

BRIEF REPORT

Computer-Delivered, Home-Based, Attentional Retraining Reduces Drinking Behavior in Heavy Drinkers

John E. McGeary

Providence Veterans Affairs Medical Center and Rhode Island Hospital, Providence, Rhode Island and Brown University

Sydney P. Meadows

Binghamton University

Nader Amir

San Diego State University/University of California

Brandon E. Gibb

Binghamton University

To examine the impact of a computer-delivered, home-based, alcohol-specific attention modification program (AMP), 41 heavy drinking college students were randomly assigned to AMP or an attention control condition (ACC). Participants selected 10 alcohol-related words most relevant to their own drinking experience as well as 10 neutral words not related to alcohol. These personalized stimuli were used in an attention retaining program based upon the probe detection paradigm twice weekly for 4 weeks. Participants in the AMP condition reported decreased drinking, whereas those in the ACC condition reported no change in their drinking. These preliminary data suggest that a computer-delivered, home-delivered, attention-retraining for alcohol treatment may be an inexpensive and efficacious adjunct to standard alcohol treatments.

Keywords: attentional retraining, drinking behavior

The 12-month prevalence of alcohol use disorders (AUDs) has been estimated at 10.8% in a nationally representative sample (Agrawal, Heath, & Lynskey, 2011) and cause an estimated 79,000 deaths annually (Bouchery et al., 2011). Furthermore, with estimated annual economic costs of \$223.5 billion dollars (Bouchery et al., 2011), AUDs constitute a major public health problem and efficacious treatments have the potential to reduce many of these direct and indirect consequences. Although treatments for AUDs

have substantially improved in recent decades, only a third of those who receive treatment remain abstinent over one year (Miller, Walters, & Bennett, 2001), demonstrating a clear need for continued improvement. Focusing treatments on the specific mechanisms that maintain AUDs may help to advance current treatments. Attentional biases for alcohol-related cues offer one promising mechanism of change.

There is a well-supported association between alcohol use and attentional bias toward alcohol-relevant cues. For instance, heavy drinkers show a stronger attentional bias for alcohol-related pictures than non-alcohol-related pictures when these pictures are presented for longer durations of 500 and 2000 ms (Field, Mogg, Zetteler, & Bradley, 2004). This bias has also been demonstrated in clinical alcoholic populations using the Stroop Task (Johnsen, Laberg, Cox, Vaksdal, & Hugdahl, 1994). Furthermore, there is preliminary evidence that attentional biases may influence treatment outcome for substance use disorders. Specifically, in abstinent inpatient heroin users, pretreatment attentional biases for drug-related stimuli predicted relapse (Marissen et al., 2006). This has also been demonstrated in patients diagnosed with alcohol dependence, where increases in attentional bias for alcohol-related words between intake and discharge predicted relapse following discharge (Cox, Hogan, Kristian, & Race, 2002). This suggests that attentional bias for substance-relevant cues may be an important mechanism leading to substance use disorder, and that efforts to directly target the reduction of this bias could reduce substance use.

John E. McGeary, Providence Veterans Affairs Medical Center and Division of Behavioral Genetics, Rhode Island Hospital, Providence, Rhode Island and Department of Psychiatry and Human Behavior, Brown University; Sydney P. Meadows, Department of Psychology, Binghamton University; Nader Amir, Department of Psychology, Joint Doctoral Program of San Diego State University/Joint Doctoral Program of University of California; Brandon E. Gibb, Department of Psychology, Binghamton University.

This project was supported by National Institutes of Health Grants R01 MH087623-04 R34 MH073004-01 awarded to Dr. Amir, and R01 HD057066 and R01 MH098060 awarded to Dr. Gibb. Dr. Amir has financial interest in Cognitive Retraining Technologies Incorporated, which has licensed elements of the technology described in this study for commercial purposes. The views expressed in this article are those of the authors and do not necessarily reflect the position or policy of the Department of Veterans Affairs.

Correspondence concerning this article should be addressed to John E. McGeary, Providence Veterans Affairs Medical Center, 830 Chalkstone Avenue, Providence, RI 02908. E-mail: john_mgeary@brown.edu

Computer-based methods of attentional biases modification (ABM) have shown promise in several forms of psychopathology. Specifically, at least four randomized, controlled trials showed significantly larger improvement of symptoms in the ABM when compared with the attention control conditions (ACCs) that were maintained at follow-up (Amir, Beard, Burns, & Bomyea, 2009; Amir, Beard, Taylor, et al., 2009; Heeren, Reese, McNally, & Philippot, 2012; Schmidt et al., 2009). However, at least four recent attempts to replicate the above findings have failed to find improvements in anxiety following ABM when compared with the ACC (Carlbring et al., 2012; Boettcher et al., 2012; Bunnell, Beidel, & Mesa, 2013). Although a number of factors could account for these discrepant results (e.g., method of delivery: in lab delivery vs., Internet delivery, etc.), the most parsimonious explanation may be that in these latter studies, the active dose of the mechanism of change for attention training (i.e., change in attention bias) was similar in both groups.

Although research is more limited for the role of attention training in alcohol use disorders, there is some evidence that it may be an important tool for reducing attentional biases and actual alcohol consumption. For example, with just a single attention training session, Schoenmakers, Wiers, Jones, Bruce, and Jansen (2007) were able to reduce alcohol-related attentional biases in undergraduate heavy drinkers.

Fadardi and Cox (2009) used multiple attention training sessions using personalized stimuli and showed that this training resulted in a reduction in attention bias in heavy and hazardous drinking groups, with reduced alcohol consumption in the harmful drinking group. There has been some promise in clinical populations as well, with alcoholic patients who complete attention bias modification being released from treatment earlier and taking a longer time to relapse as compared with patients who do not complete the modification program (Schoenmakers et al., 2010).

Though the work on modifying attention bias for alcohol has been lab- or clinic-based thus far, there is increasing evidence from work in the area of anxiety disorder treatment that such approaches may be successfully implemented using home-based computerized methods (e.g., Amir & Taylor, 2012). The advantages of such an approach over lab or clinic-based implementation include the following: the ability to increase access to those who are unable to regularly attend in-person intervention meetings, a low-cost adjunct to traditional clinic-based interventions that may improve clinical outcomes, and the convenience of allowing individuals to engage in treatment at a time and location of their choice.

The primary goal of the current study was to examine the effectiveness of a computer-delivered, home-based, attentional bias modification in undergraduates reporting heavy drinking. We predicted that those randomized to active attention bias modification training, compared with those allocated to a control condition, would exhibit greater decreases in drinking behavior across the course of treatment.

Method

Participants

Participants were 41 male undergraduate students. Subjects provided informed consent, and the procedures followed were in accord with the standards of the Committee on Human Experi-

mentation of the institution in which the experiments were done or in accord with the Helsinki Declaration of 1975. All participants received course credit for their participation. The mean age of participants in this study was 18.98 ($SD = 1.05$) and 70.5% were Caucasian. To be included in the study, participants had to score higher than an 8 on the Alcohol Use Disorders Identification Test (AUDIT; Saunders et al., 1993), reflecting harmful or hazardous alcohol use.

Measures

Participants were recruited based on their scores on the AUDIT. The AUDIT has exhibited good psychometric properties as a screening tool for hazardous drinking in previous research (Bush, Kivlahan, McDonell, Fihn, & Bradley, 1998; Piccinelli & Homen, 1997). The scale exhibited good internal consistency ($\alpha = .81$).

Participants' changes in drinking behavior were assessed using an item from Calahan's Drinking Habits Questionnaire (DHQ; Cahalan & Room, 1974): *How often did you have any drink containing alcohol, whether it is wine, beer, whisky, or any other drink during the past week?*, which was administered at the initial assessment and then again at the end of treatment. Response options for this question were as follows: *never, only one day of the weekend, nearly every day of the weekend, once a day, two times a day, and three or more times a day*, which were scored on a scale from 0–6. The DHQ was administered at pre- and post-treatment in the laboratory.

Procedure

The AUDIT was administered as part of a larger screening procedure, and individuals scoring above 8 (see Kokotailo et al., 2004 for psychometrics in college students) on the AUDIT were invited to the laboratory to complete "a research study looking at the link between attention and alcohol use." Upon arrival to the laboratory, participants were administered the DHQ and then randomly assigned to either the Attention Modification Program (AMP; $n = 19$) or the Attention Control Condition (ACC; $n = 22$). All participants were blind to their condition. The stimuli for the attention training program were 24 alcohol-related words paired with 24 neutral words. Each participant selected 10 words from the 24 alcohol-related words most related to their personal experiences with drinking, as well as 10 words from the neutral stimuli set that did not relate to alcohol. The most common alcohol-related words chosen were alcohol ($n = 40$), liquor ($n = 39$), vodka ($n = 38$), beer ($n = 37$), shotglass ($n = 36$), and bar ($n = 35$). Following an initial training session in the laboratory, participants were given an USB drive which contained the program and were then asked to complete the training program at home twice a week for 4 weeks, totaling eight training sessions. After this, participants came back to the laboratory to complete the DHQ again. Compliance with the training was good, with 63% of participants completing all of the training sessions, 27% missing one or two training sessions, and only 10% missing more than two training sessions. The training program utilized a probe detection paradigm (Amir et al., 2008). Each trial comprised a fixation cross (+) that remained on the screen for 500 ms. Next, two words appeared on the screen for 500 ms, one above the other, and were followed by a probe (either the letter E or the letter F) that appeared in the

position of one of the words and then remained on the screen until the participants responded by pressing a corresponding mouse button (*E* if the letter *E* appeared as the probe and *F* if the letter *F* appeared).

In both the AMP and ACC conditions participants saw a total of 360 trials per training session. These trials comprised 10 words \times 3 (trials type, alcohol-neutral, neutral-alcohol, or neutral-neutral) \times 2 (Probe position; top or bottom) \times 2 (probe type: *E* or *F*) \times 3 repetitions for a total of 360 trials per training session. In the AMP condition on trials with one neutral word and one alcohol word, the probe always followed the neutral word. The ACC sessions were identical to those in the AMP, except that in the trials with one of each word type, the probe followed the neutral and alcohol words with equal frequency.

Results

An ANCOVA was used to determine whether group assignment (AMP vs. ACC) predicted residual change in drinking over the course of treatment. In this analysis, the independent variable was group and the dependent variable was posttreatment level of drinking, with pretreatment level of drinking entered as the covariate. As hypothesized, group assignment (AMP vs. ACC) predicted residual change in drinking over the course of treatment, $F(1, 38) = 5.28, p = .03, \eta^2_p = .12$. To determine whether this group difference was, as predicted, driven by greater reductions in drinking among our AMP group, we examined within group changes in drinking from pretreatment to posttreatment in our two treatment groups separately. As predicted, participants in the AMP group exhibited a significant decrease in drinking across the course of treatment, $F(1, 21) = 10.81, p = .004, \eta^2_p = .34$. In contrast, participants in the ACC group exhibited no significant change in drinking across the course of treatment, $F(1, 18) = 1.28, p = .27, \eta^2_p = .06$.

Discussion

The goal of the current study was to examine the effectiveness of a computer-delivered, home-based, attention bias modification treatment in reducing attention biases and alcohol consumption in heavy drinkers. We found AMP was associated with reductions in drinking behavior across the course of treatment. These findings add to a growing body of research suggesting that attention training using alcohol related stimuli may help curb drinking behaviors.

The study had a number of strengths, including the use of a computer-based, home-delivered intervention, multiple training sessions over a month to maximize treatment effects, and the use of ideographically chosen training stimuli to best match each participants' drinking cues. However, it is important to note some potential limitations as they may provide future areas of research. First, our population consisted of heavy drinking undergraduates, so it is not clear whether these findings would generalize to a clinical population. Future research using participants with diagnosed alcohol use disorders is needed to confirm the usefulness of the AMP in a more clinical setting. Second, we did not determine whether attentional biases changed over the course of the treatment. Therefore, although our results are consistent with the hypothesis that the attention modification program reduced participants' attentional biases, which then lead to reductions in drinking,

future research is needed to formally test this hypothesis. Finally, our assessment of drinking relied on a single item and future research should utilize more standardized measures of drinking (e.g., the Timeline Followback), which would also allow for a more nuanced assessment of alcohol use including binge drinking episodes.

In conclusion, the current study adds to a growing body of research that demonstrates not only the importance of attentional biases as driving factors in alcohol use disorders, but the possibility of changing these biases to reduce actual drinking behaviors. To our knowledge, this study is the first to test a transportable attention modification treatment program for alcohol-related concerns. Future research is needed to determine the effectiveness of this form of attention modification in clinical populations. Furthermore, the use of more finely tuned assessments of attentional allocation may help to determine the specific components of attention that must be targeted to maximize treatment gains.

References

- Agrawal, A., Heath, A. C., & Lynskey, M. T. (2011). DSM-IV to DSM-5: The impact of proposed revisions on diagnosis of alcohol use disorders. *Addiction*, 106, 1935–1943. doi:10.1111/j.1360-0443.2011.03517.x
- Amir, N., Beard, C., Burns, M., & Bomyea, J. (2009). Attention modification program in individuals with generalized anxiety disorder. *Journal of Abnormal Psychology*, 118, 28–33. doi:10.1037/a0012589
- Amir, N., Beard, C., Taylor, C. T., Klumpp, H., Elias, J., Burns, M., & Chen, X. (2009). Attention training in individuals with generalized social phobia: A randomized controlled trial. *Journal of Consulting and Clinical Psychology*, 77, 961–973. doi:10.1037/a0016685
- Amir, N., & Taylor, C. T. (2012). Combining computerized home-based treatments for generalized anxiety disorder: An attention modification program and cognitive behavioral therapy. *Behavior Therapy*, 43, 546–559. doi:10.1016/j.beth.2010.12.008
- Amir, N., Weber, G., Beard, C., Bomyea, J., & Taylor, C. T. (2008). The effect of a single-session attention modification program on response to a public-speaking challenge in socially anxious individuals. *Journal of Abnormal Psychology*, 117, 860–868. doi:10.1037/a0013445
- Boettcher, J., Berger, T., & Renneberg, B. (2012). Internet-based attention training for social anxiety, a randomized controlled trial. *Cognitive Therapy and Research*, 36, 522–536. doi:10.1007/s10608-011-9374-y
- Bouchery, E. E., Harwood, H. J., Sacks, J. J., Simon, C. J., & Brewer, R. D. (2011). Economic costs of excessive alcohol consumption in the U.S., 2006. *American Journal of Preventive Medicine*, 5, 516–24. doi:10.1016/j.amepre.2011.06.045
- Bunnell, B. E., Beidel, D. C., & Mesa, F. (2013). A randomized trial of attention training for generalized social phobia: Does attention training change social behavior? *Behav Ther.*, 44, 662–673. doi:10.1016/j.beth.2013.04.010
- Bush, K., Kivlahan, D. R., McDonell, M. B., Fihn, S. D., & Bradley, K. A. (1998). The AUDIT alcohol consumption questions (AUDIT-C): An effective brief screening test for problem drinking. Ambulatory Care Quality Improvement Project (ACQUIP). Alcohol Use Disorders Identification Test. *Archives of Internal Medicine*, 158, 1789–1795. doi:10.1001/archinte.158.16.1789
- Cahalan, D., & Room, R. (1974). *Problem drinking among American men*. New Brunswick, NJ: Rutgers Center for Alcohol Studies.
- Carlbring, P., Apelstrand, M., Sehlén, H., Amir, N., Rousseau, A., Hofmann, S. G., & Andersson, G. (2012). Internet-delivered attentional bias modification training in individuals with social phobia – a double blind randomized controlled trial. *BMC Psychiatry*, 12, 66. doi:10.1186/1471-244X-12-66

- Cox, W. M., Hogan, L. M., Kristian, M. R., & Race, J. H. (2002). Alcohol attentional bias as a predictor of alcohol abusers' treatment outcome. *Drug and Alcohol Dependence*, 68, 237–243. doi:10.1016/S0376-8716(02)00219-3
- Fadardi, J. S., & Cox, W. M. (2009). Reversing the sequence: Reducing alcohol consumption by overcoming alcohol attentional bias. *Drug and Alcohol Dependence*, 101, 137–145. doi:10.1016/j.drugalcdep.2008.11.015
- Field, M., Mogg, K., Zetteler, J., & Bradley, B. P. (2004). Attentional biases for alcohol cues in heavy and light social drinkers: The roles of initial orienting and maintained attention. *Psychopharmacology (Berl)*, 176, 88–93. doi:10.1007/s00213-004-1855-1
- Heeren, A., Reese, H. E., McNally, R. J., & Philippot, P. (2012). Attention training toward and away from threat in social phobia: Effects on subjective, behavioral, and physiological measures of anxiety. *Behav Res Ther.*, 50, 30–39. doi:10.1016/j.brat.2011.10.005
- Johnsen, B. H., Laberg, J. C., Cox, W. M., Vakdal, A., & Hugdahl, K. (1994). Alcoholic subjects' attentional bias in the processing of alcohol-related words. *Psychology of Addictive Behaviors*, 8, 111–115. doi:10.1037/0893-164X.8.2.111
- Kokotailo, P. K., Egan, J., Gangnon, R., Brown, D., Mundt, M., & Fleming, M. (2004). Validity of the alcohol use disorders identification test in college students. *Alcoholism: Clinical and Experimental Research*, 28, 914–20. doi:10.1097/01.ALC.0000128239.87611.F5
- Marissen, M. A., Franken, I. H., Waters, A. J., Blanken, P., van den Brink, W., & Hendriks, V. M. (2006). Attentional bias predicts heroin relapse following treatment. *Addiction*, 101, 1306–1312. doi:10.1111/j.1360-0443.2006.01498.x
- Miller, W. R., Walters, S. T., & Bennett, M. E. (2001). How effective is alcoholism treatment in the United States? *Journal of Studies on Alcohol*, 62, 211–220.
- Piccinelli, M., & Homann, F. G. (1997). *Gender differences in the epidemiology of affective disorders and schizophrenia*. Geneva, Switzerland: World Health Organization.
- Saunders, J. B., Aasland, O. G., Babor, T. F., de la Fuente, J. R., & Grant, M. (1993). Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO Collaborative Project on Early Detection of Persons with Harmful Alcohol Consumption-II. *Addiction*, 88, 791–804. doi:10.1111/j.1360-0443.1993.tb02093.x
- Schmidt, B., Richéy, J., Buckner, J., & Timpano, K. (2009). Attention training for generalized social anxiety disorder. *Journal of Abnormal Psychology*, 118, 5–14. doi:10.1037/a0013643
- Schoenmakers, T. M., de Bruin, M., Lux, I. F., Goertz, A. G., Van Kerckhof, D. H., & Wiers, R. W. (2010). Clinical effectiveness of attentional bias modification training in abstinent alcoholic patients. *Drug and Alcohol Dependence*, 109, 30–36. doi:10.1016/j.drugalcdep.2009.11.022
- Schoenmakers, T., Wiers, R. W., Jones, B. T., Bruce, G., & Jansen, A. T. (2007). Attentional re-training decreases attentional bias in heavy drinkers without generalization. *Addiction*, 102, 399–405. doi:10.1111/j.1360-0443.2006.01718.x

Received April 8, 2013

Revision received September 17, 2013

Accepted November 12, 2013 ■