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Changes in Affect and Drinking Outcomes in a Pharmacobehavioral Trial for Alcohol Dependence

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Abstract

Objective—Despite extensive research exploring affect in alcohol dependent individuals in recovery, empirical research on affective changes over the course of psychosocial treatment and their role on drinking outcomes has been minimal. The present study examined the relationship between changes in positive affect (PA), negative affect (NA), and drinking outcomes during a pharmacobehavioral trial.

Method—Data for these post-hoc exploratory analyses were derived from a clinical trial of 321 alcohol dependent male and female individuals. The study design had four treatment arms for medication: three levels of dose of ondansetron as well as a control condition (placebo). All participants received weekly cognitive behavioral therapy for twelve weeks. We conducted an exploratory evaluation of changes in negative and positive affect and drinking behavior over time during the treatment phase of the trial using multilevel modeling.

Results—Participants experienced substantial reductions in drinking, decreases in NA, and increases in PA over the course of treatment. Individuals who experienced increases in PA over the course of treatment significantly reduced their drinking in subsequent weeks, while those who had reductions in NA only experienced reductions in drinking later in treatment if they also reported increases in PA. These results support the role of affect regulation in treatment.

Conclusions—These results suggest that affective change during the course of treatment may serve as one potential mechanism of action for changes in drinking behavior. The interaction between reductions in NA and increases in PA may be particularly important in promoting new coping skills and reducing drinking.

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Keywords

Alcohol dependence; Affect Regulation; Cognitive Behavioral Therapy; Pharmacobehavioral Trials

High levels of negative affect (NA) have been linked to the development and maintenance of alcohol dependence, as individuals may develop maladaptive coping patterns in which alcohol becomes a mechanism for temporarily reducing or blunting negative affective states^{1,2}. Research examining factors predicting relapse among those with substance dependence has demonstrated links between NA and alcohol craving³. Increases in NA also predicted relapse into substance use post-treatment^{4,5}. For instance, increased NA precipitated greater than one-quarter of relapses among alcohol dependent individuals in recovery⁶, with findings more pronounced for men (31%) than women (16%).

NA may serve to narrow and focus attention and behavioral choices⁷, maintaining existing cognitive and behavioral patterns. This may leave individuals feeling “stuck” or trapped in patterns of thoughts and behavior. For example, individuals with alcohol dependence may continue to rely upon alcohol to regulate mood and cope with unpleasant internal states and interpersonal situations. Furthermore, experimental research has demonstrated a link between negative affective states and risky decision making^{8,9,10}.

Recent longitudinal research on the relationship between NA and relapse also supports this relationship. Kelly and colleagues¹¹ found that the effects of psychosocial treatment on reductions in alcohol use among alcohol dependent individuals were partially mediated by reductions in NA within the first 15 months after treatment. Furthermore, Witkiewitz and Villaroel¹² found that level of NA was linked to lapses in drinking among participants in Project MATCH, with those experiencing increases in NA post-treatment more likely to report lapses in drinking within the 12 months after completing psychosocial treatment for alcohol dependence. Witkiewitz and Villaroel¹² argue that their findings demonstrate how NA “maintains the stability of the system” (p. 641) in returning to previous patterns of behavior, creating a negative feedback loop between NA and maladaptive use of alcohol. Similar findings by Evren and colleagues¹³ have supported this link between high NA and relapse at 6 month follow-up, consistent with the inclusion of NA as a major category within measures assessing self-reported factors in relapse in drinking^{14,15}.

Positive Affect

Although a substantial amount of research has supported the link between NA and substance dependence, research on the relationship between positive affect (PA) and substance dependence has been limited. Some research has suggested that individuals rely on alcohol to increase PA¹⁶, but these findings have been inconsistent^{16,17,18}.

Extending the broaden-and-build model of PA^{19,20} to psychosocial interventions, Fitzpatrick and colleagues^{21,22} have argued that the promotion of PA may cause positive cognitive and behavioral change. The broaden-and-build model hypothesizes that positive affective states promote the expansion and development of both cognitions and behavioral options^{7,23}, allowing individuals to think and plan more openly and creatively. This increases openness and creativity may, in turn, increase capacity to consider and contemplate new ideas and solve problems. Termed broad-minded coping, this phenomena has been shown to promote greater cognitive flexibility, more accurate perceptions, and the use of innovative, problem-solving coping skills within the context of stressful situations²⁴⁻³⁰. Fredrickson argues that PA also has the ability to “undo” or counteract the influence of NA^{31,32}. Increases in PA have been associated with reductions in emotion-

focused or avoidance coping strategies^{25,27}, including a direct inverse relationship between PA and use of alcohol to cope with stress¹⁶.

In a review of the empirical literature on PA, Isen²⁹ highlighted the promise of PA to promote “broad, flexible, cognitive reorganization and ability to integrate diverse material” (p. 89). This is relevant to CBT, in that increased PA during CBT may increase thorough, open, and accurate thinking, enhanced decision making, greater cognitive flexibility, and more innovative and creative problem-solving skills. Experimental research has also demonstrated that increasing PA causes individuals to use more problem-solving coping strategies^{33,34,35}, and reduces the tendency to select risky behaviors^{9,36}.

These results suggest that levels of PA during psychosocial interventions may play a critical role in the formation of new, problem-focused coping skills that allow individuals with alcohol dependence to reduce their drinking. These shifts in PA may create upward spirals in functioning over times. Positive emotions cause broadening of cognitive and behavioral perspectives and building of psychological, physical, social, and emotional resources, which leads to more positive emotion.

Emotion Regulation

Although PA and NA may individually play important roles in cognition and behavior relevant to alcohol dependence, the larger task of emotional regulation (ER;³⁷) may have the greatest implication for the treatment of this disorder. ER refers to the process of optimizing both levels of PA and NA, impacting the types of emotion felt, as well as when, and how they are experienced³⁷. Learned over time through life experience, ER involves a wide range of complex cognitive and behavioral skills to manage attention, modifying perception of life events as well as behavioral choices.

Individuals with alcohol dependence have been shown to have impairments in impulse control and behavioral disinhibition linked to prefrontal lobe damage³⁸⁻⁴¹. In the words of Lyvers “long-lasting frontal cortical changes resulting from chronic high alcohol intake may be at least partly responsible for the impairment of control exhibited by severely dependent alcoholics over their consumption of alcoholic beverages” (p. 231). Such impairments in prefrontal functioning can be reversed over time and with proper treatment^{42,43}, although previous research has indicated such changes take months or years to emerge.

CBT and ER

CBT forms an ideal environment for developing ER skills, as the structured environment provides opportunities to learn, practice, and obtain feedback regarding these skills⁴⁴. CBT for substance dependence specifically includes a focus on reducing high-risk behaviors and developing more adaptive problem-solving and coping skills over time (e.g., avoiding triggers, changing problematic thoughts, identifying alternatives/refusal skills, and coping with lapses;⁴⁵). A substantial body of evidence has demonstrated that the development of new cognitive and behavioral skills within CBT produce reductions in NA and promotion of PA^{46,47}. In fact, the combination of reductions in NA and increases in PA over the course of therapy routinely have been used as a marker of success in the context of ER training^{48,49}.

Since the Great Psychotherapy Debates of the 1950s and ‘60s, it has been established that psychotherapy does reduce symptoms of a wide variety of mental health problems⁵⁰. Of these modalities, CBT occupies a central role in treatment because of its perceived effectiveness by practitioners, strong theoretical base, absence of superior alternative treatments, and measured positive outcomes in clinical samples⁵¹. Research on the potential

mechanisms by which CBT may be effective in reducing symptoms of psychological disorders has consistently shown that CBT is effective in producing early-onset, relatively long-term increases in PA, increasing both the frequency and intensity of positive emotions such as happiness, pleasure, and joy^{52,53}. These increases in PA over the course of CBT have been linked to important therapeutic outcomes such as reductions in perceived pain in chronic pain patients⁵⁴. CBT has been shown to reduce symptoms of NA within the context of treatment of substance use disorders^{55,56,57} and to boost levels of PA in various populations⁵².

Although the direct etiology and underlying mechanisms of CBT has not been definitively identified, experiences of PA within the context of treatment for alcohol dependence may play an important role in promoting behavioral change. Thus far, research examining how levels of affect (particularly PA) change over the course of psychosocial or pharmacobehavioral treatment has been quite rare, and none have explored the relationship between changes in affective states and substance or alcohol use throughout the course of treatment.

In the present study we sought to explore both the impact of CBT for alcohol dependence on positive and negative affect, as well as the relationship between changes in positive and negative affect, or emotional regulation during CBT on reductions in drinking over the course of a pharmacobehavioral clinical trial for alcohol dependence. Data for this exploratory analysis are from a parent study⁵⁸ that examined the impact of ondansetron or a placebo on alcohol dependent individuals who all received CBT. We hypothesized, based on prior research, that drinks per drinking day (DDD) would decrease over the course of treatment, and that percent days abstinent (PDA) would increase over the course of treatment. Secondly, we hypothesized that participants would report increased PA and decreased NA over the course of treatment. Lastly, we hypothesized that (a) increases in PA and (b) decreases in NA would predict reductions in drinking.

Method

Parent Study

Data for these analyses were derived from a clinical pharmacobehavioral treatment trial with four treatment arms that included three levels of dose of ondansetron (1 µg/kg twice daily, 4 µg/kg twice daily, or 16 µg/mg twice daily) as well as a control condition. All medication and control conditions received weekly CBT for twelve weeks. Ondansetron is a selective 5-HT₃ (serotonin) antagonist that is hypothesized to reduce cravings in alcohol dependent individuals, presumably by ameliorating an underlying serotonergic abnormality⁵⁸. Although there is no evidence that ondansetron alters mood^{59,60}, medication status was controlled for within this study to eliminate this potential confounding variable.

Cognitive Behavioral Therapy for Addiction

The CBT provided in the study consisted of a non-therapeutic introduction session involving an introduction to CBT, followed by twelve therapeutic sessions, each held once a week for 50 minutes. During the early meetings, initial treatment goals were discussed and set collaboratively, with the patient having the final say in the establishment of his/her goals. Abstinence was encouraged but was not an absolute requirement. Goals were revisited and revised as needed throughout treatment, based primarily upon the client's progress which was assessed regularly. Within each session, material was presented and reviewed regarding specific areas of concentration that relate to substance use disorders as well as more general issues related to emotional dysfunction. Session material was presented orally and in writing, and participants were encouraged to take notes and were provided with handouts.

Issues covered included: understanding addictive behaviors, coping with cravings, thinking about using, problem solving, refusal skills, dealing with lapses, and relapse prevention. In addition, there were four additional elective sessions offered, such as assertiveness training, anger management, recognizing and managing negative moods. Weekly assignments were assigned at each session and reviewed at the following session. Patients were encouraged to complete the homework, preferably in writing, and always through real-world practice. The final session was a wrap-up, review, and termination session.

Participants

Participants ($N = 321$) were enrolled in the study if they met the following inclusion criteria: (a) a current diagnosis of alcohol dependence, as defined by the Diagnostic and Statistical Manual of Mental Disorders Revised—Third Edition⁶¹; (b) a score of 5 or more on the Michigan Alcoholism Screening Test⁶²; (c) an average of drinking three or more standard drinks per drinking day at the time of the telephone screen; and (d) negative urine toxicological screens for narcotics, amphetamines, or sedative hypnotics at enrollment. Participants all reported a desire to stop drinking (although a goal of abstinence was not a required criterion) and a willingness to participate in psychosocial treatment. Participants were excluded from the study if they (a) had a current psychiatric diagnosis other than alcohol or nicotine dependence, (b) were currently experiencing alcohol withdrawal symptoms that necessitated inpatient detoxification, (c) were pregnant or lactating, (d) were currently taking medication that may affect alcohol consumption, (e) were mandated to complete alcohol treatment, (f) had received treatment for alcohol in the past 30 days, or (g) had demonstrated clinically significant abnormalities on a series of medical tests (i.e., physical examination, electrocardiographic recording, elevated bilirubin).

The sample included 226 (70.4%) men and 95 (29.6%) women, ranging in age from 21 to 63 years ($M = 40.46$, $SD = 8.60$). The sample was 70.7% White, 17.4% Black, and 11.9% other (i.e. Latino/a, bi/multiracial). Seventy-one percent of the sample was classified as heavy drinkers, defined as drinking 5 standard U.S. drinks per day (men) or 4 drinks per day (women). Fifty percent of the sample was classified as early-onset alcoholics, defined as developing symptoms of alcohol dependence at 25 years or younger. Participants reported drinking a mean of 8.04 drinks per drinking day ($SD = 5.80$) in the 90 days prior to enrollment.

Measures

Drinking—The drinking parameters used in the study were DDD and PDA, assessed using the timeline follow-back (TLFB) technique⁶³. DDD was assessed over the past 90 days at screening, and both DDD and PDA were assessed over the previous week at subsequent visits. Drinking quantity is important to measure because it is a proxy for adverse drinking consequences (i.e., the subsequent effects of pathological drinking, such as impaired physical and mental function or health, health-related quality of life [QoL], economic status, and death⁶⁴. PDA is a measure of frequency of drinking and ability to establish more extensive self-regulatory control over drinking during a period of time. PDA also represents ability to establish more complete abstinence, the traditional criteria of success.

Positive and negative affect—The Profile of Mood States questionnaire (POMS;^{65,66}) was used to assess levels of positive and negative affect within the present study. The POMS is a 65-item questionnaire that assesses experiences of current mood. Participants rate each item on a 5-point rating scale from 0 = *not at all* to 4 = *extremely*. PA scores were derived from the POMS-Vigor subscale, with scores ranging from 0-32. NA scores were derived by summing the POMS subscales for Tension-Anxiety, Depression, Anger-Hostility, Fatigue,

and Confusion/Bewilderment, with scores ranging from 0 to 200. The subscales have demonstrated internal consistency reliabilities of .84 to .95^{65,66}.

Procedure

This study was approved by the Committee for the Protection of Human Subjects at the University of Texas-Houston Health Science Center. Participants were recruited by newspaper or radio advertisement directed at individuals who were interested in reducing their consumption of alcohol or quitting drinking, as part of a double-blind, randomized, placebo-controlled clinical trial on alcohol dependence⁵⁸.

At enrollment (visit 0) and each subsequent weekly visit (visits 1 through 11), all participants completed measures of their alcohol consumption (TLFB) and positive and negative affect (POMS). In addition, they received CBT and study medication (either placebo or one of three levels of dosage). At visit 0, participants were asked to report their drinking for the 90 days prior to enrollment. For subsequent visits, participants reported their drinking for the previous week.

Data Analysis Strategy

The primary aims of this research study were to evaluate the effects of positive and negative affect on drinking outcomes in the context of a pharmacobehavioral trial. The data are grouped as repeated measures nested within individuals. Multilevel modeling is a statistical method that is appropriate for such data, as it allows for the examination of individual growth trajectories by analyzing the information contained in the repeated measures⁶⁷. A two-level multilevel model was used for the present analyses that consisted of repeated measures (level 1) nested within individuals (level 2). The basic multilevel model took the following form:

$$\begin{array}{ll} \text{Level 1 (repeated measures):} & \text{DDD}_{it} = \pi_0 + \pi_1 (\text{Time}) + e_{it} \\ \text{Level 2 (individuals):} & \begin{array}{l} \pi_0 = \beta_{00} + \beta_{01} + r_{0i} \\ \pi_1 = \beta_{10} + \beta_{11} + r_{1i} \end{array} \end{array} \quad (1)$$

where t indexes time and i indexes individuals. For these analyses, we included a random intercept and random slope for time at the individual level, which allow individual-specific intercepts and slopes. In addition, a quadratic term for time was included to explore nonlinearity in outcomes. Dosage of medication was entered as a level-2 covariate. Positive and negative affect were standardized and entered as level-1 time-varying covariates. For the analyses examining the relationship between positive/negative affect and drinking outcomes, positive and negative affect were lagged one session behind the drinking outcome variable to provide evidence that changes in positive and negative affect preceded changes in drinking. Multilevel models assume normality and homoscedasticity of all error terms and conditional independence of the outcome, given the random effects.

Results

Means, standard deviations, and the number of participants providing data at each time point for the main outcome measures are summarized in Table 1. The first set of hypotheses addressed overall changes in drinking over the course of treatment. Specifically, we hypothesized that DDD would decrease over the course of treatment, and PDA would increase over the course of treatment. These hypotheses were supported. There was a negative linear effect of session on DDD ($p < 0.001$), indicating that participants decreased in DDD over the course of treatment. There also was a positive quadratic effect of session on DDD ($p < 0.001$), indicating that the decrease in DDD decelerated over the course of

treatment. Overall, participants decreased about 3.5 DDD over the course of treatment. Given the standard deviation of this measure, this represents a Cohen's d of approximately .71, a medium-to-large effect size⁶⁸. Similarly, there was a positive linear effect of session on PDA ($p < .001$), indicating that participants increased in PDA over the course of treatment. There was also a negative quadratic effect of session on PDA ($p < .001$), indicating that the increase in PDA decelerated over the course of treatment. Overall, participants increased about 17 PDA over the course of treatment ($d = .55$), representing a medium effect size.

The second set of hypotheses addressed overall changes in positive and negative affect. Specifically, we hypothesized that participants would increase in PA and decrease in NA over the course of treatment. These hypotheses were supported. There was a positive linear effect of session on PA scores ($p = .019$), indicating that participants increased in PA over the course of treatment. There was also a negative quadratic effect of session on PA scores ($p = .011$), indicating that the increase in PA scores decelerated over the course of treatment. Overall, participants increased their mean PA score by about .78 points (28-point scale; $d = .14$), representing a small effect size.

There was a negative linear effect of session on NA scores ($p < .001$), indicating that participants decreased in NA over the course of treatment. There was also a positive quadratic effect of session on NA scores ($p = .003$), indicating that the decrease in NA scores decelerated over the course of treatment. Overall, participants increased their mean NA score by about 1.81 points (28-point scale; $d = .37$), representing a small to medium effect size.

The third set of hypotheses addressed the relationship between (a) PA; (b) NA; and drinking outcomes. Specifically we hypothesized that (a) increases in PA and (b) decreases in NA would predict decreases in DDD and increases in PDA. For these analyses, positive and negative affect were standardized and lagged one session behind the drinking outcome variable to provide evidence that changes in the covariate preceded changes in drinking. These hypotheses were partially supported. For DDD, there was no main effect for NA ($p = .237$), but there was a negative main effect for PA ($p = .008$), indicating that participants with high levels of positive affect reported fewer DDD the following week. However, this main effect was qualified by a PA by NA interaction ($p = .001$, see Figure 1). For participants with low levels of NA, PA had a large effect on DDD the following week. However, for participants with high levels of NA, PA had little effect on DDD the following week. The best drinking outcomes were for participants with high levels of PA and low levels of NA. For PDA, there was no main effect for PA ($p = .350$), NA ($p = .066$), and the interaction between PA and NA was not significant ($p = .387$).

Discussion

The present study assessed the relationship between within-person changes in positive and negative affect and drinking outcomes over the course of CBT among individuals with alcohol dependence enrolled in a pharmacobehavioral trial, while controlling for the effects of medication. Consistent with hypotheses, participants reported decreased DDD and increased PDA over the course of treatment. Participants also reported modest decreases in NA and increases in PA, particularly within the first three weeks of treatment. Evidence from the current study suggests that CBT is effective in regulating affect within individuals with alcohol dependence through the development and use of new ER skills. This finding is consistent with previous research demonstrating the effectiveness of CBT in reducing unpleasant affect^{2,53} and increasing PA^{52,53}. The present study suggests that CBT may be an effective way to regulate affective states in the context of treatment for alcohol

dependence, and that the interaction between reductions in NA and increases in PA may be particularly important in promoting new coping skills and reducing drinking. As the combination of shifts in PA and NA early in treatment predicted lower levels of drinking, this study provides evidence that the development of ER skills via CBT may begin to produce changes in drinking behavior in treatment, although the magnitude of such changes in affect may be small within the first three months of treatment. CBT is promoted as developing new coping skills, which may lead to more effective ER as a consequence. Other therapies, such as interpersonal, emotion-focused, or psychodynamic therapies, may result in more dramatic changes in affect within the context of treatment. The complex interaction between shifts in PA and NA in reductions in drinking provide further support for the underlying role of ER as a potential mechanism of change across therapeutic modalities, as well as the direct link between greater ER and reductions in drinking within the context of treatment for alcohol dependence. As the role of ER in psychosocial treatment for alcohol dependence, has received very little empirical attention, these results demonstrate the unique opportunity to examine the interactions of changes in PA and NA as they relate to behavioral change, including the often-neglected literature on PA.

Consistent with Fredrickson's broaden-and-build model, these results provide support for the assertion that increases in PA promote cognitive and behavioral change. Positive affective states are thought to be influential in producing short-term changes in thought and behavior, allowing individuals to think more creatively and use more adaptive problem-solving coping strategies, which may support the election of more low-risk behavior options. Thus, consistent with the findings of the present study, individuals who report increases in PA should be more likely to perceive and employ more adaptive coping skills (vs. substance coping) when confronted with stressful experiences, leading to reductions drinking in following week. As increases in PA have also been discussed as a potential common factor underlying diverse psychosocial treatments²² and a marker of successful therapy⁶⁹, these results provide support for these assertions. CBT may serve to promote and support the development of PA by increasing awareness of emotional states, as well as providing new coping tools and social support that may create a sense of hope and interest in the process of change. As individuals experience initial successes in reducing their drinking as part of CBT, their sense of safety and self-control may develop, which may create experiences of self-mastery that are likely to help increase or maintain positive emotions. These increases in PA may promote more creative problem-solving skills and strengthen working memory by increasing levels of dopamine in the brain²⁴. These improved skills and cognitive abilities help build more permanent psychological and social resources²⁰ over the course of therapy.

Unfortunately, research on the potential effects of PA (including increases in PA within persons) in the context of psychosocial interventions for substance dependence has been rare, providing little comparative data. Doran and colleagues⁷⁰ found that nicotine-dependent participants who reported higher levels of PA early in CBT treatment were more likely to be abstinent at the conclusion of treatment, with high levels of PA predicting higher rates of abstinence at the later stages of treatment. In one of the few within-persons studies on mood in individuals receiving coping skills training to reduce alcohol use, Kranzler and colleagues¹⁸ found that increases in PA during treatment were associated with heavier drinking, although it was unclear from their analyses the causal direction of this relationship. However, these divergent results may be partially explained by the fact that the Kranzler¹⁸ study was limited to individuals who were "problem drinkers" (vs. those with alcohol dependence) and may over represent binge drinkers and those suffering from alcohol abuse. Such populations have been found to be more likely to drink to enhance or maintain positive affective states. Therefore, Kranzler's¹⁸ results may not apply to alcohol dependent populations who are more likely to use alcohol to cope^{71,72}.

It is important to note that the benefits of PA on drinking outcomes occurred primarily in the context of low NA, suggesting a complex interaction between shifts in affect during treatment and behavioral change that has not been discussed in the PA literature. These findings are consistent with those of Wills & colleagues⁷³, who found that the combination of high levels of PA along with low levels of NA in adolescents led to lower rates of drinking over time. This interaction suggests that high levels of PA may also serve to buffer or counteract the effects of NA in perpetuating the negative cycle of NA (NA; Use of substances to cope with NA; Negative consequences of use; NA). Fredrickson, Mancuso, Branigan and Tugade³² termed this phenomenon the “undoing effect”, demonstrating that the physiological effects of NA (anxiety) can be completely reversed by inducing PA states. Individuals seeking treatment for alcohol dependence are likely to experience a mix of positive and negative affective states as they navigate the difficult process of treatment. Such results indicate that promoting and supporting PA states may be particularly important aspects of treatment. Within the context of CBT, this may take the form of recognizing and building on initial successes that produce PA, assisting clients in seeking out new, low-risk pleasurable activities to enhance their behavioral repertoires, and providing encouragement and building a sense of hope in treatment.

In contrast to the number of significant predictors of quantity of drinking (DDD), changes in rates of abstinence were found to be unrelated to levels of PA and NA during treatment. These results indicate that changes in affective states may not produce demonstrable increases in abstinence during treatment, despite substantial reductions in number of daily drinks. One explanation for this finding may be that DDD focuses on quantity of alcohol on non-abstinent days, while PDA is more traditional indicator of changes in drinking behavior based on abstinence-only models of recovery. The lack of impact of affect on PDA may be explained by the fact that study participants did not necessarily establish abstinence as their primary goal during treatment. PDA may be a less useful measure of success in programs using CBT and Motivational Interviewing-based approaches that utilize harm reduction strategies vs. abstinence goals. Additionally, the CBT protocol used in this study did not concentrate explicitly on promoting PA thus the link between PA and reductions in drinking may be stronger in psychosocial treatments where increasing PA is an explicit goal. As such, adding modules on enhancing positive emotions through CBT training may be beneficial. Recent research findings indicate that individuals suffering from depression have a tendency to show diminished emotion reactivity to both negative emotions as well as positive emotions⁷⁴. As many individuals with alcohol dependence also have a co-occurrence of major depressive disorder⁷⁵, concentrating on understanding positive emotions may improve treatment outcomes for alcohol dependent individuals who are also experiencing depression or symptoms of depression.

The present study has several important limitations. Although the data analytic strategy employed allowed the researchers to demonstrate that the combination of increased PA and decreased NA predicted lower levels of drinking during treatment, no definitive causal relationships about the role of changes in affect in reducing drinking can be made. It is possible that third variables such as positive outcome expectancies, nonspecific treatment factors, or initial reductions in drinking occurring at the onset of treatment may serve as primary mechanism(s) that influenced both affect levels and subsequent levels of drinking. Although medication status was controlled for within the present analyses, it is possible that the nature of this pharmacobehavioral clinical trial may differ in important ways from non-clinical trials and studies that do not include the possibility of receiving medication that could decrease cravings and drinking. Expectancies regarding receiving psychotropic medication and/or participating in a clinical trial may have facilitated reductions in NA and/or increases in PA that may not otherwise occur within the context of CBT for alcohol dependence. The lack of a true control group (waitlist, attention-only) also prohibits any

definitive conclusions about the effects of CBT on PA and the drinking outcomes examined within this study. Future pharmacobehavioral studies will benefit from asking participants if they think they took active medication and what they think was the effective treatment, if any, that they received.

The present study provides support for the relationship between shifts in PA and NA and decreases in alcohol consumption during psychosocial treatment for alcohol dependence, although direct causal pathways are unknown. Understanding the role and potential power of shifts in PA and NA (as well as potential interactive effects) could also further research on improving psychosocial treatment for individuals with alcohol dependence and may provide particular insight to challenges of individuals dually diagnosed with mood disorders. Future research should examine the dynamic relationship between changes in PA and NA to investigate possible causal directional links between PA and NA during therapy to aid clinicians in understanding how to most effectively support cognitive behavioral changes in this population. Similarly, longitudinal research (ideally, including a non-treatment control group) assessing the relationship between shifts in PA and NA both during treatment and over the course of follow-up are needed to replicate these findings and explore whether shifts in affect during treatment are predictive of long-term reductions in drinking. Future research should examine which specific aspects of PA are increased by CBT (and other psychosocial therapies) in line with Fredrickson's⁷ call to examine the effectiveness of specific interventions in increasing PA as a unique and potentially invaluable aspect of successful psychosocial treatment for alcohol dependence.

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Figure 1.
Effect of PA and NA on DDD the following week.

Table 1

Descriptive Statistics for Main Outcome Variables

Variable	Session	N	Mean	SD
DDD	0	319	8.04	5.80
	1	191	7.09	4.77
	2	175	5.57	3.95
	3	158	5.52	4.20
	4	156	5.57	4.00
	5	122	5.32	3.19
	6	101	5.16	3.36
	7	97	4.97	3.32
	8	104	5.04	3.49
	9	93	4.78	3.61
	10	84	5.04	3.87
	11	80	4.52	3.53
PDA	0	NA	NA	NA
	1	200	.24	.29
	2	183	.36	.33
	3	159	.43	.30
	4	161	.44	.33
	5	126	.40	.31
	6	108	.40	.31
	7	103	.44	.33
	8	107	.41	.31
	9	97	.40	.33
	10	85	.45	.32
	11	86	.41	.33
PA	0	302	14.61	5.24
	1	274	14.70	5.08
	2	256	15.35	5.17
	3	238	14.75	5.62
	4	227	15.30	5.55
	5	199	15.54	5.72
	6	183	15.46	5.78
	7	175	15.44	5.81
	8	178	15.53	5.73
	9	160	15.63	5.83
	10	151	15.53	5.85
	11	153	15.34	5.81
NA	0	310	5.25	5.15

Variable	Session	N	Mean	SD
	1	281	5.13	5.60
	2	261	4.87	5.32
	3	244	4.70	5.59
	4	234	4.55	5.57
	5	206	3.84	4.96
	6	186	3.57	5.00
	7	180	3.51	4.46
	8	180	3.35	4.53
	9	162	3.12	4.44
	10	154	3.70	5.10
	11	156	3.44	4.71