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How Much Is Too Much? Patterns of Drinking During Alcohol Treatment and Associations With Post-Treatment Outcomes Across Three Alcohol Clinical Trials

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ABSTRACT. Objective: This secondary data analysis examined patterns of drinking during alcohol treatment and associated drinking outcomes during the first year following treatment. The goal was to provide clinicians with guidance on which patients may be most at risk for negative long-term outcomes based on drinking patterns during treatment. **Method:** This study was an analysis of existing data (*N* = 3,851) from three randomized clinical trials for alcohol use disorder: the COMBINE Study (*n* = 1,383), Project MATCH (*n* = 1,726), and the United Kingdom Alcohol Treatment Trial (*n* = 742). Indicators of abstinence, non-heavy drinking, and heavy drinking (defined as 4/5 or more drinks per day for women/men) were examined during each week of treatment using repeated-measures latent class analysis. Associations between drinking patterns during treatment and drinking intensity, drinking consequences, and physical and mental health 12 months following intake were examined. **Results:** Seven drinking patterns were identified. Patients who engaged in persistent heavy drinking throughout treatment and those who returned to persistent heavy drinking during treatment had the worst long-term outcomes. Patients who engaged in some heavy drinking during treatment had better long-term outcomes than persistent heavy drinkers. Patients who reported low-risk drinking or abstinence had the best long-term outcomes. There were no differences in outcomes between low-risk drinkers and abstainers. **Conclusions:** Abstinence, low-risk drinking, or even some heavy drinking during treatment are associated with the best long-term outcomes. Patients who are engaging in persistent heavy drinking are likely to have the worst outcomes and may require a higher level of care. (*J. Stud. Alcohol Drugs, 78,* 000–000, 2017)

ALCOHOL USE DISORDER (AUD) is a significant public health problem that affects millions of individuals worldwide (World Health Organization, 2014). Treatment for AUD has traditionally focused on abstinence from alcohol as the most acceptable outcome. Yet, pioneering work in the latter half of the 20th century examined “resumed normal drinking” (Davies, 1962), “controlled drinking” (Sobell & Sobell, 1976, 1978; Vaillant et al., 1983), “non-problem drinking” (Polich et al., 1980), and “social drinking” (Nordström & Berglund, 1987; Öjehagen et al., 1994) outcomes among individuals in alcohol treatment programs. Early research also considered a variety of drinking goals (Pattison, 1976), including social drinking goals, as potential outcomes (Öjehagen & Berglund, 1989). However, small sample sizes in these studies, political distaste for non-abstinence outcomes, and the growing popularity of Alcoholics Anonymous led to a “controlled drinking controversy” in the 1980s and early 1990s (Edwards, 1994; Heather & Robertson, 1981; Roizen, 1987), with skepticism among treatment providers regarding non-abstinence drinking goals. A response to the controlled drinking debate and several commentaries (Sobell & Sobell, 1995) highlighted the disagreement within the field among both treatment researchers and providers, as well as the need for a broadening of perspectives and more data to inform the treatment community regarding the viability of non-abstinence treatment goals.

More recently in the United States and Europe, “low-risk drinking” has been considered by researchers, clinicians, and regulatory agencies as an alternative indicator of treatment success (Davis & Rosenberg, 2013; Food and Drug Administration [FDA], 2015; Kline-Simon et al., 2013; Maremmani et al., 2015; Witkiewitz, 2013). The definitions of low-risk drinking vary (Pearson et al., 2016); however, both the FDA (2015) and the National Institute on Alcohol Abuse and Alcoholism (NIAAA, 2005) define low-risk drinking as no more than four standard

drinks per occasion for women and no more than five standard drinks per occasion for men. Thus, *heavy drinking* is defined as four or more drinks per occasion for women and five or more drinks per occasion for men.

Recent studies suggest that no heavy drinking days (e.g., never exceeding the 4/5 threshold on a given day) could be used as an indicator of treatment success (Falk et al., 2010). Yet, no studies have quantified the patterns of heavy drinking, low-risk drinking, and abstinence among a large sample of AUD patients during treatment and modeled how these patterns predict posttreatment outcomes. As a result, there is currently very little guidance to help clinicians understand which non-abstinence patterns of drinking may be associated with successful treatment outcomes and which patterns of drinking may indicate a need for a higher level of care.

The aim of the current study was to evaluate whether discrete patterns of drinking emerged across weeks during AUD treatment in a large sample of AUD patients (N = 3,851) and whether specific drinking patterns predicted posttreatment outcomes. The goal of this inquiry was to provide guidance to clinicians regarding the patterns of drinking during treatment that may be prognostic of positive long-term outcomes, as compared with patterns of drinking that may confer poorer long-term outcomes.

Method

The data for this study were drawn from three randomized clinical trials for AUD (N = 3,851). Inclusion/exclusion criteria and participant demographics are provided in Table 1.

[COMP: Table 1 about here]

Participants

COMBINE Study. The Combined Pharmacotherapies and Behavioral Interventions for Alcohol Dependence (COMBINE) Study (COMBINE Study Research Group, 2003), conducted

between 2001 and 2004, randomized participants (*n* = 1,383) from 11 research sites across the United States into 9 treatment groups consisting of medical management or combined behavioral intervention and medications (acamprosate, naltrexone, or placebo). Treatment occurred over 16 weeks, and follow-up assessments were conducted at 4, 6.5, 13, and 17 months following intake to treatment.

Project MATCH. Project MATCH (Matching Alcoholism Treatments to Client Heterogeneity; Project MATCH Research Group, 1997), conducted between 1991 and 1993, randomized outpatients (*n* = 952) and aftercare patients (*n* = 774) from 9 research sites across the United States into three treatment groups: Cognitive Behavioral Therapy, Motivational Enhancement Therapy, or Twelve-Step Facilitation. Treatment occurred over 12 weeks and follow-up assessments were conducted at 3, 6, 9, 12, and 15 months following intake to treatment.

United Kingdom Alcohol Treatment Trial. The United Kingdom Alcohol Treatment Trial (UKATT; UKATT Research Team, 2005), conducted between 1998 and 2001, recruited participants (*n* = 742) across seven sites in the United Kingdom. Patients were randomized into Motivation Enhancement Therapy or Social Behavior and Network Therapy. Treatment occurred over 12 weeks, and follow-ups were conducted at 3 and 12 months following intake to treatment.

Measures

Weekly alcohol consumption during treatment was assessed by the Form 90 (Miller, 1996). We created three indicators of weekly drinking during treatment: abstinent (no drinking during a given week), low-risk drinking (1 or more days with less than 4/5 drinks and no heavy drinking days during a given week), and heavy drinking (at least 1 day with 4/5 or more drinks during a given week).

To measure long-term outcomes, we used data collected from the 13-month (COMBINE) and 12-month (Project MATCH and UKATT) postbaseline assessment (which corresponded to 9 months posttreatment in all three studies). We computed drinks per drinking day during the past 30 days as an aggregate measure of alcohol consumption at the 12-month postbaseline assessment. In addition, consistent with recent calls to examine non–consumption outcomes in addiction treatment research (Donovan et al., 2012; Tiffany et al., 2012), we examined drinking consequences, physical health outcomes, and mental health outcomes at the 12-month postbaseline assessment. Drinking consequences were assessed via the Drinker Inventory of Consequences (DrInC; Miller et al., 1995) in COMBINE and Project MATCH, and the Alcohol Problems Questionnaire (APQ; Williams & Drummond, 1994) in UKATT. Ten drinking consequence items were identified as having matching item content on the DrInC and APQ and were used in the current study as a combined measure of drinking consequences. The Short Form (SF) Health Survey 12-item (SF-12; Ware et al., 1996) and 36-item (SF-36; Ware & Gandek, 1998) measures were used to assess physical and mental health in COMBINE and UKATT, respectively. The SF was not administered in Project MATCH, and thus the SF measure was missing for Project MATCH participants. The SF-12 and SF-36 were scaled using *T* scores with a normative mean of 50 and a standard deviation of 10. Internal consistency reliabilities of all measures exceeded $\alpha = .80$ at all assessment time points.

Statistical analyses

The current study examined discrete patterns of drinking across weeks during treatment. To identify discrete drinking patterns, we used a person-centered statistical approach (Muthén & Muthén, 2000)—repeated-measures latent class analysis (RMLCA) (Lanza & Collins, 2006; McCarthy et al., 2015)—that could accommodate weekly indicators of drinking across multiple

weeks of treatment. RMLCA is a latent class model in which the indicators of the latent class are repeated measures. All models, described below, were estimated within each study and in the total sample ("pooled sample"), which combined all three studies for greater sample representation and a larger sample size.

Latent class modeling uses categorical latent variables, which are unobserved variables assumed to represent a mixture of subpopulations (Hagenaars & McCutcheon, 2002). In the current study, the classes of the categorical latent variable were defined by individuals' patterns of responses to each weekly drinking indicator (i.e., abstinent, low-risk, and heavy drinking), and individuals with similar patterns were considered part of the same subpopulation (i.e., latent class). One of the strengths of RMLCA is that it does not impose time in the model; in other words, RMLCA does not impose fixed forms for how change should happen over time. Other person-centered statistical approaches that have previously been used to examine alcohol use trajectories (Chen et al., 2012; Gueorguieva et al., 2010; Witkiewitz et al., 2010) were not used for the current study because we were interested in discrete patterns and did not want to impose functional forms of time (e.g., assuming change over time follows a linear, quadratic, or cubic form).

Two parameters of the RMLCA are of great interest: (a) latent class proportions indicate how many people are expected to be in each class; and (b) response probabilities are the probabilities of endorsing a weekly drinking indicator, given a particular latent class membership. Probabilities closer to 1.0 indicate a strong correspondence between latent class membership and endorsement of the item (Collins & Lanza, 2009). The number of classes was determined by multiple indices of model fit, classification precision, size of the final class sizes based on latent class proportions, and interpretability of the final latent class solutions. As

measures of model fit, the Bayesian Information Criterion (BIC) and sample-size–adjusted BIC (aBIC) were examined, where lower BIC and aBIC indicates a better fitting model (Schwarz, 1978). Classification precision (defined by relative entropy) was used to evaluate how well the final latent class solution classified individuals into latent classes. Relative entropy ranges from 0 to 1, with values closer to 1 indicating greater classification precision and values of entropy greater than .80 considered good classification precision (Nylund et al., 2007).

Class proportions within each class were also examined, and latent class solutions with less than 5% of the sample represented by any one class were considered too sparse and rejected (Nagin, 2005). Finally, we examined the interpretability of latent classes and the consistency of latent class solutions across studies and in the pooled samples (Nylund et al., 2007). Once the final class solution for the RMLCA was selected, we used distal outcome analysis via a modified approach (Asparouhov & Muthén, 2014)—originally described by Bolck and colleagues (2004)—to examine class differences in weekly low-risk and heavy drinking days, as well as long-term outcomes at 12 months postbaseline. The distal outcome analysis provides differences in mean outcomes across classes using a Wald chi-square test.

All models were estimated using Mplus Version 7.3 (Muthén & Muthén, 2012). Because of the complex sampling design in each of the studies (i.e., participants recruited from multiple sites), all parameters were estimated using a weighted maximum likelihood function and all standard errors were computed using a sandwich estimator. The robust maximum likelihood estimator provides the estimated variance–covariance matrix for the available data and, therefore, all available data were included in the models. Maximum likelihood is a preferred method for estimation when some data are missing and is unbiased if data are missing at random (Witkiewitz et al., 2014).

Results

Repeated-measures latent class models with 2–15 classes were estimated within each study and in the pooled sample. The model log-likelihood, BIC, aBIC, and entropy for each model are provided in Table 2. Model entropy was excellent, exceeding .90, for all studies and the pooled sample. The BIC identified the seven-class model as fitting the best in both Project MATCH and UKATT, and more than seven classes resulted in latent class proportions less than 5% across all studies. An inspection of the interpretability of the resulting class solutions suggested a seven-class model was interpretable with respect to distinct patterns of drinking that were clinically meaningful across all three studies and in the pooled sample. The seven-class models had similar response probabilities for each of the studies and in the pooled sample.

[COMP: Table 2 about here]

Latent class descriptions

The class proportions and response probabilities for endorsing each level of drinking (abstinence, low-risk drinking, heavy drinking) by week of treatment in the seven-class model for the pooled sample are shown in Figure 1. Classes 1 and 2 were the heaviest drinking classes, with Class 1 (19.3% of the pooled sample) characterized by a high probability of heavy drinking throughout the entire treatment period and Class 2 (9.0% of the pooled sample) characterized by a high probability of abstinence initially, an increasing probability of heavy drinking during treatment, and a high probability of heavy drinking by the end of treatment. Classes 3 and 4 were characterized by a mix of heavy drinking and either low-risk drinking (Class 3) or abstinence (Class 4). Specifically, Class 3 (6.3% of the pooled sample) was characterized by a moderate probability of both heavy drinking days and low-risk drinking days throughout the entire treatment period. Class 4 (7.8% of the pooled sample) was characterized by a high probability of

heavy drinking initially, an increasing probability of abstinence during treatment, and a high probability of abstinence by the end of treatment. Classes 5, 6, and 7 were low-risk drinking or abstainer classes. Class 5 (6.8% of the pooled sample) was characterized by a high probability of low-risk drinking throughout the entire treatment period. Class 6 (10% of the pooled sample) was characterized by a high probability of abstinence initially and an increasing probability of low-risk drinking during treatment. Class 7 (40.8% of the pooled sample) was characterized by a high probability of abstinence during the entire treatment period.

[COMP: Figure 1 about here]

Daily drinking patterns by latent class membership

Figure 2 provides the average number of heavy drinking days and low-risk drinking days within each week of treatment by expected latent class membership based on the distal outcome analysis. Those most likely classified in Class 1 engaged in heavy drinking approximately 4 days per week and had nearly 0 low-risk drinking days. Participants most likely classified in Class 2 increased their heavy drinking from nearly 0 days per week to almost 3 days per week and had nearly 0 low-risk drinking days. Participants most likely classified in Class 3 engaged in heavy drinking up to 1.5 days per week and low-risk drinking approximately 2 days per week, on average. Participants most likely classified in Class 4 engaged in heavy drinking approximately 3 days initially but decreased to abstinence (nearly 0 heavy drinking days and 0 low-risk drinking days per week) by the end of treatment. Participants most likely classified in Classes 5, 6, and 7 had almost no heavy drinking days each week throughout treatment. Participants most likely classified in Class 5 engaged in approximately 3 low-risk drinking days per week, and Class 6 was characterized by engagement in approximately 1 low-risk drinking day per week, on

average, throughout the treatment period. Class 7 was characterized by abstinence, with no heavy drinking days and no low-risk drinking days.

[COMP: Figure 2 about here]

Association with posttreatment outcomes

Last, we examined whether the seven latent classes differed with respect to average drinks per drinking day, drinking consequences, physical health, and mental health at the 12-month follow-up assessment. Distal outcome analysis indicated significant differences between patterns of drinking during treatment for each of the outcomes (Table 3). Classes 1 and 2 had significantly higher drinking consequences and significantly worse mental health (i.e., lower scores on SF-12/SF-36) than all other classes (all $p < .05$). Classes 1 and 2 also had significantly more drinks per drinking day and significantly worse physical health than Classes 3, 5, 6, and 7 (all ps $< .05$). Classes 3 and 4 did not significantly differ from each other on any of the outcomes, reported significantly fewer drinking consequences and better mental health compared with the heavier drinking classes (Classes 1 and 2), but had significantly more consequences, higher drinks per drinking day, and worse mental health than the low-risk drinking or abstaining classes (Classes 5, 6, and 7) at the 12-month follow-up.

[COMP: Table 3 about here]

Class 3 had significantly better physical health than Classes 1 and 2 but was not significantly different from the other classes on physical health. Class 4 was not significantly different on physical health as compared with Classes 1, 2, 3, or 7 but was significantly lower on physical health as compared with the low-risk drinking classes (Classes 5 and 6). Classes 5, 6, and 7 did not significantly differ from one another on drinking consequences, physical health, or mental health. Classes 5, 6, and 7 also had significantly lower drinking consequences and

significantly better mental health than all other classes and significantly lower drinks per drinking day than most other classes.

Discussion

Using data from three alcohol clinical trial data sets, the current study identified seven discrete patterns of drinking over the course of the first 12 weeks of treatment, and these drinking classes were significantly associated with outcomes at 12 months following intake to treatment. Individuals who engaged in persistent heavy drinking throughout treatment (Class 1) and those who returned to persistent heavy drinking toward the end of treatment (Class 2) had the worst long-term outcomes in terms of drinking, drinking consequences, and self-reported physical and mental health. Individuals who engaged in some heavy drinking (Classes 3 and 4) had significantly fewer drinking consequences and better mental health than persistent heavy drinkers (Classes 1 and 2) but had significantly more drinking consequences and worse mental health outcomes than individuals who primarily engaged in low-risk drinking or abstinence (Classes 5, 6, and 7). Individuals with patterns of abstinence or low-risk drinking consistently had the best long-term outcomes. The results from this study, in a large sample of patients, are well aligned with prior smaller sample studies that have found evidence of drinking patterns during treatment being associated with long-term outcomes up to several years following treatment (Finney & Moos, 1992; Öjehagen et al., 1994; Pettinati et al., 1982; Vaillant, 2003).

The current findings also provide some guidance for ongoing monitoring of drinking intensity during treatment for AUD. First, our findings suggest that persistent engagement in heavy drinking over time during treatment is predictive of the poorest long-term outcomes. Second, our findings indicate that individuals who engage in some non-persistent heavy drinking throughout treatment are likely to have significantly better outcomes compared with persistent

heavy drinkers. Last, our findings suggest that individuals who maintain low-risk drinking or abstinence throughout treatment are likely to have the best long-term outcomes. There were no significant differences between abstainers and low-risk drinkers on drinking-related consequences, mental health outcomes, or physical health outcomes, which is consistent with other recent studies (Aldridge et al., 2016; Kline-Simon et al., 2013; Witkiewitz, 2013).

Implications for treatment planning

Consulting with patients about treatment goals at the beginning of treatment and continuing to monitor treatment goals throughout treatment is a critical component of treatment planning (Raistrick et al., 2006), with many individuals changing treatment goals throughout treatment (Hodgins et al., 1997; Öjehagen & Berglund, 1989). The length of treatment and treatment setting may also be considered when evaluating treatment goals. For example, brief interventions or treatment of AUD in health care settings might be more accommodating of non-abstinence goals (Sobell & Sobell, 2006). Importantly, the current study did not examine baseline predictors of drinking patterns, which could help inform the selection of drinking goals

The drinking goals for COMBINE and Project MATCH were abstinence focused, and individuals in COMBINE and Project MATCH met the criteria for alcohol dependence. In UKATT, therapists negotiated a drinking goal with each patient, and individuals were not required to meet criteria for dependence; however, the severity of dependence in UKATT was considerably higher, on average, than in COMBINE and Project MATCH (Witkiewitz et al., 2016). Prior research has found that individuals who are higher in severity of dependence may be more likely to select and be successful with abstinence goals (Adamson et al., 2010; Öjehagen & Berglund, 1989; Sobell & Sobell, 1995). Psychiatric and other drug comorbidity, which is very common in AUD (Grant et al., 2015), may also be important in the selection of treatment goals,

with abstinence goals commonly recommended for individuals with psychiatric and drug comorbidity (Berglund et al., 2016). However, it is also important to note that research has found that individuals with psychiatric and other drug comorbidity are not less likely to achieve moderate drinking (Kuerbis et al., 2012).

Regardless of the initial treatment goal, providers may want to discuss the benefits of reducing heavy drinking during treatment and offer information on the downsides of persisting in heavy drinking beyond the first month of treatment. Linking this information to consequences of drinking that are central to the patient's treatment goals may make this information more salient for a patient. Providing feedback after a drinking episode may be particularly important to reduce the rule violation effect (Witkiewitz & Marlatt, 2004). Based on the current study, providers could inform patients that one heavy drinking episode itself is not predictive of long-term failure and that returning to abstinence or low-risk drinking following heavy drinking is predictive of better long-term outcomes. Moreover, it is also important to consider increasing the intensity or duration of treatment and expanding treatment options (e.g., pharmacotherapy) if heavy drinking is persistent.

Limitations

Numerous limitations of the current study need to be acknowledged. First, we were limited to the available data in the existing clinical trial data sets. For example, the measure of drinking consequences varied across studies, requiring the creation of a brief 10-item measure of drinking consequences that incorporated items from within each study. The resulting measure of drinking consequences had excellent psychometric properties, but it is not an established measure of drinking consequences. An additional limitation was the lack of the SF Health Survey measure in the Project MATCH study. Likewise, all three studies were limited with

respect to treatment length (3 months in Project MATCH and UKATT; 4 months in COMBINE) and mostly focused on patients with alcohol dependence; thus, the current results do not extend to the broader continuum of AUD severity.

A major limitation of the analytic approach is that latent class models are probabilistic and therefore always have some degree of misclassification. A related concern is the decision to select the seven-class solution versus alternative class solutions. We decided on the seven classes based on class sizes, interpretability, and consistency of the seven-class solution across data sets. Inspection of all class solutions suggested that models with more than seven classes seemed to identify patterns that were similar to those obtained from the seven-class solution and tended to produce small class sizes.

Finally, the study was limited by relying on the definitions of heavy drinking days and low-risk drinking used by the FDA (2015) and NIAAA (2005), and we did not include weekly frequency of consumption as indicators in our models. Most guidance regarding alcohol consumption is based on both daily and weekly limits. Thus, future research might consider including weekly consumption when examining patterns of drinking during treatment. The low-risk drinking classes did not exceed 3 low-risk drinking days per week, thus within the 7+/14+ weekly limits for low-risk drinking set by NIAAA (2005). Importantly, there is very little empirical research to validate 4/5 drinks per day or 7/14 drinks per week as ideal cutoffs (Pearson et al., 2016), and there is evidence that some heavy drinking might not be significantly worse than low-risk drinking with respect to subsequent outcomes following AUD treatment (Aldridge et al., 2016). More research is needed to quantify alternative outcome definitions that consider both intensity and frequency of drinking, and those outcome definitions that are based on harm-reduction goals (Aubin et al., 2015; Maremmani et al., 2015).

Future directions and conclusions

The focus on abstinence has dominated the AUD research and treatment communities for more than 100 years (Kraepelin, 1904). Yet, the desirability of low-risk drinking goals has been accepted for some time in various countries (Coldwell & Heather, 2006)—including Australia (Donovan & Heather, 1997), the United Kingdom (Robertson & Heather, 1982; Rosenberg et al., 1992), Sweden (Nilsen et al., 2011), and Norway (Duckert, 1989)—and there is growing recognition of this option in other parts of Europe and the United States (Davis & Rosenberg, 2013; FDA, 2015; Maremmani et al., 2015). Future research should consider the development of guidelines for monitoring progress in treatment when initial treatment goals are not focused on abstinence (Raistrick et al., 2006). The current study found that patients who report abstinence or low-risk drinking throughout treatment are likely to have similar outcomes, with respect to drinking consequences, mental health, and physical health outcomes, up to 12 months following intake to treatment. Patients who continue to engage in persistent heavy drinking throughout treatment or who return to persistent heavy drinking by the end of treatment have the worst outcomes. Monitoring low-risk and heavy drinking throughout treatment could supply important prognostic information, provide guidance for when treatment intensity or duration should be increased to help reduce heavy drinking, and ultimately improve long-term outcomes following AUD treatment.

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TABLE 1. Demographic characteristics, exclusion criteria, and drinking outcomes for COMBINE, Project MATCH, UKATT, and pooled sample

Variable	COMBINE	Project MATCH	UKATT	Pooled sample
Demographic characteristic				
Sample size	1,383	1,726	742	3,851
Gender, % male	69.1%	75.7%	74.1%	73.0%
Age, *M* (*SD*)	44.4 (10.2)	40.2 (10.9)	41.6 (10.1)	42.0 (10.7)
Ethnicity, % White	76.8%	80.0%	95.6%	81.8%
Marital status, % married/ cohabitating	46.3%	41.4%	54.1%	41.7%
Inclusion/exclusion criteria				
Inclusion				
Age	≥18	≥18	≥16	
Meet criteria for abuse/ dependence[a]	Past year[a]	Past year[a]	N/A[a]	
Reading level	Literate	6th grade	Literate	
Exclusion				
Comorbid psychiatric diagnoses	X	X	X	
Unable to identify collateral informant		X	X	
Severe cognitive impairment		X	X	
Residential instability		X	X	
Other illicit drug dependence	X	X		
Outcomes (12 months after treatment intake)				
Drinks per drinking day, *M* (*SD*), range: 0–50	4.8 (5.5)	4.3 (6.4)	7.8 (7.7)	5.1 (6.5)
Drinking consequences, *M* (*SD*), range: 0–10	2.30 (2.45)	2.67 (2.39)	2.75 (2.53)	2.69 (2.57)
SF Physical Health, *M* (*SD*), range: 11–67	51.85 (8.58)		47.48 (10.0)	50.25 (9.4)
SF Mental Health, *M* (*SD*), range: 0–76	47.96 (10.4)		39.17 (14.1)	44.75 (12.6)

Notes: Drinking consequences range from 0 to 10, with each additional consequence experienced indicating more drinking consequences. SF Physical and Mental Health are standardized to nationally representative sample with *M* = 50 and *SD* = 10 in representative sample. COMBINE = The Combined Pharmacotherapies and Behavioral Interventions for Alcohol Dependence Study; Project MATCH = Matching Alcoholism Treatments to Client Heterogeneity; UKATT = United Kingdom Alcohol Treatment Trial; SF = Short Form Health Survey; N/A = not applicable. [a]Participants in COMBINE and Project MATCH were required to meet the criteria for alcohol dependence, whereas participants in UKATT were not required to meet the criteria for dependence. Yet, participants in UKATT reported higher levels of alcohol dependence severity than participants in COMBINE and Project MATCH (Witkiewitz et al., 2016).

TABLE 2. Model fit statistics for repeated-measures latent class analysis (RMLCA) by study and for the pooled sample

	COMBINE				Project MATCH				UKATT				Pooled sampl	
Class	LL	BIC	aBIC	Ent.	LL	BIC	aBIC	Ent.	LL	BIC	aBIC	Ent.	LL	E
2	-16,223.4	32,917	32,710	.94	-11,451.7	23,267	23,111	.96	-5,038.1	10,395	10,240	.97	-29,981.1	6
3	-14,330.2	29,369	29,057	.95	-10,224.1	20,997	20,762	.97	-4,088.5	8,659	8,424	.98	-26,059.3	5
4	-13,716.6	28,380	27,964	.92	-9,703.5	20,141	19,826	.93	-3,803.7	8,252	7,937	.98	-24,827.5	5
5	-13,416.6	28,018	27,497	.92	-9,461.0	19,841	19,447	.92	-3,644.5	8,096	7,702	.98	-24,222.0	4
6	-13,147.8	27,719	27,093	.92	-9,252.6	19,610	19,136	.92	-3,543.9	8,058	7,585	.98	-23,678.0	4
7	**-12,913.0**	**27,488**	**26,757**	**.92**	**-9,112.4**	**19,515**	**18,962**	**.92**	**-3,459.5**	**8,052**	**7,499**	**.97**	**-23,312.3**	**4**
8	-12,763.8	27,428	26,593	.90	-9,030.7	19,537	18,904	.92	-3,378.5	8,052	7,421	.97	-23,077.1	4
9	-12,637.0	27,413	26,473	.91	-8,954.3	19,569	18,857	.93	-3,323.9	8,106	7,395	.98	-22,936.9	4
10	-12,527.6	27,433	26,388	.92	-8,886.8	19,619	18,828	.93	-3,273.0	8,167	7,376	.98	-22,809.9	4
11	-12,441.1	27,498	26,348	.92	-8,835.7	19,703	18,832	.93	-3,239.8	8,263	7,393	.98	-22,681.8	4
12	-12,368.8	27,592	26,337	.91	-8,785.8	19,788	18,838	.93	-3,203.2	8,353	7,404	.98	-22,594.8	4
13	-12,307.3	27,707	26,348	.91	-8,748.1	19,898	18,869	.93	-3,178.2	8,466	7,437	.98	-22,511.0	4
14	-12,255.1	27,841	26,377	.91	-8,715.5	20,018	18,910	.92	-3,152.0	8,576	7,468	.97	-22,432.5	4
15	-12,208.5	27,987	26,418	.91	-8,682.6	20,138	18,950	.92	-3,106.6	8,648	7,460	.98	-22,361.2	4

Notes: COMBINE = The Combined Pharmacotherapies and Behavioral Interventions for Alcohol Dependence Study; Project MATCH = Matching Alcoholism Treatments to Client Heterogeneity; UKATT = United Kingdom Alcohol Treatment Trial; class = number of classes estimated in the RMLCA; LL = log-likelihood; BIC = Bayesian Information Criterion; aBIC = sample-size–adjusted Bayesian Information Criterion; ent. = relative entropy.

TABLE 3. Distal outcome analysis of drinking outcomes at 12 months after treatment intake by latent classes for the pooled sample, *M* (*SE*)

Variable	Drinks per drinking day, *M* (*SE*)	Drinking consequences, *M* (*SE*)	SF Physical health, *M* (*SE*)	SF Mental health, *M* (*SE*)
Class 1 (19.3%; high probability of heavy drinking)	8.47 (0.39)[3,4,5,6,7]	3.43 (0.11)[3,4,5,6,7]	48.23 (0.88)[3,5,6,7]	39.66 (1.19)[3,4,5,6,7]
Class 2 (9%; increasing probability of heavy drinking)	8.04 (049)[3,5,6,7]	3.82 (0.24)[3,4,5,6,7]	47.30 (0.99)[3,5,6,7]	40.56 (1.43)[3,4,5,6,7]
Class 3 (6.3%; heavy drinking and low-risk drinking)	5.40 (0.44)[1,2,5,6,7]	2.84 (0.21)[1,2,5,6,7]	50.75 (0.96)[1,2]	44.47 (1.09)[1,2,5,6,7]
Class 4 (7.8%; increasing probability of abstinence)	6.31 (0.72)[1,5,6,7]	3.03 (0.19)[1,2,5,6,7]	49.80 (1.05)[5,6]	43.56 (1.53)[1,2,5,6,7]
Class 5 (6.8%; high probability of low-risk drinking)	3.97 (0.31)[1,2,3,7]	1.76 (0.13)[1,2,3,4]	51.54 (0.99)[1,2,4]	48.47 (1.05)[1,2,3,4]
Class 6 (10%; medium probability low-risk drinking)	4.27 (0.25)[1,2,3,4,7]	1.81 (0.11)[1,2,3,4]	52.55 (0.70)[1,2,4]	48.84 (0.58)[1,2,3,4]
Class 7 (40.8%; high probability of abstinence)	2.95 (0.21)[1,2,3,4,5,6]	1.85 (0.23)[1,2,3,4]	51.45 (0.48)[1,2]	48.06 (0.88)[1,2,3,4]

Notes: In each column, superscript numbers indicate significant differences between latent classes on mean outcomes ($p < .05$) based on Wald chi-square tests. Drinking consequences range from 0 to 10, with each additional consequence experienced indicating more drinking consequences (pooled sample $M = 2.7$, $SD = 2.6$). SF Physical and Mental Health are standardized to nationally representative sample with $M = 50$ and $SD = 10$ in representative sample (for current sample of pooled sample, $M_{\text{Physical Health}} = 50.3$, $SD = 9.4$, and $M_{\text{Mental Health}} = 44.8$, $SD = 12.6$). SF = Short Form Health Survey.

FIGURE 1. Response probabilities for levels of drinking (abstinence, low-risk drinking, and heavy drinking) across weeks of treatment by class. The *y*-axes indicate the probability of endorsing a particular level of drinking, the *x*-axes indicate week of treatment, and the lines represent response probabilities for each latent class. Latent class proportions are provided in the Figure 1 legend.

FIGURE 2. Average number of heavy drinking days and low-risk drinking days across weeks of treatment by class. The *y*-axes indicate the average number of drinking days during each week (top panel: heavy drinking days; bottom panel: low-risk drinking days), the *x*-axes indicate week of treatment, and the lines represent response probabilities for each latent class. Latent class proportions (e.g., proportion of sample most likely to be classified within each latent class) are provided in the Figure 2 legend.

Figure 1

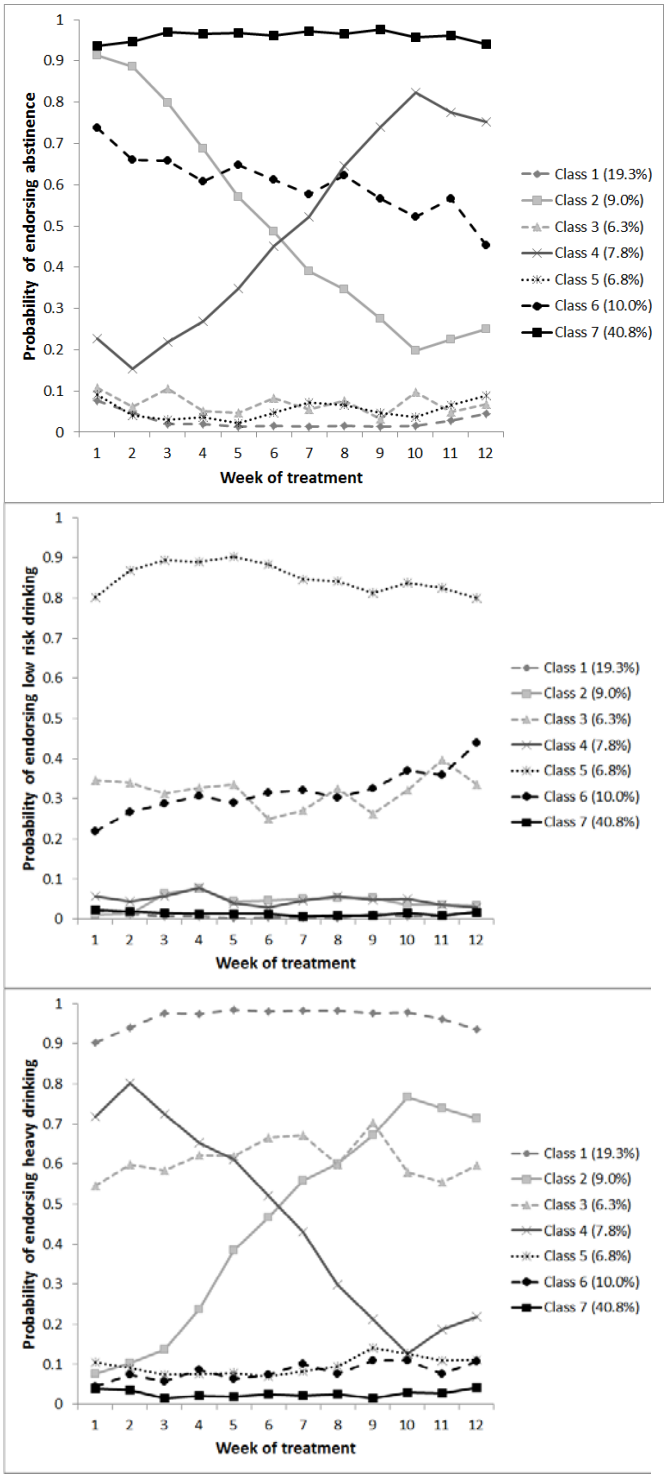
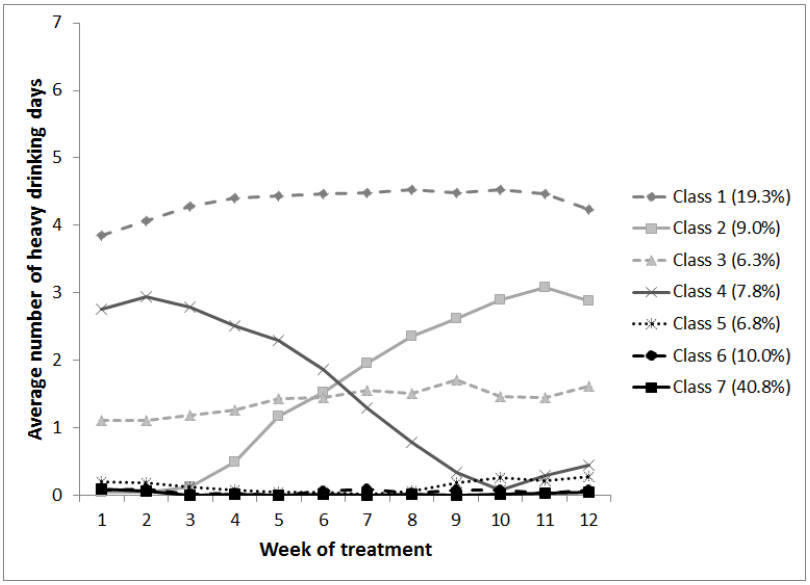
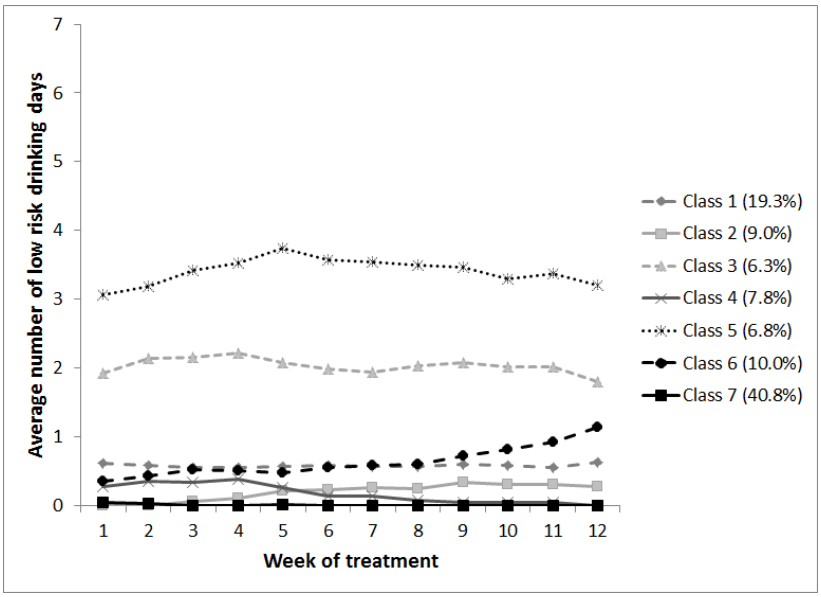

Probability of endorsing abstinence
Week of treatment
Probability of endorsing low risk drinking
Week of treatment
Probability of endorsing heavy drinking
Week of treatment
Class 1 (19.3%)
Class 2 (9.0%)
Class 3 (6.3%)
Class 4 (7.8%)
Class 5 (6.8%)
Class 6 (10.0%)
Class 7 (40.8%)

Figure 2


Average number of heavy drinking days
0
1
2
3
4
5
6
7
1 2 3 4 5 6 7 8 9 10 11 12
Week of treatment
Class 1 (19.3%)
Class 2 (9.0%)
Class 3 (6.3%)
Class 4 (7.8%)
Class 5 (6.8%)
Class 6 (10.0%)
Class 7 (40.8%)


Average number of low risk drinking days
0
1
2
3
4
5
6
7
1 2 3 4 5 6 7 8 9 10 11 12
Week of treatment
Class 1 (19.3%)
Class 2 (9.0%)
Class 3 (6.3%)
Class 4 (7.8%)
Class 5 (6.8%)
Class 6 (10.0%)
Class 7 (40.8%)