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Mindfulness-Based Cognitive Therapy for Bipolar Disorder: Effects on Cognitive Functioning

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Abstract

Bipolar disorder is associated with impairments in cognition, including difficulties in executive functioning, even when patients are euthymic (neither depressed nor manic). The purpose of this study was to assess changes in self-reported cognitive functioning in patients with bipolar disorder who participated in an open pilot trial of mindfulness-based cognitive therapy (MBCT). Following MBCT, patients reported significant improvements in executive functioning, memory, and ability to initiate and complete tasks, as measured by the Behavior Rating Inventory of Executive Function (BRIEF) and the Frontal Systems Behavior Scale (FrSBe). Changes in cognitive functioning were correlated with increases in mindful, nonjudgmental observance and awareness of thoughts, feelings, and sensations, and were not associated with decreases in depression. Improvements tended to diminish after termination of treatment, but some improvements, particularly those in executive functioning, persisted after 3 months. These results provide preliminary evidence that MBCT may be a treatment option that can be used as an adjunct to medication to improve cognitive functioning in bipolar disorder.

Keywords

bipolar disorder; executive functioning; cognitive functioning; mindfulness; mindfulness-based cognitive therapy (MBCT); psychosocial treatment

Bipolar disorder is a severe and chronic mood disorder that is characterized by periods of depression and/or mood elevation. It is the sixth leading cause of disability worldwide.¹ Individuals with bipolar disorder often experience a highly recurrent course of illness,² which is associated with poor outcomes. Bipolar disorder is linked to impairment in many areas of functioning, including deficits in cognitive functioning, poorer academic and work achievement, divorce, substance abuse, and suicide.^{3–9}

Pharmacotherapy is the first line of treatment for individuals with bipolar disorder, but unfortunately, such treatment often fails to bring patients with bipolar disorder to sustained

remission.^{10,11} Several adjunctive psychosocial interventions have been developed to treat bipolar disorder (for a review, see Miklowitz 2008¹²), including cognitive-behavioral therapy (CBT), family-focused treatment (FFT), and interpersonal and social rhythm therapy (IPSRT). CBT approaches^{13–15} target cognitive restructuring, activity scheduling, mood monitoring, and techniques for relapse prevention, and they have been shown to reduce severity and rates of relapse^{14–16} and increase adherence to medication.¹³ FFT involves familial psychoeducation, improvement of communication skills among family members, family recognition of warning signs of relapse, and group problem-solving training.¹⁷ It has been found to be more effective in preventing relapse in patients with bipolar disorder than family psychoeducation¹⁸ as well as a combination of patient psychoeducation, problem solving, and case management.¹⁹ IPSRT, which focuses on improvement of interpersonal problems and increasing the consistency of social rhythms²⁰, was shown to be associated with reduced relapse rates in patients with bipolar disorder during a 2-year follow-up period following remission from an acute mood episode.²¹ CBT, FFT, and IPSRT have each been shown to decrease length of time until recovery from depressive mood episodes and to improve psychosocial functioning.^{22,23} However, despite these advances in psychosocial treatments, many patients with bipolar disorder continue to experience persistent mood symptoms that place them at risk for relapse and often do not achieve sustained periods of remission.^{2,24,25}

For this reason, mindfulness-based cognitive therapy (MBCT) was recently adapted for the treatment of patients with bipolar disorder.^{26–28} MBCT was originally derived from the mindfulness-based stress reduction (MBSR) program developed by Jon Kabat-Zinn,²⁹ and was designed to prevent relapse in patients in remission from recurrent major depressive episodes.³⁰ It integrates elements of cognitive therapy and mindfulness-based meditative practices with the goal of developing a capacity for awareness of distressing thoughts and feelings and the ability to disengage from them without taking countermeasures to try to change, replace, or fix anything about them.^{30,31} Previous studies have found that mindfulness training such as MBSR was associated in both clinical and non-clinical samples with improved cognitive functioning, including improved attentional control,^{32–39} memory,^{40–43} and executive functioning,^{42–43} as well as reduced emotional interference during a cognitive task.⁴⁴ Furthermore, neuroimaging studies have linked meditation to increased cortical thickness in areas related to attention and cognitive processing,⁴⁵ and changes in hippocampal volume have been found to be associated with participation in MBSR.⁴⁶ Because individuals with bipolar disorder also have significant cognitive impairments (e.g., in attention, memory, and executive functioning) and are often disorganized in their daily lives, even when euthymic,^{3,47–55} they may also benefit from treatments that aim to improve cognitive functioning in order to increase ability to function in daily life (e.g., Deckersbach et al. 2010³⁴).

We recently conducted a trial of MBCT in individuals with bipolar disorder. In that study, participants showed increased mindfulness, reduced residual depressive symptoms, fewer attentional difficulties, and increased emotional regulation abilities, psychological well-being, positive affect, and psychosocial functioning.²⁸ This paper presents the results of a secondary analysis of data from that study. We hypothesized that prior to treatment, individuals would experience difficulties in executive functioning and memory and that these difficulties would be reduced after MBCT. We also hypothesized that improvements in cognitive functioning would be associated with increases in mindfulness and decreases in mood symptoms as a result of MBCT.

METHOD

For a detailed description of the treatment trial, methods, and study entry criteria, see Deckersbach et al.²⁸ Treatment was administered in a group format in 12 weekly, 120-minute sessions, and included elements of cognitive-behavioral therapy and mindfulness meditation as described by Segal et al.³⁰ We also added psychoeducation about bipolar disorder, mood monitoring, and problem-solving, as well as additional exercises designed to ease participants into mindfulness with mindful body movements and bringing mindfulness into routine activities.

Participants

Twelve adults were enrolled in the study, 10 of whom actually began treatment. Of these 10 participants, 9 completed treatment, one of whom was excluded from analyses due to missing data on the cognitive functioning scales, which resulted in a final sample of 8 patients. Individuals included in the final analysis met DSM-IV criteria for bipolar I disorder ($n = 6$, 4 females) or bipolar II disorder ($n = 2$, both females). Their mean age was 42 years (mean = 41.9 years, standard deviation [SD] = 7.5), and they had a mean of 16 years of education (mean = 15.8 years, SD = 3.1). Participants were recruited through the Bipolar Clinic and Research Program at Massachusetts General Hospital (MGH) and provided written informed consent prior to participation in the study, in accordance with MGH-approved Institutional Review Board consenting procedures. Approval was obtained for the study from the MGH IRB. Diagnoses of bipolar disorder were determined using the Mini International Neuropsychiatric Interview (MINI).⁵⁶ Participants were included in the trial if they a) had bipolar I or II disorder; b) had residual depressive symptoms, defined as feeling depressed or experiencing decreased interest at least 3 days every week during the month prior to the study, but no more than three associated symptoms on the MINI, c) had few residual symptoms of mania, as determined by a score on the Young Mania Rating Scale (YMRS)⁵⁸ of less than 8; d) had not had an episode of major depression and/or hypomania or mania in the month prior to the screening; and e) were taking a stable dose of psychiatric medication.

Exclusion criteria were a) schizophrenia, schizoaffective disorder, delusional disorder, psychotic disorders not otherwise specified, major depressive disorder, or mood congruent or incongruent psychotic features, b) substance dependence disorders, including alcohol dependence, currently or within the previous 12 months, c) untreated hypothyroidism, d) unsafe suicidal ideation, plan, and intent, e) having received electroconvulsive therapy within the 6 months preceding study enrollment, and f) current neurologic conditions as well as any medical conditions affecting the patient's ability to participate in treatment.

Assessments and Treatment

After the initial screening, participants completed a baseline assessment that included measures of mindfulness, depression, mania, and cognitive functioning (see discussion of "Instruments" below). Participants then completed twelve 120-minute sessions of MBCT for bipolar disorder followed by a post-treatment assessment (within one week of session 12) and a 3-month follow-up assessment using the same instruments that were administered at the baseline assessment. Details about the treatment program and primary outcomes are provided elsewhere.²⁸

Instruments

The *Five-Factor Mindfulness Questionnaire (FFMQ)*⁵⁸ is a 39-item instrument that measures five areas of mindfulness:

- Observing (noticing or attending to internal and external stimuli, such as physical sensations, emotions, thoughts, sights, smells and sounds; scale “Observe”)
- Describing (mentally noting stimuli with words; scale “Describe”)
- Acting with awareness (attending to one’s actions in the moment, as opposed to automatic or absent-minded behavior; scale “Awareness”)
- Non-judging of inner experience (refraining from evaluating one’s sensations, emotions, and cognitions; scale “Nonjudgmental”)
- Non-reactivity to inner experience (allowing thoughts and feeling to come and go, without attention getting caught up in them; scale “Nonreact”).

Questions on the FFMQ are rated on a 5-point Likert scale ranging from 1 (*never or very rarely true*) to 5 (*very often or always true*). Higher scores on the FFMQ indicate greater mindfulness.

Hamilton Rating Scale for Depression (Ham-D)

Severity of depressive symptoms was evaluated using the Ham-D, 17-item version.⁵⁹ Items were rated by a trained interviewer. Scores range from 0 to 54, with higher scores denoting greater depressive symptoms.

Young Mania Rating Scale (YMRS)

The severity of manic symptoms was assessed with the Young Mania Rating Scale.⁵⁷ Items were rated by a trained interviewer. Scores range from 0 to 56, with higher scores indicating greater symptoms of mania or hypomania.

The Frontal Systems Behavior Scale (FrSBe) is a 46-item self-report inventory that assesses executive functioning in adults.^{60,61} The instrument is composed of three subscales. The Apathy subscale contains items related to indifference or lethargy (e.g., “[I] have lost interest in things that used to be fun or important to me”). The Disinhibition subscale evaluates the ability to regulate and control one’s behavior (e.g., “I do things impulsively”). The Executive Functioning subscale contains items assessing abilities to plan and mentally organize activities (e.g., “[I] mix up a sequence, get confused when doing several things in a row”). Items are rated on a Likert scale from 1 (*almost never*) to 5 (*almost always*), and higher scores indicate greater impairment in functioning. Raw total and subscale scores were converted into scaled T-scores prior to analyses, so that data could be standardized across demographic characteristics and enabling comparisons to a normative sample. All T-scores have a standard deviation of 10, with a T-score of 50 representing the 50th percentile (the normative mean).

The Behavior Rating Inventory of Executive Function (BRIEF) is a 75-item self-report measure of executive functioning.⁶² It is composed of nine subscales: Inhibit (impulsiveness or distractibility), Shift (cognitive flexibility), Emotional Control (ability to temper one’s emotions when necessary), Self-Monitor (ability to think before acting), Initiate (ability to begin new activities), Working Memory (attention and focus while completing activities), Plan/Organize (prioritizing and goal-setting), Task Monitor (cognizance of quality during completion of tasks), and Organization of Materials (the ability to regulate belongings and keep things clean). It also includes two subscale summary scores: Behavioral Regulation (composed of the Inhibit, Shift, Emotional Control, and Self-Monitor subscales), and Metacognition (a summary of the Initiate, Working Memory, Plan/Organize, Task Monitor, and Organization of Materials subscales). Items are rated as never, sometimes, or often true, and higher scores indicate greater impairment in functioning. Raw total and subscale scores

were converted into T-scores prior to analyses, so that data could be standardized across demographic characteristics and enabling comparisons to a normative sample.

Statistical Analyses

Descriptive statistics at each of the three assessment points (pre-treatment, post-treatment, and follow-up) are reported (Table 1). Changes in cognitive functioning were evaluated with Friedman nonparametric rank-ordered repeated measures tests across the three assessment points, followed by pairwise Wilcoxon signed rank tests, when appropriate. Because small sample sizes provide limited statistical power to detect changes, we also computed effect sizes (Cohen's *d*) for all BRIEF and FrSBe subscales across treatment (Table 1). Following the convention of Cohen,⁶³ an effect size of 0.2 is considered small, 0.5 medium, and 0.8 large. To evaluate correlates of changes in cognitive functioning, Spearman rank-ordered correlations were computed between difference scores from pre- to post-treatment for cognitive functioning, mindfulness, and mood symptoms.

RESULTS

Level of Cognitive Functioning Prior to Treatment

Table 1 shows the means and standard deviations (SDs) of the FrSBe and BRIEF scores prior to treatment. Cognitive functioning in the participants prior to treatment was substantially lower than normative comparison samples. Prior to treatment, participants' scaled Global Executive Composite scores on the BRIEF ($M = 66.38$, $SD = 15.63$) were 1.6 SDs above the normative mean, placing them in the 6th percentile of executive functioning compared to the normative sample. BRIEF Behavioral Regulation summary scores ($M = 61.25$, $SD = 17.31$) were 1.1 SDs above the normative mean, placing participants in the 13th percentile compared to the normative sample. Individuals exhibited even greater deficits in BRIEF Metacognition summary scores ($M = 68.13$, $SD = 13.27$), which were 1.8 SDs above the normative mean, and in the 3rd percentile compared to the normative sample.

Scores on the BRIEF subscales also indicated marked impairment prior to treatment. Individuals scored 1.2 SDs above the mean on the BRIEF Inhibit ($M = 61.88$, $SD = 15.17$) and Shift ($M = 61.63$, $SD = 15.20$) subscales, placing them in the 12th percentile compared to the normative sample. On the BRIEF Emotional Control subscale ($M = 58.00$, $SD = 17.06$), participants were 0.8 SDs above the mean and in the 19th percentile compared to the normative sample. Participants were less impaired on the Self-Monitor subscale ($M = 56.13$, $SD = 13.75$), on which they were 0.6 SDs above the mean and in the 27th percentile. However, on the Initiate subscale ($M = 65.13$, $SD = 10.12$), individuals were 1.5 SDs above the normative mean, placing them in the 6th percentile. On the Working Memory ($M = 68.25$, $SD = 15.76$), Plan/Organize ($M = 69.13$, $SD = 14.42$) and Task Monitor ($M = 69.13$, $SD = 9.58$) subscales, participants were 1.8 to 1.9 SDs above the mean and in the 3rd percentile compared to the normative sample. Finally, on the Organization of Materials subscale of the BRIEF ($M = 59.88$, $SD = 12.24$), individuals were 1.0 SDs above the normative mean, placing them in the 16th percentile on this subscale.

Scores on the FrSBe also indicated marked impairment prior to treatment. Total scores on the FrSBe ($M = 63.25$, $SD = 11.47$) were 1.3 SDs above the normative mean (9th percentile compared to the normative sample). On the Apathy subscale of the FrSBe ($M = 62.25$, $SD = 13.78$), individuals were 1.2 SDs above the mean (12th percentile). Participants' scores on the Disinhibition subscale ($M = 57.00$, $SD = 20.42$) were 0.7 SDs above the normative mean, placing them at the 25th percentile. Finally, individuals' scores on the Executive Functioning subscale of the FrSBe ($M = 66.88$, $SD = 7.04$) were 1.6 SDs above the

normative mean, placing them in the 5th percentile of executive functioning compared to the normative sample.

Changes in Cognitive Functioning Following MBCT

To compare changes in cognitive functioning as a function of treatment with MBCT, we conducted Friedman's nonparametric rank-ordered repeated measures tests across the three assessment points (pre-treatment, post-treatment and follow-up). For each instrument, we computed Friedman's tests first for total scores, then for summary scores (on the BRIEF), and finally for each instrument's subscale scores. To control Type I error, follow-up pairwise Wilcoxon signed ranks tests were conducted only when Friedman's tests were significant. However, for descriptive purposes, effect sizes for all pairwise comparisons were computed (Table 1).

Friedman's test did not indicate statistically significant changes across timepoints in BRIEF Global Executive Composite scores. However, there were improvements from pre-treatment to post-treatment in the Global Executive Composite score that were consistent with a large effect size. Friedman's test also indicated no statistically significant changes over time in the Behavioral Regulation or the Metacognition summary scores, but the change from pre- to post-treatment in Metacognition scores was consistent with a large effect size.

There were significant changes in cognitive functioning on the BRIEF as a function of time (see Table 1) on the Initiate subscale, $\chi^2 = 9.41$, $p < 0.01$, and on the Working Memory subscale, $\chi^2 = 6.90$, $p < 0.05$. Follow-up Wilcoxon signed ranks tests indicated that there were significant improvements in functioning from pre-treatment to post-treatment on both the Initiate ($Z = -2.21$, $p < 0.05$, $d = 1.20$) and Working Memory ($Z = -2.37$, $p < 0.05$, $d = 1.13$) subscales, and these improvements were consistent with a large effect size. Pairwise effect size comparisons also indicated improvements from pre-treatment to post-treatment on the Shift, Plan/Organize, and Task Monitor subscales that were consistent with large effect sizes. Improvements on the Behavioral Regulation summary score and the Emotional Control subscale were consistent with small to medium effect sizes, and there were small improvements on the Inhibit, Self-Monitor, and Organization of Materials subscales.

On the FrSBe, Friedman's rank-ordered repeated measures test did not indicate a statistically significant change across timepoints in Total Score, but the change from pre- to post-treatment was consistent with a large effect size. However, Friedman's tests indicated that there was a significant change across time on the Apathy subscale, $\chi^2 = 6.65$, $p < 0.05$, and the Executive Functioning subscale, $\chi^2 = 9.75$, $p < 0.01$. Wilcoxon signed ranks tests indicated that there were significant improvements in both Apathy ($Z = -2.21$, $p < 0.05$, $d = 0.93$) and Executive Functioning ($Z = -2.52$, $p < 0.01$, $d = 1.39$) from pre-treatment to post-treatment that were consistent with a large effect size. The FrSBe Executive Functioning subscale also remained significantly improved at follow-up ($Z = -2.38$, $p < 0.05$, $d = 1.32$), and this improvement maintained consistency with a large effect size. Improvements in FrSBe Apathy scores were reduced to statistical non-significance at follow-up, but there was evidence that the Apathy and Disinhibition subscales were improved compared to baseline, as indicated by small to medium effect sizes (Table 1).

Of note, FrSBe total scores ($M = 50.88$, $SD = 16.13$) and Executive Functioning subscale scores ($M = 51.25$, $SD = 14.29$) at post-treatment were improved to levels comparable to the normative mean, placing individuals with bipolar disorder at the 50th percentile compared to the normative sample after participating in 12 weeks of MBCT. In addition, all BRIEF and FrSBe summary and subscale scores were within one standard deviation of the normative mean at post-treatment.

Correlates of Improvement in Cognitive Functioning

To investigate whether increased mindfulness and decreased depression were related to improvements in cognitive functioning, we correlated changes in mindfulness (FFMQ), depression (HAM-D), and mania (YMRS) from pre-treatment to post-treatment with changes in cognitive functioning (BRIEF summary scores and FrSBe subscales) using Spearman rank-ordered correlations. As noted in the publication describing the primary outcomes of this study,²⁸ depressive symptoms were elevated prior to treatment.

Increases in the Nonjudgmental subscale of the FFMQ (e.g., “I tell myself that I shouldn’t be feeling the way I’m feeling”) were significantly related to improvements in the BRIEF Global Executive Composite score ($r = -.84, p < 0.01$), the BRIEF Behavioral Regulation score ($r = -.87, p < 0.01$), and the FrSBe Disinhibition score ($r = -.86, p < 0.01$), and they were marginally correlated with changes in the FrSBe total score ($r = -.64, p < 0.10$). Improvements in the Awareness subscale of the FFMQ (e.g., “I notice changes in my body, such as whether my breathing slows down or speeds up”) were also significantly correlated with improvements in the Executive Functioning subscale of the FrSBe ($r = -.71, p < 0.05$). There were no other significant correlations between primary indices of cognitive functioning and other subscales of the FFMQ.

Decreases in manic symptoms were associated with improvements in the BRIEF Initiate subscale ($r = .74, p < 0.05$), but not with any other subscales on the BRIEF or FrSBe, all $ps > 0.11$. Contrary to our hypotheses, improvements in cognitive functioning on the BRIEF and FrSBe were not significantly associated with decreases in depressive symptoms, all $ps > 0.27$.

DISCUSSION

The study described here evaluated changes in cognitive functioning associated with MBCT in individuals with bipolar disorder who had residual mood symptoms. Prior to treatment, our sample of participants with bipolar disorder reported substantial impairment in levels of cognitive functioning. Our results indicate that patients with bipolar disorder who participated in MBCT showed improvement in executive functioning and memory to levels comparable with normative samples. Improvements were seen at post-treatment compared to before treatment, as indicated by large effect sizes on many subscales, but the effects of the treatment appeared to be attenuated over time. Nevertheless, improvements in many areas of cognitive functioning, particularly memory and task monitoring, were maintained at the follow-up evaluation 3 months after treatment, as indicated by small to medium effect sizes on most subscales of the BRIEF and FrSBe. Previous studies have noted increases in hippocampal volume associated with mindfulness training,⁴⁶ suggesting that such neural mechanisms may underlie improvements in memory and cognition associated with MBCT, but this remains to be evaluated in future studies of MBCT for bipolar disorder. Of note, improvements in executive functioning in the current study were maintained at especially high levels several months after completing MBCT, as indicated by a large effect size from pre-treatment to 3-month follow-up on the Executive Functioning subscale of the FrSBe. More regular follow-up care may be required for patients to maintain the full cognitive benefits received during treatment, but this study provides initial evidence that MBCT may be useful in improving cognition in nonremitted patients with bipolar disorder.

Our secondary hypothesis that improvements in cognitive functioning would be related to increases in mindfulness received partial support. Increases in the nonjudgmental and awareness factors of the FFMQ were related to improvements in several areas of cognitive and executive functioning. It is important to note that these improvements were not accounted for by decreases in symptoms of depression, although there was evidence of some

improvements in cognitive functioning associated with decreases in manic symptoms. These findings indicate that patients with bipolar disorder who became more mindful after participating in MBCT also improved in cognitive functioning, as was hypothesized based on previous research about the cognitive benefits of mindfulness,^{33,35,36,38,41} and they suggest that mindfulness itself may be a mechanism of improvement in cognitive functioning as a result of treatment with MBCT. These findings are consistent with the goals of our adapted version of MBCT for bipolar disorder,²⁸ which emphasize nonjudgmental observance of bodily sensations, thoughts, and feelings associated with depression and anxiety, as well as mindful observance and awareness of prodromal signs of mood elevation (e.g., bodily sensations, feelings, and increased rate of thoughts). It may be that improving the ability to observe thoughts and feelings while disengaging from interpreting their meaning frees up cognitive resources otherwise tied to focusing on one's thoughts, resources that are useful in allowing one to plan, organize, and perform other executive functions. Similarly, awareness of one's bodily sensations may make people cognizant of their mood and their body's needs, making these needs less likely to go unmet and thus to interfere with their cognitive functioning. These potential mindfulness-based mechanisms of improvement in cognitive functioning should be evaluated further in future studies of MBCT for bipolar disorder.

Overall, the results of the present study are consistent with the notion that mindfulness has effects on multiple levels of functioning. Mindfulness appears to have positive effects on cognition, particularly through increasing the ability to maintain focus over longer periods of time. Indeed, previous research has shown that mindfulness is associated with increases in attentional control.^{28,32–39} Mindfulness meditation has also been linked to activation and increases in white matter in the anterior cingulate cortex,^{64–67} a region implicated in executive attention⁶⁸ and that is impaired in individuals with bipolar disorder.⁶⁹ Mindfulness may also have an impact on other executive functioning abilities (e.g., memory and the ability to plan, organize, or initiate tasks) through a bottom-up effect via improved ability to sustain attention. Meditation has been linked to increased cortical thickness in areas related to attention and cognitive processing,⁴⁵ as well as to changes in hippocampal volume,⁴⁶ which is associated with memory. Thus, there may be a neural basis for the cognitive and executive changes implicated in mindfulness meditation, because the practice of mindfulness requires the frequent utilization of prefrontal cortical areas in a specific and controlled manner. Another mechanism by which mindfulness and MBCT may affect cognitive functioning is their effects on emotion regulation. By increasing awareness and tolerance of negative emotional states, mindfulness may result in habituation of negative emotions resulting in less time spent dwelling on them in the future. Previous studies have shown that meditation training leads to decreased emotional reactivity⁷⁰ and reduces distractive and ruminative thoughts.^{28,33} Mindfulness may also improve control systems in prefrontal areas of the brain that are implicated in emotion regulation.^{64,71–74}

Several limitations of the present study should be noted. Appropriate caution is warranted when interpreting the results of open trials, which lack a valid comparison group. It is unclear whether MBCT would improve cognitive functioning to a greater extent than would other adjunctive, manualized treatments for bipolar disorder (e.g., FFT,¹⁷ IPSRT,²⁰ CBT for depression⁷⁵ or relapse prevention^{14,15}). However, the demonstrated cognitive benefits of mindfulness, in addition to the results of the current study, suggest that future research investigating MBCT in bipolar disorder is warranted. The frequency of practice of the mindfulness techniques learned in MBCT was also not systematically evaluated in this study. Future studies should determine how much practice is needed to maintain benefits of MBCT after termination of treatment. This study was also limited by a small sample size, which limited statistical power and prevented full mediation/moderation analyses from being conducted. In addition, findings were reported from participants who completed the

cognitive functioning measures, all of whom also completed the treatment trial. Therefore, the findings must be interpreted cautiously. Nevertheless, the data suggest that MBCT will be beneficial for those patients who are able to complete the program. Future studies with larger sample sizes will allow us to more rigorously test these findings, as well as determine which patients are most likely to respond to the program. It is also important to note that the cyclical nature of bipolar disorder may have contributed to some extent to the cognitive and mood changes observed in this study. It is possible that the times at which the measures were given may reflect improvement that would have occurred even in the absence of the intervention.

In addition, this study used only self-report measures of cognitive functioning. Hence, the instruments used in this study evaluated self-perceived cognitive functioning and may not be fully indicative of true functioning. However, self-report may be an effective method of evaluating certain subjective experiences,⁷⁶ and cognitive and executive functioning are processes about which people may be self-aware. Nonetheless, future studies should also consider evaluating changes in cognition through the use of other sources of information, such as behavioral computer tasks and neuropsychological tests. The present study also utilized a sample of bipolar patients with residual mood symptoms, rather than a sample of individuals in a current mood episode. Future studies should consider evaluating MBCT in currently depressed bipolar patients. However, individuals with bipolar disorder often remain symptomatic even when not in a current mood episode,^{2,24,25} so the study sample used here may be appropriate for evaluating the effects of this treatment in such individuals. Because cognitive impairment in bipolar disorder is common even outside mood episodes,^{3,47–55,77} future work should also evaluate effects of MBCT in euthymic bipolar patients.

In summary, the results of this study indicate that MBCT may be an effective treatment option for improving cognitive functioning in nonremitted individuals with bipolar disorder. Future research should evaluate MBCT in a randomized, controlled trial to determine its comparative effectiveness in improving cognitive functioning.

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Table 1
Cognitive Functioning at Pre-Treatment, Post-Treatment and Follow-up Assessments

	Pre-Treatment			Post-Treatment			Follow-Up			Cohen's d		
	Mean	SD		Mean	SD		Mean	SD		Pre-Post	Post-Follow-up	Pre-Follow-up
BRIEF												
Global Executive Composite	66.38	15.63		57.88	17.37		63.63	12.46		0.72	0.75	0.40
Summary scores												
Behavioral Regulation	61.25	17.31		55.87	18.10		59.63	14.19		0.44	0.36	0.29
Metacognition	68.13	13.27		58.63	15.11		65.00	10.64		0.89	1.02	0.43
Subscales												
Inhibit	61.88	15.17		58.13	18.94		61.25	13.36		0.31	0.41	0.09
Shift	61.63	15.20		53.38	11.21		59.00	10.17		0.89	0.72	0.40
Emotional Control	58.00	17.06		53.12	15.07		54.88	13.04		0.40	0.16	0.45
Self-Monitor	56.13	13.75		54.50	15.85		58.50	10.62		0.13	0.43	0.25
Initiate	65.13 ^{**a}	10.12		56.13	11.90		63.25	13.25		1.20	1.33	0.24
Working Memory	68.25 ^{*a}	15.76		56.75	14.70		54.88	17.31		1.13	0.08	0.57
Plan/Organize	69.13	14.42		59.88	13.54		67.38	9.18		0.85	0.86	0.17
Task Monitor	69.13	9.58		57.50	13.94		62.75	9.72		0.99	0.56	0.68
Organization of Materials	59.88	12.24		56.25	13.49		57.38	11.10		0.33	0.11	0.26
FrSBe												
Total Score	63.25	11.47		50.88	16.13		61.25	12.97		0.90	0.84	0.11
Subscales												
Apathy	62.25 ^{*a}	13.78		49.63	15.22		56.38	16.53		0.93	0.53	0.34
Disinhibition	57.00	20.42		50.75	21.23		53.75	17.28		0.31	0.40	0.17
Executive Functioning	66.88 ^{**aab}	7.04		51.25	14.29		55.38	12.39		1.39	0.47	1.32

^{**} $p \leq .01$;

^{*} $p \leq .05$ for Friedman's nonparametric repeated measures test (pre-treatment, post-treatment, and follow-up)

^{aa} $p \leq .01$;

^a $p \leq .05$ for paired comparison with Wilcoxon signed ranks test (pre-treatment vs. post-treatment)

$p \leq .05$ for paired comparison with Wilcoxon signed ranks test (pre-treatment vs. follow-up)

SD: standard deviation; BRIEF: Behavior Rating Inventory of Executive Function; FRSBe: Frontal Systems Behavior Scale.

Note: Higher values on BRIEF and FRSBe indicate greater impairment in functioning. Cohen's d values are based on the standard deviation of the change scores. Mean values listed are standardized scores (T-scores), with a standard deviation of 10. T-scores of 50 are considered normal (50th percentile).