

A Guide to Tackling Maths Anxiety

*Building more
confident and resilient
learners, teachers and
communities*

Insights from the Power of Maths Roundtable



The Power of Maths Roundtable Series



The Power of Maths Roundtable Series

#PowerofMaths

At Pearson, we believe in the power of maths. It's an integral part of the world around us. That's why everything we do focuses on building skills and confidence in maths so everyone can engage with opportunities, achieve, and progress throughout their lives.

As we cannot effect such great change alone, our **Power of Maths Roundtable series** brings together leading influencers across education, academia, industry and the third sector to discuss and unlock contemporary issues facing mathematics in the UK today.

Putting the spotlight on tackling maths anxiety

Maths anxiety affects thousands of children, young people and adults in the UK. Seen and felt in classrooms, homes and workplaces across the nation, it is widely acknowledged as a barrier to engagement and progress in maths, as well as other areas of education, employment and life.

Our second Roundtable brought teachers, academics, charity and business leaders together to explore how to tackle maths anxiety. This guide draws upon the insights and practical tips gathered at the event so you can join us in helping build more confident and resilient learners, teachers and communities.



Contents



Foreword

4

Maths anxiety: the headlines

5

Solutions at the chalkface

8

Understanding and identifying
maths anxiety

9

Tools to support maths-anxious
learners

13

Rethinking teaching approaches

16

Solutions beyond the school gates

20

Challenging perceptions and
broadening horizons

21

Engaging adults and boosting
maths confidence

24

Conclusions

26

Further reading and acknowledgements

27

Join the conversation

30



1

Foreword



By Bobby Seagull

Maths teacher, author and TV presenter
Chair of Pearson's Power of Maths Roundtable

“

The average person on the street may not have heard of the term ‘maths anxiety’, but it is likely they or someone they know will have suffered from it.

Having been a student in the classroom myself and now on the other side of the desk as a classroom teacher, I have witnessed how maths anxiety can negatively impact the competence and confidence of people in dealing with maths. This can sadly harm their ability to engage with maths for their rest of their lives.

While academic discussions around maths anxiety began to appear in the 1950s, it is a concept that has been expressed for centuries. An Elizabethan nursery rhyme written by Scottish mathematician John Napier, dating back to 1570 even read:

“Multiplication is vexation, division is bad. The rule of three doth puzzle me, and practice drives me mad.”¹

As someone who advocates the magic of numbers, it was therefore a privilege and honour to chair Pearson's Power of Maths Roundtable, where leading academics, business leaders, teachers and educators came together to discuss how we can tackle this long-standing and significant issue.

The Roundtable showed there are many driven people and organisations who are committed to building a more confident and resilient nation when it comes to maths. And this guide gives an insight into some of the solutions and ideas that can be taken forward in schools and wider society to help make this vision a reality.

Change can and will happen, but society will not transform overnight. Together, we must continue the conversation and fight for the wonder of maths.

”

2 Maths anxiety: the headlines



Definition by Sue Johnston-Wilder

Associate Professor, University of Warwick
Leading academic into mathematics anxiety
and developing mathematical resilience

What is maths anxiety?

Mathematics anxiety has been defined as:

“

A feeling of tension and anxiety that interferes with the manipulation of numbers and the solving of mathematical problems in ordinary life and academic situations.

Richardson and Suinn (1972)²

”

It is a negative emotional reaction to mathematics that acts as an **‘emotional handbrake’** and holds up progress in maths. The severity can range from a feeling of mild tension to experiencing a strong and deep-rooted fear of maths.

Maths anxiety is not always obvious: it can sometimes be invisible and often unnoticed. It can manifest itself as poor behaviour, anger, frustration, avoidance, under-attainment and helplessness.

It doesn't begin or end within the school walls either: it affects children through to the elderly, presenting in homes, classrooms and workplaces. In schools, it spans across the attainment spectrum, from high-flyers to those who find the subject more challenging.

Research suggests that the majority of those who experience maths anxiety are usually learners with a ‘feeling’ rather than a ‘thinking’ preference, otherwise known as empathisers.³ These learners prefer to understand the value, meaning, purpose and narrative of the mathematical tools they are required to learn.



2 Maths anxiety: the headlines

36%

of 15-24-year-olds

in the UK feel anxious about maths ⁵



1 in 10

eight to 13-year-olds
in Britain suffer from
maths anxiety ⁴



1 in 4

parents don't feel able to
teach their children basic
addition and subtraction
without a calculator ⁹



1 in 5

parents suffer from
arithmophobia –
a fear of numbers ⁸



Maths anxiety in numbers

Women are more
than twice as anxious
as men about using
maths and numbers ⁷



only 26%

of undergraduate
students have the numerical
skills and understanding
necessary for daily life and work ⁶



40%
of parents

wouldn't be able to show
their children how to split a
restaurant bill with friends ¹⁰



2 Maths anxiety: the headlines



What causes maths anxiety?

Maths anxiety has many possible causes and contributing factors that are currently being researched.

We all have curious brains that have an in-built, highly-tuned safety mechanism that protects us so we can avoid danger. And when faced with a perceived 'danger', we have a 'fight or flight response'.

When it comes to maths anxiety, the same principle applies. If faced with a task that requires maths, many could perceive 'danger' to be:

- **social threats** – such as humiliation, exclusion and being left behind or isolated
- **fear of failure** – being asked to do something the learner experiences as too hard through insufficient scaffolding, context, meaning or narrative.

Research has shown so far that these are common contributing factors to maths anxiety across different ages and stages of life.



In schools, many students report experiencing maths anxiety as a result of finding the work difficult, competing with peers, gender bias and insensitivity from teachers, and lack of remediation.¹¹



Beyond the school gates, being asked to work out a share of a bill, help with homework or answer a quick-fire question involving maths in front of others can commonly invoke panic and anxiety for people of all ages.

The good news is that maths anxiety can be tackled. With the right tools and commitment, everyone can build confidence and resilience when it comes to mathematics...



3

Maths anxiety: solutions at the chalkface

As part of our Power of Maths Roundtable, attendees were not only asked to discuss the causes and extent of maths anxiety, but also how we can tackle this issue.

At the Roundtable Elsie, aged 13, shared her experience of overcoming maths anxiety to help our search for solutions.

“

I was bad at maths and I didn't understand it, so I got frustrated and upset. It made me feel a bit dumb and stupid – like I was bad at everything, so I gave up on my other subjects too.

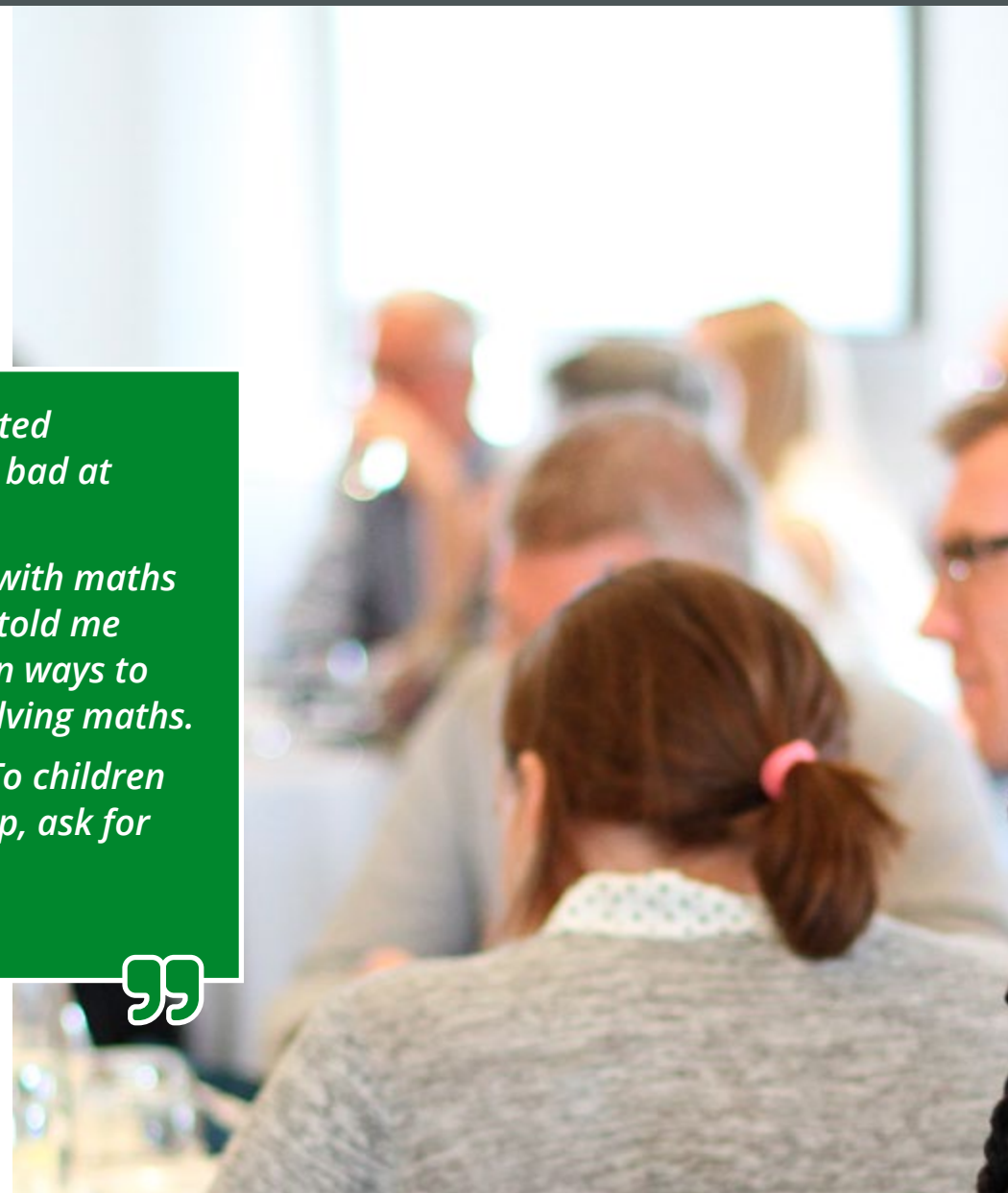
I was put into a smaller group with other kids who struggled with maths and I also had one-to-one time with a specialist teacher. She told me that I wasn't bad at maths and that I'm not stupid. I was given ways to stop feeling frustrated and she showed me fun activities involving maths.

I still struggle with some areas of maths but I don't give up. To children who are experiencing maths anxiety now, I'd say: don't give up, ask for help and don't let it affect your other subjects.

Elsie, aged 13

”

Inspired by Elsie's story, Roundtable attendees shared their tips and strategies to help prevent and treat maths anxiety in schools and colleges.





Within schools and colleges, teachers and leaders are vital to preventing, tackling and treating maths anxiety. They can help identify students who are suffering from maths anxiety and ensure tools and approaches are in place to help.

Building on 60 years of research into the area, there's still much more we can do to improve our approaches to maths anxiety in schools and colleges.

So how can we do this? Roundtable attendees highlighted three key areas in their search for solutions...



Training and CPD

Roundtable attendees highlighted the importance of more training and CPD in helping teachers and leaders understand and identify maths anxiety.



Recommendation

Initial Teacher Training in the UK, as well as in-school training, should include exploring maths anxiety.



Recommendation

Every opportunity to raise awareness of the issue can make a difference – be it running focused CPD with staff drawing on the likes of the Cambridge Espresso research digests on maths anxiety, or putting the definition of maths anxiety on a board in the staffroom.



Recommendation

Support Early Years professionals to develop 'maths talk' by introducing mathematical concepts and language in a way that young children already understand, such as through discussing 'sharing' and 'fairness'. This was considered an important starting point in helping to normalise maths and help prevent future anxiety.



3 Understanding and identifying maths anxiety

Pupil and teacher questionnaires



As no two schools or colleges are the same, it's important for leaders and teachers to understand the issue in their own context.

Questionnaires for pupils and teachers can be useful tools to help:

- understand the scale of the issue
- identify any patterns
- inform prevention and treatment strategies.

Surveys could range from simply asking pupils to anonymously rate their anxiety when they are asked a maths question from 1–10, to more detailed questions for staff.

A teacher's perspective: West Lakes Academy Research Project



Rob Brown, a maths teacher at West Lakes Academy in Cumbria, shares the impact pupil and teacher questionnaires made to understanding maths anxiety in his school.

At West Lakes Academy, we wanted to investigate the best way to help pupils with maths anxiety. That's why we created a small research project aiming to identify those with anxiety by:

- providing more than 300 students with a questionnaire, so they could self-evaluate their anxiety levels in a variety of contexts
- speaking to students about their experiences
- asking teachers to identify 10–20% of their class who they thought exhibited most symptoms of anxiety and speaking to them about the symptoms they had observed.





A teacher's perspective: West Lakes Academy Research Project



What we learned

1. A gender divide



- Girls were far more likely to report feeling anxious around mathematics – more than $\frac{3}{4}$ of our self-reported anxious students were girls.
- Teachers predominantly identified girls as exhibiting symptoms of maths anxiety, but also identified boys who had not reported themselves as anxious.
- Questions for further consideration: Do fewer boys suffer from maths anxiety? Or are boys less keen to share their feelings or just less aware of their own anxieties?

2. Knowing the students matters



- Self-reported maths-anxious students were more likely to be identified if their teacher taught them more regularly, i.e. for at least four lessons a week.
- Teaching the same class for a long period of time matters. Experienced teachers who had taught the same class for the entire academic year, were more likely to identify the self-reported students.
- Teaching for only one or two hours a week hampered a teacher's ability to identify their maths-anxious students.





A teacher's perspective: West Lakes Academy Research Project



What we learned

3. Many anxious students are unidentified



- Teachers did not identify all those that self-reported symptoms of maths anxiety.
- If both the self-reported surveys and the teachers in the classroom missed students, then it is possible that large numbers of students go completely unidentified.
- Many symptoms of maths anxiety are also symptoms of poor behaviour. If the two issues are conflated, pupils who are suffering may receive punishment rather than the support they need.

Similarities between 'lazy' students and those with maths anxiety

Not starting work

Spending too much time on easy questions

Automatically responding "I don't know" to spoken questions

Claiming they don't know where to start

Saying the first number that comes to mind

Not showing working out

Not completing, or doing the bare minimum for homework

4. A whole-school approach to solutions is needed



- With many maths-anxious students potentially unidentified, it is important that interventions are delivered to whole cohorts or classes, allowing pupils more thinking time and appropriate scaffolding to questions.
- Over the next academic year, we'll be exploring more specific interventions, including encouraging students to write prose, introducing students to the exam hall in a less threatening way and keeping students with a consistent class teacher, in the bid to tackle this important issue and build confidence among all our maths learners at West Lakes Academy.



3 Tools to support maths-anxious pupils

Once those struggling with maths anxiety have been identified, what happens next? How can their symptoms be treated and what about those who are suffering under the radar?

Roundtable attendees shared and explored tools to support those experiencing maths anxiety.

Building mathematical resilience

Mathematical resilience focuses on encouraging mathematical engagement in a way that reduces the negative effects of maths anxiety. It can be defined as “maintaining self-efficacy in the face of personal or social threat to mathematical well-being”.¹²



“

Educational interventions emphasising control of negative emotional responses to math stimuli (rather than merely additional math training) will be most effective in revealing a population of mathematically competent individuals, who might otherwise go undiscovered.

Lyons and Beilock (2012)¹³

”

“

Treatment can restore the performance of formerly high-anxious students to the performance level associated with low mathematics anxiety.

Hembree (1990)¹⁴

”

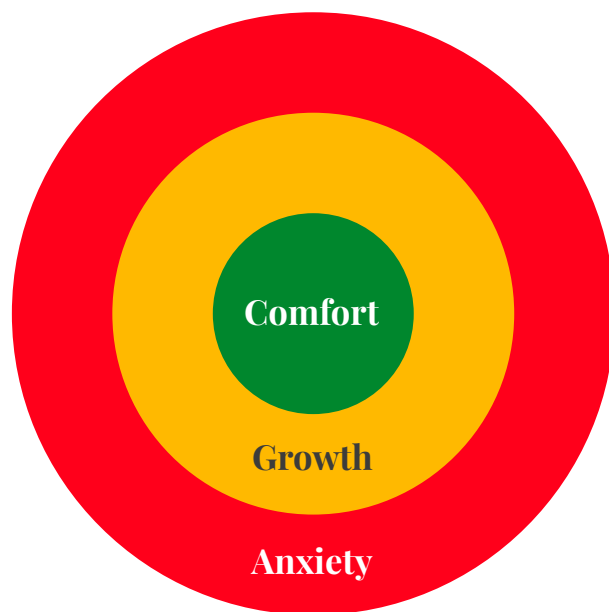


3 Tools to support maths-anxious pupils

The Growth Zone Model

Many researchers who have studied maths anxiety and worked with teachers and learners suggest the following tool to help reduce its impact and build greater resilience.

The Growth Zone Model gives a framework for learners to name and communicate their feelings.¹⁵



- **The comfort zone** is where a learner could be working on familiar tasks independently, building their self-confidence and providing opportunities for practice and automaticity
- **The growth zone** is where new learning happens – here, it should be safe to make mistakes, get stuck, require support, and find activities challenging and tiring
- **The anxiety zone** is where what is being asked is not within the learner's reach at that moment. The learner starts to experience threat rather than challenge, stress increases, cognition decreases, and little or no useful learning takes place.



Practical tip

How to use the model with learners

- **Introduce learners to the framework** in lessons and encourage them to use their own words to describe their feelings when faced with different situations such as feeling challenged or comfortable with activities.
- **Print copies of the growth zone model for your learners as a tool to use regularly.** Learners can place an object on the colours of the model to indicate their emotions. This will help them to be more aware of their emotional responses and allows teachers to better understand when to challenge learners in the comfort zone with a question or support learners in the red zone.



3 Tools to support maths-anxious pupils

Reducing anxiety and supporting maths-anxious learners

When pupils are in the anxiety zone, healthy learning cannot take place. The aim should instead turn to reducing the anxiety as quickly and supportively as possible.

“

If you try to teach a pupil in a maths anxious state, they will not hear you – they will certainly not be able to learn...

Janet Baker

Doctoral Researcher leading interventions into maths anxiety



”



Recommendation

Every learner and their experience of maths anxiety will differ but depending on the severity and frequency of the anxiety, they should:

- have one-to-one intervention sessions with targeted support
- be encouraged to take a break, listen to calming music or go for a walk.

Encouraging a relaxation response can also be a helpful tool for anxious learners to regulate their emotions. Developed by Dr Herbert Benson in 2000, it is seen as a quick, effective way to switch off the brain's 'fight or flight response' by engaging the parasympathetic nervous system and returning the learner to a calm state.



Practical tip

Using the relaxation response with learners

- Learners should focus on their breathing, surrounding sounds or the repetition of a well-chosen word, for instance 'calm' or 'joy'.
- As the learner repeats their chosen word, in time with their breathing (if possible), they'll be able to clear their mind, become calm and return to thinking effectively.
- Learners can do this consciously, as and when they are beginning to feel anxious.
- For a more detailed description of the relaxation response, watch '[Relaxation Response: Dr. Herbert Benson Teaches You The Basics](#)' on YouTube.



3 Rethinking teaching approaches

As well as exploring targeted initiatives around maths anxiety, the Roundtable discussion highlighted wider implications for how we teach maths to prevent maths anxiety. Recommendations included:

Easing time pressure

Many of the practitioners and academics at the Roundtable have witnessed how the effect of time pressure or feeling a rush has contributed to pupils' anxiety in maths lessons.

“

When we do maths tests in class I get really nervous when they are timed. When it can be done at my own pace I feel a lot better.

Heath, aged 9

”



Recommendation

Teachers should be encouraged to allow more thinking time before asking for responses to questions.

For instance, although there is a six-second time limit in times tables tests, it may sometimes be appropriate to allow more time in class for pupils to reach the correct answer.





3 Rethinking teaching approaches

Ensuring appropriate scaffolding and teaching for depth

“

In maths, we often ask children to climb a ladder where the rungs are missing...

Attendee at Pearson's Power of Maths Roundtable

”

Roundtable attendees reported how some teachers feel the Key Stage 2 maths curriculum is very broad and, as a result, they can find it challenging to teach for depth.

Some teachers also feel there is a great deal of content to cover. This can mean they feel pressure to race through content, increasing the chance of some pupils being left behind or exacerbating maths anxiety for those pupils who are already suffering.

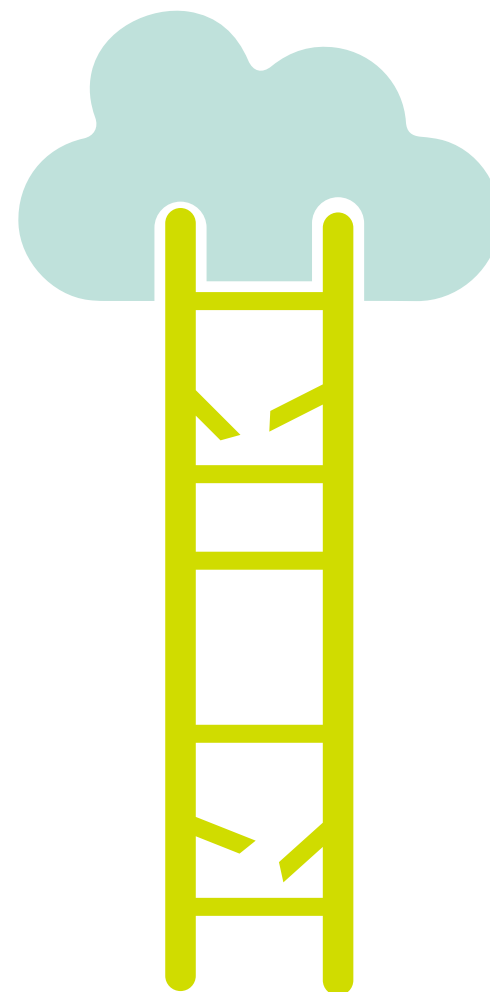


Recommendation

High-quality resources that support teachers with teaching a range of attainers for greater depth were considered to make a real difference.

Many of interventions for maths anxiety essentially equate to good teaching for all students:

- questions should be asked with low entry points so those who are maths-anxious can make a start on a problem
- work should be explained with context and examples appropriately scaffolded.





3 Rethinking teaching approaches

Reviewing repeated GCSE Maths resits

The UK pass rate for resits has been reported as low as 22.7%.¹⁶ Teachers of retake classes report feeling under pressure to re-cover the curriculum in a short time frame, and aren't able to address underlying barriers. This can contribute to learners experiencing maths anxiety and lead to them not progressing, or even regressing.¹⁷



Practical tip

The latest rules to the English and Maths Condition of Funding mean there are now alternative qualifications some students can take instead of retaking GCSE Maths repeatedly and before they are ready. As such, teachers and students can feel more empowered to explore additional pathways for their individual learning and support their journey accordingly. Many colleges are now considering two-year courses to support students and help them feel confident and ready before retaking GCSE Maths.





Making the creativity and relevance of maths more obvious

“

What I don't like about maths lessons, is that we have to sit in a chair and just write...

Millie, aged 6

”

“

I often feel anger and frustration in maths lessons, but I feel happy when our teacher makes the lesson fun!

Oliver, aged 10

”

“

Mathematics is for everyone... just like literacy isn't only about Shakespeare, maths isn't just about numbers.

Ems Lord, Director, NRICH



”



Recommendation

A key way to reduce the anxiety that surrounds maths is to bring the fun elements to life and to the fore. It should reflect real life and include real-world contexts. It should be tangible and creative, conjuring a sense of exploration and curiosity rather than just 'right' or 'wrong' answers.

Mathematicians regularly work in groups to explore concepts and challenges, so let's encourage more group working and teamwork in classrooms too. This can support creative thinking and engagement with the subject as it promotes collaborative problem solving and mathematical discussion.

Why not explore Archimedes' Principle by seeing how many ping pong balls, in theory, could raise the Titanic from the ocean floor?

Dr Tom Crawford

Maths Tutor at the University of Oxford and creator of tomrocksmaths.com.



4

Solutions beyond the school gates

“

One in four people would be deterred from applying for a job if it listed using numbers and data as a requirement.

National Numeracy (2019)¹⁸

”

Schools and colleges alone cannot be responsible for tackling maths anxiety. Businesses, parents, carers, government, the media and wider society all have their part to play in breaking down entrenched perceptions of maths and shaping a more number-confident and resilient nation. But, how?





We asked a selection of children and young people who they imagined when they thought of people who were good at maths. Here's what they had to say:

I think of a scientist who does weird things on a chalkboard. I also think of Archimedes!

Oliver, aged 10

When I think of mathematicians or people who are really good at maths, I imagine them wearing big glasses, a long woolly coat and carrying a book in their hand.

Izzy, aged 12

Einstein? Sennen, aged 11

Teachers in my school, teachers all over the world and some of my school friends.

Harrison, aged 7

In our society there are deeply rooted caricatures around what a 'mathematician' might commonly look like. Yet, one of the factors considered as contributing to maths anxiety is a feeling of exclusion, that you don't belong.

Maths anxiety that's fuelled by this feeling of exclusion can mean that many capable and talented young people are not choosing certain careers because they perceive that they're for stereotypical 'mathematicians' and not for them.

This may be one reason why, of those working in the engineering industry, only 12% are women¹⁹ and 7.8% are from black and minority ethnic (BAME) backgrounds.²⁰ In this context, challenging stereotypes is crucial to making maths inclusive and reducing maths anxiety.



Celebrating diversity and creativity

The best way to challenge stereotypes is to stop them from becoming prevalent.

It's time to celebrate and raise the profile of diverse individuals who are breaking ceilings and excelling in STEM. While celebrities speaking positively about maths in the media would go some way towards this, Roundtable attendees emphasised the importance of promoting amazing maths and science teachers, alongside the likes of astronauts, mathematicians and STEM experts.

Organisations like WISE and the Association for Black and Minority Ethnic Engineers (AFBE-UK) are leading the way in promoting diversity within STEM, with engaging initiatives to encourage everyone to better understand the hands-on applications of the subjects.





Spotlight on campaigns and movements

AFBE-UK's 'Making Engineering Hot' campaign



Our mission is to support young people to explore a career in engineering and increase the number of black and minority ethnic engineers who succeed professionally.

The 'Making Engineering Hot' (MEH) campaign uses STEM role models and partnerships with leading employers to bring engineering careers to life for school and college-age young people, teachers and parents.

MEH's success relies on building close working relationships with teaching staff to understand the needs of their students and project focused activities and mentoring sessions with leading STEM role models.

A continued and sustained approach towards inspiring young people makes a big impact: 91% of over 4,000+ young people engaged through the programme would consider engineering careers.

Find out more about the '[Making Engineering Hot](#)' campaign.

Dr Nike Folayan, founder and chairperson, AFBE-UK

The STEAM Movement



The growing 'STEAM' movement, which includes the arts alongside science, technology, engineering and maths, is helping challenge preconceived ideas that maths lacks creativity.²¹

As part of the [#HipHopEd initiative in America](#), urban youth communities are engaged with STEM subjects through Hip-Hop music.

How can we further celebrate the vibrancy and creativity of these subjects in the UK? Is there value in an applied qualification, for example a STEAM GCSE or a Duke of Edinburgh for STEAM with topics covered that are similar to the resources in the [STEM Archives](#)?



Ensuring greater access to industry

We need to showcase the opportunities and careers that maths can unlock, and this means more businesses opening their doors.

Whether businesses go into schools, or vice versa, the chance to see the real-life and practical application of maths can help demystify the subject and break down barriers.



Recommendation

Roundtable attendees discussed whether the Apprenticeship Levy could be used more effectively to make this possible and the need for clearer and more diverse career information especially from primary school age.

And it's not just about pupils. Placements in industry for parents, carers and teachers can help to educate and enthuse adults about STEM, impacting how they discuss the subject with their children and learners.





4

Engaging adults and boosting maths confidence

“

Maths is very important because it will just make your whole life easier!

Dexter, aged 7

”

Focusing on numeracy skills and maths confidence for adults

Adults' maths skills and attitudes towards the subject have a huge part to play in maths anxiety among children and young people.

Research has found that when parents and carers in particular are more mathematically anxious, their children learn significantly less maths and develop greater maths anxiety.²²

So how can this be addressed?



Inspiring life-long learning

Research carried out by National Numeracy, a charity established to help raise low levels of numeracy among both adults and children and to promote the importance of everyday maths skills, found that 43% of adults did not want to improve their maths and numeracy skills.²³ Building a numerate and number-confident nation is essential if we want to tackle maths anxiety more widely.



Practical tips

UK-wide initiatives are striving to boost adults' maths confidence:

- **National Numeracy Challenge** – an online assessment and learning tool that facilitates accessible and unintimidating learning for maths-anxious adults.
www.nnchallenge.org.uk
- **National Numeracy Day** – an annual event run by National Numeracy and founding supporter KPMG that empowers everyone in the UK to build the confidence and skills to use numbers in everyday life. So far it has helped over 48,000 people take the first step to improving their numeracy skills.
www.numeracyday.com.



Engaging parents and carers effectively

For parents/carers who lack confidence or suffer from maths anxiety themselves, maths homework can cause stress and exacerbate a negative reaction, with long-lasting consequences for both parent/carer and child.

Roundtable attendees discussed the value of maths homework and whether it should be scrapped altogether. However, it was agreed that maths activities carried out at home can have a positive impact on children's learning and perceptions of maths.

“

Parents and carers can have a massive impact just by playing simple games at home with their children, linking their learning to fun and the real world.

Tom Harbour, Founder, Maths with Parents



”

“

The impact caused by different levels of parental involvement is much bigger than differences associated with the quality of schools.

Desforges, 2003²⁴

”

“

One in five parents with children aged 6–16 completely avoid their children's maths homework as they're scared of numeracy.

Open University, 2018²⁵

”



Practical tips

Activities for parents/carers and children could include:

- Play 'rock, paper, scissors' but instead hold up a number of fingers. First person to shout out the total number wins.
- Making a 'shop' with toys, each with a price on. Use real coins to pay the correct prices.
- Hunt for shapes around your home and take pictures on your phone to check you've found them all.
- Practise number bonds with 10 grapes. Hide some of the grapes under a bowl. Your child can use their number bonds to 10 to say how many grapes are hiding.



“

We really want to build a number-confident, resilient nation.

Sharon Hague, Senior Vice President, UK Schools, Pearson



”

Maths anxiety is a complex and far-reaching issue, but it can be overcome. The Guide has highlighted starting points for doing so. In order for maths anxiety to be tackled, it needs to be widely understood so we can better support those experiencing it. At the chalkface, reviewing the way maths is taught, presented and assessed in schools and colleges can help to prevent maths anxiety from forming.

Relaxation techniques may feel more appropriate in a yoga studio, but the strategies to keep calm under pressure and better understand our emotions will have benefits that extend far beyond reducing maths anxiety. Rather than intimidation and fear, maths classrooms can become a place of enjoyment, self-growth and achievement for all learners.

Of course, addressing this issue cannot fall to the responsibility of schools alone. While the voices, backgrounds and experiences of attendees at the Power of Maths Roundtable were diverse and wide-ranging, here the group was unequivocally unified.

Maths anxiety is a societal issue. Educators, parents, carers, policy-makers, businesses, charities and the media all have important roles to play if we are to build maths-confident communities. From the way we present mathematicians in popular culture, to opening the doors to industry and inspiring a culture of continued learning and enthusiasm for STEM, there are both practical and aspirational steps that we can all take to ensure every learner, at whatever age, enjoys the life-changing power of maths. This is not the end of the conversation, but one that we can all continue.

6 Further reading



Reports of interest

- Education Endowment Foundation. (2017). [Improving Mathematics in Key Stages Two and Three.](#)
- Goodall, J., Johnston-Wilder, S., (2015). [Overcoming Mathematical Helplessness and Developing Mathematical Resilience in Parents: An Illustrative Case Study.](#)
- Hunt, T. E., Bhardwa, J., & Sheffield, D. (2017). [Mental arithmetic performance, physiological reactivity and mathematics anxiety amongst U.K primary school children.](#)
- Hunt, T. E., Clark-Carter, D., Sheffield, D., (2011). [The Development and Part Validation of a U.K. Scale for Mathematics Anxiety.](#)
- Johnston-Wilder, S., et al. (2018). [Overcoming Statistical Helplessness and Developing Statistical Resilience in Learners: An Illustrative, Collaborative, Phenomenological Study.](#)
- Johnston-Wilder, S., et al. (2014). [A survey of mathematics anxiety and mathematical resilience among existing apprentices.](#)
- Johnston-Wilder, S., et al. (2013). [Measuring mathematical resilience: an application of the construct of resilience to the study of mathematics.](#)
- Lee, C. (2016). [Developing Mathematical Resilience: Teachers' reflections on working to develop mathematical resilience in learners.](#)
- Lee, C., Johnston-Wilder, S. (2019). [How can we address mathematics anxiety more effectively as a community?](#)
- Marshall, E., Johnston-Wilder, S., (2017). [Overcoming affective barriers to mathematical practice.](#)
- Maths Anxiety Trust and Learnus. (2018). [Maths Anxiety Summit Report.](#)
- Pearson and Riley, A. (2019). [The Power of Maths Roundtable: Changing Britain's Perceptions of Maths report.](#)
- Petronzi, D., Staples, P., Sheffield, D., Hunt, T.E., & Fitton-Wilde, S. (2018). [Further development of the children's mathematics anxiety scale UK \(CMAS-UK\) for ages 4-7 years.](#)
- Szucs, D., et al. (2019). [Understanding Mathematics Anxiety: Investigating the experiences of UK primary and secondary school students.](#)

Resources and initiatives

- [AFBE-UK's Making Engineering Hot](#)
- [Cambridge Mathematics Espresso Digest on mathematics anxiety](#)
- [Dan Siegel's Hand Model of the Brain](#)
- [Dr Benson's Relaxation Response](#)
- [HipHopEd STEM](#)
- [Maths Calculation Anxiety Scale](#)
- [Maths Teaching Anxiety Scale](#)
- [National Numeracy Challenge](#)
- [National Numeracy Day](#)
- [National Numeracy Star Dash Studios smartphone game](#)
- [National Numeracy The Family Maths Toolkit](#)
- [Shirley Conran's Money Stuff – Maths course](#)
- [The Growth Zone Model](#)
- [The Maths Anxiety Trust](#)
- [The Mathematical Resilience Website](#)

6 Further reading



References

1. Napier, J. (c. 1570). *A description of the Admirable Table of Logarithmes*.
2. Richardson F. C., Suinn R. M. (1972). 'The Mathematics Anxiety Rating Scale: Psychometric data.' *Journal of Counseling Psychology*, 19 (6), 551–554.
3. Escovar, E., Rosenberg-Lee, M., Uddin. L. Q. & Menon, V. (2016). 'The Empathizing-Systemizing Theory, Social Abilities, and Mathematical Achievement in Children.' *Scientific Reports*, 6, [23011]. Retrieved from <https://doi.org/10.1038/srep23011>
4. Carey, E., Devine, A., Hill, F., Dowker, A., McLellan, R., & Szucs, D. (2019). 'Understanding Mathematics Anxiety: Investigating the experiences of UK primary and secondary school students.' Retrieved from: <https://www.repository.cam.ac.uk/bitstream/handle/1810/290514/Szucs%2041179%20-%20Main%20Public%20Output%208%20March%202019.pdf>
5. Maths Anxiety Trust and Learnus. (2018). *Maths Anxiety Trust Summit Report*. Retrieved from <https://www.learnus.co.uk/Maths%20Anxiety%20Summit%202018%20Report%20Final%202018-08-29.pdf>
6. National Numeracy and Nuffield Foundation. (2019). *Numeracy for Q-Step: Assessing the numerical ability of undergraduate students in order to better support them*. Retrieved from https://www.nuffieldfoundation.org/sites/default/files/files/Numeracy%20for%20Q-Step%20Report_February%202019.pdf
7. Ipsos Mori and National Numeracy. (2019). *Numerate nation? What the UK thinks about numbers*. Retrieved from https://www.nationalnumeracy.org.uk/sites/default/files/national_numeracy_day_2019.pdf
- 8–10. The Open University Business School (OUBS). (2018). 'The True Potential Centre for the Public Understanding of Finance'. Retrieved from <http://business-school.open.ac.uk/news/true-potential-centre-public-understanding-finance>.
11. Nardi E. and Steward, S. (2003). 'Is Mathematics T.I.R.E.D? A Profile of Quiet Disaffection in the Secondary Mathematics Classroom.' *British Educational Research Journal*, Vol. 29, No. 3, 2003, 346–367. Retrieved from: <https://eclass.uoa.gr/modules/document/file.php/MATH103/ELENA%20NARDI/NARDI3.pdf>
Cousins, S. B., Brindley, J., Baker, J., and Johnston-Wilder, S. (2019) 'Stories of mathematical resilience : how some adult learners overcame affective barriers.' *Widening Participation and Lifelong Learning*, 21 (1), 46–70. doi:10.5456/WPLL.21.1.46
12. Clarkson, P., Bishop, A. J., & Seah, W. T. (2010). Mathematics education and student values: The cultivation of mathematical wellbeing. In T. Lovat, R. Toomey, & N. Clement (Eds.), *International Research Handbook on Values Education and Student Wellbeing*, 111–135.
13. Lyons, I. M., Beilock S. L. (2012.) 'Mathematics Anxiety: Separating the Math from the Anxiety'. *Cerebral Cortex*, Volume 22, Issue 9, September 2012, 2102–2110. Retrieved from <https://doi.org/10.1093/cercor/bhr289>
14. Hembree, R. (1990). 'The nature, effects, and relief of mathematics anxiety.' *Journal for Research in Mathematics Education*. Vol. 21, No. 1 (Jan., 1990), 33–46.
15. Lugalía et al. (2013). 'The Role of ICT in developing mathematical resilience in learners.' Retrieved from: https://www.researchgate.net/publication/262950745_Lugalía_M_Johnston-Wilder_S_and_Goodall_J_2013_The_Role_of_ICT_in_developing_mathematical_resilience_in_learners_INTED_2013
Lee, C. and Johnston-Wilder, S. (2018). 'Getting into and staying in the Growth Zone.' Retrieved from: <https://nrich.maths.org/13491>
16. Poismans, N. and bksb. (2019). 'English and maths pass rate drops for GCSE resits.' Retrieved from: <https://www.bksb.co.uk/blog/2019/02/06/pass-rate-drops-gcse-resits/>
17. Johnston-Wilder, S., Lee, C., Brindley, J., and E. Garton. (2015.) 'Developing Mathematical Resilience in School-students who have Experienced Repeated Failure.' Retrieved from <http://wrap.warwick.ac.uk/73734/>
18. Ipsos Mori and National Numeracy. (2019). *Numerate nation? What the UK thinks about numbers*. Retrieved from https://www.nationalnumeracy.org.uk/sites/default/files/national_numeracy_day_2019.pdf
19. Engineering UK. (2018). *Engineering UK: The state of engineering*. Retrieved from <https://www.engineeringuk.com/research/engineering-uk-report/>.
20. Royal Academy of Engineering. (2019). 'Celebrating leading minority ethnic engineers'. Retrieved from <https://www.raeng.org.uk/policy/diversity-in-engineering/diversity-and-inclusion-at-the-academy/celebrating-leading-ethnic-minorities-in-engineer>
21. EducationCloset. (2014-2016). 'What is STEAM?'. Retrieved from: <https://educationcloset.com/steam/what-is-steam/>
22. Maloney et al. (2015). 'Intergenerational Effects of Parents' Math Anxiety on Children's Math Achievement and Anxiety'. *Psychological Science*. Volume: 26 issue: 9, 1480–1488.
23. Ipsos Mori and National Numeracy. (2019). *Numerate nation? What the UK thinks about numbers*. Retrieved from https://www.nationalnumeracy.org.uk/sites/default/files/national_numeracy_day_2019.pdf
24. Desforges, C. & Abouchaar, A. (2003). 'The Impact of Parental Involvement, Parental Support and Family Education on Pupil Achievements and Adjustment: A Literature Review'. Retrieved from https://www.nationalnumeracy.org.uk/sites/default/files/the_impact_of_parental_involvement.pdf
25. The Open University Business School (OUBS). (2018). 'The True Potential Centre for the Public Understanding of Finance'. Retrieved from <http://business-school.open.ac.uk/news/true-potential-centre-public-understanding-finance>



Thank you to all those who helped shaped this report, including the Power of Maths Roundtable attendees and learners who shared their experiences with us

Kate Aspin	University of Huddersfield
Janet Kilpatrick Baker	University of Warwick
Dr Adam Boddison	NASEN
Professor Margaret Brown OBE	King's College London
Rob Brown	West Lakes Multi-Academy Trust
Sam Butters	Fair Education Alliance
Lucy Chown	Pearson
Amy Clark	Education Endowment Foundation
Shirley Conran OBE	Maths Anxiety Trust
Mark Dawes	Cambridge Maths Hub
Mike Ellicock	National Numeracy
Dr Nike Folayan	Association for Black and Minority Ethnic Engineers (AFBE-UK)
Charlie Gilderdale	University of Cambridge
Trevor Goddard	City Learning Trust and Stoke MEP
Jane Griffiths	Eastern High School
Tom Harbour	Maths with Parents
Corrine Harms	KPMG
Sharon Hague	Pearson
Lucy Hoyes	University of Southampton
Professor Dame Celia Hoyles OBE	UCL IoE
Dr Thomas Hunt	University of Derby
Andrew Jeffrey	Magic Message Ltd
Berwyn Jones	Pearson
Kate Kibler	Pearson
Dr Clare Lee	Open University
Matt Lewis	NCETM

Ems Lord	NRICH
Ruth Lowe	Parentkind
Christine Morse	Senior Marker / Coder
Cherri Moseley	Mathematical Association
Dr Naomi Norman	Techademic
Dominic Oakes	FMSP Wales
Susan Okereke	Maths Hubs & NCETM
Ndidi Okezie	Pearson
Farhana Patel	Northern Education Trust, The Ferns Primary Academy
Catherine Ream	SASCAL, Sixth-Form College
Bruno Reddy	Maths Circle
Louise Reilly	Department for Education
Alexandra Riley	Pearson
Rebecca Rosenberg	Pearson
Lucy Rycroft-Smith	Cambridge Mathematics
Tony Staneff	White Rose Maths
Bobby Seagull	Maths teacher, author, TV presenter and Power of Maths Roundtable Chair
Caroline Shott	Learning Skills Foundation and Learning Skills Research
John Thomas	Dartford Grammar School
Professor Geoffrey Wake	University of Nottingham
Professor Anne Watson	University of Oxford
Julie Wheel	Painsley Catholic College/North Mids & Peaks Maths Hub
Associate Professor Sue Johnston-Wilder	University of Warwick
Vanessa Wright	Pearson
Suha Yassin	Pearson

Join the #PowerofMaths conversation

