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Implicit stereotypes and women's math performance: How implicit gender-math stereotypes influence women's susceptibility to stereotype threat

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Abstract

This experiment examined the effects of implicit gender-math stereotyping and implicit gender and math identification on women's math performance under stereotype threat and reduced threat conditions. Results showed that of the three, only implicit gender-math stereotyping moderated stereotype threat effects on women's math performance: women who showed less implicit math-gender stereotyping showed the largest performance difference across experimental conditions. These results suggest that women's implicit associations between gender and math interact with situational cues to influence their math performance: women who implicitly associate women more than men with mathematics were most benefited by reduction of stereotype salience during testing.

Keywords: Women; Math performance; Implicit associations; Stereotypes

Gender differences in mathematical performance are well known. For example, junior high school boys outperform girls on advanced quantitative assessments (e.g., Benbow, Lubinski, Shea, & Eftekhari-Sanjani, 2000), and high school and college men perform better than women on tests of advanced mathematical ability, including standardized tests such as the Scholastic Aptitude Test (SAT) and the Graduate Record Exam (GRE; Brown & Josephs, 1999; Hyde, Fennema, & Lamon, 1990). Gender differences in performance translate into different career trajectories: men are more likely than women to major in mathematics and pursue mathematics or math-intensive careers, such as engineering and computer science (U.S. Department of Education, 2005).

Contributing to these differences are stereotypes concerning gender and math ability that propose that women have less mathematical aptitude than men. A growing body of research evidence indicates that these *gender-math stereotypes* influence women's interest and performance in the math domain (Davies, Spencer, Quinn, & Gerhardstein, 2002; Jacobs & Eccles, 1992; Quinn & Spencer, 2001; Sekaquaptewa & Thompson, 2003; Shih, Pittinsky, & Ambady, 1999; Spencer, Steele, & Quinn, 1999). In particular, research has indicated that women's math performance is highly influenced by external or situational factors, most notably by stereotype threat (see Steele, Spencer, & Aronson, 2002, for a review). Stereotype threat occurs when people fear that their performance may be evaluated in light of a negative stereotype about their social group (Steele & Aronson, 1995). Under these circumstances, fear of confirming the stereotype poses a threat to targets of the stereotype, thereby undermining their performance (Steele & Aronson, 1995).

Stereotype threat has been shown to impair the test performance of a range of negatively stereotyped groups, including women being tested in mathematics (e.g., Sekaquaptewa & Thompson, 2003; Shih et al., 1999; Spencer et al., 1999). Under standard test-taking situations, in

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which math tests are perceived to be diagnostic of math ability, women typically experience stereotype threat (Smith & White, 2002) and perform worse than men. However, when stereotype threat is reduced by instructing women that the math test is gender-fair (e.g., Schmader, 2002), or by informing women that the test is not a diagnostic measure of mathematical ability (e.g., Gonzales, Blanton, & Williams, 2002; Quinn & Spencer, 2001), women perform as well as men.

Evidence suggests that unconscious processing of stereotype-relevant information during testing may be sufficient to cause the decrements observed in targets' performance under threat. Under stereotype threat, targets do not reliably report concerns about the stereotype, even when questioned directly (Steele & Aronson, 1995). Targets' reports of explicit concerns about being stereotyped or stereotype-consistent performance, such as evaluation apprehension, anxiety, and performance expectations, do not reliably mediate stereotype threat effects (Bosson, Haymovitz, & Pinel, 2004; Wheeler & Petty, 2001; but see also Johns, Schmader, & Martens, 2005), implying that participants cannot always accurately detect when their performance is affected by stereotypes. Furthermore, priming participants with a negative stereotype, even when the prime is subliminal and therefore not accessible to conscious awareness, impairs performance (Shih et al., 1999; Wheeler, Jarvis, & Petty, 2001). Similarly, if they are primed with the African American stereotype White participants perform worse on a subsequent test of intellectual ability (Wheeler et al., 2001). Thus stereotype threat effects occur—at least some of the time—without conscious awareness. If stereotype threat occurs through unconscious processing of stereotype-relevant information, then *implicit gender-math stereotypes*, or non-conscious associations of men more than women with mathematics, may influence women's susceptibility to stereotype threat.

Implicit gender-math stereotypes

The personality traits culturally ascribed to different genders are widely known, and these traits influence both implicit and explicit self-perception. At both an explicit and an implicit level, individuals associate feminine and masculine stereotypic traits with the categories men and women, respectively (Rudman, Greenwald, & McGhee, 2001). Women tend to implicitly associate their personal information, such as their names and hometowns, with stereotypically feminine traits, whereas men tend to associate their personal information with stereotypically male traits (Greenwald & Farnham, 2000; Lemm & Banaji, 1998). These associations extend to the academic domain as well. Men and women implicitly associate men more with math and science and women more with arts and humanities (Kiefer & Sekaquaptewa, in press; Nosek, Banaji, & Greenwald, 2002), that is, they possess implicit gender-math stereotypes. Moreover, these implicit stereotypes correspond to less explicit math identification, less favorable attitudes towards mathematics, and lower reported performance on math-related achievement tests for women but not for men (Kiefer & Sekaquaptewa, in press; Nosek et al., 2002), suggesting that they may indeed moderate stereotype threat.

In this study, we examined two possible hypotheses for how implicit gender-math stereotyping might influence susceptibility to stereotype threat. First, women who hold implicit stereotypes may be more affected by stereotype threat than those who do not, because women with greater (implicit) knowledge of gender-math stereotypes may be especially influenced by them. From this perspective, only the performance of women with strong implicit gender-math stereotypes would be diminished under stereotype threat, whereas performance would not differ depending on implicit stereotyping level in the reduced threat condition. Alternatively, the performance of women with strong implicit stereotypes may be *less* affected by a reduction of the salience of the stereotype during testing, because their implicit stereotypes are so firmly entrenched that standard stereotype threat reduction instructions (e.g., stating that this particular test is gender-fair or non-diagnostic) do not reduce the salience of stereotypes for them. Women with weak implicit stereotypes, on the other hand, may perform particularly well when the relevance of the stereotype to the situation has been reduced, because they only view the test through a stereotypic lens when the testing situation calls gender-math stereotypes to mind. According to this second hypothesis, only under reduced threat would women's math performance differ depending on their level of implicit math-gender stereotyping. Favoring the latter perspective, we predicted that women with strong implicit gender-math stereotypes would have these stereotypes chronically accessible, and thus experience stereotype threat even under "reduced threat" conditions. In other words, we expected that there would be a negative correlation between implicit gender-math stereotyping and performance only under conditions of reduced threat.

Other implicit moderators

Several studies have suggested moderating variables of the stereotype threat effect (see Steele et al., 2002, for a review). Among recently studied moderators are gender identification and math identification. For example, women who reported strong gender identification performed worse on a math test than women who reported less gender identification when their individual performance was described as representative of women's mathematical ability (Schmader, 2002). Similarly, stereotype threat is most detrimental to women who are explicitly invested in, i.e., strongly identified with, math (Spencer et al., 1999).

In contrast to the proposed effects of implicit gender-math stereotyping, strong implicit math and gender identification may heighten the effects of stereotype threat on performance. On the explicit level, highly gender identified and highly math-identified women are more impaired by threat (e.g., Schmader, 2002; Spencer et al., 1999). To the extent that these findings generalize to implicit math and