



Maths Anxiety Summit 2018

Wednesday 13 June 2018
Senate House, UCL, University of London, UK

Summit report and key messages

Learnus[®]

About ...

The Maths Anxiety Trust

The Maths Anxiety Trust, which is a sister organisation to Learning Skills Foundation, consists of Mathematics educators and other influential voices who explore ways to improve the teaching of maths and eliminate Maths Anxiety in children, teachers and other adults in the UK. Working together with others, the Trust aims to enable people to achieve their potential in education and the workplace, helping to prevent poverty and increasing social mobility through the confidence that comes from knowledge of and ease with everyday maths. The Trust is an independent, not-for-profit organisation with no political affiliations.

Further details of the work of The Maths Anxiety Trust can be found at:

www.mathsanxietytrust.com

Learnus

Learnus is an educational think-tank at the centre of a community dedicated to bringing educators and those who specialize in the study of the brain, the mind and behaviour together in order to use the insights gained from high quality research to improve and enrich learning for all. It is our belief that learning and, by extension, teaching are at the centre of high quality education; understanding how we learn is at least as important as defining what we should learn.

Further details of the work of Learnus can be found at: www.learnus.co.uk

The Author of this report

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The full report along with speaker presentations and video material of the Maths Anxiety Summit 2018 is available on the Maths Anxiety Trust website, www.mathsanxietytrust.com, and the Learnus website: www.learnus.co.uk

Maths Anxiety Summit 2018: Executive summary

Introduction

More than 20 per cent of the population admit to experiencing Maths Anxiety; this rises to 35 per cent among young people. The resulting stress impacts on the confidence and ability of individuals to tackle everyday mathematical problems both at home and in the workplace. More widely it affects the levels of numeracy in the population of the UK which in turn ripples through into the economic performance of the UK.

The Maths Anxiety Summit, held on 13th June 2018, was an opening salvo in tackling the problem of Maths Anxiety. It was also the official launch of the Maths Anxiety Trust, established by Shirley Conran OBE, which aims to explore ways of improving maths education and finding ways to overcome the effects of anxiety and stress caused by Maths Anxiety.

Summit themes

1. *Maths Anxiety: scoping the problem.*

Maths Anxiety has been known for over fifty years and is defined as “a negative emotional reaction to mathematics, leading to varying degrees of helplessness, panic and mental disorganisation that arise among some people when faced with a mathematical problem, either in ordinary life or in an academic situation.”¹

Based on recent surveys commissioned by the Maths Anxiety Trust, 1 in 4 people have an anxiety associated with maths with the highest rates being noted among 16/17 year old students. The strength of the anxiety varies but approximately 10% of people have a strong ‘fear’ or ‘hate’ of maths. One of surveys indicates that 80% of adults questioned had not heard of the term ‘Maths Anxiety’ emphasising that general awareness of the issue is low.

2. *Maths Anxiety: signs, symptoms and influences*

The condition is not well understood and evidence suggests that in part it is related to general stress associated with pressures such as examinations but there is also an important element which relates specifically to maths. Maths Anxiety is multi-faceted and it is not restricted to particular groups or types of individuals. Thus there is a need to be on the alert for signs, sometimes very subtle, that indicate someone might be inclined towards an anxiety of doing maths. It isn’t simply that they can’t do maths, nor that it comes to the surface in every situation.

3. *Maths Anxiety: the image of mathematics*

The widespread perception of maths is that it is ‘hard’, ‘only for clever people’ and ‘not for me’. Perhaps even more worrying is the culture in the UK that not being able to do maths is something to be ‘proud’ of. No one would argue that everyone should be able to derive complex mathematical theorems but there is a very strong argument that everyone should be comfortable with numbers. They should be able to recognise where maths is relevant to

¹ Definition adopted by The Maths Anxiety Trust available at www.mathsanxietytrust.com (accessed 29/08/2018)

their everyday life and adult work and to be able to use these aspects of maths confidently and effectively.

4. Maths Anxiety: understanding the pupils' perspective

The way in which children and young people perceive maths is critical in terms of the levels of anxiety they experience. Their views of, and attitudes towards, maths are strongly influenced by the adults around them and their peers. Thus they 'absorb' much of the cultural 'baggage' around maths and, unless steps are taken to counteract this, the cycle continues. Building children's confidence with maths, recognising that other pupils find it hard as well, is essential to helping them develop positive attitudes towards the subject. All pupils need to feel they can go on to learn maths.

5. Maths Anxiety: the maths curriculum in compulsory education

No curriculum is perfect and, given the long debates over many years, the National Curriculum in England is certainly no exception. Whilst there are arguments which suggest the need for another review of the National Curriculum, there is a strong argument that the upheaval it would cause at the present time would be counter-productive. In the longer term, planning for a revision of the National Curriculum should start with a view to managing the revision and implementation over a period of 5 to 10 years.

6. Maths Anxiety: the pedagogy of maths education

Effective pedagogy engages learners, builds their knowledge and consolidates their understanding of the subject matter. It also goes beyond the mathematical content and enables learners to develop qualities of creativity, curiosity, resilience and determination alongside expertise in solving problems, communicating ideas and working co-operatively as well as individually. Developing and implementing effective pedagogical approaches to maths depends on the expertise and confidence of teachers.

Key messages and actions

Maths Anxiety is a genuine problem, which is complex and resistant to change. Addressing the problem is the responsibility of a range of groups, including teachers and parents, working together with government. There is a need for actions that should be taken at different levels, in different contexts and sustained over a period of time because there is no 'quick fix'. As a starting point for consideration of further action there is a need for:

- i. a national publicity campaign to raise public awareness of Maths Anxiety and influence policy;
- ii. improving the public image of maths;
- iii. more research into the environmental and emotional factors influencing Maths Anxiety;
- iv. a better understanding of, and a greater sensitivity towards children's emotional responses to maths;
- v. building up a suite of activities and resources that can be used by teachers and parents to place maths in relevant 'everyday' contexts in a non-threatening manner;
- vi. in the longer term, a review of the National Curriculum provision needs to be planned over a 5 -10 year period, ensuring it meets the needs of ALL pupils;
- vii. exploring and developing, pedagogical approaches that take account of Maths Anxiety more explicitly than currently;

- viii. initial teacher training and CPD programmes for teachers to embed approaches and activities that acknowledge the existence of Maths Anxiety in both teachers and pupils.

Summary

This very successful and lively summit reflected a clear recognition that Maths Anxiety is an issue that needs to be tackled with some urgency. The arguments presented strongly favour the need to initiate a nationwide publicity campaign to raise awareness of Maths Anxiety and the need to address it more widely so that more people can say, about maths, that "I can do it!"

Maths Anxiety Summit 2018

Introduction: the challenge

This Maths Anxiety Summit, held on 13th June 2018, was the official launch of the Maths Anxiety Trust, established by Shirley Conran OBE. The trust has set itself four ambitious aims:

- to define and explain Maths Anxiety and alert people to its existence;
- to enable pupils with Maths Anxiety to achieve their potential in education, working with parents and teachers;
- to enable people with Maths Anxiety to achieve their potential in the workplace;
- to help prevent poverty and debt and increase social mobility with the confidence that comes from knowledge of and ease with everyday maths.

The successful event reported here provided an excellent early step towards these goals. The programme (see Appendix 1) for the Summit was structured in order to provide a range of perspectives on the phenomena referred to as Maths Anxiety. The multi-faceted nature of Maths Anxiety was vividly highlighted by the speaker contributions (see Appendix 2 for presentation abstracts and Appendix 3 for speaker biographies):

- Who's afraid of mathematics? Some glimpses of Maths Anxiety.
- Discovering Learning without Limits.
- Strategies to reduce Maths Anxiety.
- Holding out for a maths superhero (or heroine).
- "I hate maths": tackling Maths Anxiety head on.

Individually and collectively these contributions demonstrated the complexity and scale of the challenge to be addressed in order to improve the situation specifically with regard to Maths Anxiety and, more generally, the important place of maths in UK society. The summit was an opening salvo in exploring, once again, ways of improving maths education and, in particular, finding ways to overcome the anxiety and stress which impedes the mathematical understanding of a significant proportion of the population. The impact of Maths Anxiety is evident not only for individuals but also ripples through into the economic performance of the UK. As the contributions to the summit demonstrated, Maths Anxiety exists and has significant impact on the lives of individuals and society. The big challenge is the need to take action to address the situation and minimise the effects of Maths Anxiety; the underpinning goal of the Maths Anxiety Trust.

Themes of the summit

The report which follows draws out the main themes of the event and is supported by slides from the presentations and video material of the whole event, which are available on the Maths Anxiety Trust website (www.mathsanxietytrust.com). Six cross-cutting themes developed:

1. Maths Anxiety: scoping the problem.

The phenomena referred to as Maths Anxiety has been known for over fifty years and is defined as “a negative emotional reaction to mathematics, leading to varying degrees of helplessness, panic and mental disorganisation that arise among some people when faced with a mathematical problem, either in ordinary life or in an academic situation.”² In their important review of 60 years of research Dowker *et. al.* (2016³) concluded that to date we have learned something about Maths Anxiety and its relationship with maths performance, its variation with age and social stereotypes, and something about how Maths Anxiety might be overcome. Significantly they argued that, going forward, it is important to understand the interplay between the individual factors influencing Maths Anxiety. The contributions to the summit very much reflected these findings but extended the thinking to emphasise the importance of the context of learning and the urgency of the need for practical action to be taken, individually and collectively.

The fact that Maths Anxiety is genuine and affects a significant proportion of the population was once again strongly supported by the results of two surveys, specially commissioned by the Maths Anxiety Trust. In her presentation Professor Margaret Brown, announced the findings. The first survey was a specially commissioned Ipsos-Mori Poll of the general public undertaken in April-May 2018 with a balanced sample of 2019 individuals over the age of 15 years. The main findings indicated that:

- 20% of adults in Great Britain have felt anxious when confronted with a mathematical problem (e.g. using mental arithmetic to split a restaurant bill) of which 8% reported feeling anxious within the last month;
- 36% of younger(15-24 year-old) people have felt anxious about maths, decreasing gradually to 10% of older (65+) people;
- 23% of parents of children aged 5-15 report that their eldest child often feels anxious when attempting to solve maths problems;
- 80% of adults have never heard of the term Maths Anxiety.

The second survey involved over 2000 students between ages of 11 and 18 years with approximately equal numbers of male and female. The students came from two highly performing schools, one for boys and one for girls. The main findings of this survey indicated:

- little difference between responses from boys and girls;
- 40% of students are anxious about maths at least ‘sometimes’ (cf. 36% of 15-24 year olds on Ipsos MORI);
- about 25% are anxious most of the time (cf. 23% of parents say their child is often anxious on Ipsos MORI);
- about 10% say they hate maths;
- anxiety is highest at age 16/17.

² Definition adopted by The Maths Anxiety Trust available at www.mathsanxietytrust.com (accessed 29/08/2018)

³ Dowker, A., Sarkar, A., and Yen Loo, C. (2016) Mathematics Anxiety: What have we learned in 60 years? *Frontiers in Psychology* April 2016, Volume 7 Article 508

In her presentation Michelle Doyle Wildman presented the results of a further survey conducted by her organisation, Parentkind, and reflected the views of parents as follows:

- over 30% had a negative experience of maths at school, but nearly 70% said they had a positive experience;
- 25% said their children did not enjoy maths but 75% said they do;
- 45% believe their children share their view of maths (whether positive or negative).
- 70% said they feel confident with everyday maths;
- 66% feel confident helping their children with school maths, over 15% do not feel confident, over 17% feel about average;
- looking back, over 50% said their teachers had a positive impact on them enjoying maths;
- 40% said their own parents had a positive impact.

Of particular note is the fact that the findings of the surveys were consistent and in line with previous studies indicating that 1 in 4 people have an anxiety associated with maths with the highest rates being noted among 16 to 17 year old students. The strength of the anxiety also varies with approximately 10% having a strong reaction they would describe as 'fear' or 'hate' of maths.

It is clear that a significant proportion of people have a negative response to maths and lack confidence in their ability to carry out what might be regarded as straight forward calculations. Yet, the finding in the Ipsos-Mori survey indicate that 80% of adults questioned had not heard of the term 'Maths Anxiety' which suggests that general awareness of the issue is low and needs to be addressed. As Professor Dame Alison Peacock said in her presentation, "Exposing the problem allows us the opportunity to make things better."

2. Maths Anxiety: signs, symptoms and influences

The condition is not well understood. Evidence suggests that in part it is related to general stress associated with pressures such as examinations but there is also an important element which relates specifically to maths. This is clear from the responses given by the students in completing the second survey referred to above, for example:

I only feel anxious if I come across difficult Maths questions especially fractions.

I feel alright about just writing down maths but when asked to do a question out loud I panic.

Tests make me anxious.

I love Maths it is my favourite subject but I have a crippling fear of failing my exam and being unable to fulfil my life dreams so it is incredibly stressful.

Similarly, the same survey indicates that adults, such as teachers, can have both negative and positive impact on students, for example:

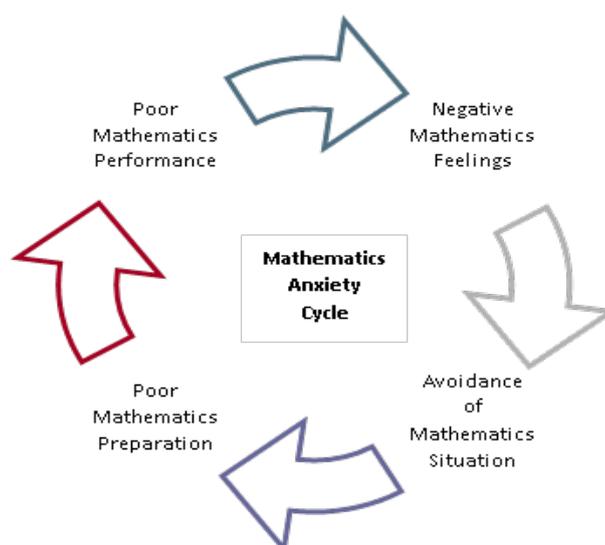
Some teachers put too much pressure on us to do well which makes us do worse.

Teachers go way too fast and don't actually understand that it is really hard and confusing.

I had a bad Primary education developing a mental block in maths...I have a great teacher currently and now feel a lot more confident about maths.

Although anxiety relating to other subjects is not unheard of, the evidence suggests that there is something about maths and the way in which it is perceived in the UK that leads to higher levels and intensity of anxiety being experienced by more individuals when faced with mathematical problems. As already suggested above there is no single factor that causes Maths Anxiety; rather it appears to be a combination of several factors which include, but are not limited to: public image of the subject, attitudes towards maths, visual presentation of the subject, approaches to teaching, and the abstract nature of much of the subject matter. This theme was picked up by all the speakers and in the question and answer session.

Professor David Sheffield and Dr Tom Hunt presented what might be referred to as a formal model, depicting the potential vicious cycle of Maths Anxiety (after Preis and Biggs, 2001⁴)



While such a model has value, it is clearly not the only way to view the problem. Professor Dame Celia Hoyles painted a much more intricate picture of the underlying issues around Maths Anxiety. In particular she highlighted the counter-intuitive idea that people who are good at maths can also suffer from Maths Anxiety. Referring to Maryam Mirzakhani as an example of a highly talented mathematician, Professor Hoyles demonstrated the strong emotional feelings that are engaged in working on maths problems and the 'deep-seated sense of being useless' in failing to find a solution immediately. Appearing to be 'good' at maths to a high level can often lead to a feeling of the 'imposter syndrome' and fear that one is not good enough or that one will be caught out because of a failure to solve a problem, especially as they get more difficult.

⁴ Preis, C., and Biggs, B. T., (2001) Can Instructors Help Learners Overcome Math Anxiety? *Australian Teacher Education Association Journal*, 28 (4), p6-10. Apr-May 2001.

The important thing to note is the multi-faceted nature of Maths Anxiety and that it is not restricted to particular groups or types of individuals. Thus there is a need to be on the alert for signs, sometimes very subtle, that indicate someone might be inclined towards anxiety when doing maths. It isn't simply that they can't do maths, nor that it comes to the surface in every situation. What is essential is that, as explored under heading 4 below, close attention must be given to understanding the student's perspective.

3. Maths Anxiety: the image of mathematics

The widespread perception of maths is that it is 'hard', 'only for clever people' and 'not for me'. Perhaps even more worrying is the culture in the UK that not being able to do maths is something to be 'proud' of. To some extent this makes the issue of Maths Anxiety a particular problem in the UK because of the way in which people, some high profile, from all walks of life play down, in public and in private, the need to have competence in maths. No one is arguing that everyone should be able to derive complex mathematical theorems but there is a very strong argument that everyone should be comfortable with numbers. They should be able to recognise where maths is relevant to their everyday life and be able to use these aspects of maths effectively. Being able to use fundamental mathematical functions to address problems such as calculating the interest being charged on a loan, should be a life skill for nearly all the population.

Professor Mike Askew in his presentation explicitly raised the question as to whether it was 'maths' as a discipline that was the problem or whether it was 'school maths' which creates the problem. In particular he argued that Maths Anxiety was a 'learned response' which arose from the experiences children and young people had when studying maths. They feel pressure when asked to provide answers rapidly and feel that being good at maths depends on being able to give answers immediately; 'without having to think about it'. Failure to give quick answers is seen, wrongly, as an inability to do maths. While being able to come up with the correct answer quickly has some advantages, perhaps more important is the ability to work at a problem in order to solve it over a period of time. Addressing some of the issues of how maths is tackled in school is addressed in more detail on the remaining themes (4 to 6) below.

Michelle Doyle Wildman drew attention to the fact that the focus on addressing some of the issues relating to maths is a relatively recent phenomena compared with steps to address underperformance and anxiety around literacy, including the ability to read and write. Mounting high profile campaigns to tackle low literacy levels can be traced back at least to 1966 with the introduction of International Literacy Day, followed by World Book Day in 1995. In 1993 the National Literacy Trust was established to work to promote improvements in reading and writing. In contrast Maths Action was set up in 2004, the first World Maths Day wasn't until 2007, National Numeracy Organisation was established in 2012 and the first National Numeracy Day only took place in 2018! In short, well-funded, high profile efforts to improve literacy began 40 years before those for maths, which suggests that there is much to do in order to catch up and ensure improvements for all.

4. Maths Anxiety: understanding the pupils' perspective

Without doubt the way in which young children and older children perceive maths is critical in terms of the levels of anxiety they experience. Their views of, and attitudes towards, maths are strongly influenced by the adults around them and their peers. Thus

they 'absorb' much of the cultural 'baggage' around maths and, unless steps are taken to counteract this, the cycle will continue.

Breaking into the cycle is not easy but an obvious way is to explicitly explore with children not only what they find difficult with the maths itself but also what it is that is making them anxious. What might be referred to as 'emotional intelligence of learning' is an important concept here. Better understanding how children and young people feel at different stages in the learning process and offering ways to overcome the negative responses are important areas to be addressed. Somewhat counter-intuitively, constantly giving general praise and reassurance doesn't necessarily result in progress; rather it can produce an acceptance of 'failure'. A more positive approach requires the acknowledgement of the 'failure', accepting it as part of the learning process and directly addressing the emotional and academic issues that are being exhibited.

Adults, whether in the role of teacher, parent or more senior person, also need to consciously work to avoid passing their worries about maths on to children. Getting the correct answer is important but it is also, possibly more, important to recognise that there may be different ways of getting to the answer. Some children are more comfortable with an alternative approach rather than the 'traditional' methods.

Building children's confidence with maths, recognising that others find it hard, is essential to helping them develop positive attitudes towards the subject. Pupils need to feel they can learn maths. Just because someone is 'better' than you at maths doesn't mean you can't do maths. Children recognise this in some areas such as sport or music so why not in maths and other academic subjects? Helping children build their resilience towards maths as a subject is essential, as is being comfortable with the processes such as problem solving. As was pointed out, some children move from feeling 'comfortable' with a problem to 'panic' when a solution is not immediately obvious. There seems to be no middle ground in which alternative approaches to the problem might be explored. In this context the work of Associate Professor Sue Johnson Wilder⁵ of the University of Warwick into 'maths resilience' was highlighted, emphasising the need to help bridge this gap between 'comfort' and 'panic' with a period of 'growth' in maths confidence and the resilience to overcome not simply the mathematical problem but the emotions associated with tackling the problem. Such a period of 'growth' might be established by, among other things:

- increasing understanding of the relevance of maths in everyday life;
- de-emphasising the 'speed' of calculation;
- accepting that making mistakes is part of learning;
- allowing for flexibility in the use of problem-solving strategies;
- freeing-up short-term (working) memory;
- encouraging a 'growth mind-set' and taking responsibility in recognising one's own mind-set.

5. Maths Anxiety: the maths curriculum in compulsory education

⁵ More information on maths resilience can be found at: <https://warwick.ac.uk/fac/soc/ces/research/current/mathematicsresilience> (accessed 29/08/2018)

Inevitably questions were raised around the appropriateness of the school curriculum, especially that in England, and its associated structures of assessment and accountability. Undoubtedly this triumvirate of key policy issues have a major influence on the way in which maths is perceived and, given the high stakes nature of school performance, in themselves almost certainly contribute to the levels of Maths Anxiety among children.

No curriculum is perfect and, given the long debates over many years, the National Curriculum in England is certainly no exception. Whilst there are arguments which suggest the need for another review of the National Curriculum, there is an equally strong argument that the resulting upheaval would be counter-productive. However, a lack of change to the National Curriculum doesn't mean that it is not possible to adjust the 'school curriculum' which can be tailored more directly for the pupils. In particular all pupils should be introduced to ways in which maths is used by them and their families 'everyday'. This might include things such as basic financial management and budgeting, calculating interest on loans, planning how to get a mortgage, interpreting graphs in newspapers or keeping score in games such as darts. In addition, raising awareness of ways in which maths applies to a range of occupations and underpins processes such as programming and cyber security.

In the longer term, planning for a revision of the National Curriculum should start with a view to managing the revision and implementation over a period of 5 to 10 years. Such a review should take into account not only the mathematical content but also the attitudes towards and emotional responses to the subject, ensuring that the concepts and functions are embedded in relevant contexts. Note should be taken of international approaches to maths and assessments including the OECD PISA tests. A wide range of stakeholders needs to be involved, all of whom need to come to agreement as to why particular items are included in the curriculum. Attention also needs to be given to the visual and text presentation of the curriculum documents and the supporting teaching resources and pupil study materials. Importantly it is essential that there is a shared understanding of the purpose of maths and that the justification for inclusion of each item in the curriculum can demonstrate its usefulness not only to enable further study of maths but also inform day-to-day actions.

6. Maths Anxiety: the pedagogy of maths education

The curriculum provides the subject content and a framework for progression through the mathematical concepts and techniques in terms of breadth as well as depth. It is a statement of the 'what' should be taught and learnt. However, this is only part of the equation because appropriate pedagogy, the 'how' of teaching and learning, is just as important. Effective pedagogy engages learners, builds their knowledge and consolidates their understanding of the subject matter. It also goes beyond the mathematical content and enables learners to develop qualities of creativity, curiosity, resilience and determination alongside expertise in solving problems, communicating ideas and working co-operatively as well as individually.

It is important to emphasise that effective pedagogy depends on using a range of approaches which should enable the 'unleashing of teachers as well as pupils'; if teachers aren't engaged then pupils will not engage. What happens in school is only part of the story; home background of pupils and parental influence are very important factors

in learning. Effective pedagogy also depends on the use of a variety of resources including books, models and electronic /online learning programmes. Finally pedagogy needs to be sensitive to, and cater for, pupils' anxieties, which should be addressed sensitively and explicitly when possible.

Developing and implementing effective pedagogical approaches to maths depends on the expertise and confidence of teachers. Accomplished teachers not only have good knowledge of maths but also a sound understanding of teaching and learning processes. They elicit and build on children's pre-existing ideas by setting the appropriate level of challenge for their pupils. As Professor Peacock demonstrated in her presentation, it is important to involve the children in the setting of challenges and having confidence that they will do so at an appropriate level. What is particularly crucial is for teachers, using their expertise and knowledge, to be alert to and introduce alternative ways of explaining and tackling the mathematical ideas and problems in question.

Dr Hunt and Professor Sheffield reviewed a range of specific, simple and inexpensive interventions that have been explored in order to reduce levels of Maths Anxiety. These included approaches that directly addressed the maths; for example, providing targeted, formative feedback to children on their work and being sensitive to the pace of lessons and selection of appropriate equipment. In addition they drew attention to more psychology- based interventions which focussed on the emotions children experience. These included children writing about the things they 'fear' in relation to their maths and approaches for building maths resilience. While the interventions showed encouraging results, further testing and development is needed on a larger scale and - most importantly - the need to communicate the evidence beyond the 'academic' confines of universities and in to schools.

Ensuring that the quality of teaching is as high as possible is itself a major challenge, especially given the shortage of specialist maths teachers in secondary schools and teachers confident in teaching maths in primary schools. The anxiety of teachers who feel uncomfortable teaching maths appears to be 'transmitted' to pupils. Perhaps more significantly, tentative teachers tend to be more rigid in their approach to teaching and so are unable to provide the flexibility that is required to respond to individual pupils needs and explore alternative ways of approaching the problems. Thus there is a major need to address the shortage of maths teachers and to encourage existing teachers to attend maths CPD that is targeted specifically to raising teachers' confidence and expertise in teaching mathematical concepts and problems.

Key messages and actions.

Inevitably the summit raised many questions, but it also emphasised 3 important messages.

The first is that Maths Anxiety is a real problem, which is complex and resistant to change. Although the causes aren't fully understood, there is a body of research evidence which indicates there are ways forward. Addressing the problem is not simply about getting pupils to pass examinations; it is much wider and more fundamental in building confidence and the ability to use appropriate maths as part of everyday life, whether dealing with personal matters or in relation to employment and careers.

The second key message is that addressing the problem is the responsibility of a range of groups, including teachers and parents, working together with government. It is also vital to change social attitudes towards maths and tackle the cultural perception that being unable to do maths is acceptable.

The third key message is that there is a need for actions that should be taken at different levels and in different contexts. In considering a programme of actions it needs to be recognised that there is no 'quick fix' and that specific strategies and programmes need to work together in order to maximise their impact. As a starting point for consideration of further action in tackling the problem of Maths Anxiety, the following actions points can be derived from the themes of the summit. There is a need for:

- i. a national publicity campaign to raise public awareness of Maths Anxiety and influence policy on ways in which the problems might be addressed and, in due course, overcome;
- ii. improving the public image of maths by specifically highlighting why it is important and ways in which it is used in everyday contexts;
- iii. more research into the environmental and emotional factors influencing Maths Anxiety, ways of recognising it as a potential problem, and to test the effectiveness of interventions;
- iv. a better understanding of, and a greater sensitivity towards children's emotional responses to maths; examples of best practice and strategies to reduce anxiety need to be gathered together and then shared more widely;
- v. building up a suite of activities and resources that can be used by teachers and parents to place maths in relevant 'everyday' contexts in a non-threatening manner;
- vi. in the longer term, a review of the National Curriculum provision, text design and visual input needs to be planned over a 5 -10 year period that make provision for all pupils appropriate to their needs;
- vii. exploring and, as necessary, developing, pedagogical approaches that take account of Maths Anxiety more explicitly than currently; the impact of such developments and any changes to the curriculum evaluated through rigorous trialling programmes and results made public – a process which has been introduced through the work of the Educational Endowment Foundation (EEF);
- viii. initial teacher training and CPD programmes for teachers to embed approaches and activities that acknowledge the existence of Maths Anxiety in both teachers and pupils.

Summary

This very lively and successful summit reflected a clear recognition that Maths Anxiety is an issue that needs to be tackled with some urgency. There is substantial evidence that Maths Anxiety has significant effects on individuals as they go through their formal education, enter their careers and go about their everyday life. The implications go beyond the sphere of individuals and ripple in through to impact the effectiveness of the workforce and the UK economy. The arguments presented at the summit strongly favour the need to initiate a national publicity campaign to raise awareness of Maths Anxiety and the need to address it more widely. Furthermore the summit emphasised the need for development projects working with groups of students who experience Maths Anxiety in order to 'test / refine'

strategies that reduce its impact on their reactions to maths and improve their confidence and mathematical performance. More fundamentally future actions would work to increase the number of people who would join Professor Mike Askew in saying that they “love maths because it is elegant, creative and challenging” and have the confidence to say “I can do it!”

APPENDICES

Appendix 1: Maths Anxiety Summit 2018: programme

- 18.30 **Welcome** and opening remarks.
Professor Derek Bell
Director of Learnus, Educational Think Tank
- 18.35 **What some recent surveys can tell us about the prevalence of Maths Anxiety**
Professor Margaret Brown OBE
Emeritus Professor of Mathematics Education at King's College London
Co-Chair MATHSWORLDDUK
- 18.45 **Who's afraid of mathematics? Some glimpses of mathematics anxiety**
Professor Dame Celia Hoyles OBE
Chair of Mathematics Education, UCL IOE
- 19.15 **Discovering Learning without Limits**
Professor Dame Alison Peacock
CEO Chartered College of Teaching
- 19.30 **Strategies to reduce maths anxiety**
Dr Tom Hunt, Senior Lecturer in Psychology and Professor David Sheffield,
Associate Head of Centre for Psychological Research,
College of Life & Natural Sciences at Derby University
- 19.40 **Holding out for a Maths superhero (or heroine)**
Michelle Doyle Wildman
Acting CEO Parentkind (formerly PTA UK)
- 19.50 **"I hate maths": tackling maths anxiety head on**
Professor Mike Askew
Distinguished Professor of Mathematics Education, University of
Witwatersrand. President of the Mathematical Association
- 20.05 **Q & A Panel Discussion with all speakers**
Chair Derek Bell
- 20.35 **Closing remarks**
- 20.45 **Formal part of the evening ends: wine and canapes available**
- 21.30 **Evening ends**

Appendix 2: Maths Anxiety Summit 2018: Presentation Abstracts

What some recent surveys can tell us about the prevalence of Maths Anxiety

Professor Margaret Brown

The Maths Anxiety Trust has funded two recent surveys. The first is in the form of questions included in an Ipsos Mori national poll about the experience of maths anxiety among people of different ages and among parents in relation to their children. The second is a survey of nearly 2,000 pupils in two highly regarded London schools including almost all students age 11-18. This survey allowed students to provide their own comments. This presentation will provide a summary of the main results, providing a background to the other presentations.

Who's afraid of mathematics? Some glimpses of mathematics anxiety

Prof Dame Celia Hoyles

In this talk, I will illustrate through text and video, a wide range of instances of what I would describe as expressions of mathematics anxiety. The aim will be to show not only the depth and complexity of the feelings voiced, but also the ease with which they can be glossed over, even rendered inaudible. Maybe now is the time to accord such expressions of maths anxiety more attention?

Discovering Learning without Limits

Professor Dame Alison Peacock

As CEO of the Chartered College of Teaching, Alison Peacock is keen to share research and stories of practice that liberate the profession. Alison will discuss her own research 'Learning without Limits', an ethic that seeks to teach without labelling children. She will draw upon her experience as a primary headteacher to present an inclusive approach to teaching and learning that builds trust, agency and expertise. Alison will illustrate her talk with film clips from primary aged children engaged meaningfully in mathematics.

Strategies to reduce maths anxiety

Dr Tom Hunt and Professor David Sheffield

During the last two decades the concept of maths anxiety has received increased attention, including many strands to the empirical investigation of it. In our talk we will outline some brief strategies that appear to be effective in reducing maths anxiety. Such strategies are often based on an improved understanding of the mechanisms that underpin the relationship between maths anxiety and arithmetic performance, including panic and intrusive thoughts. Not only are known strategies cost effective, they can be easily implemented inside and outside the classroom. Despite this, the validation of strategies, including combinations and

age-appropriateness of them, need to be further tested. Our suggestions for future work will be highlighted in our talk.

Holding out for a Maths superhero (or heroine)

Michelle Doyle Wildman

Maths and numeracy in the UK is in need of a make-over! Maths and numbers are clearly an essential part of our daily lives. However, too often, we allow under-confidence, boredom and ineptitude around numbers and calculations to be reinforced and to flourish – something that is simply no longer acceptable in our schools and wider society when we consider reading and writing.

So now is the time for the forces for good to assemble around supercharging maths education. We need a fresh campaign that targets and teams up parents and teachers so we can lessen the fear around maths for children and adults alike. We need role models to inspire us to value, enjoy and be empowered by being good with numbers. Now is the time for all of us to be maths superheroes and heroines.

“I hate maths”: tackling maths anxiety head on

Professor Mike Askew

While I think evolution may have hard-wired us to be anxious about snakes, spiders and cliff-edges, I consider anxiety towards maths as a learned response. There is nothing intrinsically threatening about maths, but the possibility of being shamed is anxiety inducing. In this talk I'll share ways in which we have encouraged teachers and learners to directly address their feelings towards maths and defuse the sense of shame and threat.

Appendix 3: Maths Anxiety Summit 2018: Speaker biographies

Professor Mike Askew

Mike Askew is Distinguished Professor of Mathematics Education in the School of Education at the University of Witwatersrand, Johannesburg, having previously held Professorships at King's College, University of London and Monash University, Melbourne. Originally a primary school teacher, Mike moved into teacher education and developed his interest in research. He has directed many research projects including the influential *Effective Teachers of Numeracy in Primary School* and was deputy director of the five-year *Leverhulme Numeracy Research Programme*. His research has been widely published both in the academic arena and as books and resources for teachers, including *Transforming Primary Mathematics* (Routledge). He writes a regular column in *Teach Primary* magazine, and co-authored (with Rob Eastaway) the highly successful books, *Maths for Mums and Dads* and *Maths on the Go* (Random House). Mike believes that mathematical activity can be, and should be, engaging and enjoyable for all children and that the majority of learners can come to see themselves as mathematicians, in the sense of having confidence in their ability to do maths and not filled with anxiety. Mike is pleased to be the current President of the Mathematical Association.

Professor Derek Bell

Derek Bell is a teacher, researcher, and advisor, having worked in schools and universities before becoming Chief Executive of the Association for Science Education (ASE) and Head of Education at the Wellcome Trust. He remains very active in education, nationally and internationally, through his committee and advisory work and has a wide range of publications. Awarded an honorary Doctorate of Education by Manchester Metropolitan University in 2011, he is currently a trustee of several organisations, a visiting research associate at UCL Institute of Education, London and Director of LEARNUS.

Professor Margaret Brown

Margaret Brown is an Emeritus Professor of Mathematics Education at King's College London and is currently Co-Chair of MathsWorldUK, a charity aiming to establish the first interactive visitor centre for mathematics in the UK. She has directed more than 25 research and development projects on the learning, teaching and assessment of maths and has served on four government committees between 1987 and 2012 devoted to reforming the mathematics curriculum. Margaret is an ex-President of the Mathematical Association and the British Educational Research Association, an ex-Chair of the Joint Mathematical Council of the UK, and a winner of the Royal Society Kavli medal for contributions to research in mathematics/science education. She was awarded an OBE partly for services to governance of primary and secondary schools in South London (including helping establish the King's Maths School).

Professor Dame Celia Hoyles

Celia Hoyles was awarded a first class honours degree in mathematics from the University of Manchester and holds a masters and doctorate in mathematics education. She taught mathematics in London schools from the late 60s before moving into higher education. She was inspired by the vision of using digital technology to open access to mathematics. She has published widely and worked constantly to change the public face of mathematics, initially by co-presenting a popular TV mathematics quiz show, Fun and Games, which topped the prime-time ratings between 1987 and 1990. Celia was the first recipient of the International Commission of Mathematics Instruction (ICMI) Hans Freudenthal medal in 2004, and also of the Royal Society Kavli Education Medal in 2011 both for her research work. She was the UK Government's Chief Adviser for mathematics (2004- 07), the director of the National Centre for Excellence in the Teaching of Mathematics (2007-13). and President of the Institute of Mathematics and its Applications (IMA) (2014-15). Celia was made an Officer of the Order of the British Empire in 2004 and a Dame Commander in 2014. In 2016, she was selected for the Suffrage Science award for Communications.

Dr Tim Hunt and Professor David Sheffield

Tom Hunt achieved his PhD in 2011 and has worked at Staffordshire University, The Open University and the University of Derby. David Sheffield has been studying maths anxiety for 15 years at Staffordshire University and the University of Derby. We have worked together as academic psychologists for a number of years, most recently at the University of Derby where we have supervised a number of undergraduate and postgraduate research projects investigating maths anxiety. We have also continued our own work in the area, producing a number of peer-reviewed publications and presenting our work nationally.

Professor Dame Alison Peacock

Dame Alison Peacock is Chief Executive of the Chartered College of Teaching. The Chartered College opened membership in January 2017 and aims to provide a professional body 'by teachers, for teachers'. Prior to joining the Chartered College, Dame Alison was Executive Headteacher of The Wroxham School in Hertfordshire. Her career to date has spanned primary, secondary and advisory roles. She is a member of the Royal Society's Education Committee, a trustee of Teach First and a Visiting Professor of both the University of Hertfordshire and Glyndŵr University. In March 2015, Alison was appointed by the Department for Education as a member of the Commission on Assessment Without Levels and she is author of Assessment for Learning without Limits.

Michelle Doyle Wildman

Michelle Doyle Wildman joined Parentkind (formerly PTA UK) in May 2015 as its Policy and Communications Director and since May 2017 has been the charity's Acting CEO. She has over 20 years' experience of leading teams, public affairs and stakeholder engagement; previously holding senior roles at the Environment Agency and South East Water. As a mother of two boys and wife of a Maths teacher, Michelle takes a keen personal interest in our schools. She has spoken and written widely on how parents can participate positively in education. Michelle is an accredited practitioner and member of the Chartered Institute of Public Relations and is a member of ACEVO.