Role of Relative-Reinforcement Value of Alcohol-Free Activities During Recovery from Alcohol Use Disorder in an Adult Clinical Sample

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Abstract

Behavioral economic theory has been extensively applied to understand alcohol use disorder (AUD). Applications of behavioral economic theory conceptualize AUD as a pattern of harmful alcohol use over extended periods of time in which choices between drinking or engaging in alcohol-free activities favor drinking. Recovery, in contrast, entails a sustained shift towards a pattern of selecting rewarding alcohol-free activities. The current study examined whether alcohol-free activity engagement and the relative reinforcement value (RRV) of engaging in those activities predicted AUD treatment outcomes via secondary analysis of data from Project MATCH, a multisite randomized clinical trial examining behavioral treatments for AUD ($N = 1,279$, 75.8% male, 81.0% non-Hispanic White, 9.5% Black, 7.7% Hispanic/Latino, 1.5% American Indian/ Alaska Native, < 1% Asian American and other race/ethnicity). Regression analyses indicated that every additional alcohol-free activity reported at 6 months post-treatment was associated with 7% fewer drinking days, 5% fewer heavy drinking days, and approximately one less drink per drinking day, as well as with significant improvements in depression, purpose in life, and psychosocial functioning at 12 months following treatment. Consistent with behavioral economic theory, higher RRV of alcohol-free activities also predicted significant reductions in drinking and improvements in functioning, and these associations were stronger compared to results for alcohol-free activity frequency only. The findings highlight the importance of understanding environmental contexts conducive to recovery and support the value of increasing alcohol-free activity engagement and the RRV of engaging in such activities to facilitate reductions in drinking and improved functioning among individuals with AUD.

Keywords

Alcohol Use Disorder; Behavioral Economic Theory; Alcohol-Free Activity Engagement; Behavioral Alcohol Treatment

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Alcohol use disorder (AUD) is a major public health problem globally, with approximately 8.6% of people meeting lifetime criteria for an AUD (Glantz et al., 2020). In the United

States, fewer than 10% of people who meet criteria for AUD receive treatment (Probst et al., 2015). The consequences of this treatment gap are further compounded by the fact that sustained engagement with treatment is relatively difficult to achieve among those who do seek help (Harris & McElrath, 2012; McKay, 2017, 2021).

One approach to understanding harmful alcohol use is behavioral economic theory, which is useful for understanding the etiology of AUD and for guiding treatment and prevention (Tucker et al., 2023; Vuchinich et al., 2023; Vuchinich & Heather, 2003). Behavioral economics views AUD and other substance use disorders as involving a temporally-extended or molar pattern of behavior involving a series of choices between engaging in substance use or substance-free activities that offer positive opportunities and rewards with respect to life functioning. In other words, choices are framed in terms of extended patterns of problem use or engagement in substance-free alternatives, rather than a discrete choice on a given occasion between the act of using substances or engaging in a substance-free activity (Rachlin et al., 2018). In the short run, a discrete choice between using or engaging in a substance-free activity may favor using substances. However, choosing a pattern of adaptive functional activities and minimal or no substance use, if sustained over time, generally has higher value and offers more rewards in life functioning than a pattern dominated by substance use. Choosing substance-free activities more than substance use over time increases access to positive opportunities that ultimately reinforce recovery from substance use disorder.

This emphasis on behavioral patterning over molar timeframes contrasts with earlier neobehavioral operant conditioning theories that are based on a temporally contiguous analysis of stimulus-response-reinforcer relationships (see Baum, 2011), and it is supported by extensive research on the matching law (Herrnstein, 1970, 1997), which states that time spent engaging in specific behaviors matches their relative rates of reinforcement. A related difference concerns the context-dependence of patterns of choice behavior. A given choice is dependent on the other activities and commodities available in the context of choice, and the matching law, originally derived from animal experimental choice research and later extended to human choice behavior, quantifies this relationship (Vuchinich et al., 2023). Hence, the relative reinforcement value (RRV) of a given activity reflects its strength of preference in relation to the other options available in the context of choice. Shifts in RRV away from drinking in favor of alcohol-free activities are viewed as a central process involved in beneficial drinking behavior change (Baum, 2011; Herrnstein, 1970, 1970; Murphy et al., 2021; Murphy & Dennhardt, 2016; Tucker, 2021; Tucker, Cheong, et al., 2021).

In addition, extensive research spanning human clinical and preclinical studies has demonstrated that a pattern of harmful substance use is most likely to occur when immediate constraints on engaging in substance use are minimal and few rewarding alternatives are available (Murphy et al., 2021; Vuchinich et al., 2023). Of these two domains, the extent of rewarding substance-free alternatives is generally more influential on patterns of substance use over time compared to simply punishing use or reducing drug access. Thus, environmental enrichment with substance-free activities is a primary intervention approach to reduce problem use and can be promoted by increasing access to alternative reinforcers

either through treatment interventions (Higgins et al., 2004; Murphy et al., 2021; Tucker, 2021) or as natural occurrences in the usual environments of individuals attempting to recover on their own (Tucker, 2022).

Several treatments for AUD guided by reinforcement and behavioral economic theory have demonstrated efficacy (MacKillop, 2016; Murphy et al., 2021). Contingency management is an effective intervention with high compliance rates in which participants receive treatment-delivered financial rewards for not using substances (Prendergast et al., 2006). The related community reinforcement approach is another effective treatment that focuses on increasing rewards associated with abstinence and decreasing rewards associated with alcohol and other substance use via differential treatment-delivered reinforcement (R. J. Meyers et al., 2011). Newer interventions focus on providing clients with tools to find alternative substance-free rewards in their natural environment. Some of these include the substance-free activity session (SFAS) implemented in conjunction with alcohol brief interventions (Murphy et al., 2012, 2019) and the behavioral activation approach used in the Life Enhancement Treatment (LETS ACT) (Daughters et al., 2008, 2018). The single-session SFAS, initially developed and evaluated with college students, focuses on academic and career goals and highlights how behavioral allocation patterns to drinking and substance-free activities may help or hinder goal attainment (Murphy et al., 2012). A randomized controlled trial using college student heavy drinkers found that the SFAS was associated with significant, large effect size reductions in drinking and alcohol-related problems compared to an assessment-only condition (Murphy et al., 2019). LETS ACT researchers adapted behavioral activation treatment for problem substance use and focused on increasing engagement in positively-reinforcing valued activities. Randomized controlled trials of LETS ACT supported its efficacy in reducing substance use and related problems in residential (Daughters et al., 2018) and intensive outpatient (Paquette et al., 2023) treatment settings. Overall, treatments that can help people shift their allocation of time and resources away from alcohol-involved activities and toward alcohol-free activities are effective in promoting positive behavior change and AUD recovery (Murphy et al., 2021; Tucker, Lindstrom et al., 2021; Tucker et al., 2023). A similar shift has been associated with stable natural recovery among untreated persons with AUD (Tucker, 2021).

Given empirical support for the effectiveness of AUD treatments that emphasize connecting with contexts that support engagement in alcohol-free activities, there is a need to broaden the focus of research on AUD treatment processes and outcomes to include examination of the role of alcohol-free activities. Treatments that focus primarily on reducing alcohol use, rather than increasing engagement in enriching and enjoyable alcohol-free activities, may fail to address contextual features and other behavior patterns that are integrally intertwined with alcohol problems and important for recovery initiation and long-term maintenance. Further investigation is warranted concerning whether increases in alcohol-free activities following AUD treatment are associated with better treatment outcomes.

To address this need, the current study examined associations between engagement in and enjoyment of alcohol-free activities with drinking outcomes one year after treatment in a large clinical sample of adults with AUD. The study used longitudinal data from Project MATCH (Mattson et al., 1993) to investigate the relationship between the number and

relative reinforcement value of alcohol-free activities (i.e., an index based on frequency and enjoyment of alcohol-free activities compared to all activities) and key treatment outcome indicators. Outcomes included both drinking-related and functional measures assessed 12 months after the completion of AUD treatment. We anticipated that engagement in alcohol-free activities and particularly the relative reinforcement value of engaging in those activities six months after treatment completion would be associated with reduced drinking and greater social functioning 12 months after treatment. Behavioral economic theory emphasizes the critical role of shifts in RRV from alcohol-involved to alcohol-free activities to promote successful recovery outcomes. While such shifts are dependent upon access to and engagement in alcohol-free activities, it is the relative reinforcement received from them from among the total reinforcement available that is viewed as the primary indicator of changes in strength of preference for drinking.

Method

Participants and Procedures

Below, we report how we determined our sample size, all data exclusions, all manipulations, and all measures in the study. The current study was a secondary analysis of data collected as part of Project MATCH ("Matching Alcoholism Treatments to Client Heterogeneity"), which enrolled participants between 1991 and 1993. This multisite randomized clinical trial recruited people with an AUD diagnosis from both intensive inpatient and community/outpatient treatment centers from nine sites across the United States and randomly assigned them to one of three behavioral treatments: (1) Cognitive Behavioral Therapy (CBT), (2) Motivational Enhancement Therapy (MET), and (3) Twelve-Step Facilitation (TSF) (Mattson et al., 1993). In the TSF condition, participants were encouraged to spend time engaging in substance free activities, including going to Alcoholics Anonymous meetings, and engaging in exercise, recreation, hobbies, and other interests. The CBT condition discussed engaging in "distracting activities" that included reading, a hobby, going to a movie, and exercising and also had an optional session on engaging in pleasant activities that might provide alternatives to alcohol use (Kadden et al., 2003; Miller et al., 1999; Nowinski et al., 1992). MET did not have an explicit focus on alternative activities.

Our study included those participants who completed both the follow-up conducted six months after treatment and the follow-up conducted 12 months after treatment (i.e., they had no missing data for measures assessed at these timepoints). The final sample in the current study ($N = 1,279$) was 75.8% male, 25.5% unemployed, and 41.9% married, and 81.0% non-Hispanic White, 9.5% Black, 7.7% Hispanic/Latino, 1.5% American Indian/Alaska Native, and less than 1% Asian American and other races. Project MATCH was powered to detect matching effects and aimed to recruit 1600 patients (Project MATCH Research Group, 1993). The current study with a sample size of 1279 has power of .95 to detect small effect sizes ($r = .02$) in a linear regression model. See Table 1 for other sample characteristics.

Measures

Six outcome measures were of interest that encompassed drinking-related variables and variables assessing psychosocial well-being. Drinking-related variables were assessed at baseline and 12 months after the completion of treatment (15 months from baseline) and were based on drinking during the previous month. All drinking outcomes included in this study were calculated using data from the Form 90 (Miller & del Boca, 1994), which is a collection of instruments designed to assess alcohol consumption using multiple indicators over time. The Form 90 provided data to calculate drinking intensity (drinks per drinking day, DDD), drinking frequency (percent drinking days, PDD), and percent heavy drinking days (PHDD), which was defined as the percentage of days in which the participant consumed at least 4 or 5 drinks for women and men, respectively. Psychosocial well-being was assessed by three measures: Beck Depression Inventory (BDI; Beck et al., 1988), Purpose in Life scale (PIL; Marsh et al., 2003), and the social behavior subscale of the Psychosocial Functioning Inventory (PFI; Feragne et al., 1983). The PIL assesses an individual's assessment of meaning in their life (e.g., "I regard my ability to find a meaning, purpose or mission in life as · ['practically none'] to ['very great']"). The social behavior subscale of the PFI assesses functioning within interpersonal relationships (e.g., "How often were you upset, angry, or disappointed with the way people did things?" and "Did you do things that upset family/friends?" rated from 1 "almost daily" to 4 "not at all").

Independent variables (i.e., predictors) were two calculated measures of engagement in alcohol-free activities. Both were derived from participants' responses to the Important People and Activities instrument (Clifford & Longabaugh, 1991). In Project MATCH, this instrument was only administered at baseline and 6 months after completion of treatment. Our analysis used activity data collected 6 months post-treatment to predict relevant outcomes. The instrument collects information on the most important people in a participant's social network as well as up to 12 important activities; i.e., "activities may be your work, doing housework, looking for a job, your bowling club, Sunday dinner with your family, working on your car or in your garden, or whatever else you identify as activities which are important to you." Participants were asked to rate each activity in terms of their level of enjoyment of that activity ("How much have you liked this activity?" with response options ranging from 1 = "Totally disliked" to 7 = "Totally liked") and to report the approximate number of hours they spent on the activity each week during the last 6 months. Each reported activity was coded as either being alcohol-involved or alcohol-free, depending on participant responses to the question: "How often did you drink alcohol during this activity?" If participants responded that they "Never" or "Rarely" drank alcohol during an activity, it was coded as "alcohol-free," and if they responded that they "Sometimes," "Often," "Usually," or "Always" drank alcohol during the activity, it was coded as alcohol-involved.

Independent variables derived from this questionnaire included the total number of alcohol-free activities and the relative-reinforcement value (RRV) of alcohol-free activities based on the frequency and enjoyment of engagement in alcohol-free activities relative to all activities, including those that did and did not involve drinking. Specifically, activity frequency multiplied by the enjoyment rating was computed for each activity and then the

product was summed for all alcohol-free activities and for all alcohol-free and all alcohol-involved activities combined (Murphy et al., 2006). The RRV of alcohol-free activities was computed using the following equation:

$$RRV = \frac{alcohol-free\ activities\ (frequency*enjoyment)}{alcohol-free\ (frequency*enjoyment) + alcohol-involved\ (frequency*enjoyment)}$$

Analytic Strategy

Ordinary least squares (OLS) regression in R version 4.1.2 (R Core Team, 2021) was used to assess the extent to which the number of alcohol-free activities and the RRV of alcohol-free activities 6 months after the completion of AUD treatment were associated with drinking and psychosocial well-being 12 months after treatment. All models controlled for treatment arm (outpatient or aftercare), treatment condition (TSF, CBT, or MET), and the baseline value of the outcome variable. MET did not have an explicit focus on alternative activities, whereas TSF and CBT did, MET served as the reference category. To control for multiple comparisons, we used the false discovery rate (FDR) correction (Benjamini & Hochberg, 1995) with an adjusted p-value criterion of $p < 0.00298$. This study was not preregistered. The authors do not have permission to provide access to restricted Project MATCH data, but have made their data cleaning and analytic code available as supplementary material.

Results

Table 2 presents descriptive statistics of the main dependent variables at baseline, 6-months and 12-months post-treatment and the independent variables at available time points of baseline and 6-months post-treatment. As shown in Table 2, alcohol-free activity engagement and the relative reinforcement value (RRV) of alcohol-free activities increased, on average, from baseline to 6-months post-treatment, and drinking and drinking-related consequences decreased across follow-up time-points. Functioning also improved across follow-up time-points.

Overall, results from the regression analyses, shown in Table 3, indicated that both the frequency of alcohol-free activities and their RRV were significantly associated with decreases in drinking and with increases in measures of functioning. For alcohol-free activity frequency, each additional alcohol-free activity reported at 6 months post-treatment was associated with drinking approximately one fewer drink per drinking day at 12 months post-treatment. Further, each additional alcohol-free activity reported at 6 months after treatment was associated with 7% fewer drinking days and 5% fewer heavy drinking days 12 months after completion of treatment.

With regard to functional outcomes, each alcohol-free activity was associated with nearly a 1-point decrease in BDI score and a nearly 2-point increase in PIL score. Each alcohol-free activity reported at 6 months post-treatment was associated with a 0.04 increase in PFI score. Betas showed that effects sizes of total number of alcohol-free activities on functional outcomes were approximately half as large as the effects on drinking outcomes (see Table 3).

For the RRV predictors, similar associations were found between RRV of alcohol-free activities and drinking and functional outcomes measured 12 months after completion of treatment. Participants with a higher RRV drank 7 fewer drinks per drinking day compared to those with a lower RRV. Having a higher alcohol-free RRV also was associated with a 46% reduction in drinking days and a 37% reduction in heavy drinking days. Betas for these analyses showed that the effects of RRV of alcohol-free activities was slightly stronger than those for total number of alcohol-free activities (see Table 3).

Finally, we investigated the nature of the relationship between alcohol-free RRV (which is scored continuously and represents the ratio of alcohol-free reinforcement to total reinforcement) and several functional outcomes. Having a higher alcohol-free RRV was associated with a 6-point lower BDI score and a 13-point increase in PIL score compared to having a lower alcohol-free RRV. Having a higher alcohol-free RRV 6 months after completion of treatment was associated with a 0.3 increase in PFI score compared to having a lower alcohol-free RRV 12 months following treatment completion.

Regarding covariate effects, significant differences were observed in each outcome between the aftercare and outpatient arms, which was expected given baseline differences among these groups (Project MATCH Research Group, 1997). We did not observe significant differences between the three treatment groups.

Discussion

Overall, the results supported the hypothesized relationships among alcohol-free activities, relative reinforcement value (RRV) of alcohol-free activities, and drinking and functional indicators of AUD treatment outcomes. Engagement in alcohol-free activities and their RRV based on the frequency and enjoyment of engagement predicted reduced drinking and better functional outcomes at 12-months after treatment completion among this large clinical sample. The study adds to evidence of the value of alcohol-free activities in promoting improvements in outcomes following AUD treatment.

Significant associations were observed between the total number of alcohol-free activities and recovery outcomes measured one year after the treatment completion. Number of alcohol-free activities had a slightly stronger impact on drinking-related outcomes compared to the three functional outcomes. However, when participants' frequency and enjoyment of alcohol-free activities were considered, the explanatory power of the model increased and effects on the outcomes under investigation were larger, with clinically significant effects on drinking-related outcomes. The impact of alcohol-free RRV on the functional outcomes was relatively weaker than effects for drinking outcomes, but stronger than what was observed in the relationships with total number of alcohol-free activities and functional outcomes. The weaker effects for functional outcomes are not particularly surprising given that alcohol-related activity engagement (or not) would be expected to be linked more closely to drinking outcomes than to depression, purpose in life, and psychosocial functioning outcomes.

These findings provide support for the behavioral economic proposition that shifting the proportion of total reinforcement received away from alcohol-involved to alcohol-

free activities is associated with beneficial drinking behavior change and improved life functioning. Although the results were positive for both activity frequency and alcohol-free RRV, they were relatively stronger for RRV, which aligns with behavioral economic emphasis on assessing shifts in strength of preference for drinking during recovery attempts within the context of total available reinforcement. Examining the RRV of alcohol-free activities over time allows researchers to put these behavioral allocation patterns into context and understand how value ascribed to alcohol-free activities relative to all possible activities can shape future behaviors related to drinking. Increasing the relative proportion of behavioral allocation to alcohol-free activities depends on their availability in the context of choice, which highlights environmental enrichment with alcohol-free alternative reinforcers as an intervention target, particularly in more impoverished natural environments.

Developers of interventions for substance use disorders have recognized the importance of engagement in substance-free activities, but with some notable exceptions (e.g., Daughters et al., 2008, 2018; Kristjansson et al., 2020; Murphy et al., 2016, 2021), many available AUD interventions consider engagement in alcohol-free activities as an ancillary, rather than a primary, intervention goal. The present research suggests that finding ways to encourage engagement in enjoyable, alcohol-free activities may improve treatment efficacy across a number of important AUD-related outcomes. Treatment should focus more on increasing rewarding activities that "bring a sense of meaning, purpose, and even excitement" (McKay, 2017, p. 753) to the life of the person in recovery, rather than focusing nearly exclusively on reducing or stopping alcohol use or asking individuals to forgo the social rewards often associated with drinking. Provision of these types of alternative reinforcers will enable individuals with AUD to make choices involving alcohol use and other activity engagement that comprise molar recovery behavior patterns over time. Moreover, such an expansion of intervention goals may make it easier for clinicians and treatment providers to obtain buy-in from individuals who are otherwise not convinced of the benefits of treatment (McKay, 2017). In the treatments studied in Project MATCH, there was some minimal discussion of alcohol-free activities. The TSF condition included discussion of going to Alcoholics Anonymous meetings and engaging in other interests in one treatment session. The CBT condition included an optional session on engaging in pleasant activities that might provide alternatives to alcohol use, but how many individuals received the optional session was not tracked in the dataset.

Limitations

This study has several limitations. First, the data used were collected over 30 years ago, and results may not generalize to contemporary samples. The participants in Project MATCH also were predominantly male, non-Hispanic and White, which further limits generalizability. Nevertheless, the treatment approaches evaluated in Project MATCH remain among the most commonly used ones today, and White males represent a larger proportion of treatment seeking individuals with AUD (Venegas et al., 2021), which is consistent with the considerably higher population prevalence of AUD among males than females (Tucker et al., 2020). Also, recent use of the Important People and Activities instrument has prioritized the Important People aspect of the instrument to analyze the impact of social network factors on alcohol use and recovery (Francis et al., 2022; Johnson et al., 2021; Soto-Nevarez et

al., 2022). As a result, very few datasets, and certainly none of the size and geographic diversity of Project MATCH, include data on individuals' engagement in alcohol-involved or alcohol-free activities.

Second, the present analysis was limited by only having one follow-up time point in which the Important People and Activities instrument was administered, namely, six months after treatment completion. As a result, the impact of dynamic changes in activity engagement on drinking and functional outcomes over time during and following treatment could not be examined. Future studies should include measures of activity engagement patterns and enjoyment administered at multiple follow-up time points to illuminate the role of alcohol-free activities on treatment outcomes over time. For example, repeated follow-up assessments in evaluations of the SFAS found that treatment effects were mediated by changes in proportional reinforcement from substance-related activities in the predicted direction (e.g., Murphy et al., 2019).

Third, since Project MATCH was conducted, scientific progress has been made with respect to measuring alternative reinforcement and relating different dimensions of alternative reinforcement to meaningful drinking-related measures (Acuff et al., 2019; Yurasek et al., 2021). For instance, there are other dimensions of reinforcement that may be influential in decisions to drink (e.g., reinforcer quality, magnitude, and delay) and were not assessed here (Acuff et al., 2019). Relying on frequency and enjoyment in the construction of reinforcement ratios also has limitations. For example, in one study, lack of enjoyment of an activity was associated with heavy episodic drinking, while frequency of engagement in an activity was unrelated to drinking (Magidson et al., 2017). Further, measures of frequency of engagement do not assess total duration of engagement in an activity in a given episode. The dependence of reinforcement ratios on enjoyment ratings means that these reinforcement measures cannot address the possibility of an activity being reinforcing with respect to controlling behavior without also being subjectively enjoyable (Acuff et al., 2019).

Finally, Project MATCH did not collect data on specific contextual and environmental characteristics that existed when participants were enrolled that might constrain the types and availability of alcohol-involved and alcohol-free activities. Although the present study illuminated relationships between engagement in alcohol-free activities and their reinforcement value in predicting drinking behaviors, future research should take into account how such contextual factors may affect these relationships and potentially exacerbate AUD disparities by restricted access to reinforcing alcohol-free activities.

Future Directions and Conclusions

Future research in this area should incorporate alcohol-free activities into a socio-ecological framework to understand how environments shape access to and engagement with alcohol-free activities and promote or constrain individuals' access to alcohol-free alternatives to drinking. Addressing this issue at the community level through environmental enrichment could extend the benefits of engagement in alcohol-free reinforcement to the majority population segment of individuals with alcohol and substance use disorders who do not seek treatment (Andrabi et al., 2017; Murphy & Dennhardt, 2016). Developing community infrastructure for substance-free activities (such as community centers, free or subsidized

gyms, or educational opportunities) may increase access to health promotive resources for the 90% of individuals with AUD who do not receive treatment in a given year and facilitate such activity engagement among those who have sought treatment.

Evidence for the value of the approach for prevention also is emerging. One approach that incorporates an understanding of the significance of substance-free activity in delaying and limiting substance use is the Icelandic Prevention Model (IPM). This model adopts a socioecological model for delaying substance use among adolescents. Orienting assumptions of the IPM are that behaviors, especially substance use behaviors, are driven by (1) a lack of sanctions in the social environment against substance use, (2) low individual and/or community investment in traditional and positive values, and (3) lack of opportunities for participation in positive and prosocial development (Koning et al., 2021; Kristjansson et al., 2020). Evidence has shown that this community integration of substance-free activities is effective at delaying the onset and reducing the prevalence of substance use among adolescents (Kristjansson et al., 2020; C.C.A. Meyers et al., 2023). Thus, the behavioral economic emphasis on promoting access to alternative alcohol-free rewards and enriching the environment is useful at multiple levels of the socio-ecological model of health and behavior change spanning natural recovery, clinical treatment, and prevention programming (Rachlin et al., 2018; Tucker et al., 2023; Vuchinich et al., 2023). Future research on the role of alcohol-free activities across populations of individuals with AUD and levels of analysis spanning individual to community to policy interventions is recommended.

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Public Health Significance:

Using a large clinical sample of persons with Alcohol Use Disorder (AUD), this secondary data analysis found that post-treatment engagement in alcohol-free activities and the relative reinforcement value of those activities compared to all activities combined predicted reductions in drinking and positive changes in functional outcomes. Developing community infrastructure for substance-free activities may increase access to health promotive resources for persons with AUD, including the 90% of individuals with AUD who do not receive treatment.

Table 1

Demographic Characteristics of Project MATCH Sample at Baseline

	N (%)
Study Arm	
Outpatient	714 (55.8%)
Aftercare	565 (44.2%)
Treatment Assignment	
Cognitive Behavioral Therapy	429 (33.5%)
Motivational Enhancement Therapy	427 (33.4%)
Twelve Step Facilitation	423 (33.1%)
Sex	
Male	969 (75.8%)
Female	310 (24.2%)
Race/Ethnicity	
American Indian/ Alaska Native	19 (1.5%)
Asian American/ Pacific Islander	1 (0.1%)
Black/African American	122 (9.5%)
Hispanic	98 (7.7%)
Non-Hispanic White	1036 (81.0%)
Other	3 (0.2%)
Unemployed	315 (25.5%)
	Mean (SD)
Age	40.3 (11.0)
Education (years)	13.3 (2.1)

Table 2

Descriptive Statistics of Alcohol-Free Activities and Relative Reinforcement Value

	Baseline		6-month post-treatment follow-up		12-month post-treatment follow-up	
Predictors	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
# Alcohol-Free Activities	2.057	1.615	3.587	1.846	-	-
# Alcohol-Involved Activities	2.696	1.512	1.044	1.403	-	-
Alcohol-Free Relative Reinforcement Value	0.447	0.340	0.781	0.317	-	-
Outcomes	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Drinks per Drinking Day	14.249	9.789	4.481	6.270	4.382	6.328
Percent Days Drinking	69.097	29.962	23.659	32.889	24.711	34.419
Percent Heavy Drinking Days	61.033	32.068	16.019	28.047	16.011	28.721
Beck Depression Inventory	10.166	8.244	7.778	7.964	7.938	8.403
Purpose in Life Score	94.044	18.946	102.543	19.191	102.344	19.457
Psychosocial Functioning Inventory	3.120	0.564	3.382	0.481	3.391	0.490

Note. The Important People and Activities instrument was only administered at baseline and the 6-month follow-up.

Table 3

Effects of Total Number and Relative Reinforcement Value of Alcohol-Free Activities at 6-Months Post-Treatment in Predicting Drinking and Functioning Outcomes at 12-Months Post-Treatment

12-Month Post-Treatment Outcomes	Total # of Alcohol-Free Activities at 6-Months						RRV of Alcohol-Free Activities at 6-Months					
	B	SE	B 95% CI	Beta	p	R^2	B	SE	B 95% CI	Beta	p	R^2
DDD	−1.000	0.083	[−1.16, −0.84]	−0.317	<0.001	0.136	−6.882	0.480	[−7.78, −5.89]	−0.366	<0.001	0.169
PDD	−7.241	0.478	[−8.10, −6.31]	−0.392	<0.001	0.225	−46.693	2.667	[−51.42, −40.95]	−0.427	<0.001	0.251
PHDD	−5.542	0.398	[−6.32, −4.75]	−0.358	<0.001	0.162	−37.342	2.309	[−41.72, −32.66]	−0.408	<0.001	0.199
Beck Depression Inventory	−0.830	0.111	[−1.06, −0.62]	−0.186	<0.001	0.217	−6.362	0.646	[−7.73, −5.19]	−0.241	<0.001	0.241
Purpose in Life score	1.797	0.007	[1.34, 2.28]	0.174	<0.001	0.328	13.328	0.039	[10.79, 16.25]	0.217	<0.001	0.346
Psychosocial Functioning Inventory	0.039	0.239	[0.03, 0.05]	0.148	<0.001	0.186	0.309	1.393	[0.24, 0.39]	0.199	<0.001	0.204

Note. DDD = Drinks per drinking day; PDD = Percent drinking days; PHDD = Percent Heavy Drinking Days. All *p*-values reported here met the Benjamini-Hochsberg p-value criterion for significance based on the unstandardized regression coefficient. All models controlled for treatment arm (outpatient or aftercare), treatment condition (CBT, MET, or TSF), and the baseline value of the outcome variable.