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The effect of mindfulness meditation on time perception

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ABSTRACT

Research has increasingly focussed on the benefits of meditation in everyday life and performance. Mindfulness in particular improves attention, working memory capacity, and reading comprehension. Given its emphasis on moment-to-moment awareness, we hypothesised that mindfulness meditation would alter time perception. Using a within-subjects design, participants carried out a temporal bisection task, where several probe durations are compared to "short" and "long" standards. Following this, participants either listened to an audiobook or a meditation that focussed on the movement of breath in the body. Finally, participants completed the temporal bisection task for a second time. The control group showed no change after the listening task. However, meditation led to a relative overestimation of durations. Within an internal clock framework, a change in attentional resources can produce longer perceived durations. This meditative effect has wider implications for the use of mindfulness as an everyday practice and a basis for clinical treatment.

1. Introduction

Research over the last few decades has begun to explore the effects of traditional Buddhist practices that have been around for millennia. Mindfulness, originally defined as having awareness, attention, and remembering (Bodhi, 2000), is one such example. Practitioners learn to focus their attention on both external and internal sensory stimuli with a non-judgmental awareness of the present moment (Kabat-Zinn, 2003). The goals of such a practice include improved metacognitive awareness, decreased rumination through a reduction in perseveration, and enhanced attention through gains in working memory (Davis & Hayes, 2011). Important for the current research is the idea that mindfulness meditation can help practitioners to focus their attention on moment-to-moment awareness, and that this attention can be directed internally (such as on one's breathing) as well as externally. An enhanced moment-to-moment awareness might be expected to alter our sense of time, given the increased focus on the 'here and now'. However, few studies to date have considered the effects of such practices on time perception, i.e., how mindfulness meditation might affect the subjective passage of time.

Investigators have started to identify the benefits of mindfulness and mindfulness-based therapies in a variety of domains. These include decreases in rumination (Chambers, Lo, & Allen, 2008), improvements in cognitive flexibility (Moore & Malinowski, 2009), working memory capacity and sustained attention (Chambers, Lo, & Allen, 2008; Jha, Stanley, Kiyonaga, Wong, & Gelfand, 2010; MacLean et al., 2010; Mrazek, Franklin, Phillips, Baird, & Schooler, 2013), and reductions in reactivity (Cahn & Polich, 2009), anxiety and depressive symptoms (Hoffman, Sawyer, Witt, & Oh, 2010). Indeed, mindfulness-based

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treatments appear to provide broad antidepressant and antianxiety effects, as well as decreases in general psychological distress (Marchand, 2012). As such, these interventions have been applied with a variety of patients, including those suffering from fibromyalgia, psoriasis, cancer, binge eating, and chronic pain, although the efficacy of specific methods requires further investigation (see meta-analysis by Baer, 2003).

While researchers have begun to uncover the effects of mindfulness on cognitive processes like working memory or attention, there has been little experimental consideration with regard to how mindfulness practice may affect the perception of time. The most common models used within the field of time perception posit a single internal clock, which includes a pacemaker (Church, 1984; Treisman, Faulkner, Naish, & Brogan, 1990) and an attentional gate (Zakay & Block, 1997). In these models, the pacemaker is responsible for emitting pulses, while the attention-controlled switch closes at the onset, and opens at the offset, of a stimulus, allowing pulses to enter an accumulator. Time estimation is based on the number of pulses accumulated, with more pulses leading to an increase in perceived duration. Arousal produces an overestimation of time due to an increase in the pacemaker's speed (Maricq, Roberts, & Church, 1981; Meck, 1983; Wearden & Penton-Voak, 1995; although see Lui, Penney, & Schirmer, 2011). In contrast, if attention to the task distracts from the processing of temporal information, this opens the switch and some pulses are lost. The result is an underestimation of time (e.g., Tipples, 2010; for a review, see Lejeune, 1998). Importantly, meditation appears to manipulate both attention and arousal level (e.g. West, 1987). Glicksohn's (2001) modification of the above model aimed to incorporate the potential effects of meditation. Here, perceived duration is defined as the product of the number of subjective time units (synonymous with pulses in the internal clock model) and the size of these units. During focussed meditation, there is an increase in internally oriented attention and a reduction in arousal (Schuman, 1980). A more efficient allocation of attentional resources to internal stimulation is thought to decrease the number of subjective time units (due to a decrease in arousal, much like the original model) and increase the size of the subjective time units (Zakay, 1989). Consequently, there is an increase in perceived duration and the flow of time becomes slower.

Mindfulness training involves deliberately staying in the present moment for as long and as continuously as possible (Hollis-Walker & Colosimo, 2011). Indeed, researchers found that mindfulness meditation experts were able to stabilise a bistable image (the Necker Cube) for longer in comparison with non-meditators, suggesting a longer duration of subjective nowness (Sauer et al., 2012). This result can be explained by evidence suggesting that mindfulness meditation trains attentional skills and produces increased attentional resources (Lutz, Slagter, Dunne, & Davidson, 2008). If mindfulness meditators are able to attend to a given task while still being able to apply these increased resources to the processing of temporal information, this would close the internal clock's switch and accumulate additional pulses (in terms of the conventional model above). Alternatively, the ability to increase the amount of internally oriented attention would increase the size of subjective time units (modified model). In both cases, we might therefore hypothesise a resulting overestimation of time. In the only previous study on this topic, participants were asked to produce specified target durations by pressing a finger button, and mindfulness meditation practitioners produced longer durations than controls (Berkovich-Ohana, Glicksohn, & Goldstein, 2012). This is equivalent to participants underestimating durations since the slower accumulation of pulses (or time units) would cause participants to wait longer before responding that a target duration had passed, but would feel like an experienced duration had lasted for a shorter amount of time. Longer produced durations may be explained by a decrease in arousal (due to a decrease in pacemaker speed), potentially combined with the hypothesised increase in size of the subjective time units.

In the current experiment, we employed the temporal bisection task, which was developed to test the predictions of clock-based models (e.g., Chambon, Droit-Volet, & Niedenthal, 2008). In a training phase, participants learn two standard durations, one short and one long. In the testing phase, they are presented with comparison stimulus durations (the standards and also intermediate durations). The task is to classify each comparison duration as more similar to either the short or the long standard duration. If mindfulness meditation produces an overestimation of time, this should lead participants who carry out a meditation task to more often classify the comparison durations as similar to the long standard (compared with their performance prior to meditation). In contrast, performance for participants in a control group should remain unchanged.

2. Materials and methods

2.1. Participants

Forty undergraduate students from the University of Kent (age range, 18–24 years; 35 females) participated in exchange for course credits.

2.2. Design

The experiment was defined by five factors that described the testing and stimuli: *Group* (control or meditation) × *Session* (first or second) × *Shape* (circle or square) × *Colour* (red, green, blue) × *Duration* (400, 600, 800, 1000, 1200, 1400, 1600 ms).