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Chapter 2: Recognising and measuring mathematics anxiety and resilience

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A variety of measures are available to show the presence of maths anxiety because of its multidimensional nature and the need to address a specific target population. Measuring maths anxiety helps our understanding of this form of anxiety and its similarities to and differences from other constructs such as maths self-efficacy or other forms of anxiety, e.g., general or test anxiety. This chapter will help readers get to grips with some of the most commonly used measures and scales available, taking into account empirical findings that suggest other ways to recognise mathematics anxiety.

Introduction

Maths anxiety is central to the discussion of psychological safety and well-being within maths education. It is a core issue in addressing mathematical resilience and is prevalent across many groups of learners. For example, in a study of over 300 adult learners, Hunt and Maloney (2022) found that maths anxiety was generally higher among those with lower mathematical resilience. More recently, Hunt and colleagues (paper in preparation) studied over 1,600 14-16 year-olds from 7 different countries and again found a significant negative relationship between these variables. After many years of research, it is clear that maths anxiety is one of the main psychological barriers for maths learning, performance, and general engagement with maths. It has been suggested that children start school with intrinsically positive attitudes towards math (Nicolaidou & Philippou, 2003), but research has indicated that maths anxiety can develop in children as young as four years of age (e.g., Petronzi et al., 2017) with attitudes formed because of classroom-based negativity (Fraser & Honeyford, 2013) such as experiencing failure and negative peer evaluation. Given the prevalence and potentially long-term impact of maths anxiety, the development of suitable measures is important, particularly for those who may experience challenges associated with dyscalculia or math learning difficulties. Given our understanding of the general cognitive implications of experiencing maths anxiety, for example, limited working memory leading to an affective drop in performance (Ashcraft & Moore, 2009), emotional implications (Luo et al., 2009; Young et al., 2012) and avoidance via the 'no-attempt' error (Chinn, 2012) this further emphasises the need for early identification of children at risk of maths anxiety. Quantitative research into maths anxiety almost always adopts some form of self-report rating scale of maths anxiety. Within classrooms especially, such scales provide researchers with a way of quantifying maths anxiety; it means relationships can be tested with other psychological variables, but also behaviours too, such as maths performance. It also means that differences can be tested between groups and over time, e.g., assessing the effectiveness of an intervention for reducing maths anxiety. Also, a perhaps under-recognised use of scales is as part of the initial psychoeducation phase of intervention work or action research. This involves equipping learners with the knowledge to understand their own feelings and beliefs; scales can provide learners with something concrete to work with. In some cases, it might be the first time that a learner has properly considered concepts such as maths anxiety and resilience and scales can act as an aid to reflect on these. Here we discuss maths anxiety rating scales alongside other ways in which maths anxiety might be recognised and measured. As we do this, we will also consider how mathematical resilience can be, and has been, measured.

Mathematics anxiety is central to any discussion of psychological safety and well-being within mathematics education. Decades of research have made it clear that mathematics anxiety is one of the main psychological barriers for successful mathematics learning, performance, and general engagement with mathematics. It has been suggested that children start school with intrinsically positive attitudes towards mathematics (Nicolaidou & Philippou, 2003), but research has indicated that mathematics anxiety can develop in children as young as four years of age (e.g., Petronzi et al., 2017), with attitudes formed because of negative experiences in the classroom (Fraser & Honeyford, 2013). Mathematics anxiety can limit a learner's working memory leading to an affective drop in performance (Ashcraft & Moore, 2009), have emotional implications (Luo et al., 2009; Young et al., 2012) and be expressed as avoidance via the 'no-attempt' error (Chinn, 2012).

Research has also demonstrated that a learner's mathematical resilience is related to their level of mathematics anxiety. For example, in a study of over 300 adult learners, Hunt and Maloney (2022) found that mathematics anxiety was generally higher among those with lower mathematical resilience. More recently, Hunt and colleagues (paper in preparation) studied over 1,600 14–16-year-olds from 7 different countries and again found a significant negative relationship between anxiety and resilience.

Given the prevalence and potentially long-term impacts of mathematics anxiety, it is important that teachers and researchers are able to recognise and measure it. There is a need for early identification of children at risk of mathematics anxiety, and a particular concern for learners who may experience additional challenges, such as those associated with dyscalculia or learning difficulties.

Quantitative research into mathematics anxiety almost always adopts some form of self-report rating scale. These scales provide researchers with a way of quantifying mathematics anxiety, allowing them to test relationships with other psychological measures and behaviours, such as mathematical performance. Rating scales allow researchers to look for differences between groups and over time, for example when assessing the effectiveness of an intervention for reducing mathematics anxiety.

However, rating scales can also help teachers and researchers in the initial psychoeducation phase of intervention work or action research. The questions and reflection involved in self-report scales can provide learners with something concrete, equipping them with knowledge to understand their own feelings and beliefs. In some cases, completing a self-report scale might be the first time that a learner has properly considered concepts such as mathematics anxiety and resilience and scales, or reflected on their own emotions and experiences.

In this chapter we discuss different mathematics anxiety rating scales, alongside other ways in which mathematics anxiety might be recognised and measured. As we do this, we will also consider how mathematical resilience can be, and has been, measured.

Self-report scales for maths anxiety

Dreger and Aiken (1957) are often cited as being the first to empirically study maths anxiety, beginning with what they termed “number anxiety”. They did this by including an additional three maths-specific items to an existing anxiety scale. The wording of two of these items suggests that Dreger and Aiken conceptualised numerical anxiety in terms of nervousness and “freezing up” in relation to doing” arithmetic and “seeing” math problems. In relation to recognising maths anxiety, the distinction between doing and seeing maths is an important one. Whilst some people find actual engagement with a maths task to be very anxiety provoking, simple exposure to mathematical content (even thinking about it) can also induce anxiety. Therefore, it is essential that teachers understand how maths anxiety might appear or increase in individual learners.

It was not until 1972 that the first purpose-built scale was designed to measure math anxiety: The Mathematics Anxiety Rating Scale (MARS; Richardson & Suinn, 1972). Since its publication, many further maths anxiety scales have been based on the MARS, including more concise versions and variations of it. A second family of self-report maths anxiety measures for adults is based on the Abbreviated Mathematics Anxiety Scale, or AMAS (Hopko et al., 2003). A typical format for maths anxiety scales is to ask the learner to respond on a scale of 1 to 5 how anxious they would feel during an event specified by a series of items such as “Thinking about an upcoming math test one day before”. Arguably, one of the reasons for the popularity of the AMAS is its short length (9 items), although it has proven to be a valid and reliable measure. It should be noted, however, that it usually requires some modification for use outside of the American education system.

The Mathematics Anxiety Scale U.K. (Hunt et al., 2011) is a 23-item self-report measure that has been used extensively since its publication, owing to its design with a U.K. audience in mind. Created for adults and older adolescents, it covers a wider range of maths situations compared to other scales and is closer to the American Shortened Mathematics Anxiety Rating Scale (Alexander & Martray, 1988). A 10-item version of the MAS-UK was also piloted for secondary school pupils and is available from the authors of this chapter on request. The Mathematics Anxiety Scale (Betz, 1978) is another popular scale and has been modified according to specific groups of learners (see Table 2.1).

The original 23-item MAS-UK was administered to over 1,000 undergraduate students in the U.K. and the distribution of scores (the sum of scores on the 23 items) can be seen in Figure 2.1. The maximum score is 115 and the minimum score is 23. This is a good example of how maths anxiety scores are typically distributed; whilst they begin to approximate a normal distribution, there is some skew towards a small but significant number of high scores at the top end of the scale. The data suggests that most people experience some degree of maths anxiety. It also suggests that there is no obvious cut-off for what we might consider "high maths anxiety". Many studies arbitrarily divide participants into groups, indicating levels of maths anxiety, such as "low maths anxiety" and "high maths anxiety" based on a median split, i.e., those who fall below or above the median value. This has some practical value, but it is important to acknowledge that it does not necessarily reflect the reality of the spread of maths anxiety scores across a group of learners.

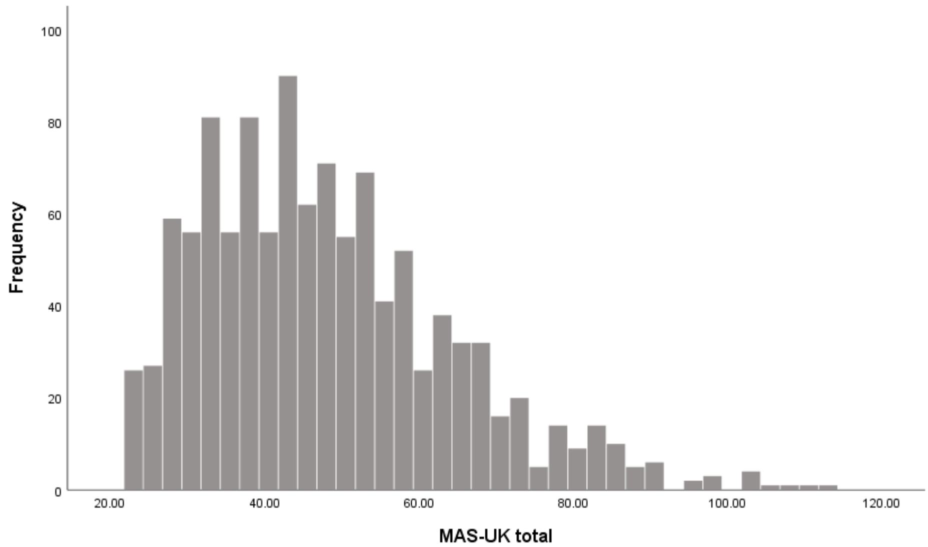


Figure 2.1. The distribution of total MAS-UK scores in Hunt et al. (2011)

It is worth highlighting a study carried out by Carey and colleagues (2017), in which they administered a modified version of the AMAS (Hopko et al., 2003) to over 1,700 pupils aged 8-13 in the U.K. This research not only involved a large sample of UK learners, but explored separately how pupils experience anxiety when they are learning mathematics and when they are being tested. As per the findings of Hunt et al. (2011), the overall distribution of total maths anxiety scores was slightly skewed, with a higher proportion of pupils at the lower end of the scale. However, upon viewing the scores for the sub-scales of Maths Learning Anxiety and Maths Evaluation Anxiety separately, the distributions were very different. The scores for Maths Learning Anxiety were quite highly skewed, with the majority of learners scoring quite low in anxiety concerning learning maths. On the other hand, anxiety concerning maths evaluation was more evenly distributed, with a higher average score. The finding that maths anxiety was higher in the context of being evaluated or tested is very common and is likely closely linked to various features that predict maths anxiety, such as others' attitudes towards the maths learner and the maths learner's self-efficacy, as discussed in Chapter 1. This has important implications within maths education given the prevalence of maths tests.

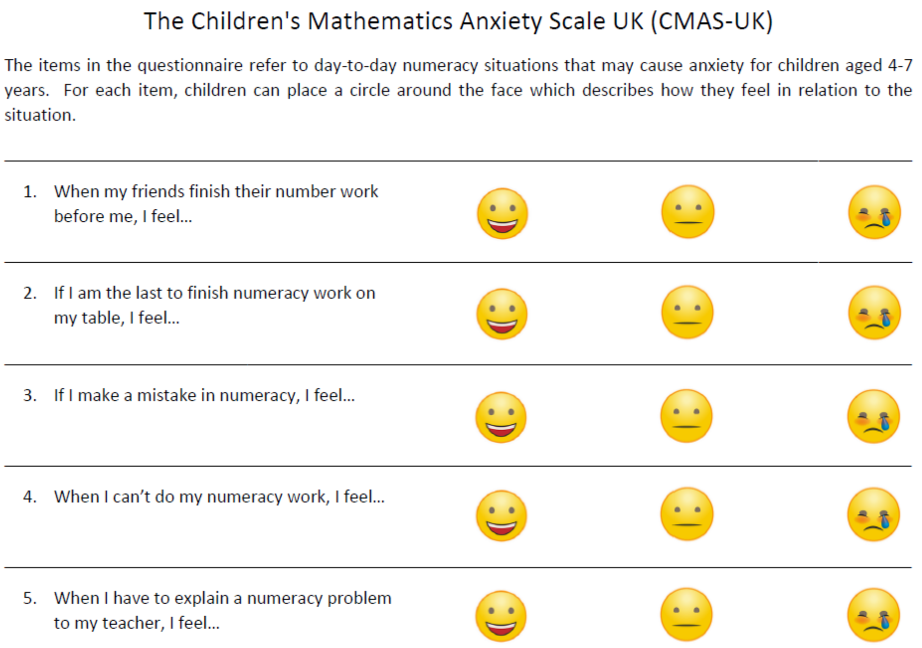
In more recent years, new maths anxiety scales have been created with younger people in mind, particularly those within primary/elementary education. This is largely because the original maths anxiety measures were devised with adults in mind, resulting in both content that is not relatable, and response options that might not be easily understood. Table 2.1 shows some of the self-report scales for maths anxiety that we recommend for children or adolescents. It is important to be aware that there is some variation in content and style between these scales, mostly based on the age groups that were targeted when the scales were designed. Therefore, careful consideration should be given to which scale is most suitable for the age of the learners completing it.

Scale	Suggested suitability / group of learners	No. Items (specific to maths anxiety)
Children's Mathematics Anxiety Scale UK (Petronzi et al., 2018)	Lower primary	19
Child Math Anxiety Questionnaire (Ramirez et al., 2013, developed from MARS-EC, Suinn et al., 1988)	Lower-to-mid primary	8
Scale for Early Mathematics Anxiety (Wu et al., 2012)	Mid primary	20
Maths Attitude and Anxiety Questionnaire (Dowker et al., 2012)	Mid-to-late primary	7
Children's Anxiety in Math Scale (Jameson, 2013)	Primary	16
Modified Abbreviated Math Anxiety Scale (Carey et al., 2017)	Mid primary to mid secondary	9
Mathematics Anxiety Scale for Children (Chiu & Henry, 1990)	Mid primary to mid secondary	22
Mathematics Anxiety Rating Scale for Elementary Children (Suinn et al., 1988)	Upper primary to secondary	26
Modified version of the Betz (1978) Mathematics Anxiety Scale (Baker, 2021)	Lower secondary	10
Mathematics Calculation Anxiety Scale (Hunt et al., 2019)	Upper secondary and adults	26
Mathematics Anxiety Scale U.K. (Hunt et al., 2011)	Adults	23

Abbreviated Math Anxiety Scale (Hopko et al., 2003)	Adults	9

Table 2.1. Suggested self-report maths anxiety scales for different learners.

Anxiety rating scales for young learners can look very different to those for adolescents for adults. For example, the Children's Mathematics Anxiety Scale-UK (CMAS-UK) (Petronzi et al., 2018) is a 19-item scale which utilises an emoji response format (see Figure 2.2.) The items, developed through focus groups with children aged between 4 and 7 in the U.K., reflect a typical mathematics lesson and the types of situation that a child might encounter, which the qualitative research suggested might be associated with feelings of anxiety. Items represent core concepts such as a fear of failure and negative feelings related to peer comparison. It may be useful to consider how these items relate to the principles of mathematical resilience, including growth mindset, value, struggle, and support. The CMAS-UK has proven to be a useful tool for teachers in U.K. primary schools, although there are some practical considerations, such as the need to support younger learners in completion of the scale owing to challenges related to reading ability and sustained attention.



The Children's Mathematics Anxiety Scale UK (CMAS-UK)

The items in the questionnaire refer to day-to-day numeracy situations that may cause anxiety for children aged 4-7 years. For each item, children can place a circle around the face which describes how they feel in relation to the situation.

1. When my friends finish their number work before me, I feel...
2. If I am the last to finish numeracy work on my table, I feel...
3. If I make a mistake in numeracy, I feel...
4. When I can't do my numeracy work, I feel...
5. When I have to explain a numeracy problem to my teacher, I feel...

Figure 2.2. The first 5 items on the Children's Mathematics Anxiety Scale UK (Petronzi et al., 2018)

Even though mathematics anxiety scales can be quite short - one scale proposed by Nunez-Pena et al. (2014) was just one question long - research suggests that there are many aspects or dimensions to mathematics anxiety. Some studies use factor analysis, a statistical method for exploring whether certain items group together in a way that suggests an underlying factor (measured via a subscale). A typical example would be the Maths Learning Anxiety and Maths Evaluation Anxiety subscales of the AMAS (Hopko et al., 2003). These subscales represent what are thought to be two of the main dimensions of maths anxiety It is useful for teachers to have a broader awareness of the range of factors and subscales that have been proposed as these have implications for addressing maths anxiety through classroom pedagogy and targeted interventions. Some scales have been shown to have a subscale relating to anxiety associated with social or everyday maths, beyond a formal educational setting. Others have suggested the existence of anxiety associated with abstract maths (as separate from standard numerical problem solving), e.g., algebra. In fact, one self-report scale was designed to measure maths calculation anxiety associated with a wider range of maths tasks than is typically included in maths anxiety scales. The Mathematics Calculation Anxiety Scale (Hunt et al., 2019) includes maths problems from across the English GCSE curriculum and is thought to be a useful measure for understanding anxiety associated with specific areas of maths: abstract maths anxiety, statistics probability anxiety, statistics calculation anxiety, and numerical calculation anxiety.

A question that we often receive from teachers is "what score [on a particular self-report scale] represents high maths anxiety?" However, it is difficult to answer this question given the lack of data from specific groups of learners; we cannot assume that the distribution of maths anxiety scores from self-report measures is the same for all groups of learners. This question also represents an interesting point about what the results of the scales can be used for. Teachers might use the results of a self-report scale to change their grouping practices or to help identify individual learners in need of specific support. They might also use them as part of direct intervention resources, whether that relates to maths anxiety specifically, or as part of a broader intervention that targets mathematical resilience. Whilst such scales are useful as a way of observing changes in maths anxiety across time, care should always be taken to avoid using scores from maths anxiety scales to label a learner in a particular way. Values derived from scales should be viewed in relation to the wider group. For example, a child might score high on maths anxiety compared to the rest of their class, but their score could actually be fairly normal – or even low – compared to all other children in their age group.

Self-report measures are often a quick and (fairly) easy way of assessing maths anxiety among many learners in a short period of time. However, the learners who are most at risk are those whose self-report score does not quite get them into the bracket of high maths anxiety. After all, self -report measures are not perfect – they are subject to response bias, e.g., learners might not want to appear maths anxious; also, as mentioned earlier, the concept of a threshold for a high maths anxiety score is often ill-defined or unnecessary. Therefore, when the intention is to identify maths anxiety in learners for the purpose of supporting individuals with high maths anxiety, we need to employ a broader range of techniques.

Moving beyond self-report measures

Another way of identifying mathematics anxiety in learners is through observation of their behaviour. Naturally, teachers observe learners during lessons, but it is worth thinking about the types of behaviours that might suggest a learner is maths anxious. This approach offers another dimension to identifying and measuring maths anxiety over and above self-reports. It also represents a useful way of identifying learners who might be feeling maths anxious, especially when they are not forthcoming in speaking out. Indeed, many learners might not associate certain negative feelings (whether psychological or physiological) with maths learning or testing. Instead, they might have more of a general feeling or attitude towards the subject, such as a dislike or lack of enjoyment. We should consider the possibility that behaviours – including withdrawal, avoidance, and disruption – frequently observed in learners that struggle with maths anxiety – are a form of communication and typically indicates a learner's wants or needs; perhaps that their resilience is too low to manage the stress and worry that they feel when doing maths.

Behaviours might include those that indicate a certain degree of avoidance, e.g. inattentiveness or generally being disruptive. Anxiety could also manifest itself through a learner appearing frustrated or angry. They may attempt to copy from peers to avoid exerting mental effort or run the risk of individual failure. Or they might speed through maths work to simply get it over and done with at the expense of making mistakes (otherwise known as the speed-accuracy-trade-off). Also, appearing withdrawn or subdued might suggest a conscious or subconscious attempt to avoid being questioned or have their maths work acknowledged in some way; it might also indicate the existence of intrusive thoughts (a common occurrence among those with higher maths anxiety). Moreover, at times, intrusive thoughts can translate into negative self-talk, especially that which hints at low self-efficacy. Therefore, teachers should note what learners say during, maths lessons. For instance – as per the findings of Petronzi et al. (2017) - do learners say things that suggest they are comparing their understanding or performance against their peers'? Do they mention possible negative consequences of failure? Or maybe they comment on their perceived inability to progress. It is a common theme among current or former learners who self-report as being highly maths anxious that being asked a maths question in front of others is a key trigger for their anxiety. This might be in relation to fellow learners, i.e., a fear of looking foolish if an incorrect (or no) response is given, or it might be through a fear of how a teacher might react. If we consider this in relation to recognising maths anxiety, it becomes important for teachers to observe learners' reactions during evaluative situations involving maths. A no-response might be indicative of experiencing fear, rather than an absence of motivation or attention.

A major challenge when drawing links between behaviours and maths anxiety is whether learners behave in certain ways in lessons other than maths. A comparison of learners' behaviours in maths vs non-maths situations is therefore important in forming conclusions about a learners' anxiety that is specific to maths. In addition to external behaviours, in a study carried out by one of the authors (Hunt et al., 2017), it was observed that primary school learners' self-reported maths anxiety was positively related to their change in blood pressure as maths problems became more difficult. As such, the physiological changes learners might experience in response to challenge sometimes go beyond what might be regarded as normal, possibly resulting in physical signs, e.g., looking flush in the face, excessive sweating, etc, that need to be acknowledged by teachers. Teachers can also aid learners to recognise and understand their own bodily changes, perhaps tied with useful tools such as the Growth Zone Model (Johnston-Wilder et al., 2020); this is one of the core components of a reappraisal approach to tackling maths anxiety (Jamieson et al., 2016).

From maths anxiety to self-efficacy and resilience

Before we turn to consider mathematical resilience, it is worth being mindful that maths anxiety is not the only psychological concept which feeds into mathematical learning. Motivation, beliefs, and self-efficacy all play a part. Self-efficacy refers to the individual's belief that they can complete a certain task, and research shows that self-efficacy, in terms of academic work, can be a predictive factor for academic outcomes (Owen & Froman, 1988). Moreover, both pessimism and negative attitudes in maths have been shown to relate to self-efficacy and can lead to motivational and cognitive deficits (Kolacinski, 2003). Therefore, it is clear to see why self-efficacy has been considered as a crucial factor within maths education and, importantly, it can be increased by developing cognitive skills which also support persistence, performance, and interest; it seems important for resilience. There are scales and ways to observe and measure these constructs too, but there is insufficient space here to discuss these fully. In Chapter 1, the authors propose that students low in mathematical resilience can progress in maths by overcoming their maths anxiety with the help of teachers and resources that can empower them. Therefore, those who learn to strengthen their ability to manage their emotions and cope with threatening and challenging situations can enhance their mathematical resilience. Consequently, it is important to recognise and measure mathematical resilience along with maths anxiety among learners. This enables both learners and educators to increase awareness of a hidden dimension in the classroom, to target attention, and to identify the extent of that challenges that are faced. All these features help educators understand how best to support learners and to direct resources accordingly. Resilience can be considered on a continuum, rather than as being, for example, 'good or 'bad' or 'resilient' and 'not resilient' and there may be a number of interacting life experiences that lead a learner to have higher or lower resilience, as well as a potential genetic basis that can be activated under certain environmental conditions (Rubinsten et al., 2018).

Example item	Sub-scale
Math can be learned by anyone	Growth
Math is essential for my future	Value
Everyone struggles with math at some point	Struggle

Table 2.2. Example items from the Mathematical Resilience Scale (Kooken et al., 2015)

We have already seen that maths anxiety can be considered to be multi-dimensional. Similarly, in the previous chapter it is proposed that mathematical resilience comprises four components: growth mindset, struggle, value, and support. The first three relate to an individual learner's self-beliefs concerning their maths learning. The Mathematical Resilience Scale (MRS) (Kooken et al., 2015) is a self-report scale that can be used to measure these components. This includes 24 statements (see Table 2.2 for examples) and learners respond on a scale from 1 "strongly agree" to 7 "strongly disagree". Scores can be created for the individual components of growth mindset, struggle, and value, or a total mathematical resilience score can be created for the components combined. The MRS can be used to ascertain learners' current level of mathematical resilience, including which components might need to be targeted, e.g., one learner may have particularly unhelpful beliefs regarding the value of struggle in maths learning, whereas another learner might clearly experience a fixed mindset.

Currently, the MRS does not measure learners' perceptions of support. Recent work by Lau et al. (2022) highlighted the importance of the role of others in the context of learners' maths anxiety, demonstrating a negative relationship between learners' perception of teacher competence and the learner's maths anxiety. Also, people with high maths anxiety often talk about negative maths experiences with others, especially teachers (Bekdemir, 2010). Therefore, measuring perceived support could be important in the context of understanding the development of mathematical resilience.

Another scale designed to explore resilience in mathematics learning is the Academic Resilience in Mathematics Scale (ARMS) (Ricketts et al., 2017) Whilst this 9-item scale is not as extensive as the MRS, it considers resilience in the context of maths slightly differently, although there is some obvious overlap. One of the differences is the inclusion of items related to support, e.g. "I know where to get help if I'm having trouble with math" (note that an item pertaining to seeking support was included in the original MRS as part of the development process but was later removed following various statistical analyses). Aside from such self-reports, we can also look to broader indicators of resilience. At the macro level, selecting courses involving maths could reflect a high degree of resilience if the learner struggles with maths in one way or another. Similar observations can also be made at the micro level, e.g., attempting maths problems in-class.

Measurement within action research

Some studies have utilised a mathematical resilience model to inform interventions for reducing maths anxiety. For instance, recently, Para and Johnston-Wilder (2023) used the Growth Zone Model (Johnston-Wilder et al., 2020) and the hand model of the brain (Siegel, 2020) to successfully reduce maths anxiety in Brazilian high school pupils. Others have used a growth mindset-based intervention, including explaining the principles of growth mindset theories, reciting positive affirmations about maths learning beliefs, and reframing fixed mindset statements, to address maths anxiety and maths self-beliefs in community college students in the U.S.A. (Samuel & Warner, 2019). Furthermore, Apostolidu and Johnston-Wilder recently explored the effectiveness and accessibility of the Mathematical Resilience Toolkit (Johnston-Wilder et al., 2020) for building resilience, reducing maths anxiety, and increasing effectiveness of learning in adult learners in a U.K. further education college. In this case, outcomes were measured via observations of learners' verbal and non-verbal reactions to the concepts and tools introduced on the maths course, in addition to interviews with learners. Observation of learners in real time provides an opportunity for teachers and researchers to note behaviour and speech in a way that is more subtle, perhaps circumventing some of the issues that interviews carry, such as general biases in responding e.g., because of inaccuracies in learners' memory or wanting to appear in a particular light. On the other hand, interviews provide the level of depth required to delve into the intricacies of individual experiences. In Apostolidu and Johnston-Wilder's study, interviews provided learners with the chance to reflect on their experiences of the toolkit; this is something that is not always considered as part of intervention work and including learners in this way has the benefit of helping i) learners to consider their own thoughts and feelings, ii) learners and teachers to understand the extent to which resilience and maths anxiety may have changed across time, and iii) develop tools further based on feedback.

> "The CMAS-UK is an essential part of my assessment toolkit in my role as specialist Maths teacher. It enables me to quickly determine if, and the extent to which, the child is experiencing maths anxiety. The interactive nature of the questionnaire offers the opportunity for the child to qualify their responses, both on paper and verbally, and for me to informally explore specific aspects further.
>
> Once processed, I use the scores as a basis to conduct further conversations with both the teachers and parents/carers, to validate the child's responses and determine the child's self-reported levels of maths anxiety, are typically 'lived out' day to day.
>
> I also analyse the child's responses and use them to alert teachers of potential situations within maths lessons that may trigger them in the classroom, or at home when completing homework.
>
> The results, discussions and recommended strategies are then recorded in my assessment report and used to inform the child's Individual Learning Plans." Gail an Schalkwyk, Specialist Maths Teacher.

Recently, Petronzi et al., (2023) implemented a child-friendly storybook approach in classrooms in a bid to promote children's reflection on maths experiences and to normalise maths talk. In this qualitative work, children aged 6-7 years (N=15) across two UK primary schools first completed the CMAS-UK (Petronzi et al., 2018) to indicate their level of maths anxiety and give further context to their discussion points. The children took part in one-to-one discussion surrounding engagement with a specially designed and written maths anxiety storybook. Following reflexive thematic analysis of the transcriptions of the discussions, three global themes were identified: [1] Maths Application: (a) counting, and (b) mathematical language, [2] Strategies: (a) social learning, (b) resilience and self-regulation, and [3] Emotive Responses: (a) perceptions of self and maths, and (b) success and happiness. The findings suggest that children were able to engage with the storybook approach - with integrated maths problems - which normalised maths talk in a non-judgement-based environment, leading to more positive perspectives of maths and more resilient approaches and solutions. Even for those with higher self-reported CMAS-UK scores this approach encouraged children to independently implement their individual maths knowledge to become progressively more confident as they worked through the storybook. This exemplifies the use of validated maths anxiety scales alongside targeted intervention approaches to support the emotion regulation and resilience of maths learners. As a final point, it is sometimes surprising that intervention work does not result in a change in maths anxiety scores as measured via self-report scales. However, this might be due to action researchers not having adequate measurement tools at their disposal; maybe the question is not so much whether a learner's anxiety has changed, but instead whether they feel better equipped to deal with feelings of anxiety and negative self-belief.

Andy, Head of Maths at a secondary school, used the MAS-UK (Hunt et al., 2011) as part of some action research and had the following to say: "What was interesting about the Mathematics Anxiety Scale UK was that it didn't just identify the students who were struggling with the basic concepts of maths, or suffered general anxiety issues, but it shone a light on other students across the attainment spectrum. Easy to use, it made students aware that they were not alone!

Conclusion

In conclusion, it is useful for teachers to be aware of the range of self-report scales available to measure maths anxiety, but careful consideration should be given to the age group of learners and the suitability of the content when selecting scale. Such scales provide teachers with a quick and (usually) easy way of identifying maths anxiety in learners, providing a starting point for appropriate allocation of support. However, an over-reliance on self-reports should be avoided; having an awareness of typical behaviours associated with maths anxiety can often be helpful alongside them. Measuring maths anxiety is an important feature of developing and testing strategies for addressing mathematical resilience and mathematical resilience itself can be assessed in similar ways. Attempts to measure mathematical resilience are in their infancy compared to maths anxiety alone, and existing self-report scales are likely to be developed further as our conceptual understanding of mathematical resilience improves.

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