



Reset a task set after five minutes of mindfulness practice



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ABSTRACT

This study aimed to evaluate the impact of a brief mindfulness practice on reducing the carryover effect caused by a previous task set and to determine the mechanism for its effectiveness. Experiment 1 showed that a memorized color interfered with subsequent visual search as a singleton distractor only when color was a defining feature for the search target. In Experiment 2, three interventions (scene-viewing, distraction, and mindfulness practice) were implemented across three groups for five minutes between two blocks; color was relevant to search in the first block and irrelevant in the second. Only the mindfulness group showed a non-significant carryover effect. Experiment 3 demonstrated that the scene-viewing participants continued adopting a suppressive mode of attentional control on a previously distracting color during letter judgment. In contrast, mindfulness practice could reset a task set. Mindfulness practice could enhance concentration in the present moment via reconfiguring the mode of attentional control.

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1. Introduction

What is on the mind may interfere with the present task even when the activated mental set is irrelevant to the current behavioral goal. Moreover, this processing mode may carry over to the subsequent task when the task shares similar elements. The current study is interested in how this carryover could be reset. Specifically, we investigate whether a brief period of mindfulness practice, attentional restoration, or distraction can disrupt a carryover effect induced by the previous task set. Given the effectiveness of mindfulness practice, we investigated the underlying mechanism for its effectiveness in a context that occurs in everyday life.

1.1. Task-set inertia (TSI)

Imagine driving to work: you should focus on the current task-relevant stimuli involving the traffic lights, the pedestrians, and other cars on the road. In addition to all these current task-relevant stimuli, your attention may also be captured by many irrelevant stimuli lingering from previous episodes, such as a gift shop for holiday shopping that you were just discussing with your family. The interference caused by previous mental processes reflects task-set inertia (TSI); TSI results in poor performance when people must switch from one task to another in a similar context (see [Monsell, 2003](#), for a review).

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Task set is a configuration of the perceptual, attentional, mnemonic, and motor processes required to perform a task (see Sakai, 2008, for a review). The appropriate configuration of the mental set (Jersild, 1927), mental resources, procedural schema or task-set (Monsell, 2003) is necessary to effectively select and process task-relevant information (Pashler, 1998). Once people have established a task set, they may continue using the same set when the subsequent task shares similar elements with the previous task. Empirical research on task switching has demonstrated this phenomenon, showing poor performance when people must switch from one task to another sharing the same set of stimuli (Allport, Styles, & Hsieh, 1994; Wylie & Allport, 2000; Yeung & Monsell, 2003). Switching to another task requires reconfiguration of the task rule, the attentional weighing of various perceptual features, and the stimulus-response mapping rule to delay responses. TSI, reflected by the switching cost, can be transient from one trial to the next (see Monsell, 2003, for a review) or long-term after performing one task through multiple trials or a block of trials (Mayr, 2002; Waszak, Hommel, & Allport, 2003). TSI may proceed without conscious awareness because unconscious representation can modulate TSI (Lau & Passingham, 2007; Reuss, Kiesel, Kunde, & Hommel, 2011; Weibel, Giersch, Dehaene, & Huron, 2013). Importantly, TSI is robust because a long preparation interval can reduce but not eliminate the inertia (see Monsell, 2003, for a review).

1.2. Mindfulness training improves general cognition

If a long interval of preparation cannot eliminate TSI, what would be an effective intervention to eliminate TSI? We addressed this issue with a focus on mindfulness practice. Mindfulness practice requires self-regulating the focus of attention on the present moment without judgment while inhibiting the elaboration on irrelevant thoughts (Marlatt & Kristeller, 1999). Marlatt (1994) suggested that mindfulness can address changing situations in an adaptive way to focus on the present moment. Mindfulness-based interventions have been proven clinically effective for reducing pain, stress, anxiety, depressive relapse, and eating disorders (see Baer, 2003, for a review). It has also been demonstrated that mindfulness-based interventions can enhance cognitive abilities, including attention, memory and executive functions in non-clinic populations (see Chiesa, Calati, & Serretti, 2011, for a review). Mindfulness, as a promising strategy for improving task focus and performance, has been shown to reduce mind wandering in a vigilance task (Mrazek, Smallwood, & Schooler, 2012).

Malinowski (2013) emphasized the central role of attentional control for the benefits of mindfulness practice on physical well-being, behaviors, or mental well-being. Mindfulness training, which focuses on “pay attention to the present experience”, increases alertness (Anderson, Lau, Segal, & Bishop, 2007; Jha, Krompinger, & Baime, 2007), which may improve awareness of physical sensations (Dickenson, Berkman, Arch, & Lieberman, 2013). Mindfulness facilitates orienting and detecting new stimuli (Anderson et al., 2007; Fernandez-Duque & Posner, 1997). Mindfulness training also benefits attentional control functions such as voluntary attentional control, conflict monitoring (Jha et al., 2007), mental set shifting (Dickenson et al., 2013), flexibility in re-directing attention to new information (Hodgins & Adair, 2010) and the inhibition of non-relevant proponent responses (Heeren, Van Broeck, & Philippot, 2009).

If mindfulness practice can improve attentional control and cognitive flexibility, this practice should be effective for reducing or eliminating TSI. After mindfulness practice, conscious awareness of the present moment should enable people to disengage from the previous task set and focus on the current task rule. Mindfulness practice should be an effective intervention to eliminate the TSI effect. However, evidence is equivocal in supporting the benefit of mindfulness training on task switching. Expert meditators were better at attentional switching than non-meditators (Hodgins & Adair, 2010), but the benefit of mindfulness training on attentional switching was not observed among new learners compared with the control group (Anderson et al., 2007; Chambers, Lo, & Allen, 2008; Heeren et al., 2009). Moreover, the contrast between experts and non-meditators may reflect an enhancement of general cognitive abilities rather than providing direct evidence supporting that people can reconfigure a task set after mindfulness practice. We aimed to provide direct evidence and uncover the mechanism underlying the effectiveness of mindfulness practice.

1.3. The current study

To investigate whether mindfulness practice can reduce or eliminate TSI and to determine the mechanism underlying its effectiveness, we conducted three experiments. In all three experiments, a color set was introduced before the participants performed another task. In Experiment 1, the color set was established by requiring the participants to remember a color for subsequent recognition while performing a visual search task. The memory activation capture (MAC) effect, reflecting the interference caused by the memorized color as a distractor in visual search compared with the neutral condition in which the memorized color did not occur in visual search, was the result of validating the influence of a color set. Experiment 1 verified a hypothesis that the MAC effect would be observed in a demanding search task only when color was relevant to the search goal.

Three interventions (mindfulness, scene-viewing, and distraction) were incorporated across three groups in Experiment 2; color was relevant to the search goal in the first block and irrelevant in the second block. The results of interest relate to the carryover effect, the TSI, in the second block. If an intervention is not effective for reducing or eliminating the TSI, we should observe the MAC effect in the second block due to continued operation of the task set established in the first block. If an intervention is effective, we should not observe the MAC in the second block. An intervention lasted for five minutes between the two blocks.

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