ORIGINAL ARTICLE

Cognitive Functioning in Patients Remitted from Recurrent Depression: Comparison with Acutely Depressed Patients and Controls and Follow-up of a Mindfulness-Based Cognitive Therapy Trial

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Abstract Mindfulness-Based Cognitive Therapy (MBCT) is a promising intervention to prevent depressive relapse. Yet beyond efficacy studies, little is known regarding the mechanisms that could be modified through MBCT. Objectives of the present study were twofold: determine whether cognitive functioning was altered among patients remitted from depression at admission in a MBCT trial; and document possible changes during the trial and follow-up. In a cross-sectional perspective, cognitive functioning (autobiographical memory, shifting capacities, dysfunctional attitudes, mindful attention awareness and rumination habits) was first compared between 36 patients remitted from depression, 20 acutely depressed patients and 20 control participants. In a longitudinal perspective, changes in the remitted sample were explored during a MBCT plus Treatment As Usual versus Treatment As Usual randomized controlled trial and 9-month follow-up. Performances of remitted patients were similar to the ones of control participants for autobiographical memories, shifting capacities, and mindful attention awareness, whereas levels of rumination and dysfunctional attitudes were significantly elevated. Participation in the MBCT program was accompanied with a

significant decrease of dysfunctional attitudes that continued up to 9-month postintervention. No other change was observed that was specific to MBCT. Results suggest that MBCT might help people to identify dysfunctional attitudes at a very early stage and to avoid engaging further in these attitudes.

Keywords Mindfulness · Depression · Remission · Cognitive functioning

Introduction

Ten years ago, Mindfulness-Based Cognitive Therapy (MBCT; Segal et al. 2002a) was developed to prevent depressive relapse. Since then, four randomized controlled trials (RCT) have compared MBCT + TAU (Treatment As Usual) to TAU only (Bondolfi et al. 2010; Godfrin and van Heeringen 2010; Ma and Teasdale 2004; Teasdale et al. 2000). A recent meta-analysis of these studies (Chiesa and Serretti 2011) concluded that 32 % of patients with 3 or more past depressive episodes relapsed in the 12 months following MBCT compared to 60 % of patients with TAU only. All four studies demonstrated that MBCT significantly delayed relapse compared to TAU. Other studies showed that MBCT leads to relapse/recurrence rates that are comparable to those of patients with maintenance antidepressant medication, suggesting that MBCT could be an alternative to pharmacotherapy (Kuyken et al. 2008; Segal et al. 2010).

Beyond the need to establish the efficacy of a new treatment, the psychological and cognitive mechanisms that may be modified by mindfulness treatments or account for observed benefits require clarification (e. g. Bishop et al. 2004; Grossman et al. 2004). Better identifying

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mechanisms of action could help to adapt existing interventions (e.g. increasing or decreasing the time allocated to mindfulness practices). One of the known impacts of Mindfulness-Based Therapies is their positive effect on anxiety and depressive symptomatology (see Hofmann et al. 2010 for a meta-analysis). Moreover, practicing mindfulness may have an impact on the regulation of attention. This could happen through meditation exercises during which meditators repeatedly train to focus their attention for a prolonged period on specific aspects such as breathing (sustained attention). When they notice that their mind is wandering (monitoring faculties), they observe this happening without elaborating the encountered content (inhibition capacities) and bring their attention back to their focus point (shifting abilities). In a recent literature review, Chiesa et al. (2011) showed that better attentional performances are observed in people with extensive experience of mindfulness practice (e.g. experienced Buddhist meditation practitioners) and that practicing mindfulness meditation entails significant long-term benefits for most attentional aspects (sustained, selective and executive attention).

Only few behavioural studies explored the longitudinal impact of mindfulness training (e.g. mindfulness retreat, Mindfulness-Based Stress Reduction program – MBSR) on cognitive functioning and results are mixed. For example, Chambers et al. (2008) showed a significant increase in sustained attention for participants in a 10-day retreat compared to controls, whereas Anderson et al. (2007) did not evidence attentional changes (sustained, selective attention or shifting abilities) in participants in a 8-week MBSR program compared to controls. Recently, several neuroscientific studies showed that mindfulness training causes structural and functional changes in brain structures that could be related to attentional processing (e.g. anterior cingulate cortex) (see Hölzel et al. 2011 for a review).

Regarding the acute phase of depression, it has often been reported that patients present a wide range of cognitive dysfunctions in domains such as attention, memory and executive functions. More specifically in relation to the aspects explored in the present article, literature consistently demonstrates that depressed patients show overgeneral autobiographical memories recall deficit (see Williams et al. 2007 for a review), impaired shifting abilities (Murphy et al. 1999), elevated dysfunctional attitudes which are rigid maladaptive schemes (Beck 1967), and increased rumination habits that correspond to repeatedly focusing on symptoms, causes and consequences of sad mood (Nolen-Hoeksema 1991).

Concerning patients in remission, the literature is less extensive than for acutely depressed patients and results are often less unanimous. However, regarding the specific cognitive functions addressed in the present study, studies have shown that patients in remission present an overgeneral autobiographical memory recall deficit (Williams et al. 2007). Moreover, it has consistently been shown that dysfunctional attitudes and ruminative habits could be cognitive vulnerability factors to relapse in remitted patients (Segal et al. 2006; Teasdale 1988).

To date, little is known about whether a therapy like MBCT could impact on cognitive functioning in patients remitted from depression. Williams et al. (2000) showed that MBCT participants recalled more specific autobiographical memories after the programme than before, compared to TAU participants. They postulated that MBCT may have an impact on autobiographical memory by training participants to be attentive to specific aspects of their environment (making encoding more specific may make retrieval more specific) and encouraging them to allow mental content to occur without avoiding it (reducing functional avoidance). MBCT participants also learn to respond differently to possible rumination episodes, which may also affect autobiographical memory. Recently, Hargus et al. (2010) have explored suicidal depressed patients' memories and found that at post-assessment, MBCT patients recalled more specific memories of the warning signs of their suicidal crises and showed more meta-awareness (capacity to distinguish the self from the content of thoughts and emotions) than TAU participants. Altogether, these results seem to indicate that MBCT has an impact on autobiographical memory. Studies investigating the influence of MBCT on other cognitive capacities, such as attention or executive functioning, have been rare. Recently, Bostanov et al. (2012) showed, with an event-related brain potential technique, that remitted patients who took part in MBCT increased their concentration abilities compared to a waiting list group. In a study examining a form of mindfulness training derived from MBCT for healthy participants, Heeren et al. (2009) found no improvement after MBCT for various tasks measuring executive functioning (inhibition, flexibility) compared to non-MBCT participants. Finally, recent studies have shown that depressive symptomatology decreases over time in MBCT participants (Godfrin and van Heeringen 2010; Kuyken et al. 2008; Michalak et al. 2008), whereas mindfulness capacities increase (Michalak et al. 2008) and quality of life improves (Godfrin and van Heeringen 2010; Kuyken et al. 2008).

The general objectives of the present study were two-fold: determine whether cognitive functioning was actually altered among patients remitted from depression, in a cross-sectional perspective, and investigate the possible impact of MBCT on these functions, in a longitudinal perspective. More specifically, we hypothesized that mindfulness meditation would increase a particular aspect of attention, namely shifting abilities that correspond to the

capacity to engage and disengage one's attention. It was expected that mindfulness practices would lead participants to be more frequently aware of the present moment in their daily life. It was postulated that new ways of dealing with thoughts and emotions would render autobiographical memories recall less general, and diminish dysfunctional attitudes and ruminative habits. As participants entering the MBCT trial were in remission, no effect was expected on depression severity.

The present study was designed as part of a RCT that compared the efficacy of MBCT + TAU and TAU for relapse prevention in patients remitted from recurrent depression. Cognitive functions were first measured in remitted patients at inclusion in the MBCT trial (baseline measures) and compared with the ones of acutely depressed patients and controls. The impact of MBCT was then explored in remitted participants who entered the trial and were assessed again after 3 and 9 months.

Method

Participants

Remitted Participants in the MBCT Trial

Sixty remitted patients (17 men) with at least three past depressive episodes participated in the MBCT efficacy trial (Bondolfi et al. 2010). Inclusion criteria were: history of recurrent major depression according to DSM-IV (Diagnostic and Statistical Manual of Mental Disorders; American Psychiatric Association 1994), assessed with the Structured Clinical Interview for DSM-IV (First et al. 1996); remission at the time of inclusion (Montgomery-Asberg Depression Rating Scale score ≤13—MADRS; Montgomery and Asberg 1979); and off antidepressant medication. Exclusion criteria were: history of schizophrenia or schizoaffective disorder, current substance abuse, eating disorder, obsessive compulsive disorder, organic mental disorder, pervasive developmental disorder, borderline personality disorder or dysthymia with onset before age 20. Twenty-nine patients were randomly allocated to TAU and thirty-one patients were allocated to MBCT plus TAU. The research team was blind to group assignment.

Study flow chart, as well as detailed information about power analysis, MBCT program and study procedures have been provided in our earlier publication (Bondolfi et al. 2010). Briefly, MBCT participants attended 8 weekly 2-h sessions and TAU participants had unrestricted access to any type of treatment or help service. Instructors were four senior CBT psychotherapists all having undergone at least one training program taught and supervised by one of the

developers of MBCT (Z. Segal). Instructors' adherence to the MBCT protocol was evaluated with the MBCT adherence scale (MBCT-AS; Segal et al. 2002b) and was shown to be high (see Bondolfi et al. 2010 for more details). Patient attendance rates were high and MBCT participants practiced mindfulness exercises regularly (see Bondolfi et al. 2010 for more details).

Patients were monitored for relapse during the 8-week intervention and 1-year follow-up. Five participants dropped out during the study (3 patients participated in less than 4 MBCT sessions; 2 patients decided to withdraw after 3 and 5 months, respectively). The occurrence of relapse or recurrence meeting DSM-IV criteria for major depressive episode was assessed with the depression module of the Structured Clinical Interview for DSM-IV (First et al. 1996). Relapse/recurrence was confirmed by a senior psychiatrist listening to the audiotaped assessments. During the trial, relapse rates were 29 % in the MBCT + TAU group (n = 9/31) and 34 % in the TAU group (n = 10/29) (see Bondolfi et al. 2010 for more details). All participants who relapsed (n = 19) were excluded from the investigation because relapse would have been a confounder when investigating change in cognitive functioning in relation with MBCT participation. On the one hand, time to relapse differed in the MBCT + TAU and TAU groups (see Bondolfi et al. 2010). On the other hand, re-occurrence of a depressive episode was expected to directly influence cognitive measures. The final sample thus included 36 remitted patients (n = 18 MBCT + TAU, 6 men; n = 18 TAU, 5 men; mean number of past episodes was 4.5, SD 2.2). See remitted sample characteristics in Table 1. Mean age in the MBCT + TAU group was 45.4 years (SD 11.6) and mean number of years of education was 15.6 (SD 3.8); mean age in the TAU group was 48.2 (SD 9.4) and mean number of years of education was 15.1 (SD 3.0).

Depressed Participants

Twenty acutely depressed patients (5 men) were recruited in an adult university psychiatric out-patient clinic specialized in the treatment of depression (Depression Program). All patients were diagnosed by experienced psychiatrists during routine clinical treatment for major depressive episodes according to DSM-IV criteria. Exclusion criteria were bipolar disorder, ongoing substance abuse and/or a neurological problem that would impair cognitive functioning. None of the patients were in remission. Mean number of past episodes was 2.4 (SD 2.2), with less than 3 episodes in 70 % of the sample. All patients except one were taking antidepressant medication at the time of testing (4 with SSRIs [selective serotonin reuptake inhibitor], 6 with SNRIs [serotonin-norepinephrine reuptake inhibitor], 3 with TCAs [tricyclic antidepressant], 1 with a MAOI [monoamine

Table 1 Cross-sectional comparison of acutely depressed patients, patients remitted from depression and never depressed controls with respect to age, years of education, cognitive tasks and questionnaires

	Depressed (n = 20)		Remitted (n = 36)		Controls (n = 20)		One-way ANOVA	
	Mean	SD	Mean	SD	Mean	SD	F(2,73)	p value
Sample characteristics								
Age	46.1	8.3	46.8	10.5	45.9	8.8	0.08	0.93
Years of education	12.6	5.0	15.4	3.4	14.0	3.4	3.5	0.036
Cognitive tasks								
Autobiographical memory test (AMT; proportion of memories)								
Categoric	0.34	0.23	0.19	0.17	0.17	0.19	5.2	0.007
Specific	0.62	0.22	0.74	0.17	0.76	0.20	3.3	0.042
Plus-minus task (PM)								
Shift cost (%)	63.0	58.3	20.1	13.7	30.7	27.4	10.3	<0.001
Questionnaires								
MADRS	25.8	4.4	4.6	4.4	0.5	0.8	266.9	<0.001
BDI-II	34.7	12.2	8.4	8.5	2.7	2.7	82.1	<0.001
MAAS	50.8	13.7	66.7	11.2	71.3	9.1	18.5	<0.001
DAS	130.7	40.4	115.6	30.9	98.5	17.1	5.3	0.007
RRQ								
Rumination	46.3	5.5	37.6	8.7	30.6	7.4	21.2	<0.001
Reflection	35.9	8.8	44.6	7.9	40.0	8.7	7.3	0.001

oxidase inhibitor], 1 with a combination of NSM [norepinephrine-serotonin modulator] and TCA, 2 with a combination of NSM and SNRI, 1 with a combination of MAOI and TCA and 1 with a combination of TCA and mood stabilizer). Five patients were taking benzodiazepines, 3 patients had antipsychotic medication (prescribed to reduce anxiety) and 5 patients were on both kinds of drugs.

Never-Depressed Control Participants

Twenty comparison participants (5 men) were recruited in the same cultural community by word of mouth in order to match depressed participants in terms of gender, age and education. They had never previously suffered from clinical depression according to DSM-IV criteria and had no prior neurological impairment or history of substance abuse as assessed by a clinical psychologist during an interview.

Characteristics of patients and controls in the 3 groups are provided in Table 1. There were no differences for age (see Table 1) and gender ($X^2 = 0.29$; $p = 0.86$). Remitted participants had a significantly longer education than depressed patients (Fisher's LSD post hoc test, $p < 0.05$), but there was no difference between remitted and control participants ($p = 0.19$) and between depressed and control participants ($p = 0.26$). As expected from the study design,

remitted participants had experienced more depressive episodes than acutely depressed patients ($t(54) = 3.4$; $p < 0.01$).

Tasks

Plus-Minus (PM—adapted from Jersild 1927 and Spector and Biederman 1976)

The PM task was used to evaluate shifting abilities. Its reliability and validity have been demonstrated in clinical samples (e.g. ecstasy-polydrug users—Montgomery et al. 2005) and non-clinical participants (Miyake et al. 2000). Participants were given a sheet of paper with three lists of 30 two-digit numbers (numbers 10–99). On the first list, participants were instructed to add 7 to each number and write down their answers. On the second list, they were instructed to subtract 7 from each number. On the third list, participants had to alternate between adding 7 and subtracting 7. Participants were instructed to complete each list quickly and accurately. Times for completion were measured in seconds with a stopwatch and errors were counted. The cost of shifting was calculated as a percentage, i.e. the time needed to complete the alternating list divided by the mean time needed to complete the addition and subtraction lists.

Autobiographical Memory Test (AMT—Williams and Broadbent 1986)

Each participant was given 12 cue words one at a time: six cue words were positive (e.g. happy, relaxed) and six cue words were negative (e.g. hopeless, sad). Three sets of 6 positive and 6 negative words were compiled so that the sets could be counterbalanced across participants. Each set was matched for word frequency and level of arousal. For each cue word, participants were asked to recall a specific autobiographical memory, i.e. something that happened once in a particular place at a particular time and lasted no longer than 24 h. Responses were scored according to the following categories: a) the memory was categoric (happened more than once); b) the memory was extended (happened once but lasted more than 24 h); c) the memory was specific; d) no memory. The proportions of categoric, extended and specific memories were computed for responses triggered by positive and negative cue words. As proportion of extended memories were low (means <0.08), these were not submitted to statistical analyses. All memories were audiotaped and scored by two raters. Inter-rater reliability was good (kappa = 0.71, based on scoring 720 memories) and raters resolved discrepancies through discussion.

Questionnaires

Montgomery-Asberg Depression Rating Scale (MADRS—Montgomery and Asberg 1979)

The MADRS is a widely used clinician rated depression rating scale. Ten items are rated from 0 to 6. Total score ranges from 0 to 60 with higher score representing more severe depressive symptoms. The French version used in this study was translated by Pellet et al. (1980).

Beck Depression Inventory II (BDI-II—Beck et al. 1996)

The BDI-II is a widely used self-report inventory for assessing the severity of depressive symptoms. Twenty-one items are rated on a 4-point Likert scale (range 0–3). Total score ranges from 0 to 63, with higher score representing more severe depressive symptoms. The French version used in this study was developed by the Editions du Centre de Psychologie Appliquée (Beck et al. 1998) and has shown strong reliability and validity in both clinical (depressed) and non-clinical samples.

Mindful Attention Awareness Scale (MAAS—Brown and Ryan 2003)

The MAAS is a 15-item scale that measures the tendency to be attentive and aware of present moment experience in daily life in people who have no specific experience with mindfulness meditation. Items are rated on a 6-point Likert scale ranging from 1 (almost always) to 6 (almost never). Total score ranges from 15 to 90 with higher score representing more present attention and awareness. The English version was developed among non-clinical adults. The French version was validated in a non-clinical adult sample by Jermann et al. (2009). Internal consistency of the French MAAS was good (Cronbach's alpha 0.84).

Dysfunctional Attitude Scale (DAS—Weissman and Beck 1978)

The DAS measures the dysfunctional beliefs that are often related to depression. Forty items are rated on a 7-point Likert scale (range 1–7). Total score ranges from 40 to 280 with higher score representing more dysfunctional attitudes. The French version was established by Bouvard et al. (1994). Internal consistency of the French DAS was good (Cronbach's alpha 0.79 for depressed patients and 0.86 for control participants).

Rumination/Reflection Questionnaire (RRQ—Trapnell and Campbell 1999)

The RRQ measures two aspects: rumination (recurrent negative thoughts about self, but without reference to depressed mood) and self-reflection (positive thoughts about self motivated by intellectual curiosity rather than distress). Items are rated on a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree). Scores range from 12 to 60 for each subscale with higher scores corresponding to higher tendencies for rumination or self-reflection. The English version was developed in student samples. The French version was validated by Jermann et al. (2010) in a sample of young adults. Internal consistency of the French RRQ was good to excellent (Cronbach's alpha 0.87 for rumination and 0.92 for self-reflection).

Procedure

All participants were evaluated with the same tasks and order of questionnaires. Evaluations started with the MADRS, followed by the AMT, RRQ, PM, DAS and MAAS. At the end of the evaluation, participants completed the BDI-II. Depressed and control participants were evaluated on a single occasion. Remitted patients who entered the MBCT trial were evaluated on three occasions: at baseline (T1), after 3 months (T2, 90 ± 14 days) and 9 months (T3, 278 ± 20 days).

The study protocol and informed consent form received approval from the ethics committee of the Geneva University Hospitals. All participants signed the consent form

before the evaluation started. They received a financial compensation of CHF 50.- (about 50 USD) for their participation.

Statistical Analysis

One-way analysis of variance (ANOVA) was used to test for differences between the 3 groups, without and with adjustment for education level. Significant differences were further investigated with Fisher's LSD post hoc tests. Change over time was analysed with repeated measures ANOVA, which considered group (MBCT + TAU vs. TAU), time (T1 to T3) and time by group interaction. Associations between number of past depressive episodes and outcome variables were tested with the Spearman rank-order correlation coefficient.

Results

Cross-Sectional Assessment: Remitted versus Acutely Depressed and Control Participants

Means and standard-deviations (SD) of all cognitive measures and questionnaires are shown in Table 1.

Severity of Depressive Symptoms and Rumination

As expected, significant differences between groups were observed for the MADRS, BDI-II and RRQ (Table 1).

Regarding depressive symptomatology, post hoc tests showed that remitted patients displayed significantly lower scores than depressed patients (Fisher's LSD post hoc test, $p < 0.001$ for the MADRS; $p < 0.001$ for the BDI-II), but higher scores than control participants (MADRS, $p < 0.001$; BDI-II, $p < 0.05$).

On the rumination subscale of the RRQ, remitted patients similarly displayed lower scores than acutely depressed patients ($p < 0.001$) but higher scores than control participants ($p < 0.01$). On the reflection subscale, however, remitted patients displayed higher scores than depressed patients ($p < 0.001$) and control participants ($p = 0.05$), with no significant difference between the latter two groups ($p = 0.12$).

Mindfulness and Dysfunctional Attitudes

One-way ANOVAs showed significant differences for the MAAS and DAS (Table 1).

Both remitted patients and control participants displayed higher scores of mindful attention/awareness in daily life than acutely depressed patients (Fisher's LSD post hoc test,

$p < 0.001$). No significant difference was observed between remitted and control participants ($p = 0.16$).

Regarding dysfunctional attitudes, remitted and depressed patients did not significantly differ ($p = 0.09$). Both remitted patients ($p = 0.05$) and acutely depressed patients ($p < 0.01$) had more dysfunctional attitudes than control participants.

Cognitive Tasks: Autobiographical Memory and Shifting Abilities

Groups significantly differed with respect to the AMT proportions of categoric and specific memories and shift cost in the Plus-Minus task (Table 1).

Regarding autobiographical memory, both remitted patients and control participants recalled less categoric memories (Fisher's LSD post hoc test, $p < 0.01$ and $p < 0.01$, respectively) but more specific memories ($p < 0.05$ and $p < 0.05$, respectively) than depressed patients. Remitted patients did not show a significant autobiographical memory deficit compared with control participants (categoric memories $p = 0.78$; specific memories $p = 0.72$).

In the PM task, remitted patients ($p < 0.001$) and control participants ($p < 0.01$) presented less shift cost than depressed patients. Executive capacity of shifting was not significantly impaired in remitted patients, as compared to control participants ($p = 0.27$).

Effects of Education and Number of Past Depressive Episodes

Because groups significantly differed with respect to education, statistical analyses were repeated after adjustment for years of education. All group differences in Table 1 remained statistically significant, except for the AMT proportion of specific memories ($p = 0.11$).

As number of past depressive episodes was significantly higher in remitted participants than in acutely depressed patients, we explored associations between number of episodes and MADRS, BDI-II, RRQ, MAAS, DAS, AMT proportions of categoric and specific memories, and shift cost in the Plus-Minus task. In either remitted or acutely depressed patients, no significant correlation was observed.

Longitudinal Assessment During MBCT Trial and Follow-up

Means and standard-deviations (SD) of all cognitive measures and questionnaires at baseline, 3 and 9-month follow-up are shown in Table 2.

Table 2 Time course of cognitive tasks and questionnaires for 36 participants in a 8-week MBCT + TAU versus TAU trial

Tasks and questionnaires		Time 1 baseline		Time 2 after 3 months		Time 3 after 9 months		Repeated measures ANOVAs					
		Mean	SD	Mean	SD	Mean	SD	Time F(2,68)	p value (η_p^2)	Group F(1,34)	p value (η_p^2)	Interaction F(2,68)	p value (η_p^2)
Autobiographical memory test (AMT; proportion of memories)													
Categoric	MBCT + TAU	0.15	0.15	0.20	0.21	0.17	0.14	0.43	0.66 (0.01)	0.07	0.80 (0.002)	1.00	0.37 (0.03)
	TAU	0.22	0.19	0.18	0.15	0.15	0.19						
Specific	MBCT + TAU	0.78	0.15	0.74	0.22	0.76	0.17	0.66	0.52 (0.02)	0.02	0.89 (0.001)	1.53	0.22 (0.04)
	TAU	0.70	0.19	0.76	0.18	0.80	0.25						
Plus-minus task (PM)													
Shifting cost (%)	MBCT + TAU	18.2	12.7	21.8	14.2	21.0	12.7	0.70	0.50 (0.02)	0.20	0.66 (<0.01)	2.08	0.13 (0.06)
	TAU	21.8	13.3	13.6	17.8	21.5	9.7						
MADRS	MBCT + TAU	5.4	4.8	5.7	4.9	5.2	5.7	0.87	0.42 (0.03)	4.39	0.04 (0.11)	0.34	0.71 (0.01)
	TAU	3.8	4.0	4.0	5.8	2.0	2.3						
BDI-II	MBCT + TAU	9.8	9.8	9.3	6.2	6.7	6.6	4.45	0.02 (0.12)	4.07	0.05 (0.11)	0.14	0.87 (<0.01)
	TAU	6.9	6.9	5.7	8.1	2.4	2.9						
MAAS	MBCT + TAU	63.5	10.5	63.9	9.5	63.9	9.3	0.01	0.99 (<0.001)	4.06	0.05 (0.11)	0.04	0.97 (<0.01)
	TAU	69.9	11.2	69.7	9.7	69.8	10.8						
DAS	MBCT + TAU[a]	123.3	36.4	105.7	30.2	93.6	30.8	12.4	<0.001 (0.28)	0.01	0.93 (<0.001)	5.05	0.01 (0.14)
	TAU	110.6	24.5	105.6	25.8	104.1	26.0						
RRQ													
Rumination	MBCT + TAU	41.2	5.4	36.2	9.5	34.9	7.7	4.53	0.01 (0.12)	4.88	0.03 (0.13)	0.66	0.52 (0.02)
	TAU	34.0	9.9	31.9	11.0	31.1	8.7						
Reflection	MBCT + TAU	45.0	8.9	41.6	10.2	42.4	9.8	5.12	0.01 (0.13)	0.04	0.84 (0.001)	2.93	0.06 (0.08)
	TAU	44.3	7.1	44.3	7.1	42.0	7.8						

[a] Missing data for one participant at time 1 and one participant at time 3

Severity of Depressive Symptoms and Rumination

Regarding the clinician-rated MADRS, ANOVA results indicated a significant group effect, with higher depression severity in the MBCT + TAU than TAU group. No time effect or time by group interaction was detected (Table 2). For the self-rated BDI-II, a trend toward higher severity in the MBCT + TAU group was also found. Depression severity decreased significantly over time, but no time by group interaction was observed (Table 2).

For the RRQ, MBCT + TAU participants had higher rumination scores than TAU participants. Both groups showed fewer rumination and reflection habits over time (Table 2), with no significant time by group interaction for rumination, and a trend toward different time courses according to group for reflection.

Mindfulness and Dysfunctional Attitudes

Regarding attention/awareness of the present moment, a trend toward a group effect was observed (Table 2), with MBCT + TAU participants showing lower MAAS scores than TAU participants. No significant time or time by group interaction was detected.

For dysfunctional attitudes, a significant time effect and time by group interaction were observed, in the absence of a main group effect (Table 2). Planned comparisons showed that DAS scores decreased from Time 1 to Time 2 ($t(16) = 2.91$; $p < 0.05$) and from Time 2 to Time 3 ($t(16) = 2.59$; $p < 0.05$) in the MBCT + TAU group. No significant change over time occurred in the TAU group. Groups did not significantly differ with respect to baseline DAS score ($t(33) = 0.99$; $p = 0.33$).

Cognitive Tasks: Autobiographical Memory and Shifting Abilities

No significant time, group or time by group interaction was observed for categoric memories, specific memories and PM task (Table 2).

Discussion

Studies that evaluate cognitive changes following MBCT and compare performances of remitted, acutely depressed and control participants have been scarce. The present study considered cognitive functioning, as examined with tasks (autobiographical memories, shifting), and questionnaires (rumination, dysfunctional attitudes, frequency of attention/awareness), both in cross-sectional and longitudinal perspectives. Patients in remission from chronic depression (at least 3 previous episodes) at inclusion in a MBCT + TAU

vs. TAU trial displayed cognitive functioning similar to that of control participants for several aspects, such as autobiographical memories, shifting capacities and mindful attention/awareness. They differed from controls, however, by having more dysfunctional attitudes, rumination habits and depressive symptoms. Compared with acutely depressed patients, remitted patients had similar levels of dysfunctional attitudes, although they recalled fewer overgeneral memories, showed better shifting capacities, displayed fewer depressive symptoms, fewer rumination habits and more mindful attention/awareness in daily life. Interestingly, they scored higher on the reflection subscale, possibly in relation with a high motivation to enter the trial.

The influence of MBCT was explored over the 2-month intervention and 9-month follow-up. Whereas a significant decrease was observed for self-rated symptoms (BDI-II), depression severity, as measured with the MADRS, remained stable over time, with scores in the range expected for remitted patients with 1 or 2 mild symptoms, or without symptom but still considering that they are not back to their normal selves (Zimmerman et al. 2004). Shifting abilities and autobiographical memory did not change over time, whether in the MBCT + TAU or TAU groups. There was no evidence that MBCT had any specific impact on ruminative habits (RRQ) and attention-awareness to the present moment (MAAS). This latter result should be interpreted in the light of ongoing discussions about the validity of instruments used to assess mindfulness. As mentioned by Grossman (2011), the MAAS might present limitations in terms of validity and sensitivity to change, in addition to difficulties in semantic interpretation of the items and possible response bias related to experience with mindfulness practice.

Specific change with MBCT was detected on a single aspect of cognitive functioning, namely dysfunctional attitudes, which were significantly higher in remitted and acutely depressed patients than in controls. Level of dysfunctional attitudes (DAS) significantly decreased during the intervention and continued decreasing up to 9 months after starting the MBCT program. Decreased dysfunctional attitudes and unchanged rumination in the present study are in contrast with Ramel et al. (2004), who showed reduced rumination but no change in dysfunctional attitudes after MBSR. Differences between interventions could account for discrepant results. MBCT is a program specifically tailored for previously depressed patients to help them identify thought contents that are often present in depressive states (automatic thoughts). MBSR is a more general stress management intervention that does not explicitly focus on thoughts associated with depression and might not allow participants to dis-identify with them. Many studies have questioned the stability of dysfunctional attitudes during the course of depression. Most of them showed a state dependence of DAS scores (e.g. Ingram et al. 1998; Zuroff et al.

1999), but some did not (e.g. Beevers and Miller 2004; Peselow et al. 1990; Zuroff et al. 1999). To account for inconsistent results, Zuroff et al. (1999) proposed a state-trait vulnerability model, in which vulnerable people present a greater availability of dysfunctional attitudes (traits) that are more or less accessible depending on the severity of depressive symptoms (state). The present study suggests that availability of dysfunctional attitudes might be similar in remitted and depressed patients, with remitted patients particularly vulnerable to relapse when low mood triggers these beliefs and makes them more accessible. MBCT meditation practices may help people identify such thoughts (availability) at a very early stage and observe them without engaging with them (decreased accessibility).

The present study also shed some light on the MBCT efficacy trial, from which the remitted sample was part (Bondolfi et al. 2010). Whereas MBCT + TAU significantly delayed the time to relapse compared with TAU alone, both groups relapsed at similar rates over the 1-year follow-up. When compared to other studies (Bishop et al. 2004; Godfrin and van Heeringen 2010; Teasdale et al. 2000), socio-demographic characteristics and depressive history of patients in Bondolfi et al. (2010) were quite similar. However, none of the three previous efficacy studies explored cognitive functioning. The hypothesis that MBCT might be particularly efficient for people presenting cognitive deficits remains to be addressed.

Limitations and Future Studies

The present investigation presents limitations that should be acknowledged. Firstly, the remitted sample took part in a trial that did not show the expected relapse prevention effect (Bondolfi et al. 2010). It might be argued that probability of observing cognitive changes was low. However, as instructors' adherence to the protocol was elevated, participants' attendance rate was high and practice of mindfulness exercises was regular (see Bondolfi et al. 2010), MBCT might nevertheless have had an impact on cognitive functioning. Statistical power is a second limitation. In the cross-sectional part of the study, small to moderate differences between groups might have been undetected because of small sample size, in particular for acutely depressed patients and control participants. In the longitudinal part of the study, power to detect small to moderate changes over time was also limited. A third limitation is associated with task selection and sequence. On the one hand, a paper–pencil task like the PM may not have been sensitive enough to detect changes. In the future, it will be important to measure change with MBCT on tasks that are known to be related to mood disorders (e.g. memory bias toward negative content, affective shifting), and specifically to depression vulnerability (Mathews and MacLeod 2005). On the other hand, counterbalancing the

order of tasks and questionnaires might be considered in the future, in order to control for a possible sequence effect. Fourthly, it should be noted that no structured diagnostic interview was used in depressed patients, even though attending psychiatrists had a long experience with DSM-IV criteria. Furthermore, comorbidity was not investigated systematically. It might have led to heterogeneity in patient samples, and a moderating role of comorbid disorders, e.g. anxiety, cannot be excluded. Moreover, all but one acutely depressed patient were taking psychotropic medications at the time of testing, so that drug effects on cognitive functioning cannot be excluded. Finally, number of depressive episodes significantly differed in the remitted and acutely depressed patients and might be a confounding factor when examining differences between groups. Future studies are awaited to disentangle the effect of group and depression chronicity, as some data indicate that a larger number of depressive episodes might be associated with increasing impairment of cognitive performances (e.g. Kessing 1998). Taking into account other possible confounders and moderating factors will be another challenge.

Conclusion

In summary, the present study suggests that MBCT might have a specific impact on dysfunctional attitudes. Changes were not only observed immediately after group sessions but continued up to 9 months, in line with the hypothesis of MBCT-initiated long-term changes. Because of methodological limitations, these results nevertheless await replication and confirmation. At the clinical level, when conducting MBCT groups, clinicians often observe changes in patients during the 8-week program and participant feedback confirms the observed changes. At the research level, further work is needed to measure these gains and identify the processes through which they happen.

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