RUNNING HEAD: Inhibitory processing and MBCT

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Changes in Attentional Processing of Emotional Information following Mindfulness-Based Cognitive Therapy in People with a History of Depression: Towards an Open Attention for all Emotional Experiences

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Abstract

Mindfulness-based cognitive therapy (MBCT) has been demonstrated to be successful in the prevention of relapse in patients with recurrent major depressive disorder (MDD). With regard to its working mechanisms, it is hypothesized that mindfulness meditation influences the processing of emotional information and that it could therefore reduce cognitive vulnerability factors that are observed during and after remission of depressive episodes. In this study we investigated the effects of an eight week MBCT training versus no intervention on the facilitation and inhibition of attention for sad versus happy faces in a group of people with a history of MDD, N=45. The comparison group consisted of a non-treatment seeking group with a history of MDD, recruited from the community, N = 26. At baseline, we found that formerly depressed patients who applied for MBCT training inhibited attention for positive information, and showed facilitation of attention for negative information. However, the comparison group did not show similar attentional characteristics. After MBCT, participants showed a reduced facilitation of attention for negative information and a reduced inhibition of attention for positive information, which is indicative of open attention towards all emotional information.

Key words: Mindfulness-based Cognitive therapy, Attention, Inhibition, Emotion, Depression

Changes in Attentional Processing of Emotional Information following Mindfulness-Based Cognitive Therapy in People with a History of Depression: Towards an Open Attention for all Emotional Experiences

Major depressive disorder is one of the most common psychiatric disorders (Goodwin, Jacobi, Bittner & Wittchen, 2006). Although there are currently a range of effective treatment options for depression (Dimidjian *et al.*, 2008), there is a high rate of relapse or recurrence after remission or recovery (Kessler *et al.*, 2003). Mindfulness-based cognitive therapy (MBCT; Segal, Williams & Teasdale, 2002) is a training program that was developed for the prevention of relapse in patients with recurrent depression. Mindfulness based approaches were introduced by Kabat-Zinn (1990), who demonstrated beneficial effects of a Mindfulness-based stress reduction (MBSR) program in patients with intractable somatic conditions and psychological distress. Mindfulness stems from Buddhist meditation practices and is defined as paying attention to the present moment, non-judgmentally, and being open and accepting to all experiences (Kabat-Zinn, 1994). In MBCT, mindfulness is combined with cognitive-behavioral techniques, such as psycho-education and activity scheduling. Unlike conventional cognitive behavior therapy, MBCT does not aim to change dysfunctional thinking, but emphasizes acceptance of and openness towards all thoughts, and a metacognitive perspective to experience emotions and thoughts as temporary internal events. Paying equal and unprejudiced attention to all thoughts and feelings is different to the response of prolonged focusing on the causes and implications of one's depressive mood, a negative thinking style which is often observed in depression and referred to as rumination (Nolen-Hoeksema, 1991).

MBCT has demonstrated to be promising in the prevention of relapse in patients with recurrent depression (for a review see Brow, Ryan & Creswell, 2007, Chiesa & Serretti, 2010).

However, to date little is known about the underlying working mechanisms responsible for its success. As a first step towards answering this question, Bishop and coworkers (2004) proposed a formal operationalisation of the concept of mindfulness. They proposed a two-component definition based on the hypothesized underlying cognitive mechanisms, including (1) self-regulation of attention and (2) an accepting, open awareness of experiences. Related to these components, Bishop *et al.* (2004) suggested that research should focus on the investigation of sustained attention, attention switching, and inhibitory processing. Research efforts have recently been directed towards investigating the effects of mindfulness training on several attention-related tasks and measuring these specific constructs. Wenk-Sormaz (2005) demonstrated reduced interference and more flexible word production on a non-emotional Stroop task after brief mindful sitting meditation compared to rest and a cognitive control condition. In another study (Jha, Krompinger & Baime, 2007), the effects of an eight-week MBSR course or other meditation practice was studied to assess the impact on three attentional subsystems as measured by the non-emotional attention network test (Fan, McCandliss, Fosella, Flombaum & Posner, 2005) in (1) a group of meditation-naive participants, (2) a group of experienced meditators, and (3) a control group. The attentional subsystems involved alerting, orienting, and conflict monitoring. Alerting can be described as a bottom-up or stimulus-driven attentional process, orienting as a top-down attentional process, and conflict monitoring as a top-down response-related process. Jha and colleagues (2007) found that (1) meditation practice improved alerting in the experienced meditators, (2) mindful meditation improved orienting in the inexperienced meditators, and (3) experienced meditators demonstrated better conflict-monitoring than the other participants at baseline.

However, not all studies have shown beneficial effects on measures of attention. In a study by Anderson and coworkers (Anderson, Lau, Segal & Bishop, 2007), attentional switching

between neutral stimuli as well as sustained attention, object detection, and non-emotional Stroop interference were investigated in a population of healthy adults. Contrary to previous studies, they found no improvements in attentional processes relative to a control group after 8 weeks of MBSR. They found only a significant correlation between improvements in mindfulness and improvements in object detection.

Studies investigating cognitive processing of affective stimuli are still scarce. A study by Chambers, Lo and Allen (2008) examined the effects of a 10-day mindfulness meditation retreat on working memory updating and internal switching between neutral and affective stimuli. The participants were non-clinical novice meditators. Significant improvements in working memory were observed. Also, there was a significant correlation between improved depressive symptoms and decreased switch costs when switching between neutral stimuli, although there was no correlation with increasing mindfulness. In the affective condition, there was no correlation with changes of depressive symptoms but there was a trend significant correlation between increasing mindfulness and decreasing switch costs when switching between affective stimuli. Ortner, Kilner and Zelazo (2007) investigated the effect of mindfulness meditation on attentional control in emotional contexts in a sample of mindfulness practitioners. The amount of experience with meditation correlated negatively with interference from affective pictures (study 1). In study 2, a randomized controlled trial compared participants who received mindfulness training, relaxation meditation training or no intervention. Only the mindfulness training group showed reductions in emotional interference from unpleasant pictures.

We conclude that the studies of underlying working mechanisms of mindfulness yield promising but preliminary results. No attention has yet been paid to the receptiveness or open attention to emotional experience, which has been specifically hypothesized to be a crucial working mechanism of mindfulness (Kabat-Zinn, 1994; Bishop *et al.*, 2004). In addition,

research has mainly investigated the processing of neutral stimuli, although mindfulness is mostly practiced in relation to emotional experiences. Moreover, there is an inconsistency of results that might be due to differences in methodology of previous studies. Meditation practice, for example, ranged from one 20-minute meditation session to an 8 week course including daily homework sessions or years of meditation practice. To our knowledge no studies have investigated the working mechanisms of MBCT, which has been demonstrated to be effective in the prevention of relapse in patients with recurrent depression.

Therefore, our aim was to investigate the effects of an eight-week MBCT program on attentional processing of emotional stimuli using a well established experimental paradigm. We used the Negative Affective Priming paradigm (NAP), which is designed to measure inhibition and facilitation of attention towards positive and negative valenced material (Joormann, 2004). The NAP task enables us to investigate whether MBCT enhances open attention towards emotional stimuli, without inhibition or facilitation. In the NAP task, there are two trial types that are presented consecutively, called prime trials and probe trials. Prime and probe trials both consist of a distracter and a target. In each trial, the participant is instructed to evaluate the target as negative or positive, while ignoring (inhibiting) the distracter. In experimental trials, the valence of the target in the probe trial corresponds to the valence of the formerly presented prime-trial distracter. Experimental trials are compared to control trials where there is no such similarity between prime and probe. The participants are unaware of these different trial types.

In healthy populations there is a slowdown in response time on the target of the probe trial of experimental trials compared to control trials, a phenomenon referred to as the negative affective priming effect. This slowdown is explained by a still active inhibition of the valence of the probe trial target that had to be inhibited in the formerly presented prime trial. In a study by Joormann (2004) using this NAP task, it was demonstrated that undergraduate students with

depressive symptoms showed less inhibition of negative words than non-depressed students. Similar results were found with a population of clinically depressed patients, even showing facilitation for sad faces (Goeleven, De Raedt, Baert & Koster, 2006). Furthermore, it has also been demonstrated that inhibition of negative information remains problematic in formerly depressed students following remission (Joormann, 2004).

Our aim was to investigate whether these NAP findings of reduced attentional inhibition and facilitation of negative information can be replicated in a large sample of formerly depressed patients using emotional faces as stimuli. Furthermore, we wanted to investigate whether after MBCT, which was developed as a depression relapse prevention program, these inhibitory dysfunctions would be reduced. We also checked for improvements in mindfulness and depressive symptoms. Specifically, we hypothesized that (1) at baseline our total sample would show a faster response (facilitation) to negative probe targets and a delayed response to positive probe trials (inhibition) in the experimental versus the control condition of the NAP task; (2) that, over the whole sample, higher dysfunctional inhibitory processing at baseline would be related to lower mindfulness and more severe depressive symptoms; (3) that the MBCT group would show reduced facilitation of negative information and inhibition of positive stimuli after the training (open attention towards all emotional experiences), whereas no such effects were anticipated in a comparison group without intervention and that (4) after MBCT mindfulness scores would be increased and depressive symptoms decreased .

Methods

Participants

The research population consisted of two groups of formerly depressed adults. Exclusion criteria were the current presence of a major depressive episode, dyslexia, current or past alcohol

or drug abuse, mental retardation, pervasive developmental disorder, cognitive disorder, psychotic disorder, bipolar (I) disorder and personality disorder (Cluster A) according to the Diagnostic and Statistical Manual of Mental Disorders (4th ed., DSM-IV, American Psychiatric Association, 2000). Inclusion and exclusion criteria were based on two clinical interviews, the Mini International Neuropsychiatric Interview (MINI; Sheehan et al., 1998) and the Hamilton Depression Rating Scale (HDRS; Hamilton, 1960).

One group, the MBCT group, was recruited after they applied for a MBCT training course, organized at one of five cooperating institutions (psychiatry departments or centers for mental health care). After controlling for the exclusion criteria, 50 adults were included in the study. Five participants did not perform the NAP task at the second measurement, so the final group consisted of 45 adults (33 females, 12 males) with a mean age of 45.2 (SD = 9.8; range = 19-60) (but only 44 participants filled out the questionnaires). None of these participants received other forms of psychotherapy during the course of the training.

The comparison group was contacted through advertisement in the national press and on the website of Ghent University. They were preselected based on a telephone screening. Thirty pre-selected participants were invited to participate, and they received the same diagnostic interview as the MBCT group. Inclusion and exclusion criteria were the same as the MBCT group. They did not receive MBCT, but were tested before and after an 8 week period without any intervention in between. Four participants didn't participate at the second test measure moment. The final comparison group consisted of 26 adults (19 females, 7 males) with a mean age of 45 years (SD = 8.6; range = 25-55).

Materials

Negative Affective Priming Task. The NAP task was programmed using the INQUISIT Millisecond software package and ran on a Windows XP computer with a 72 Hz 17-inch colour monitor. The stimuli were presented against a gray background. Targets and distracters were presented in pairs, one above and one below a black fixation cross. Stimuli consisted of 88 coloured pictures of emotional faces without hairline, which were selected from the Karolinska Emotional Directed Faces database (Lundqvist, Flykt, & Öhman, 1998) based on a valence and arousal rating obtained from prior validation (Goeleven, De Raedt, Leyman & Verschuere, 2008). The selected pictures were positive (happy; n = 33), negative (depressive; n = 33) or neutral (n = 22) and were divided into eight lists of 11 randomly chosen pictures sharing the same valence: one negative and one positive prime target list, one negative and one positive prime distracter list, one negative and one positive probe target list and two neutral probe distracter lists. Pictures measured 5 cm width by 5.5 cm height and were indicated as target or distracter by a 3 mm black or grey coloured frame. Responses to the targets were made by pressing one of two keys on a standard AZERTY keyboard.

The participants were seated each at 60 cm viewing distance from the computer screen. The instructions were displayed on the screen. They were told that a picture of a face would appear in the upper and the lower half of the screen: one picture with a black frame, the other with a grey frame. The participants were asked to evaluate the valence of the emotional expression of the target picture - indicated by the color of the frame - as accurately and as fast as possible by pressing a corresponding key on the computer keyboard. Correspondence of the keys (q key and m key) was randomly assigned (for example: target positive: q key with the left index finger; target negative: m key with the right index finger). Furthermore they were asked to ignore the distracter picture. Participants practiced the task for 32 trials. The test phase consisted of one

block of 128 prime trials and 128 probe trials. The spatial position of the target and the distracter was randomly assigned from trial to trial. The sequence of events (depicted in Figure 1) started with a fixation cross for 1000 ms. Next, two prime pictures appeared and remained on screen until a response was made. A blank screen was then presented for 1000 ms, followed by thenext fixation cross that appeared for 1000 ms, followed by the target pictures. The next trial started after a 1000 ms blank screen presented after the response.

[Figure 1 about here]

Mindful Awareness Attention Scale. The MAAS (Brown & Ryan, 2003) is a 15-item 6-point scale assessing the individual frequency and strength of mindful states (Dutch translation by the authors). The participant has to report on his/her awareness of being easily distracted, running on automatic pilot and ease of paying attention to activities. Factor analyses demonstrated that all items loaded high on the same single factor, which is mainly related to the attention component of mindfulness. The questionnaire has good reliability (Brown & Ryan, 2003) and there is a significant correlation with other mindfulness scales such as the Cognitive and Affective Mindfulness Scale-revised (Schmertz, Anderson, & Robins, 2009).

Beck Depression Inventory-II. The BDI-II (Beck, Steer & Brown, 1996) is a self-administered 21-item self-report questionnaire that was specifically developed to measure depressive symptoms including a cognitive component (e.g. self-criticism, thoughts of failure), an affective component (e.g. pessimism, feelings of sadness, loss of interest, and pleasure), and a somatic component (e.g. fatigue, loss of energy and sexual desire and sleep and appetite disturbances) (Beck *et al.*, 1996). The Dutch translation of the BDI-II showed good reliability and validity (Van der Does, 2002).

Mini International Neuropsychiatric Interview. The MINI (Sheehan et al., 1998) is a short structured diagnostic interview for DSM-IV-TR psychiatric disorders covering 17 axis I categories. It has a good correlation with the Structured Clinical Interview for DSM-IV-TR - Axis I (SCID-I) (Pinninti, Madison, Musser & Rismiller, 2003).

Hamilton Depression Rating Scale. The HDRS (Hamilton, 1960) is an interviewer-administered rating scale used to assess the severity of present depressive symptoms. Research of the Dutch version of the HDRS showed good reliability and discriminant validity (Evers, Van Vliet-Mulder & Ter Laak 1992). The HDRS-cut-off score for participation was set at max. 18.

Procedure

All test sessions were conducted in the institutional buildings where the MBCT course took place. The first test session was organized the day before or the same day of, yet prior to the first MBCT training session and included the computer task, the two screening interviews and three questionnaires. All participants completed the questionnaires and computer task in random order.

After eight MBCT training sessions involving 2,5-hours a week and one full day of practice group classes, all participants were invited to a second test session that was organized either at the same day after a one hour break or the next day. At this point, questionnaires and computer task were offered in the same order as the first test session. At the end of the procedure, all participants were fully debriefed. The participants of the comparison group were invited twice, with a time interval of eight weeks, to fill in the questionnaires and perform the computer task.

Results

Data Preparation

The responses to the prime and the probe trials were recorded, but only the responses to the probe trials were considered in the analyses. Trials with errors were discarded from the analyses.

Also, RTs < 300 ms and RTs > 2000 ms (Goeleven *et al.,* 2006) were considered outliers, indicating anticipatory responding and delayed responding respectively, and were excluded from analyses.

A NAP score was calculated for both negative and positive valence by subtracting the mean reaction time on control trials from the mean reaction time on experimental trials. The higher the score, the more inhibition. A positive score indicates inhibition of the valence, whereas a negative score indicates facilitation of the valence. We report Cohen's *d* effects sizes for all significant t-tests, using the formula based on the original means and SDs, as suggested by Dunlap, Cortina, Vaslow and Burke, 1996.

Group characteristics

The MBCT group did not significantly differ from the comparison group on age, $t(65) = .08$, $p = .94$, or gender distribution, χ^2 (1, n=71) = .001, $p = .98$.

Inhibition/facilitation at baseline

As expressed in hypothesis 1, to check whether our initial population of patients with a history of MDD demonstrated the hypothesized deficient inhibition (or even facilitation) of negative information at baseline (whole group: N= 50 in the MBCT group and N=30 in the comparison group), we performed an ANOVA with the NAP scores as dependent variable, Valence (negative, positive) as within-subjects factor and Group (MBCT, comparison) as between subjects factor. This analysis yielded a significant interaction effect, $F(1,78) = 7.11$, $p < .01$(see Table 1).

Using independent follow-up t-tests to further test this interaction effect, we observed a significant difference on the NAP score for negative information, $t(78) = 2.18$, $p < .05$, $d = .50$,

and for positive information, $t(78) = 2.00$, $p = .05$, $d = .41$ *(equal variance not assumed)*, with respectively better inhibition for negative information and less inhibition for positive information in the comparison group as compared to the MBCT group. Based on one-sample t-tests on the NAP effects, the MBCT group showed a significant facilitation for sad faces, $t(49) = 2.20$, $p < .05$, and inhibition for happy faces, $t(49) = 2.80$, $p < .01$, whereas the comparison group showed no significant NAP effects, all ts < 1.1.

Relationship between inhibition and depressive symptoms / mindfulness at baseline

Testing our second hypothesis, there was a negative correlation between the BDI scores and the NAP score for negative information, $r(78) = -.237$, $p < .05$ (the more depressive symptoms, the less inhibition for negative information) and a positive correlation between the NAP score for negative information and the MAAS scale, $r(78) = .279$, $p < .05$ (the more mindful, the more inhibition for negative information) over the whole population. There was also a negative correlation between the NAP score for positive information and the MAAS score, $r(78) = -.265$, $p < .05$ (the more mindful, the less inhibition for positive information).

Changes in depressive symptoms and mindfulness from pre to post

Pertaining to our fourth hypothesis, the 2 x 2 ANOVA for the BDI score with Time (pre-post) as repeated measures factor and Group (MBCT- comparison) as between subjects factor yielded a significant main effect for Time , $F(1,68) = 12.48$, $p < .001$, and for Group, $F(1,68) = 10.92$, $p < .01$. Moreover, there was a significant interaction effect, $F(1,68) = 8.51$, $p < .01$.

The same ANOVA for the MAAS score yielded a significant main effect for Group, $F(1,68) = 15.52$, $p < .001$, and a significant interaction effect, $F(1,68) = 4.31$, $p < .05$. Table 2 displays all means and standard deviations of these questionnaires.

[Table 2 about here]

Paired sampled t-tests in the comparison group revealed, as expected, no significant differences between pre and post measurements of depressive symptoms (BDI) and mindfulness (MAAS) (all *t*s < 1). The MBCT group on the other hand showed improvement on both questionnaires after 8 weeks of MBCT training. There was a significant decrease of depressive symptoms as measured by the BDI, $t(43) = 4.86$, $p < .001$, $d = .63$, and a significant increase in the MAAS scores, $t(43) = 2.62$, $p < .05$, $d = .33$, indicating more mindfulness awareness.

Using independent t-tests, significant differences between the groups were found for both BDI scores, $t(68) = 4.11$, $p < .001$, $d = 1.02$, and MAAS scores, $t(68) = 4.35$, $p < .001$, $d = 1.08$ at baseline, indicating that the MBCT group started respectively with more depressive symptoms and being less mindful. After 8 weeks of training or no interventions the groups still differed in a similar way on MAAS scores, $t(68) = 2.77$, $p < .01$, $d = .69$, and significant on the BDI scores $t(68) = 1.97$, $p = .05$, $d = .43$ (*equal variances not assumed*).

The effect of MBCT on inhibition/facilitation

Thereafter, to test our third hypothesis, the NAP scores were subjected to a 2 x 2 x 2 ANOVA with Valence (negative, positive) and Time (pre, post) as within subject variables and Group (MBCT, comparison) as between subject variable. This revealed a significant three-way interaction effect of valence x time x group, $F(1, 69) = 7.53$, $p < .01$.

To further investigate this three-way interaction effect a 2 x 2 ANOVA was performed for both groups separately. In the MBCT group there were marginally significant effects: a main effect of valence, $F(1, 44) = 3.40$, $p = .07$, and an interaction effect between valence and time, $F(1, 44) = 3.37$, $p = .07$, as shown in Table 1.

[Table 1 about here]

To test our a priori hypothesis concerning changes over time in the MBCT group, one-tailed paired sample t-tests were used to compare pre and post NAP scores for each valence separately. These tests revealed an increase of the NAP effect for sad faces after MBCT, $t(44)= 1.64$, $p = .05$, $d = .34$, indicating less facilitation for negative information. The NAP score for positive information decreased, showing less inhibition for positive information, but this effect was only marinal significant, $t(44)= 1.35$, $p = .09$, $d = .27$. Interestingly, post MBCT, the significant NAP effects as observed before the training disappeared, all ts < 1 (one sample t-tests), which is indicative for an open attention for all emotional experience.

The 2 x 2 ANOVA in the comparison group only revealed a significant interaction effect between valence and time, $F(1, 25) = 6.35$, $p < .05$. As expected, for the comparison group, paired sample t-tests comparing pre and post NAP scores (see Table 1) did not show significant differences for inhibition towards negative information between pre and post, ts < 1. Surprisingly however, there was a highly significant increase in the NAP score for positive information, $t(25) = 3.80$, $p < .001$, $d = .83$, pointing towards more inhibition for positive information in the comparison group after 8 weeks without any intervention.

Discussion

Attentional biases are considered to play a crucial role in the onset, maintenance and recurrence of depression (De Raedt & Koster, 2010). Several studies have shown a reduced inhibition and even facilitation of attention for negative information in dysphoric and depressed persons (Goeleven *et al.,* 2006; Joormann, 2004). Furthermore, there is evidence to suggest that this impaired inhibition remains a vulnerability factor after remission (Joormann, 2004). In this

study, we investigated the effect of an 8-week MBCT program on dysfunctional inhibition, as measured by the Negative Affective Priming task, in a sample of formerly depressed patients who are currently in remission. Based on the operational definition of mindfulness by Bishop *et al.* (2004), it was hypothesized that MBCT would affect attentional processing, which is considered to be one of the core working mechanisms through which MBCT might prevent relapse. We expected that MBCT would on the one hand reduce the facilitation of negative information and on the other hand reduce the inhibition of positive information, creating an open attention towards all emotional experiences. The main findings were: (1) at baseline, we found a significant attentional bias as hypothesized on the NAP, indicating facilitated attention to negative pictures compared to normal inhibition of attention for positive pictures, but these dysfunctional processes were only observed in the group of participants who applied for the MBCT course; (2) facilitation of attention for negative stimuli was related to lower mindfulness and increased severity of depressive symptoms, whereas less inhibition of attention for positive information was related to more mindfulness over the whole group; (3) in the MBCT group, the facilitation of attention for negative information and the inhibition of attention for positive information was reduced from pre to post measurement, which is indicative of an open attention for all emotional information, whereas in the comparison group without intervention, inhibition of attention for positive information increased; and (4) the MBCT group showed reduced depressive symptoms and improved mindfulness, whereas we observed no changes in the comparison group.

The first result replicates the findings of Joormann (2004) indicating a reversed NAP effect on negative trials in formerly depressed individuals. Whereas we found a normal delay on positive trials, the response to negative pictures was even faster when a negative picture had first

to be ignored, which indicates facilitation. This further confirms that formerly depressed patients are unable to sufficiently inhibit negative information, which makes them vulnerable to depression relapse. These results are in line with other studies that found a problematic disengagement from depressogenic information in currently as well as remitted depressed patients (Joormann & Gotlib, 2007; Gotlib, Krasnoperova, Yue & Joormann, 2004; Leyman, De Raedt, Schacht & Koster, 2007). Problematic inhibition and even facilitation, and problematic disengagement from negative information both indicate maintained attention specifically focusing on negative information.

Interestingly, the more mindful people are, the less they show facilitation for negative information and the less they inhibit of positive information. This result is indicative of a relationship between specific information processing as measured by an experimental task and frequency and strength of mindful states, as measured by self-reported awareness of being easily distracted, running on automatic pilot and ease of paying attention to activities. Moreover, the more depressive symptoms, the more facilitation for negative information, which replicated earlier findings of a relationship between depressed states and facilitation as measured with exactly the same task (Goeleven *et al.,* 2006). Although former studies showed that this attentional pattern is absent in healthy never depressed individuals (e.g. Joormann, 2004; Goeleven *et al.,* 2006), the current study has no healthy control group.

After 8 weeks of MBCT training, we found a significant reduction in facilitated attention for negative information. We also observed a reduction in the inhibition of positive information (although this effect was only marginal significant). These results appear to suggest that MBCT training caused open attention to all experiences. Indeed, after the training, all facilitation and inhibition has disappeared (see one sample t-tests on the NAP scores), which is exactly what is intended by mindfulness practice, and it has been referred to as having a “beginner’s mind”, the

ability to observe each experience as something new, without any attention bias or interpretation bias (Bishop *et al.*, 2004). However, the increased inhibition for positive information in the comparison group is more difficult to explain, because depressive symptoms did not increase in this group.

In the MBCT group, there was a significant increase in the mindfulness score, and a significant decrease in depressive symptoms. The increase in mindfulness after the training can be seen as a manipulation check of the training, and is a replication of many other studies (see Chiesa & Serretti, 2010). The decrease in depressive symptoms is important with regard to depression relapse. Attentional improvement has been proposed as a working mechanism of MBCT, suggesting that depressive symptoms and affect are a consequence of attentional bias change. However, based on only a pre and post measurement of these symptoms we cannot conclude on the causal sequence of improvements. The change towards an open attention towards emotional experience might have caused symptom improvement, but it could also be that attentional processing is caused by improved affect.

There are certain limitations to this study. First of all, the comparison group without any training showed less facilitation for negative information, less inhibition for positive information, less depressive symptoms and less mindfulness before the start of the experiment, which is due to a lack of randomization. One could thus argue that the effects in the MBCT training group would be caused by a regression to the mean. Although this is an important shortcoming, in the comparison group, we observed a –although difficult to explain- increase in inhibition for positive information, which indicates that NAP scores are not susceptible to such regression effects. Moreover, in another study a placebo condition with pre- and post-measurement of the NAP task revealed no changes over time (Leyman, De Raedt, Vanderhasselt & Baeken, 2009).

Secondly, there was no follow-up testing, so we cannot conclude whether the new learned abilities would be maintained over time.

The fact that the MBCT group started out being less mindful, more depressed and with more attentional bias as compared to the comparison group might be caused by a self-selection bias, because the participants in the MBCT training specifically applied for this course. In future research, we should randomize participants to the comparison and MBCT condition to avoid this problem. Moreover, this study should be replicated in a larger sample, to investigate whether attentional processes mediate the effects of the training on depressive symptoms and mindfulness scores.

However, although further research is warranted, our results add to the understanding of the underlying processes of mindfulness. To our knowledge, this is the first study to investigate the relationship of mindful states and the inhibition/facilitation of attention for emotional information, and the effects of MBCT on a bias that has been related to vulnerability for depression. The most important finding is that MBCT leads to a reduced facilitation for negative and a reduced inhibition of attention for positive information. This outcome can be interpreted as open, equal attention to all new experiences.

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Figure 1. Negative Affective Priming design. One complete NAP-trial: prime trial and probe trial. Prime and probe trial includes a target and a distracter. In the experimental condition the valence of the prime-trial distracter and the probe-target corresponds. In the control condition there is no such similarity between prime and probe.

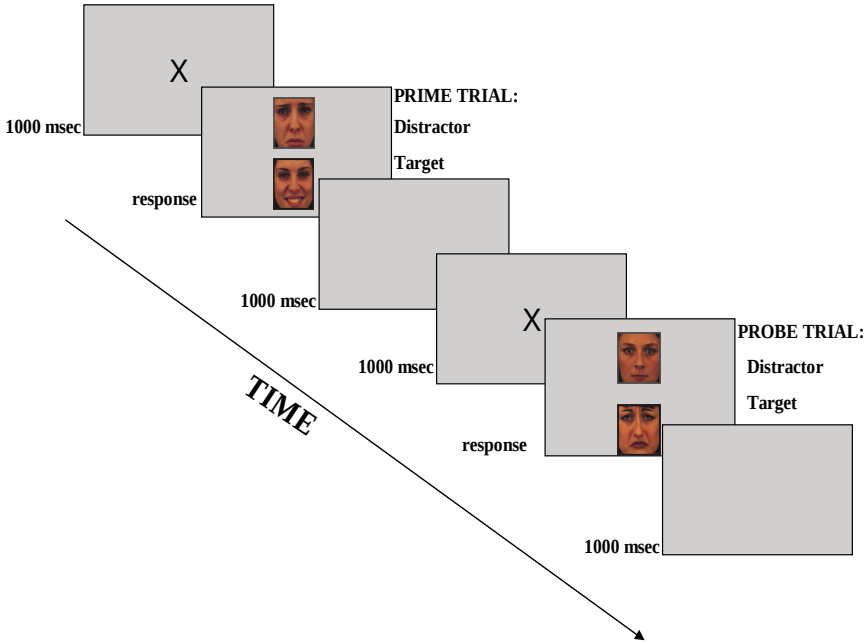

Table 1: Means and standard deviations of the NAP scores in msec. Negative scores indicate facilitation, positive scores indicate inhibition.

	MBCT group		Comparison group	
	M	SD	M	SD
pre NAP negative	-15.66[1]	71.77	14.46	71.02
pre NAP positive	28.41	74.41	0.96[2]	47.15
post NAP negative	9.53[1]	74.70	4.00	76.87
post NAP positive	9.91	64.82	43.35[2]	54.48

[1, 2] Scores with same numbers differ significantly

Table 2: Means and standard deviations of the questionnaire scores.

	MBCT Group		Comparison group	
	M	SD	M	SD
pre BDI	17.64[1]	10.34	7.88	8.17
post BDI	11.29[1]	10.03	7.27	6.50
pre MAAS	54.80[2]	12.01	66.69	9.19
PostMAAS	58.56[2]	10.42	65.73	10.65

[1, 2] Scores with same numbers differ significantly