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Short Communication

Mood & alcohol-related attentional biases: New considerations for gender differences and reliability of the visual-probe task

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HIGHLIGHTS

- Tested associations between attentional biases and weekly alcohol consumption.
- Tested if mood activates attention biases and are conditional upon drinking motives.
- Attentional biases were positively related with alcohol consumption but only in men.
- Split-half and test–retest reliability of the visual-probe task were poor.
- Issues related to the reliability of visual-probe task are discussed.

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ABSTRACT

Introduction: Alcohol-related attentional biases are positively associated with drinking history and may represent a mechanism by which alcohol use behavior is maintained over time. This study was designed to address two unresolved issues regarding alcohol-related attention biases. Specifically, this study tested whether acute changes in positive and negative mood increase attentional biases toward alcohol cues and whether coping and enhancement drinking motives moderate these effects.

Methods: Participants were 100 college students aged 18–25, who drank alcohol at least once in the last 90 days. In a 2×3 mixed design, participants were randomized to one of three mood conditions (neutral, negative, or positive) and completed visual-probe tasks pre- and post-mood-induction.

Results: Attentional biases toward alcohol cues were significantly associated with alcohol consumption among men, but not women. Although the mood manipulation was highly successful, attentional biases did not vary as a function of mood condition and hypothesized moderating effects of drinking motives were not significant.

Conclusions: The largely null findings of the experiment are discussed in light of the fact that the visual probe task had poor reliability. Issues related to the reliability of visual-probe task are discussed, as more research is needed to evaluate and improve the psychometrics of this method.

1. Introduction

The prevalence of alcohol consumption and associated consequences are elevated among college students (SAMHSA, 2013). Thus, understanding psychological mechanisms that contribute to the development of problem drinking is important for both prevention and treatment efforts. One mechanism thought to contribute to problem drinking is alcohol-related attentional biases (AAB; Field & Wiers, 2012). AAB are the propensity for alcohol-related stimuli to capture the attention of the sensory systems at the expense of processing competing stimuli. Research indicates that individuals with problematic alcohol use patterns exhibit AAB (Field & Cox, 2008). AAB are thought to index the processes that promote compulsive substance-seeking behavior (Franken, 2003; Robinson & Berridge, 2003). A more comprehensive understanding of AAB and their associations with internal and external cues, individual difference factors, and substance use outcomes is needed to better delineate their role in the etiology of alcohol use disorder.

AAB develop through classical conditioning where alcohol-related cues acquire conditioned incentive-motivational properties due to their repeated pairing with the specific effects of alcohol, such as increased positive affect (PA) or alleviation of negative affect (NA; Franken, 2003; Robinson & Berridge, 2008). AAB develop over time in concert with increased drinking (Field & Cox, 2008; Field & Quigley, 2009) and are thought to have a reciprocal relationship with alcohol consumption. However, the exact role of AAB in drinking decisions remains unclear (Field & Cox, 2008; Field & Wiers, 2012).

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Table 1
Correlation matrix and descriptive statistics ($N = 100$).

Variables	*M*	(*SD*)	1	2	3	4	5	6	7
1. Gender	–	–	–						
2. Enhancement motives	15.02	4.87	−.01	–					
3. Coping motives	9.35	3.60	−.17	.53***	–				
4. Alcohol consumption	14.59	11.46	.45***	.36***	.28**	–			
5. Alcohol use frequency	5.39	1.26	−.17	−.23*	−.32**	−.60***	–		
6. Alcohol-related attentional bias T1	9.36	5.53	−.05	−.16	−.16	.03	.16	–	
7. Alcohol-related attentional bias T2	−0.23	12.60	.18	−.08	−.04	−.01	.07	−.01	–

Note: Gender (men = 1, women = 0), alcohol use frequency (9 = no use, 1 = more than once a day).
* $p < .05$.
** $p < .01$.
*** $p < .001$.

The influence of AAB on drinking decisions varies as a function of both individual difference and contextual factors (Field & Powell, 2007). Research shows that contextual factors appear to activate AAB, increasing them compared to when these factors are absent (Field & Quigley, 2009). For example, laboratory stressors increase AAB, but only among drinkers with high levels of coping motives (Field & Powell, 2007; Field & Quigley, 2009). Conversely, associations between PA and implicit biases are conditional upon level of enhancement motives (Birch et al., 2008; Grant, Stewart, & Birch, 2007). These findings suggest that person × situation interactions contribute to AAB and individual drinking decisions.

Given the above literature, we sought to replicate previous research by examining the following hypotheses: first, alcohol consumption would be positively associated with AAB. Second, induced NA and PA would increase AAB, and those relationships would be moderated by mood-congruent drinking motives (i.e., negative × coping and positive × enhancement), strengthening them.

2. Method

2.1. Participants

One-hundred participants aged 18–24 ($M = 19.85$, $SD = 1.45$, 61% female) who reported drinking alcohol at least once in the past 90 days were recruited. Four-percent identified their ethnicity as Hispanic or Latino. The sample was 87% White, 3% African American, 3% Asian, 2% Native American/Alaskan Native, 1% Native Hawaiian/Pacific Islander, 2% Multiracial, 1% Other, and 1% did not wish to respond.

2.2. Measures

2.2.1. Positive and negative affect schedule: expanded form (PANAS; Watson & Clark, 1999)

The PANAS assessed affect in the current moment on a 5-point scale. To assess NA, the 10-item NA subscale (e.g., distressed; α ranged from .84–.91) was used. PA was assessed by the 8-item joviality subscale (e.g., happy; α ranged from .94–.96).

2.2.2. Visual-probe task

AAB was assessed with the visual-probe task, which consisted of 80 trials where 2 images were presented simultaneously on a computer screen. There were 20 filler trials containing 2 matched neutral images. The remaining 60 trials had 1 alcohol-related picture and 1 matched neutral picture. Both trial types were randomly distributed throughout the task. Trials began with a fixation cross centrally presented for 500 ms, followed by a left–right bilateral presentation of a picture pair for 500 ms. After which, a small dot was presented in the space previously occupied by an image. Probes remained until participants identified which side the probe was on by pressing the corresponding button on a two button response box which recorded their reaction time, or until 2000 ms elapsed. This was followed by a 1000 ms intertrial interval. AAB scores were calculated using the following formula (Kujawa et al., 2011; MacLeod & Mathews, 1988).[1]

$$\textbf{AAB score} = \tfrac{1}{2}[(\textbf{Rneutral}-\textbf{Ralcohol}) + (\textbf{Lneutral}-\textbf{Lalcohol})]$$

2.2.3. Drinking motive questionnaire—revised (DMQ-R; Cooper, 1994)

The DMQ-R is a 20-item questionnaire that measures motives for drinking on a 5-point scale. Only the 5-item coping (α = .77) and enhancement (α = .84) subscales were used.

2.2.4. Alcohol consumption

Alcohol consumption in the past 90 days was assessed using the Modified Daily Drinking Questionnaire (MDDQ; Dimeff, Baer, Kivlahan, & Marlatt, 1999). The MDDQ is a grid representing the 7 days of the week; participants indicate typical daily alcohol consumption for a normal week. Weekly alcohol consumption was the total drinks per week. Alcohol use frequency in the past 90 days was assessed by 9-point anchored rating scale (Simons, Oliver, Gaher, Ebel, & Brummels, 2005).

Moods were induced with evocative picture slides and mood-congruent music (Treloar & McCarthy, 2012; Wardell, Read, Curtin, & Merrill, 2012). Sixty slides from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2008) were selected from each valence group to ensure the highest average rating for each mood. Positive and negative valenced slides were also selected for high arousal ratings. Each slide-set was paired with mood-congruent music to enhance mood effects, Alexander Nevsky's *Op.78 Russia Under the Mongolian Yoke* and *The Battle on the Ice* for negative, excerpts from George Frideric Handel's *Water Music* for positive (Conklin & Perkins, 2005; Treloar & McCarthy, 2012) and Gabriel Faure's *Ballad for Piano and Orchestra Op.19* played at half-speed for neutral (Stöber, 1997). Each slide was presented for 8 s (total duration = 8 min).

2.3. Procedure

Participants were randomly assigned to a mood group (33 negative, 33 neutral, 34 positive). All participants completed the following, in order; demographics, baseline PANAS, T1 visual-probe, pre-mood PANAS, assigned mood-induction, post-mood PANAS, T2 visual-probe, positive mood-induction (to ensure no residual distress), and alcohol consumption and drinking motives questionnaires.

[1] In this equation, the R and L refer to the right and left side of the screen, while neutral and alcohol refer to what image the probe replaced. The equation subtracts the mean reaction time (RT) from trials where the probe replaced the neutral image from the mean RT from trials where the probe replaced the alcohol images for both the left and right sides of the screen, and then takes the average of the 2 scores. If participants were preferentially attending to alcohol images, then RTs will be shorter on trials where the probe replaces those alcohol images, and the bias scores will be positive. If participants were preferentially attending to neutral images, the bias scores will be negative.

Table 2
Regression analyses.

Variable	*B*	*SEB*	*t*	*p*	R^2
1. Weekly alcohol consumption predicted from T1 attentional bias scores, gender, and gender × T1 attentional bias					
					.28
Gender	11.23	2.36	4.75	.000	
T1 attentional bias	−0.10	0.06	−1.65	.103	
Gender × T1 attentional bias	0.50	0.20	2.52	.014	
2. T2 attentional bias scores predicted from affect × drinking motives interactions					
Step 1					.03
Gender	5.18	2.72	1.91	.060	
T1 attentional bias	0.01	0.10	0.07	.942	
Positive affect	−0.15	3.79	−0.04	.969	
Negative affect	−1.26	2.72	−0.46	.646	
Step 2					.04
Gender	5.37	2.71	1.98	.051	
T1 attentional bias	−0.01	0.10	−0.02	.986	
Positive affect	−0.10	3.77	−0.03	.980	
Negative affect	−1.15	2.82	−0.41	.684	
Enhancement motives	−0.27	0.33	−0.82	.413	
Coping motives	0.18	0.37	0.49	.628	
Step 3					.10
Gender	4.67	3.00	1.57	.120	
T1 attentional bias	0.05	0.10	0.50	.620	
Positive affect	−0.32	3.72	−0.09	.931	
Negative affect	−1.55	2.86	−0.54	.590	
Enhancement motives	0.53	0.47	1.15	.253	
Coping motives	−0.39	0.71	−0.55	.581	
Positive affect × Coping motives	−1.95	1.10	1.12	.264	
Negative affect × Coping motives	0.43	0.81	0.53	.600	
Positive affect × Enhancement motives	−1.95	0.90	−2.18	.032	
Negative affect × Enhancement motives	−0.27	0.62	−0.43	.665	

Note 1. $N = 99$ (1 participant responded incorrectly on every trial of the T1 visual-probe task and was excluded from analysis). Full model $F(3, 95) = 9.05$, $p < .001$, $R^2 = .28$. *Note 2.* $N = 98$ (2 participants responded incorrectly on every trial of the T2 visual-probe task and were excluded from analysis). The test for each incremental Step are as follows: Step 1 $F(4, 93) = 1.05$, $p = .384$, $R^2 = .03$; Step 2 $F(2, 91) = 0.34$, $p = .712$, $\Delta R^2 = .01$; Step 3 $F(4, 87) = 1.29$, $p = .282$, $\Delta R^2 = .06$. Full model $F(10, 87) = 1.24$, $p = 278$, $R^2 = .10$.

3. Results

3.1. Descriptive data

Participants most frequently reported drinking *once or twice a week* (36%) during the previous 90 days. Weekly alcohol consumption ranged from 0–53 drinks in the past 90 days ($M = 14.59$, $SD = 11.46$) (Table 1).

3.2. Preliminary analyses

To examine effects of the mood-induction, 2 × 3 mixed ANOVAs were conducted, with a within-subjects factor of time and between-subjects factor of affect group. For PA, results showed an affect × time interaction ($F(2,97) = 38.84$, $p < .001$). Planned contrasts indicated that PA increased from pre to post-mood-induction in the positive condition ($t(97) = 2.83$, $p = .006$, $d = 0.45$) and post-induction PA was elevated in the positive condition ($M = 3.10$, $SD = 0.93$) relative to neutral ($M = 2.05$, $SD = 0.92$, $t(194) = 4.64$, $p < .001$, $d = 1.14$) and negative conditions ($M = 1.50$, $SD = 0.56$, $t(194) = -7.10$, $p < .001$, $d = 2.07$).

For NA, there was an affect × time interaction ($F(2, 97) = 32.48$, $p < .001$). Planned contrasts revealed that NA increased from pre to post-mood-induction in the negative condition ($t(97) = 9.60$, $p < .001$, $d = 1.24$) and post-induction NA was higher in the negative condition ($M = 2.16$, $SD = 0.70$) relative to the neutral ($M = 1.42$ $SD = 0.61$, $t(194) = 6.25$, $p < .001$, $d = 1.13$) and positive conditions ($M = 1.19$, $SD = 0.37$, $t(194) = 8.29$, $p < .001$, $d = 1.74$).

To test the reliability of AAB, split-half reliability for the T1 visual-probe task and test–retest reliability in the neutral mood group were calculated. Results revealed that the task had poor split-half reliability ($r = -.19$, $p = .059$) and test–retest reliability ($r = .13$, $p = .467$). Unfortunately, these results undermine the ability to interpret the findings. However, some researchers argue that the visual-probe task can still be used, despite its low reliability (Field & Christiansen, 2012), but interpreted with caution. The remaining analyses were conducted with this precedent in mind.

3.3. Primary analyses

In the regression models, predictors were mean centered and robust standard-errors were calculated using Huber–White sandwich estimators to accommodate for heteroscedasticity (Croux, Dhaene, & Hoorelbeke, 2004). In the initial model, weekly alcohol consumption was regressed on gender and T1-AAB ($F(2,96) = 10.20$, $p < .001$, $R^2 = .22$). Regression diagnostics (i.e., omitted variable test) indicated patterning in the residuals. Including an interaction between gender and T1-AAB ($b = 0.50$, $p = .014$) corrected this problem, final model ($F(3,95) = 9.05$, $p < .001$, $R^2 = .28$). The simple slopes revealed that the there was a significant effect of AAB for men ($b = 0.40$, $p = .036$), but not women ($b = -0.10$, $p = .103$).

Hierarchical linear regression was used to test the hypothesized effects of mood on AAB and moderating effects of drinking motives. Experimental condition was a categorical factor with neutral as the reference group. At Step 1, T2-AAB scores were regressed on gender, T1-AAB, and affect condition ($F(4,93) = 1.05$, $p = .384$, $R^2 = .03$). Contrary to hypothesis, no predictors were significant. At Step 2, drinking motive scores (i.e., coping, enhancement) were added ($F(2,91) = 0.34$, $p = .712$, $\Delta R^2 = .01$). At Step 3, affect × drinking motives interactions were added ($F(4,87) = 1.29$, $p = .282$, $\Delta R^2 = .06$). In the final model ($F(10,87) = 1.24$, $p = .278$, $R^2 = .10$), neither the affect × enhancement motives ($F(2,87) = 2.47$, $p = .096$) nor affect × coping motives interactions ($F(2,87) = 0.63$, $p = .533$) were significant (Table 2).

4. Discussion

The current study sought to replicate previous research by testing AAB's association with drinking and whether state affect exhibits associations with AAB that are conditional upon alcohol motives.

4.1. Attentional bias and alcohol consumption

AAB was positively associated with alcohol consumption among men but not women. Although a gender interaction was not hypothesized, regression diagnostics indicated patterning in the residuals consistent with a missing higher-order interaction. Hence, the gender × AAB interaction was added post-hoc. Previous research shows significant associations between AAB and drinking, but has not reported that this varied as a function of gender (Field & Cox, 2008; Field & Wiers, 2012). AAB and their association with drinking are more pronounced among heaver drinkers (Field & Cox, 2008), and consistent with this, men drank more than women. This suggests a curvilinear association whereby drinking is influenced by social factors among lighter drinkers and the role of AAB become more pronounced as drinking increases. Alternatively, this may be due to gender differences in neural processing of emotionally evocative stimuli (Cahill, 2006; Sass et al., 2010), as men often show greater visual activity to appetitive stimuli (Sabatinelli, Flaisch, Bradley, Fitzsimmons, & Lang, 2004). These findings highlight the importance of testing gender interactions, which may have significant implications for understanding the greater prevalence rates of alcohol use disorders in men (APA, 2013). Although AAB was related to drinking history for men, AAB did not vary as a function of mood as hypothesized. This null finding may, in part, be a consequence of the visual probe task's poor reliability.

4.2. Reliability of the visual-probe task

In this study, split-half and test–retest reliability of the visual-probe task were poor. A recent meta-analysis (Ataya et al., 2012) examining reliability of AAB tasks showed that the visual-probe produced unreliable estimates, which is consistent with our findings. Some suggest that image selection contributes to the poor reliability because an array of alcohol-related pictures are used (e.g., beer, liquor), and there is little evidence participants respond to each similarly (Field & Christiansen, 2012). Thus, the overall AAB may be small given it is the average of all alcohol-related stimuli. However, assuming images are randomly distributed in the task, this should not affect split-half reliability, nor can it affect test–retest reliability. Therefore, the stimuli content could account for the magnitude of effects, but is unlikely to account for poor reliability found here.

Individuals may use strategies to maximize performance that undermine the detection of AAB. For example, a "left" response is signified by either perceiving the cue on the left or by *not* perceiving it on the right. Some visual-probe variations have accounted for this by using arrow-probes, which require the individual to detect the arrows' direction to respond properly (Christiansen, Cole, & Field, 2012). Alternatively, if individuals strive to maintain a wide visual-field rather than attending to a single image there will be no AAB. Image presentation time may also be a factor irrespective of response strategy. A 500 ms presentation allows for multiple attentional shifts, assuming 50 ms for shifting attention to a cue and 150–200 ms for disengaging (Allport, 1989; LaBerge, 1995). Hence, attention could be anywhere when the probe is presented and would be irrespective of bias.

The visual-probe task used here was closely modeled after previous AAB research (Forestell, Dickter, & Young, 2012; Noël et al., 2006). Although these studies did not report the reliability, they do report significant associations between AAB and drinking (partially replicated here). Our findings coupled with the meta-analysis discussed above, indicate that further research is needed to identify approaches to maximize reliability of visual-probe tasks.

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Contributors

Mr. Emery and Dr. Simons designed the study and collected the data. Mr. Emery conducted the data analyses and prepared results as well as the first draft of the manuscript. All authors contributed to and approved the final manuscript.

Conflict of interest

The authors have no conflicts of interest.

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