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Self-Efficacy as a Potential Mechanism of Behavior Change in Mindfulness-Based Relapse Prevention

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Declarations: The authors declare that they have no conflict of interest.

Abstract

Objectives: Self-efficacy, the belief in one's ability to moderate or abstain from heavy drinking and drug use, predicts outcomes following substance use disorder (SUD) treatment. The current study examined whether self-efficacy was associated with treatment outcomes in a trial of mindfulness-based relapse prevention (MBRP), cognitive-behavioral relapse prevention (RP), and treatment as usual (TAU). We hypothesized self-efficacy would mediate the effects of treatment on substance use outcomes.

Methods: Secondary analyses of a randomized clinical trial of MBRP, RP, versus TAU among individuals with SUD in an aftercare setting (*n*=286; 71.5% male; 42.1% non-White) were performed. Change in self-efficacy, measured via the Drug Taking Confidence Questionnaire at baseline, post-treatment, 6-, and 12-month follow-ups, was examined using latent growth mediation models on 12-month heavy drinking and drug use.

Results: Greater self-efficacy at post-treatment and increases in self-efficacy over time predicted a significantly higher probability of no drug use and no heavy drinking at 12-month follow-up. Greater self-efficacy at post-treatment was also associated with significantly fewer days of heavy drinking among those who drank, and mediated the association between treatment condition and probability of no drug use and fewer heavy drinking days at 12-month follow-up. Those who received MBRP had the highest self-efficacy at post-treatment, which was associated with greater probability of no drug use and fewer heavy drinking days.

Conclusion: Self-efficacy is an important treatment target for individuals with SUD. These results highlight the potential utility of MBRP in improving self-efficacy and suggest self-efficacy may be one mechanism by which MBRP is effective.

Parent Trial Registration: https://ClinicalTrials.gov; registration number: NCT01159535

Keywords: Self-Efficacy, Mindfulness-Based Relapse Prevention, Cognitive-Behavioral Relapse Prevention, Substance Use Disorders, Mechanisms of Behavior Change

Substance use disorders (SUD) remain a public health concern given their adverse effects on multiple domains for both individuals and communities (Striley & Hoeflich, 2021). Evidence-based treatments for SUD stem from different theoretical foundations, yet demonstrate relatively equivalent and moderate efficacy (Miller & Wilbourne, 2002). Given this treatment equivalency, there has been a growing effort to improve the efficacy of evidence-based treatments by delineating the mechanisms through which therapeutic change occurs (Hayes & Hofmann, 2021; Huebner & Tonigan, 2007). Understanding these mechanisms of behavior change will increase knowledge of how best to deliver evidence-based treatments for individuals with SUD (Mechanisms of Behavior Change Satellite Committee, 2018). Likewise, understanding mechanisms of behavior change will allow for evidenced-based care as a whole to move beyond diagnosis-specific protocols and instead tailor treatment based on the unique processes which underlie psychopathology (Hayes et al., 2020; Ruggero et al., 2019).

One well-documented mechanism of behavior change across varying evidence-based treatments for SUD is self-efficacy (Hartzler et al., 2011; Magill et al., 2015, 2020; Witkiewitz et al., 2022). First conceptualized by Bandura (1977), self-efficacy refers to one's self-perceived belief in their ability to successfully carry out behaviors needed to produce a desired outcome. When applied to SUD treatment, self-efficacy refers to an individual's confidence in their ability to implement and sustain desired behaviors that directly impact their substance use patterns. Although self-efficacy has most often been measured and framed as confidence in the capacity to attain and/or sustain abstinence, such a framing is arguably a limited conceptualization of the role of self-efficacy in SUD treatment. It is more inclusive of a range of SUD treatment goals to extend the conceptualization of self-efficacy to include one's confidence in being able to

moderate, though not necessarily abstain from, heavy drinking and substance use – an equally valid and important form of recovery (Witkiewitz et al., 2020).

Studies of various evidence-based treatments for SUD across multiple populations have identified self-efficacy, particularly abstinence-self efficacy, as an important mediator and/or predictor of treatment outcomes (Adamson et al., 2009; Gause et al., 2018; Hartzler et al., 2011; Maisto et al., 2015). One such study by Holzhauer et al. (2020) examined the relationship between abstinence self-efficacy and drinking outcomes for women randomized to two different forms of cognitive behavioral therapy to treat alcohol use disorder. Across treatment conditions, self-efficacy was an important mechanism in reducing drinking for this sample, even while controlling for other mechanisms such as social support and improvements in comorbid psychiatric symptoms. Witkiewitz et al. (2012) assessed the relationship between drink refusal skills and self-efficacy for individuals with alcohol dependence who received a cognitive behavioral intervention, and whether self-efficacy mediated the effectiveness of drink refusal training. They found that those who received the training had significantly fewer drinking days up to one year following treatment, and that this outcome was significantly mediated by self-reported abstinence self-efficacy (Witkiewitz et al., 2012).

As demonstrated by Witkiewitz et al. (2012), the temporal utility of self-efficacy in predicting substance use outcomes across time has been well demonstrated (Ilgen et al., 2005; Müller et al., 2019). One study which investigated SUD treatment outcomes for recently incarcerated individuals found that higher self-efficacy at post-treatment significantly predicted lower substance use at a two-year follow up (Majer et al., 2016). Likewise, Moos and Moos (2006) found that higher self-efficacy at baseline was predictive of remission three years following treatment, and that lower self-efficacy was predictive of relapse 16 years following

discharge. Recent meta-analyses and systemic reviews provide even further evidence for the strength of self-efficacy in predicting treatment outcomes for individuals with SUD (Kadden & Litt, 2011). One review by Sliedrecht et al. (2019) examined 25 studies that investigated the relationship between self-efficacy and alcohol use disorder relapse. They found that higher self-efficacy was significantly associated with lower relapse risk in 22 of the 25 studies (Sliedricht et al., 2019). Taken in aggregate, the literature indicates strong support for the importance of self-efficacy in SUD treatment.

As previously argued, mapping the underling mechanisms of evidence-based treatments for SUD is an essential step to advancing the efficacy of SUD treatments, as is replicating these findings to examine whether a given mechanism is shared across evidence-based treatments, or unique to any one particular evidence-based treatment (Hsiao et al., 2019; Lilienfeld, 2017; Witkiewitz et al., 2022). Examining the function of self-efficacy as a mechanism of behavior change within both cognitive-behavioral relapse prevention (RP) and mindfulness-based relapse prevention (MBRP) is one step in this direction.

RP is rooted in cognitive behavioral principles that offer a framework for individuals with SUD to first identify high-risk situations that precede relapse, then build cognitive and behavioral skills to reduce the risk of relapse in such situations (Witkiewitz & Marlatt, 2004). Since its foundation, RP has been widely implemented as an efficacious treatment for individuals with SUD (Irvin et al., 1999; Magill et al., 2019). Presently, there is some evidence to suggest that self-efficacy is one potential mechanism, among many, by which RP is effective (Hallgren et al., 2019; Kadden & Litt, 2011; Magill et al., 2019). Though, further research is needed to concertedly establish self-efficacy as a mechanism of behavior change within RP.

MBRP draws on components of RP (e.g., increasing awareness of risk factors for relapse and building skills to prevent relapse); however, MBRP differs via its foundation in mindfulness practices intended to enhance an individual's awareness of and ability to respond to high-risk situations with an accepting and non-judgmental attitude (Bowen et al., 2011). A growing body of literature has indicated at least equal, and at times greater, support for MBRP as an effective evidence-based treatment for SUD (Grant et al., 2017; Li et al., 2017; Witkiewitz et al., 2014). Korecki et al. (2020) recently reviewed 30 studies on the efficacy of mindfulness-based treatments for SUD, over half of which examined MBRP specifically, and concluded that there is significant evidence for MBRP as efficacious evidence-based treatment for a variety of SUD. Despite the growing body of literature on the effectiveness of MBRP in treating SUD, and support for self-efficacy in mediating SUD treatment outcomes within other evidence-based treatments like RP, there is no known research on the function of self-efficacy within MBRP.

As such, the present study aims to examine if self-efficacy is an important mechanism within MBRP specifically, and within SUD treatments broadly via exploratory secondary analysis of data from a clinical trial which compared the effectiveness of MBRP, RP, and a treatment as usual (TAU) condition (Bowen et al., 2014). Because self-efficacy is a treatment target within cognitive-behavioral treatments, and has been found to increase following engagement in RP (Holzhauer et al., 2020; Witkiewitz et al., 2012), we hypothesize that post-treatment self-efficacy scores will be highest for individuals assigned to the RP condition relative to the other two conditions. Notably, this was hypothesized in the original grant of the parent trial [NCT01159535] but has yet to be tested. We also hypothesize that post-treatment self-efficacy will mediate the relationship between RP and substance use outcomes at a 12-month follow-up. Despite the lack of research on self-efficacy in mindfulness-based SUD interventions,

but support for it as an important mechanism within other SUD treatments, we hypothesize that self-efficacy will additionally mediate the association between MBRP and 12-month substance use outcomes.

Method

Participants

Participants were 286 individuals (71.5% male; 48% Non-Hispanic White, 23% Black/African American, 13% Hispanic or Latino/a/x, 4% American Indian/Alaskan Native, 12% "other" or mixed or not specified) with average age of 38.45 (SD=10.92) recruited between October 2009 and July 2012 from two community substance use treatment facilities that provided detoxification, inpatient treatment, intensive outpatient treatment, and standard aftercare services. Participants had varying SUD and met the following inclusion criteria: age 18 years or older, English fluency, medical clearance, ability to attend treatment sessions, agreement to random assignment and follow-up assessments, and completion of initial intensive outpatient treatment or inpatient care. Exclusion criteria for the parent study were current psychotic disorder, dementia, suicidality, imminent danger to others, or participation in previous MBRP trials.

Procedures

Participants in the parent study were recruited following the completion of an initial inpatient or intensive outpatient treatment and were then randomized to receive one of the following aftercare treatment conditions: MBRP, RP, or TAU. These treatments are described in greater detail below. The present study included baseline (prior to randomization), post-treatment, and follow-up assessments at 6- and 12-months following completion of MBRP, RP, or TAU.

Measures

Drug Taking Confidence Questionnaire. The eight-item version of the Drug Taking Confidence Questionnaire (DTCQ-8) is a self-report questionnaire measuring abstinence self-efficacy (Sklar & Turner, 1999). The DTCQ-8 asks participants to rate their confidence in their ability resist an urge to drink heavily or use other drugs in eight different high-risk situations. A DTCQ-8 score was computed by taking the mean of items rated on a six-point Likert-type response scale with range of mean scores of 0 to 5. Internal consistency reliability of the DTCQ-8 was excellent at all timepoints ($\Omega = .89$ at baseline to $\Omega = .96$ at 12-month post-treatment).

Timeline Follow-back. The Timeline Follow-back is a well-validated calendar-based interview method to assess alcohol and drug use over the 90-day period prior to assessment (Sobell & Sobell, 1992). Measures of quantity and frequency were obtained, and summary statistics were generated including the number of drug use days and number of heavy drinking days, defined as greater than 4/5 standard drinks for women/men.

Interventions

The MBRP and RP interventions were delivered by research study staff, and the TAU intervention was delivered by clinical staff at the community treatment facilities. Treatment adherence to the RP and MBRP interventions was established by weekly supervision and adherence and competence was rated as good by independent raters (see Bowen et al., 2014 for more details).

Mindfulness-based relapse prevention. The MBRP intervention was delivered as described in the MBRP Clinician's Guide (Bowen et al., 2011). Participants received MBRP in group format, attending one 2-hour group per week over the course of eight weeks. MBRP groups were facilitated by two therapists who were either clinical psychologists, in a doctoral

training program, or had master's degrees. All MBRP therapists had a personal mindfulness practice, including attendance at intensive mindfulness meditation retreats. MBRP sessions included guided formal mindfulness practices, discussion of personal experiences during practice, and additional practice and discussion related to core themes. Examples of themes included are: autopilot and relapse, noticing triggers and urges, mindfulness in challenging situations, acceptance, and skillful action. Sessions also included discussion of the applications of formal and informal mindfulness practice in daily life. While MBRP does not directly target self-efficacy, repeated application of learned skills in higher-risk situations and resulting shifts in reactivity may strengthen a client's sense of self-efficacy. Participants were given audio-recordings of mindfulness practices for suggested daily practice between sessions.

Relapse prevention. The RP intervention was based on cognitive-behavioral relapse prevention treatment manuals (Daley & Marlatt, 2006; Monti et al., 2002) and matched the MBRP intervention in terms of time, format, size, location, amount of assigned homework, and therapist credentials. RP sessions covered topics including managing high-risk situations, cognitive and behavioral coping skills, problem solving, goal setting, self-efficacy, and building social support. Participants were asked to monitor their craving and mood daily.

Treatment as usual. The TAU intervention was based primarily on an Alcoholics/Narcotics Anonymous 12-step program (Alcoholics Anonymous, 1952). TAU groups were process-oriented and abstinence-based, with facilitated discussion on recovery-oriented topics such as communication and stress management. The TAU intervention was delivered one or two times per week in 90-minute sessions.

Data Analyses

The statistical analyses for the current study followed the approach of the parent study

(Bowen et al., 2014). All models were estimated using robust maximum likelihood estimation in Mplus, version 8.6, with a sandwich estimator to adjust standard errors for individuals clustering within treatment cohorts. Maximum likelihood estimation is a preferred method for handling missing data under the assumption that data are missing at random (Hallgren & Witkiewitz, 2013). For the self-efficacy outcome, 1%, 38%, 34%, and 33% of participants were missing DTCQ-8 measures at baseline, post-treatment, 6-months, and 12-months respectively. However, all individuals who contributed self-efficacy and substance use data at any time point were included in the variance-covariance matrix under the missing at random assumption of maximum likelihood estimation. Age was significantly associated with missing data at the 12-month follow-up and, as such, was included in the current study as a covariate. Notably, akin to the analyses of the main outcomes paper of the parent trial (Bowen et al., 2014), we did not include 6-month drinking and drug use outcomes as covariates in the present analyses. Five individuals were missing data on covariates for a final analysis sample of n=281.

Intent-to-treat analyses were conducted using sample size–weighted orthogonal contrasts between RP and MBRP vs TAU (contrast 1) and MBRP vs RP (contrast 2, with TAU set at 0) as the independent variables. The first contrast gives RP and MBRP the same weight, and then compares them to TAU, whereas the second contrast compares MBRP to RP. Drug use and heavy drinking days in the 90-day period before the 12-month follow-up were the outcome variables. Drug use and heavy drinking were non-normally distributed and were estimated using a negative binomial hurdle distribution, which simultaneously estimates the logistic outcome (e.g., drug use vs no drug use, with the logistic portion predicting no drug use) and the count outcome (e.g., days of use).

Latent growth curve modeling. We used latent growth curve models to examine

changes in self-efficacy measured by the DTCQ-8 assessed at baseline, post-treatment, 6-, and 12-month follow-ups. The time scores were set with the intercept at post-treatment (baseline = -0.5, post-treatment = 0.0, 6-month follow-up = 1.5, 12-month follow-up = 3.0), such that associations with the intercept of the growth model reflected associations with post-treatment self-efficacy. First, we estimated an unconditional latent growth curve model of self-efficacy without covariates to ascertain whether the model provided a reasonable fit to the data. Model fit was assessed using the model χ^2, root mean square error of approximation (RMSEA), and comparative fit index (CFI). Conventions for these fit indices recommend non-significant χ^2, RMSEA<.06, and CFI>.96 as indicating acceptable fit of the model to the data.

Mediation analyses. Mediation was tested within the context of a latent growth mediation model, which provided a test of whether self-efficacy at post-treatment (intercept) and change in self-efficacy over time (slope) mediated the statistical association between treatment and both drug use and heavy drinking outcomes, with drug use and heavy drinking tested in separate models. The product of coefficients approach (MacKinnon, 2008; MacKinnon et al., 2002) was used to estimate the indirect effect of treatment conditions in predicting drug use and heavy drinking outcomes via the intercept and slope of self-efficacy, as shown in Figure 1. Standardized effect size measures (Miočević et al., 2018) for the indirect effects were calculated for the count outcome (days of use/heavy drinking, incident rate ratios) and logistic outcome (any use/heavy drinking, odds ratios) with 95% confidence intervals. The incident rate ratio can be interpreted as percentage increase (above 1.0) or decrease (below 1.0) in drug use or heavy drinking days for a 1-unit increase in the indirect effect. The odds ratio can be interpreted as the increase (above 1.0) or decrease (below 1.0) in the odds of not using drugs or not engaging in heavy drinking for a 1-unit increase in the indirect effect. We also calculated the proportion of

variance explained by the model with and without the mediator using model estimated R^2.

Results

Participant characteristics on variables included in the current study are presented in Table 1. As reported previously (Bowen et al., 2014), there were no significant treatment group differences on demographic measures or follow-up retention rates, and treatment explained a small amount of variance in 12-month drug use (R^2=.04) and heavy drinking (R^2=.04).

Latent growth curve modeling. An unconditional latent growth curve model with a linear slope of self-efficacy scores over time provided an excellent fit to the data (n=281; χ^2 (5)=6.91, p=0.23; RMSEA=0.037; CFI=0.98). The intercept (i.e., mean self-efficacy at post-treatment) was significantly different from zero (B(SE)=4.033 (0.04), p<0.001) and the slope was not significantly different from zero (B(SE)=-0.04 (0.03), p=0.20). In other words, individuals were at very high levels of self-efficacy at post-treatment (maximum score of 5, on a 0 to 5 scale) and reported a non-significant decrease in scores over time. The variances of the intercept and slope were both significant, indicating significant variability in individual growth curves (intercept variance: B(SE) =0.54 (0.10), p<0.001; slope variance: B(SE)=0.10 (0.02), p<0.001).

Mediation analyses. Results from the latent growth mediation models indicated several significant effects (i.e., a- and b-paths in Figure 1) and the model explained additional variance in 12-month drug use (R^2=.24) and heavy drinking (R^2=.20). For the a-paths, there was a significant effect of RP and MBRP vs. TAU (contrast 1) and MBRP vs. RP (contrast 2) in predicting the intercept (mean self-efficacy at post-treatment; see Tables 2 and 3). Those who received MBRP or RP had greater self-efficacy at post-treatment as compared to those who received TAU, and those who received MBRP had greater self-efficacy as compared to those

who received RP. Treatment was not associated with change in self-efficacy over time.

For the b-paths, there were significant effects of the intercept and change in self-efficacy (slope) in predicting drug use (Table 2) and heavy drinking (Table 3) at the 12-month follow-up. Those with greater self-efficacy at post-treatment (intercept) had a higher probability of no drug use and no heavy drinking days, and also fewer days of heavy drinking among those who drank heavily. Those who experienced greater increases in self-efficacy over time (slope) also had a higher probability of no drug use and no heavy drinking days, and fewer days of drug use among those who used drugs.

Indirect effect estimates indicated that for the drug use model (Table 2), there were significant indirect effects of post-treatment self-efficacy mediating the effect of treatment condition in predicting no drug use, with both MBRP and RP versus TAU and MBRP versus RP associated with greater post-treatment self-efficacy, which predicted a higher probability of no drug use. Namely, participants in the MBRP condition reported the highest levels of post-treatment self-efficacy which was associated with a higher probability of no drug use, followed by RP and TAU, respectively. For the heavy drinking model (Table 3), post-treatment self-efficacy significantly mediated the effect of treatment condition in predicting heavy drinking days, with MBRP and RP versus TAU and MBRP versus RP associated with greater post-treatment self-efficacy, which predicted fewer heavy drinking days. In this model participants in the MBRP condition once again reported the highest levels of post-treatment self-efficacy which was associated with fewer days of heaving drinking, followed by RP and TAU, respectively. Self-efficacy did not significantly mediate the effect of treatment condition in predicting the probability of no heavy drinking.

Discussion

The main hypothesis of the original grant for the parent study was that individuals assigned to the RP aftercare treatment condition would indicate higher self-efficacy scores as measured by the DTCQ-8 at follow up compared to those assigned to a MBRP or TAU condition. Contrary to this hypothesis, individuals assigned to MBRP indicated higher self-efficacy, on average, than individuals assigned to both the RP or TAU condition across all points of follow-up (see Table 1) and had significantly higher self-efficacy at post-treatment.

Although individuals assigned to MBRP consistently averaged higher post-treatment self-efficacy compared to individuals in the two other treatment conditions, it is important to note that there was a non-significant decrease in self-efficacy scores in all conditions following treatment. This decrease is understandable given that participants were recruited into each treatment arm directly following discharge from intensive outpatient or residential treatment for SUD, an environment in which participants encountered a high level of support for resisting substance use and thus may strengthen confidence to abstain (Burling et al., 1989). As individuals are confronted with life stressors and increased opportunities for substance use following discharge from treatment, it is possible for self-efficacy to decrease. However, this may not always be the case following substance use treatment. For example, across several clinical trials for alcohol treatment, self-efficacy, on average, increased after treatment and those gains were maintained throughout 12 months, with some variation among treatment conditions (Kruger et al., 2020). Nonetheless, the results of the present study underscore the potential utility of MBRP in maintaining self-efficacy gains acquired during intensive inpatient/outpatient treatment. This is notable given previous research has shown sufficient support of RP in eliciting gains in self-efficacy (Hallgren et al., 2019, Kadden & Litt, 2011; Magill et al., 2019), yet the results of the

current study support MBRP as potentially superior to RP in sustaining self-efficacy for individuals with SUD.

Given the evidence for self-efficacy as a mechanism of behavior change across evidence-based treatments for SUD, the second hypothesis of the present study was that post-treatment self-efficacy would mediate the effect of treatment condition on substance use outcomes at a 12-month follow-up. As hypothesized, the results of our analysis confirmed self-efficacy mediated the association between treatment condition and substance use outcomes at a 12-month follow-up across all conditions. Specifically, the data showed indirect effects of post-treatment self-efficacy for MBRP and RP vs TAU (contrast 1; see Tables 2 and 3) in mediating the association of treatment condition and amounts of heavy drinking and substance use frequency. Given that self-efficacy scores were consistently highest in the MBRP condition compared to the RP condition, and the statistical significance of contrast 2 (MBRP vs RP; see Tables 2 and 3), it is clear that MBRP is driving the difference found in contrast 1. In other words, MBRP predicted higher self-efficacy at post-treatment compared to both RP and TAU, and this greater self-efficacy mediated the relationship between treatment and substance use outcomes. These results confirm our second hypothesis and lend support to self-efficacy as a potential mechanism of behavior change within MBRP.

Notably, the data from the clinical trial from which the present secondary analyses were derived has not only provided evidence for other potential mechanisms of behavior change within MBRP such as approach coping (Roos et al., 2020), mindfulness, and trait psychological flexibility (Mallik et al., 2021), but has also been used to explore differences in the efficacy of MBRP between racial groups (Witkiewitz et al., 2013), among individual gender and group gender composition (Roos et al., 2019), and as a function of baseline depression and anxiety

symptom severity (Roos et al., 2017). Taken together, the results of the present study further contextualize the nuanced mechanisms and interactions found within MBRP broadly, while also adding to existing literature on MBRP established via this clinical trial specifically.

Limitations and Future Research

Despite the findings of the present study supporting self-efficacy as a potential mechanism of MBRP, our results are not without limitations. First and foremost, establishment of mediation alone is not sufficient to establish a mechanism of behavior change. It is important to differentiate statistical mediation from the stipulation of casual mechanisms of change (Witkiewitz et al., 2022). Mediation amounts to the achievement of a certain set of statistical conditions, namely that the addition of a third variable which carries the significant effect found between two previously correlated variables (MacKinnon et al., 2002). This significant mediating effect alone does not imply causality. As such, we cannot conclude that self-efficacy *caused* the decrease in alcohol and drug use outcomes within our sample. Rather, the current study identified an *association* between treatment condition and substance use outcomes with self-efficacy mediating this association.

Additionally, we cannot rule out the possible existence of additional constructs (i.e., confounders) not captured by our model that may influence this association (Tofighi et al., 2019). For example, Kelly and Claire Green (2014) found significant moderating effects of motivation on self-efficacy and substance use outcomes. Their analysis found that for young adults undergoing residential treatment for SUD, the association between self-efficacy and percent of days abstinent following treatment was significantly influenced by their level of motivation, with motivation having a substantial effect for individuals with low self-efficacy (Kelly & Claire Green, 2014). Furthermore, the literature is unclear on whether the association

between self-efficacy and substance use outcomes is linear (i.e., self-efficacy affects substance use outcomes) or reciprocal (i.e., each factor affects the other in a bidirectional relationship) (Kadden & Litt, 2011; Majer et al., 2016). For example, in investigating mechanisms of behavior change for women with alcohol use disorder, Hallgren et al. (2019) found that while self-efficacy did appear to facilitate maintained behavioral change over time, initiating abstinence also facilitated increases in self-efficacy. The present study cannot discern the directionality of the association between self-efficacy and substance use outcomes. Future research will benefit by identifying the directionality of the association between self-efficacy and substance use outcomes within MBRP specifically, and evidence-based treatments generally. Furthermore, to support the legitimacy of self-efficacy as a mechanism of MBRP, future research will benefit from employing quantitative approaches that test mechanisms of change over time and in context of biopsychosocial and cultural factors (Baum, 2002; Córdoba-Salgado, 2017).

Importantly, the DTQC-8 measured participants levels of abstinence self-efficacy (i.e., one's confidence in abstaining from substance use). The use of this measure does not negate the findings of the present study, especially considering that higher levels of post-treatment self-efficacy as measured by DTQC-8 were associated with fewer numbers of heavy drinking days for those who engaged in alcohol use. However, it does bring some question to the predictive utility of abstinence self-efficacy for individuals with non-abstinent recovery goals in promoting the accomplishment of non-abstinent goals. Although there is no clear reason to doubt the utility of self-efficacy for individuals with moderation goals, future research that utilizes measures of self-efficacy that are not exclusively abstinence-based is recommended. Including such measures will further clarify the utility of self-efficacy for those with moderation goals.

Additionally, although the present sample comprised approximately 50% non-Hispanic White and 50% non-White individuals, it is important to consider potential differences in the function of self-efficacy on substance use treatment outcomes between individuals from different demographic backgrounds. Although prior research indicates MBRP may be more effective for individuals from marginalized groups (Greenfield et al., 2018; Witkiewitz et al., 2013), future research on the role of self-efficacy in promoting beneficial treatment outcomes for marginalized individuals is needed. Individuals from marginalized groups often face increased disparities in mental health and substance use as a result of discrimination and decreased access to resources (McGuire & Miranda, 2008; McKnight-Eily et al., 2021; Williams, 2016). Exploring the potential implications of this may offer further insight into the role of self-efficacy within MBRP.

Finally, although it is not possible to delineate precisely why MBRP predicts higher self-efficacy than RP and TAU based on our data, inferences can be drawn from previous literature on both MBRP and mindfulness-based approaches generally. There is evidence that mindfulness skills, specifically the facets of non-judgment and acceptance found within traditional mindfulness practices, promote the acceptance of challenging emotions via constructs such as psychological flexibility and cognitive diffusion (Brandon et al., 2021; Shorey et al., 2017). Because negative affect has been found to be a common antecedent of relapse (Sliedrecht et al., 2019; Witkiewitz., 2015), it is possible that the acceptance skills cultivated within the mindfulness practices of MBRP may promote the capacity of individuals to turn towards (i.e., accept), rather than push away (i.e., resist or react to) challenging emotions. As an individual gains experience accepting verses resisting or reacting to challenging emotions, one may gain confidence (i.e., self-efficacy) in their capacity to respond to such emotions in a skillful versus

reactive or habitual way. Additionally, it is possible that the loving-kindness practices in MBRP naturally increase one's belief in their ability to achieve their recovery goals, while also decreasing the likelihood of shame and self-doubt in triggering relapse (Sawer et al., 2020; Yu-Hsin Liao et al., 2021). Future research on MBRP would benefit from delineating the precise facets of the modality that drive beneficial effects on both self-efficacy and overall treatment effects at various timepoints, both cross-sectionally and longitudinally. Doing so may further support clinicians in providing the most efficient and efficacious care possible.

Self-efficacy is an important treatment target for individuals with SUD in attaining recovery. Our study tested whether self-efficacy varied across three aftercare treatment conditions and whether this difference mediated treatment outcomes. Results highlight the utility of MBRP as an aftercare treatment intervention in sustaining self-efficacy gains acquired during primary SUD treatment. Individuals who engaged in MBRP had fewer heavy drinking days and a lower likelihood of engagement in drug use compared to those engaged in RP or a TAU condition, and self-efficacy mediated this association. Our findings lend support to the validity of self-efficacy as a potential mechanism of behavior change within MBRP.

Conflicts of Interest Statement: The authors have no conflicts of interest to declare.
Ethics Statement: All procedures of the parent trial were approved by the University of Washington Institutional Review Board.
Informed Consent Statement: Written informed consent was obtained from all participants of the parent trial.

Author Contributions

DML: wrote the manuscript and collaborated on the analyses of the present study. ES: collaborated in the writing and editing of the final manuscript, specifically regarding the methods section. SB: conceptualized the study and collaborated in the writing and editing of the final manuscript. KW: conceptualized the study, conducted the analyses of the present paper, and collaborated on the writing and editing of the final manuscript.

Data Availability Statement: We are unable to publicly make available data as participants did not explicitly consent to public data sharing and public data sharing was not in our protocol. However, we have made available the analyses of the present secondary analysis (code and output) on the Open Science Framework (https://osf.io/9mf6v/).

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Appendix

Table 1

Descriptive statistics for self-efficacy and outcomes by treatment group

Measure	Total	TAU	RP	MBRP	
	M (SD)	M (SD)	M (SD)	M (SD)	Cohen's f
DTCQ baseline	4.09 (1.01)	3.98 (1.03)	3.99 (1.13)	4.29 (0.84)	0.14
DTCQ post-treatment	3.93 (1.25)	3.70 (1.19)	3.80 (1.34)	4.21 (1.17)	0.18
DTCQ 6-months	3.97 (1.35)	3.84 (1.52)	3.96 (1.27)	4.08 (1.26)	0.08
DTCQ 12-months	3.92 (1.39)	3.77 (1.55)	3.94 (1.3)	4.04 (1.35)	0.08
Drug use days	4.50 (16.64)	4.63 (16.03)	6.01 (18.93)	3.06 (15.08)	0.07
Heavy drinking days	3.27 (11.92)	4.64 (14.93)	3.83 (12.10)	1.44 (7.66)	0.12

Note. DTCQ = Drug Taking Confidence Questionnaire; TAU = Treatment as usual; RP = Relapse Prevention; MBRP = Mindfulness-Based Relapse Prevention; Cohen's f is a measure of effect size where f = 0.10 is often considered a small effect and f = 0.25 is considered a medium effect.

Table 2

Latent growth mediation model results with unstandardized (B) and standardized (β) path coefficients of treatment in predicting drug use via self-efficacy (*N*=281)

Direct effects	B (SE)	*p*-value	β
Intercept self-efficacy mean	**4.03 (0.04)**	**<0.001**	
Slope self-efficacy mean	-0.04 (0.04)	0.21	
Intercept self-efficacy variance	**0.55 (0.10)**	**<0.001**	
Slope self-efficacy variance	**0.10 (0.02)**	**<0.001**	
Contrast 1 → intercept (a-path)	**0.05 (0.01)**	**<0.001**	**0.07**
Contrast 2 → intercept (a-path)	**0.10 (0.04)**	**0.005**	**0.13**
Contrast 1 → slope (a-path)	-0.001 (0.02)	0.96	-0.003
Contrast 2 → slope (a-path)	-0.02 (0.02)	0.23	-0.07
Intercept → drug use days (b-path)	-0.39 (0.59)	0.52	-0.29
Intercept → no drug use (b-path)	**0.80 (0.21)**	**<0.001**	**0.29**
Slope → drug use days (b-path)	-0.95 (0.45)	0.04	-0.30
Slope → no drug use (b-path)	2.23 (1.04)	0.03	0.34
Contrast 1 → drug use days	-0.18 (0.12)	0.15	-0.18
Contrast 2 → drug use days	-0.25 (0.18)	0.19	-0.25
Contrast 1 → no drug use	-0.01 (0.17)	0.94	-0.01
Contrast 2 → no drug use	0.29 (0.22)	0.19	0.14

Indirect effects	B (SE)	*p*-value	IRR/OR (95% CI)
Contrast 1 → intercept → no drug use	0.04 (0.02)	0.04	1.04 (1.002, 1.08)
Contrast 2 → intercept → no drug use	0.08 (0.03)	0.02	1.08 (1.01, 1.16)

Note. Contrast 1 = RP and MBRP vs. TAU; Contrast 2 = MBRP vs. RP. Indirect effects were only estimated for significant a- and b-paths **in bolded font**. IRR = incident rate ratio, which can be interpreted as percentage increase (above 1.0) or decrease (below 1.0) in drug use days for a 1-unit increase in the predictor. OR = odds ratio, which can be interpreted as the increase (above 1.0) or decrease (below 1.0) in the odds of not using drugs for a 1-unit increase in the predictor. All models included age as a covariate, which was grand mean centered.

Table 3

Latent growth mediation model results with unstandardized (B) and standardized (β) path coefficients of treatment in predicting heavy drinking via self-efficacy (*N*=281)

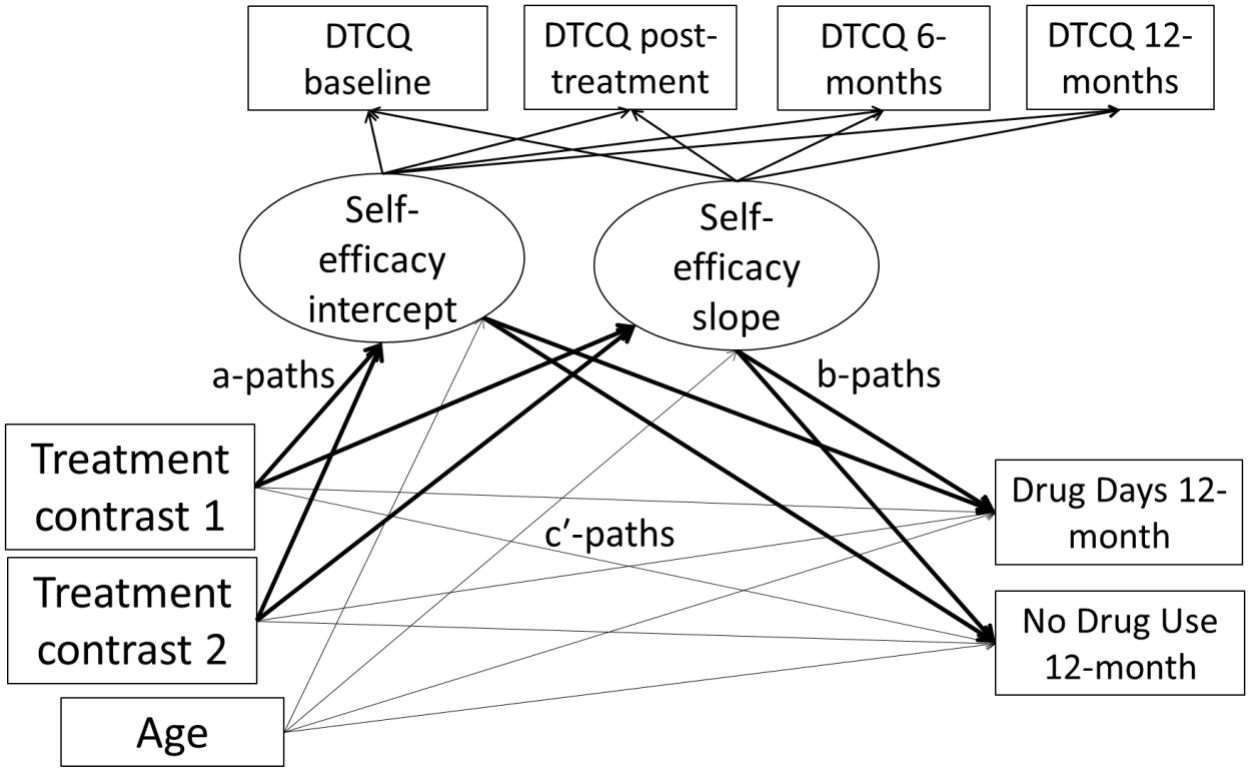
Direct effects	B (SE)	*p*-value	β
Intercept self-efficacy mean	**4.04 (0.04)**	**<0.001**	
Slope self-efficacy mean	-0.05 (0.03)	0.19	
Intercept self-efficacy variance	**0.55 (0.10)**	**<0.001**	
Slope self-efficacy variance	**0.10 (0.02)**	**<0.001**	
Contrast 1 → intercept (a-path)	**0.05 (0.01)**	**<0.001**	**0.06**
Contrast 2 → intercept (a-path)	**0.10 (0.03)**	**0.005**	**0.13**
Contrast 1 → slope (a-path)	-0.001 (0.02)	0.96	-0.002
Contrast 2 → slope (a-path)	-0.02 (0.02)	0.20	-0.07
Intercept → heavy drinking days (b-path)	**-0.93 (0.26)**	**<0.001**	**-0.70**
Intercept → no heavy drinking (b-path)	**0.53 (0.24)**	**0.03**	**0.20**
Slope → heavy drinking days (b-path)	-1.48 (0.78)	0.06	-0.46
Slope → no heavy drinking (b-path)	1.80 (0.84)	0.03	0.28
Contrast 1 → heavy drinking days	-0.16 (0.17)	0.33	-0.16
Contrast 2 → heavy drinking days	-0.11 (0.44)	0.81	-0.11
Contrast 1 → no heavy drinking	0.14 (0.13)	0.27	0.07
Contrast 2 → no heavy drinking	0.41 (0.14)	0.003	0.20

Indirect effects	B (SE)	*p*-value	IRR/OR (95% CI)
Contrast 1 → intercept → heavy drinking days	-0.05 (0.02)	0.040	0.96 (0.92, 0.99)
Contrast 2 → intercept → heavy drinking days	-0.08 (0.04)	0.046	0.92 (0.84, 0.99)
Contrast 1 → intercept → no heavy drinking	0.03 (0.01)	0.050	1.03 (1.00, 1.05)
Contrast 2 → intercept → no heavy drinking	0.05 (0.03)	0.120	1.05 (0.99, 1.11)

Note. Contrast 1 = RP and MBRP vs. TAU; Contrast 2 = MBRP vs. RP. Indirect effects were only estimated for significant a- and b-paths **in bolded font**. IRR = incident rate ratio, which can be interpreted as percentage increase (above 1.0) or decrease (below 1.0) in heavy drinking days for a 1-unit increase in the predictor. OR = odds ratio, which can be interpreted as the increase (above 1.0) or decrease (below 1.0) in the odds of not engaging in heavy drinking for a 1-unit increase in the predictor. All models included age as a covariate.

Figure 1

Mediation model of treatment being associated with drug use outcomes via an indirect effect of self-efficacy at post-treatment (intercept) and change in self-efficacy (slope) over time.



Note. Paths related to the mediation analysis highlighted in bold. Treatment contrast 1 = RP and MBRP vs. TAU; Treatment contrast 2 = MBRP vs. RP. Drug use model is shown, and the same model was estimated for heavy drinking outcomes.