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ANXIETY AND MIND WANDERING AS INDEPENDENT CONSEQUENCES OF STEREOTYPE THREAT

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We investigated the mediating effects of anxiety and mind wandering in the relationship between stereotype threat and academic performance, testing our multiple mediation model with 5,000 bootstrap samples. The participants were 76 female undergraduate students at South China Normal University. Results showed that both anxiety and mind wandering

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independently mediated the relationship between stereotype threat and the women's mathematics performance. These findings underscore the importance of integrating anxiety and mind wandering to understand how stereotype threat impacts academic performance. Suggestions for future research are offered.

Keywords: women, stereotype threat, academic performance, mathematics performance, anxiety, mind wandering.

Stereotype threat is a situational experience, in which a member of a stigmatized group feels vulnerable and pressured by the possibility of confirming, or being judged by, a negative stereotype. In numerous studies, researchers have confirmed that invoking group memberships associated with stereotypes can harm performance on a variety of tasks (e.g., Joanisse, Gagnon, & Voloaca, 2013), resulting in, for example, underachievement in mathematics and science (e.g., Good, Aronson, & Harder, 2008), self-handicapping strategies, including reduced practice time and effort spent on a task (e.g., Gupta & Bhawe, 2007), and a reduced sense of belonging to the stereotyped domain (e.g., Good, Rattan, & Dweck, 2012).

Researchers have shown that factors such as distraction (e.g., Beilock, Rydell, & McConnell, 2007), narrowed attention (e.g., Beilock, Jellison, Rydell, McConnell, & Carr, 2006), withdrawal of effort (e.g., Stone, 2002), reduced working memory capacity (e.g., Schmader & Johns, 2003), increased anxiety (e.g., Spencer, Steele, & Quinn, 1999), and mind wandering (e.g., Mrazek et al., 2011) can all occur under stereotype threat, and that each of these factors might contribute to lowered performance. However, few have considered more than one factor simultaneously to reveal the joint effect they have on performance in a stereotyped domain. In this study, we focused on anxiety and decreased attention (i.e., mind wandering) as elicited by stereotype threat, as these factors relate to mathematics performance, with these factors forming the basis of explanation for poor mathematics performance.

Literature Review

Anxiety Elicited by Stereotype Threat

One possibility consistently reported across the spectrum of research relevant to stereotype threat is that the activation of stereotype threat can result in stereotyped task performance and preferences via anxiety (e.g., Krendl, Richeson, Kelley, & Heatherton, 2008; Osborne, 2007). However, there is some inconsistent evidence indicating that self-reported anxiety does not mediate the association between stereotype threat and performance (e.g., Spencer et al., 1999), which may be attributable to the timing of the measurement of emotions (e.g., before versus

after a test; Wu, Wen, Marsh, & Hau, 2013) and the reliance on verbal reports (Bosson, Haymovitz, & Pinel, 2004). The measurement of emotions at pre- and posttest is not optimal in that, when this procedure was followed, it was not clear to what degree the anxiety that arose during the test affected test performance. Therefore, in this study, we used the difference in state anxiety before and after a test as the indicator of increased anxiety during the test.

Mind Wandering Elicited by Stereotype Threat

Mind wandering, as a typical example of the mental state of inattention, refers to the situation in which an individual focuses on thoughts and internal feelings that are unrelated to the current activity. There is considerable evidence that reduced memory span scores are related to the presence of more thoughts being unrelated to the task (McVay & Kane, 2009). Other investigators have also demonstrated that stereotype threat disrupts working memory and executive function (e.g., Inzlicht, McKay, & Aronson, 2006). Thus, there is potentially a link between stereotype threat and mind wandering.

Mrazek et al. (2011) are, to our knowledge, the only group of researchers to have focused on investigating the mechanism of stereotype threat in relation to mind wandering. Having found that individuals under stereotype threat experienced more off-task thoughts, which accounted for their poorer test performance compared to those in a control condition, these authors argued that stereotype threat can result in mind wandering. However, there is a substantial body of evidence supporting a close association between emotion and mind wandering (e.g., Carriere, Cheyne, & Smilek, 2008), and the role of attention in perpetuating emotional states (Eysenck, Derakshan, Santos, & Calvo, 2007). That this is so indicates that the conclusion reached by Mrazek et al. should be revisited in further detail by considering mind wandering under stereotype threat in combination with anxiety.

Moreover, although anxiety and mind wandering under stereotype threat could affect performance in a stereotyped domain, it remains unclear whether the indirect effect of stereotype threat on performance is stronger in relation to mind wandering or in relation to anxiety, or if the effects are comparable. Therefore, we tested the following hypotheses in this research:

Hypothesis 1: Anxiety will mediate the linkage between stereotype threat and academic performance.

Hypothesis 2: Mind wandering will mediate the linkage between stereotype threat and academic performance.

Hypothesis 3: The mediating effects of anxiety and mind wandering will be independent from each other.

Using the multiple mediation macro developed by Preacher and Hayes (2008), we compared the indirect effects of the relationship between stereotype threat and

women's mathematics performance, as mediated by anxiety and mind wandering, which enabled us to examine the trajectories of stereotype threat as it influences performance impairment.

Method

Participants

The participants were 76 female Chinese who were undergraduate students at South China Normal University (M_{age} = 21 years, SD = 1.40). Our focus was on the stereotype that women are expected to perform worse than men in mathematics. Thus, we selected only women as participants and made them aware of this negative stereotype with the aim of invoking feelings of vulnerability, and of being pressured by the possibility of confirming, or being judged by, the negative stereotype (stereotype threat).

Procedure

The experiment was conducted in four sessions. In the first session, the participants were randomly allocated to one of two reading comprehension tasks. After reading either a short report on a computer screen about astronomy (control condition) or about gender difference in performance in mathematics (stereotype threat condition), participants answered a question to show their understanding of the content. All participants provided the correct answer. Differing from the manipulations used by Mrazek et al. (2011), we applied the social priming technique to create stereotype threat among women. The manipulation used by Mrazek et al. to elicit stereotype threat involved asking the women in the stereotype threat condition to do a mathematics examination paper while they were sitting next to men, whereas women in control condition did the examination while they were sitting next to other women. We had reasoned that this manipulation was confounded by other effects, such as the participants in the stereotype threat condition becoming more nervous or experiencing mind wandering because of the presence of men, compared to those in control condition who were working with other women around them. That is, the poorer performance in the first of these two conditions may not reflect the true effect of stereotype threat.

In the second session, the participants were required to complete the state anxiety subscale of the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983), with the 20 items (e.g., "I am tense") randomly presented on a computer screen. In the current study, the internal consistency reliability of the state anxiety subscale was .82 and .80 for women in the control and stereotype threat conditions, respectively.

In the third session, all participants were asked to work out the answers to 18 mathematics problems, with a 2-minute response time limit for working on each

problem. All items were inference questions and selected from a public service examination used in China. Participants in the stereotype threat condition were told that the mathematics test was designed to measure gender differences in mathematical ability, and participants in the control condition were told that the test was a problem-solving exercise, rather than a diagnostic test. All participants were informed that performance feedback would be given at the end of the test.

In order to examine the frequency of mind wandering, prior to beginning the task, all participants were told that during the time that they were doing the mathematics task the program would randomly probe how they were working on the tests at that moment. Each time that the prompt was activated the test timer would stop until the participant answered the prompt. An example of the probe was then presented onscreen by asking participants to respond to a probe to describe their current focus on a 5-point scale, ranging from 1 (*completely focused on the mathematics task*) to 5 (*completely focused on unrelated concerns*). Participants were instructed to respond to the prompt whenever it popped up, and each participant was probed 10 times at unpredictable quasirandom intervals during the test.

In the final session, participants were asked to complete the state anxiety subscale of the STAI for a second time. The scale's internal consistency reliability was .83 and .85 for women in the control and stereotype threat conditions, respectively. The test–retest reliability was .81 and .60 for the control and stereotype threat conditions, respectively, so that state anxiety ratings of the group of women in the control condition remained stable before and after taking the mathematics examination but changed for the women in the stereotype threat condition.

Results

Mediation Analyses With Anxiety and Mind Wandering as Mediators

To estimate and test the significance of the mediating effects of anxiety and mind wandering on the poorer performance of the women in the stereotype threat condition, we used the multiple mediation macro developed by Preacher and Hayes (2008). The difference between state anxiety before and after completing the mathematics test was calculated to indicate the increased anxiety experienced during the mathematics task. Because of the insensitivity of test accuracy, response time was used to indicate the level of mathematics performance. When the proposed mediation effect was tested using 5,000 resamples, condition was found to positively affect anxiety (B = 3.47, $t = 2.31$, $p = .024$), anxiety to positively affect response time (B = .06, $t = 3.94$, $p < .001$), condition (i.e., control condition = 0 and stereotype threat condition = 1) to positively affect mind wandering (B = 3.03, $t = 2.73$, $p = .008$), and mind wandering to positively affect response time (B = .06, $t = 2.79$, $p = .007$).

In multiple mediation models, it is not only the total indirect effect (.38, $z = 2.78$, $p = .006$) of condition on mathematics performance that is being considered, but also the specific indirect effects. In our study, the specific indirect effects were .21 ($z = 2.01$, $p = .045$; through anxiety) and .17 ($z = 1.98$, $p = .048$; through mind wandering). The standard errors and critical ratios for these effects are reported in Table 1. The 95% confidence interval (CI) true indirect effect via anxiety was [.050–.451] and the estimated effect was .207, which lies between these two values. The indirect effect for anxiety was significant as well, because zero did not occur between the lower and upper limits for anxiety. Finally, the 95% CI true indirect effect via mind wandering was [.038–.406] and the estimated effect was .173, which lies between these two values. The indirect effect for mind wandering was also significant because zero did not occur between the lower and upper limits for mind wandering. Therefore, Hypotheses 1 and 2 were supported. However, the two indirect effects cannot be distinguished in terms of magnitude because zero was contained in the CI.

Table 1. *Indirect Effects of Stereotype Threat on Mathematics Performance Through the Mediators of Anxiety and Mind Wandering*

			Product of coefficients		Bootstrapping BC 95 % CI	
	Point estimate	Bootstrap estimate	*SE*	*z*	Lower limit	Upper limit
Total	.3799	.38	.14	2.78*	.16	.66
Anxiety	.2067	.20	.10	2.01*	.05	.45
Mind wandering	.1732	.18	.09	1.98*	.04	.41
C1	.0335	.02	.13	0.25	-.25	.33

Note. C1 = contrast of the two indirect effects, BC = bias-corrected, * $p < .05$.

Relationships Among Stereotype Threat, Anxiety, and Mind Wandering

In order to examine whether or not anxiety and mind wandering independently affected the link between stereotype threat and mathematics performance, we separately tested the role of anxiety in mind wandering and the role of mind wandering in anxiety. It was found that anxiety did not significantly mediate the effect of stereotype threat on mind wandering (B = .01, $p = .36$), nor did mind wandering mediate the effect of stereotype on anxiety (B = .01, $p = .27$). These results suggest that anxiety and mind wandering were two independent mediators influencing the effect of stereotype threat on the mathematics performance of the women. Therefore, Hypothesis 3 was supported.

Discussion

In this study, we tested the mediating effects of anxiety and mind wandering on the relationship between stereotype threat and mathematics performance of a group of women students. Our results are in line with those of previous researchers, who found that stereotype threat activation leads to anxiety (e.g., Osborne, 2007) and mind wandering (e.g., Mrazek et al., 2011), which, in turn, leads to poorer mathematics performance (e.g., Bosson et al., 2004). Our findings represent the first empirical evidence that increased anxiety and task-unrelated thoughts independently contribute to stereotype threat effects, and this supports the avoidance hypothesis, in which it is posited that anxiety tends to inhibit deep processing of threatening information, leading to cognitive avoidance of threatening stimuli (e.g., Sposari & Rapee, 2007).

We found it of interest that our results showed that anxiety and mind wandering independently mediated the link between stereotype threat and the performance of the women in an academic-related task. Differing from previous studies, in which anxiety was measured before or after the test, we used the increase in state anxiety during the mathematics test as the index of anxiety produced by stereotype threat. Similarly, we measured mind wandering using the prompt that popped up during the mathematics test, rather than self-reports by the participants after the mathematics test. These manipulations increase the sensitivity when detecting the consequences of stereotype threat.

As noted, previous researchers have separately examined the mediating roles of anxiety and mind wandering in the relationship between stereotype threat and academic performance (e.g., Mrazek et al., 2011), but, to the best of our knowledge, our study is the first in which the focus has been on the comparison between the mediation effects of these factors. In the current study, we showed that although anxiety was a prominent characteristic of stereotype threat, the mediation effect of anxiety was as strong as that of mind wandering, suggesting that stereotype threat can directly elicit many different negative effects, such as increased anxiety and mind wandering, with similar activation weights for both these factors.

Although our findings offer insights of interest to future researchers in this field and fill a gap in the related literature, this study has limitations that will need to be addressed in future research. Given that stereotype threat may hinder learners' ability to exert cognitive effort, subsequently reducing the standard of their performance on academic tests (Schmader & Johns, 2003), and because increased anxiety reduces the standard of performance by reducing available working memory capacity (Miller & Bichsel, 2004), it is likely that anxiety

and mind wandering mediate the association between stereotype threat and mathematics performance by influencing working memory. In future studies, researchers should add working memory into the model to seek evidence to support the mediation conclusions drawn in this study. Additionally, further research efforts can be focused on how mind wandering and anxiety are affected by stereotype threat in other social situations, and on how to apply these materialization results to protect individuals against stereotype threat. Last, we tested the mediation effects of anxiety and mind wandering in the relationship between stereotype threat and academic performance with a group of women. Therefore, we cannot generalize our conclusions to a sample of men. Thus, future researchers should conduct a similar analysis to determine whether the results we obtained can also be applied to men.

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