BIS/BAS and College Alcohol Use: Motivation, Consequences, and Attention

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College drinking is associated with adverse consequences. Motives for alcohol use and attention to alcohol-stimuli may relate to Gray's (1981) two-factor model of personality (i.e., the Behavioral Activation System (BAS) and Behavioral Inhibition System (BIS)). In study one, 41 male participants were administered measures of BIS/BAS, drinking motives, alcohol-related consequences, and an alcohol addictive-Stroop task. In study two, 26 male participants were administered measures of BIS/BAS, drinking frequency/quantity, and an alcohol dot-probe task. High BAS sensitivity predicted increased alcohol use, alcohol-related consequences, drinking for social and enhancement motives, and attention to alcohol-related stimuli. The BAS may have important implications for reducing drinking behavior in college students.

INTRODUCTION

Each year, college students spend over five and a half billion dollars on alcohol. This is more than they spend on soft drinks, milk, tea, coffee, and books combined (Torr, 2002). A study by O'Malley and Johnston (2002) found that over seventy percent of college students have drunk alcohol within the last month and forty percent reported heavy drinking. Drinking in college has been associated with academic failure, violence, injuries, and risky sexual behaviors that can result in sexually transmitted diseases (Castilla, Barrio, Belza, & Fuente, 1999; Froome & Corbin, 2004; Hingson, Heeren, Zakocs, Kopstein, & Wechsler, 2002).

In an analysis conducted by Hingson et al. (2002), it was reported that in 1998, 1,400 college students died from alcohol-related events, and 600,000 students were assaulted by students who were intoxicated. Not only does the literature suggest that individuals who use alcohol in college are more at risk for adverse consequences, but Jennison (2004) found that binge drinking in college was predictive of alcohol abuse and dependence ten years later. While drinking has many adverse consequences, the reasons that individuals drink are varied. Personality characteristics, environmental factors, and automatic underlying processes all influence alcohol use (Lecci, MaClean, & Croteau, 2002). The purpose of this study is to link Gray's (1981) Behavioral Activation System (BAS) and Behavioral Inhibition System (BIS) to alcohol use, drinking motives, and attentional bias to alcohol-stimuli in a college sample.

In Gray's personality theory, the BAS is related to sensitivity to reward, non-punishment, and feelings of hope, elation, and happiness. The BAS responds to incentives and is activated when trying to obtain a reward (Hagopian & Ollendick, 1994). People with high BAS sensitivity tend to be impulsive, extroverted, and sensation seekers (Gray, 1981; Torrubia, Avila, Molto, & Caseras, 2011).

The Behavior Inhibition System, on the other hand, is associated with sensitivity to punishment, non-reward, and feelings of fear, anxiety, frustration, and sadness. High BIS sensitivity relates to reducing the risk of punishment by inactivity and abandoning behaviors that are not rewarded (Gray, 1981). The BIS relates to high neuroticism, low impulsivity, and very low extroversion (Hagopian & Ollendick, 1994; Torrubia et al., 2001). The BAS and the BIS both appear to be related to substance abuse.

Literature suggests that an overactive BAS and underactive BIS are predictors of high frequency and quantity of alcohol use, and those with high BAS sensitivity have a stronger desire to consume alcohol than those with low BAS sensitivity (Franken, 2002; Genovese & Wallace, 2007; O'Connor & Colder, 2005; Pardo, Aguilar, Molinuevo, & Torrubia, 2007). Sensation seeking, a component of the BAS, has been found to be positively correlated with the age of individual's first alcohol drink (Donohew, Hoyle, Clayton, Skinner, & Colon, 1999; Grau & Ortet, 1999; Lyvers, Czerczyk, Follent, & Lodge, 2009; Willem, Bijttebier, & Claes, 2010). As for the BIS sensitivity and alcohol use, the findings have been mixed. While there does not appear to be a relationship between BIS sensitivity and alcohol use, BIS sensitivity has been found to be related to alcohol-related consequences (Feil & Haskings, 2008).

Furthermore, the BIS and the BAS may be related to different alcohol drinking motives. Jimenez, Grana, Montes, and Rubio (2009) found that high BAS sensitivity was correlated with taking substances for positive reinforcement (e.g., euphoria), while high BIS sensitivity was correlated with taking substances for negative reinforcement (e.g., relieving the symptoms of withdrawal and anxiety).

Just as individuals with varying BIS/BAS sensitivity drink for different reasons, the motives for drinking in general are different (Jimenez et al., 2009). People drink in order to attain certain value outcomes, and consuming alcohol is based on the

affective change that a person expects to achieve by drinking compared to not drinking (Cox & Klinger, 1988). Cooper (1994) found that individuals drink to either decrease negative emotions (e.g., take away pain) or enhance positive emotions (e.g., add pleasure) and these motivations are internally sourced (e.g., drinking for yourself) or externally sourced (e.g., influenced outside of the self).

Using these two categories of motivations, Cooper (1994) found that there are four primary motives for drinking: coping (negative/ internal), enhancement (positive/ internal), social (positive/ external), and conformity (negative/ external). These motives help predict how much an individual will drink, and the consequences from drinking, and they can be used to guide prevention and intervention (Kuntsche & Kuntsche, 2009).

Coping motives are positively related to alcohol-related consequences, drinking at home, and drinking alone (Cooper, 1994; Kuntsche, Knibbe, Gmel, & Engels, 2005). Enhancement motives predict heavy alcohol use, alcohol consequences, and drinking in situations that encourage heavy drinking such as drinking with friends (Cooper, Russell, Skinner, & Windle 1992; Cooper, 1994; Kuntsche et al., 2005). Social motives are significantly positively related to moderate alcohol use and drinking in celebratory situations (e.g., parties), and significantly negatively associated with drinking at home or with family (Cooper, 1994; Kuntsche et al., 2005). Lastly, conformity motives were negatively related to drinking at bars and at home, as well as quantity and frequency of alcohol use, but they were significantly positively related to drinking at parties and drinking consequences (Cooper, 1994).

O'Connor and Colder (2005) investigated the link between BIS/BAS and drinking motives. They sampled 533 freshman at a large public university who were under the age of twenty-one and administered the participants surveys that identified alcohol use, alcohol-related consequences, drinking motives, and BIS/BAS. They found that high BAS scores were associated with drinking consequences as well as drinking for enhancement, coping, and social reasons. BIS scores, however, did not predict drinking consequences, but did predict drinking for conformity and coping reasons.

These motivations to drink alcohol may be amplified as a result of biased attention to alcohol-related stimuli (Cox, Farardi, & Pothos, 2006). This is known as the incentive-sensitization theory (Robinson & Berridge, 1993), and can cause alcohol-using individuals to become responsive to alcohol-related stimuli via their attention-grabbing properties.

The importance of these attention-grabbing stimuli have been demonstrated via addictive-Stroop tasks, which measure interference (i.e., participant's reaction time) for addiction related stimuli compared to neutral stimuli. Cox et al. (2006) completed a meta-analysis on addictive-Stroop tasks for alcohol and tobacco and found that individuals with more familiarity with the addicting substance were more distracted by the alcohol and tobacco stimuli than the neutral stimuli and therefore showed more attentional bias. Similarly, participants who displayed attentional bias towards alcohol-stimuli on a dot-probe task also reported consuming more drinks, spending more days drinking, and being drunk more days (Miller & Fillmore, 2010; Townshend & Duka, 2001).

As alcohol-stimuli are experienced, they become conditioned stimuli. For example, Waters and Feyerabend (2000) found that abusers of addictive substances became aware of addicted-related stimuli (i.e., words relating to tobacco stimuli) in their environment faster than non-abusers. These conditioned stimuli create similar emotional, cognitive, and physiological states as alcohol itself, and these responses are not limited to individuals with alcoholism, as social drinkers experience similar arousal (Glautier, Drummond, & Remington, 1992, as cited in Kambouropoulos & Staiger, 2001; Willner, Field, Pitts, & Reeve, 1998). Furthermore, individuals who have greater attentional bias towards pictures of alcohol-stimuli rate these stimuli as more pleasant, arousing, and craving-inducing (Drobes, Carter, & Goldman, 2009).

Literature suggests that alcohol-stimuli create attentional biases for individuals who have had experience with alcohol (Townshend & Duka, 2001). Yet, emotionally arousing stimuli, in general, have been shown to attract attention, and people shift their attention to emotional content over neutral content (Allegri, 2000; Keil, Moratti, Sabatinelli, Bradley, & Lang, 2005). As the BAS is activated in response to positive stimuli and the BIS is activated in response to negative stimuli, the valence of the stimuli may affect attention of individuals with varying BIS/BAS sensitivity differently. For example, Caseras, Fullana, Riba, Barbanoj, Aluja, and Torrubia (2006) found that individuals high in BIS sensitivity showed greater attention to fear pictures than individuals low in BIS sensitivity. Similarly, Hawk and Kowmas (2003) found that individuals high in BAS sensitivity showed greater attention towards pleasant pictures compared to individuals with low BAS sensitivity. While these results suggest that the valence of the alcohol-stimuli may affect attention biases for individual's differing in BIS/BAS sensitivity, research has yet to examine this effect.

Overall, research suggests that BAS sensitivity and BIS sensitivity may be influential in

differentiating an individual's reason to use alcohol, the consequences for using alcohol, and the attention-grabbing properties of alcohol-stimuli. Study one focuses on motives of alcohol use, consequences of alcohol use, and attention to alcohol-word stimuli on an alcohol addictive-Stroop task in relation to individual differences in BIS/BAS sensitivity. Study 2 focuses on BIS/BAS sensitivity relative to drinking behavior and attention to specific valences of alcohol-word stimuli on an alcohol dot-probe task.

STUDY 1

O'Connor and Colder (2005) showed that individuals with high BAS sensitivity and individuals with high BIS sensitivity have different amounts of alcohol consequences and drink for different motives. Based on this study, it is hypothesized that a higher BAS score will relate to more alcohol-related consequences. BAS scores are also hypothesized to predict drinking for social and enhancement motives, while it is hypothesized that BIS scores will predict coping and conformity drinking motives as those with a high BIS sensitivity have higher levels of anxiety and are nervous around others (Carver & White, 2004; O'Connor & Colder, 2005).

To examine attention to alcohol-related stimuli, an alcohol addictive-Stroop task will be used. On this task, it is hypothesized that the higher the BIS or BAS score, the greater interference for alcohol-related stimuli than neutral stimuli (i.e., animals). This is predicted because individuals with high BAS sensitivity are attracted to alcohol-related stimuli, and individuals with a high BIS sensitivity experience anxiety when alcohol-related stimuli are present.

METHODS

Participants Participants were forty-one male students from introductory psychology courses at a small liberal arts college who were given extra credit for their participation. All participants consented to being part of the study and were made of aware of their right to withdraw their scores at any time.[1]

Material *The Sensitivity to Punishment and Sensitivity to Reward Questionnaire-short form* (Cooper & Gomez, 2008) tests individual differences of one's Behavioral Activation System and Behavioral Inhibition System. The SPSRQ-sf consists of fifteen remarks related to the BAS (e.g., "I crave excitement and new sensations") and five items that relate to the BIS (e.g., "I worry about making mistakes"). Participants rate each item on a 1 (strongly agree) to 4 (strongly disagree) likert scale. When calculating results, items were reversed scored indicating stronger agreement for the higher number.

The Drinking Motives Questionnaire (DMQ) developed by Cooper (1994) rates individuals as drinking for either conformity (e.g., "because your friends pressure you to drink"), social (e.g., "because it helps you enjoy a part"), enhancement (e.g., 'because you like the feeling"), or coping (e.g., "because it helps you when you feel depressed or nervous") motives. Participants rate each of the twenty statements on a 1 (almost never/never) to 5 (almost always/always) likert scale. The four drinking motive scales assess similar underlying constructs across gender, race, and age groups (Cooper, 1994). Kuntsche et al. (2005) found that the DMQ is the most commonly used questionnaire to assess drinking motives, and the DMQ demonstrates high internal consistency, good reliability, and predictive validity (Cooper et al., 1992; Cooper, 1994).

The Young Adult Alcohol Consequences Questionnaire (YAACQ) developed by Read, Kahler, Strong, and Colder (2006) rates individual's consequences of using alcohol. The forty-eight questions, answered yes or no, are divided into eight subscales. The subscales consist of social interpersonal problems (e.g., "my drinking has created problems between myself and my girlfriend, parents, or other relative"), control problems (e.g., "I often drank more than I originally planned"), self-perception (e.g., "I have felt bad about myself because of drinking"), self-care (e.g., "because of my drinking, I have not eaten properly"), risk (e.g., "I have driven a car when I knew I had too much to drink"), work and academic problems (e.g., "the quality of my work or school work has suffered because of drinking"), physical dependence (e.g., "I have felt like I've needed a drink after I'd gotten up"), and blackout (e.g., "I have had a blackout after drinking heavily"). The overall score for the YAACQ is the sum of all "yes" answers. The YAACQ demonstrates strong internal consistency, test-retest reliability, and concurrent and predictive validity (Read et al., 2006).

The *alcohol addictive-Stroop task* is derived from the original Stroop Task (Stroop, 1935) and measures the time it takes for an individual to say the color of the word shown as opposed to reading the word. The alcohol addictive-Stroop task focuses on alcohol-related stimuli words (e.g., "alcohol", "Jim Beam") and non-appetitive animal stimuli words (e.g., "bird", "frog"). The latencies, or difference in response times, were calculated between alcohol and animal stimuli words.

During the alcohol addictive-Stroop task, each stimulus is presented in the center of a computer screen against a gray backdrop. The stimulus remains on the screen until the participant verbally answers into a microphone (correct vs. incorrect

answers are not scored) triggering the next stimulus to appear. Each participant is given five practice trials to become familiar with the program. After the practice problems are completed, participants complete six blocks of twenty trials each.

The alcohol addictive-Stroop task consists of twenty alcohol-related stimuli, twenty appetitive-food related stimuli, and forty neutral-animal related stimuli. All lists were matched for similar mean word length.

Procedure All participants in the study were made aware of their right to refuse participation, their right to stop participation at anytime without consequence, and their right to confidentiality. All participants were required to sign a consent form. After consent, participants were taken to an isolated room where participants were asked to complete the alcohol addictive-Stroop task created on *Inquisit* after directions were explained. Once participants completed the alcohol addictive-Stroop task, they were administered the three surveys in a small classroom and directions were individually explained. Having completed the survey, participants were briefed on the intention of the study and asked if they had any questions about the study. Once participants had no further questions, they were thanked for their time.

RESULTS

Correlations show that the motives for drinking are inter-correlated, and there was no significant correlation between BIS and BAS scores ($r=-0.09$, $p=.54$).

Correlations were run to examine the relationship between BIS/BAS scores and drinking motives. BAS scores significantly correlated with coping motives ($r=.49$, $p=.003$), social motives ($r=.43$, $p=.01$), and enhancement motives ($r=.41$, $p=.01$), but not with conformity motives. Conversely, BIS scores correlated with conformity motives ($r=.34$, $p=.04$) but not with coping, social, or enhancement motives.

To examine the relationships between BIS/BAS, alcohol-related consequences, and interference on the alcohol addictive-Stroop task, a series of regressions were run.

In the first regression, BIS/BAS scores were the predictor variables and the number of alcohol consequences was the predicted variable. Together BIS/BAS scores accounted for 23% of the variance of alcohol-related consequences ($p=.02$). However, BAS scores ($\beta=.48$, $p=.004$) were a significant predictor of consequences, while BIS scores were not ($\beta=.02$, $p=.91$).

The second regression examined BIS/BAS scores and interference on the alcohol addictive-Stroop task. BIS/BAS accounted for only 9.3% of the variability of the difference in latency ($p=.16$). While the model is not significant, there was a trend for a main effect of BAS scores ($\beta=.30$, $p=.06$) but not BIS scores ($\beta=-.02$, $p=.89$) for increased interference.

DISCUSSION

Consistent with O'Connor and Colder (2005), results showed that high BAS scores correlated with coping, social and enhancement motives, and BIS scores correlated with conformity motives. While BIS scores did not significantly correlate with coping motives, there was a trend in this predicted direction.

BAS scores significantly correlated with consequences of drinking, while BIS scores did not. This could be due to the possibility that individuals who have higher BIS sensitivity are more careful of where they drink and what they do while they are drinking as they are sensitive to the possibility of punishment. Individuals with higher BAS sensitivity, conversely, are more impulsive and act in more potentially rewarding situations without thinking about the consequences (Gray, 1981; O'Conner & Colder, 2005).

Regardless of BIS and BAS sensitivity, the motives behind an individual's drinking behavior can predict the amount of consequences one will encounter. While no individual motive was a significant predictor of consequences, internal motives were stronger predictors of alcohol-related consequences than external motives.

It is also of note that individuals drink for multiple reasons (Cooper, 1994), and motives are not distinctly separated into four groups, which is apparent from the high-inter correlations between the different motives. Individuals drink for different reasons at different times. For example, an individual may often drink because of stress (i.e., coping), but may occasionally drink to celebrate an achievement with friends (i.e., social).

When BIS and BAS scores were examined in relation to the level of interference for alcohol-stimuli words on the alcohol addictive-Stroop task, the hypothesis was partially supported. While not at the level of significance, the higher the BAS score, the greater interference for alcohol-stimuli words. BIS scores, conversely, did not predict increased interference. This suggests that individuals with high BAS sensitivity may be more aware of alcohol-related stimuli in the environment, may experience more alcohol-related cognition, and may be more prone to seek out alcohol-related settings (Colder & O'Connor, 2002; Franken, 2002).

Study One examined motives, consequences, and overall attention to alcohol use in relation to the BIS and BAS. Study Two will expand this work to examine alcohol use and the role of valence of alcohol-related stimuli on attention in relation with BIS/BAS sensitivity.

STUDY 2

The results of the Study One suggest that individuals with an overactive BAS may have attentional bias towards alcohol-related stimuli. Yet, if the participants viewed the stimuli on the alcohol addictive-Stroop task of Study One as pleasant, it is expected that the BAS would be activated, given the BAS's association with positive stimuli. Consistent with this finding, Drobes et al. (2009) and Townsend and Duka (2001) found that heavy drinkers had increased attention to alcohol-related stimuli and rated the stimuli as more pleasant and arousing. Yet, the BIS is activated by aversive stimuli (Hagopian & Ollendick, 1994). It may be possible that the valence of the alcohol-stimuli may moderate the relationship between BIS/BAS sensitivity and attention.

The purpose of Study Two is to test attentional bias of individuals with varying BIS/BAS sensitivity to negative valence and positive valence alcohol-related stimuli. To test attentional bias, an alcohol dot-probe task was used. During a dot-probe task, a pair of stimuli is presented simultaneously on a computer screen followed immediately by a dot-probe which replaces one stimulus, while the other stimulus disappears from the screen. Participants are required to respond to the location of the dot-probe, and response times are recorded to measure visual attention to the stimuli. With the dot-probe task, individuals respond faster to probes that appear in the location of the attended, rather than unattended, stimulus. In alcohol dot-probe tasks, the assumption is that probe detection is faster for individuals who use alcohol more frequently when the dot replaces the alcohol-stimuli because attention was already drawn to the probe's location by the earlier display of the alcohol-related stimulus (Miller & Fillmore, 2010; Townshend & Duka, 2001).
On the alcohol dot-probe task, it is hypothesized that high BAS scores will predict decreased response times when the dot-probe replaces the positive valence word, and high BIS scores will predict decreased response times when the dot-probe replaces the negative valence word. This is hypothesized because the BAS is activated with approach states and incentives, while the BIS is activated with avoidance states and signals of punishment (Gray, 1981; Torrubia et al., 2001).

Frequency and quantity of alcohol use were not tested during the first study, and BIS/BAS sensitivity may be a significant predictor of frequency and quantity of alcohol use which in turn causes alcohol-related consequences (see Anderson & Gadaleto, 2001 as cited in Wray, Simons, & Dvorak, 2011; Franken, 2002; Kambouropoulos & Staiger, 2004). It is hypothesized that high BAS scores will predict greater frequency and quantity of alcohol use.

RESULTS

Participants Participants were 26 male students from introductory psychology courses at a small liberal arts college who were given extra credit for their participation. All participants consented to being part of the study and were made of aware of their right to withdraw their scores at any time.

Materials *The Sensitivity to Punishment and Sensitivity to Reward Questionnaire-short form* (Cooper & Gomez, 2008) tests individual differences of one's Behavioral Activation System and Behavioral Inhibition System. The SPSRQ-sf consists of fifteen remarks related to the BAS (e.g., "I crave excitement and new sensations") and five items that relate to the BIS (e.g., "I worry about making mistakes"). Participants rate each item on a 1 (strongly agree) to 4 (strongly disagree) likert scale. When calculating results, items were reversed scored indicating stronger agreement for the higher number.

Hazardous Alcohol Use Domain (HAUD) of the Alcohol Use Disorder Identification Test (AUDIT; Saunders, Aasland, BarborLa Fuente, & Grant, 1993) was used to assess the frequency of drinking ("how often do you have a drink containing alcohol?"), typical quantity when drinking ("how many drinks containing alcohol do you have on a typical day when you are drinking?"), and the frequency of heavy drinking ("how often do you have six or more drinks on one occasion?"). Participants are informed that 1 drink equals a 12 oz beer, 5 oz wine, or 1.5 oz spirit, and rate each question on a 0-4 scale. Therefore, participants' scores can range from 0 to 12. The HAUD questions (i.e., questions 1-3 of the AUDIT) capture participant's typical drinking patterns, and the AUDIT shows strong test-retest reliability and convergent validity (Saunders et al., 1993).

The *alcohol dot-probe task*, created on *inquisit*, is used to assess attention to positive and negative alcohol-stimuli. The alcohol dot-probe task uses positive alcohol valence stimuli words (e.g., "party", "shots), negative alcohol valence stimuli words (e.g.,"busted", "dangerous"), and neutral valence stimuli words with no relation to alcohol (e.g., "television", "chair").
During the alcohol dot-probe task, participants are first presented with a black cross against a white backdrop. After 900 ms, the cross disappears and a word pair appears (i.e., one word on the left, and one word on the right). Each word pair contains a neutral word and a valence word (i.e., positive or negative). After 900 ms, the words disappear, and

the red dot appears on the left or right side of the screen. The participants are instructed to respond to the location of the red dot as quickly as possible by pressing "S" on the keyboard if the dot is on the left side or "K" if the dot is on the right side of the computer screen. On 50% of the trials, the dot appears in the location previously occupied by the valence word, and on 50% of the trials, the dot appears in the location previously occupied by the neutral word. In all, participants complete 48 trials that consist of 12 positive valence words, 12 negative valence words, and 24 neutral words. Average response times to each type of word were used in the analysis. Shorter latencies indicate increased attention, while longer latencies are believed to represent decreased attention.

Procedure All participants in the study were made aware of their right to refuse participation, their right to stop participation at anytime without consequence, and their right to confidentiality. All participants were required to sign a consent form. After consent, participants were taken to an isolated room where the alcohol dot-probe task was explained, and participants were asked to complete the alcohol dot-probe task. Once participants completed the task, they were administered the two questionnaires in a small classroom. Having completed the survey, participants were briefed on the intention of the study, and asked if they had any questions about the study. Once participants had no further questions, they were thanked for their time.

RESULTS

A correlation was run to examine the relationship between BIS/BAS scores and HAUD scores. While there was no correlation between BIS scores and HAUD scores (r= .09, p=.66), BAS scores significantly positively correlated with HAUD scores (r=.55, p=.004).

A regression analysis was run to examine the relationships between BIS/BAS scores, HAUD scores, and response times to dot-probes that replace the positive valence alcohol-stimuli words on the alcohol dot- probe task after controlling for responses to neutral words. There was no significant main effects for BIS scores (β=.001, p=.99), BAS scores (β=.06, p=.40), or HAUD scores (β=.04, p=.57).

Another regression analysis was run to examine the relationships between BIS/BAS scores, HAUD scores, and response times to dot-probes replacing negative valence alcohol-stimuli words on the dot-probe task after controlling for responses to neutral words. While there was no significant main effect for BIS scores (β=.01, p=.10; partial correlation= .35), there was a significant main effect for BAS scores (β=.14, p=.03; partial correlation=.44) and HAUD scores (β=-.25, p=.001; partial correlation= -.67).

DISCUSSION

As predicted, BAS scores significantly positively correlated with increased frequency and quantity of alcohol use as assessed by the HAUD, and this finding was consistent with previous literature (Colder & Connor, 2002; Franken, 2002; Pardo et al., 2007). Furthermore, there was no association between BIS scores and HAUD Scores. It appears that the higher BAS sensitivity an individual has, the more days that individual spends drinking, and the more he drinks he consumes on those days. It should also be noted that although frequency and quantity were assessed with only the first three questions of the ten question AUDIT, fifteen participants, or 58% of our sample, scored over the cut-off for "harmful user of alcohol" (i.e., 8+).

The hypotheses were not supported in relation to attention on the alcohol dot-probe task. Results showed that BAS scores did not predict attention to positive stimuli, and BIS scores did not predict attention to negative stimuli. However, there was an unexpected association between BAS scores and increased response times to dots that replaced the negative alcohol-related stimuli, suggesting that individuals with high BAS sensitivity directed their attention away from these stimuli. While the BAS corresponds with approach motivation, Feil and Hasking (2008) found that the BAS also related to active avoidance of punishment. In the dot-probe task, it appears that individuals with high BAS sensitivity may be focusing their attention away from the negative component and onto the neutral stimulus, perhaps as a form of active avoidance.

There may be several possible reasons that the expected effects were not observed. The first possible explanation may be that the positive valence alcohol-stimuli words were not appetitive enough. The words on the alcohol dot-probe task were a generated set of words that had not been reviewed. It is possible that these words were not appetitive enough, did not capture the appetitive nature of alcohol, or that pictures of appetitive alcohol-related stimuli are needed to capture attentional bias. Consistent with this, the majority of dot-probes that have found significant results (e.g., Drobes et al., 2009; Vollstadt-Klein, Loeber, Goltz, Mann, & Kiefer, 2009) have used pictures instead of words. In a dot-probe study that used both pictures and words to assess attention to alcohol-related stimuli associated with craving and withdrawal (Towshend & Duka, 2001), a significant effect for attentional bias was found with pictures but not words.

Another explanation may involve the arousing nature of the stimuli. As individuals are drawn to emotionally arousing stimuli in general, it may be possible that the negative words were more arousing than the neutral counterpart, but the positive valence words were not (Keil et al., 2005).

HAUD scores significantly negatively correlated with response times to negative stimuli. The higher the HAUD score, the more an individual was paying attention to the negative alcohol stimulus. This finding may be a result of sensitivity to alcohol-related stimuli in general. As supported by the literature, individuals who have experience with alcohol show increased attention to alcohol-related stimuli (e.g., Cox et al., 2006; Drobes et al., 2009; Townshend & Duka, 2001). Individuals showing higher scores on the HAUD have more experience with alcohol than individuals scoring lower, and it is possible that individuals with more alcohol-related experience notice punitive over appetitive alcohol-stimuli (Castilla et al., 1999; Froome & Corbin, 2004).

GENERAL DISCUSSION

The purpose of this study was to research the relationship between the Behavioral Inhibition System and Behavioral Activation System with various alcohol-related self-reports and two attention tasks within a sample of college students. Upon completion of the study, it appears that interventions centered around the BAS could be implemented to reduce alcohol use on college campuses.

First, BAS scores correlated with coping, social and enhancement motives, while BIS scores only correlated with conformity motives. These differences may be important. While Cooper (1994) found that conformity motives are related to alcohol-related consequences, they are significantly negatively related to heavy episodic drinking. The internal motives (i.e., coping and enhancement), on the contrary, are the drinking motives of grave concern as they most strongly correlate with extremely heavy binge drinking (e.g., enhancement) and drinking alone (e.g., coping). These motives for drinking often lead to the most alcohol-related consequences, and in study one, a trend for internal motives and alcohol-related consequences was found.

Second, when frequency and quantity of alcohol were assessed in Study Two, BAS scores, but not BIS scores, were a significant predictor of increased alcohol use. Similarly, in Study One, BAS scores, but not BIS scores, correlated with alcohol-related consequences. These findings are consistent with previous literature (e.g., Grau & Ortet, 1999; Pardo et al., 2007), and it appears that individuals with high BAS sensitivity not only drink more alcohol than those with lower BAS sensitivity, but are also experiencing more negative consequences from drinking. Conversely, individuals with high BIS sensitivity are drinking in smaller amounts where the negative alcohol consequences are not as frequent or apparent.

Third, it appears that BAS sensitivity may be related to attentional biases to alcohol-stimuli in the environment. While not significant, there was a trend for this proposal in the first study as individuals high in BAS sensitivity showed increased interference for alcohol-stimuli, while there was no significant relationship between interference and BIS sensitivity. Similarly, when this attentional bias was assessed via the alcohol dot-probe task, decreased attention to negative valence words for individuals with high BAS sensitivity was found.

These findings may help explain how alcohol-related stimuli may be a moderator between BAS sensitivity and alcohol use. It is possible that individuals high in BAS sensitivity have greater attention to alcohol-related stimuli in general. These individuals are attracted to alcohol via its attention-grabbing properties and drink at high levels for the positive effects. However, by drinking as such high levels, they also experience many negative consequences of alcohol use. This may result in these individuals diverting their attention away from the negative outcomes (i.e., engage in active avoidance).

In summary, these results suggest that BAS sensitivity plays an important role in alcohol use. With BAS sensitivity having such a strong correlation with frequency and quantity of alcohol use and consequences of drinking alcohol, selectively targeting individuals with high BAS sensitivity may be beneficial for reducing drinking levels and thus alcohol-related consequences. By screening for BAS sensitivity and assessing drinking motives, clinicians may be able to reduce the amount of alcohol use and abuse on college campuses.

One potential limitation of this study was the high proportion of at-risk drinkers (i.e., 58% of the sample of study 2) who scored over an 8 on the AUDIT (Saunders et al., 1993). While this may be greater than the proportion of at-risk drinkers in the general population, Mossler, Harshey, and Adams (2012) found a similar proportion of at-risk drinkers (i.e., 55.4% , as defined by 5+ drinks at least once per week) in a larger sample of the same college population (n=188). Even if this sample represented a population of at-risk drinkers and does not generalize to the population as a whole, at-risk drinkers appear to have higher BAS sensitivity than non-risk drinkers, and at-risk drinkers are the individuals who clinicians will be treating for alcohol-related problems.

Another possible limitation to this study is the use of an all male sample drawn from an all

male population. While it appears that the BAS relates to alcohol use in males, it may be the case that gender moderates the relationship between BIS/BAS and alcohol use. Consistent with this, several studies have found that females have higher BIS sensitivity than males (e.g., Jorm, Christensen, Henderson, Jacomb, Korten, & Rodgers, 1999; Leone, Perugini, Bagozzi, Pierro, & Mannetti, 2001; Wright, Hardie, & Wilson, 2009). Furthermore, while males drink more than females, both genders report similar alcohol related consequences (Young & Mayson, 2010). This data infers that women are even more vulnerable to the effects of alcohol as they are consuming less yet experiencing the same negative outcomes. As a female sample was unavailable at the time of this study, future studies should include females as well.

More and more, clinicians are interested in how individual personality variables affect alcohol drinking behavior, and the effects that drinking alcohol has on college campuses (e.g., Jennison, 2004; O'Connor & Colder, 2005; Wray et al., 2011). With BAS sensitivity correlating with the most dangerous drinking motives, increased alcohol use, and greater attention to alcohol-stimuli, it is a personality trait that clinicians should screen for when assessing the probability of alcohol-related consequences. Future studies should focus on the role of attention for alcohol-related stimuli for individuals with high BAS sensitivity to clarify the conditions in which attention occurs. Understanding the relationship between BIS/BAS sensitivity and alcohol use is necessary to create specific interventions to reduce effectively the level of alcohol use and consequences for these individuals.

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FOOTNOTES

[1] Six participants indicated that they have not consumed alcohol within the past year. Their data is used for the SPSRQ-sf form but was excluded for the DMQ and YAACQ.