 = the variance predictable by the models. r_{sp} = the semi- partial coefficient, the correlation of the specific predictor and criterion with all other predictors statistically removed. r_{sp}^2 = unique variance of the specific predictor. IAT= Implicit Association Test. APP*SR= interaction term for Self-Restraint subscale for Barkley Deficits in Executive Functioning Scale and Approach IAT.

Table 3

Predicting DPDD with Self-Restraint and the Approach IAT

	Unstandardized		Standardized			
Predictor	B	Standard Error	β	Significance	r_{sp}	r_{sp}^2
Model 1						
Approach IAT	-4.81	2.39	-0.20	0.048	-0.20	0.04
Self Restraint	0.27	0.13	0.20	0.049	0.20	0.04
Model 2						
Approach IAT	-2.11	11.35	-0.09	-.85	-.02	0.00
Self Restraint	0.27	0.14	0.21	0.049	0.20	0.04
App*SR	-0.09	0.37	-0.12	0.81	-0.03	0.00

Note: Model 1:R^2= 0.09, *p*= 0.01, Model 2: R^2= 0.09, *p*= 0.04. R^2 = the variance predictable by the models. r_{sp} = the semi- partial coefficient, the correlation of the specific predictor and criterion with all other predictors statistically removed. r_{sp}^2 = unique variance of the specific predictor. IAT= Implicit Association Test. APP*SR= interaction term for Self-Restraint subscale for Barkley Deficits in Executive Functioning Scale and Approach IAT.

Table 4

Predicting AUDIT with Self-Restraint and the Cope IAT

	Unstandardized		Standardized			
Predictor	B	Standard Error	β	Significance	r_{sp}	r_{sp}^2
Model 1						
Cope IAT	-2.07	1.30	-0.16	0.12	-0.16	0.03
Self Restraint	0.22	0.08	0.28	0.01	0.27	0.08
Model 2						
Cope IAT	-7.03	6.11	-0.54	0.25	-0.12	0.01
Self Restraint	0.21	0.08	0.27	0.01	0.27	0.07
Cope*SR	0.17	0.12	0.39	0.41	0.08	0.01

Note : Model 1: R^2= 0.11, *p*= 0.01, Model 2:R^2= 0.12, *p*= 0.01. R^2 = the variance predictable by the models. r_{sp} = the semi- partial coefficient, the correlation of the specific predictor and criterion with all other predictors statistically removed. r_{sp}^2 = unique variance of the specific predictor. IAT= Implicit Association Test. Cope*SR= interaction term for Self-Restraint subscale for Barkley Deficits in Executive Functioning Scale and Cope IAT.

Table 5

Predicting AUDIT with Self-Restraint and the Cope IAT

	Unstandardized		Standardized			
Predictor	B	Standard Error	β	Significance	r_{sp}	r_{sp}^2
Model 1						
Cope IAT	-3.19	2.23	-0.15	0.16	-0.15	0.02
Self Restraint	0.273	0.14	0.21	0.046	0.21	0.04
Model 2						
Cope IAT	-7.58	10.48	-0.35	0.47	-0.07	0.01
Self Restraint	0.27	0.14	0.21	0.05	0.20	0.04
Cope*SR	0.15	0.34	0.21	0.67	0.04	0.00

Note: Model 1:R^2= 0.71, *p*= 0.04, Model 2:R^2= 0.73, *p*= 0.08. R^2 = the variance predictable by the models. r_{sp} = the semi- partial coefficient, the correlation of the specific predictor and criterion with all other predictors statistically removed. r_{sp}^2 = unique variance of the specific predictor. IAT= Implicit Association Test. Cope*SR= interaction term for Self-Restraint subscale for Barkley Deficits in Executive Functioning Scale and Cope IAT.

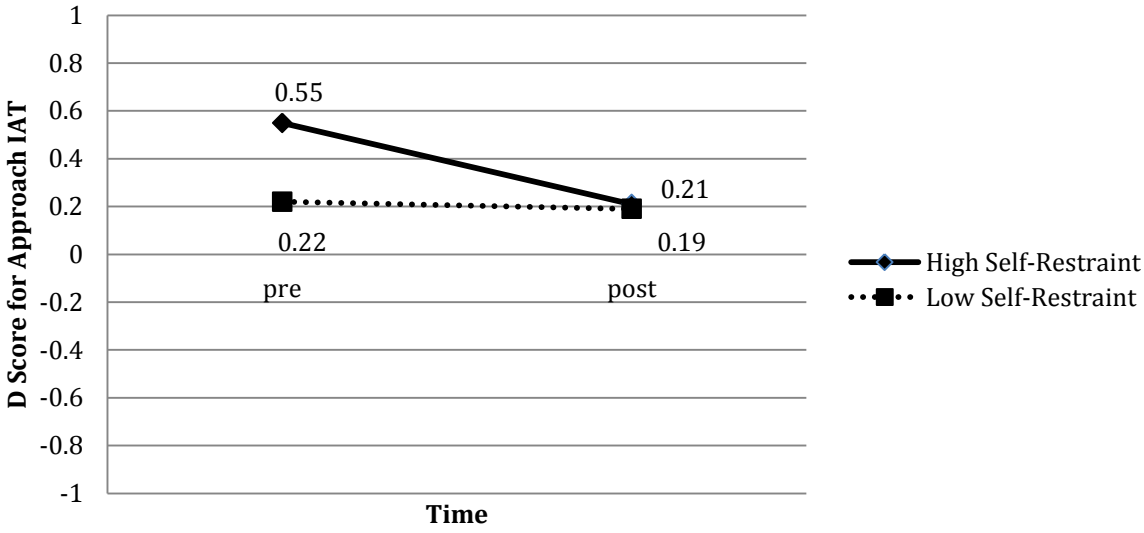

Figure 1. Interaction of Stress Effects (pre and post vignette) with BDEFS Self-Restraint scores on Approach IAT scores. The interaction was significant, $p = 0.047$. *Note*: Lower D scores indicate higher implicit associations with alcohol and approach.

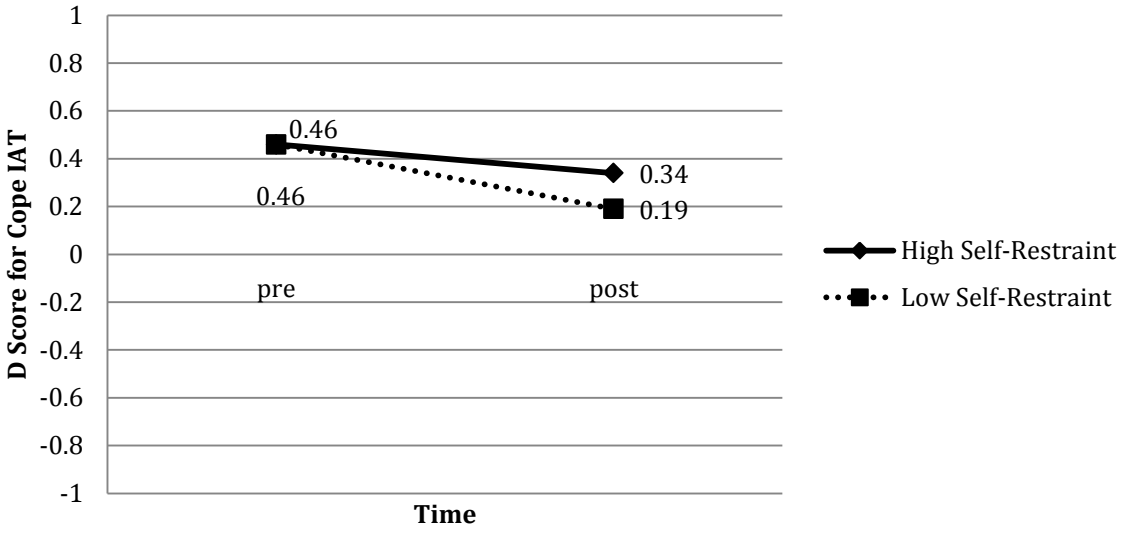

Figure 2. Interaction of Stress Effects (pre and post vignette) with BDEFS Self-Restraint scores on Cope IAT scores. The interaction was not significant, p=0.39. *Note*: Lower D scores indicate higher implicit associations with alcohol and approach.

Appendix A
Vignettes

Stress Vignette

For the next task, please read the following story about a day on Richmond campus. Try to imagine yourself as the character in this story and how you would feel.

You wake up 15 minutes into your first class. Your phone died in the middle of the night and your alarm never went off. Today, you have a group presentation worth 35% of your grade. The other members of the group tried to contact you, and will be angry when you show up late. Wearing a wrinkled t-shirt, you arrive to class 25 minutes late and interrupt another presentation when you walk in the door. The professor looks disappointed, and everyone stares as you walk to an empty seat at the back. Your group is last to present; however, in your rush you completely forgot your notes. You fumble through your share of the presentation and the professor asks to set up a meeting to discuss your performance. You speak with your professor and apologize to your group members before walking to your next class. At the end of class, the professor reminds the class of the 10 page paper that is due in 2 days. You completely forgot about the assignment. As you think about your schedule, you realize that every extra moment will be spent in the library working to finish the paper. Upset and tired, you head to d-hall for lunch. As you walk to your table, you stumble and spill your tray. You feel humiliated as everyone stares while you scramble to clean up the mess. You eat in just enough time, and rush across campus for your last class. Finally done, you go back to your room to nap and charge your phone, but continue to think about all you have to do, and cannot sleep. Your parents call you, but when you try to vent, they only yell at you for not staying on top of your work. Hanging up the phone, you feel guilty for letting them down. You head to the library and work through dinner, only stopping to get a stale bagel from 8:15. Around midnight, you doze off for an hour. You wake up, confused and angry that you fell asleep, and keep working until 2 am. You can no longer keep your eyes open,

so you give up and head back to your dorm. Lying in bed, you think about your day, and try to ignore the loud music coming from next door.

Neutral Vignette

For the next task, please read the following story about a day on Richmond campus. Try to imagine yourself as the character in this story and how you would feel.

You wake up early for your first class and eat a bowl of cereal for breakfast. After taking a shower and getting dressed, you unplug your phone from the charger and walk to your first class of the day. You arrive 5 minutes early, and sit in your usual seat. During class, your professor gives a short lecture and discusses the day's assigned reading. She assigns some new readings for next class, and you get out on time. You go to your second class where you watch a documentary, and discuss the content in the time that remains. He assigns a few more questions that you will cover at length in the next class. After class, you borrow a green bike and ride to D-Hall to meet some of your friends for lunch. Finding an empty table, you all discuss recent events on campus, and leave after an hour or so. You go home to take a nap before your last class of the day. During class you split into groups and work on a presentation that was assigned last week. Each member of the group plans to give a short presentation, and you will help to design a powerpoint. After some discussion, your group decides to meet in the library later that evening. After class you walk to D-Hall for dinner and sit with a few of your friends. You talk about your classes, and help one of your friends think of a title for his creative writing project. After dinner, you call your parents and talk about everything that is happening back home. You walk into 8:15 and grab a drink before meeting with your group. You spend an hour at the library with your small group discussing and planning your presentation. When you get back to your room, you complete your assigned readings and discussion questions. Having completed your homework,

you watch a short movie with your roommate and a few friends. Lying in bed, you review the events of the day, before falling asleep at your normal time.

Appendix B
Drink Conversion Chart

STANDARD DRINKS

ONE STANDARD DRINK IS EQUAL TO:

BEER (≤ 4% alcohol) ……..…… **12 ounce** can or bottle

Examples: Natural light ("Natty Light"), Busch, Keystone Light, Pabst Blue Ribbon, Milwaukee's Best, Miller Light, Budlight, Budweiser, Corona

BEER/MALT LIQUOR (8% alcohol)…… **6 ounces**
* A 40oz bottle of 8% malt liquor = 6.4 drinks

Examples: Mike's Hard Lemonade or Smirnoff Ice (5% alcohol per bottle), Colt 45, Old English "800", King Cobra, Haffenreffer

WINE (10% alcohol)……..... **5 ounce** glass
(12% alcohol) …… **4 ounce** glass
*1 bottle @ 10% alcohol……..5 standard drinks

Examples: Pinot Grigio, Riesling, Chardonnay, Merlot, Shiraz, Cabernet

WINE COOLERS (5-7% alcohol)..... **8-10 ounces**
*(includes Bacardi Breezers, Skyy, ciders, etc.)
* Three 12 oz. bottles at 7% alcohol is equivalent to 4-1/2 standard drinks.

Examples: Seagram's

LIQUOR
(80-proof, 40% alcohol)……..... **1-1/2 ounce** shot

(100-proof, 50% alcohol) ……..… **1 ounce** shot
(grain alcohol – near 200% proof)…… **½ ounce** (1 Tbs.)

Examples: Smirnoff (not ice: 80-proof), Pinnacle (80-proof), Absolut Vodka (80-proof), Captain Morgan (100-proof), Malibu (42-proof), Jose Cuervo (80-proof), Jagermeister (70-proof)

12 oz beer can

12 oz beer bottle

1 standard shot