



Short Communication

Mindful maths: Reducing the impact of stereotype threat through a mindfulness exercise

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ABSTRACT

Individuals who experience stereotype threat – the pressure resulting from social comparisons that are perceived as unfavourable – show performance decrements across a wide range of tasks. One account of this effect is that the cognitive pressure triggered by such threat drains the same cognitive (or working-memory) resources that are implicated in the respective task. The present study investigates whether mindfulness can be used to moderate stereotype threat, as mindfulness has previously been shown to alleviate working-memory load. Our results show that performance decrements that typically occur under stereotype threat can indeed be reversed when the individual engages in a brief (5 min) mindfulness task. The theoretical implications of our findings are discussed.

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1. Introduction

It has been known for more than a decade that performance in a given task suffers when people are under pressure of a stereotype that they fear may be unfavourable for them. This so-called stereotype-threat occurs under the presence of cues that point to one's own (assumed) incompetence – one of the classical examples being that women underperform in a maths test when informed that the test is about assessing gender differences in maths. The effects of stereotype-threat have been observed across various social groups (e.g., Spencer, Steele, & Quinn, 1999; Steele & Aronson, 1995) and domains of performance (e.g., Levy, 1996; Stone, Lynch, Sjomeling, & Darley, 1999; cf. Steele, 1997).

Different accounts of the mechanisms involved in stereotype threat have been proposed, including anxiety (Bosson, Haymovitz, & Pinel, 2004) and arousal (O'Brien & Crandall, 2003). One other compelling account that may well encompass these former two is that the stress imposed by stereotype threat drains the very same resources necessary for task performance (e.g. Beilock, Rydell, & McConnell, 2007; Schmader & Johns, 2003). According to this account, it is the individual's ability to exercise cognitive control and to direct attentional resources systematically and efficiently that is impaired by the experience of stereotype threat. Working memory capacity is critical in allowing one to exercise such cognitive control (cf. Engle, 2002). Working memory capacity has been shown to be implicated in various high level tasks such as language processing (e.g. Daneman & Carpenter, 1980), reasoning (Suess, Oberauer, Wittmann, Wilhelm, & Schulze, 2002) or inhibitory control (e.g. Redick, Calvo, Gay, & Engle, 2011). In their important work, Schmader and Johns (2003) have indeed shown that working memory capacity mediates the effect of stereotype threat on woman's performance in a maths test.

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Given these findings, one might hypothesise that alleviating the draining of working memory capacity is a suitable way to reduce the effects of stereotype threat. Such findings would be important given the significance of the stereotype threat effect and its impairment of performance in various contexts. A few studies have already explored the possibility of reducing the impact of stereotype threat on performance, for instance via the retraining of attitudes or by inducing a re-appraisal of the situation (e.g. [Forbes & Schmader, 2010](#)). These approaches tend to be effortful and task-specific, however. Perhaps more important, they do not always fall under the individual's direct control as they often involve laboratory procedures that may not be easily applicable in everyday settings. Tasks that enhance cognitive control may prove more effective in reducing the effects of stereotype threat.

1.1. *The role of mindfulness*

The last several years has seen a significant interest in the psychological construct of mindfulness – a state and trait in which individuals experience their environment by focusing on the present in an unbiased and non-judgmental way ([Brown & Ryan, 2003](#); [Brown, Ryan, & Creswell, 2007](#)). Mindfulness has been implicated in various attentional processes such as conflict monitoring or endogenous attentional control (e.g. [Jha, Krompinger, & Baime, 2007](#)) and – more pertinent to the current study – in modulating working memory capacity. More specifically, the training of mindfulness has led to a more effective use of available working memory resources ([Chambers, Lo, & Allen, 2008](#); [Jha, Stanley, Kiyonaga, Wong, & Gelfand, 2010](#)). In a mindful state, the individual takes a principled approach in directing attentional resources to a target, the consequence being that threat-related information that taxes working-memory and undermines performance is constrained. As such, we see a principled mindfulness task as being different from comparable activities (e.g. distractions) where individuals allow themselves to be carried away by other information in a less controlled way. We were particularly interested in studying the impact of state- rather than trait-mindfulness on stereotype threat because state-mindfulness can effectively be manipulated by the individual in a brief setting.

In the following experiment, participants were randomly assigned to a 5 min mindfulness or control task. We then induced stereotype threat (female = low math performance) in some of our participants and subsequently measured their performance on a test of mathematic ability. Our hypothesis was that the practice of mindfulness would counteract stereotype threat and hence attenuates the performance decrements that are typically associated with it.

2. Method

2.1. *Participants and design*

Seventy-one female Psychology students between the ages of 18 and 37 years ($M = 20.14$, $SD = 3.99$) took part in the study in exchange for course credit. The participants were of various ethnicities (White British = 66%, Black African/British = 14%, Asian British = 11%, White European = 5%, Chinese = 4%). All participants studied Mathematics at Secondary School level (up to the age of 16), whilst 7 of those had studied Mathematics at Post-Secondary School level (up to the age of 18). None of the participants reported any prior exposure to a mindfulness training (one reported to be familiar with mindfulness but her understanding of mindfulness proved to be inaccurate).

The participants were randomly assigned to one of the conditions in a 2 (Intervention: mindfulness vs. no mindfulness) \times 2 (Stereotype threat: activated vs. not activated) between subjects design.

2.2. *Materials*

2.2.1. *Maths tests*

Participants were required to complete two maths tests pre- and post-intervention. The maths tests were taken from [Crisp, Bache, and Maitner \(2009\)](#). Test items included general maths questions such as dividing fractions and statistical procedures such as finding the mean of a set of numbers. Participants were required to generate responses – it was not a multiple choice test that provided alternative answers. Order of test presentation was counterbalanced between pre- and post-intervention sets within participant groups.

2.2.2. *Intervention*

Mindfulness was manipulated using the 'raisin task' via a pre-recorded audio file. The raisin task has been used in past work (e.g., [Heppner et al., 2008](#); [Hong, Lishner, Han, & Huss, 2011](#); [Kabat-Zinn, 2003](#)) and is designed to induce a state of mindfulness by encouraging participants to strengthen their awareness of the present and to "drop in" on the actuality of their lived experience and then to sustain it as best they can" ([Kabat-Zinn, 2003, p. 148](#)). Participants in the mindfulness conditions received a 5 min audio file providing explicit instructions on how to practice mindfulness while eating two raisins. The task had participants pay attention to multiple sensory experiences, as if eating a raisin for the first time. We have shown the task to be effective in increasing state mindfulness in our other work ([Hopthrow, Hooper, Meier, & Weger, in preparation](#)), and used it because it is in principle also suitable for administration outside a laboratory context. In the control conditions, participants were merely asked to eat two raisins in 5 min.

2.2.3. Toronto Mindfulness Scale (TMS: Lau et al., 2006)

To assess whether the mindfulness manipulation had the desired effect, we used the Toronto Mindfulness Scale (TMS: Lau et al., 2006), a state measure of mindfulness, as a manipulation check. The TMS includes 13 items (e.g., “I approached each experience by trying to accept it, no matter whether it was pleasant or unpleasant”) with four answer alternatives (0 = not at all; 4 = very much). For each participant we computed summed scores from the individual items (alpha = .90; see Lau et al. (2006), for further psychometric details).

2.3. Procedure

Upon entering the experimental laboratory participants were randomly allocated to one of the four groups. From this point, all instructions were administered by the computer program. Participants completed the maths test 1 and then the 5 min mindfulness or control tasks. Participants in the stereotype threat condition were then informed that they are about to take part in a test to explore “why males are better than females in maths”. They then completed the maths test 2. In the non-threat condition, participants simply completed the maths test 2. Subsequently all participants completed the TMS and were debriefed.

3. Results

A 2 (mindfulness vs. control group) \times 2 (threat vs. no threat) Analysis of Variance (ANOVA) on TMS scores revealed higher scores in the mindfulness condition compared to the control condition, 27.8 vs. 15.1, $F(1,67) = 35.90$, $p < .001$, $\eta^2 = .35$, indicating that our mindfulness manipulation had the desired effect. There was no main effect of stereotype threat and no interaction between both factors, both $F_s < 1$.

In order to assess our central prediction regarding the moderation of stereotype threat by mindfulness, we computed difference scores for maths performance in tests 1 and 2 so as to be able to assess the impact of the stereotype threat and mindfulness manipulations relative to baseline performance. Positive numbers reflect an increase in performance from pre to post while negative numbers reflect a decrease in performance.

A 2 (mindfulness vs. control group) \times 2 (threat vs. no threat) ANOVA of these difference scores revealed a main effect of mindfulness, $F(1,67) = 5.61$, $p = .021$, $\eta^2 = .077$, with people in the mindfulness condition performing better on the post- rather than pre-test compared to people in the control condition. The main effect of stereotype threat was not significant, $F(1,67) = .16$, $p = .69$, $\eta^2 = .002$. Critically, the predicted interaction of mindfulness and stereotype threat was significant, $F(1,67) = 4.39$, $p = .04$, $\eta^2 = .061$. Simple effects indicate that participants in the threat activated condition performed significantly better after a mindfulness manipulation than non-mindful controls ($M = .94$ in the mindful condition, indicating a performance boost from tests 1 to 2; as opposed to $M = -.72$ in the non-mindful condition, indicating a performance decrement – the typical stereotype threat effect, $F(1,67) = 10.14$, $p = .002$, $\eta^2 = .13$. There was no difference across conditions when participants did not experience stereotype threat, $M = .31$ in the mindfulness group as opposed to $M = .21$ in the non-mindfulness group, $F(1,67) = .04$, $p = .85$, $\eta^2 = .001$. In the control condition, threat activated participants performed more poorly than non-threat activated participants $F(1,67) = 3.26$, $p = .075$, $\eta^2 = .046$. The results are shown in Table 1.

4. Discussion

The central finding of our study – the fact that the impact of stereotype threat was reduced when participants engaged in a mindfulness task – is of particular interest in light of the significance of this effect and because of the debilitating impact it has on various parameters of performance. Of note is the fact that a 5 min mindfulness manipulation is sufficient to reduce the effect of stereotype threat in the present context. Although ours was a laboratory study, the task could be applied to everyday situations and is ultimately only subject to the user's willingness and readiness to exercise control. It remains to be seen whether the effect will last beyond the brief duration of the maths test like the one applied here (which lasted only approximately 10 min). Still, the fact that it made a reliable difference is of far-reaching significance in light of the importance of the initial moments of engagement with a situation or a task.

We were surprised to find that not only were mindful participants spared from the performance decrements that otherwise occurred once stereotype threat was introduced – their performance even improved relative to the test–retest gains that were observed in the no-threat mindful condition, although this difference was not significant. It is possible that mindfulness dissociates the cues linked to social comparison from their threatening value, allowing the individual to reinterpret

Table 1

Means and standard deviations for the four groups on maths test 1 and maths test 2. Difference scores and average scores on the Toronto Mindfulness Scale (TMS) that was used as a manipulation check are also reported.

Mindful ST activated	4.11 (1.60)	5.05 (2.01)	0.94	28.2 (8.7)
Mindful ST not activated	3.5 (1.55)	3.81 (1.68)	0.31	27.5 (6.7)
Control ST activated	4.33 (1.91)	3.61 (1.54)	−0.72	15.3 (10.8)
Control ST not activated	3.53 (2.25)	3.74 (2.35)	0.21	14.9 (9.7)

these cues in light of what is factually stated: that this is a diagnostic situation. Perhaps the most natural reaction to such a statement is that the individual feels compelled to show her strengths rather than experiencing a cycle of self-definition and identity considerations.

It was also interesting to find that mindfulness does not have an effect in the no-threat condition. This suggests that mindfulness is not a general performance enhancer but has a more specific effect that works by alleviating factors that would otherwise debilitate performance.

Our core finding that the impact of stereotype threat is reduced under a mindfulness manipulation also illustrates the difference between effortful inhibition vs. relaxation in the stereotyping context. Unlike with inhibitory control where the attempt is made to combat stereotypes via thought suppression – only to make stereotypes rebound (e.g. Devine, 1989) – the relaxation approach of quieting the mind and practicing moments of concentrated attention in the case of mindfulness seems to aid cognitive functioning more effectively in the stereotype context (but see for instance Anderson & Levy, 2009, for positive evidence of an active inhibition/forgetting processes outside the stereotype context).

Earlier studies have already reported that an alleviation of stereotype threat is possible. In a study by Forbes and Schmader (2010), for instance, a retraining procedure was used in which an associations test paired up skills and gender information in either a stereotype-consistent or an inconsistent way. When female participants engaged in trials that allowed them to learn stereotype-inconsistent associations (women are good at maths), a roughly 10% performance increase was observed, compared to a control group that showed the conventional stereotype threat pattern. Likewise, when participants were encouraged to re-appraise a situation, the negative consequences of stereotype threat were counteracted: A test that was introduced as a general knowledge test yielded better results than a test that was introduced as a maths test and as a form of assessment that is diagnostic of gender differences (Johns, Schmader, & Martens, 2005). Likewise, Brown and Josephs (1999) found that the impact of stereotype threat is reduced when other factors are available that could account for anticipated decrements. In many contexts, re-learning or re-appraisal is challenging, however, especially when re-learning requires exposure to new stimuli or a re-appraisal appears counterintuitive to the person. The mindfulness approach we have pursued here, by contrast, relies on the participant's resources and control and is therefore an alternative when the conditions for re-learning or re-appraisal are not met.

Various factors may play a mediating role in the way mindfulness reduces the impact of stereotype threat. We have already mentioned Working Memory Capacity as one such factor. The experience of stereotype threat drains available working memory resources (Schmader & Johns, 2003) while mindfulness restores depleted working memory resources (Chambers et al., 2008; Jha et al., 2010). Mindfulness may therefore facilitate performance by countering the resource-depleting impact of stereotype threat. While our work has portrayed the impact of the mindfulness manipulation in the working-memory context, it has not deliberately addressed the mediating role of working memory and thus future work on this link is valuable. Another potential mediating factor is emotion regulation. Stereotype threat has been shown to debilitate emotion regulation (by reducing executive resources, see Johns, Inzlicht, & Schmader, 2008), while mindfulness improves emotion regulation (Heppner et al., 2008). Emotion regulation could hence also be a possible mediator of this effect. On a more general level, there is an emerging conception of a triangular link between (stereotype) threat, self-regulation and mindfulness. Muraven and Baumeister (2000) have shown that self-regulation is a limited resource that can be depleted by resource-demanding practices such as exercises in self-control. Stereotype threat can also deplete self-regulation, as it is a stressor that triggers a resource-depleting coping response (e.g. Inzlicht & Kang, 2010). Mindfulness, by contrast, is increasingly framed in terms of its capacity to improve self-regulation (e.g. Baer, 2003; Jimenez, Niles, & Park, 2010) and thereby appears to be a potential tool to counteract the resource-depleting effect of stereotype threat. The pattern observed here can therefore be seen as a specific instantiation of this general linkage between threat, the depletion of self-regulation, and decreased performance – with mindfulness interrupting this problematic cycle.

Future work will need to explore the role of mediating factors more directly, although theoretical frameworks of the components of mindfulness are beginning to emerge (e.g. Hoelzel et al., 2011). Our work aimed to first examine whether mindfulness can reduce the impact of stereotype threat but did not explore the role of mediating variables (or the duration of the effect). Nonetheless, the fact that a simple 5 min mindfulness exercise eliminated the typical stereotype threat effect holds considerable promise for the development of mindful-based strategies to reduce the detrimental effects of social threat.

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