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Approach coping and substance use outcomes following mindfulness-based relapse prevention among individuals with negative affect symptomatology

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Abstract

Objectives: Mindfulness-based relapse prevention (MBRP) for substance use disorders (SUDs) appears to be particularly effective among individuals with high levels of co-occurring affective symptoms. We sought to understand whether changes in approach and avoidance coping may explain the effects of MBRP among this subpopulation.

Method: The sample included 286 individuals with SUDs randomized to MBRP, relapse prevention (RP), or treatment-as-usual (TAU) as an aftercare treatment. We conducted conditional indirect effect models with treatment condition as the predictor, baseline affective symptoms as the moderator, changes in approach and avoidance coping over time from baseline through 6-months post-treatment as mediators, and substance use and substance-related problems at 12-months post-treatment as the outcome. Affective symptomatology at baseline was modeled as a latent factor indicated by depression, anxiety, and PTSD symptoms. Change in approach and avoidance coping was modeled using latent growth curve analyses.

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Author Contributions

All authors contributed to the study conceptualization and design. CRR conducted the data analyses and wrote the initial drafts of the results and discussion sections. KW and SB contributed the oversight of the data analyses and study execution, and the writing and editing of the final manuscript.

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Compliance with Ethical Standards

This paper is a secondary analysis of data from a clinical trial. The original clinical trial was approved by the University of Washington Institutional Review Board. All procedures were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. All participants enrolled in the study gave their informed consent prior to their inclusion in the study.

Conflicts of Interests

Drs Bowen and Witkiewitz conduct MBRP trainings for which they receive monetary incentives, although the findings presented in this article have not yet been presented as part of these trainings. No other authors have conflicts and there has been no significant financial support for this work that could have influenced its outcome.

Results: We found significant conditional indirect effects of MBRP, such that the interaction of MBRP vs. TAU by affective symptoms predicted increases in approach coping, which in turn predicted fewer heavy drinking days and substance-related problems at month 12. Follow-up analyses showed that increases in approach coping mediated the therapeutic effect of MBRP on these outcomes among those with high, but not low or moderate, affective symptoms. We did not find indirect or conditional indirect effects when comparing RP to TAU, or when avoidance coping was the mediator.

Conclusions: The pronounced therapeutic effects of MBRP among individuals with SUD and relatively higher negative affective symptoms may be due to increases in approach coping over time.

Keywords

mindfulness-based relapse prevention; substance use disorder; conditional indirect effects; approach coping; latent growth curve models

Mindfulness-based relapse prevention (MBRP) (Bowen et al. 2011) is a manual-guided, group-delivered behavioral intervention for reducing the risk and severity of substance use relapse among individuals with substance use disorders (SUDs). As a mindfulness-based intervention, a cornerstone of MBRP is training in formal mindfulness meditation. A key focus of MBRP is assisting individuals in becoming more aware and accepting of subjective experiences that may precipitate substance use, such as distressing emotions, thoughts, and physical sensations (Witkiewitz et al. 2014). Although MBRP is still a relatively new treatment, the evidence base supporting its efficacy is steadily growing (Goldberg et al. 2018; Grant et al. 2017; Wilson et al. 2017). The largest and most rigorous study of MBRP was a randomized clinical trial (RCT; N = 286) comparing MBRP, relapse prevention (RP), and treatment as usual (TAU) in the context of outpatient aftercare treatment among individuals stepping down from more intensive SUD treatment (Bowen et al. 2014). This study found that MBRP resulted in lower rates of substance use one-year following treatment than both comparison treatment groups.

We recently conducted a secondary analysis using data from the abovementioned trial (Bowen et al. 2014), as well as data from an earlier pilot RCT (Bowen et al. 2009), to evaluate whether MBRP, relative to RP and TAU, was more or less efficacious among certain types of individuals. Results from these analyses showed that in both trials MBRP had particularly high effect sizes among individuals with relatively high levels of co-occurring depressive and anxiety symptoms (Roos et al. 2017a). The notion that MBRP may be most effective among individuals with high levels of affective symptoms is supported by other empirical studies as well. For example, in an earlier secondary data analysis, MBRP weakened the association between post-treatment depressive symptoms and follow-up substance craving, which in turn predicted lower rates of substance use at follow-up (Witkiewitz & Bowen 2010). Similarly, among individuals with stimulant use disorders, those with depression or anxiety disorder diagnoses had a better treatment response to MBRP (Glasner et al. 2017). In the broader literature, there is evidence that mindfulness-based cognitive therapy for depression may be most effective among those with more severe depression (Kuyken et al. 2016; Piet & Hougaard 2011). The mindfulness stress-buffering

account also proposes that mindfulness training may be most beneficial in high-stress populations (Creswell & Lindsay 2014).

Despite these prior promising findings, to date there is a lack of studies on *why and how* MBRP may be more effective among individuals with co-occurring SUDs and high levels of affective symptoms. That is, while it is evident that MBRP may be especially helpful for this subpopulation, no studies have evaluated specific mechanisms of change that might be more strongly mobilized in MBRP among those with higher affective symptoms, relative to those with lower affective symptoms. Importantly, studying mechanisms of change in MBRP, and the contextual conditions that might influence these mechanisms, can advance the precision delivery of MBRP in real-world clinical practice (Longabaugh & Magill, 2011; Kazdin, 2007).

The extent to which self-regulation mechanisms function as therapeutic mechanisms in a given treatment may depend on certain contextual demands (i.e., any internal or external contextual condition an individual is embedded in that may warrant self-regulation), such as the severity of one's primary diagnosis, comorbid symptomatology, or environmental stressors (Roos & Witkiewitz 2017). This contextual model posits that improvement in self-regulation skills would be more likely to function as a therapeutic mechanism among individuals with higher levels of demands at the outset of treatment. That is, individuals with the greatest levels of current demands may have the greatest need to modulate their self-regulatory behavior to effectively manage these demands and achieve desired levels of functioning. It is therefore plausible that improvement in self-regulation factors, such as coping, may explain the strong effect of MBRP among individuals with higher levels of co-occurring affective symptoms at the outset of treatment.

Coping is a broad term that refers to the process of consciously engaging in efforts to manage ongoing demands or stressors (Carver & Connor-Smith 2010; Lazarus & Folkman 1984). One particular classification of coping is the distinction between approach and avoidance coping (Moos & Holahan 2003). Approach coping refers to efforts to directly manage ongoing demands, such as making a plan of action for achieving a desired outcome, seeking out guidance and support from others, or reframing the perceived meaning or significance of a situation. Avoidance coping refers to efforts to manage ongoing demands through *indirect* means, such as trying to not think about a problem, distracting oneself with other activities, denying that one has any personal control over a problem, or discharging one's emotions via any means possible. Among individuals with SUDs, approach coping has generally been associated with better substance use treatment outcomes, whereas avoidance coping has generally been associated with worse outcomes (Chung et al. 2001; Moos et al. 1990; Moggi et al. 1999).

Theory and empirical research to date provides support for approach coping as a plausible candidate mechanism of change in MBRP. Several theoretical accounts of the mechanisms of mindfulness training include the hypothesis that mindfulness training enhances approach-oriented coping (Brown & Ryan 2003; Garland et al. 2015a; Garland et al. 2017a; Shapiro et al. 2006). These theories contend that mindfulness training may facilitate greater "distancing" from, and nonreactivity to, distressing thoughts and feelings arising from

stressful circumstances, as well as clearer awareness and recognition of internal and external contextual circumstances, which in turn support the ability to cope with a stressful situation in a non-reflexive, flexible, and direct manner. Empirical studies to date, largely among individuals without SUDs, demonstrate effects of mindfulness training on approach coping. For example, numerous studies have found that higher trait mindfulness is associated with greater approach-oriented coping (Brown et al. 2015; Garland et al. 2017c; Garland et al. 2011; Garland et al. 2009; Garland et al. 2017b; Hanley et al. 2017; Hanley et al. 2014; Weinstein et al. 2009; Wu & Buchanan 2019;). Moreover, several studies show that mindfulness training increases approach-oriented coping (Donald & Atkins 2016; Halland et al. 2015; Henderson et al. 2012; de Vibe et al. 2018; Garland et al. 2015b; Rayan & Ahmad 2016; Garland et al. 2014).

There is also support for avoidance coping as a plausible candidate mechanism of change in MBRP. Existing theories posit that mindfulness training reduces reliance on avoidance coping by fostering greater willingness and ability to tolerate or remain in contact with distressing thoughts and feeling related to ongoing stressors (Garland et al. 2017a; Lindsay & Creswell 2017; Shapiro et al. 2006). Empirical work shows that higher trait mindfulness is associated with less frequent use of avoidance-oriented coping (Weinstein et al. 2009; Wu & Buchanan 2019), and that mindfulness training has a significant effect on reducing avoidance-oriented coping (Cousin & Crane 2016; de Vibe et al. 2018; Donald & Atkins 2016).

One empirical study suggests a stronger influence of mindfulness training on approach and avoidance coping among individuals with greater demands, relative to individuals with fewer demands. The Donald et al. (2016) study found that brief mindfulness training had the strongest effects in increasing approach coping and decreasing avoidance coping among individuals with higher levels of perceived stress. This study aligns with the notion that contextual demands may moderate the effect of behavioral treatments on self-regulatory mechanisms of change.

The primary aim of the current study was to evaluate whether MBRP interacts with baseline affective symptoms in its indirect (i.e., mediated) effect on substance use outcomes via changes in approach and avoidance coping. Figure 1 provides the conceptual framework guiding this study. We used data from a RCT comparing MBRP, cognitive-behavioral relapse prevention (RP), and treatment as usual (TAU) as outpatient aftercare treatments (Bowen et al. 2014). Our main hypothesis was that the effect of MBRP on 12-month post-treatment outcomes would be mediated by increases in approach coping and decreases in avoidance coping over time from baseline through the 6-month follow-up, but only among individuals with higher baseline negative affective symptoms, relative to those with lower baseline affective symptoms. The inclusion of standard RP as a comparison treatment in the parent RCT offered the opportunity to test whether our hypothesized conditional indirect effect was specific to MBRP, or whether it might be the case that this same conditional indirect effect could be found for another skills-focused behavioral therapy for SUD, such as RP. Thus, our analytic plan prioritized two treatment contrasts, MBRP vs. TAU and RP vs. TAU, for all conditional indirect effect models and follow-up analyses.

Method

Participants

The parent trial for the current secondary data analysis was a RCT in which 286 individuals with SUDs were randomly assigned to one of three outpatient aftercare treatments for SUD: MBRP (n = 103), RP (n = 88), or TAU (n = 95) (Bowen et al. 2014). Inclusion criteria included: age 18 or older, fluency in English, medical clearance, ability to attend treatment sessions, agreement to random assignment, and prior completion of either intensive outpatient or inpatient SUD treatment. Exclusion criteria included: current psychotic disorder, dementia, suicidality, imminent danger to others, or participation in prior MBRP trials. Table 1 provides descriptive data on demographic and study variables for the sample. The majority of the sample (82.4%, n = 234) indicated polysubstance use, defined as reporting two or more primary drugs of choice at baseline.

Procedures

The parent trial was conducted across two clinical sites within the same community SUD treatment agency. MBRP involved eight weekly 2-hour closed-cohort group sessions. MBRP includes guided in-session mindfulness meditations and imaginal exposure exercises, inquiry-based discussion about participants' experiences during and following exercises, guided discussion about how mindfulness principles relate to recovery, some CBT-based home practices (e.g., monitoring of urges), and assignment of daily formal and informal (i.e., "on-the-go") mindfulness practice outside of sessions. RP was adapted to match MBRP in time, format, size, location, and amount of assigned homework. RP focuses on teaching coping skills related to several key topics, including self-efficacy, communication, goal setting, problem solving, and social support (Marlatt & Donovan 2005; Monti 2002). For both MBRP and RP, two therapists facilitated each group session. TAU was also in group format and included 12-step approaches, as well as process-oriented groups focused on topics such as communication and stress management. TAU groups met 1 to 2 times per week for 1.5-hour sessions.

Measures

Approach and avoidance coping.—The Coping Responses Inventory (CRI) (Moos 1988), a 48-item self-report measure, was used to assess approach and avoidance coping. Example items from the approach scale include: "Think of different ways to deal with the problem," "Try to tell yourself that things will get better," and "talk with a friend about the problem." Example items from the avoidance scale include: "Try not to think about the problem," "Keep away from people in general," and "Turn to work or other activities to manage things." The CRI was administered at baseline, post-treatment, 2-, 4-, and 6-months post-treatment. Participants indicate the frequency (0 = Not at all, 3 = Fairly often) in which they used different coping strategies for the most stressful situation in the past 6 months at baseline, and "since the last interview" at subsequent assessments. The current study used the approach and avoidance subscales (each 24 items) of the CRI. Total scores on the approach and avoidance subscales range from 0 to 144. The approach subscale demonstrated good internal consistency; Cronbach's alphas for baseline, post-treatment, 2-, 4-, and 6-months post-treatment were: .88, .89, .89, .90, and .93, respectively. The avoidance subscale

also demonstrated adequate internal consistency; Cronbach's alphas for baseline, post-treatment, 2-, 4-, and 6-months post-treatment were: .74, .81, .84, .88, and .90, respectively.

Depressive symptoms.—The Beck Depression Inventory-II (BDI-II) (Beck et al. 1996), a 21-item self-report measure, was used to assess depression symptoms at baseline. Total scores on the BDI range from 0 to 63, with scores of 0-13 considered minimal, 14-19 considered mild, 20-28 considered moderate, and 29-63 considered severe symptoms. Internal consistency reliability was high (Cronbach's alpha = .92).

Anxiety symptoms.—Beck Anxiety Inventory (BAI) (Beck et al. 1988), a 21-item self-report measure, was used to assess anxiety symptoms at baseline. Total scores on the BAI range from 0 to 63, with scores of 0-7 considered minimal, 8-15 considered mild, 16-25 considered moderate, and 26-63 considered severe symptoms. Internal consistency reliability was high (Cronbach's alpha = .94).

PTSD symptoms.—The PTSD Checklist- Civilian (PCL-C) (Weathers et al. 1994) was used to assess PTSD symptoms at baseline. The PCL-C is based on DSM-IV criteria for PTSD and includes 17 items. For the current study, one item of the PCL-C (i.e., item 17: feeling jumpy or easily startled) was not administered to participants due to a programming error. Hence, a 16-item version of the PCL-C was used in this study. Participants indicated the extent they had been bothered by various problems in response to stressful life experiences (e.g., repeated disturbing memories, thoughts, or images of a stressful experience) over the past month on a scale from 1 = not at all to 5 = extremely. Scores were computed as average score per item (summing all items and dividing by 16). Therefore, average score per item ranged from 1 to 5. Internal consistency reliability was high (Cronbach's alpha = .93). To assess a broad range of variability in PTSD symptomatology, all participants were administered the PCL-C, not just participants who met DSM-V criteria for current PTSD.

Substance use disorder severity.—The Severity of Dependence Scale (SDS) (Gossop et al. 1995), a 5-item self-report measure, was used to assess SUD severity at baseline. Total scores on the SDS range from 0 to 15. The SDS demonstrated good internal consistency in the current sample (Cronbach's alpha = .85).

Substance use and substance-related problems.—Outcomes examined in the current study included number of drug use days, number of heavy drinking days (defined as 4+/5+ standard drinks for women/men), and number of substance-related problems over the 90-day period prior to the 12-month post-treatment follow-up assessment. For the current analyses, we focused on the final 12-month follow-up outcomes because it was the most distal, and because Bowen and colleagues (2014) found that MBRP outperformed both RP and TAU on 12-month follow-up outcomes. The Timeline Follow-back interview (TLFB; Sobell & Sobell 1992), a calendar-based method, was used to assess substance use. The Short Inventory of Problems (SIP) (Blanchard et al. 2003), a 15-item self-report measure, was used to assess substance-related problems. For each item, participants indicated whether or not (yes or no) they experienced a given problem (e.g., "I have failed to do what is expected of me because of my drinking/drug use") in the past three months. The SIP

demonstrated excellent internal consistency (baseline and 12-months post-treatment: $\alpha=.95$ and $\alpha=.96$, respectively).

Statistical Analyses

Mplus Version 8 was used to conduct analyses (Muthén & Muthén 2018). First, we conducted confirmatory factor analysis (CFA) in which baseline affective symptomatology was modeled as a latent factor indicated by depression, anxiety, and PTSD symptoms. Second, we conducted latent growth curve (LGC) analyses to examine changes in approach and avoidance coping over time (in separate models). The LGC models included the following timepoints as indicators: baseline, post-treatment, and 2-, 4- and 6-months post-treatment. The intercept was set at baseline. For all latent variable analyses, model fit was determined by non-significant χ^2 , CFI > 0.9 and RMSEA < .08 (Hu & Bentler 1999). Third, we conducted a series of conditional indirect effect models with treatment condition as the predictor, baseline affective symptoms as the moderator, changes in approach and avoidance coping over time from baseline through 6-months post-treatment (the slope from the LGC models) as mediators, and heavy drinking days drug use days, and substance-related problems at 12-months post-treatment as the outcomes. We conducted separate models with approach coping and avoidance coping included as mediators. For all conditional indirect models, we controlled for the same covariates included in the main outcome analyses (Bowen et al. 2014): age, dependence severity, number of prior treatment episodes, treatment hours completed, and treatment site (two sites, coded 0,1), and also controlled for the coping intercept (set at baseline) derived from the LGC models. We used the sandwich estimator to account for the effect of clustering within therapy groups (White 1980).

Figure 1 shows a conceptual model guiding the conditional indirect effect analyses. As shown in the Figure, baseline affective symptomatology was included as a moderator of the effect of treatment condition on the approach and avoidance coping slopes. We examined two treatment contrasts: MBRP vs TAU and RP vs. TAU. To probe the nature of significant conditional indirect effects, we conducted follow-up analyses in which we examined the indirect effect of treatment condition outcomes via changes in coping over time among those with high (1 SD above mean), moderate (> 1 SD below and < 1 SD above mean), and low baseline (1 SD below mean) affective symptoms. For all regression models, we used negative binomial regression because the outcome variables were count data and there was an over-dispersion of data in the outcome variables due to a high frequency of zero values.

Mediation analyses were conducted with the product of coefficients approach (MacKinnon et al. 2002). Confidence intervals for indirect effects were computed with the Monte Carlo confidence interval calculator program for mediation analysis (Falk and Biesanz 2016). Confidence intervals not containing zero were deemed statistically significant.

We first attempted to conduct conditional indirect effect analyses that were fully model-based in Mplus and included both the CFA and LGC analyses in the conditional indirect effect regression model. That is, the latent variables for both the affective symptoms factor and the intercept and slope factors for the coping variable were both included in one model. However, these models led to convergence issues. Accordingly, given the model complexity, we saved the scores for the affective symptoms factor and included these scores as an

observed variable in the conditional indirect models (while still including the latent intercept and slope factors derived from the LGC model). Using this approach, the models ran normally. Of note, as sensitivity analyses, we also conducted conditional indirect effect models with the intercept and slope factors from the LGC saved out and included as observed variables (while including the latent affective symptoms factor in the model). These models led to the same substantive pattern of results. In the current paper, we report the results from the models with the affective symptoms factor scores included as an observed variable, while maintaining the latent coping intercept and slope factors in the model.

As reported in the primary outcome paper (Bowen et al. 2014), completion of follow-up assessments did not significantly differ across treatment conditions. A total of 231 participants (80.7% of the sample) completed the month 12 follow-up assessment. There was a total of 28% missing data on the CRI assessments across all timepoints, including baseline, post-treatment, and the 2-, 4-, and 6-month follow-ups. The only study variable significantly related to missing data on the CRI was treatment hours completed ($r = -.24$). Treatment hours was included as a covariate in the conditional indirect effect models. We used full information maximum likelihood estimation, which utilizes all available data and identifies model parameters that maximize the fit of the model to the observed data (Hallgren & Witkiewitz 2013).

Results

Confirmatory Factor Analysis

The CFA model with baseline depressive, anxiety, and PTSD symptoms, was “just identified” (i.e., zero degrees of freedom) ($\chi^2(0) = 0.0$; RMSEA = 0.0 (90% CI = 0.0,0.0); CFI = 0). When adding number of prior treatment episodes as a covariate to the CFA (thereby making the model identified, i.e., greater than zero degrees of freedom), the model provided an adequate fit to the data ($\chi^2(2) = .70$, $p = .70$; RMSEA = 0.00 (90% CI = 0.00,0.08); CFI = 1.00). Standardized factor loadings were all significant and above .75 for all indicators (depressive symptoms = .844; anxiety symptoms = .781; PTSD symptoms = .802).

Changes in Approach and Avoidance Coping Over Time

Unconditional LGC models.—Before conducting conditional indirect effect models, we first evaluated the model fit of unconditional LGC models without any other variables in the model. The LGC model for approach coping, with the intercept set at baseline and a linear slope, provided an adequate fit to the data ($\chi^2(10) = 16.6$, $p = .08$; RMSEA = .049 (90% CI = 0.0,0.08); CFI = .96). The LGC model for avoidance coping, with the intercept set at baseline and a linear slope, also provided an adequate fit to the data ($\chi^2(10) = 18.27$, $p = .06$; RMSEA = 0.05 (90% CI = 0.00,0.09); CFI = .92). The LGC models with a linear and quadratic slope did not provide a better fit to the data for the approach coping model ($\chi^2(9) = 16.5$, $p = .05$; RMSEA = 0.06 (90% CI = 0.00,0.10) and the avoidance coping model ($\chi^2(10) = 17.77$, $p = .03$; RMSEA = 0.06 (90% CI = 0.00,0.10). Hence, we included the LGC models with the linear slope for subsequent conditional indirect effect models.

For the LGC model with approach coping, the average intercept was 50.78 ($SE = .74$), $p < .001$, and the average linear slope was $-.16$ ($SE = .13$), $p = .22$, indicating relatively low approach coping scores at baseline (range: 0 to 144) and non-significant decreases in approach coping over time through the 6-month follow-up for the full sample. For the LGC model with avoidance coping, the average intercept was 43.00 ($SE = .61$), $p < .001$, and the average linear slope was $-.28$ ($SE = .13$), $p = .03$, indicating relatively low avoidance coping scores (range: 0 to 144) at baseline and significant decreases in avoidance coping over time over time through the 6-month follow-up for the full sample.

Treatment condition predicting linear change in the full sample.—MBRP vs. TAU did not significantly predict the linear slope for approach coping ($B = .23$, $SE = .28$, $p = .39$) or avoidance coping ($B = .009$, $SE = .28$, $p = .97$), and RP vs. TAU did not significantly predict the linear slope for approach coping ($B = .29$, $SE = .30$, $p = .32$) or avoidance coping ($B = -.04$, $SE = .30$, $p = .88$).

Linear change predicting 12-month outcomes in the full sample.—The linear slope for approach coping significantly predicted fewer heavy drinking days ($B = -.34$, $SE = .16$, $p = .03$) and fewer substance-related problems ($B = -.32$, $SE = .14$, $p = .02$), but not drug use days ($B = -.29$, $SE = .28$, $p = .30$). The linear slope for avoidance coping did not significantly predict heavy drinking days ($B = -.23$, $SE = .41$, $p = .57$), drug use days ($B = -.00$, $SE = .17$, $p = .99$), or substance-related problems ($B = -.03$, $SE = .11$, $p = .76$).

Conditional Indirect Effect Models

Supplementary Table 1 provides mean scores for approach and avoidance coping at each timepoint, as well as 12-month use and related negative consequences outcomes, for the full sample and for subgroups based on treatment condition and level of affective symptoms at baseline.

Approach coping as the mediator.—Table 2 provides a summary of results from the conditional indirect models with the approach coping slope as the mediator. There were significant conditional indirect effects of MBRP vs. TAU, such that the interaction of treatment by affective symptoms predicted increases over time in approach coping from baseline through the month 6 follow-up, which in turn predicted fewer heavy drinking days and fewer substance-related problems at the month 12 follow-up. Follow-up analyses to probe the conditional indirect effects (see Figure 2) showed that increases in approach coping mediated the therapeutic effect of MBRP on these outcomes among those with high affective symptoms (1 SD above the mean), but not with low (1 SD below the mean) or moderate affective symptoms (> 1 SD below the mean and < 1 SD above the mean). There were no significant conditional indirect effects when RP vs. TAU was the predictor, or when drug use days was the outcome.

Avoidance coping as the mediator.—Table 3 provides a summary of results from the conditional indirect models with the avoidance coping slope as the mediator. There were no significant conditional indirect effects for any of the models with avoidance coping as the mediator. In the model with drug use days as the outcome, the interaction of RP vs. TAU by

baseline affective symptoms predicted decreases in avoidance coping. However, this effect was not significant in the other models with heavy drinking days and substance-related problems as the outcome. Changes in avoidance coping over time did not significantly predict any outcomes.

Characterizing the low, moderate, and high affective symptomology

subgroups—To further characterize the level of psychiatric severity among the low, moderate, and high subgroups, we examined the observed mean scores by subgroup for the BDI-II, BAI, and the PCL-C. The high affective symptomology subgroup reported a mean total depression symptom score on the BDI-II ($M = 28.60$, $SD = 7.62$) in the severe range (Beck et al. 1996), a mean total anxiety symptom score on the BAI ($M = 27.81$, $SD = 11.18$) in the severe range (Beck & Steer 1993), and a mean PTSD symptom score *per item* slightly between the “3 = moderately” and “4 = quite a bit” response anchors ($M = 3.44$, $SD = .64$). The moderate affective symptomology subgroup reported a mean total depression score on the BDI-II ($M = 12.06$, $SD = 6.67$) in the minimal-to-mild range, a mean total anxiety score on the BAI ($M = 8.98$, $SD = 7.76$) in the mild range, and a mean PTSD symptom score *per item* between the “2 = a little bit” and “3 = moderately” response anchors ($M = 2.30$, $SD = .59$). The low affective symptomology subgroup reported a mean total depression score on the BDI-II ($M = 2.03$, $SD = 2.06$) in the minimal range, a mean total anxiety score on the BAI ($M = .74$, $SD = 1.15$) in the minimal range, and a mean PTSD symptom score *per item* between the “1 = not at all” and “2 = a little bit” response anchor ($M = 1.34$, $SD = .29$).

Effect Sizes

Because the outcome variables in this study were count outcomes, we were not able to report common indices of effect size for mediation models, such as kappa-squared (Preacher & Kelley 2011) or proportion of the total effect mediated (Hayes & Rockwood 2017). Accordingly, here we report separate effect sizes of the a-path (treatment condition predicting approach coping slope) and the b-path (approach coping slope predicting the outcomes). In regard to the a-path, we saved the latent slope scores from the LGC models as an observed variable and estimated between-treatment group Cohen’s d effect sizes among individuals with high baseline affective symptoms. Mean slope scores by treatment group among only individuals with high baseline affective symptoms were: MBRP (Mean = .06, $SD = .45$) and TAU (Mean = $-.27$, $SD = .43$). The Cohen’s d effect size was $d = .71$ for the mean difference in slope between MBRP and TAU. In regard to the b-path, we computed the incidence rate ratio (IRR) for the model-estimated effect of the approach coping slope on the outcomes among individuals with high baseline affective symptoms. IRRs show the rate of increase (when the IRR is above 1.0) or the rate of decrease (when the IRR is below 1.0) in a given count outcome for a 1-unit increase in the predictor (with other predictors in the model held constant). Among individuals with high baseline affective symptoms, the IRR for the effect of the approach coping linear slope on heavy drinking days at month 12 was $IRR = .000003$, indicating almost a 100% decrease in rates of heavy drinking per 1-unit increase in the approach coping linear slope. Among individuals with high baseline affective symptoms, the IRR for the effect of the approach coping linear slope on substance-related problems at month 12 was $IRR = .18$ indicating an 82% decrease in rates of substance-related problems per 1-unit increase in the approach coping linear slope.

Sensitivity Analyses

We conducted sensitivity analyses in which we also controlled for substance of choice (0 = did not report alcohol as substance of choice, 1 = reported alcohol as substance of choice). Moreover, given prior research on gender and race/ethnicity as potential treatment moderators in MBRP (Greenfield et al. 2018; Roos et al. 2019), we conducted sensitivity analyses controlling for gender (0 = male, 1 = female) and race/ethnicity (0 = non-Hispanic White, 1 = racial/ethnic minority). The substantive pattern of results reported above remained unchanged when including the extra covariates in the models. When conducting sensitivity analyses with the race/ethnicity covariate coded (1 = non-Hispanic Black/African-American, 0 = not non-Hispanic Black/African-American), the results also remained unchanged. Of note, there were no statistically significant differences by substance of choice category (alcohol vs. no alcohol as substance of choice and polysubstance use vs. no polysubstance use) for baseline dependence severity (all p 's > .05). There were also no significant differences by treatment condition for frequencies of substance of choice categories (all p 's > .05).

Discussion

Prior work suggests that MBRP is particularly effective among individuals with SUD and high co-occurring affective symptoms (Roos et al. 2017a). The current study evaluated whether changes in approach and avoidance coping over time, as measured by the Coping Response Inventory (CRI), may explain this moderation effect. We conducted secondary data analyses from the largest trial of MBRP to date, which compared MBRP, cognitive-behavioral relapse prevention (RP), and treatment-as-usual (TAU) as outpatient aftercare treatments (Bowen et al. 2014). Affective symptomatology at baseline was modeled as a latent factor indicated by depressive, anxiety, and PTSD symptoms. In line with our hypotheses, we found significant conditional indirect effects of MBRP, such that the effect of MBRP vs. TAU on heavy drinking days and substance-related problems 12-months post-treatment was mediated by increases in approach coping over time (baseline through 6-months post-treatment) among individuals with high baseline affective symptoms, but not low or moderate baseline affective symptoms. We did not find any significant conditional indirect effects of RP vs. TAU on outcomes via approach and avoidance coping. Hence, the key conclusion from this study is that the pronounced therapeutic effects of MBRP on long-term substance-related outcomes among individuals with SUD and high affective symptoms may be at least partially explained by improvements in approach coping over time. It is important to note that individuals in this study with “high” negative affective symptoms had scores on the both the BDI-II and BAI in the severe range, as well as average scores per item on the PCL-C in the “moderately” to “quite a bit” range. Hence, this “high” subgroup indeed exhibited severe levels of psychiatric symptoms based on commonly used and well-established psychiatric screening measures.

Indeed, MBRP has a strong focus on promoting awareness and acceptance of, and nonreactivity to, negative affect, which in turn may facilitate more adaptive coping responses to strong negative affective states related to ongoing stressors (Garland et al. 2017a; Shapiro et al. 2006). In other words, MBRP may assist individuals with high affective symptoms in

tolerating, and not automatically reacting to, strong negative affective states, thereby “allowing space” to respond to negative affect in a non-reflexive, flexible, and approach-oriented manner. It is notable that changes in approach coping were measured in the current study over the course of a relatively long period of time (baseline to the 6-month post-treatment follow-up). Thus, MBRP appears to mobilize relatively *durable and long-term* improvements in approach coping among individuals with SUD and high affective symptoms. Moreover, there was a medium-to-large effect size for the difference between MBRP and TAU in changes over time in approach coping, suggesting that the effect of MBRP on approach coping may be clinically meaningful. Our findings suggest that mindfulness training may be a potent therapeutic strategy for facilitating greater use of approach coping strategies in the long-term among individuals with SUD and high affective symptoms. Interestingly, MBRP does not explicitly teach the specific approach-oriented coping skills measured by the CRI, such as positive reappraisal, problem-solving, and seeking social support. Our findings are consistent with theories that propose that mindfulness training alone may enhance an individual’s ability to employ a range of skillful approach-oriented responses in the context of stressors (Brown and Ryan 2003; Garland et al. 2009; Garland et al. 2017a; Shapiro et al. 2006).

Clarifying precise mechanisms at play in MBRP, as well as the contexts in which these mechanisms are most salient, is critical for advancing the precision delivery of MBRP in real-world clinical practice (Longabaugh & Magill 2011; Kazdin 2007). For example, a treatment center could prioritize the delivery of MBRP for clients with high negative affective symptoms at initiation of treatment, and clinicians could monitor approach coping skills over time during treatment to assess whether this key mechanism is being mobilized by MBRP. However, further studies are needed to replicate our findings before informing clinical guidelines.

The current findings are particularly consistent with findings from a study among undergraduate students without SUDs, in which brief mindfulness training had the strongest effects in increasing approach coping among students with high levels of perceived stress (Donald & Atkins 2016). Our findings also align with the contextual model of self-regulation change mechanisms in addiction (Roos & Witkiewitz 2017), which predicts that self-regulation is more likely to function as a mechanism of change among individuals with more severe contextual demands. The current study suggests that a person’s overall level of self-reported affective symptomatology may be a key moderating contextual factor to consider for future studies investigating changes in distress-related coping skills as a mechanism of change following behavioral treatments for SUD.

Counter to hypotheses, we did not find that changes in avoidance coping mediated the effect of MBRP among individuals with high affective symptoms. It is possible that improved approach coping, rather than decreased avoidance coping, may be driving the effects of MBRP among individuals with high affective symptoms. However, it is important to note that the average score on the avoidance subscale of the CRI at baseline among the full sample was relatively low. Hence, it is plausible that individuals in the sample had already reduced their avoidance coping to a substantial degree following the residential or intensive outpatient treatment they received prior to enrollment in outpatient aftercare treatment.

Future work can explore the effect of MBRP on changes in approach and avoidance coping at different stages of in the treatment process (i.e., MBRP offered during residential or intensive outpatient treatment, rather than outpatient aftercare treatment).

Even though RP targets approach-oriented coping skills, we did not find any indirect or conditional indirect of RP on outcomes via changes in approach or avoidance coping. It was somewhat surprising that RP did not impact approach and avoidance coping to a greater extent than TAU. Yet, these findings are in line with prior work that found equivalent increases in approach coping and decreases in avoidance coping in CBT for SUD relative to twelve-step treatment for SUD (Finney et al. 1998; Ouimette et al. 1999). Importantly, studies that have found a significant mediational effect of coping skills in CBT for SUD have examined substance-specific coping for avoiding and reducing substance use, rather than general skills for managing life stressors (Acosta et al. 2017; Lévesque et al. 2017; Kiluk et al. 2010; Roos et al. 2017b; Witkiewitz et al. 2018). In the current study, we did not examine substance-specific coping skills following RP, which could have resulted in different findings.

Although we found significant conditional indirect effects of MBRP on heavy drinking days and substance-related problems at month 12, we did not find significant effects on drug use days at month 12. It is not clear why this was the case. It is plausible the therapeutic effect of MBRP on illicit drug use behavior itself is not mediated by changes in approach coping, but via other mechanisms. Among the full sample, approach coping significantly predicted fewer heavy drinking days and substance-related problems, but not drug use days at month 12. Future work is needed to clarify the pathways by which MBRP is associated with various long-term outcomes.

Limitations and Future Research Directions

A key limitation in the current study is the reliance on retrospective self-report measures, which could have led to recall biases. It may be more ideal to administer brief momentary or daily surveys of affective symptoms, coping behavior, substance use, and substance-related problems when individuals are in naturalistic contexts. Hence, future work can use methods such as smartphone-delivered ecological momentary assessment, rather than retrospective self-report measures. Even though our study included individuals with SUDs, we only examined a measure of general coping, not substance-specific coping. Hence, we are unable to conclude how MBRP affects coping behaviors directly related to urges or substance use in high-risk situations. The use of a 16-item PCL-C due to accidental omission of one item on the 17-item PCL-C is another limitation. Concerns about small sample size and limited statistical power arise when parsing a sample into subgroups (e.g., high, moderate, and low affective symptomatology) for probing an interaction effect with a continuous moderator variable. The number of individuals with “high” affective symptoms (1 standard deviation above the mean) was relatively small ($n = 45$). Yet, it is important to note that omnibus conditional indirect effect models were based on the full sample of 286, and these models revealed statistically significant effects that indicate that the indirect effect of treatment condition on 12-month outcomes via changes in approach coping depend on individual differences on the continuous variable of affective symptomatology. Additionally, the sample

for our study included a relatively small percentage of females (28.2%), potentially limiting the generalizability of the findings. Yet, a strength of this study is the relatively diverse sample in regard to race/ethnicity. Finally, therapists in the active treatment groups (MBRP and RP) and TAU had higher levels of education than therapists in TAU. However, the therapists in MBRP and RP were matched for therapist training.

Future research is needed to further elucidate mechanistic pathways by which MBRP may modulate self-regulation over time. In particular, research is needed to examine whether mindfulness mediates the effect of MBRP or other mindfulness-based interventions on approach coping. Ecological momentary assessment may be especially useful for examining within-person mechanisms, such as whether state mindfulness may enhance approach coping in the moment, thereby reducing the likelihood of substance use during episodes of high negative affect. Future research could also examine whether indices of decreased reactivity to negative affect, such as laboratory-based subjective and physiological measures of affective reactivity, might be associated with improvements in approach coping among individuals with SUDs and co-occurring affective symptomatology.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.
Conceptual model of the conditional indirect effect. Squares indicate observed variables.
Circle indicate latent variables.

Figure 2.

Indirect effects of MBRP vs TAU via approach coping on month 12 heavy drinking days among those with low, moderate, and high baseline affective symptoms. Confidence intervals of indirect effects not containing zero are bolded. $* = p < .05$; $** = p < .01$. $*** = p < .001$

Moderate Affective Symptoms (n = 190)

High Affective Symptoms (n = 45)

Figure 3.

Indirect effects of MBRP vs TAU via approach coping on month 12 heavy drinking days among those with low, moderate, and high baseline affective symptoms. Confidence intervals of indirect effects not containing zero are bolded. $* = p < .05$; $** = p < .01$. $*** = p < .001$

Table 1.

Descriptive statistics for the full sample, n (%) or Mean (SD)

Male Gender	201 (71.8%)
Non-Hispanic White	146 (51.6%)
Black/African-American	61 (21.3%)
Native American	18 (6.3%)
Asian	2 (0.7%)
Native Hawaiian/Pacific Islander	2 (0.7%)
Mixed Race	27 (9.4%)
Race not specified	5 (1.7%)
Hispanic or Latin-x	32 (11.2%)
Age	38.44 (10.92)
Prior treatment episodes	1.53 (1.48)
Baseline dependence severity	9.43 (4.18)
Baseline substance of choice	
Alcohol only	39 (13.7%)
Cocaine only	3 (1.0%)
Opioids only	2 (0.7%)
Methamphetamine only	4 (1.4%)
Marijuana only	2 (0.7%)
2+ drugs of choice (i.e., polysubstance use)	234 (82.4%)
Treatment hours completed	11.81 (7.07)
Attended at least 4 of study assigned treatment sessions	193 (67.5%)
Baseline depressive symptoms	13.21 (10.21)
Baseline anxiety symptoms	10.81 (11.43)
Baseline PTSD symptoms	2.34 (.84)
Baseline approach coping	50.76 (13.26)
Baseline avoidance coping	43.12 (10.08)
Baseline HDD	0.23 (1.49)
Baseline DUD	0.43 (1.49)
Baseline SIP	10.61 (5.38)

Note. Total scores on the approach and avoidance subscales range from 0 to 144. Total scores for depressive and anxiety symptoms range from 0 to 63. Total scores for PTSD symptoms ranged from 1 to 5. Total scores on SIP range from 0 to 15. Treatment hours completed was the total treatment hours at the treatment center, including study intervention hours and any additional care the participant received at the treatment center.

Table 2.

Summary of Results from Conditional Indirect Models with Approach Coping Slope as the Mediator

	Model with HDD as Outcome	Model with DUD as Outcome	Model with SIP as Outcome
	B (SE)	B (SE)	B (SE)
Baseline Affective Symptoms → Approach Coping Slope	-.02 (.02)	-.19 (.02)	-.02 (.02)
MBRP vs. TAU → Approach Coping Slope	.24 (.27)	.25 (.28)	.24 (.29)
RP vs. TAU → Approach Coping Slope	.28 (.24)	.30 (.29)	.29 (.29)
MBRP vs. TAU X Baseline Affective Symptoms → Approach Coping Slope (Moderation Effect)	.06 (.03)*	.06 (.02)*	.066 (.02)*
RP vs. TAU X Baseline Affective Symptoms → Approach Coping Slope (Moderation Effect)	.01 (.03)	.01 (.03)	.01 (.03)
Baseline Affective Symptoms → Outcome Approach Coping Slope → Outcome	-.13 (.07)	.10 (.04)*	.09 (.03)*
Approach Coping Slope → Outcome	-.48 (.20)*	-.37 (.19)	-.45 (.17)**
MBRP vs. TAU x Baseline Affective Symptoms → Approach Coping Slope → Outcome (Conditional Indirect Effect)	-.032 95% CI (-.08, -.001)	-.022 95% CI (-.054, .000)	-.030 95% CI (-.072, -.002)
RP vs. TAU X Baseline Affective Symptoms → Approach Coping Slope → Outcome	-.004 95% CI (-.039, .026)	-.003 95% CI (-.032, .021)	-.004 95% CI (-.036, .024)

Note.

* =
 $p < .05$ ** =
 $p < .01$.*** =
 $p < .001$.

HDD = Heavy drinking days. DUD = Drug use days. SIP = Short Inventory of Problems. For all models, we controlled for the approach coping intercept factor (set at baseline), age, site, baseline dependence severity, number of treatment hours completed, and number or prior treatment episodes. Indirect effects with confidence intervals not containing zero are bolded.

Table 3.
Summary of Results from Conditional Indirect Models with Avoidance Coping Slope as the Mediator

	Model with HDD as Outcome	Model with DUD as Outcome	Model with SIP as Outcome
Baseline Affective Symptoms → Avoidance Coping Slope	.03 (.03)	.04 (.03)	.03 (.03)
MBRP vs. TAU → Avoidance Coping Slope	.07 (.39)	.13 (.33)	.07 (.39)
RP vs. TAU → Avoidance Coping Slope	-.002 (.32)	.07 (.32)	-.004 (.01)
MBRP vs. TAU X Baseline Affective Symptoms → Avoidance Coping Slope (Moderation Effect)	.01 (.03)	.004 (.03)	.009 (.03)
RP vs. TAU X Baseline Affective Symptoms → Avoidance Coping Slope (Moderation Effect)	-.05 (.03)	-.06 (.03) *	-.05 (.03)
Baseline Affective Symptoms → Outcome	-.11 (.09)	.07 (.35)	.12 (.04)
Avoidance Coping Slope → Outcome	.25 (.35)	-.07 (.55)	-.24 (.16)
MBRP vs. TAU x Baseline Affective Symptoms → Avoidance Coping Slope → Outcome 95% CI (-.023, .034) (Conditional Indirect Effect)	.002 95% CI (-.023, .034)	-.0002 95% CI (-.037, .036)	-.002 95% CI (-.022, .015)
RP vs. TAU X Baseline Affective Symptoms → Avoidance Coping Slope → Outcome (Conditional Indirect Effect)	-.012 95% CI (-.064, .025)	.004 95% CI (-.072, .084)	.012 95% CI (-.005, .040)

Note.

* = $p < .05$

** = $p < .01$

*** = $p < .001$.

HDD = Heavy drinking days. DUD = Drug use days. SIP = Short Inventory of Problems. For all models, we controlled for the approach coping intercept factor (set at baseline), age, site, baseline dependence severity, number of treatment hours completed, and number or prior treatment episodes.