Stereotype-induced math anxiety robs women's working memory

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A popular stereotype that boys are better at mathematics than girls undermines girls' math performance because it causes worrying that erodes the mental resources needed for problem solving, new research at the University of Chicago shows.

The scholars found that the worrying undermines women's working memory. Working memory is a short-term memory system involved in the control, regulation and active maintenance of limited information needed immediately to deal with problems at hand.

They also showed for the first time that this threat to performance caused by stereotyping can also hinder success in other academic areas because mental abilities do not immediately rebound after being compromised by mathematics anxiety.

"This may mean that if a girl takes a verbal portion of a standardized test after taking the mathematics portion, she may not do as well on the verbal portion as she might do if she had not been recently struggling with math-related worries and anxiety," said Sian Beilock, Assistant Professor in Psychology and lead investigator in the study.

"Likewise, our work suggests that if a girl has a mathematics class first thing in the morning and experiences math-related worries in this class, these worries may carry implications for her performance in the class she attends next," she added.

The results of the study appear in the paper "Stereotype Threat and Working Memory: Mechanisms, Alleviation, and Spill Over," published in the current issue of the *Journal of Experimental Psychology: General*. Co-authors are Robert Rydell, a postdoctoral researcher in psychology at the University of California, Santa Barbara and Allen McConnell, University Distinguished Professor of Psychology at Miami University.

Researchers have been aware that stereotypes can undermine achievement in schools in many ways, but little research has focused on the specific mental processes that prompt this response.

In order to examine those mental processes, the team selected a group of college women who performed well in mathematics. They were then randomly assigned to two groups, with one set of women being told that they were being tested to see why men generally do better on math than women, and the other group being told simply that they were part of an experiment on mathematics performance.

The information that men do better in mathematics than women undercut performance drastically. The accuracy of women exposed to the stereotype was reduced from nearly 90 percent in a pretest to about 80 percent after being told men do better in mathematics. Among women not receiving that message, performance actually improved slightly.

The researchers asked the women exposed to the stereotyping message what they were thinking during the tests and many of them reported being distracted by thoughts such as "I thought about how boys are usually better than girls at math so I was trying harder not to make mistakes" and "I was nervous in the last set because I found out that the study is to compare mathematical abilities of guys and girls." Women not exposed to stereotyping had fewer such thoughts of inferiority.

Further tests showed that the verbal portion of the working memory was the portion of the women's mental resources that was most strongly undermined by the anxiety. The researchers showed that women experiencing mathematics anxiety found it more difficult to do problems when they were written out horizontally than when they appeared vertically. Previous findings show that

solving horizontal problems relies heavily on verbal resources. In order to see if mathematics anxiety had any lasting impact on performance in the short term, the researchers again had women solve math problems, with half being told they were part of a test to determine why men generally do better in mathematics than women and the other half being told only that they were being tested for mathematics performance. They then gave the women a standard memory test involving verbal information and found that the women did less well on that test if they were exposed to the mathematics stereotyping.

“We demonstrated that worries about confirming a negative group stereotype may not only impact performance in the stereotyped domain, but that this impact can spill over onto subsequent, unrelated tasks that depend on the same processing resource the stereotype-related worries consume,” Beilock and her colleagues wrote.

Source: University of Chicago