Exposure to Scientific Theories Affects Women's Math Performance

Ilan Dar-Nimrod and Steven J. Heine*

On 14 January 2005, Lawrence Summers, then president of Harvard University, speculated that one reason why women are underrepresented in science and engineering professions is because of a "different availability of aptitude at the high end" (*1*). These remarks were met with much outcry by some critics of President Summers, and social scientists were divided in their reaction to his comments. The question of sex differences in math in the context of the nature-versus-nurture debate is not new and remains contentious. For this paper, we did not explore whether such innate sex differences exist. Instead, we investigated how women's math performance is affected by whether they are considering genetic or experiential accounts for the stereotype of women's underachievement in math. Such a question is relevant to how people respond to scientific arguments and science education more generally.

Stereotype threat is a phenomenon in which the activation of a self-relevant stereotype leads people to show stereotype-consistent behavior, thereby perpetuating the stereotypes (*2*). For example, African Americans perform worse on intelligence tests when their race is highlighted (*2*), and women's math performances decrease when their gender is made salient (*3*). Stereotype threat can be reduced when people focus on the malleability of the traits at hand (*4*).

Past research reveals that people respond differently to genetic and experiential accounts of behaviors. Undesirable behaviors with experiential causes are seen as more voluntary and blameworthy than behaviors with genetic causes (*5*). Experiential causes, in contrast to genetic ones, appear to be viewed as less impactful and more controllable. We reasoned that stereotypes about one's groups are often perceived as inescapable, because many stereotypes are viewed in essentialized terms (*6*). That is, people may view the origin of some stereotypes as resting on the perceived genetic basis that distinguishes these groups. If individuals share the same genetic foundation at the base of the stereotype, they might feel that the stereotype applies to them and hence are vulnerable to stereotype threat. In contrast, we propose that people might react differently if the origins of the group differences were perceived to rest on the specific experiences that people's groups have had. People may reason that their own experiences are different or that they can resist the effects of their experiences.

Our studies manipulated participants' beliefs regarding the source of gender differences in math and measured their subsequent math performance (Fig. 1). In study 1 (*7*), women undertook a Graduate Record Exam–like test in which they completed two math sections separated by a verbal section. The verbal section contained the manipulation in the form of reading comprehension essays. Each test condition used a different essay. Two of the essays argued that math-related sex differences were due to either genetic (G) or experiential causes (E). Both essays claimed that there are sex differences in math performance of the same magnitude. Two additional essays served as a traditional test of stereotype threat. One essay, designed to eliminate underperformance, argued that there are no math-related gender differences (ND). The other essay, designed as a standard stereotype-threat manipulation (S), primed sex without addressing the math stereotype. Controlling for performance on the first math section, we used analyses of covariance to demonstrate that women in the G and the S conditions exhibited similar performances on the second math test ($F < 1$). Women in the E and the ND conditions, although not different from each other ($F < 1$), significantly outperformed women in G and S conditions (all P values ≤ 0.01).

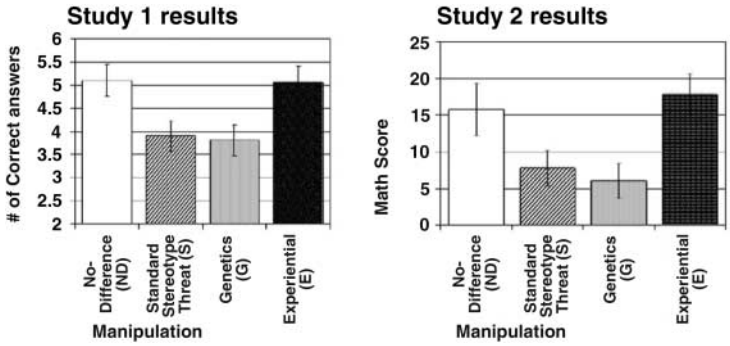

Fig. 1. (**Left**) Study 1 results. Scores on second math test (controlling for scores on first test) after reading essays. (**Right**) Study 2 results. Scores on math test after hearing manipulation.

These findings were replicated in a second study (*7*) that used a different experimental design. An analysis of variance identified significant performance differences between the conditions [$F(3,88) = 4.15$, $P < 0.01$]. Fisher probable least-squares difference (PLSD) comparisons revealed that women in G and S conditions performed comparably ($P > 0.50$) but significantly worse than women in E and ND conditions (all P values < 0.02), which did not differ ($P > 0.50$).

These studies demonstrate that stereotype threat in women's math performance can be reduced, if not eliminated, when women are presented with experiential accounts of the origins of stereotypes. People appear to habitually think of some sex differences in genetic terms unless they are explicitly provided with experiential arguments. It remains to be seen whether the results generalize to stereotypes about other groups and abilities.

Whether there are innate sex differences in math performance remains a contentious question. However, merely considering the role of genes in math performance can have some deleterious consequences. These findings raise discomforting questions regarding the effects that scientific theories can have on those who learn about them and the obligation that scientists have to be mindful of how their work is interpreted. What President Summers perhaps intended to be a provocative call for more empirical research on biological bases of achievement may inadvertently exacerbate the gender gap in science through stereotype threat.

References and Notes

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2136 West Mall, University of British Columbia, Vancouver, BC V6T 1Z4, Canada.

*To whom correspondence should be addressed. E-mail: heine@psych.ubc.ca

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