Brain Study Points to Potential Treatments for Math Anxiety

By Sarah D. Sparks on October 20, 2011 7:18 AM | 9 Comments | 16 Recommendations

For some students, an announcement of a math pop quiz can send them into a cold sweat. A new brain-imaging study suggests that the way they deal with that first rush of anxiety can be critical to their actual math performance.

The study, published this morning in the journal *Cerebral Cortex*, is a continuation of work on highly math-anxious people being conducted by Sian L. Beilock, associate psychology professor at the University of Chicago, and doctoral candidate Ian M. Lyons. In **prior research**, Beilock has found that just the thought of doing math problems can trigger stress responses in people with math anxiety, and adult teachers can pass their trepidation about math on to their students.

But nobody likes to perform badly. And **dyscalculia**—a serious math disability—affects about as many people as dyslexia. So which comes first: the struggle to do math, or the fear of it?

The latest study suggests fear may be a bigger hindrance than previously thought. The researchers analyzed 32 college students, ages 18 to 25, identified as high or low math anxiety based on their answers to a questionnaire. The students were scanned using functional magnetic resonance imaging, or fMRI—a brain imaging technology which measures blood flow to different areas of the brain—while the students performed a series of equally difficult math and spelling tasks. As expected, students who were highly anxious about math performed less accurately on math than on spelling and less accurately in math than students who were not afraid. But the story doesn't end there.

"We know that anxiety or fear of math can lead people to perform worse than what they know," said Beilock, author of the 2010 book *Choke*, on brain responses to performance pressure. "We know that when people perform poorly in a particular subject area, they tend to develop anxiety about their abilities, but being math anxious doesn't mean you are going to perform poorly in math. Some of these math anxious individuals were able to overcome their fear and succeed."

Students were shown a symbol before each question, telling them whether the item would be math- or spelling-related. So the brain scan was able to distinguish a student's anxiety about the upcoming question—and response to that anxiety—separately from what the student did while actually answering the problem. The researchers found some highly math-anxious students performed considerably better on the actual math problems than others, and these students' brains looked very different as they prepared to answer a math question.

Students who were anxious about math but performed well anyway showed high activity in the frontal and parietal regions of the brain when they learned a math problem was coming up; these are not the areas of the brain associated with calculating numbers, but those associated with cognitive control, focus, and regulating negative emotions. Students who activated these parts of the brain before attempting the math problem got 83 percent of the problems correct, nearly the same as the 88 percent accuracy of students with low math anxiety. By contrast, highly anxious students whose brains did not register activity in those regions got only 68 percent of the math questions correct.

Moreover, the researchers found that students' performance had less to do with how afraid they were of

the coming math problem—as measured by activity in the amygdala, the brain's fear center—and more to do with how they responded to that fear. While the study focused on college-age students, the regions of the brain that govern cognitive control and emotional regulation do not completely mature until a person reaches her mid-20s, so Beilock said the effects of anxiety may be even more important for younger students.

"Think about walking across a suspension bridge if you're afraid of heights versus if you're not—completely different ballgame," Lyons said in a statement on the study.

For highly math-anxious students, the researchers found, "it is not necessarily the level of one's self-reported math anxiety per se that predicts one's math deficit, rather it is one's ability to call upon frontoparietal regions before the math task has even begun."

Moreover, Beilock told me, that sort of focus can be taught, and math interventions that address anxiety may be more helpful than those that remediate math skills alone. Previous research has identified benefits from meditation and cognitive control interventions that improve the brain's focus and ability to control negative emotions. Mark H. Ashcraft, a psychology professor at the University of Nevada, Las Vegas is planning one such study next year of a potential intervention focused on changing middle school students' attention and attitudes.

"This study really suggests we can devise interventions that can help students reappraise the situation and control emotions before they even get into a task," Beilock said. "It shows how some math anxious people are able to engage brain power to succeed."

A copy of the study is available here: **Math anxiety.pdf**

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