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Meditation, mindfulness and cognitive flexibility

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ABSTRACT

This study investigated the link between meditation, self-reported mindfulness and cognitive flexibility as well as other attentional functions. It compared a group of meditators experienced in mindfulness meditation with a meditation-naïve control group on measures of Stroop interference and the "d2-concentration and endurance test". Overall the results suggest that attentional performance and cognitive flexibility are positively related to meditation practice and levels of mindfulness. Meditators performed significantly better than non-meditators on all measures of attention. Furthermore, self-reported mindfulness was higher in meditators than non-meditators and correlations with all attention measures were of moderate to high strength. This pattern of results suggests that mindfulness is intimately linked to improvements of attentional functions and cognitive flexibility. The relevance of these findings for mental balance and well-being are discussed.

1. Introduction

In recent years the interest in the effects of buddhist meditation practice has been growing rapidly (Barinaga, 2003; Ekman, Davidson, Ricard, & Wallace, 2005; Knight, 2004). In particular, the benefits of utilising meditation as therapeutic measure in the health care setting have been discussed and meditation-based interventions are increasingly being implemented adjunct or complementary to classical medical or psychological approaches. The most popular approach within this emerging field is probably the mindfulness-based stress reduction programme (MBSR) developed by Jon Kabat-Zinn in the early 1980s (e.g. Kabat-Zinn, 1984, 1990; Kabat-Zinn, Lipworth, & Burney, 1985). While the programme is rapidly gaining in popularity and has been subjected to numerous evaluation studies covering a variety of physical and psychological disorders, its effectiveness is not yet established beyond any doubt (Baer, 2003; Bishop, 2002; Grossman, Niemann, Schmidt, & Walach, 2004). Similarly, the mechanisms how meditation practice and improvement in mindfulness contribute to physical as well as psychological well-being are not well understood (Brown, Ryan, & Creswell, 2007; Malinowski, 2009).

An alternative perspective on buddhist meditation practice is concerned with cognitive, emotional and neurophysiological changes resulting from extensive meditation practice, where meditation is often conceptualised in terms of mental or cognitive training (e.g. Cahn & Polich, 2006; Carter et al., 2005; Slagter et al., 2007). Results are frequently discussed with respect to neuroplasticity, as several findings suggest that extended meditation training may lead to functional as well as structural changes of the brain (e.g. Davidson et al., 2003; Lazar et al., 2005; Lutz, Greischar, Rawlings, Ricard, & Davidson, 2004; Pagnoni & Cekic, 2007).

These two approaches provide different perspectives which contribute to a broader understanding of the processes and effects of meditation practice. In an attempt to align western psychological and buddhist thinking about this topic, Wallace and Shapiro (2006) provide a framework that facilitates the integration of such different perspectives. Drawing from

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buddhist sources as well as psychological theory and evidence they propose a four-component model, outlining areas for development that contribute to overall psychological well-being. According to their mental balance model the components *conation* (motivation, intention), *attention*, *cognition* and *affect/emotion* need to be developed and balanced to achieve profound well-being. In particular, though not exclusively, the components attention and cognition bear a close relationship to mindfulness (see Malinowski, 2009), which has been conceptualised in terms of *self-regulation of attention* and *orientation towards one's experiences* (Bishop et al., 2004). Also Kabat-Zinn's operational definition of mindfulness as "the awareness that emerges through paying attention on purpose, in the present moment, and non-judgmentally to the unfolding of experience moment by moment" (Kabat-Zinn, 2003, p. 145) acknowledges these two aspects. Thus, mindfulness meditation encompasses various aspects of attention as for instance the ability to focus and sustain ones attention and a reduced proneness to distraction. Cahn & Polich's definition of meditation as "practices that self-regulate the body and mind, thereby affecting mental events by engaging a specific attentional set" (Cahn & Polich, 2006, p. 180), also indicates that training of attentional functions is an essential aspect of any form of meditation practice. In a similar way traditional buddhist texts describe the practice of bare attention, the attending "to the bare facts of perception without reacting to them by deed, speech or mental comment", as a corner stone of mindfulness (Thera, 2005, p. 3). To cultivate mindful awareness, attention needs to be combined with a non-judgmental orientation towards and openness for the flow of one's experiences.

The aim of the current study is to investigate attentional functions and in particular cognitive flexibility within the theoretical framework outlined above. As Roemer and Orsillo (2003) argue, research that examines the effect of mindfulness on cognitive flexibility is currently lacking. Cognitive flexibility is here understood as the human ability to adapt cognitive processing strategies to face new and unexpected conditions and is intrinsically linked to attentional processes (Cañas, Quesada, Antolí, & Fajardo, 2003). As mindfulness meditation is dependant on the (re-)investment of attention on a moment by moment basis, mindfulness training should hypothetically lead to increased cognitive flexibility and an increased ability to respond in a non-habitual fashion.

In this study we are employing two well-established measures, the Stroop task (Stroop, 1935) and the d2-test of attention (Brickenkamp & Zilmer, 1998), to test participants' ability to suppress interfering information and to focus and direct their attention. As these skills are characteristic of good cognitive flexibility and are practiced during mindfulness training, individuals who practice mindfulness meditation should perform well on such tasks. Although recent research suggests a positive relation between meditative practice and attentional function (Jha, Krompinger, & Baime, 2007; Pagnoni & Cekic, 2007; Slagter et al., 2007; Valentine & Sweet, 1999), a clear link between mindfulness and cognitive flexibility still needs to be established. Only few studies attempted to do so by employing the Stroop paradigm. Wenk-Sormaz's (2005) showed that engaging in meditative practice resulted in a reduction of Stroop interference. However, a study by Anderson and co-workers failed to find an improvement of attentional functions after participation in an 8-week MBSR-programme as assessed by various measures of attention, attention switching and Stroop interference (Anderson, Lau, Segal, & Bishop, 2007). Thus, evidence for a relation between mindfulness and attentional functions remains ambiguous. An important difference between Anderson et al.'s (2007) study and that by Wenk-Sormaz (2005) is that the latter measured the effects of brief exposure to mindfulness meditation *immediately* after the end of the last of three 20 min meditation sessions, administered over the course of 2 weeks. In comparison, Anderson et al. investigated the effects of a more expansive mindfulness training (8-weeks) which usually also includes other aspects such as psychological education and physical exercises, and the tests took place up to 4 weeks after completion of the programme, preceded by a 10 min meditation session. A further difference between these studies is that Anderson et al. employed a modified version of the Stroop task, which originally was developed to assess the self-representation of clinical patients (Segal, Gemar, Truchon, Guirguis, & Horowitz, 1995) rather than the standard Stroop task employed by Wenk-Sormaz. Thus, not finding a reduction of Stroop interference in Anderson et al.'s study may be attributed to the fact that the employed task does not tap attentional functions per se but rather measures the interference of cognitive and affective content on behavioural responses. As in both studies the tests were carried out immediately following the experimental induction of mindfulness, one may, furthermore, argue that the findings only apply to this specific situation, whereas the ecologically more important question regarding changes that pertain to everyday life, were not addressed.

To sum up, the link between cognitive flexibility and mindfulness and its possible relevance for everyday life remains unclear.

Following these ideas, in our study we are comparing a group of meditators with experience in mindfulness meditation with a group of non-meditators on several tests of attention and assess them in a quiet experimental situation, but without inducing a meditative state or state of mindfulness. Furthermore, for estimating their levels of mindfulness, they are required to complete a mindfulness self-report questionnaire, the Kentucky Inventory of Mindfulness Skills (KIMS, Baer, Smith, & Allen, 2004). This approach allows us to compare between meditators and non-meditators and additionally to investigate the relation between mindfulness and cognitive control more closely.

The concurrent use of the d2-test of attention and the Stroop task enables us to test the ability to focus, sustain and direct ones attention and to suppress interfering information. As cognitive flexibility implies the ability to interrupt or deautomatise automated responses, that is to respond non-habitually, we shall briefly introduce the concepts of automatisation and deautomatisation in relation to meditative practice.

According to Shiffrin and Schneider (1977) cognitive processes can typically be classified as being either controlled or automatic. They suggested that automatic processes operate in parallel and independent of attention, "automatic [processes] do not require attention, though they may attract it if training is inappropriate, and they do not use up short-term memory capacity" (Shiffrin & Schneider, 1977, p. 38). Spelke, Hirst, and Neisser (1976) have also stressed that behaviour should only