

TALKING POINT:

HOW DOES MATHS ANXIETY AFFECT MATHEMATICS LEARNING?

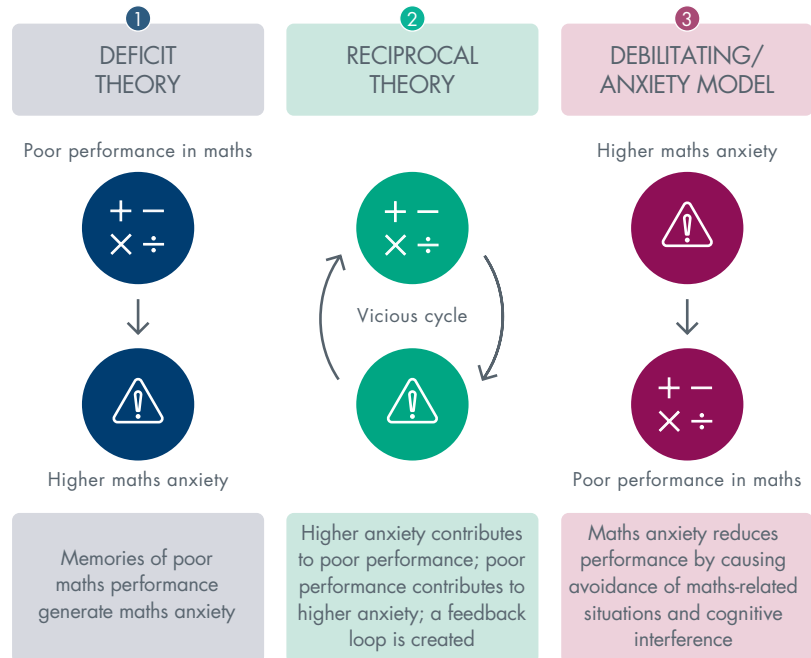
'For someone who has math anxiety, the anticipation of doing math prompts a similar brain reaction as when they experience pain — say, burning one's hand on a hot stove'

Sian Beilock

'interventions are easier and less painful if they take place before mathematics anxiety has set in'

Ann Dowker

THREE POSSIBLE THEORIES ON MATHS ANXIETY AND MATHS PERFORMANCE



Adapted from ideas in Carey et al (2014)

IN SUMMARY

- Maths anxiety is associated with poor maths performance and the two could form a feedback loop
- Maths anxiety may be both mental and emotional; intervention should consider both aspects
- Maths anxiety appears to affect a significant proportion of school and university students at all ages, as well as adults; girls report it more than boys
- Maths anxiety affects working memory; addressing the anxiety and providing strategies to control it may be effective
- Teachers who experience maths anxiety may transmit it to pupils
- Use of manipulatives when planning may help to reduce maths anxiety for teachers

1

Maths anxiety is defined as a 'debilitating emotional reaction to maths' by the Nuffield Foundation¹; other experts suggest it has both a cognitive and an affective dimension³. Maths anxiety correlates with measures of more general anxiety, but cannot be reduced to either general anxiety or text anxiety³ and is not simply a proxy for low mathematics ability^{7,12}. There is a negative correlation between maths anxiety and performance on maths tests², which has been explained by maths anxiety causing both avoidance of mathematical tasks and disruption of working memory^{2,3}. Researchers do not currently agree as to which theoretical model might explain the link between maths anxiety and maths performance (see infographic) – whether the link is one-way, or a cycle.⁴

IMPLICATIONS: Pupils with maths anxiety may avoid maths tasks and experience cognitive disruption, which could form a feedback loop with poor maths performance

Maths anxiety may have both a cognitive and affective dimension; intervention should consider both aspects

2

A substantial proportion of both children and adults have cognitive and/or emotional difficulties with mathematics³; some studies find prevalence as high as 60% in university students (taking a range of subjects)⁵, while others report around 25%^{6,8,12}. Recent research suggests maths anxiety can begin much earlier than previously thought¹² (it has been observed in 5 year-olds) – and not just in response to complex mathematics, but also early number skills⁷. Girls report higher levels of maths anxiety than boys.¹³

IMPLICATIONS: A high proportion of students may experience maths anxiety – and not just older students working on complex maths

Girls are more likely to report maths anxiety

3

Maths anxiety is often self-reported, but more recently brain imaging studies have found a distinct pattern in those who report it, showing decreased activity in regions associated with working memory and numerical processing⁸. Maths anxiety appears to rob students of working memory, and affects those with high working memory the most¹². Students who had maths anxiety but whose brains showed activity in areas associated with control of negative emotions performed nearly as well on a difficult math task as those without maths anxiety, showing helping students to eliminate the anxious response once it occurs can be effective.⁸

IMPLICATIONS: Maths anxiety affects the brain, particularly working memory; overtly helping students to deal with anxiety as it occurs can be effective

4

Maths anxiety can be transmitted from teacher to student¹⁰; teachers who are anxious or negative about mathematics can instil the same attitudes in their students⁷; there also seems to be a gender effect, where female teachers who are anxious about mathematics may have a negative impact on female (but not male) students' maths achievement and attitudes to maths⁹. Maths anxiety has been linked to intense feelings of shame or guilt, and can have a negative effect on teachers' performance as well as that of pupils; use of manipulatives in planning can decrease maths anxiety in teachers at the primary level¹⁰.

IMPLICATIONS: Teachers who experience maths anxiety may induce it in pupils, especially female teachers and female pupils

Maths anxiety can inhibit effective teaching; use of manipulatives while planning may be useful

5

Students with early difficulties in numerical and spatial skills are more likely to develop maths anxiety – therefore interventions to help bolster these skills may help to prevent development of maths anxiety⁷. Students who believe they can improve with practice are much less prone to maths anxiety than those with more fixed beliefs¹¹. Taking away time pressures reduces maths anxiety for pupils¹². Using the Growth Zone model (considering one's own Comfort zone, Growth zone and Anxiety zone)¹⁴ can help people characterise and deal with maths anxiety.

IMPLICATIONS: Early mathematics difficulty can be associated with maths anxiety; prevention of maths anxiety may be possible by bolstering early numerical and spatial skills

Promoting a growth mindset of mathematics learning, using the Growth Zone model, and minimising the number of time-pressured tasks for pupils may help to prevent maths anxiety

Lucy Rycroft-Smith, 2017

REFERENCES

1. Nuffield Foundation (2013) Understanding Maths Anxiety, [online] available at: www.nuffieldfoundation.org/understanding-mathematics-anxiety [Accessed 23 May 2017]

2. Ashcraft M.H., Krause J.A. (2007) Working memory, math-performance, and math anxiety, *Psychonomic Bulletin and Review*. 14: 243–248

3. Dowker, A., Sarkar, A., & Looi, C.Y. (2016) Mathematics Anxiety: What Have We Learned in 60 Years?, *Frontiers in Psychology*, 7: 508

4. Carey, E., Hill, F., Devine, A., & Szűcs, D. (2016) The Chicken or the Egg? The Direction of the Relationship Between Mathematics Anxiety and Mathematics Performance, *Frontiers in Psychology*, 6

5. Pérez-Tyteca, P., Castro, E., Segovia, I., Castro, E., Fernández, F.Y., Cano, F. (2009). El papel de la ansiedad matemática en el paso de la educación secundaria a la educación universitaria [The role of mathematical anxiety in the

transition from high school education to higher education], *PNA*, 4(1): 23–35

6. Beilock, S.L., & Mahoney, E.A., (2015) Math Anxiety: A Factor in Math Achievement Not to Be Ignored, *Policy Insights from the Behavioral and Brain Sciences*, Vol. 2(1) 4–12

7. Mahoney, E.A., & Beilock, S.L., (2012) Math anxiety: who has it, why it develops, and how to guard against it, *Trends in Cognitive Sciences*, Vol. 16, No. 8 pages 404–406

8. Lyons, I.M. and Beilock, S.L. (2011) Mathematics anxiety: separating the math from the anxiety, *Cerebral Cortex*

9. Beilock, S.L., Gunderson, E.A., Ramirez, G., & Levine, S. C. (2010), Female teachers' math anxiety affects girls' math achievement, *Proceedings of the National Academy of Sciences of the United States of America*, 107(5), 1860–1863

10. Haciomeroglu, G., (2013) Mathematics Anxiety and Mathematical Beliefs: What Is the Relationship in Elementary Pre-Service Teachers? *IJMPST: The Journal*. Vol 5 (Teacher Attributes)

11. Dweck, C. S. (2008). *Mindsets and math/science achievement*, New York, NY: Carnegie Corp. of New York–Institute for Advanced Study Commission on Mathematics and Science Education

12. Beilock, S., Willingham, D.T., (2014) Ask the Cognitive Scientist: Math Anxiety, Can Teachers Help Students Reduce It?, *American Educator*, 28–32

13. 'Devine, A., Fawcett, K., Szűcs, D., & Dowker, A. (2012), Gender differences in mathematics anxiety and the relation to mathematics performance while controlling for test anxiety, *Behavioral and Brain Functions*, 8(33), 1–9

14. Johnston-Wilder, S., Lee, C., Garton, E., Brindley, J. (2014). Developing teaching for mathematical resilience in further education, *7th International Conference of Education, Research and Innovation, ICERI2014, Seville (SPAIN)*, 2014