

The Myth of the Math Brain

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Are you or your child a “math person” or “not a math person?” Aren’t we born good at math or bad at math? According to Stanford professor Jo Boaler, there is no such thing as a math brain! How then, did we come to think of ourselves in these terms? Where did we catch math anxiety?

Let’s begin by defining math anxiety. Working memory allows you to keep several things in your mind at one time. These include focusing attention, manipulating information, temporarily storing information, all taking place within a few seconds. Anxiety about math, however, produces thoughts that consume valuable space in one’s working memory.

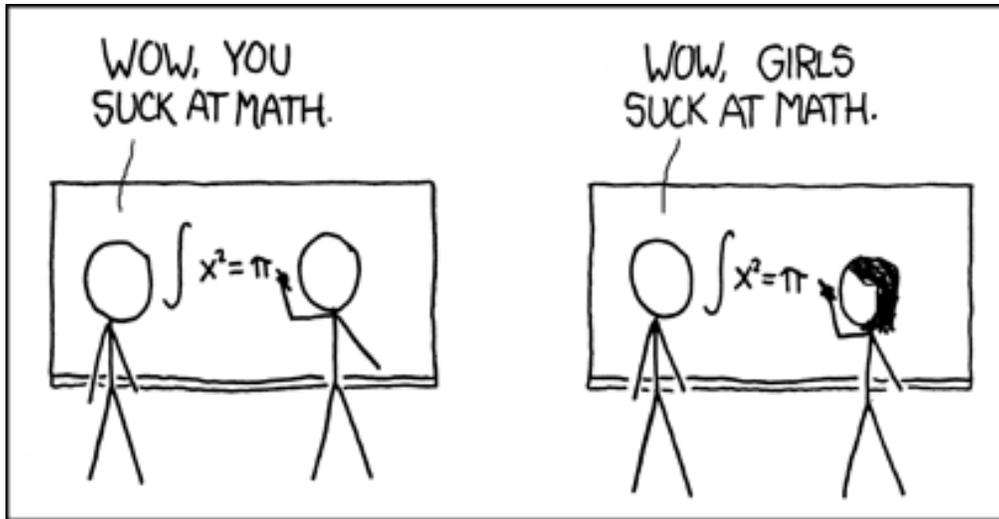
Do gifted students get math anxiety? Gifted children typically have more working memory available. When they become anxious, a greater amount of working memory is affected causing even greater anxiety for them. Sometimes when gifted students struggle with math, they conclude they are not smart after all. People who are good at math are considered “smart” in our society.

I think math still gives me a bit of anxiety because according to society, you’re great, smart, gifted, and beautiful if you’re a mathematician.

Mia, Teacher candidate

Relationships have a strong impact on learning, either enhancing or suppressing. The relationships in a student’s life, from parent to teacher to peers, can affect math anxiety. If a child’s mother is uneasy with math, these feelings may be passed down, especially to daughters. Children are apt to emulate their same sex parent when it comes to math. Some parents may have stereotypes about who is “supposed” to be good at math, and they may have different expectations for different children. And lastly, for our purposes, many parents believe that math is a fixed ability and cannot be improved. (*You are a “math person” or “not a math person.”*)

So, is math anxiety all the parents’ fault? Studies show that undergraduates who major in elementary math have the highest math anxiety of any major. Ninety percent of teachers are female. The more anxious teachers were about math the more likely that girls in their classrooms were to endorse negative stereotypes about female’s math ability, although boys were also affected but to a lesser degree. (Beilan et. al.)



What about the students themselves? Have you ever heard of someone bragging that they are not good at reading? Students tend to see math as a fixed ability, because unlike other subjects, math is performative, and their job is to come up with answers quickly. The feeling is either you can or cannot perform in math. Neuroscience researchers, like Carol Dweck, Camille Farmington, and David Yeager, have shown there is a strong connection between how children view themselves and how they perform academically. It even affects the way the brain approaches learning.



How can we change our students' (and our) brains/minds? Students should know that their brains are like muscles and can shrink and grow, and that productive struggle, not anxiety, helps their brains to grow. This is called a growth mindset. People with a growth mindset believe that smartness increases with hard work. When students make a mistake in math, their brain is growing because it is struggling, even if they are not aware of the mistake. A second synapse fires if they recognize the mistake. Additionally, thinking about a problem visually lights up different brain pathways than just thinking about a problem numerically. The more pathways dedicated to a problem, the stronger the learning.

Teachers and parents must also have a growth mindset instead of a fixed mindset about math ability. Below are some tips for teachers and parents to combat the development of math anxiety.

Teachers:

- Give students time and space to work through their answers. Timed tests increase the likelihood of anxiety. Mathematicians do not rush through their work. They are actually very slow!
- Solve problems, don't "do" problems. Math is not a discrete subject or phenomenon. It is a natural everyday part of our lives. Rarely do we just "do" problems. It is very difficult to have a growth mindset when you are given short, closed questions with a right or wrong answer.
- Look for arguments vs. answers. An answer is one dimensional. An argument needs explanation and justification. Encourage students to TALK about math.
- Think carefully about how you respond to a student who is struggling. Acknowledge the struggle, praise the effort and express confidence in the ability to solve the problem.
- Researchers found a course on how to teach math concepts was more effective in addressing math anxiety among preservice teachers than a course focused directly on math concepts themselves. Tooke, D.J. & Lindstrom, L.C. (1998)

Parents:

- Encourage your children to play with puzzles and games.
- Don't tell your child they are wrong when they are working on math. Ask them to explain their thinking and find the logic in their argument and build on it.
- Don't associate math with speed. This is one of the most powerful ways to start a child on the path to anxiety.
- Never share with your children that you were not good in math!!!
- Encourage number sense (how big numbers are, how we can think about them flexibly).
- Encourage informal math literacy, like we do with language literacy with young children.

Below is an excerpt from Molly. It is from an assignment in which preservice teachers were asked to write a "math autobiography", as is Mia's above. In these few short paragraphs Molly's story moves from excitement to anxiety, as remembered 20-25 years later. Please keep Molly in mind as you work with the children in your life.

At first I was really excited about math. Numbers welcomed me like old friends and intrigued me like a good mystery novel. When I was very young, while most kids were adding and subtracting single digits, my dad was making math worksheets for me to do for fun at home. They often consisted of 6 digit+ addition and subtraction problems, as well as multiplication. I always begged my dad for more and more worksheets. I remember math being fun and incredibly interesting in the way that numbers made sense and were present in everything from gravity to grocery shopping. However, my excitement in math was short lived.

I always see this scene in black and white. I was in 4th grade. We were taken to a neighboring teacher's classroom, Mrs. Todd. Students chattered and laughed, but I shook nervously like a cow to slaughter. The classroom was dark. We sat at desks arranged in a circle. We "played" a game called "Around the World." One student stood behind another student, a math question (often multiplication) was asked, and the first student to answer correctly got to move on, while the other had to remain in their seat, everyone knowing their failure. Whenever my turn came close, I would start to sweat, breathing became very difficult, and thinking felt like driving through thick fog. At that point, math stopped being fun; it turned into an anxiety filled competition, where there was a winner and a loser. Even if you knew the answer, if you didn't answer fast enough, you lost. And I lost, I lost often, and that negative feeling, that dark cloud of shame that hung over our heads as we were left behind in the dust of our seats, grew into a storm of doubt and anxiety that followed me until my 1st year of college.

In 5th grade, the school had a brilliant idea. I could only conclude that the teachers were super villains who held top-secret meetings on the weekends and discussed how to make math an even more unbearable experience. I envisioned secret passwords, colorful costumes, and giant screens with lit up holographic pictures of students and their top weaknesses. At one of these meetings, probably, they decided to implement a negative reinforcement activity. We had daily "pop" quizzes, a page with 50 math questions, which was timed. If you couldn't answer 80% of the page correctly in the short time limit, you had to spend your recess in a supplemental math class. My problem wasn't with the material; it was with the time limit. Needless to say, I rarely saw a single recess that year.

These experiences made me look at math from a perspective of anger and disdain. Math didn't like me, so I didn't like math. I didn't try or put in any effort, because "why bother," "why try," I would never get it. I stopped paying attention in class and fell further and further behind.

For further resources on how you can support your child in learning, visit this website:

[PERTS: Raising Academic Achievement](https://www.perts.net/)

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