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Age effects on attentional blink performance in meditation

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A B S T R A C T

Here we explore whether mental training in the form of meditation can help to overcome age-related attentional decline. We compared performance on the attentional blink task between three populations: A group of long-term meditation practitioners within an older population, a control group of age-matched participants and a control group of young participants. Members of both control groups had never practiced meditation. Our results show that long-term meditation practice leads to a reduction of the attentional blink. Meditation practitioners taken from an older population showed a reduction in blink as compared to a control group taken from a younger population, whereas, the control group age-matched to the meditators' group revealed a blink that was comparatively larger and broader. Our results support the hypothesis that meditation practice can: (i) alter the efficiency with which attentional resources are distributed and (ii) help to overcome age-related attentional deficits in the temporal domain.

1. Introduction

Human attentional resources are limited, thereby imposing the need to select information for further processing and conscious identification. A convincing demonstration of this in a laboratory setting is the attentional blink (AB) phenomenon. The AB task is a measure of the temporal characteristics of attention. During the AB task participants are asked to identify two targets embedded in a rapid serial visual presentation (RSVP). In an RSVP paradigm stimuli are presented briefly in the same location and in rapid succession. Whereas the first target is generally correctly identified, the second target is poorly identified if it appears between 200 and 500 ms after the first target (Raymond, Shapiro, & Arnell, 1992). There appears to be a refractory period in which attention is not available for processing the second target if it appears between 200 and 500 ms after the first. Targets presented later in the RSVP stream are normally easily identified though this is not the case in aging populations in which the blink recovers more slowly (Georgiou-Karistianis et al., 2007; Maciokas & Crognale, 2003).

Aging, in fact, causes overall AB performance to worsen, both on early and late lags. Specifically, it has been shown that age negatively correlates with performance on the AB task and that the magnitude of the AB increases with age (Georgiou-Karistianis et al., 2007; Maciokas & Crognale, 2003). This increase in blink is twofold: Firstly, older participants miss the second target more frequently and secondly, they miss it for longer periods of time following T1 detection (Georgiou-Karistianis et al., 2007; Maciokas & Crognale, 2003). Presumably, aging participants have a longer blink due to a reduced ability to

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sustain attention. Both sustained attention and the efficiency of inhibitory mechanisms have been shown to be reduced in the older adults (Chao & Knight, 1997). This weakened inhibitory control leads (Pagnoni & Cekic, 2007) to increased distractedness and is thought to result from altered prefrontal cortex function in aging populations (Chao & Knight, 1997). Attentional training in the form of meditation can be expected to counteract these aging effects, helping to preserve attentional resources. The results of previous research have indeed suggested this. The cortical thickness of brain regions functionally related to attention was thicker in meditation practitioners than in controls (Lazar et al., 2005). Most interestingly, between group differences were most pronounced in older participants suggesting that meditation may offset age-related cortical thinning. Similarly, while grey matter volume is expected to decrease with age, no such correlation was found in a group of Zen meditation practitioners (Pagnoni & Cekic, 2007). As attention is crucial to other processes like memory, consciousness and decision making, understanding the possibilities and consequences for training attention and overcoming cognitive attentional decline may prove to be very valuable.

Additional studies have provided evidence that meditation does indeed alter attentional processing (Brefczynski-Lewis, Lutz, Schaefer, Levinson, & Davidson, 2007; Carter et al., 2005; Jha, Krompinger, & Baime, 2007; Lazar et al., 2000, 2005; Lutz, Greischar, Rawlings, Ricard, & Davidson, 2004; Tang et al., 2007). A recent study by Tang et al. (2007) revealed that 20 min of meditation a day over a five-day period improves executive attention (Tang et al., 2007). In this study executive attention was assessed by determining the efficiency of mental conflict resolution. Other studies, employing fMRI, have shown that meditation is accompanied by increased activation in cortical regions involved in the control of attention (Brefczynski-Lewis et al., 2007; Lazar et al., 2000). These cortical regions are also those regions known to be involved in target processing during the attentional blink (Kranczioch, Debener, Schwarzbach, Goebel, & Engel, 2005; Marois, Chun, & Gore, 2000). Furthermore, in response to distractor sounds, expert meditators had more activation in regions related to response inhibition and attention than did novice meditators. Furthermore, the fact that the level of activation correlated with hours of practice suggests plasticity of the attention mechanisms (Brefczynski-Lewis et al., 2007). Together, these findings suggest that mental training, in the form of meditation, leads to lasting alterations in the attention controlling systems.

Despite the fact that attentional recourses are limited, this limitation can be significantly altered as a result of an externally induced change in attentional state (Olivers & Nieuwenhuis, 2005, 2006) as well as through different types of training (Green & Bavelier, 2003; Slagter et al., 2007). Olivers and Nieuwenhuis (2005, 2006) showed that when participants are asked to focus less on the task or are distracted by music, they reveal a reduction in AB (Olivers & Nieuwenhuis, 2005, 2006). This reduction in blink is thought to result from a more distributed attentional state. Furthermore, participants showed a reduction in AB following 6 months of action video game playing (Green & Bavelier, 2003). This suggests that exposure to an altered external visual environment can modify the visual attentional system. Internally driven mental training in the form of meditation can also be expected to affect performance on the AB task. A fundamental aspect of many forms of meditation is attentional training and instructions for practice lay much emphasis on this aspect. In fact, internally driven non-task specific intense mental training in the form of a 3-month meditation retreat has shown to improve performance on the task (Slagter et al., 2007). After the retreat, meditation practitioners exhibited a significant reduction of the AB. Furthermore, meditation practitioners were better able to share their attentional resources between the first and second target, as measured by the P3b ERP component. Specifically, meditation practitioners showed a reduction in amplitude of the P3b component for T1 as compared to control participants.

To investigate the effect of meditation training on attention in an aging population, the current experiment tested performance on the AB task in an older population of long-term meditation practitioners and compared this to performance levels of both age-matched and younger control participants who had never engaged in any meditation practice.

We hypothesized that the long-term practice of meditation would produce changes in attentional processing that mitigate aging effects on the temporal characteristics of attention. Specifically, we predicted that older populations of meditation practitioners engaging in regular Shamatha–Vipashyana meditation practice on a long-term basis would have a reduced AB as compared to age- and education-matched control participants. Shamatha meditation is a concentration practice that serves to enhance sustained voluntary attention on an object such as the breath. During the course of this practice, practitioners often realize that their mind has wandered. Upon detection of this, they are instructed to let go of the wandering thought, without attributing too much importance to it, and re-engage their attention back to the breath. Lutz, Slagter, Dunne, and Davidson (2008) refer to this as a focused attention (FA) meditation. Vipashyana meditation involves no explicit focus on the breath or any other object. It is a follow up to the monitoring of the mind that occurs during Shamatha practice. It involves the open non-reactive monitoring of experience itself, without focusing on, or clinging to, any specific object. This style of meditation can also be referred to as an open monitoring (OM) style of meditation (Lutz et al., 2008). It can be understood as a more distributed state of awareness that involves the open, non-reactive awareness of automatic cognitive and emotional interpretations of sensory, perceptual and endogenous stimuli (Lutz et al., 2008). We predicted that long-term practice in directing and sustaining attention to an object combined with training in the open, non-reactive, monitoring of cognitive events should allow meditation practitioners not only to direct and sustain attention to a target more efficiently but also to react and cling to the first target in the stream less strongly, allowing sufficient recourses to process the second target in the AB task stream. Furthermore, even though performance on the AB task is expected to be negatively correlated with age, we expected meditation practitioners to perform better than their age-matched counterparts and equally well as the control group of younger participants.