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The Effect of a Brief Mindfulness Intervention on Memory for Positively and Negatively Valenced Stimuli

Hugo J. E. M. Alberts · Roy Thewissen

Abstract A core component of mindfulness is non-judgmental observation of internal and external stimuli. The present study investigated the effect of mindfulness on memory for emotional stimuli. Participants were exposed to a brief mindfulness intervention and subsequently performed a verbal learning test consisting of positive, neutral, and negative words. Control participants received no intervention and directly performed the verbal learning test. After 20 min, participants recalled as many words as possible. Participants in the mindfulness condition remembered a significantly lower proportion of negative words compared to control participants. No differences between both groups were observed for the proportion of remembered positive words. These findings suggest that memory processes may be a potential mechanism underlying the link between mindfulness and subjective well-being.

Keywords Mindfulness · Memory · Recall · Bias · Well-being

Introduction

Mindfulness has been conceptualized as "the non-judgmental observation of the ongoing stream of internal and external

H. J. E. M. Alberts (✉)
Department of Clinical and Psychological Science,
Maastricht University,
P.O. Box 616, Maastricht, The Netherlands
e-mail: h.alberts@maastrichtuniversity.nl

R. Thewissen
SeeTrue Mindfulness Training,
Maastricht, The Netherlands

stimuli as they arise" Baer (2003, p. 125). Mounting evidence suggests a clear unidirectional link between mindfulness and positive subjective experience. For instance, a study by Frewen et al. (2007) showed that higher levels of dispositional mindfulness were related to fewer negative automatic thoughts. In addition, mood and affective processes have been found to improve after participation in mindfulness-based stress reduction programs (Nyklícek and Kuijpers 2008; see also Brown and Ryan 2003). Today, the vast majority studies on mindfulness are field studies with clinical populations including individuals with eating, mood, anxiety, or personality disorders (Bach and Hayes 2002; Campbell-Sills et al. 2006; Levit et al. 2004). Although these studies demonstrate the benefits of mindfulness-based practice, relatively little is known about the mechanisms that underlie the effects of mindfulness on well-being. A potential mechanism underlying this effect may be the alteration of memory for emotional information. Rather than focusing on ways to alter or avoid stimuli, the emphasis in mindfulness is on allowance and acceptance, thereby changing one's relationship to stimuli. Mindfulness draws on the ability to remain aware, irrespective of the apparent valence of states or stimuli, which may alter their impact on memory. The present study was designed to address the effect of mindful awareness on memory for positively and negatively valenced stimuli, using a laboratory setting.

In general, people tend to recognize a greater proportion of emotional information than emotionally neutral information (for a review, see Buchanan and Adolphs 2002; Hamann 2001). At a neural level, this finding has been associated with activity of the amygdala and related limbic areas. Previous studies reveal that activity in the amygdala is significantly greater for positive and negative stimuli (relative to neutral stimuli), which implies that emotional, but not neutral, stimuli are processed by the amygdala

(Garavan et al. 2001; Hamann and Mao 2002). In line with this, depressed individuals have been found to have superior recall of negative, compared with positive, information (Matt et al. 1992), a finding that has been related to dysfunctional amygdala activity (Drevets et al. 2002). For instance, a neuroimaging study by Siegle et al. (2007) found that depressive patients, compared with health control participants, showed hyperactivity of the amygdala when exposed to emotional stimuli.

So far, to our knowledge, no studies have directly addressed the link between mindfulness and memory processes. Recently, however, a study by Way et al. (2010) on the neural relationship between mindfulness and depression provided indirect evidence for a possible impact of mindfulness on memory. This study revealed that amygdala reactivity was positively related to depressive symptomatology and negatively correlated with dispositional mindfulness. When exposed to emotional stimuli, participants high in trait mindfulness showed relatively low amygdala reactivity. Given the fact that people tend to recognize emotional information better than emotionally neutral information, which has been linked to greater activity of the amygdala, the findings of Way et al. (2010) may imply that the reduced amygdala reactivity in mindfulness during exposure to emotional stimuli may attenuate the enhanced memory effect for emotional stimuli.

Moreover, from a more cognitive perspective, it seems plausible that mindful awareness can influence memory for emotional events. According to interactive cognitive subsystems (ICS) model (Teasdale and Barnard 1993), it is the explicit encoding of the emotional aspects of to-be-remembered stimuli that is responsible for emotional memory biases. Congruent with this assumption, a study by Ridout et al. (2009) revealed that, when the explicit processing of the emotional content of stimuli was reduced, no memory biases were observed. In this study, depressed individuals were exposed to a series of photographs consisting of emotional faces and were instructed to identify the gender (non-emotional encoding) of the individuals featured in the photographs. The results showed that, when this instruction was given, the consistently demonstrated enhanced memory effect for sad faces among this group was not observed. Likewise, mindful awareness may also reduce explicit processing of the emotional content of stimuli. Mindfulness is characterized by awareness without evaluation or judgment. In case of emotionally valenced stimuli, the absence of a negative or positive judgment may reduce the subjectively experienced negativity or positivity of a stimulus. Consequently, the previously discussed enhanced memory effect for emotional stimuli (Buchanan and Adolphs 2002; Hamann 2001) may be less pronounced when people are in a mindful mode of experiencing.

In order to test this prediction, participants were exposed to a brief mindfulness intervention and subsequently performed a verbal learning test consisting of positive, neutral, and negative words. Control participants did not receive this intervention and directly performed the verbal learning test. After 20 min, all participants were requested to recall as many words as possible.

Method

Participants and Design

Forty (20 women and 20 men; mean age 21.6 years, SD 2.1) undergraduates of the Maastricht University were randomly assigned to either the mindfulness condition or the control condition. Participants were individually tested in 50-min sessions and received course credit for their participation. In order to minimize experimenter effects, the experimenter used a written protocol throughout the whole experimental procedure (all instructions to participants were equal). The experiment was approved by the standing ethical committee of our faculty.

Procedure

When participants arrived at the lab, the experimenter provided them with a consent form to read and fill out. The experiment was presented as a series of unrelated tasks that tested participants' cognitive abilities.

Mood

Next, participant's mood was assessed. Previous research has demonstrated that people display the tendency to retrieve information consistent with one's mood (for a review, see Watkins 2002). In order to order to control for possible mood-congruent memory effects, participants completed the 16-item Brief Mood Inspection Scale (Mayer and Gaschke 1988) twice: before the experimental procedure and after receiving the instructions. Participants had to indicate the extent to which each statement applied to them best on a five-point scale ranging from 1 (*very slightly* or *not at all*) to 5 (*extremely/totally*). A total score on each of the 16 statements was calculated (Cronbach's α=.83).

Audio Taped Instructions

Next, both participants in the mindfulness and control group received audio taped instructions. In order to induce a mindful state, participants in the mindfulness conditions

were instructed for approximately 12 min to focus their attention on their breathing and as much as possible on the present moment. Moreover, when intrusive thoughts arose, they were asked to notice them, accept them without judging them and subsequently direct their attention back to the breathing. Participants in the control condition were only instructed (for approximately 30 s) to focus on the following task as good as possible. After listening to these instructions, participants completed the second mood questionnaire.

Manipulation Check

In addition, in order to check whether the mindfulness instruction successfully induced a mindful state, participants completed the Toronto Mindfulness Scale (TMS, Lau et al. 2006). The TMS is a 13-item scale that estimates state awareness of bodily sensations, thoughts, and feelings as well as the approach of curiosity, acceptance, and openness with respect to these phenomena. Participants had to indicate their current thoughts and feelings by rating the statements on a five-point scale from 0 (*not at all*) to 4 (*very much*). A total score was calculated with higher scores suggesting greater mindfulness (Cronbach's α=.76).

Verbal Learning Test

Subsequently, participants completed a visual verbal learning test. This test has been successfully used to assess declarative episodic memory in previous research (Sambeth et al. 2009). On a computer screen, ten positive (e.g. "friend," "rich"), ten negative (e.g. "hell," "murder"), and ten neutral (e.g. "voice," "door") monosyllabic Dutch words (18 nouns and 12 adjectives) were presented in three trials. All words were presented in a fixed order at a rate of one word per 2 s. After each trial, participants were asked to perform an immediate recall.

Filler Task

The computer game "Tetris" was used as a filler task. Tetris is a puzzle game which draws on the ability of mental rotation. Because the game does not include any verbal components, playing the game would be unlikely to interfere with the previously learned words. Participants played the game for 20 min.

Recall

After playing Tetris, participants were asked to recall as many words as possible (delayed recall). The proportion of correctly negative and positive words recalled served as the main dependent variable. Finally, they were asked to write down what they thought the experiment was about. Participants were debriefed and thanked.

Results

Two participants realized the true purpose of the experiment and were therefore excluded from the analysis. Hence, analyses described below included the data of the remaining 38 participants. Including these two participants in the analysis did not lead to a different pattern of results.

Manipulation Checks

One-way analysis of variance (ANOVA) with condition as independent variable and scores on the TMS as dependent variable revealed a significant effect $F(1, 36)=5.25$, $p=.027$, $\eta^2=0.13$. Participants in the mindfulness group (m=1.79, SD 0.57) reported significantly higher scores on the TMS compared with participants in the control condition (m=1.38, SD 0.53). This suggests that the mindfulness induction was successful.

Recall

One-way ANOVA with condition as independent variable and the total number of correctly recalled words as dependent variable did not reveal a significant effect, $F(1, 36)<0.1$. This suggests that the number of correctly remembered words was equal for participants in the mindfulness condition (m=12.17, SD 2.15) and participants in the control condition (m=12.15, SD 2.32). In other words, no differences in memory performance were observed between both conditions.

Valence of Recall

In order to address possible differences in memory for positive and negative words, the proportion of positive words recalled and the proportion of negative words recalled were calculated by dividing the number of each by the total number of words recalled. Separate ANOVAs are reported for the proportion of positive and negative words. For proportion of positive words recalled, no significant effect was found, $F(1, 36)=0.42$, $p=.52$. In other words, both conditions did not differ in the proportion of positive words recalled. For proportion of negative words recalled, a significant effect was found. Participants in the mindfulness condition recalled a significantly smaller proportion of negative words than did participants in the control condition, $F(1, 36)=4.54$,

$p=.04$, $\eta^2=0.11$. Mean proportions and standard deviations of participants' recall of positive and negative words are summarized in Table 1.

Mood

A repeated-measures ANOVA with mood measurement as within factor (two levels) and condition as between factor was used to assess differences in mood between groups on the two measurements. This analysis revealed no significant main or interaction effect (all p values > .53). These results indicate that the previously reported differences in recall for negative words cannot be attributed to changes in mood.

Discussion

The present study addressed the effect of mindful awareness on memory for positively and negatively valenced stimuli. Participants who received a brief mindfulness intervention before engaging in a verbal learning test remembered a significantly lower proportion of negative words compared to control participants on a delayed recall task. This effect was only observed for negative stimuli; no differences between both groups were observed for the proportion of remembered positive words. Moreover, no mood differences between groups were found, ruling out the alternative explanation that mindfulness may have induced better mood and accordingly resulted in mood-congruent memory effects (Watkins 2002). In summary, the current findings suggest that mindful awareness reduces memory for negative, rather than for positive, stimuli.

In terms of mechanisms, the non-judgmental observation that is cultivated by mindfulness may "neutralize" the negative valence of a stimulus. Stated differently, mindfulness may reduce the explicit processing of the negative content of a stimulus and thereby diminish its impact on memory (Teasdale and Barnard 1993). The finding that only memory for negative words was affected in the mindfulness condition suggests that the processing of positive items is less or not affected during mindful awareness. Although previous studies have reported enhanced memory effects for both positive and negative stimuli, a study by Dewhurst and Parry

(2000) reported a stronger memory bias for negative stimuli. Likewise, compared to positive events, negative events have been found to be remembered better (Skowronski and Carlston 1989). Possibly, negative information may be more susceptible to non-emotional encoding than positive information. Clearly, this issue awaits future investigation.

The present findings may also provide more insight in the previously established link between mindfulness and subjective well-being (Brown and Ryan 2003; McCracken and Yang 2008; Ortner et al. 2007). For instance, a study by Collard et al. (2008) investigated the effect of mindfulness-based cognitive therapy on subjective well-being and found that, after the therapy, participants reported significantly lower levels of negative affect. Interestingly, positive affect remained unchanged. In line with the present findings, these findings suggest that mindfulness may, in particular, have an impact negative states and information. In addition, previous research has shown that forgetting negative events is associated with increased well-being over lifetime (Charles et al. 2003). Increasing mindful awareness may be a way to reduce the impact of negative events on memory and thus enhance well-being. In the clinical domain, mindfulness-based treatment of depression has been found to effectively reduce symptoms of depression (for an overview, see Hofmann et al. 2010). Depression has been linked with superior recall of negative, compared with positive, material (Matt et al. 1992). This higher accessibility of negative information has been identified as a potential factor contributing to the maintenance of depression and has been suggested to impair successful mood-repair activities (Teasdale 1983). Possibly, the effectiveness of mindfulness-based treatment of depression may, at least in part, be attributed to reduced memory for negative information. Directly addressing the impact of mindfulness on emotional memory among depressed patients may entail an interesting route for future research.

Although the present findings are promising, some limitations remain. First, the current study only used verbal stimuli. In order to extend the ecological validity of the findings, it seems worthwhile to also include different types of stimuli such as personal memories or images. Second, at this point, it remains unclear if the observed effect of mindfulness on memory is solely due to differences in encoding or that retrieval of emotional information is also affected by mindful awareness. This issue could be addressed by, for instance, presenting a brief mindfulness intervention directly after a learning test. Third, it remains unclear to what extent the present findings can be attributed to relaxation. Although the scores on the TMS suggested that mindfulness was induced successfully, including a control condition in which participants received a brief relaxation intervention could have provided more insight in the specificity of the observed effects. To conclude, the present study extends the relatively small range of studies addressing the effects of mindfulness in a controlled laboratory setting.

Table 1 Mean proportions and standard deviations of participants' recall of positive and negative words

| | Condition | |
	Control	Mindfulness
Proportion of positive words	32.85 (14.08)	35.5 (10.61)
Proportion of negative words	37.34 (12.32)[1]	29.75 (9.20)[2]

Standard deviations are given in parentheses. Means with different superscript differ significantly at $p<.05$

Using this experimental approach, future studies may further illuminate the (memory) processes underlying mindfulness and thereby help to enhance integration with previous research findings.

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