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Association between a Brief Alcohol Craving Measure and Drinking in the Following Week

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Abstract

Background and aims—Craving for alcohol is thought to be a predictor of alcohol use, particularly in the near future. The assessment of craving in clinical practice requires brief, simple measures that can be implemented routinely. This study tested whether greater alcohol craving was associated with a higher likelihood of alcohol use in the subsequent week.

Design—The COMBINE Study was a large, multi-site clinical trial of treatment for alcohol dependence. Participants were randomized (stratified by site) to 1 of 9 treatment conditions involving combinations of pharmacotherapy and psychotherapy. Craving was assessed every other week throughout the treatment period.

Setting—Substance use disorder treatment settings at 11 academic sites across the United States.

Participants—Participants from the COMBINE Study (N=1,370) with available craving data.

Measurements—Craving was assessed using the 3-item self-report Craving Scale. Drinking was assessed using the Timeline Followback method, and was defined as alcohol use in each study week.

Findings—There was an average of 5.8 (of a possible 7) observation pairs per participant. Craving was strongly associated with alcohol use in the following week ($B=0.27$, $SE_B=.06$, Wald Chi-Square=43.34, $OR=1.31$, 95% CI=1.16, 1.47, $p<.001$). For each 1-unit increase in the Craving Scale, the likelihood of drinking in the next week was 31% higher.

Conclusions—Craving for alcohol is strongly associated with alcohol use in the following week. Clinicians can measure alcohol craving effectively using a brief self-report craving scale.

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Keywords

alcohol use disorder; craving; assessment; treatment

Introduction

Craving is a core feature of alcohol use disorder (1). Greater craving for alcohol is associated with a higher likelihood of relapse and shorter time to relapse both during and after treatment (2–5), and thus is an important marker of risk in clinical settings. Nonetheless, findings in the literature on the link between craving and alcohol use outcomes have been mixed, which may be attributable to differences in the amount of time between craving measurement and alcohol use outcomes. When considering proximal alcohol use (e.g., 24 hours-1 week), results have more consistently supported this association (3, 6) relative to examination over a longer period of time (e.g., craving before treatment predicting relapse after treatment) (7, 8). Craving is a complex and heterogeneous construct that is measured in research settings using detailed self-report assessments, often combined with other behavioral or physiological measures. Although such detailed assessments of craving provide valuable information about this complex construct, clinical settings require efficient strategies of measurement to feasibly collect data on a routine basis. Since “craving for alcohol” is now a diagnostic criterion in DSM-5 (as it has been in ICD-10), it will be increasingly important to routinely measure this variable during assessment and treatment.

A brief, three-item craving scale has demonstrated predictive validity for future cocaine (9) and prescription opioid use (10) among treatment-seeking patients with substance use disorders. For example, every one-point increase (on a scale from 0–30) was associated with a 17% higher likelihood of opioid use in a sample dependent upon prescription opioids. This measure may have particular value in clinical settings as a simple and brief marker of risk for future use. However, its predictive validity in patients with alcohol use disorder has not yet been established.

The aim of this study was to examine the predictive validity of a brief measure of alcohol craving within a large multi-site clinical trial of treatment for alcohol dependence (11). The COMBINE Study was a large randomized clinical trial investigating combinations of pharmacotherapy and psychotherapy for alcohol dependence. We hypothesized that greater craving in each week would be associated with a higher likelihood of any alcohol use in the following week, even when controlling for alcohol use in the previous week (i.e., the week of the craving measurement). In a secondary analysis, we examined whether craving was associated with likelihood of “heavy drinking” in the subsequent week, and hypothesized that greater craving would also be associated with a higher likelihood of heavy drinking.

Methods

A complete description of the study methods for the COMBINE Study clinical trial, as well as the overall outcomes, can be found in previous reports (11, 12). Below, a brief overview of the COMBINE Study methods, with a focus on those pertinent to the current study, is reported.

Participants

Adults interested in treatment for alcohol dependence were recruited for the COMBINE Study. Participants were eligible if they met the following inclusion criteria: (1) current diagnosis of alcohol dependence according to DSM-IV (13), (2) heavy drinking in the previous 90 days (an average of >21 drinks per week for men or >14 per week for women, and a minimum of 2 days of drinking 5 or more drinks for men, or 4 or more drinks for women), and (3) 4–21 days of abstinence prior to enrollment. Participants were excluded if they had a past or current DSM-IV drug use disorder (excluding cannabis and nicotine), had used the study medications (naltrexone and acamprosate) in the past 30 days, or had a co-occurring psychiatric disorder for which medication was indicated, an unstable medical condition, or a medical condition for which the study medications were contraindicated.

In the current analysis, 1,370 participants (423 women, 947 men) who had complete data for all variables of interest at baseline were included (the total sample size for the original study was 1,383). Of these participants, 1,350 had sufficient data to be included in the longitudinal analyses; the average number of observation pairs for the 7 time points examined was 5.8 (range 1–7). Alcohol use was common in the study; at each study week, approximately half of the sample reported at least one drinking episode. At baseline, the mean age was 44.4 years ($SD = 10.2$), and the majority of the sample self-reported race as non-Hispanic White (76.7%), followed by 11.2% Hispanic American, 7.9% Black or African American, 1.3% American Indian or Alaskan Native, 1.5% multi-racial, 1.2% other race, and <1% Asian American or Pacific Islander. The average years of educational was 14.6 ($SD = 2.7$) and the modal current marital status was married (42.2%), followed by single (27.8%), divorced (20.5%), and other (9.5%).

Procedures

Following provision of informed consent, participants were randomized to a treatment condition. These conditions included nine combinations of psychotherapy, naltrexone, acamprosate, and pill placebo. All participants received medical management, except one arm that received psychotherapy with no medication (active or placebo). The treatment phase consisted of 16 weeks of active treatment, followed by 1 year of follow-up assessments.

Measures

Alcohol use was measured using the Timeline Followback Method (14). This interviewer-administered method utilizes a calendar to anchor respondents to dates and events to enhance recall for substance use behaviors. For this study, we utilized a dichotomous outcome (presence vs. absence of alcohol use), consistent with prior analyses of the COMBINE Study (15). Heavy drinking was defined as consuming 4 or more drinks for women or 5 or more drinks for men on a single day. These outcomes were chosen to optimize clinical interpretation of findings; specifically, to understand the link between scores on this measure and likelihood of any drinking and heavy drinking in the coming week.

The Drinker Inventory of Negative Consequences (DRINC) (16) is a 50-item self-report measure of alcohol-related consequences. The DRINC was used in the current analysis as a measure of concurrent validity of the craving questionnaire to establish that these are related, but distinct constructs. The DRINC has demonstrated strong psychometric properties in the current sample (17).

Participants in COMBINE completed two self-report measures of craving. The Craving Scale (9) is a three-item self-report measure of substance craving that has been previously validated in cocaine- (9) and prescription opioid-dependent samples (10). This measure was adapted for use with alcohol in this study. The three items assess general urge to drink alcohol (“How strong is the drive to consume alcoholic beverages?”), cue-induced craving (“Please rate how strong your desire to drink has been when something in the environment has reminded you of drinking. [examples: seeing a beer ad, walking past the liquor section in the grocery store].”), and the likelihood of drinking alcohol if one was in the environment in which he or she usually drinks (“Please imagine yourself in the environment in which you previously drank alcohol [for example, a bar, a restaurant, or a particular room where you live]. If you were in this environment today and if it were the time of day that you typically drank, what is the likelihood that you would drink today?”). Higher scores on these items reflect more alcohol craving, and the range of possible scale scores was 0–12 (each item had a range of possible scores from 0–4).

The Obsessive Compulsive Drinking Scale (OCDS) (3, 18) is a 14-item self-report measure of alcohol craving. The OCDS has excellent reliability and validity and is a commonly used measure of certain aspects of alcohol craving in research settings. A prior study (3) identified 3 subscales including resistance/control impairment (i.e., control over thoughts and urges related to drinking), obsession (i.e., obsessive thoughts about drinking), and interference (i.e., interference of drinking in functional domains) and it was reported to be predictive of both future alcohol use and naltrexone response. The OCDS was used as a measure of concurrent validity in this investigation. The internal consistency of the OCDS in the current sample was strong ($\alpha = .85$).

Data Analysis

First, we examined cross-sectional associations at baseline between the Craving Scale and consequences of alcohol use (DRINC total score). Additionally, the correlation between the Craving Scale and the OCDS was evaluated as a measure of concurrent validity. Pearson’s correlation was calculated as a measure of these cross-sectional associations.

Second, we examined whether alcohol craving (Craving Scale total score) at each week was associated with alcohol use the following week using a lagged logistic regression model estimated by the generalized estimating equation (GEE) approach. Models controlled for alcohol use in the previous week (i.e., the week in which craving was measured) because of the likely correlation between ongoing drinking and craving that could artificially inflate the association between craving and future alcohol use.

Craving data collected during the treatment period on weeks 1, 2, 4, 6, 8, 10, and 12 were used. Because the craving data were collected every other study week (with the exception of

weeks 1 and 2), we also ran this model examining the association between craving and alcohol use over the following 2 weeks. These models included interaction terms examining the craving by time interaction to test whether the association between craving and subsequent alcohol use varied over the course of treatment (e.g., if the association between craving and use weakened later in treatment), the craving by treatment interaction to determine whether this association varied by treatment condition, and the craving by treatment by time interaction to determine whether treatments differentially impacted the craving-alcohol link over time. In addition, the craving by previous week drinking interaction was included to examine whether previous week drinking impacted the association between craving and alcohol use. Models also included age, gender, race, and study site as covariates. These models were then replicated with presence of heavy drinking as the outcome, to examine whether craving was also specifically linked to heavy drinking. All analyses were conducted in SPSS Version 20.

Results

Preliminary Analyses

The 1,370 participants with valid baseline craving data were included in preliminary analyses. At baseline, the internal consistency reliability of the Craving Scale was poor ($\alpha = .46$); this improved at week 1 ($\alpha = .68$), and was adequate at all subsequent time points ($\alpha > .70$). The relatively low values for α at baseline and week 1 may have been attributable to a truncated range of values prior to the initiation of treatment (i.e., a clustering of scores at the high end of the scale). The variance in scores was substantially (15–27%) lower at baseline relative to later time points.

The Craving Scale demonstrated excellent concurrent validity with the OCDS, a detailed measure of alcohol craving (r values over time ranged from .54 to .85, all p values $< .001$). The Craving Scale was significantly associated with all three validated OCDS subscales at baseline, with the strongest correlation for the resistance/control impairment subscale ($r = .49$, $p < .001$), followed by the obsession subscale ($r = .40$, $p < .001$), and the interference subscale ($r = .27$, $p < .001$). The Craving Scale total score was associated with alcohol-related consequences on the DRINC at baseline ($r = 0.23$, $p < .001$).

Craving and Alcohol Outcomes over Time

Two models were calculated; the primary model tested the association between craving and alcohol use in the subsequent week ($n=1,350$). This model was re-calculated for alcohol use in the subsequent two weeks ($n=1,323$). The results of the model examining the association between craving and alcohol use in the following week are presented in Table 1. Craving was significantly associated with alcohol use in the following week ($B = 0.27$, $SE_B = .06$, $OR = 1.31$, 95% $CI = 1.16, 1.47$, $p < .001$), even controlling for alcohol use in the week when the craving measure was given. For every 1-unit increase in the Craving Scale score, there was a 31% increase in likelihood of drinking in the subsequent week.

There was a modest craving by time interaction. This was characterized by a general decrease in the association between alcohol craving and use, with a strong relationship

between craving and use in the first half of treatment ($B = 0.27$, $SE_B = .08$, $OR = 1.31$, 95% $CI = 1.12, 1.53$, $p < .001$) and no significant association in the second half of treatment ($B = -.07$, $SE_B = .86$, $OR = 0.49$, 95% $CI = 0.09, 2.65$, $p < .001$). Additionally, there was a modest craving by previous week's drinking interaction; specifically, when a participant drank in the previous week the association between craving and alcohol use in the next week was stronger ($B = 0.29$, $SE_B = .09$, $OR = 1.34$, 95% $CI = 1.12, 1.59$, $p = .002$), relative to the association following an abstinent week ($B = 0.18$, $SE_B = .09$, $OR = 1.20$, 95% $CI = 1.00, 1.43$, $p < .05$).

The results from the model examining alcohol use over the following 2 weeks were similar. Higher levels of craving were associated with an increased likelihood of drinking alcohol in the next two weeks ($B = 0.25$, $SE_B = .07$, $OR = 1.28$, 95% $CI = 1.12, 1.47$, $p < .001$). For every 1-unit increase in the Craving Scale score, there was a 28% increase in likelihood of drinking in the next 2 weeks. Similarly, there was a significant craving by time interaction ($B = 0.04$, $SE_B = .01$, $OR = 1.04$, 95% $CI = 1.02, 1.06$, $p = .003$), reflecting a mitigation of this effect over time.

When considering each individual item separately, each item was significantly associated with likelihood of drinking in the next 1 or 2 weeks (ORs ranged from 1.32–1.63). To compare each individual item to the total scale score, the total score was divided by 3 to reflect an average of the 3 items and to place the total score on the same scale as the individual items. No individual item was associated with a stronger effect size than the combination of items; when placed on the 0–4 scale, this composite was most strongly associated with alcohol use in the following week ($B = 0.64$, $SE_B = .04$, $OR = 1.90$, 95% $CI = 1.75, 2.05$, $p < .001$).

Craving and Heavy Alcohol Use over Time

These models were then calculated with heavy drinking in the following week as the dependent variable (Table 2). Results were consistent with previous analyses; craving was significantly associated with heavy drinking in the following week ($B = 0.25$, $SE_B = .05$, $OR = 1.28$, 95% $CI = 1.16, 1.42$, $p < .001$) and the following 2 weeks ($B = 0.30$, $SE_B = .07$, $OR = 1.35$, 95% $CI = 1.18, 1.55$, $p < .001$). These findings suggest that for every 1-unit increase in the Craving Scale score, the likelihood of heavy drinking in the next week increased by 28%, and the likelihood of heavy drinking in the following 2 weeks was 35% higher.

Similar to the prior analyses, there was a significant interaction between the Craving Scale and heavy drinking in the previous week. However, in this analysis, in weeks without heavy drinking, craving was strongly associated with next-week heavy alcohol use, and in weeks following heavy drinking, there was no association between craving and heavy alcohol use.

Discussion

Brief measures that can be administered routinely in treatment are of particular value to clinical practice. It is necessary for such measures to also provide a meaningful assessment of the factor of interest and its implications. This secondary analysis of data from the COMBINE Study found that a 3-item self-report measure of craving was associated with

subsequent alcohol use. Each 1-unit increase in this scale was associated with a 31% higher likelihood of drinking in the next week and a 28% higher likelihood of heavy drinking in the next week, implying that those scoring higher on this scale are at an increased risk of drinking. This is comparable to findings from previous studies in cocaine and prescription opioid dependent samples (9, 10). Although the difference in scaling precludes direct comparison, taken together these results suggest that this brief scale provides robust predictive validity across three drug classes, above and beyond the prediction afforded by substance use in the previous week. All analyses controlled for drinking in the previous week, suggesting that these findings do not simply reflect high cross-sectional correlations between craving and alcohol. In fact, our data show that both previous drinking and craving account for unique variance as predictors of subsequent drinking. That is higher craving predicts drinking over and above that predicted by previous drinking.

These findings are consistent with previous studies reporting a strong association between craving and alcohol use when this association is examined over the short term. The OCDS has been shown to be a robust predictor of alcohol use in the following week (3), but not when measuring drinking over a 3-month period (7). Thus, craving appears to have the strongest clinical utility when considering its relationship to imminent risk for drinking, rather than longer-term risk; this may explain, in part, mixed findings on the craving-alcohol use association reported in the literature.

This association was characterized by several moderational effects. There was a modest craving by time interaction, characterized by a weaker relationship later in treatment than there was early in treatment. This finding suggests that treatment successfully decreased the link between craving and alcohol use over time; that is, treatment decoupled craving from use. Although it was beyond the scope of this evaluation, it is possible that naltrexone or behavioral treatment could account for this observation since one purported mechanism of action is reducing the association of craving and alcohol use, a notion supported by previous work (3,19). Additionally, presence of alcohol use in the previous week moderated the association between craving and drinking in the next week. There was a significant association between craving and heavy drinking following a week without heavy drinking; however, there was no association between craving and heavy drinking following a heavy drinking week. This might imply that craving is a predictor on the initiation of drinking but not of escalating or uncontrolled drinking where the pharmacological effects of alcohol become more salient.

These results support the clinical utility of the brief Craving Scale for populations with alcohol use disorder. The measure can be administered in about a minute and provides a marker of risk for near-future alcohol use that may be used to guide treatment. For example, elevated craving may indicate the use of an intervention targeted to manage craving states (e.g., cognitive-behavioral therapy or naltrexone) or the utilization of additional supports (e.g., self-help attendance or clinic visits) in the coming week to prevent relapse. A previous analysis of the COMBINE Study found that reduction in craving (measured by the OCDS) mediated the association between treatment and alcohol use outcomes for certain treatment arms (naltrexone, psychotherapy, and their combination) among those with high craving scores (19). In a commentary on the COMBINE Study, one of the authors (RA) emphasized

the value of utilizing measurement of craving for both initial treatment planning (those with high craving may benefit from naltrexone or behavioral interventions), and ongoing measurement to inform treatment adjustments (e.g., adding behavioral intervention to naltrexone if craving reduction has not occurred after 1 month of treatment) (20). Although more in-depth measures of various craving aspects, such as the OCDS, might be more suitable to understanding mechanisms of treatment effects, the brief measure used in the current analysis would be a promising and feasible tool for clinical applications where time constraints necessitate brief measurement approaches.

There are also several limitations to the current study. First, this was an unplanned secondary analysis from an existing dataset. Second, despite evidence for strong internal consistency of the brief Craving Scale in prior studies, the internal consistency of this scale at pre-treatment was low. It is possible that the alpha was impacted by a ceiling effect prior to treatment when participants were recently detoxified or had quit drinking. Notably, the range of scores on the measure was shorter relative to other investigations, which may have contributed to this ceiling effect. Nonetheless, the internal consistency improved over time and the predictive validity results mirrored those of studies in other populations diagnosed with substance use disorders. In the current study, we cannot rule out the possibility that the association between craving and alcohol use is related to other variables correlated with craving that may affect this association (such as stress). From a clinical perspective, regardless of the relative contribution of other overlapping factors, this measure of craving appears to offer predictive validity for future drinking and thus may be of use in treatment settings. It is unclear whether these results generalize to adults with lower levels of drinking or those who are not dependent upon alcohol.

There are a number of future directions for this research. For example, consideration of how changes in craving (e.g., large vs. small increases) and trajectories of craving (e.g., those with high variability over time) are associated with alcohol use will further enhance understanding of this association.

This study provides further support that alcohol craving is a marker of risk for drinking during treatment. This brief self-report Craving Scale provides strong predictive validity for future alcohol use and may be of value in clinical and research settings in which time for routine assessment is limited.

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Table 1
Generalized Estimating Equations Logistic Model of Craving Predicting Alcohol Use Over the Next 1 Week (N=1350)

	B	SE _B	OR	Lower 95% CI	Upper 95% CI	p
Age	0.004	0.004	1.00	1.00	1.01	0.29
Gender (reference = male)	-0.28	0.09	0.76	0.63	0.90	0.01
Treatment (reference = Pill placebo)						
Acamprosate	0.62	0.32	1.86	0.99	3.48	0.05
Naltrexone	0.28	0.31	1.32	0.72	2.43	0.37
Acamprosate+naltrexone	0.16	0.32	1.17	0.63	2.20	0.63
Pill placebo+CBT	0.32	0.33	1.38	0.72	2.63	0.33
Acamprosate+CBT	0.58	0.30	1.79	0.99	3.22	0.05
Naltrexone+CBT	0.32	0.30	1.38	0.76	2.48	0.29
Acamprosate+naltrexone+CBT	0.14	0.32	1.15	0.61	2.15	0.66
CBT	0.58	0.31	1.79	0.97	3.28	0.06
Site (reference = 1)						
2	-0.01	0.18	0.99	0.69	1.40	0.93
3	0.01	0.16	1.01	0.73	1.39	0.94
4	-0.41	0.18	0.67	0.47	0.95	0.02
5	-0.75	0.20	0.47	0.32	0.69	0.00
6	-0.42	0.18	0.66	0.46	0.94	0.02
7	-0.84	0.19	0.43	0.30	0.63	0.00
8	-0.17	0.18	0.85	0.59	1.21	0.36
9	-0.04	0.17	0.96	0.69	1.35	0.82
10	-0.41	0.17	0.67	0.48	0.93	0.02
11	-0.38	0.16	0.68	0.49	0.94	0.02
Alcohol use previous week	2.93	0.16	18.73	13.69	25.63	<.001
Time	-0.06	0.03	0.94	0.89	1.00	0.05
Craving Scale	0.27	0.06	1.31	1.16	1.47	<.001
Craving Scale X Time	0.03	0.01	1.03	1.01	1.05	0.03
Craving Scale X Alcohol use previous week	-0.07	0.03	0.93	0.88	0.99	0.04

Note. Non-significant interaction terms for Craving Scale by Treatment (Wald Chi-Square=9.40, p=.31) and Craving Scale by Treatment by Time (Wald Chi-Square=9.40, p=.31) are not presented in the table. OR=odds ratio; CI=Confidence Interval; CBT=cognitive behavioral therapy.

Table 2

GEE Logistic Model of Heavy Alcohol Use Over the Next Week (N=1350)

	B	SE _B	OR	Lower 95% CI	Upper 95% CI	p
Age	-.01	.00	0.99	0.98	1.00	.01
Gender (reference = male)	-.02	.09	0.98	0.82	1.17	.84
Treatment (reference = Pill placebo)						
Acamprosate	.10	.32	1.11	0.59	2.07	.77
Naltrexone	-.17	.31	0.84	0.46	1.55	.59
Acamprosate+naltrexone	-.70	.33	0.50	0.26	0.95	.03
Pill placebo+CBT	-.11	.31	0.90	0.49	1.64	.73
Acamprosate+CBT	-.12	.30	0.89	0.49	1.60	.69
Naltrexone+CBT	-.02	.32	0.98	0.52	1.84	.96
Acamprosate+naltrexone+CBT	-.25	.34	0.78	0.40	1.52	.46
CBT	.19	.32	1.21	0.65	2.26	.55
Site (reference = 1)						
2	-.31	.19	0.73	0.51	1.06	.10
3	.00	.10	1.00	0.82	1.21	.99
4	-.22	.17	0.80	0.58	1.12	.23
5	-.64	.21	0.53	0.35	0.80	.00
6	-.31	.19	0.73	0.51	1.06	.11
7	-.72	.19	0.49	0.34	0.71	<.001
8	.01	.18	1.01	0.71	1.43	.98
9	-.09	.17	0.91	0.65	1.28	.57
10	-.44	.18	0.64	0.45	0.92	.02
11	-.42	.18	0.66	0.46	0.94	.02
Heavy alcohol use previous week	2.84	.17	17.12	12.27	23.88	<.001
Time	-.05	.03	0.95	0.90	1.01	.18
Craving Scale	.25	.05	1.28	1.16	1.42	<.001
Craving Scale X heavy alcohol use previous week	-.10	.03	0.90	0.85	0.96	.00

Note. Non-significant interaction terms for Craving Scale by Time (Wald Chi-Square=3.10, p=.08), Craving Scale by Treatment (Wald Chi-Square=5.73, p=.68), and Craving Scale by Treatment by Time (Wald Chi-Square=11.00, p=.20) are not presented in the table. OR=odds ratio; CI=Confidence Interval; CBT=cognitive behavioral therapy.