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Behavioral Activation System (BAS) Sensitivity and Reactivity to Alcohol Cues Among Hazardous Drinkers

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Abstract

Previous research has suggested that Behavioral Activation System (BAS) sensitivity may be associated with stronger appetitive responses to alcohol cues. This study was conducted to explore whether those with higher BAS sensitivity showed greater urge and affective responses to alcohol cues and whether different types of appetitive cues moderated the magnitude of these associations. One hundred eighty-eight hazardous drinkers (90 women) were exposed to the sight and smell of their favorite alcoholic beverage during a cue exposure procedure. Participants were asked to either lean towards the beverage (Cue Only) when signaled by tones, or lift the beverage towards them (Cue + Action). BAS sensitivity was significantly associated with baseline ratings of urge and affect, and was found to be a significant predictor of urge and affect reactivity; however significant interaction effects with cue type were not observed. Results provide further evidence for the influence of individual differences in reward responsiveness on alcohol use and abuse.

Keywords

behavioral activation; BAS; cue reactivity; alcohol; appetitive cues; hazardous drinking

1. Introduction

Personality traits related to sensation-seeking and extraversion have been associated with hazardous drinking and alcoholism (Hittner & Swickert, 2006; O'Connor & Colder, 2005; Sher & Trull, 1994). While this link is well documented, less is understood regarding the underlying mechanisms involved. It has been suggested that individuals with these traits may have a heightened sensitivity to reward cues as manifested by increased appetitive motivation in relevant contexts (Carver & White, 1994; Pickering & Gray, 1999).

Gray (1981, 1987) has suggested that two neurologically-based systems are involved in regulating behavior, a Behavioral Activation System (BAS) and a Behavioral Inhibition System (BIS). Appetitive motivation is regulated by the BAS which is activated by conditioned stimuli signaling reward and non-punishment and is associated with positive affect and approach behavior. Aversive motivation is regulated by the BIS which is activated by conditioned stimuli signaling punishment or non-reward and is associated with

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anxiety and avoidance behavior (Pickering & Gray, 1999). According to this view, heavier drinking among those with higher BAS sensitivity may be due to their stronger subjective, physiological, and behavioral responses to positive incentive cues such as alcohol-related stimuli (Fowles, 1993; Franken, 2002).

Previous work has provided some support for this view. BAS sensitivity has been associated with hazardous and harmful drinking in community adult (Jorm et al., 1999) and adolescent samples (O'Connor & Colder, 2005). Experimental studies have shown that individual differences in BAS-related functioning are associated with behavioral measures of reward responsiveness (Kambouropoulos & Staiger, 2004a; Pickering, Diaz, & Gray, 1995). Similarly, those higher in BAS sensitivity exhibit greater levels of positive affect following reward cues (Carver & White, 1994) and positive mood induction (Zelenski & Larsen, 1999). In particular, experimental research has shown that BAS sensitivity is associated with increased urge reactivity to alcohol cues among social drinkers (Kambouropoulos & Staiger, 2001; Kambouropoulos & Staiger, 2004b) and alcohol-dependent subjects (Franken, 2002) as measured by cue-elicited urge to drink.

Although there is growing evidence for the association between BAS sensitivity and appetitive responses to alcohol cues, there are still a number of issues that may benefit from further study. First, the link between BAS sensitivity and urge responses has been identified in a number of studies; however, significant associations with affective responses to alcohol cues have not been consistently observed (Kambouropoulos & Staiger, 2001; Kambouropoulos & Staiger, 2004b). These inconsistencies may be, in part, due to small sample sizes in previous work, as correlations between BAS and cue reactivity measures are often based on cell sizes of 20 or fewer participants (e.g., Kambouropoulos & Staiger, 2004b). Replication in larger samples may provide more stable estimates of associations between cue responses and indices of appetitive motivation.

Second, there has been relatively little research conducted on the issue of whether the association of BAS sensitivity and appetitive motivation is moderated by the type of alcohol-related cues presented to participants. Investigators have suggested that the link between BAS sensitivity and cue reactivity may be a function of the type of alcohol related cue presented (Kambouropoulos & Staiger, 2004b). Levels of appetitive motivation should rise as similarities between current environmental, subjective, and behavioral cues and those present when an individual typically consumes alcohol increase (Baker, Morse, & Sherman, 1986). Although investigators have utilized visual, olfactory and behavioral components in their cue-reactivity procedures (e.g., Monti et al., 1993) few studies have examined whether specific behavioral cues associated with substance use play a unique role in activating appetitive motivational states (Coffey & Lombardo, 1998).

A third issue is the fact that there has been relatively little experimental research on whether BAS is associated with appetitive motivational states in reward situations in the absence of environmental cues. Pickering and Gray (1999) suggest that covert reward cues present at baseline can activate the BAS. However, alcohol cue reactivity studies often examine difference or change scores from baseline to cue presentation which obscures assessment of initial levels of appetitive motivation prior to cue exposure. This study will therefore examine the association between BAS sensitivity and baseline ratings of urge, arousal, and affect.

The current study examines the association between BAS sensitivity and cue reactivity among young adult hazardous drinkers (Conigrave, Hall & Saunders, 1995). It was hypothesized that BAS sensitivity would be associated with higher levels of appetitive motivation as measured by urge, arousal, and pleasantness both before and after the

presentation of alcohol cues. Moreover, this study examines the effects of a behavioral cue on the association between BAS and alcohol cue reactivity for participants expecting to consume alcohol. Half of the sample was exposed to the sight and smell of their favorite alcohol beverage (Cue Only) while the other half was exposed to sight, smell, and the behavior of lifting the glass (Cue + Action) when signaled by a cue. It was hypothesized that the association between BAS and appetitive motivation would be stronger among those who were exposed to the cue that was more closely linked with alcohol consumption (i.e., Cue + Action condition).

2. Methods

2.1 Participants

One hundred eighty-eight hazardous drinkers (90 women) were recruited from a local newspaper and university job boards to participate in a study on “social drinkers” for which they would be compensated \$40. Hazardous drinking was defined by having scores of 8 or more on the Alcohol Use Disorders Identification Test (AUDIT; Saunders, Aasland, Babor, de la Fuente, & Grant, 1993). Participants were included if they were between 21 and 35 years old, English was their first language, and beer was their most frequently consumed alcoholic beverage. Those who were currently using medications other than oral contraceptives, were nursing or pregnant (confirmed by a urine test), had elevated symptoms of alcohol dependence (scores of 9 or greater on the Alcohol Dependence Scale [Skinner & Allen, 1982]), or had sought treatment for substance abuse or dependence were excluded. The mean age of participants was 22.56 years old ($SD = 2.65$), the mean AUDIT score was 11.22 ($SD = 2.74$), the mean number of drinking days in the past month was 13.88 ($SD = 5.45$), and the mean drinks per drinking day was 4.62 ($SD = 2.25$) (Palfai, 2006).

2.2 Measures

Alcohol Use Disorders Identification Test (AUDIT) is a 10-item self-report instrument used to identify those at risk for alcohol-related harm as indicated by heavy alcohol use, symptoms of alcohol dependence, and alcohol-related problems (Saunders et al., 1993).

Alcohol Dependence Scale is a 25-item self-report index of alcohol dependence severity, and has been shown to be reliable and valid in screening for alcohol dependence (Skinner & Allen, 1982).

Time Line Follow Back – 30 Days (TLFB-30) is a calendar-based, interviewer-administered instrument used to assess alcohol consumption patterns over the past month and has been shown to be a highly reliable and valid instrument of drinking quantity, frequency, and heavy drinking episodes (Sobell, Sobell, Leo, & Cancilla, 1988).

Urge to Drink Alcohol was assessed by asking participants to answer the question, “How strong is your urge to drink alcohol right now?” using an 11-point Likert scale anchored by “no urge” and “very strong urge”. This has been validated as a self-report measure of urge to consume alcohol in previous work (see Monti, Rohsenow, & Hutchison, 2000).

Affect Grid (Russell, Weiss, & Mendelsohn, 1989) assesses affect along the dimensions of displeasure-pleasure and sleepiness-arousal (Russell, 1979). Participants rate their affect by placing a single mark somewhere within a 9 x 9 grid that is anchored with affect descriptions. The pleasure dimension (pleasantness) is represented on the horizontal dimension by the number (1–9) of the column checked. The arousal dimension is represented on the vertical dimension by the number (1–9) of the row checked. Research has demonstrated the convergent and discriminant validity of the Affect Grid with more extensive measures of affect (Russell et al., 1989).

Behavioral Inhibition/Behavioral Activation Scales (BIS/BAS; Carver & White, 1994) were developed to measure Gray's (1981, 1987) two motivational systems of Behavioral Inhibition and Behavioral Activation. The BIS scale is designed to measure sensitivity to the mechanism controlling aversive motivation (punishment and non-reward), and the BAS scale is designed to measure sensitivity to the mechanism controlling appetitive motivation (reward and non-punishment). The BIS scale is measured on one subscale and includes items such as "I worry about making mistakes", and "If I think something unpleasant is going to happen I usually get pretty worked up". The BAS scale is a higher-order scale based on three subscales: reward responsiveness (e.g., "It would excite me to win a contest"), drive (e.g., "I go out of my way to get things I want"), and fun-seeking (e.g., "I crave excitement and new sensations"). The BIS/BAS scales have been found to be valid measures of Gray's personality traits (Carver & White, 1999; Jorm et al., 1999).

2.3 Procedure

The current study is a secondary analysis that examines the association between BAS and appetitive motivational responses from an experiment on cue reactivity and hazardous drinking [see Palfai (2006) for a detailed account of the procedures]. During the consent procedure, participants were informed that the study would examine their responses to the presentation of alcohol cues, such as the sight and smell of beer. Participants were also informed that they would be asked to consume alcohol during the study protocol as part of a beer taste rating task. After signing consent forms, completing alcohol breath analysis, and, for women, taking a pregnancy test, participants completed an interviewer-administered TLFB and a series of questionnaires, including BIS/BAS. At the end of the questionnaire phase, the Baseline Affect Grid and Urge to Drink Alcohol measures were completed. Participants were then randomly assigned to either the Cue Only condition or the Cue + Action condition, stratified by gender. Those in the Cue + Action condition were instructed to lift the beverage toward them when signaled, and those in the Cue Only condition were asked to lean toward the beverage while holding it on the table. After these instructions, the participants completed a cue exposure procedure with a two-minute water trial, followed by a two-minute alcohol trial with their favorite beer. After the alcohol trial, participants completed the Affect Grid and Urge to Drink Alcohol measures. Prior to cue exposure trial, participants were told that they would consume beer at some point during the study.

3. Results

As previous work has suggested that BAS scores (Jorm et al., 1999) and alcohol involvement (Kashdan, Vetter, & Collins, 2005; Nagoshi, Wilson, & Rodriguez, 1991) may be influenced by gender, analyses were conducted controlling for the effects of gender.

3.1 Association between BAS scores and measures of appetitive motivation

To examine the association between behavioral activation and indices of appetitive motivation, a series of partial correlations were computed that controlled for effects of gender. Table 1 presents partial correlations between BAS, BIS and baseline and post-alcohol cue responses. These results show that those who were higher in BAS sensitivity exhibited stronger urges to drink both before and after exposure to alcohol cues. Similarly, higher BAS scores were associated with higher levels of baseline and post-cue pleasantness and arousal ratings. In contrast, BIS scores were not significantly associated with urge or affect scores either before or after alcohol cue exposure.

3.2 BAS scores and indices of cue reactivity

To examine whether the association between BAS scores and appetitive motivation was moderated by the type of appetitive cue, a series of hierarchical regression analyses were

conducted in which cue type (i.e., Cue Only vs. Cue + Action) was dummy coded (0/1) and interaction terms were computed with BAS scores. To examine the main effects of BAS and whether cue type moderated the influence of BAS on cue reactivity, all analyses were conducted by entering gender and baseline urge or affect on the first step, cue type on the second step, BAS on the third step, and the BAS x Cue Type interaction on the fourth step. Regression analyses for urge, arousal, and pleasantness are presented in Tables 2-4. These analyses show a main effect for BAS for each of these analyses. Those with higher BAS sensitivity exhibited higher urge, arousal and pleasantness reactivity when exposed to alcohol cues. Although none of the interaction terms were significant, there was a trend ($p < 0.09$) for the cue type x BAS interaction on urge ratings. To explore the nature of this association we followed Kambouropoulos & Staiger (2004b) and calculated partial correlations for urge ratings within each cue condition controlling for gender and baseline urge. These results showed that BAS sensitivity was significantly associated with urge reactivity in the Action condition ($r = 0.32, p < 0.05$) but not in the Cue Only condition ($r = 0.10, ns$).

4. Discussion

Results from this study replicate and extend previous research on BAS sensitivity and alcohol cue reactivity. BAS scores were significantly associated with urge and affect reactivity following exposure to alcohol in a young adult hazardous drinking sample. This finding is consistent with a growing number of studies, utilizing distinct measures of BAS and urge, that suggest that BAS sensitivity may be associated with stronger urge responses to alcohol cues (Franken, 2002; Kambouropoulos & Staiger, 2001; Kambouropoulos & Staiger, 2004b). Hazardous alcohol use among those with high BAS sensitivity may in part be a function of these heightened appetitive responses to alcohol cues.

In addition to urge reactivity, those high in BAS showed stronger appetitive responses to alcohol cues in terms of subjective arousal and pleasantness. Although previous studies of BAS have typically utilized measures of positive and negative affect (e.g., Kambouropoulos & Staiger, 2001), the two dimensions of arousal and pleasantness provide an alternative and compatible structure for representing affect (Russell et al., 1989; Watson & Tellegen, 1985). Previous research suggests that subjective arousal in response to alcohol cues may be a particularly important predictor of alcohol use behavior (Palfai, 2001). This is the first study to show a relationship between BAS and subjective arousal and pleasantness even when controlling for baseline indices of affect.

This study also showed that baseline measures of urge and affect were associated with BAS sensitivity. Pickering and Gray (1999) reported findings that performance on an unrewarded task was associated with scores on a number of measures of reward sensitivity. The authors interpret these findings as the possibility of the presence of covert reward cues at baseline, such as social reinforcement from the experimenter. Because participants in the current study came into the laboratory knowing that they would eventually be consuming alcohol, elevated urge and affect ratings among those higher in BAS may be responses to anticipated rewards. Although the possibility of consumption was not made salient until the alcohol cue exposure, expectancy effects may in part account for the stronger urge and affective responses of those who were higher in BAS across both baseline and cue conditions. Identification of these mechanisms requires further study, however, these data suggest that urge and affect ratings are associated with BAS sensitivity even in the absence of environmental cues for alcohol consumption.

BIS was neither associated with baseline nor post-cue urge and affect ratings. This lends further support to BAS as a distinct system that regulates responses to appetitive stimuli, as

opposed to BIS that is thought to regulate responses to aversive stimuli. The role of BIS in alcohol cue reactivity may depend on whether the cue paradigm is aversively or appetitively stimulating (Kambouropoulos & Staiger, 2004b). In the current study, all participants were informed that they would consume alcohol, so few punishment or non-reward cues were present. Given the inconsistent findings on the relation between BIS/BAS and affective responses in frustrative nonreward contexts (Carver, 2004; Corr, 2002), further research is needed to distinguish with which types of cues and in what contexts BIS and BAS are triggered.

While the interaction between cue type and BAS was not significant, there was a trend in the expected direction. Further analyses suggested that those in the Cue + Action condition had significant associations between urge reactivity and BAS, while those in the Cue Only condition did not. Although these results do not indicate that those in the Cue + Action condition had significantly greater responses to alcohol than those in the Cue Only condition, the results are consistent with the idea that cues more closely associated with actual alcohol use are more likely to produce appetitive responses (Baker et al., 1986).

There are some remaining issues from this study that future work may address. First, participants were all young adult hazardous drinkers whose preferred alcoholic beverage was beer. Appetitive motivational processes may operate differently in an older and/or alcohol-dependent population. Second, although this study suggests that BAS may be associated with appetitive motivation in the absence of environmental cues for reward, this variable was not explicitly manipulated in the current study. Future work should experimentally examine the effects of different forms of anticipated reward (e.g., information provided in consent, proximity to consumption, etc.) on urge and affective responses. Such studies will provide clearer evidence for the mechanisms that may underlie drinking among those high in BAS sensitivity.

This study provides evidence supporting the idea that individual differences in responding to reward cues is an important factor in understanding hazardous drinking. Future research on how and under what conditions BAS sensitivity is related to the etiology and maintenance of hazardous alcohol use will be important in improving screening, treatment, and relapse prevention programs.

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Table 1

Partial Correlations Between BIS, BAS, and Baseline and Post Alcohol-cue Responses, Controlling for Gender

Measure	BIS	BAS
<u>Baseline</u>		
Urge	.08	.21 **
Arousal	-.13	.20 **
Pleasantness	-.05	.16 *
<u>Post-cue</u>		
Urge	.09	.29 **
Arousal	-.04	.27 **
Pleasantness	-.11	.23 **

*
p < 0.05

**
p < 0.01

Table 2

Summary of Hierarchical Regression Analysis for Variables Predicting Urge Reactivity

Variable	R ² change	F change (df)	Beta
Step 1:	0.47	F = 82.87 (2, 184)	
Gender ¹			-.01
Baseline urge			.69 ^{**}
Step 2: Cue type ²	0.00	F = 0.35 (1, 183)	.03
Step 3: BAS	0.02	F = 8.03 (1, 182)	.15 ^{**}
Step 4: BAS × cue type ²	0.01	F = 3.01 (1, 181)	.12 ⁺

*p < 0.05

¹female = 0, male = 1²Cue Only = 0, Cue + Action = 1^{**}p < 0.01⁺p = 0.08

Table 3

Summary of Hierarchical Regression Analysis for Variables Predicting Arousal Reactivity

Variable	R ² change	F change (df)	Beta
Step 1:	0.35	48.43 (2, 183)	
Gender ¹			.02
Baseline arousal			.59**
Step 2: Cue type ²	0.00	0.79 (1, 182)	.05
Step 3: BAS	0.03	7.23 (1, 181)	.16**
Step 4: BAS × cue type ²	0.00	0.70 (1, 180)	.06

*p < 0.05

¹female = 0, male = 1²Cue Only = 0, Cue + Action = 1**
p < 0.01

Table 4

Summary of Hierarchical Regression Analysis for Variables Predicting Pleasantness Reactivity

Variable	R ² change	F change (df)	Beta
Step 1:	0.41	64.26 (2, 183)	
Gender ¹			.01
Baseline pleasantness			.64 ^{**}
Step 2: Cue type ²	0.00	0.02 (1, 182)	.01
Step 3: BAS	0.02	5.55 (1, 181)	.14 [*]
Step 4: BAS × cue type ²	0.00	0.60 (1, 180)	-.06

¹ female = 0, male = 1² Cue Only = 0, Cue + Action = 1^{*} p < 0.05^{**} p < 0.01