Why Is Math So Hard for Some Children?

The Nature and Origins of Mathematical Learning Difficulties and Disabilities

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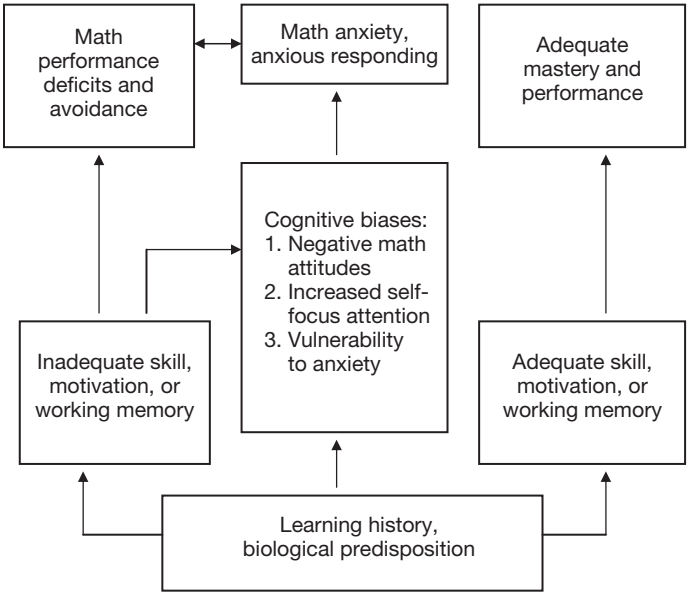

Figure 15.1. A proposed framework for situating math anxiety within the context of various etiological, developmental, and educational factors.

1. Math-anxious responding is a product of some combination of both distal and proximal learning experiences (via social learning and aversive conditioning), biological predisposition toward anxiety (Barlow, 2002), decreased computational skill at more advanced levels of math, cognitive biases that included negative attitudes toward math (Fennema, 1989), increased rumination or self-focused attention, and working memory deficits. Furthermore, the relation between math anxiety and math performance is multifaceted. First, math performance deficits and avoidance may largely be a product of anxious responding, whereby poor performance is directly related to anxiety-related interference insofar as negative cognitions consume available processing resources (i.e., interference models; Eysenck & Calvo, 1992; Sarason, 1984). Second, deficient skill levels may increase the probability of becoming anxious, leading to math performance deficits and avoidance behaviors (i.e., deficit models; Greeno, 1991; Tobias, 1985). Finally, skill deficits may negatively affect performance independent of anxiety level. In contrast, skillful performance on math-related tasks would involve adequate skills, minimal cognitive biases and decreased anxiety, and adequate motivation and approach (rather than avoidance) behavior.

2. Math anxiety will begin to appear in school settings around sixth grade. This is somewhat later than is customarily found for social anxiety or specific phobias (mean of 7.3 years of age and 6.3, respectively, according to Costello, Egger, & Angold, 2004) but would coincide with the increase in difficulty of the math curriculum at the close of the elementary school years. This increased difficulty level also would presumably allow for more direct aversive conditioning experiences.

3. Math anxiety will be particularly apparent among children who experience academic difficulties with math. Based on the cognitive work we have done, this might include students with lower working memory capacity, such as those individuals who would have more difficulty doing multistep math because of diminished working memory capacity. Alternatively, these skill deficits might increase the likelihood of experiencing a negative conditioning event and thus, the onset of math anxiety or a more generalized social phobia.

4. Students who encounter teachers similar to those described in Turner and colleagues (2002)—teachers with a high demand for correctness and little or no cognitive or motivational support during class—should be particularly at risk, especially those who are more vulnerable to performance-based anxiety (e.g., those with lower self-esteem, those with biological vulnerabilities or family history of performance-based anxiety, and those more likely to be emotionally affected by a harsh teaching style). Based on Turner and colleagues's results, we predict a straightforward, positive relationship—the more teacher-induced avoidance, the greater the math anxiety. It seems obvious that students who experience such negative teachers are more likely to avoid advanced math to a greater degree than those who experience more supportive teachers.

5. Because society tolerates such poor attitudes about math and individuals' math mastery (see Chapter 16), and because the *required* curriculum later in high school and college is minimal, we suggest that the general math avoidance seen among math-anxious individuals permits those who develop math anxiety to maintain that response pattern via the process of negative reinforcement. In this circumstance, math-related activities and environments are avoided to reduce physiological and cognitive manifestations of anxiety. Situations that might result in math success are not experienced, thus preventing extinction of the anxiety response.

6. In general, when math-anxious individuals do engage in math-related behavior, an inverse relationship should be evident between math achievement and task complexity. For less complex tasks, skill deficits will be less consequential in eliciting anxious responding and associ-

ated performance deficits. Evaluative concerns also would be less pronounced in such a circumstance. For more advanced math topics, however, we would expect math-anxious individuals to show decreased achievement, largely because of increased performance demands, associated increases in anxiety, and the greater potential for negative evaluation (Eysenck, 1992).

IS MATH ANXIETY A MATHEMATICAL LEARNING DISABILITY?

Math anxiety is related to deliberate avoidance of math, certainly of the math curriculum in high school and college, and also of career paths that rely on math achievement and skill. It compromises people's mastery of math—at least as measured by in-class and standardized tests—to a significant degree. It is associated with poor attitudes concerning math as well as poor self-attitudes, such as low self-esteem with regard to math abilities. It also interferes with math performance, certainly on standardized tests of math achievement but also in laboratory tasks with relatively simple problems like two-column addition.

We do not argue that math anxiety is the same kind of disability factor as some of the other conditions and patterns described in other chapters in this book (although the possibility of comorbidity with those conditions and patterns is worth exploring). Nor do we insist on a discrepancy-based definition of disabilities, which might classify math anxiety as a learning disability. But in some important functional ways, math anxiety does seem to operate like a genuine math learning disability, insofar as the outward manifestation includes poor math achievement under certain circumstances. What may differ are the fundamental performance abilities on very basic tests of numerosity.

Regardless of whether math anxiety is considered a disability or merely a difficulty, consider the following: If we maintain our statistical cutoff for high math anxiety at one *SD* above the mean, roughly 17% of the population would be labeled as high math anxious. Even if we found performance differences only at this level or above, this definition suggests that nearly one fifth of the population experiences high math anxiety. What other syndrome, condition, or circumstance discussed in this book is as widespread and as disruptive—possibly even for a lifetime—as math anxiety, with one fifth of the population at risk? We believe the answer to that question may be "none."

REFERENCES

Alexander, L., & Martray, C. (1989). The development of an abbreviated version of the Mathematics Anxiety Rating Scale. *Measurement and Evaluation in Counseling and Development, 22,* 143–150.

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PART III, SECTION V: Additional Influences on Math Difficulties, contains: (15) Is Math Anxiety a Mathematics Learning Disability?Â SECTION VI: Instructional Interventions, contains: (17) Early Intervention for Children at Risk of Developing Mathematical Learning Difficulties (Sharon Griffin); (18) Mathematical Problem Solving: Instructional Interventions (Lynn S. Fuchs and Douglas Fuchs); (19) Quantitative Literacy and Developmental Dyscalculias (Michael McCloskey); and Instructional Interventions/Quantitative Literacy: Commentary on Section VI (Herbert Ginsburg and Sandra Pappas). Compared with reading, little has been written about why children struggle with mathematics. The research in the past few years is significantly better than for the previous twenty. This book is an excellent addition to the literature. If you are a special education who can stand reading research, or a graduate student learning about math education, this book is a must-read. I particularly recommend the chapters on defining math disability and on the use of memory in mathematics. Read more.Â It is an exceptional review of literature on LD in maths. Good collaborators, each chapter is writen by some of the most popular scientists on the field. Necessary for any serious work. Read more. Why are arithmetic problems such as 2 + 2 easy for some children, while others struggle to find the answer? My research focuses on trying to understand why math is so hard for children who have a specific mathematics learning disability. By learning about how the brains in children who have severe math difficulties develop differently from others, I hope that one day we can use what we learn to help all children learn math better in school.