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Improving spatial abilities through mindfulness: Effects on the mental rotation task

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ABSTRACT

In this study, we demonstrate a previously unknown finding that mindful learning can improve an individual's spatial cognition without regard to gender differences. Thirty-two volunteers participated in the experiment. Baselines for spatial ability were first measured for the reaction time on the mental rotation task. Next, the participants were randomly assigned to either a mindful or mindless learning condition. After learning, the mental rotation task showed that those in the mindful learning condition responded faster than those in the mindless learning condition. This study provides promising evidence for applying mindful learning to education.

1. Introduction

Whenever learning a new skill or faced with a new issue, we are predisposed to using the same problem-solving methods that we have used in the past. These mind-sets may, to some extent, allow us to solve certain new problems. However, they may also constrain our thinking (Langer, 2000) because we are likely to equate the new issue to the old one. Previous research on the Einstellung effect has clearly shown that when solving new problems, people are easily trapped into a rigid and limited mind-set by using their old problem-solving pattern(s) and ignoring other simpler and better solutions (Hoffman, Burke, & Maier, 1963; Luchins, 1942). Mind-sets are also widely manifested in our attitudes towards certain social issues such as discrimination towards female employees (Lane & Piercy, 2003; Simpson, 1997) or automatic-stereotypical behavior towards the old and the weak (Bargh, Chen, & Burrows, 1996; Brewer, 1988). In the past several decades we have recognized the counterproductive consequences that mind-sets produce and thus the use of mindful learning and thinking has been increasingly encouraged and used more and more often. Before examining the usefulness of mindful learning, it is necessary to define what mindfulness is and to briefly review the recent related research. Langer and her colleagues (Bondner & Langer, 2001; Langer & Piper, 1987) characterized mindfulness as: (1) the sensitivity to the surrounding environment, (2) the easy acceptance of new and unfamiliar things, (3) the capability to think about an issue from different perspectives, and (4) the creative engagement in categorization. The opposite of mindfulness is mindlessness: a lack of active involvement in thinking.

Ever since the theory of mindfulness was first proposed, a great number of studies, most typically studies done in the fields of clinical psychology and social cognition intervention, have focused on the application of mindfulness. In clinical settings, it has been found that Mindfulness-based Cognitive Therapy (MBCT) (Segal, Williams, & Teasdale, 2002), which is a marriage of mindful learning and traditional cognitive therapy, has great merit in treating people with depression or anxiety (Kuyken et al., 2008; Ma & Teasdale, 2004). Mindfulness also functions in changing an individuals' social cognition as well as in tempering one's emotions. The research results of Langer, Bashner, and Chanowitz (1985) showed that the participants,

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who were trained to think mindfully, primarily thought of the disabled children as specially ''abled'' rather than incapable. In Djikic, Langer and Stapleton's (2008) experiment, people who scored at a high level of mindfulness in a picture categorization task, walked quickly, which predicted a reduced level of stereotype-activated behaviors.

To our knowledge, there is ample evidence demonstrating the profound impact in mindfulness on many areas except for the field of spatial cognition. Thus, the focus of this study was to examine whether people's spatial cognition could be improved through mindful learning. Specifically, we choose the mental rotation task (MRT), which has been identified as an important indicator of spatial ability (Carroll, 1993; Lohman, 1988).

The MRT is a task that typically shows gender differences, in which males' performance is better than females' (e.g. Masters & Sanders, 1993). It is used to examine an individual's spatial cognition by asking the person to determine whether the two pictures presented are ''identical'' or ''mirroring'' (Masters & Sanders, 1993; Shepard & Metzler, 1971). The seminal work by Shepard and Metzler has shown that the reaction time (RT) in this task was a linearly increasing function of the rotated angle (from 0° to 180°). In Bethell-Fox and Shepard's (1988) study, the RT was positively correlated with the complexity of presenting stimuli. However, after people became familiar with the complex stimuli, the RT no longer differed significantly with varying degrees of stimuli's complexity, but differed when the time was linearly increasing along with the stimuli's rotated angle. Khooshabeh and Hegarty (2010) also reported that individuals who performed on the MRT were more likely to have employed a holistic strategy one rather than an analytic one.

In summary, the present study examines whether people with either a mindful or a mindless learning condition differed in their performance on the MRT. Our hypothesis was that the participants' performance on the MRT in the mindful learning condition would be significantly better than those in the mindless one, for mindful learning would induce the participants to apply a holistic strategy. We also predicted that female performance would be less proficient than male performance under both conditions on the MRT.

2. Material and methods

2.1. Participants

Thirty-two students were recruited voluntarily from Nanjing University by advertisement. All of them were right-handed and none had ever participated in any MRT task before.

2.2. Design

We used a 2 (mindfulness or mindlessness) × 2 (male or female) factorial design. As we were concerned that the students' spatial ability was highly diverse (Kali & Orion, 1996), we collected the data for RT on the MRT before learning as the baseline of the participants' spatial ability. The dependent variable was the RT on the MRT after learning.

2.3. Materials

The whole experiment was displayed on a 19″ Lenovo LCD screen using *E*-prime. The computer was located approximately 50 cm in front of the participants, resulting in a visual angle of approximately 5°.

2.3.1. Material for mindful/mindless learning

Previous studies indicated that using different wording to introduce an item could stimulate either a mindful or mindless state (Langer & Piper, 1987). The mindfulness material was created to produce a situation in which the participants could attend to a familiar situation from a different perspective in order to break the mind-set and think out of the box (Bondner & Langer, 2001; Langer & Piper, 1987) (see Appendix 1).

The mindful or mindless learning materials were centered on the screen. The participants were required to answer every question within a limited time and to record their answers in the answer sheet. If the participants still had time left after they completed their answers, they were instructed to press the key of ''q'' to enter into the next question.

2.3.2. Materials for the mental rotation task

We selected the 20° and 120° stimuli rotated from the original pictures on an *x*, *y* or *z* axis from the Shepard and Metzler's (1971) classical experiment (see Fig. 1). As soon as the participants decided that the two pictures displayed were congruent in their shape, they were instructed to press ''f'', or if they determined that one picture was mirror-rotated from the other, they were instructed to press ''j''. The stimuli were classified into three categories: the original–original (constructed by two original items), the mirrored–mirrored (constructed by two mirrored items) and the original–mirrored (constructed by both types of items). The original–original and mirrored–mirrored category both contained 15 trials, including three trials (pictures rotated with 20° and 120° within the same axis) and 12 trials (the combination of four pairs of the two pictures with four rotated angle pairs (20°–20°,120°–120°, 20°–120°,120°–20°) and three rotated axis pairs (*x*–*y*, *x*–*z*, *y*–*z*)). The original–mirrored categories contained 36 trials consisting of the combination of four rotated angle pairs and nine rotated axis pairs (*x*–*x*, *x*–*y*, *x*–*z*, *y*–*x*, *y*–*y*, *y*–*z*, *z*–*x*, *z*–*y*, *z*–*z*).