



Increases in the right dorsolateral prefrontal cortex and decreases the rostral prefrontal cortex activation after-8 weeks of focused attention based mindfulness meditation



Barbara Tomasino^{a,*}, Franco Fabbro^{b,c}

^a Dipartimento di Scienze Umane, Università di Udine, Italy

^b Dipartimento di Scienze Mediche e Biologiche, Università di Udine, Italy

^c Perceptual Robotics Laboratory (PERCRO), Scuola Superiore Sant'Anna, Pisa, Italy

ARTICLE INFO

Article history:

Received 20 July 2015

Revised 4 November 2015

Accepted 13 December 2015

Classification:

Social sciences

Psychological and cognitive sciences

Keywords:

Mindfulness meditation

fMRI

Attention

Prefrontal cortex

ABSTRACT

Mindfulness meditation is a form of attention control training. The training exercises the ability to repeatedly focus attention. We addressed the activation changes related to an 8-weeks mindfulness-oriented focused attention meditation training on an initially naïve subject cohort. Before and after training participants underwent an fMRI experiment, thus, although not strictly a cross over design, they served as their internal own control. During fMRI they exercised focused attention on breathing and body scan as compared to resting. We found increased and decreased activation in different parts of the prefrontal cortex (PFC) by comparing pre- vs. post-mindfulness training (MT) during breathing and body scan meditation exercises that were compared against their own resting state. In the post-MT (vs. pre-MT) meditation increased activation in the right dorsolateral PFC and in the left caudate/anterior insula and decreased activation in the rostral PFC and right parietal area 3b.

Thus a brief mindfulness training caused increased activation in areas involved in sustaining and monitoring the focus of attention (dorsolateral PFC), consistent with the aim of mindfulness that is exercising focused attention mechanisms, and in the left caudate/anterior insula involved in attention and corporeal awareness and decreased activation in areas part of the “default mode” network and is involved in mentalizing (rostral PFC), consistent with the ability trained by mindfulness of reducing spontaneous mind wandering.

© 2015 Elsevier Inc. All rights reserved.

1. Introduction

Mindfulness meditation can be related to a form of attention control training (Focused attention, FA) and to non-concentrative or open monitoring (OM) meditation, (e.g., Cahn & Polich, 2006; Lutz, Slagter, Dunne, & Davidson, 2008). The focus of the present paper is on the first type of mindfulness meditation. The purpose of training in FA mindfulness meditation is to develop the ability to direct (focus) and maintain attention towards the present moment (Kabat-Zinn, 1990, 1994, 2003; Segal, Williams, & Teasdale, 2002) and requires the monitoring of the focus of attention, detecting distraction, disengaging attention from the source of distraction and re-directing attention to the intended object (Lutz et al., 2008). The final aim is the detached observation of

bodily sensations, emotions and thoughts which is assumed to interrupt automatic responding and to increase behavioural flexibility (Bishop et al., 2004). The FA training exercises thus the ability to repeatedly focus the attention fixation. Different are the strategies of focused attention used to induce mindfulness, among those, participants for example train their focus of attention on the sensation of breath entering the nostril (*ānāpānasati*), to different body parts (*body scan*), or on the observation of how thoughts, memories and fantasies appear and disappear from the mind (*vipassanā*) (Kabat-Zinn, 2003). This is an ability that can be learnt and developed through training. The typical and most known mindfulness training is the 8-week mindfulness-based stress reduction program (MBSR) (Kabat-Zinn, 1990). Similarly to other forms of insight meditation (or Samatha-Vipassana meditation) meditation, mindfulness, tends to activate predominantly frontal brain structures (Tomasino, Chiesa, & Fabbro, 2014; Tomasino, Fregona, Skrap, & Fabbro, 2012). In particular it was found that part of the

* Corresponding author at: Dipartimento di Scienze Umane, Università di Udine, via Margreth, 3, 33100 Udine, Italy.

E-mail address: barbara.tomasino@gmail.com (B. Tomasino).

prefrontal cortex was activated and part of it deactivated by meditation.

Neuroimaging studies have begun to explore the neural mechanisms related to mindfulness meditation training with functional magnetic resonance imaging (fMRI), (e.g., Farb, Segal, & Anderson, 2013; Farb et al., 2007, 2010; Goldin & Gross, 2010; Hasenkamp, Wilson-Mendenhall, Duncan, & Barsalou, 2012; Lutz et al., 2008; Tang, Rothbart, & Posner, 2012; Tang, Lu, Fan, Yang, & Posner, 2012).

Those studies directly addressing meditation exercise during fMRI scanning found increased PFC [meditators had stronger activations in the dorsal medial PFC bilaterally compared to controls, (Holzel et al., 2007); focusing attention on the breath activated the right dorsolateral prefrontal cortex (Hasenkamp et al., 2012); or decreased PFC activation [in the right mPFC during mindfulness meditation (Ives-Deliperi, Solms, & Meintjes, 2011); for sustained (compared onset) meditation in the right frontal lobes (Bærentsen et al., 2010)].

Some authors (Dickenson, Berkman, Arch, & Lieberman, 2013) investigated the neural mechanisms involved in mindfulness exercise in subjects who are not experienced practitioners. Authors compared focused breathing to mind wandering. Relative to mind wandering, focused breathing recruited activation in parietal and prefrontal. Authors suggest that the neural mechanisms of a brief mindfulness induction are related to attention processes in novices.

In the present study we further addressed the activation changes related to an 8-weeks mindfulness training. We included participants with no prior mindfulness meditation experience. Differently from Dickenson et al.'s, 2013 study our participants performed an 8-weeks mindfulness meditation training and before and after the training, they underwent an fMRI experiment, thus they served as their internal own control. In Desbordes et al. (2012)'s study, pre- and post-8 weeks mindfulness training fMRI comparisons were performed. Authors reported also that a whole-brain statistical parametric mapping analysis was also conducted and that the analysis did not reveal any significant pre-post differences at the whole-brain. At variance with Desbordes et al.'s, 2012 study, we asked participants to exercise during fMRI scanning focused attention on breathing and body scan as compared to resting. Given the above reviewed literature on mindfulness and that mindfulness exercises attention and awareness mechanisms, we reasoned that we should observe in the pre- vs. post-mindfulness training comparisons, changes in activation in areas related to attention, inhibitory control, task-related efficiency and to the resting state network. In particular, in a meta-analysis of fMRI studies on meditation (Tomasino et al., 2012) it was shown that, among other areas, parts of the medial frontal gyrus were activated and parts of it deactivated confirming that meditative states may be associated to deactivation (Dietrich, 2003; Lou, Nowak, & Kjaer, 2005), or activation (Cahn & Polich, 2006) in executive networks (Manna et al., 2010). It has been shown that focused attention based meditation enhances (predominantly right) medial frontal and reduces (predominantly left) lateral prefrontal area (Manna et al., 2010). According to these studies, both decreases and increases in the prefrontal cortex activation can be hypothesized in participants exercising focused attention on breathing and body scan after an 8-weeks mindfulness training.

2. Experimental procedure

We used the following experimental design: (T1) fMRI session pre-Mindfulness training (MT) before 8 weeks MT; (T2) 2nd fMRI session post-MT.

2.1. Subjects

Thirteen (3 males, 10 females) right-handed (Edinburgh Inventory test, (Oldfield, 1971)) healthy subjects (age range 21–35 years, mean 30.2 ± 4.5 years) gave their informed consent to participate in the study. They were all monolingual native speakers of Italian and had comparable levels of education (mean 15 ± 2.23 years). Exclusion criteria were MR incompatibility (metallic implants, claustrophobia, etc.), prior experience with mindfulness meditation, history of neurological or psychiatric disease (according to their responses on self-report measures) and use of prescription drugs. Inclusion criteria required that all participants be between 20 and 40 years of age, express interest in receiving a wellness course, and be right-handed. The study was approved by the local Ethics Committee.

The study was carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans.

Recruitment materials advertised that participants would receive a free wellness course.

The study was advertised for staff and students around the Faculty of Education of Udine University. This recruitment strategy resulted in 30 volunteers, all college students, who signed up for the study. Of this initial number, 14 subjects were found to be ineligible (6 were MRI ineligible due to either metal implants, claustrophobia). In addition an exclusion criterion for the study was prior experience (i.e. regular practice) with mindfulness meditation ($N = 4$); availability of time ($N = 4$). Out of the selected sixteen, data from thirteen participants have been analyzed and included in the present study as they completed the pre- and post-Mindfulness training fMRI scanning.

2.2. Mindfulness training (MT)

Participants have been trained to the Mindfulness-Oriented Meditation (MOM) training (Campanella, Crescentini, Urgesi, & Fabbro, 2014; Crescentini, Urgesi, Campanella, Eleopra, & Fabbro, 2014; Fabbro & Muratori, 2012). The MOM is inspired by the Theravada schools of Buddhism, e.g. (Gunaratana, 1995) and by the technique proposed by Kabat-Zinn (1990, 2003). One of the authors (FF) who is an experienced meditator and a member of the “Italian Association of Mindfulness Experiences” trained the participants for 8 weekly theoretical and practical lessons lasting two hours each.

Details about the training are described in Campanella et al. (2014) and Crescentini et al. (2014). Briefly, the training included 3 phases, a theoretical part (30 min), a practical part [MOM, 30-min, divided into 10 min of each of the meditation exercises “*ānā pānasati*” (consisting in developing a concentrated attention on the breath that comes in and out from their nostrils), “body contemplation” (consisting in gently focusing attention on different parts of the body and their single components and trying to “feel” each of them (Gnoli, 2011; Kabat-Zinn, 2006; Segal, Williams, & Teasdale, 2006b)), and “*vipassanā*” (consisting in focusing attention and observing the course of their thoughts, emotions, memories coming in and out of their minds (Naranjo, 2011; Naranjo & Ornstein, 1970)) to be exercised while keeping a “detached” attitude, behaving like a non-judging witness of oncoming thoughts, feelings and sensations; if a participant “drifted”, dragged by oncoming thoughts, he/she was encouraged to gently drift back on the concentrated attention over breath, body or thoughts], and debriefing (up to one hour). During the exercise participants were instructed to keep their eyes closed.

Daily sessions of half an hour of exercise were asked to participants; a CD containing a 30-min recording of the instructions guided them through each of the steps during their daily

Download English Version:

<https://daneshyari.com/en/article/7283086>

Download Persian Version:

<https://daneshyari.com/article/7283086>

[Daneshyari.com](https://daneshyari.com)