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Trait Self-Control Predicts Drinking Patterns During Treatment for Alcohol Use Disorder and Recovery up to Three Years Following Treatment

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Abstract

To more fully understand recovery from alcohol use disorder, we must consider several ways in which reductions in drinking and improvements in psychosocial functioning may occur. Previous research has demonstrated various patterns of drinking and functioning during and after behavioral treatment for alcohol use disorder, including groups of individuals who consume alcohol at low-risk levels and those that report occasional heavy drinking yet good psychosocial functioning. This study aimed to identify whether trait self-control, which has previously been associated with alcohol treatment outcomes, was a predictor of drinking patterns during treatment as well as three years following treatment. Latent variable mixture modeling was used to identify seven classes of drinking patterns during treatment and four profiles of drinking and psychosocial function after treatment. We found that membership in the low-risk drinking class was predicted by greater trait self-control than several of the other classes, including the consistent abstinence class. Furthermore, we found that greater trait self-control predicted membership in two high-functioning recovery profiles at three years following treatment, including a high functioning occasional heavy drinking profile. These findings suggest that self-control is an important predictor of recovery, particularly for a non-abstinent recovery.

Keywords

alcohol use disorder; alcohol treatment; recovery; trait self-control; mixture models

1. Introduction

Approximately 13% of adults in the United States meet criteria for a current alcohol use disorder (AUD) (Grant et al., 2015). Among individuals with AUD, symptoms and severity vary substantially (Lane & Sher, 2015). With myriad ways an AUD can manifest, it may also be true that AUD recovery takes various forms.

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1.1 Definitions of Recovery

Historically, recovery from AUD has been narrowly defined by sobriety (i.e., abstinence from alcohol; Betty Ford Institute Consensus Panel, 2007), yet recent contributions to the recovery literature argue for an expanded definition that includes reductions in use, psychosocial functioning, and quality of life (Kelly, Greene, & Bergman, 2018; Witkiewitz, 2013, 2018). Indeed, even among those who return to any heavy drinking in the year following treatment (defined as 4+/5+ drinks per occasion for women/men; Federal Drug Administration, 2015), some report improved psychosocial functioning, and at times even better functioning than abstainers or low-risk drinkers (Wilson, Bravo, Pearson, & Witkiewitz, 2016). Furthermore, Witkiewitz and colleagues identified that individuals who engaged in some heavy drinking were similar to abstainers with respect to psychosocial functioning and life satisfaction at three years post-treatment (Witkiewitz et al., 2018).

1.2. Trait Self-Control as a Predictor of Drinking Patterns and Recovery

Given the breadth of outcomes following alcohol treatment, it is important to identify factors that predict short and long-term recovery (Kelly, Abry, Milligan, Bergman, & Hoepfner, 2018; Moos & Moos, 2007; Witkiewitz et al., 2018). Previous work has found that those with greatest AUD severity and comorbid drug or psychiatric diagnoses were more likely to be successful with abstinent recovery than moderated drinking recovery (Dawson et al., 2005). Further, individuals with an approach coping style, greater health, and social support resources were more likely to achieve long-term recovery (Moos & Moos, 2007). In terms of demographics, individuals who are Black, Asian, or Hispanic (Dawson, Goldstein, Ruan, & Grant, 2012), or older and female (Dawson et al., 2005) were more likely to have an abstinent recovery.

Although previous literature has identified important demographic and clinical indicators related to recovery outcomes, other behavioral traits such as self-control have received less attention as long-term recovery predictors. Prior research has demonstrated that certain behavioral characteristics are associated with different aspects of alcohol use outcomes. Impulsivity and related constructs such as impaired self-control have been associated with associated alcohol initiation (Blonigen et al., 2015), and difficulty maintaining alcohol use change following treatment (Coskunpinar, Dir, & Cyders, 2013; Heather, Booth, & Luce, 1998; Stevens et al., 2014). Self-control has been hypothesized to moderate the relationship between impulsivity and subsequent problematic alcohol use (Friese & Hofmann, 2009; Lindgren, Neighbors, Westgate, & Salemink, 2014). Self-control, defined as “the ability to override or change one’s inner responses, as well as to interrupt undesired behavioral tendencies (such as impulses)” is associated with a broad range of health and psychosocial outcomes (Tangney, Baumeister, & Boone, 2004, p. 274). Thus, self-control may also predict drinking patterns and problems during treatment and longer-term.

1.3. Exploring Drinking Patterns and Recovery using Latent Mixture Models

Latent variable mixture modeling is a data driven method that identifies subpopulations based on responses to indicators (e.g., weekly drinking variables) (Muthén, 2001). Latent class analysis (LCA) is a type of latent variable mixture model that is used for categorical indicators and latent profile analysis (LPA) is a type of latent mixture model that can be

applied when indicators are continuous (Berlin, Parra, & Williams, 2014). These analytic approaches are well suited to examine subgroups of individuals with similar alcohol use and other functioning outcomes. For example, Witkiewitz and colleagues (2017) used a longitudinal extension of LCA, repeated measures latent class analysis (RMLCA; McCarthy, Ebssa, Witkiewitz, & Shiffman, 2015), to identify seven latent classes of drinking patterns among participants in three large clinical trials of alcohol treatment: (1) consistent heavy drinking throughout treatment, (2) initial abstinence then return to heavy drinking, (3) moderate probability of low-risk or heavy drinking, (4) initial heavy drinking transitioning to abstinence, (5) low-risk drinking throughout treatment, (6) initial abstinence transitioning to low-risk drinking, and (7) abstinence. Previous work by Witkiewitz and colleagues also identified four latent profiles of three-year alcohol and psychosocial functioning outcomes in a large alcohol treatment clinical trial: (1) low functioning, frequent heavy drinking, (2) low functioning, occasional heavy drinking, (3) high functioning, occasional heavy drinking, and (4) high functioning, infrequent non-heavy drinking (Witkiewitz et al., 2018).

1.4 Current Study and Proposed Hypotheses

There were two aims of this study. The first aim was to extend previous work by Witkiewitz et al. (2017) by confirming seven drinking classes of during treatment alcohol use, and then predicting class membership from a baseline measure of trait self-control. We hypothesized that lower self-control would predict membership in the heavy drinking classes and greater self-control would predict membership in the low-risk drinking and abstaining classes. The second aim of this study was to extend previous work by Witkiewitz et al. (2018) by examining four profiles of three-year outcomes following alcohol treatment, and then predicting class membership from a baseline measure of trait self-control. We hypothesized that greater self-control would predict membership in the two high functioning classes.

2. Method

2.1 Participants and Procedures

This study was a secondary analysis of data from Project MATCH (Matching Alcoholism Treatments to Client Heterogeneity; Project MATCH Research Group, 1997). Participants from two study arms (outpatient (n= 952) and aftercare (n= 774)) were randomized to receive 12 weeks of one of three types of treatment for alcohol use disorder: Cognitive Behavioral Therapy, Motivational Enhancement Therapy, or Twelve Step Facilitation. This study only included participants from the outpatient arm (n= 952) because these participants had three-year follow-up data. During the treatment phase, n= 55 had missing data on covariates and n= 21 had missing data on all indicator variables and thus were excluded, so the final sample used in first aim analyses was n= 876. At three-year follow up, n= 806 patients (84.7%) had drinking data available and n=107 had missing data on covariates, so the final sample used in the second aim analyses was n= 769.

2.2 Measures

2.2.1 Demographics—A brief demographics questionnaire assessed age and gender, which were included as covariates in the model.

2.2.2 Alcohol use and consequences—Quantity and frequency of drinking during treatment and through the three-year follow-up time period was assessed using the Timeline Follow-Back (TLFB; Sobell & Sobell, 1996). A weekly drinking indicator variable was created for each of the twelve weeks of treatment. Categorical values for each indicator variable were: abstinent (no drinking during a given week), low-risk drinking (1 or more days with less than 4/5 drinks for women/men and no heavy drinking days during a given week), and heavy drinking (at least 1 day with greater than 4/5 drinks for women/men during a given week). For the three-year follow-up, summary alcohol use variables were used, including percentage of drinking days (PDD), percentage of heavy drinking days (PHDD, i.e. 4+/5+ drinks in a day for women/men) and drinks per drinking day (DDD). Negative alcohol related consequences were measured using the Drinker Inventory of Consequences (DrInC; Miller, Tonigan, & Longabaugh, 1995). Internal consistency of DrInC in this sample was high, $\alpha = 0.97$ (Taber, 2016).

2.2.3 Psychosocial Functioning—Three year psychosocial functioning was assessed with the Psychosocial Functioning Inventory (PFI) social behavior subscale, comprised of 10 items assessing the frequency of problematic social behavior and social interactions, as well as four items that reflected general life satisfaction across several life domains. The internal consistency of the social behavior subscale in this sample was $\alpha = 0.83$, and for the four life satisfaction items it was $\alpha = 0.79$, both in the acceptable range of internal consistency reliability (Taber, 2016). Additionally, four binary indicators from the Addiction Severity Index (ASI; McLellan et al., 1992) were included to measure employment, depression, cognitive difficulty, and anxiety. The internal consistency of these four ASI items was $\alpha = 0.63$, generally considered sufficient (Taber, 2016).

2.2.4 Trait Self-Control—The Control Scale is a primary trait scale from the Multidimensional Personality Questionnaire, comprised of 24 true/false items (Tellegen & Waller, 2008). This measure assesses a range of behavioral and personality traits that describe general self-control (e.g., not an alcohol specific measure of self-control). Higher scores represent greater self-control, or a tendency towards being careful, reflective, or planful (e.g., “I am a cautious person”). Internal consistency reliability of the Control Scale was acceptable ($\alpha = 0.78$).

2.3 Statistical Analyses

To address hypothesis 1, repeated measures latent class analysis (RMLCA) was used to confirm latent classes based on twelve categorical weekly drinking indicators (no drinking, low-risk drinking, heavy drinking) for the twelve weeks of treatment that were previously found by Witkiewitz and colleagues (2017). Age and gender were included as covariates given their established association with both impulsivity and alcohol use (Cyders, 2013; Greenfield, Pettinati, O’Malley, Randall, & Randall, 2010; Witkiewitz et al., 2018). To examine the association of trait self-control with the probability of latent class membership, we also included baseline self-control as a covariate. Of note, re-testing of the RMLCA was necessary because adding the trait self-control covariate to the model could have changed the class solution.

To address hypothesis 2, we conducted a latent profile analysis (LPA) to confirm prior work by Witkiewitz and colleagues (2018). This LPA identified latent profiles based on individuals' drinking and psychosocial functioning at three years following treatment as represented by categorical indicators: employment, depression, cognitive difficulty, anxiety, social behavior, and general life satisfaction, as well as continuous alcohol indicators: percent drinking days, percent heavy drinking days, and drinks per drinking day at three years. Sex, age, and baseline self-control were covariates.

Model fit for the RMLCA and LPA was evaluated using the Lo Mendell Rubin Likelihood Ratio test (LRT), Bayesian Information Criterion (BIC), and sample-size adjusted BIC (aBIC). For each class solution, significant LRT indicates significantly better fit for a k profile model (e.g., 3 profiles) versus a k-1 profile model (e.g., 2 profiles), and a nonsignificant LRT indicates that adding an additional profile does not significantly improve model fit (Nylund, Asparouhov, & Muthén, 2007). Better model fit is also indicated by lower BIC and aBIC (Nylund et al., 2007). Further, the smallest class of any class-solution should not contain less than 5% of the sample. Classification precision was examined using model entropy, where values of 0.80 and higher were considered acceptable (Nylund et al., 2007). We also considered theoretical interpretability of the model.

SPSS version 25 was used for data preparation and descriptive statistics. RMLCA and LPA were conducted in Mplus version 8 (Muthén & Muthén, 2017) using maximum likelihood estimation with robust standard errors (MLR estimator in Mplus). Participants with missing data on covariates or those missing data on all of the indicator variables were excluded from analyses. Missing data on treatment drinking indicators was not associated with age ($p=0.96$), gender ($p=0.99$), baseline self-control ($p=0.11$), or any other measures included in the analyses and it was assumed that data were missing at random. Missing data on three year drinking and psychosocial functioning indicators was not associated with baseline control ($p=.09$), but it was associated with age ($p < .01$) and sex ($p < .01$). We covaried age and sex in the LPA and assumed data are missing at random with these covariates included in the model.

3. Results

3.1 Descriptive Data

Demographic data and covariates for the participants included in analyses are provided in Table 1. Participants were approximately 27% female and had an average age of 39 years old. About 81% of this sample identified as White, 12% as Hispanic or Latino, 2% as American Indian/Alaska Native, and 5% as Black or African American.

3.2 Repeated Measures Latent Class Analysis

RMLCA confirmed the 7-class model previously identified by Witkiewitz and colleagues (2017) with excellent classification precision (entropy=0.92), lower BIC than the 8 class solution, and no classes comprising less than 5% of the full sample. Adding the self-control covariate changed the class solution slightly, such that the 6-class model also fit the data well, marginally better than the 7-class model, with excellent classification precision

(entropy=0.91) and the lowest BIC and aBIC. However, because the 6-class model was composed of substantively similar classes and produced substantively similar results to the 7-class model (details provided in Supplemental Materials), we chose the 7-class model for this study in order to provide consistency with prior publications with these data (Witkiewitz et al., 2017). The fit of the two through nine class solutions is provided in Supplementary Table 1. For this study, the reference class was set to the high probability of low-risk drinking class. We found two heavier drinking classes: Class 1 (17.8%), characterized by consistently high probability of heavy drinking, and Class 2 (12.9%), which had high probability of abstinence initially, but then increasing probability of heavy drinking over time. Class 3 (5.4%) was mixed low-risk and heavy-drinking class. Class 4 (9.8%) was characterized by low probability of abstinence and high probability of heavy drinking initially, but this pattern was reversed by the end of treatment. Class 5 (11.3%) was characterized by moderate probability of low-risk drinking and higher probability of abstinence. Class 6 (37.4%) had high probability of abstinence throughout treatment. Finally, Class 7 (5.4%) was a low-risk drinking class with consistently high probability of low-risk drinking through treatment.

Latent class membership was predicted by baseline self-control, where higher scores represent greater self-control. Means of self-control scores by class are presented in Figure 1. The low-risk drinking class, Class 7, had significantly higher self-control scores compared to Class 1, the high probability heavy drinking class ($B(SE)=-0.074(0.032)$, $p=.02$; $OR=0.928$, 95% CI $(-0.127, -0.022)$), and Class 4, the heavy drinking to abstinence class ($B(SE)=-0.087(0.039)$, $p=.026$; $OR=0.916$, 95% CI $(-0.152, -0.023)$). Furthermore, we found that the low-risk drinking class, Class 7, also had significantly higher self-control compared to Class 6, the mostly abstinent class ($B(SE)=-0.069(0.031)$, $p=.025$; $OR=0.933$, 95% CI $(-0.120, -0.018)$), which is contrary to our hypothesis that higher self-control would predict membership in both the low-risk drinking and abstinent classes. Although not statistically significant, Class 7 also had higher selfcontrol scores than the remaining classes.

3.3 Latent Profile Analysis

LPA confirmed the four profile model previously identified by Witkiewitz and colleagues (2018) with good classification precision (entropy=0.88) and significant LRT. The fit of the two through five profile solutions is provided in Supplementary Table 2. The four profiles were consistent with prior findings: Profile 1 (low functioning frequent heavy drinking, 16.1%), profile 2 (low functioning infrequent heavy drinking, 15.2%), profile 3 (high functioning occasional heavy drinking, 16.7%), and profile 4 (high functioning infrequent non-heavy drinking, 52.0%) (Witkiewitz et al., 2018).

Latent profile membership at three years following treatment was predicted by baseline self-control. Means of self-control score by profile are presented in Figure 2. The high functioning, occasional heavy drinking profile, Profile 3, had significantly higher self-control scores compared to Profile 1, the low functioning, frequent heavy drinking profile ($B(SE)=0.049(0.023)$, $p=0.034$; $OR=0.928$, 95% CI $(0.011, 0.087)$). The high functioning, infrequent non-heavy drinking profile, Profile 4, also had significantly higher self-control

scores compared to the low functioning, frequent heavy drinking profile (Profile 1; B (SE)=0.050 (0.018), $p=0.007$; OR=1.051, 95% CI (0.020, 0.080)).

4. Discussion

This study confirmed seven latent classes of drinking during outpatient alcohol treatment and four latent profiles of drinking and functioning three years later (Witkiewitz et al., 2017; 2018). Lower behavioral control has previously been shown to be associated with poorer alcohol treatment outcomes and difficulty maintaining behavior change (Heather & Dawe, 2005; Stevens et al., 2014). Therefore, we examined trait self-control as a predictor of drinking class membership during treatment and recovery profiles at three years following treatment, hypothesizing that greater self-control would predict membership in both low-risk drinking and abstinent classes during treatment, as well as high-functioning recovery three years following treatment. Our hypothesis regarding during treatment drinking was partially supported. We found the consistent low-risk drinking class (Class 7) was associated with higher self-control, statistically significantly higher self-control than three classes: the consistent abstinent class (Class 6), the persistent heavy drinking class (Class 1), and the heavy drinking to abstinence class (Class 4). This finding has important clinical implications, suggesting that achieving low-risk drinking throughout treatment may require even more self-control than achieving abstinence. For those who have greater difficulty with self-control, abstinence may be a more achievable goal during treatment. Following treatment, we found that higher self-control predicted greater psychosocial functioning, including for individuals who engaged in occasional heavy drinking (Profile 3) and infrequent non-heavy drinking (Profile 4).

There are several possible reasons why self-control may be associated with low-risk drinking outcomes during treatment and later recovery outcomes. Impaired control over drinking has been shown to be predictive in both abstinence-oriented (Heather et al., 1998) and moderation-oriented alcohol treatment (Heather & Dawe, 2005). Indeed, a cut-point has been suggested on a measure of impaired control over drinking, over which clients are less likely to achieve alcohol moderation and should instead be recommended abstinence (Heather & Dawe, 2005).

Prior findings combined with this study may be understood within a strength model which posits that self-control is an effortful resource that can be depleted with repeated exertion (Baumeister, Vohs, & Tice, 2007). The strength model has been supported in several laboratory studies showing that participants with high temptation to drink consumed more alcohol following a self-control task than a neutral task (Muraven, Collins, & Nienhaus, 2002). Considering low-risk drinking versus abstinence, individuals who moderate their drinking face repeated opportunities to exert self-control over their drinking such as deciding to drink or abstain on a particular day, as well as negotiating finer-grain choices such as type of alcohol to consume or whether to consume an additional drink. Additionally, people high in self-control practice more alcohol protective behavioral strategies, behaviors to reduce quantity of alcohol consumed or potential harm caused by drinking, which may mediate the relationship between self-control and alcohol consumption (Pearson, Kite, & Henson, 2013). Although abstinence is certainly aided by greater self-control, it may require relatively less

self-control resources to carry out what is essentially one decision (i.e., to not drink) rather than the iterative and cumulative demands on self-control that comprise successful low-risk drinking.

The construct of trait self-control may also represent cognitive and behavioral processes that are related to, but distinct from classic impulsive traits. Self-control involves self-monitoring of behavior, evaluating how behavior relates to longer term goals, and subsequent modification of behavior. Impulsivity, on the other hand, is comprised of several distinct constructs such as response inhibition, lack of planning, sensation-seeking, and emotion-driven urgency (Evenden, 1999; Lynam, Smith, Cyders, Fisher, & Whiteside, 2007) that may predict different aspects of alcohol outcomes (Coskunpinar et al., 2013; McCarty, Morris, Hatz, & McCarthy, 2017). However, one limitation of this body of research is the inconsistency of how self-control is measured. Several prior studies have advocated for careful measurement of self-control and impulsivity using specific behavioral tasks or measures with good psychometric properties (Dick et al., 2010; Jentsch et al., 2014). A limitation of this study is the measure we used, the Control Scale of the Multidimensional Personality Questionnaire, which assesses such a broad range of aspects of self-control that it likely obscures relevant distinctions. An additional limitation is the sample selection for Project MATCH, which was conducted from 1991 to 1993 and excluded individuals with other substance use disorders (besides nicotine) or psychiatric comorbidity. Therefore generalizability is limited and these findings should be replicated in a new sample among those with comorbid disorders. Additionally, this sample includes a high proportion of men and an underrepresentation of diverse racial/ethnic groups. Given that prevalence rates for lifetime AUD are highest among those who are male, non-Hispanic White, Native American, or Hispanic or Latina/o (Grant et al., 2015), our current study may not generalize to all racial/ethnic groups or genders. Future directions of this work should include more diverse and representative samples, as well as examination of elements of recovery that may be unique to specific racial/ethnic groups and gender identities, particularly in light of epidemiologic trends showing that problematic alcohol use is increasing among women (Slade, Chapman, Swift, Keyes, & Tonks, 2016). Finally, another limitation of this study is the small number of predictors we included in our statistical models. Although we demonstrated the association between higher self-control and low-risk drinking and high-functioning recovery, there may be other relevant variables.

5. Conclusion

In this study, we demonstrated that those who achieved consistent low-risk drinking during treatment had higher levels of self-control than those who were abstinent, those who had persistent heavy drinking, and those who transitioned from heavy drinking to abstinence. Furthermore, we found that those with higher functioning at follow-up, regardless of amount of alcohol consumption, reported higher levels of self-control at baseline. These findings suggest that trait self-control is a distinguishing factor between those who achieve moderated drinking versus abstinence during treatment, as well as those who report improved psychosocial functioning at follow-up.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

- Baumeister RF, Vohs KD, & Tice DM (2007). The Strength Model of Self-Control. *Current Directions in Psychological Science*, 16(6), 351–355. 10.1111/j.1467-8721.2007.00534.x
- Berlin KS, Parra GR, & Williams N. a. (2014). An introduction to latent variable mixture modeling (part 1): Overview and Cross-Sectional Latent Class and Latent Profile Analyses. *Journal of Pediatric Psychology*, 39(2), 174–187. 10.1093/jpepsy/jst085 [PubMed: 24277769]
- Betty Ford Institute Consensus Panel. (2007). What is recovery? A working definition from the Betty Ford Institute. *Journal of Substance Abuse Treatment*, 33(3), 221–228. 10.1016/j.jsat.2007.06.001 [PubMed: 17889294]
- Blonigen DM, Durbin CE, Hicks BM, Johnson W, McGue M, & Iacono WG (2015). Alcohol Use Initiation is Associated with Changes in Personality Trait Trajectories from Early Adolescence to Young Adulthood. *Alcoholism: Clinical and Experimental Research*, 39(11), 2163–2170. 10.1111/acer.12878
- Coskunpinar A, Dir AL, & Cyders MA (2013). Multidimensionality in impulsivity and alcohol use: A meta-analysis using the UPPS model of impulsivity. *Alcoholism: Clinical and Experimental Research*, 37(9), 1441–1450. 10.1111/acer.12131
- Cyders MA (2013). Impulsivity and the sexes: measurement and structural invariance of the UPPS-P Impulsive Behavior Scale. *Assessment*, 20(1), 86–97. 10.1177/1073191111428762 [PubMed: 22096214]
- Dawson DA, Goldstein RB, Ruan WJ, & Grant BF (2012). Correlates of Recovery from Alcohol Dependence: A Prospective Study Over a 3-Year Follow-Up Interval. *Alcoholism: Clinical & Experimental Research*, 36(7), 1268–1277. 10.1111/j.1530-0277.2011.01729.x
- Dawson DA, Grant BF, Stinson FS, Chou PS, Huang B, & Ruan WJ (2005). Recovery from DSM-IV alcohol dependence: United States, 2001 – 2002. *Addiction*, 100, 281–292. 10.1111/j.1360-0443.2004.00964.x [PubMed: 15733237]
- Dick DM, Smith G, Olausson P, Mitchell SH, Leeman RF, O'Malley SS, & Sher K (2010). Understanding the construct of impulsivity and its relationship to alcohol use disorders. *Addiction Biology*, 15(2), 217–226. 10.1111/j.1369-1600.2009.00190.x [PubMed: 20148781]
- Evenden JL (1999). Varieties of impulsivity. *Psychopharmacology*, 146(4), 348–361. 10.1007/PL00005481 [PubMed: 10550486]
- Federal Drug Administration. (2015). Alcoholism: Developing Drugs for Treatment Guidance for Industry. Center for Drug Evaluation and Research (CDER) <https://doi.org/https://www.fda.gov/downloads/drugs/guidancecomplianceregulatoryinformation/guidances/ucm091219.pdf>
- Friese M, & Hofmann W (2009). Control me or I will control you: Impulses, trait self-control, and the guidance of behavior. *Journal of Research in Personality*, 43(5), 795–805. 10.1016/j.jrp.2009.07.004
- Grant BF, Goldstein RB, Saha TD, Chou SP, Jung J, Zhang H, ... Hasin DS (2015). Epidemiology of DSM-5 Alcohol Use Disorder: Results From the National Epidemiologic Survey on Alcohol and Related Conditions III. *JAMA Psychiatry*, 72(8), 757–766. 10.1001/jamapsychiatry.2015.0584 [PubMed: 26039070]
- Greenfield SF, Pettinati HM, O'Malley S, Randall PK, & Randall CL (2010). Gender differences in alcohol treatment: An analysis of outcome from the COMBINE study. *Alcoholism: Clinical and Experimental Research*. 10.1111/j.1530-0277.2010.01267.x

- Heather N, Booth P, & Luce A (1998). Impaired Control Scale: cross-validation and relationships with treatment outcome. *Addiction*, 93(5), 761–771. [PubMed: 9692275]
- Heather N, & Dawe S (2005). Level of impaired control predicts outcome of moderation-oriented treatment for alcohol problems. *Addiction*, (100), 945–952. 10.1111/j.1360-0443.2005.01104.x [PubMed: 15955010]
- Jentsch JD, Ashenhurst JR, Cervantes MC, James AS, Groman SM, & Pennington ZT (2014). Dissecting impulsivity and its relationships to drug addictions. *Annals of the New York Academy of Sciences*, 1327, 1–26. 10.1111/nyas.12388. Dissecting [PubMed: 24654857]
- Kelly JF, Abry AW, Milligan CM, Bergman BG, & Hoepfner BB (2018). On being “in recovery”: A national study of prevalence and correlates of adopting or not adopting a recovery identity among individuals resolving drug and alcohol problems. *Psychology of Addictive Behaviors*, 32(6), 595–604. 10.1037/adb0000386 [PubMed: 30070538]
- Kelly JF, Greene MC, & Bergman BG (2018). Beyond Abstinence: Changes in Indices of Quality of Life with Time in Recovery in a Nationally Representative Sample of U.S. Adults. *Alcoholism: Clinical & Experimental Research*, 1–11. 10.1111/acer.13604
- Lane SP, & Sher KJ (2015). Limits of current approaches to diagnosis severity based on criterion counts: An example with DSM-5 alcohol use disorder. *Clinical Psychological Science*, 3(6), 819–835. 10.1177/2167702614553026 [PubMed: 26783505]
- Lindgren KP, Neighbors C, Westgate E, & Salemink E (2014). Self-control and implicit drinking identity as predictors of alcohol consumption, problems, and cravings. *Journal of Studies on Alcohol and Drugs*, 75(2), 290–298. [PubMed: 24650823]
- Lynam DR, Smith GT, Cyders MA, Fisher S, & Whiteside SP (2007). The UPPS-P: a multidimensional measure of risk for impulsive behavior.
- McCarthy DE, Ebssa L, Witkiewitz K, & Shiffman S (2015). Paths to tobacco abstinence: A repeated-measures latent class analysis. *Journal of Consulting and Clinical Psychology*, 83(4), 696–708. Retrieved from <http://www.apa.org/pubs/journals/ccp/index.aspx%5Cnhttp://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=emed13&NEWS=N&AN=2015916231> [PubMed: 25867447]
- McCarty KN, Morris DH, Hatz LE, & McCarthy DM (2017). Differential Associations of UPPS-P Impulsivity Traits With Alcohol Problems. *Journal of Studies on Alcohol and Drugs*, 78, 617–622. [PubMed: 28728644]
- McLellan AT, Kushner H, Metzger D, Peters R, Smith I, & Grissom G (1992). The fifth edition of the Addiction Severity Index. *Journal of Substance Abuse Treatment*, 9, 199–213.
- Miller WR, Tonigan JS, & Longabaugh R (1995). *The Drinker Inventory of Consequences (DrInC)*. Bethesda, MA: National Institute on Alcohol Abuse and Alcoholism.
- Moos RH, & Moos BS (2007). Protective resources and long-term recovery from alcohol use disorders. *Drug and Alcohol Dependence*, 86(1), 46–54. 10.1016/j.drugalcdep.2006.04.015 [PubMed: 16769181]
- Muraven M, Collins RL, & Nienhaus K (2002). Self-control and alcohol restraint: An initial application of the self-control strength model. *Psychology of Addictive Behaviors*, 16(2), 113–120. 10.1037/0893-164X.16.2.113 [PubMed: 12079249]
- Muthén B (2001). Latent Variable Mixture Modeling In Schumacker RE & Marcoulides GA (Eds.), *New Developments and Techniques in Structural Equation Modeling* (pp. 1–33). Lawrence Erlbaum Associates.
- Muthén L, & Muthén B (2017). *Mplus user’s guide* (8th ed.). Los Angeles: Author 10.13155/29825
- Nylund KL, Asparouhov T, & Muthén BO (2007). Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte Carlo simulation study. *Structural Equation Modeling*, 14(4), 535–569. 10.1080/10705510701575396
- Pearson MR, Kite BA, & Henson JM (2013). Predictive Effects of Good Self-Control and Poor Regulation on Alcohol-Related Outcomes: Do Protective Behavioral Strategies Mediate? *Psychology of Addictive Behaviors*, 27(1), 81–89. 10.1037/a0028818. Predictive [PubMed: 22663345]

- Slade T, Chapman C, Swift W, Keyes K, & Tonks Z (2016). Birth cohort trends in the global epidemiology of alcohol use and alcohol-related harms in men and women: systematic review and metaregression, 1–12. 10.1136/bmjopen-2016-011827
- Sobell LC, & Sobell MB (1996). Timeline Followback user's guide: A calendar method for assessing alcohol and drug use. Toronto, Ontario, Canada: Addiction Research Foundation.
- Stevens L, Verdejo-García A, Goudriaan AE, Roeyers H, Dom G, & Vanderplasschen W (2014). Impulsivity as a vulnerability factor for poor addiction treatment outcomes: A review of neurocognitive findings among individuals with substance use disorders. *Journal of Substance Abuse Treatment*, 47(1), 58–72. 10.1016/j.jsat.2014.01.008 [PubMed: 24629886]
- Substance Abuse and Mental Health Services Administration. (2016). Results from the 2015 National Survey on Drug Use and Health: Detailed tables. Rockville, Maryland.
- Taber KS (2016). The Use of Cronbach's Alpha When Developing and Reporting Research Instruments in Science Education. *Research in Science Education*. 10.1007/s11165-016-9602-2
- Tangney JP, Baumeister RF, & Boone AL (2004). High Self-Control Predicts Good Adjustment, Less Pathology, Better Grades, and Interpersonal Success June. *Journal of Personality*, 72(2), 271–322. [PubMed: 15016066]
- Tellegen A, & Waller NG (2008). Exploring personality through test construction: The development of the Multidimensional Personality Questionnaire In Boyle GJ, Mathews G, & Saklofske DH (Eds.), *The SAGE Handbook of Personality Theory and Assessment, Vol. 2: Personality Measurement and Testing*. Thousand Oaks, CA: Sage Publications, Inc.
- Wilson AD, Bravo AJ, Pearson MR, & Witkiewitz K (2016). Finding success in failure: using latent profile analysis to examine heterogeneity in psychosocial functioning among heavy drinkers following treatment. *Addiction*, 111(12), 2145–2154. 10.1111/add.13518 [PubMed: 27367263]
- Witkiewitz K (2013). "Success" following alcohol treatment: moving beyond abstinence. *Alcoholism: Clinical and Experimental Research*, 37 Suppl 1(1), E9–13. 10.1111/acer.12001
- Witkiewitz K (2018). Double standards and gold standards in the evaluation of a how a person feels and functions in substance use disorder pharmacotherapy trials. *Addiction*, 114, 17–18. [PubMed: 30207010]
- Witkiewitz K, Roos CR, Pearson MR, Hallgren KA, Maisto SA, Kirouac M, ... Heather N (2017). How Much Is Too Much? Patterns of Drinking During Alcohol Treatment and Associations With Post-Treatment Outcomes Across Three Alcohol Clinical Trials. *Journal of Studies on Alcohol and Drugs*, 78(1), 59–69. 10.15288/jsad.2017.78.59 [PubMed: 27936365]
- Witkiewitz K, Wilson AD, Pearson MR, Montes KS, Kirouac M, Roos CR, ... Maisto SA (2018). Profiles of Recovery from Alcohol Use Disorder at Three Years Following Treatment: Can the Definition of Recovery be Extended to Include High Functioning Heavy Drinkers? *Addiction*, 69–80. 10.1111/add.14403 [PubMed: 30063267]

Highlights

- Identified patterns of drinking and functioning during and after alcohol treatment
- Low-risk drinking during treatment is predicted by trait self-control
- Low-risk drinkers had higher self-control than those achieving abstinence
- Better psychosocial functioning at follow-up is predicted by higher self-control
- Definitions of recovery should include several patterns of drinking and functioning

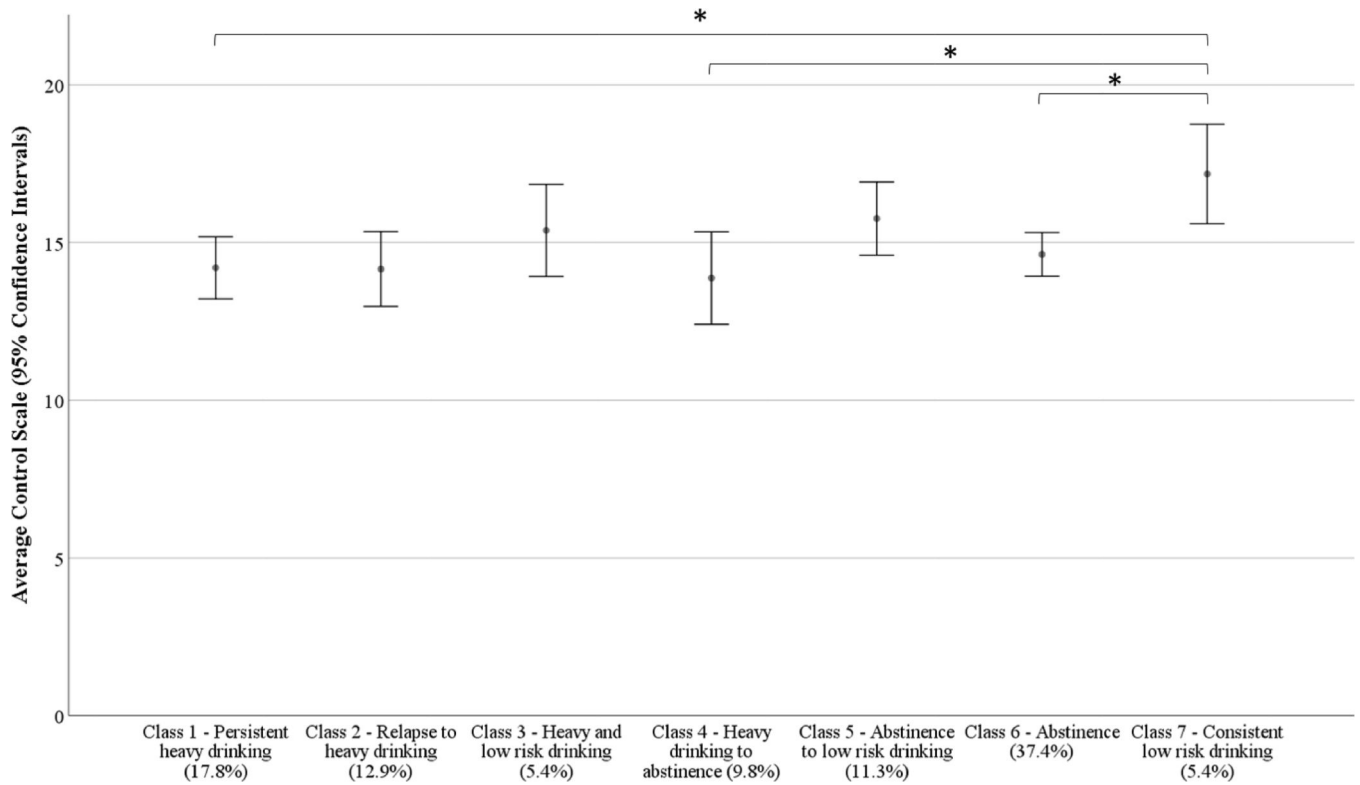


Figure 1. Means of self-control by latent classes (class prevalence based on estimated posterior probabilities) during treatment with significant differences ($* p < 0.05$) between latent classes connected by brackets.

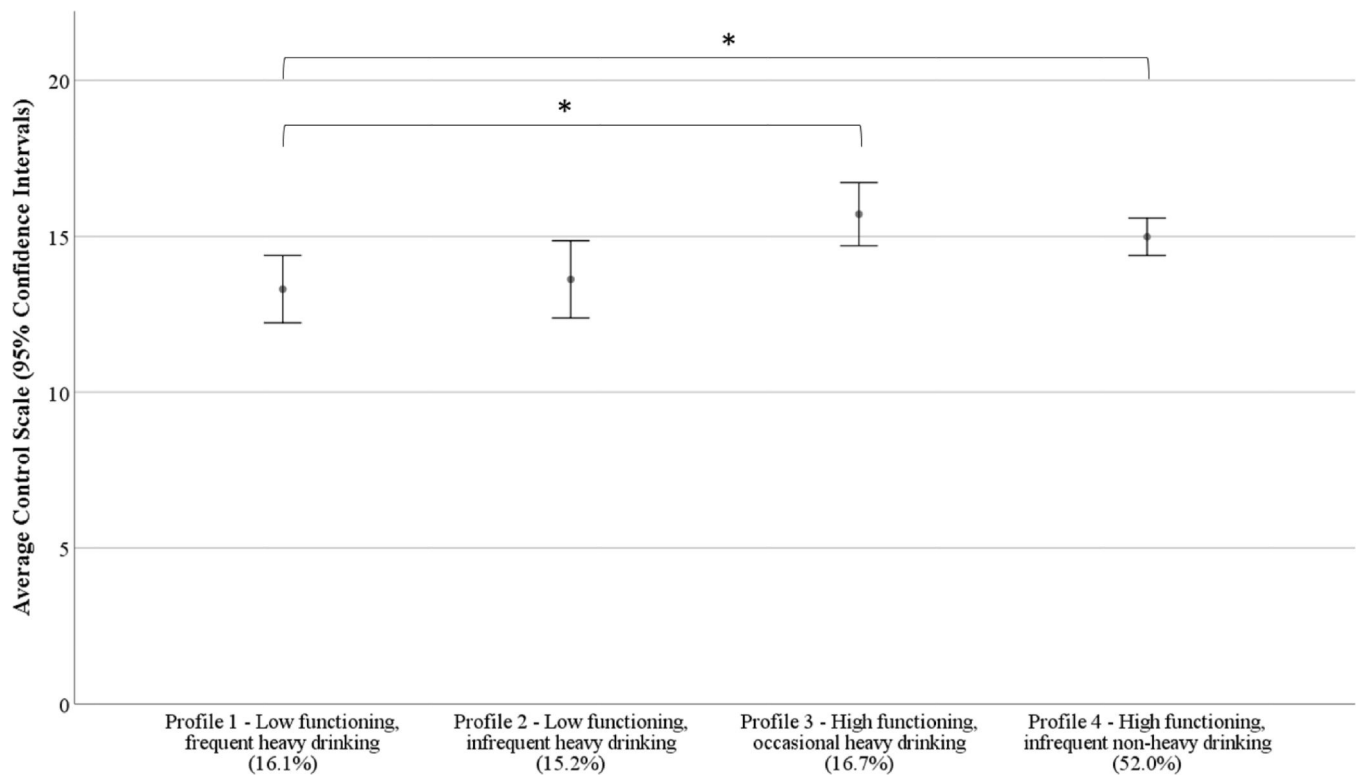


Figure 2. Means of self-control by latent profiles (profile prevalence based on estimated posterior probabilities) at three years post-treatment with significant differences ($* p < 0.05$) between latent classes connected by brackets.

Table 1

Demographics and Covariates

	During Treatment Sample (n=876)	Three-Year Follow-up Sample (n=769)
	N(%) / M(SD)	N(%) / M(SD)
Gender		
Female	239 (27.28%)	209 (27.18%)
Male	637 (72.72%)	560 (72.82%)
Age	38.80 (10.66)	38.57 (10.73)
Race/Ethnicity		
Hispanic or Latina/Latino	101 (11.53%)	89 (11.57%)
Black or African American	47 (5.37%)	43 (5.69%)
Non-Hispanic White	705 (80.48%)	617 (80.23%)
Asian or Pacific Islander	2 (0.23%)	1 (0.13%)
American Indian/Alaska Native	16 (1.83%)	14 (1.82%)
"Other"	5 (0.57%)	5 (0.65%)
Control Scale	14.72 (6.24)	14.63 (6.21)
Drinking Indicators		
Treatment week 1 heavy drinking	261 (29.79%)	-
Treatment week 2 heavy drinking	287 (32.76%)	-
Treatment week 3 heavy drinking	271 (30.93%)	-
Treatment week 4 heavy drinking	267 (30.48%)	-
Treatment week 5 heavy drinking	269 (30.71%)	-
Treatment week 6 heavy drinking	267 (30.48%)	-
Treatment week 7 heavy drinking	270 (30.82%)	-
Treatment week 8 heavy drinking	250 (28.53%)	-
Treatment week 9 heavy drinking	258 (29.45%)	-
Treatment week 10 heavy drinking	248 (28.31%)	-
Treatment week 11 heavy drinking	241 (27.20%)	-
Treatment week 12 heavy drinking	260 (29.68%)	-
3 year percentage drinking days	-	31.09% (35.66%)
3 year percentage heavy drinking days	-	20.39% (30.25%)
3 year drinks per drinking day	-	4.72 (5.46)
3 year DrInC total score	-	33.97 (25.44)