A Biobehavioral Study of Attentional Bias Modification for Alcohol

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INTRODUCTION

In alcohol research, attentional bias (AB) is defined as the preferential allocation of attention to alcohol-related stimuli in the environment, with more frequent drinkers exhibiting greater AB than less frequent drinkers. AB may be one contributor to the development of problematic drinking (Field & Cox, 2008; Field, Cox, & Rahami, 2016).

Attentional bias modification (ABM) techniques can reduce AB by training individuals to direct their attention away from alcohol-related stimuli (Field & Eastwood, 2005; Schoenmakers, Wiers, Jones, Bruce, & Jansen, 2007; Field et al., 2007).

The efficacy of ABM techniques has traditionally been measured behaviorally, via changes in response times to alcohol-related and neutral stimuli, with little research focused on changes in physiological measures of attention. The presence or absence of physiological change after ABM training could contribute to current discussions about its potential clinical relevance in alcohol use disorders (Mogoaşe, David, & Koster, 2014).

The capture and allocation of attention can be measured physiologically via electroencephalography (EEG), and in particular with the N2pc event-related potential (ERP), which reflects selective allocation of attention when horizontally-opposed stimuli are simultaneously presented in a visual field (Kappenman, MacNamara, & Hajack Proudfit, 2014).

The reduction of the N2pc component to alcohol cues after ABM training would indicate that ABM successfully reduces selective attention to alcohol cues in social drinkers.

HYPOTHESIS

We hypothesized that a single session of ABM training, compared to placebo training, will reduce selective attention to alcohol cues measured via reaction times and the N2pc.

METHOD

Participants

Participants included 44 young adult social drinkers (25 female), with an average age of 22.1 (SD = 2.0) years.

Reported ethnicity: Caucasian (27.3%), African American (18.2%), Hispanic (20.5%), Asian 27.3%), and other/not reported (4.5%).

Participants began drinking at an average age of 22.1 (SD = 2.0) years and consumed an average of 3.7 (SD = 1.9) drinks per drinking episode with 2.2 (SD = 1.1) drinking episodes per week.

Assessment of Attentional Bias

AB to alcoholic stimuli was measured pre- and post-training via a dot probe task adopted from the visual probe task used by Miller and Fillmore (2010). Attentional bias scores were calculated by comparing the average time required to correctly identify the location of probes that replaced alcohol-related stimuli to probes that replaced the neutral and filler images.

A modified (Ostafin & Palfai, 2006) Implicit Association Task (IAT) (Greenwald et al., 1998) was used to measure implicit associations about alcohol. *D*-scores were computed for each participant per the scoring method described in Greenwald, Nosek, and Banaji (2003), such that positive *d*-scores indicated an association between alcohol and "approach" and negative d-scores indicated an association between alcohol and "avoid".

Attentional Bias Modification Training

Participants completed a dot probe-based ABM task modeled on the task described in Field and Eastwood (2005). Participants viewed paired sets of alcoholic and non-alcoholic beverages and had to identify the location of a probe that replaced one of the images. In the active ABM training task, the probe replaced the non-alcoholic beverage during all trials. In the sham ABM training task, the probe replaced the two types of images with equal frequency. Participants completed three blocks of 256 trials with breaks in between.

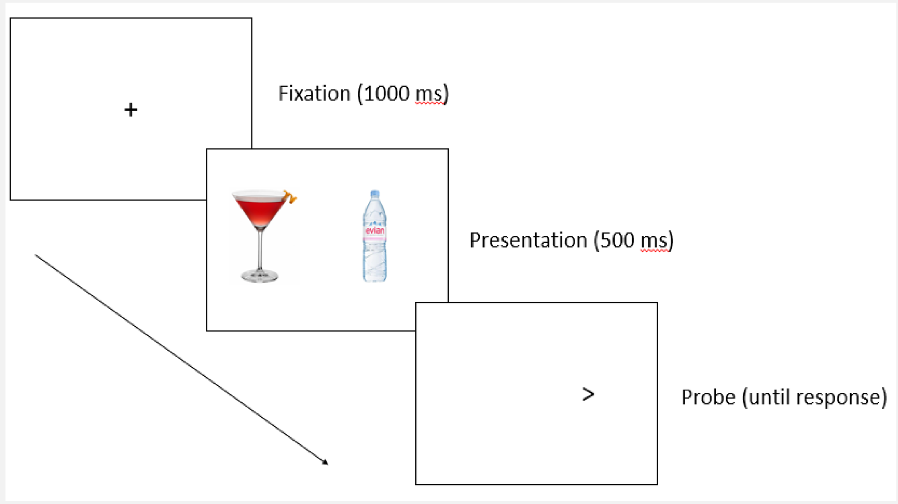

Figure 1: ABM Training Procedure

EEG Recording and Analysis

EEG activity was recorded during the dot probe assessment via BioSemi 64 Ag/AgCl scalp electrodes, sampled at 512 Hz. Using Brain Vision Analyzer, data were referenced offline to the average of the entire scalp and filtered with a low-cutoff frequency of .1 Hz and a high-cutoff frequency of 30 Hz. Stimulus-locked data were segmented into epochs from 200 ms before stimulus presentation to 600 ms after stimulus onset, with a 200 ms baseline correction period.

Following ocular correction (Gratton, Coles, & Donchin, 1983), artifacts were identified using the following criteria and removed from analyses: data with voltage steps greater than 50 µV, changes within a given segment greater than 300 µV, activity lower than .5 µV per 100 ms. Artifacts were also identified and removed manually.

To quantify the N2pc elicited by alcohol-related stimuli during the pre- and post-training dot probe tasks, we looked only at trials in which one alcohol-related image and one neutral image appeared horizontally opposed on the computer screen. We then found the average amplitude of the EEG recording at electrodes P7 and P8 (where the N2pc tends to be maximal (Holmes et al., 2009; Grimshaw et al., 2014) both contralateral and ipsilateral to the alcohol-related and neutral images between 200 and 300 ms after image onset. Finally, we calculated the N2pc to the alcohol-related stimuli as the difference between the average voltage contralateral to the alcohol-related stimuli and ipsilateral to the neutral related stimuli, such that a negative N2pc value indicated the preferential allocation of attention to the alcohol-related stimuli.

RESULTS

After controlling for pre-training reaction time scores, the ABM versus placebo group exhibited significant reductions in the time it took to respond to the probe in the alcohol incongruent condition , $F(1,41) = 5.586$, $p = .023$ and in the alcohol congruent condition, $F(1,41) = 4.129$, $p = .049$.

This suggests that the ABM group responded more quickly to probes irrespective of condition.

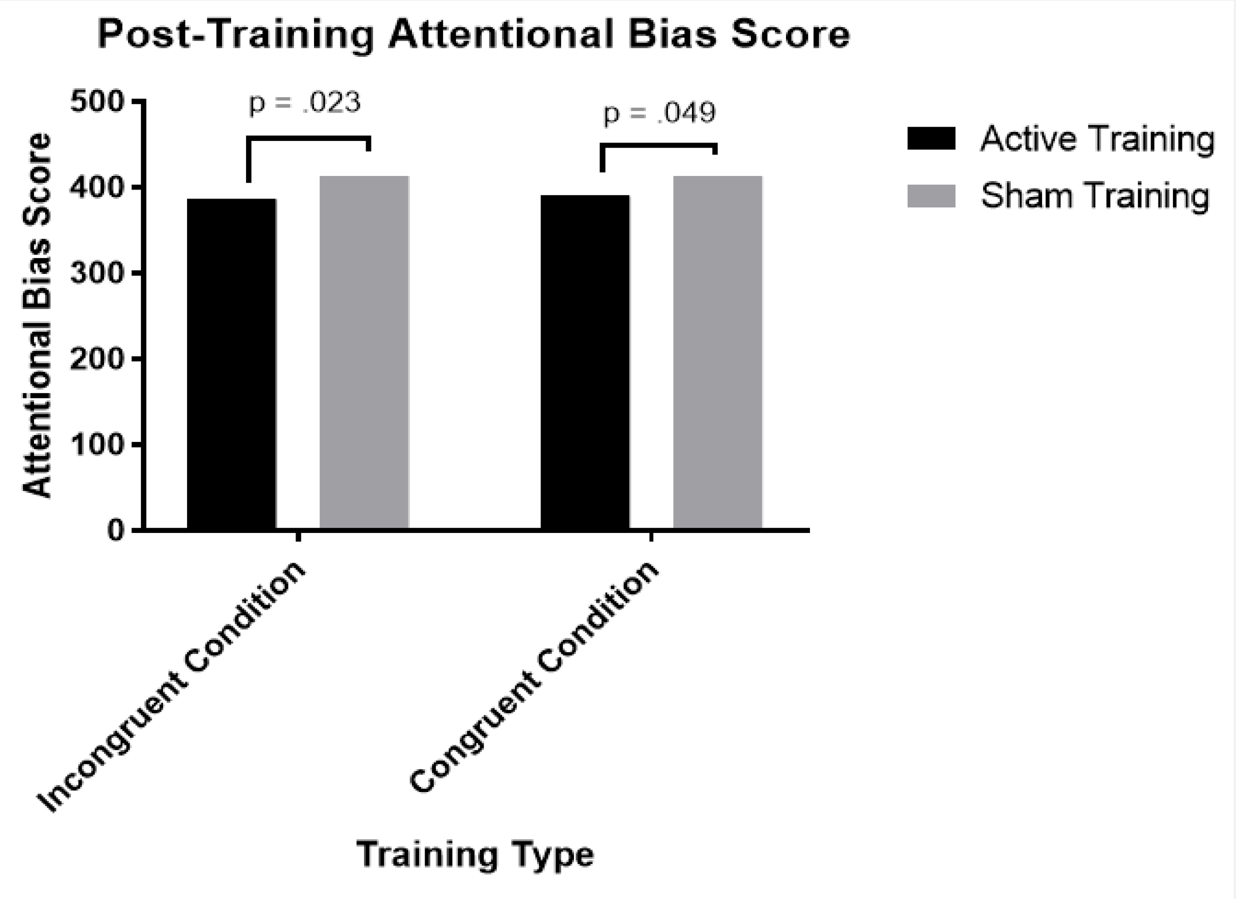

Figure 2: Post-Training Dot Probe Reaction Times

RESULTS, CONTINUED

Counter to predictions, the magnitude of the post-training N2pc did not significantly change in either the active [$t(21) = .288$, $p = .776$] or sham training groups [$t(21) = 1.039$, $p = .310$].

However, the magnitude of the post-training N2pc significantly predicted post-training performance on the implicit associations about alcohol task (beta = .559, $t(20) = 3.016$, $p = .007$) in the active training group but not the sham training group (beta = -.139, $t(20) = -.628$, $p = .537$), such that greater N2pc to alcohol-related stimuli was associated with greater implicit avoidance of alcohol-related stimuli.

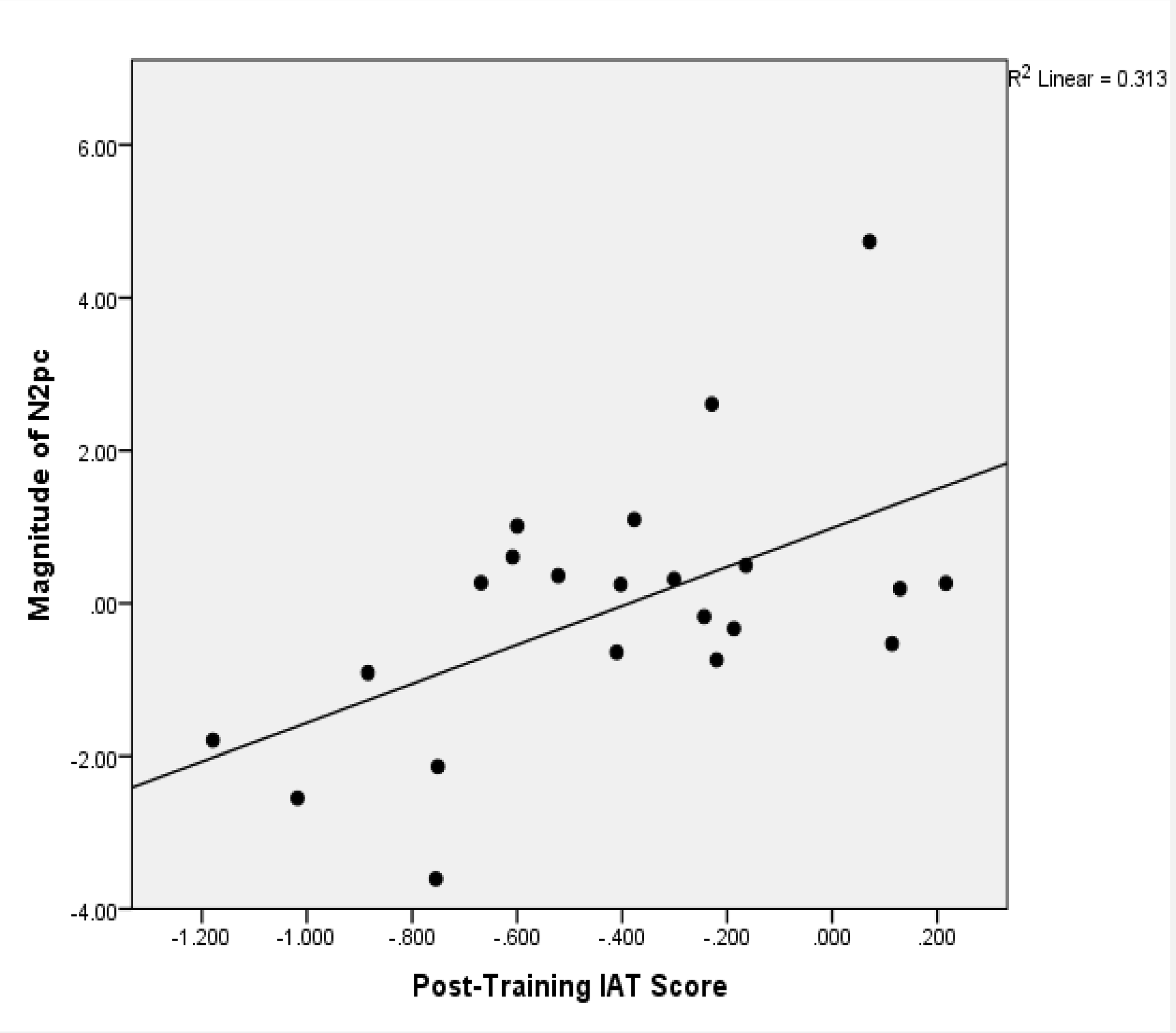

Figure 3: Magnitude of N2pc and Post-Training IAT Score

DISCUSSION

Counter to predictions, the N2pc did not decrease in the ABM versus placebo condition in this sample of young adult social drinkers even though there were marginally significant. This is similar to other studies investigating ABM training for anxiety, which did not appear to alter N2pc (Hunkin, 2014; Osinsky et al., 2014). This suggests that this very brief ABM training, while effectively altering behavioral responses to alcohol cues, did not induce neurophysiological changes in the participants.

Alternatively, the association between N2pc and IAT scores observed in this study may imply a relationship between attention and avoidance, such that the selective allocation of attention toward an alcohol-related stimuli could activate implicit cognitions of avoidance related to alcohol, which may in turn represent an individual difference that could bolsters the positive effects of ABM on the ability to successfully avoid alcohol.

A limitation in these analyses includes the small number of trials used to calculate the N2pc.

Future ABM research should continue to investigate relationships between neurophysiology and implicit cognitions to help determine how ABM may be used most effectively as a potential clinical tool.

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