Inkling on the HUNCH that SCIENCEROCKS

Confessions of a Failed Mathlete

Why brains go boom during stressful math tests

BY MEGHA SATYANARAYANA, 04 APRIL 2007

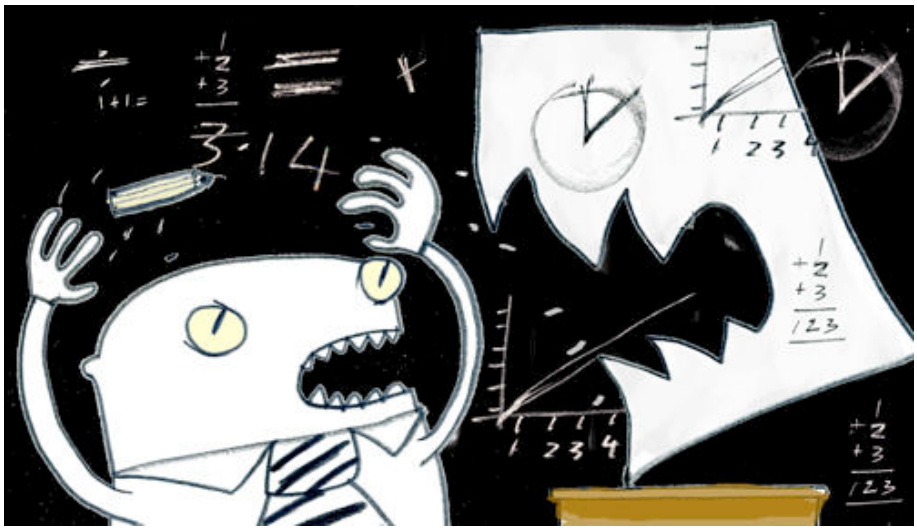

IMAGE: PAUL TANNER

The first time I ever saw a math question about two trains approaching each other at different speeds, I drew a complete blank. In a white flash of panic I saw my brilliant academic future begin to slip away. The era of straight-As and a permanent spot on honor roll was over. I was used to routinely rocking math tests, multiplying like rabbits and dividing like bacteria. I had been a star mathlete, a mental Olympian with a brain of steel.

Faced with complexity beyond "carrying the two," I lost it. Algebra pitched variables and parentheses at me, and I continuously struck out. I couldn't sleep before exams. I did practice problems during English and History and hoped to escape detection; how to explain that I wasn't passing notes, but obsessively solving for *x*? Envisioning my impending doom, I would enter math class and scrape my way through test after test, from algebra to calculus, from seventh grade through my first year in college.

Fifteen years and an algebra-laden Ph.D. in biology later, I finally know why.

My problem is common and it has a name: math anxiety. Approximately 1 in 5 college students are scared to death of math, says psychologist Mark Ashcraft at the University of Nevada, Las Vegas, among the pioneer researchers on this problem. According to Ashcraft my anxiety literally sucked away the brainpower I needed to work through complex math problems, leading to a temporary loss in my otherwise stellar problem-solving skills. The brainpower in question is called working memory, which is a bit like RAM, the memory a computer uses to run a program. In a math-anxiety attack, all my RAM was directed to the thoughts and emotions associated with panic, leaving nothing to execute the math problem. And so, like a computer, I crashed.

One of the more surprising findings is that people with more working memory – the smartypants, nerd-boys and geek-girls – do worse under stress than their peers with low working memory. So your capacity for thinking means nothing if it's filled to the brim with stress, says University of Chicago psychologist Sian Beilock.

To investigate the relationship between school smarts and math anxiety, Beilock split a group of college students into low working memory and high working memory groups based on intelligence tests. They then took a math test with complex problems. First came easy ones, which the participants were told were for practice. Then, before the hard problems, they were told four stress-inducing things: If you score 20% higher on

the real test than the practice test, you'll get $5. They were working in teams, and both had to improve their scores for either to get $5. Oh, and by the way, your partner has already taken the test, and has already done 20% better. And we're taping it, so your teachers can watch your performance. Yikes.

The students with high working memory did great on the practice test, but bombed the real test after being told how important it was to do well. The students with low working memory did the same either way. The results were published in 2005 in *Psychological Science*. The stress and anxiety, says Beilock, "impact you in that exact moment."

So a simple answer would be to control my emotions, right? Before each test, I should have taken a deep breath, recited a mantra of success and happiness, and plowed right into the test.

Apparently, that wouldn't have helped much either. The exertion of controlling emotions seems to suck up working memory just like anxiety does. Jeremy Gray, a psychologist at Yale University, found that students forced to keep a lid on their feelings fared significantly worse on intelligence tests. Gray measured his subjects' ability to think logically and solve problems before and after watching a sad movie. During the movie, one group was asked to control their emotions and the other was allowed to be as mushy as they wanted. The next day, they all took an intelligence test. The kids who suppressed their emotions did poorly on the problem-solving test after the movie. On top of that, the kids who suppressed their emotions but did well on the pre-movie intelligence test were some of the worst performers on the problem-solving test. These results will be published soon in *Cognition and Emotion*.

So again, brains on emotional overdrive burn out in testing situations. Gray theorizes that because high working memory is common in people with high fluid intelligence, the bigger your brain the harder it is to calm it before a test. "Really powerful motorcycles crash easily because they have strong engines," he says.

For Ashcraft, the key to overcoming attacks is to ignore the panic and just get on with the math – paying attention to your freak-out is part of the problem, he says. It's not just up to the student, however. Ashcraft thinks that schools and teachers who stress correct answers over an understanding of how the problem is solved can worsen the effects of math anxiety.

University of Chicago's Beilock also believes that changing testing environments is essential to helping overachievers continue to perform well in math. "How much emphasis should we place on tests?" she says, suggesting that other methods of measuring achievement would be just as useful as high-stress tests such as the SAT and GRE. It is even more important, she says, because this kind of anxiety can seep into adulthood, affecting the ability to meet deadlines or give a speech.

Math anxiety definitely stayed with me well past the era of exams. In my later years of graduate school, I had to extract DNA from small numbers of cells. Extraction yielded a minuscule amount of DNA that I needed to use for several experiments. Because I had so little starting material, my palms would sweat when I had to figure out how much to use in even the most basic experiment. I would do the equation five or six times, until I kept getting the same answer over and over. I knew I could do it, but I couldn't believe I could do it.

Math still makes me nervous. I blew a couple of big experiments because I screwed up the math. As a journalist, my first printed correction was for a bad calculation. But honestly, since leaving grad school, I don't often need complex math skills. I can split bills, calculate tips in my head and figure out how much money I will get if my team wins the NCAA Final Four. Of course none of these problems require solving under deathly stressful circumstances, it's just plain life. For now, that's enough. Until, that is, I have to suddenly meet a friend for drinks at the exact point we pass each other between San Francisco and San Jose on I-280 and he's driving 60 miles per hour from the north and I'm driving 70 miles per hour from the south and I have mere moments to make the calculation before he hops in his car with no cell phone. In which case, we'll never find each other. Thank goodness my friends are forgiving.