HHS Public Access

Author manuscript

Alcohol Clin Exp Res. Author manuscript; available in PMC 2018 December 19.

Published in final edited form as:

Alcohol Clin Exp Res. 2016 September ; 40(9): 1945–1952. doi:10.1111/acer.13151.

Implicit Alcohol Approach and Avoidance Tendencies Predict Future Drinking in Problem Drinkers

Laura Martin Braunstein, **Alexis Kuerbis**, **Kevin Ochsner**, and **Jon Morgenstern**

Department of Psychology (LMB, KO), Columbia University, New York, New York; Silberman School of Social Work at Hunter College (AK), City University of New York, New York, New York; and Northwell Health (JM), Great Neck, New York.

Abstract

Background: Addiction is characterized by compulsive drug seeking and substance use, yet many individuals break free of these patterns and change their behavior. Traditional candidate predictors of behavior change/persistence rely on self-reports of factors such as readiness to change. However, explicit measures only characterize top-down influences on behavior. The incentive sensitization model of addition suggests that more implicit, automatic processes, such as the tendency to approach substance cues, play a major role in behavior.

Methods: We examined implicit alcohol approach and avoidance tendencies using a reaction time (RT) task in a sample of problem drinkers with alcohol use disorder (AUD) seeking to reduce heavy drinking. We measured alcohol approach and avoidance tendencies at baseline and at outcome, 12 weeks later. We asked whether alcohol approach and avoidance tendencies (i) changed over time, (ii) related to current drinking, and (iii) predicted changes in drinking from baseline to outcome.

Results: Approach and avoidance tendencies did not significantly change over time, nor did they correlate with current drinking, but these tendencies at baseline did predict drinking weeks later. Faster alcohol approach was associated with greater overall drinking at outcome, and faster alcohol avoidance predicted fewer drinking days per week at outcome. Exploratory analyses examined the relationship between approach and avoidance and traditional explicit measures including appraisals of alcohol and motivation to change. Implicit approach tendencies were largely distinct from explicit measures, and approach and avoidance tendencies explained unique variance in outcome drinking.

Conclusions: The current findings suggest that implicit alcohol approach and avoidance tendencies assessed via a simple reaction time task can predict relative changes in drinking weeks later. Given that many explicit measures typically used in treatment studies fail to predict who will change, approach and avoidance tendencies are promising candidates to understand individual differences in treatment responses.

Reprint requests: Laura Martin Braunstein, Department of Psychology, Columbia University, 324 Schermerhorn Hall, 1190 Amsterdam Ave, New York, NY 10027; Tel: 212-854-9816; Fax: 212-854-3609; lnm2123@columbia.edu and Jon Morgenstern, Northwell Health, 1010 Northern Blvd. Suite 311, Great Neck, NY 11021; Tel.: 516-837-1694; Fax: 516-837-1699; Jmorgenste@northwell.edu.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

Keywords

AUD; Alcohol; Problem Drinkers; Approach; Avoidance; Implicit

Addiction is characterized by compulsive drug seeking and substance use, yet many individuals break free of these patterns and change their behavior. The ability to predict who will change and to identify the mechanisms that support behavior change is critical, yet change processes remain poorly understood (Morgenstern and McKay, 2007). Traditional candidate predictors of behavior change or persistence are self-reports of explicit constructs such as readiness and appraisals of alcohol. However, these measures can only characterize top-down influences on behavior, and the incentive sensitization model of addiction (Robinson and Berridge, 2008) suggests that more implicit and automatic processes, such as the tendency to approach substance cues, play a major role in behavior. We posit that basic, implicit tendencies to approach and avoid alcohol cues will be related to behavior and may predict behavior change. in this study, we examined implicit approach and avoidance tendencies for alcohol using a reaction time (RT) task in a sample of problem drinkers with alcohol use disorder (AUD) seeking to reduce heavy drinking. Specifically, we tested whether alcohol approach and avoidance tendencies (i) change over time, (ii) relate to current drinking, and (iii) predict changes in drinking over time.

Implicit approach and avoidance tendencies are assessed using computerized RT paradigms in which the approach and avoidance responses are incidental. That is, participants are asked to categorize alcohol/control images by making certain responses, including responses that correspond to approach and avoidance, rather than to directly report on craving for them. Two main paradigms have been used to assess alcohol approach and avoidance tendencies, and they have overlapping and distinct findings.

The first paradigm is the Stimulus-Response Compatibility (SRC) task (de Houwer et al., 2001). In this computer task, participants make keyboard responses to categorize pictures of alcohol and office supplies according to instructions to move a manikin toward or away from the pictures based on their content—alcohol present or no alcohol present. Because alcohol is the relevant feature for categorization, this task is referred to as the relevant-SRC (R-SRC). An approach bias score is calculated using the difference of RTs to approach and avoid alcohol. Heavy drinkers relative to light drinkers (Field et al., 2008) and students with high craving relative to those with low (Field et al., 2005) demonstrate an approach bias for alcohol. Approach bias in heavy drinkers was correlated with weekly alcohol consumption (Field et al., 2008), but it was not related to consumption in a study of social drinkers (Kersbergen et al., 2015). Only a few studies have examined R-SRC approach and avoidance in abstinent alcohol-dependent samples and results have varied. Although the current study tests problem drinkers, it is important to note that the pattern of R-SRC approach and avoidance tendencies in abstinent alcohol-dependent individuals is different from that in problem/heavy drinkers. In one study, recently detoxified, abstinent alcohol-dependent individuals did not exhibit an approach bias (i.e., equivalent approach and avoidance) and were not faster to approach than control subjects (Barkby et al., 2012). In two other studies, alcohol-dependent individuals showed an alcohol avoidance bias, faster to avoid than to

approach (Snelleman et al., 2015; Spruyt et al., 2013), and faster avoidance was associated with increased relapse (Spruyt et al., 2013). The lack of approach bias in these samples suggests that alcohol approach tendencies may be influenced by contextual factors such as seeking treatment or being in recovery.

The second paradigm assessing implicit tendencies is the Alcohol Approach-Avoidance Task (AAT; Wiers et al., 2009). Like the R-SRC, participants categorize alcohol and control pictures using approach and avoidance movements, but the AAT differs in several important ways. In the AAT, approach/avoid movements are made using a joystick, the pictures shrink or grow in response, and in the commonly used version, categorizations are made based on the orientation of the pictures (landscape or portrait) rather than their alcohol content. Because alcohol content is irrelevant for categorization, the typical AAT is an irrelevant-AAT (IR-AAT) (Kersbergen et al.,2015).

Importantly, performance on the R-SRC and the IR-AAT is not correlated (Wiers et al., 2013). Performance differences may stem from whether alcohol content is the relevant feature for categorization. A new study of social drinkers who completed alcohol-relevant ("R," alcohol content was used to categorize the picture) and irrelevant ("IR," alcohol content is not used to categorize the picture) versions of both the SRC and the AAT found that approach bias in only the relevant feature tasks, R-SRC and R-AAT, was associated with hazardous drinking, and approach bias in only the R-AAT was associated with weekly alcohol consumption (Kersbergen et al., 2015). Heavy drinkers show an approach bias on the IR-AAT (Wiers et al., 2009), as in the R-SRC. Unlike in the R-SRC, abstinent, alcohol-dependent individuals demonstrate an approach bias for alcohol on the IR-AAT, and this bias is associated with recruitment of brain regions involved in reward, learning, and motivation, the nucleus accumbens and medial prefrontal cortex (Wiers et al., 2014).

A modified version of the IR-AAT has been used to train participants to approach and avoid alcohol. Approach training in hazardous drinkers was associated with increased drinking in the laboratory (Wiers et al., 2010), and avoidance training in detoxified, abstinent alcohol-dependent inpatients was associated with reduced relapse rates one year later (Eberl et al., 2013; Wiers et al., 2011), with the change in approach bias mediating this effect (Eberl et al., 2013). The observation that changes in approach bias mediate the effect of avoidance training on relapse suggests that approach and avoidance tendencies are mechanisms of behavior change.

The goal of this study was to examine whether implicit alcohol approach and avoidance tendencies capture important information about change processes that occur when problem drinkers seek to reduce heavy drinking. We studied these processes in problem drinkers because we were interested in the role of approach/avoidance in individuals who were drinking. We had three primary questions about approach and avoidance tendencies: do they (i) change over time, (ii) relate to current drinking, and (iii) predict changes in drinking over time? We were also interested in understanding how these implicit measures compared to conceptually similar explicit measures of motivational and cognitive processes, as the relationship between implicit and explicit measures is not well understood.

To address these questions, we used a relevant Alcohol Approach-Avoidance Task (R-AAT). Participants categorized the images based on whether or not they contained alcohol by making instructed joystick movements for each type of image, and we measured their reaction times for approach and avoid movements. Participants completed the R-AAT before and after 8 weeks of treatment (motivational interviewing or nondirective listening treatment control referred to as spirit only) or self-change. Although participants received treatment, the goal of this study was to examine the relationship between approach and avoidance tendencies (RTs) and drinking behavior in individuals seeking to moderate their drinking; therefore, we controlled for treatment group in the analyses. We hypothesized that approach and avoidance tendencies would change over time, such that at outcome approach tendencies would be slower and avoidance tendencies would be faster than at baseline. We predicted that approach and avoidance would be correlated with current drinking, with faster approach being associated with greater drinking and faster avoidance with lower drinking. We hypothesized baseline approach and avoidance would predict changes in drinking over time —specifically, faster baseline approach would be associated with greater relative drinking at outcome and faster avoidance would be associated with lower relative drinking. Regarding the relationship between approach and avoidance tendencies and explicit measures of related constructs, we did not have specific predictions. We conducted exploratory analyses generally designed to clarify our primary hypotheses.

MATERIALS AND METHODS

Problem drinkers interested in moderating drinking ($N = 60$) were recruited to participate in a randomized controlled trial (RCT) for a brief intervention for alcohol use disorder (AUD). The larger study's aim was to build on pilot work (Morgenstern et al., 2012) to test the mechanisms of action within motivational interviewing (MI) by disaggregating it into its relational (client-counselor relationship with unique therapist stance) and directive (technical strategies) elements (Miller and Rose, 2009).

Participants

Recruitment.—Online and local media advertising and flyering were used to recruit participants seeking to moderate rather than abstain from their drinking. Participants who responded to the advertisements were initially screened by phone and, if eligible, were scheduled for an in-person screen assessment.

Study Eligibility.—Participants were eligible if they were (i) between ages 18 and 65; (ii) consumed an estimated weekly average of greater than 15 or 24 standard drinks per week for women and men, respectively, during the prior 8 weeks; and (iii) had a current AUD. Participants were excluded if they had (i) a substance use disorder (for any substance other than alcohol, marijuana, nicotine) or were greater than weekly drug users; (ii) a serious psychiatric disorder or suicide or violence risk; (iii) current or history of serious physical withdrawal symptoms; (iv) a legal mandate to substance abuse treatment; (v) social instability (e.g., homeless); (vi) a desire to achieve abstinence at baseline; or (vii) a desire or intent to pursue additional substance abuse treatment during the 8-week study period.

Procedures

Procedures and intervention conditions closely followed pilot study procedures (Morgenstern et al., 2012). Eligible participants completed a baseline assessment 1 week after the in-person screen assessment. Participants received normative feedback (about drinking and risk for developing AUD) and were then urn randomized (on gender and high/low drinking determined by the first three questions to the alcohol use disorder identification test (AUDIT, Babor et al., 2001) to one of three conditions: MI, spirit-only MI (SOMI), and self-change (SC). Participants assigned to either MI or SOMI received four sessions of psychotherapy over 7 weeks. All participants completed an end-of-treatment assessment (week 8) and a one month posttreatment assessment (week 12). This analysis examines the first 60 participants to complete the primary study.

Study Interventions

Normative feedback was provided by a research assistant during the baseline assessment and was based on their AUDIT score and risk categories. They were then assigned to one of three conditions, described next.

Motivational Interviewing.—The MI protocol was adapted from the motivational enhancement therapy used in Project MATCH (Miller et al., 1992; Project MATCH Research Group, 1993) and included structured personalized feedback.

Spirit-Only MI.—The SOMI protocol consisted of the relational elements of MI based on client-centered therapy (Bohart, 1995). Technical or directive elements (e.g., amplified or double-sided reflections, decisional balance) were proscribed.

Self-Change.—The SC protocol emphasized personal responsibility for change and encouraged participation in the research assessments. Participants were offered treatment (four sessions of MI) at the end of the 7-week study treatment period.

Measures

Sociodemographics, Screening, and Substance Use Diagnosis.—A self-report questionnaire collected data on age, gender, and level of education. The *Alcohol Use Disorders Identification Test-C* (AUDIT-C) was used to determine preliminary eligibility for the study in regard to quantity and frequency of drinking (Bush et al., 1998). The *Composite International Diagnostic Instrument, Substance Abuse Module* (Cottler et al., 1989) was used to evaluate substance dependence exclusion criteria and the number of AUD criteria a participant endorsed.

AUD Symptoms, Risks, and Problems.—Severity of AUD was measured using the *Alcohol Dependence Scale* (ADS, Skinner and Allen, 1982). The ADS is a 25-item self-report measure of various symptoms and intensity of alcohol dependence as defined by the DSM-IV (American Psychiatric Association, 2000). The *Short Inventory of Problems* (SIP, Miller et al., 1995) is a 15-item self-report measure of lifetime or past three months' negative consequences of drinking. An adapted, 10-item version of the *Obsessive Compulsive Drinking Scale* (OCDS, Morgan et al., 2004; Anton, 2000) was used to measure

obsessionality and compulsivity of craving and drinking behavior. The *Primary Appraisal Measure* (PAM, Morgenstern et al., 1997) is a 40-item measure used to assess a person's appraisal of future long-term and short-term negative and positive consequences to reducing or maintaining current drinking habits.

Readiness to Change.—The *Readiness to Change Questionnaire* (RCQ, Heather and Rollnick, 2000) is a 12-item instrument for measuring "stage of change" of the participant in changing his or her drinking. For the purposes of this study, both the composite scale and the action subscale were utilized.

Coping.—The *Processes of Change Scale*-27 (POC) is an adapted version (Morgenstern et al., 1997) of the 40-item self-report measure assessing frequency of coping strategies for avoiding heavy drinking. Two subscales delineate different forms of coping: cognitive and behavioral.

Alcohol Use Patterns.—For this analysis, quantity, frequency, and intensity of alcohol use were measured using the timeline followback interview (TLFB, Sobell et al., 1980). The TLFB has demonstrated good test-retest reliability (Carey et al., 2004), agreement with collateral reports of alcohol (Dillon et al., 2005), convergent validity, and reliability across mode of administration (i.e., in person or over the phone; Vinson et al., 2003). For this analysis, TLFB data were aggregated into summary variables averaged over two time periods: the 9 weeks before treatment (baseline drinking) and then the 4 weeks after treatment (outcome drinking). Aggregate variables included weekly mean sum of standard drinks (SSD), weekly mean number of drinking days (NDD), and weekly mean drinks per drinking day (DDD). These variables we created to facilitate comparison with guidelines for safe drinking from the National Institute on Alcohol Abuse and Alcoholism (NIAAA).

Alcohol Approach and Avoidance Tendencies: Relevant Alcohol Approach-Avoidance Task.—A relevant Alcohol Approach-Avoidance Task (R-AAT) was used to assess approach and avoidance tendencies for alcohol. The R-AAT involves viewing pictures of alcohol and office supplies and categorizing them as containing alcohol or not by making specific joystick movements. We created the R-AAT by combining the R-SRC task in which alcohol content is the relevant feature for categorizing the pictures (Barkby et al., 2012; Field et al., 2008), and the IR-AAT (Wiers et al., 2009, 2014), in which a joystick is used to categorize pictures and pictures zoom in/out to reflect approach/avoidance. We piloted the task to ensure participants understood the instructions. Recently, another group independently used an R-AAT like ours (Kersbergen et al., 2015).

The R-AAT comprised two sets of four blocks. Each block consisted of four practice trials followed by 28 test trials. A different instruction of how to respond to each stimulus (alcohol, office supplies) was given at the beginning of each block. In the "approach alcohol" block, participants were instructed to pull the joystick toward themselves for pictures of alcohol and to move the joystick left (or right) for pictures of office supplies. In the "avoid alcohol" block, participants were instructed to push the joystick away from themselves for pictures of alcohol and to move the joystick left (or right) for pictures of office supplies. In the "approach control" block, participants were instructed to pull the

joystick toward themselves for pictures of office supplies and to move the joystick left (or right) for pictures of alcohol. Finally, in the “avoid control” block, participants were instructed to push the joystick away from themselves for pictures of office supplies and to move the joystick left (or right) for pictures of alcohol. In the first set of four blocks, participants made left movements, and in the second set they made right movements.

We used data cleaning procedures based on those of Field et al. (2008). First, two participants whose error rate was higher than three SDs above the mean error rate (10.6% of trials at baseline and 13.3% of trials at outcome) were excluded from subsequent analyses. Sixty participants were included in all subsequent analyses. Next, data from error trials and trials with RTs greater than 2000 ms or more than three SDs above the mean for each participant were discarded. These criteria resulted in an average of 4% of baseline trials and 4.5% of outcome trials being discarded.

Timeline of Measures.—Measures were assessed at baseline and/or outcome. Baseline refers to pretreatment assessments that occurred at week 0 or week 1. Outcome refers to posttreatment assessments that occurred at week 8. Drinking severity measures assessed with the TLFB are aggregates of several weeks: baseline refers to the nine weeks before treatment (treatment started in week 1), and outcome refers the 4 weeks after treatment (weeks 8 to 12).

Data Analysis.—Before conducting any analyses, we calculated RT difference scores from the R-AAT RT data. We calculated four difference scores for each participant at baseline and at outcome (eight total difference scores): approach alcohol, avoid alcohol, approach control, and avoid control. These RT scores were computed by subtracting the average RT to approach or avoid each stimulus (alcohol, control) from the average RT to move sideways (average of left and right movements) to each stimulus. Rather than using one approach bias score, we included the sideways movements to account for general speed to respond to each stimulus and to allow us to calculate separate scores for approach and avoidance. Positive RT scores indicate that the participant was faster to approach/avoid the stimulus than to move sideways to it.

Using these RT scores, we conducted several analyses to address our three primary hypotheses and to explore relationships between the implicit approach/avoidance measures and traditional explicit self-report measures. To understand whether approach and avoidance changed over time, we analyzed the R-AAT RT scores using repeated-measures ANOVA with time (baseline, outcome), movement (approach, avoidance), and stimulus (alcohol, office supplies) as within-subjects factors. Next, we used linear regression to test whether R-AAT approach and avoidance were related to concurrent drinking and change in drinking. To model change in drinking, we controlled for baseline drinking and input outcome drinking as the dependent variable (DV). In all of the regressions, we entered approach and avoidance as predictors and controlled for treatment group. We ran a separate model for each measure of drinking behavior from the TLFB—SSD, NDD, and DDD. Consistent with our prior work (Kuerbis et al., 2014), we included these three indices of drinking outcomes to more fully assess the relationships between change processes and drinking outcomes among problem drinkers. In the analyses predicting outcome drinking, we controlled for baseline

drinking. In analyses using outcome approach/avoidance as predictors, we controlled for baseline approach/avoidance.

Next, we explored the relationship between approach and avoidance tendencies, explicit measures (self-report questionnaires) of several related constructs, and outcome drinking. The explicit measures were the Alcohol Dependence Scale (ADS), Obsessive Compulsive Drinking Scale (OCDS), Primary Appraisal Measure (PAM), Processes of Change (POC), Readiness to Change (RCQ), and Short Inventory of Problems (SIP); see the Measures section for descriptions. The analyses tested whether (i) the explicit measures predicted drinking outcomes, (ii) when the explicit measures were included in the model, approach and avoidance explained unique variance in drinking outcomes, and (iii) explicit measures and approach and avoidance were associated. To test relationships to outcome drinking, we ran two sets of regressions. In the first set, we entered the explicit measure as the predictor and drinking outcome (SSD, NDD, DDD) as the DV. In the second set, we entered the self-report measures and baseline R-AAT approach and avoidance as simultaneous predictors and drinking outcome as the DV. To assess the relationship between the implicit and explicit measures, we first ran bivariate correlations between approach and avoidance and the explicit measures, and then we ran regressions with explicit measures as the outcome variable and approach and avoidance scores as simultaneous predictors to assess the relationship of each while accounting for the other.

RESULTS

Sample Description

The average age of participants was 39.3 years, and about half of the sample was female. Table 1 describes the demographics and baseline/outcome descriptive statistics for alcohol severity, drinking behavior, and R-AAT measures.

Effect of Time on Approach and Avoidance

Our first question was whether approach and avoidance tendencies (Table 1) would change over time—from baseline (week 1) to outcome (week 8). The ANOVA revealed a main effect of stimulus, $F(1, 59) = 13.59$, $p < 0.001$, with faster RTs for alcohol ($M = 7.24$, $SD = 2.48$) than control ($M = -7.13$, $SD = 2.74$) pictures. There was no effect of time or movement. To qualify the lack of an effect of time, we assessed the reliability of the R-AAT approach and avoidance data by testing a split-half correlation using the baseline data. Data from the first half of the task were significantly positively correlated with data from the second half for both approach, $r(57) = 0.644$, $p < 0.01$, and avoidance, $r(57) = 0.83$, $p < 0.01$.

Relationship Between Approach and Avoidance and Concurrent Drinking

Next, we conducted regression analyses to test the relationship between approach and avoidance tendencies and concurrent drinking behavior. Baseline approach and avoidance did not significantly predict baseline drinking for any measure [SSD: $F(4, 55) = 0.62$; NDD: $F(4, 55) = 0.22$; DDD: $F(4, 55) = 0.95$]. Although the overall models with outcome approach and avoidance were significant, outcome approach and avoidance did not significantly predict outcome drinking for any measure [SSD: $F(7, 52) = 4.20$, outcome approach $p =$

0.36, outcome avoid $p = 0.35$; NDD: $F(7, 52) = 5.15$, outcome approach $p = 0.78$, outcome avoid $p = 0.94$; DDD: $F(7, 52) = 2.62$, outcome approach$p = 0.29$, outcome avoid $p = 0.26$].

Relationship Between Approach and Avoidance and Change in Drinking

Our third question was whether baseline approach and avoidance would predict changes in drinking over time—from baseline (measured as the aggregate of the 9 weeks before treatment) to outcome (measured as the aggregate of the 4 weeks after treatment, weeks 8 to 12). Results showed that when accounting for baseline drinking, baseline approach tendencies significantly predicted outcome drinking for the SSD, $b = 0.11$, SE = 0.04, $p < 0.01$ and DDD, $b = 0.02$, SE = 0.01, $p < 0.01$, and was a trend for NDD, $b = 0.01$, SE = 0.01, $p = 0.08$ (b = unstandardized coefficient). Baseline avoidance significantly predicted only NDD, $b = -0.01$, SE = 0.01, $p < 0.05$. To understand how much additional variance in outcome drinking was explained by baseline approach and avoidance, we conducted a two-step regression. We entered baseline drinking in the first step and approach and avoidance in the second step (see Table 2). Approach and avoidance accounted for an additional 12% of the variance in outcome SSD, 11% in NDD, and 11% in DDD.

Exploratory Analyses

Relationship Between Approach and Avoidance, Explicit Measures, and Drinking Outcomes.—We were interested in better understanding the significant and relatively large effect size relationship between baseline alcohol approach and avoidance and outcome drinking. Specifically, we wanted to know whether baseline approach and avoidance would remain significant predictors of outcome drinking after accounting for explicit measures that were also related to outcome drinking. The results are summarized in Table 3. Only three self-report measures were significantly related to outcome drinking, and they were all negatively associated with drinking: PAM composite (trend SSD, NDD), POC behavioral coping (SSD and NDD), and POC cognitive coping (SSD, NDD, trend DDD). There was no significant relationship between outcome drinking and scores on the RCQ action subscale, RCQ composite, ADS, OCDS, or SIP. When the above explicit measures were all included as predictors along with approach and avoidance tendencies, the overall model significantly predicted drinking outcomes, $R^2 = 0.412$, $F(8, 51) = 4.464$, $p < 0.001$. Approach remained a significant predictor of SSD and DDD outcome drinking. Avoidance was no longer a significant predictor of NDD. The PAM was now associated with NDD at a trend level. The relationships between POC behavioral and cognitive coping and outcome drinking were no longer significant.

Relationship Between Explicit and Implicit Measures.—Next, we tested whether the self-report measures that were predictive of outcome drinking behavior were related to R-AAT approach and avoidance tendencies. Approach was not correlated with the PAM or the POC. Avoidance was positively correlated with the PAM, $r(58) = 0.29$, $p < 0.05$, and was a trend for a positive correlation with the POC cognitive coping, $r(58) = 0.23$, $p = 0.081$. For completeness, we report the correlations between approach and avoidance and the other explicit measures in Table 4. In the regression analyses, in which approach and avoid were entered as simultaneous predictors, approach did not significantly predict scores on the PAM

or the POC. Avoidance significantly predicted scores on the PAM, $b = 0.168$, SE = 0.082, $p < 0.05$.

DISCUSSION

We were interested in understanding whether and how implicit alcohol approach and avoidance tendencies influence the change process among problem drinkers seeking to reduce heavy drinking. Using a relevant Alcohol Approach-Avoidance Task (R-AAT), we measured alcohol approach and avoidance at baseline and after 8 weeks of treatment or self-change. We examined whether approach and avoidance tendencies changed over time, related to concurrent drinking behavior, and predicted changes in drinking behavior over time. We also explored the relationships between approach/avoidance, explicit measures of cognitions about alcohol, and drinking behavior.

Our first hypothesis, that approach/avoidance would change over time, was not supported at the group level. Although we expected approach and avoidance to change, we note that two studies of more severe, abstinent drinkers did not observe changes in approach bias over time (see the control groups in: Eberl et al., 2013; Wiers et al., 2011). Our second prediction, that approach/avoidance would relate to concurrent drinking behavior, was not supported at baseline or outcome. As reviewed in the introduction, this result is in contrast to other studies that found a relationship between drinking behavior and approach/avoidance tendencies. This may be due to our focus on nonabstinent individuals seeking treatment to moderate their drinking. Variation in the type and magnitude of goal for moderation may have influenced the level of change or lack thereof in approach or avoidance. Unfortunately, there was no effective measure of goal choice in this study to further explore this possibility. Alternatively, the decision to change and act of enrolling in a treatment study may have altered approach and avoidance tendencies even before any treatment was received. Support for this potential explanation comes from the two R-SRC studies of abstinent alcohol-dependent participants, which found participants who were abstinent for about five days did not show an approach bias and had similar approach RTs to controls (Barkby et al., 2012), and participants who were abstinent for 18 to 21 days showed an avoidance bias for alcohol with faster avoidance predicting relapse (Spruyt et al., 2013). The length of abstinence may affect response tendencies on alcohol-relevant tasks, such that avoidance tendencies develop over time, but future research is needed to test this prediction. Another consideration is that, in the current study, baseline drinking data were an aggregate of the 9 weeks prior to the week in which baseline approach and avoidance were tested. Participants likely decided to change their drinking at some point during that 9-week window, but exactly when this occurred remains unknown.

Interestingly, approach and avoidance tendencies at baseline did predict changes in drinking over time. Specifically, faster RT scores to approach alcohol were associated with greater drinking at outcome for all three drinking measures, SSD, NDD (trend), and DDD, and faster avoidance RT scores were associated with fewer drinking days per week (NDD). Approach and avoidance explained 11 to 12% more variance in outcome drinking after accounting for baseline drinking. These results provide initial support for the idea that approach and avoidance tendencies are markers of future change. While the current data

cannot speak directly to this, approach may capture some aspect of basic reactivity to alcohol, a feature of incentive sensitization. Avoidance, on the other hand, may develop as a result of accumulating negative experiences with alcohol or growing concern that one's drinking may be getting out of control.

Outcome drinking was also predicted by explicit measures of appraisal and coping. Primary Appraisal Measure (PAM) composite and Processes of Change (POC) behavioral and cognitive coping scores were negatively associated with outcome drinking, such that higher scores on these measures predicted less drinking. Approach remained a significant predictor of behavior change when these measures were included in the models, suggesting that approach is distinct from the explicit appraisal and coping constructs assessed. Avoidance was correlated with PAM and POC cognitive coping scores. Although approach scores were more frequently predictive of behavior change, only avoidance scores were related to the explicit measures that predicted behavior change. This pattern suggests that R-AAT approach tendencies are a relatively unique predictor of changes in drinking behavior.

Taking these results together, we conclude that approach and avoidance are largely dissociated. They tracked with different drinking quantity/frequency measures, and only avoidance was related to explicit measures. Approach tendencies typically corresponded to the sum of standard drinks per week (SSD) and drinks per drinking day (DDD), whereas avoidance related to the number of drinking days per week (NDD). Although the SSD is a combination of NDD and DDD, the NDD and DDD are relatively distinct measures. DDD may be more approach driven, because it is the number of drinks you consume once you have decided to drink. The NDD is likely more closely linked to avoidance, because individuals may attempt to reduce their drinking by drinking fewer days per week. Approach tendencies seem to correspond to the change in quantity of drinks and avoidance to change in frequency.

Our results extend and clarify the prior literature. In the previous studies, the tasks assessing approach and avoidance (R-SRC, IR-AAT) and populations studied (heavy/problem drinkers, abstinent and alcohol-dependent) both varied. Both tasks, in particular alcohol-relevant versus irrelevant tasks, and sample population need to be considered when interpreting findings. In the literature, heavy/problem drinking samples were consistently associated with approach bias and/or faster approach alcohol tendencies than control groups. However, previous studies of heavy/problem drinkers did not include treatment-seeking individuals. The current study extends previous work by examining the role of implicit approach and avoidance tendencies in change processes in problem drinkers seeking to moderate their drinking. Previous work primarily examined approach and avoidance using a single approach bias score, whereas our study separates the two and demonstrates that approach and avoidance differentially contribute to outcome drinking. In this sample, R-AAT approach and avoidance tendencies at baseline predict drinking outcomes two months later and explain unique variance in drinking outcomes.

The current findings suggest that implicit alcohol approach and avoidance tendencies assessed via a simple reaction time task can predict relative changes in drinking weeks later. Approach tendencies are likely picking up on basic reactivity and avoidance tendencies on a

desire/need to regulate and control responses to alcohol cues. Given that many explicit measures typically used in treatment studies fail to predict who will change, we find approach and avoidance tendencies to be promising candidates to understand individual differences in treatment responses.

REFERENCES

American Psychiatric Association (2000) Diagnostic and Statistical Manual of Mental Disorders. American Psychiatric Association, Washington, DC.

Anton RF (2000) Obsessive-compulsive aspects of craving: Development of the Obsessive Compulsive Drinking Scale. Addiction 95:S211–S217. [PubMed: 11002915]

Babor TF, Higgins-Biddle JC, Saunders JB, Monteiro MG (2001) The Alcohol Use Disorders Identification Test (AUDIT): Guidelines for Use in Primary Care. Department of Mental Health and Substance Dependence, World Health Organization, Geneva, Switzerland.

Barkby H, Dickson JM, Roper L, Field M (2012) To approach or avoid alcohol? Automatic and self-reported motivational tendencies in alcohol dependence. Alcohol Clin Exp Res 36:361–368. [PubMed: 21895719]

Bohart A (1995) The person-centered therapies, in Essential Psychotherapies (Gurman A, Messer S eds), pp. 85–127. Guilford, New York.

Bush K, Kivlahan DR, McDonell MB (1998) The AUDIT Alcohol Consumption Questions (AUDIT-C): an effective brief screening test for problem drinking. Arch Intern Med 3:1789–1795.

Carey KB, Carey MP, Maisto SA, Henson JM (2004) Temporal stability of the timeline followback interview for alcohol and drug use with psychiatric outpatients. J Stud Alcohol 65:774—781. [PubMed: 15700516]

Cottler LB, Robins LN, Helzer JE (1989) The reliability of the Composite International Diagnostic Interview Substance Abuse Module-(CIDI-SAM): a comprehensive substance abuse interview. Br J Addict 84:801814.

de Houwer J, Crombez G, Baeyens F, Hermans D (2001) On the generality of the affective Simon effect. Cogn Emot 15:189–206.

Dillon FR, Turner CW, Robbins MS, Szapocznik J (2005) Concordance among biological, interview, and self-report measures of drug use among African American and Hispanic adolescents referred for drug abuse treatment. Psychol Addict Behav 19:404—413. [PubMed: 16366812]

Eberl C, Wiers RW, Pawelczack S, Rinck M, Becker ES, Lindenmeyer J (2013) Approach bias modification in alcohol dependence: do clinical effects replicate and for whom does it work best? Development Cognit Neurosci 4:38–51.

Field M, Kiernan A, Eastwood B, Child R (2008) Rapid approach responses to alcohol cues in heavy drinkers. J Behav Ther Exp Psychiatry 39:209218.

Field M, Mogg K, Bradley BP (2005) Craving and cognitive biases for alcohol cues in social drinkers. Alcohol Alcohol 40:504–510. [PubMed: 16157608]

Heather N, Rollnick S (2000) Readiness to Change Questionnaire: User's Manual. University of Northumbria at Newcastle, Newcastle, UK.

Kersbergen I, Woud ML, Field M (2015) The validity of different measures of automatic alcohol action tendencies. Psychol Addict Behav 29:225. [PubMed: 25134039]

Kuerbis A, Armeli S, Muench F, Morgenstern J (2014) Profiles of confidence and commitment to change as predictors of moderated drinking: a person-centered approach. Psychol Addict Behav 28:1065. [PubMed: 25134034]

Miller WR, Rose GS (2009) Toward a theory of motivational interviewing. Am Psychol 64:527–537. [PubMed: 19739882]

Miller WR, Tonigan JS, Longabaugh R (1995) The Drinker Inventory of Consequences (DrInC): An instrument for assessing adverse consequences of alcohol abuse. Test manual NIAAA Project MATCH Monograph Series Volume 4. NIAAA Project MATCH Monograph Series Volume 4, Rockville, MD.

Miller WR, Zweben A, Diclemente CC, Rychtarik RG (1992) Motivational Enhancement Therapy Manual: A Clinical Research Guide for Therapists Treating Individuals With Alcohol Abuse and Dependence. National Institute on Alcohol Abuse and Alcoholism, Rockville, MD.

Morgan TJ, Morgenstern J, Blanchard K, Labouvie E, Bux DA (2004) Development of the OCDS-Revised: a measure of alcohol and drug urges with outpatient substance abuse clients. Psychol Addict Behav 18:316–321. [PubMed: 15631603]

Morgenstern J, Kuerbis A, Amrhein PC, Hail LA, Lynch KG, McKay JR (2012) Motivational interviewing: a pilot test of active ingredients and mechanisms of change. Psychol Addict Behav 26:859–869. [PubMed: 22905896]

Morgenstern J, Labouvie E, McCrady BS, Kahler CW, Frey R (1997) Affiliation with alcoholics anonymous after treatment: a study of its therapeutic effects and mechanisms of action. J Consult Clin Psychol 65:768–777. [PubMed: 9337496]

Morgenstern J, McKay J (2007) Rethinking the paradigms that inform behavioral treatment research for substance use disorders. Addiction 102:1377–1389. [PubMed: 17610541]

Project MATCH Research Group (1993) Project MATCH: Rationale and methods for a multisite clinical trial matching patients to alcoholism treatment. Alcohol Clin Exp Res 17:1130–1145. [PubMed: 8116822]

Robinson TE, Berridge KC (2008) Review. The incentive sensitization theory of addiction: some current issues. Philos Trans R Soc Lond B Biol Sci 363:3137–3146. [PubMed: 18640920]

Skinner HA, Allen BA (1982) Alcohol dependence syndrome: measurement and validation. J Abnorm Psychol 91:199–209. [PubMed: 7096790]

Snelleman M, Schoenmakers TM, Mheen D (2015) Attentional bias and approach/avoidance tendencies do not predict relapse or time to relapse in alcohol dependency. Alcohol Clin Exp Res 39:1734—1739. [PubMed: 26247388]

Sobell MB, Maisto SA, Sobell LC, Cooper AM, Cooper T, Saunders B (1980) Developing a prototype for evaluating alcohol treatment effectiveness, in Evaluating Alcohol and Drug Abuse Treatment Effectiveness: Recent advances (Sobell LC, Ward E eds), pp. 129–150. Pergamon, New York.

Spruyt A, de Houwer J, Tibboel H, Verschuere B, Crombez G, Verbanck P, Hanak C, Brevers D, Noel X (2013) On the predictive validity of automatically activated approach/avoidance tendencies in abstaining alcohol-dependent patients. Drug Alcohol Depend 127:81–86. [PubMed: 22776440]

Vinson DC, Reidinger C, Wilcosky T (2003) Factors affecting the validity of a timeline followback interview. J Stud Alcohol 64:733–740. [PubMed: 14572197]

Wiers RW, Eberl C, Rinck M, Becker ES, Lindenmeyer J (2011) Retraining automatic action tendencies changes alcoholic patients' approach bias for alcohol and improves treatment outcome. Psychol Sci 22:490–497. [PubMed: 21389338]

Wiers RW, Gladwin TE, Rinck M (2013) Should we train alcohol-dependent patients to avoid alcohol? Front Psychiatry 4:3. [PubMed: 23382717]

Wiers R, Rinck M, Dictus M, van den Wildenberg E (2009) Relatively strong automatic appetitive action-tendencies in male carriers of the OPRM1 G-allele. Genes Brain Behav 8:101–106. [PubMed: 19016889]

Wiers RW, Rinck M, Kordts R, Houben K, Strack F (2010) Retraining automatic action-tendencies to approach alcohol in hazardous drinkers. Addiction 105:279–287. [PubMed: 20078486]

Wiers CE, Stelzel C, Park SQ, Gawron CK, Ludwig VU, Gutwinski S, Heinz A, Lindenmeyer J, Wiers RW, Walter H (2014) Neural correlates of alcohol-approach bias in alcohol addiction: the spirit is willing but the flesh is weak for spirits. Neuropsychopharmacology 39:688–697. [PubMed: 24060832]

Table 1.

Characteristics of Study Sample

Characteristic	Baseline	Outcome
Age (years), Mean (SD)	39.3(11)	-
Female, %	53.3	-
Race/ethnicity, %		
White	71.6	-
Black or African American	16.7	-
Asian/Pacific Islander	1.7	
Native American	1.7	
Other	8.3	
Hispanic/Latino, %	20	-
Education, %		
High school diploma/GED and under	5	-
Some college/associate's degree	23.3	-
Bachelor's degree	38.3	-
Some graduate school or higher	33.4	-
Full time employed, %	58.3	-
Drinking severity, Mean (SD)		
Sum of standard drinks per week (SSD)	33.0 (17.7)	19.6 (15.2)
Number of drinking days (NDD)	4.9 (1.7)	3.7 (2.0)
Drinks per drinking day (DDD)	6.75 (2.7)	5.0 (2.6)
SRC scores, Mean (SD)		
Approach alcohol	9.0 (42.5)	1.0 (28.2)
Avoid alcohol	9.7 (37.7)	9.3 (35.4)
Alcohol Dependence Scale, Mean (SD)	14.2 (6.2)	–

Unless otherwise specified, baseline measures were taken at week 1, and outcome measures were taken at week 8. Drinking severity measures (SSD, NDD, DDD) were aggregated across several weeks: Baseline = 9 weeks before treatment (treatment started in week 1); Outcome = 4 weeks after treatment (weeks 8 to 12).

Table 2.

Baseline Drinking and Baseline R-AAT Approach and Avoidance as Predictors of Outcome Drinking

	Outcome drinking													
	Sum of standard drinks (SSD)					Number of drinking days (NDD)					Drinks per drinking day (DDD)				
	B	***p***	***R***	R^2	ΔR^2	***B***	***p***	***R***	R^2	ΔR^2	***B***	***p***	***R***	R^2	ΔR^2
Step 1			0.47	0.22				0.55	0.3				0.41	0.17	
Baseline drinking	0.42	<0.01				0.434	<0.001				0.412	<0.005			
Step 2			0.58	0.34	0.12			0.64	0.41	0.11			0.53	0.28	0.11
Baseline approach	0.308	<0.01				0.196	0.075				0.334	<0.01			
Baseline avoid	−0.121	0.3				−0.236	<0.05				−0.014	0.907			

B = standardized coefficient.

Table 3.

Baseline Explicit Measures and Baseline AAT Approach and Avoidance as Predictors of Change in Drinking

	Outcome drinking											
	Sum of standard drinks (SSD)				Number of drinking days (NDD)				Drinks per drinking day (DDD)			
Predictors	***b***	**SE (*b*)**	***B***	***p***	***b***	**SE (*b*)**	***B***	***p***	***b***	**SE(*b*)**	***B***	***p***
Model 1												
PAM composite	−0.152	0.081	−0.239	0.066	−0.03	0.009	−0.358	<0.01	−0.011	0.015	−0.099	0.459
Model 2												
POC behavioral coping	−0.597	0.221	−0.306	<0.01	−0.082	0.027	−0.317	<0.01	−0.061	0.041	−0.181	0.141
Model 3												
POC cognitive coping	−0.602	0.26	−0.284	<0.05	−0.093	0.032	−0.332	<0.01	−0.085	0.046	−0.231	0.071
Model 4												
Approach	0.099	0.04	0.277	<0.05	0.007	0.005	0.155	0.135	0.02	0.008	0.314	<0.05
Avoid	−0.019	0.048	−0.047	0.696	−0.008	0.006	−0.144	0.181	0.001	0.009	0.02	0.875
PAM composite	−0.066	0.088	−0.104	0.459	−0.019	0.01	−0.225	0.072	0.004	0.016	0.037	0.806
POC behavioral coping	−0.442	0.268	−0.227	0.106	−0.054	0.032	−0.207	0.104	−0.021	0.05	−0.062	0.68
POC cognitive coping	−0.05	0.344	−0.024	0.884	−0.005	0.042	−0.017	0.909	−0.06	0.064	−0.164	0.353

In all regressions, change in drinking was modeled as regressed change with baseline drinking as a predictor and outcome drinking as the dependent variable. All regressions controlled for treatment group. In model 4, AAT approach/avoidance and the explicit measures were entered simultaneously. b = unstandardized coefficient; B = standardized coefficient.

Table 4.

Correlations Between R-AAT Approach and Avoidance and Explicit Measures

		1	2	3	4	5	6	7	8
1	R-AAT approach (week 1)								
2	R-AAT avoidance (week 1)	−0.211							
3	ADS (week 0)	0.016	−0.11						
4	SIP sum (week 0)	−0.014	−0.002	0.414**					
5	OCDS sum week 1	0.042	0.067	0.278*	0.449**				
6	PAM composite (week 1)	−0.178	0.290*	0.138	0.631**	0.487**			
7	RCQ composite (week 0)	−0.004	−0.068	0.279*	0.501**	0.247	0.448**		
8	RCQ Action score (week 0)	0.014	0.044	0.109	0.298*	0.041	0.164	0.669**	
9	POC composite (week 1)	−0.181	0.22	0.165	0.350**	0.204	0.448**	0.408**	0.303*

*$p < 0.05$;

**$p < 0.01$.

R-AAT, relevant Alcohol Approach–Avoidance Task; ADS, Alcohol Dependence Scale; SIP, Short Inventory of Problems; OCDS, Obsessive Compulsive Drinking Scale; PAM, Primary Appraisal Measure; RCQ, Readiness to Change questionnaire; POC, Processes of Change Scale. All measures were taken at baseline (week 0 or week 1) as indicated in the table.