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A single bout of meditation biases cognitive control but not attentional focusing: Evidence from the global–local task

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ABSTRACT

Recent studies show that a single bout of meditation can impact information processing. We were interested to see whether this impact extends to attentional focusing and the top-down control over irrelevant information. Healthy adults underwent brief single bouts of either *focused attention meditation* (*FAM*), which is assumed to increase top-down control, or *open monitoring meditation* (*OMM*), which is assumed to weaken top-down control, before performing a global–local task. While the size of the global-precedence effect (reflecting attentional focusing) was unaffected by type of meditation, the congruency effect (indicating the failure to suppress task-irrelevant information) was considerably larger after OMM than after FAM. Our findings suggest that engaging in particular kinds of meditation creates particular cognitive-control states that bias the individual processing style toward either goal-persistence or cognitive flexibility.

1. Introduction

Previous literature demonstrated that long-term meditation practice has a beneficial effect on how people perceive their physical and social world and how they control and monitor their visual attention (see, Lippelt, Hommel, & Colzato, 2014, for a recent review). In their seminal work Lutz, Slagter, Dunne, and Davidson (2008) pointed out that two styles of meditation are commonly investigated: Focused attention meditation (FAM) and Open monitoring meditation (OMM). While FAM requires the voluntary focusing of attention on a chosen object, OMM calls for an overt, but unreactive, monitoring of the content of experience from moment to moment (Lutz et al., 2008). More recently Lippelt et al. (2014), suggested that the two most researched types of meditation practiced, FAM and OMM, are likely to exert different, to some degree even opposite effects on cognitive control. While the impact of meditation on human cognition is commonly assumed to require considerable practice over days, weeks, or even years, we have proposed, and provided preliminary evidence that engaging in meditation is sufficient to promote the establishment of particular cognitive-control styles even in individuals without any meditation practice (Colzato, Oztürk, & Hommel, 2012; Colzato, Sellaro, Samara, & Hommel, 2015; Colzato, Sellaro, Samara, Baas, & Hommel, 2015; Hommel, 2015; Lippelt et al., 2014). We assume that FAM increases top-down control and thus strengthens top-down support for relevant information and/or local competition between relevant and irrelevant information (Duncan, Humphreys, & Ward, 1997), while OMM weakens top-down control and thus reduces top-down support and/or local competition. In support of this assumption, Colzato, Sellaro, Samara, and Hommel (2015), Colzato, Sellaro, Samara,

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Baas, et al. (2015) showed that a brief single session of either FAM or OMM is sufficient to systematically bias the allocation of attention over time in both practitioners and non-meditators: As predicted by our account, the Attentional Blink (AB) was considerably reduced after OMM as compared with FAM. Given that the AB reflects top-down "over-control" (Gross et al., 2004), this observation fits with the idea that OMM weakens attentional top-down control (Colzato, Sellaro, Samara, Baas, et al. (2015)).

The finding that meditation can affect attentional control is consistent with previous demonstrations of meditation effects on sustained attention (Ainsworth, Eddershaw, Meron, Baldwin, & Garner, 2013; Baijal, Jha, Kiyonaga, Singh, & Srinivasan, 2011; Jha, Krompinger, & Baime, 2007; Tang et al., 2007; Zeidan, Johnson, Diamond, David, & Goolkasian, 2010; Elliott, Wallace, & Giesbrecht, 2014) and on the allocation of attention over time (Lutz et al., 2008; Slagter et al., 2007; van Leeuwen, Müller, & Melloni, 2009; van Vugt & Slagter, 2014), except that these previous studies were looking into the effects of short-term (5 days to one week) and long-term (years of practice) meditation training. Given that the observations of Colzato, Sellaro, Samara, and Hommel (2015), Colzato, Sellaro, Samara, Baas, et al. (2015) suggest that significant effects can be obtained even without any practice, we were interested to test whether such ultra-short-term effects can also be found in the control of attentional allocation over space. A well-established task to assess this issue is the global–local task developed by Navon (1977). This task indexes how fast people can process global vs. local characteristics of hierarchically constructed visual stimuli (e.g., larger shapes made of smaller shapes). Participants are typically presented with a global stimulus (e.g., large square) which is composed of smaller shapes, the local stimuli, and the relationship between global and local stimuli can be congruent (e.g., a large square made of small squares) or incongruent (a large square made of small rectangles). Typically, this task gives rise to the "global precedence" effect (i.e., performance is better when responding to global than to local features), which means that global features can be processed faster than local features. Global precedence is supposed to reflect a bias toward a large, comprehensive attentional focus, while attending to local features is considered to require more effort.

Surprisingly, long-term practice does not seem to affect the global precedence effect (Chan & Woollacott, 2007). However, there are reasons to assume that single bouts of OMM and FAM might have an effect on spatial focusing, even though they may operate through different mechanisms than longer-term practice. Evidence for a role of individual differences in attentional control in the global–local task comes from Dale and Arnell (2010, 2015), who found a negative correlation between global precedence and AB magnitude: people who showed a smaller global precedence effect (i.e., a relatively stronger disposition toward processing local information) showed a greater AB magnitude. These observations suggest that individuals can exert control over the allocation of attention when processing targets. Interestingly, single bouts of OMM and FAM might impact attention in a global–local task in two, not necessarily mutually exclusive ways.

For one, processing global information is commonly assumed to require a broader, more spatially distributed focus of attention, while processing local information is assumed to rely on a smaller, more tightly controlled focus (Navon, 1977). If OMM supports the processing of global features, which people attend to spontaneously anyway, performance should be particularly good when responding to global features, which should lead to a particularly pronounced difference between global processing and local processing (i.e. increased global precedence effect). If FAM, in turn, supports the processing of local features, this should reduce the difference between performance on global and on local features (i.e. decreased global precedence effect).

For another, the global–local task induces conflict by providing irrelevant information that suggests an alternative response. As we have mentioned, global–local tasks are often using congruent and incongruent stimuli, as this prevents a number of undesirable strategies (e.g., using only congruent stimuli would make information for the two levels redundant). It is interesting that congruency commonly matters in global–local tasks, as performance is better in congruent than in incongruent trials (Navon, 1977). This suggests that adopting a global or local task set does not prevent the processing of information related to the other task, which can be taken to indicate a task or goal conflict (Kiesel et al., 2010; see Fig. 1). If we thus assume that top-down control is strengthened by FAM and weakened by OMM (Lippelt et al., 2014), we would predict that congruency effects are smaller after FAM than after OMM.

The goal of the current study was to test these two sets of hypotheses, together with a third assumption that meditation can affect behavior even without extended practice or expertise. Therefore, we exposed participants without any (reported) meditation practice to brief, single bouts of either OMM or FAM (Baas, Nevicka, & Ten Velden, 2014) and assessed whether, first, this would affect the size of the global precedence effect (with larger effects indicating broader attentional spotlight) and, second, the size of the congruency effect (with smaller effects indicating reduced interference from the irrelevant task and target level). If the first hypothesis is correct, we would predict an interaction between the instructed target level (global vs. local) and the kind of meditation (FAM vs. OMM). Theoretically, such an interaction would indicate a relatively direct (i.e., expertise-unrelated) impact of meditation on the focus or distribution of visual attention. If the second hypothesis were correct, however, we would predict instead an interaction between congruency and the kind of meditation (FAM vs. OMM), with a smaller congruency effect after FAM than after OMM. Theoretically, such an interaction would indicate a relatively general impact of meditation on cognitive (meta)control, rather than a more specific impact on visual attention. Given that meditation has been found to improve mood (Chang et al., 2004) and that current mood-state is reckoned to affect cognitive-control processes (van Steenbergen, Band, & Hommel, 2010), we also assessed participants' subjective affective states, and we did so before and after the mediation, as well as at the end of the global–local task.