Math anxiety causes trouble for students as early as first grade

September 12 2012

Many high-achieving students experience math anxiety at a young age—a problem that can follow them throughout their lives, new research at the University of Chicago shows.

In a study of first- and second-graders, Sian Beilock, professor in psychology, found that students report worry and fear about doing math as early as first grade. Most surprisingly math anxiety harmed the highest-achieving students, who typically have the most working memory, Beilock and her colleagues found.

"You can think of working memory as a kind of 'mental scratchpad' that allows us to 'work' with whatever information is temporarily flowing through consciousness," Beilock said. "It's especially important when we have to do a math problem and juggle numbers in our head. Working memory is one of the major building blocks of IQ."

Worries about math can disrupt working memory, which students could otherwise use to succeed. Beilock and other scholars have studied this impact of anxiety on working memory on older students, but her current work is the first to explore the impact on students as they begin school.

The findings are published in the article, "Math Anxiety, Working Memory and Math Achievement in Early Elementary School," in early preview on the website of the *Journal of Cognition and Development*. The lead author is UChicago PhD candidate Gerardo Ramirez. Joining he and Beilock in the work are UChicago postdoctoral scholar Elizabeth

Gunderson and Susan Levine, the Stella M. Rowley Professor in Psychology.

The team showed that a high degree of math anxiety undermined performance of otherwise successful students, placing them almost half a school year behind their less anxious peers, in terms of math achievement.

Less talented students with lower working memory were not impacted by anxiety, because they developed simpler ways of dealing with mathematics problems, such as counting on their fingers. Ironically, because these lower-performing students didn't use working memory much to solve math problems, their performance didn't suffer when worried.

"Early math anxiety may lead to a snowball effect that exerts an increasing cost on math achievement by changing students' attitudes and motivational approaches towards math, increasing math avoidance, and ultimately reducing math competence," Beilock writes in the article.

For the study, the researchers tested 88 first-graders and 66 second-graders from a large urban school system. The students were tested to measure their academic abilities, their working memory and their fear of mathematics. They were asked, on a sliding scale, how nervous they felt to go to the front of the room and work on a mathematics problem on the board.

The study found that among the highest-achieving students, about half had medium to high math anxiety. Math anxiety was also common among low-achieving students, but it did not impact their performance.

Fortunately, there is hope for alleviating the negative impact of math anxiety on math achievement. "When anxiety is regulated or reframed,

students often see a marked increase in their math performance," the researchers write.

One way to reframe anxiety is to have students write about their worries regarding math ahead of time.

A procedure termed "expressive writing" helps students to download worries and minimizes anxiety's effects on working memory. The researchers speculate that, for younger students, expressive picture drawing, rather than writing, may also help lessen the burden of math anxiety. Teachers can also help students reframe their approach by helping them to see exams as a challenge rather than as a threat, the researchers write.

Beilock is also an author of "Math Anxiety, Who Has it, Why it Develops and How to Guard Against it," published in the current issue of Trends in Cognitive Science (Tics). The article, co-written with UChicago postdoctoral scholar Erin Maloney, points out that math anxiety has a variety of sources.

"Its development is probably tied to both social factors, such as a teachers' and parents' anxiety about their own math ability and a student's own numerical and spatial competencies," they write.

Provided by University of Chicago