# Maths Anxiety: The Fear Factor in the Mathematics Classroom

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## ABSTRACT

*Currently, there is a strong political focus in New Zealand on a need to increase the mathematical literacy levels for all students. In New Zealand, one solution being widely promoted is to 'accelerate' the learning of struggling students. In looking more closely at why some students may be struggling, it is timely to consider the role of maths anxiety and its impact on students' learning practices and outcomes. This literature review highlights potential origins of maths anxiety and how teachers might assist in reducing maths anxiety in students.*

## INTRODUCTION

In New Zealand we have an increasingly diverse student population. Despite large scale numeracy initiatives across primary and secondary schools there remains ongoing concern at the levels of underachievement for those students who are from disadvantaged backgrounds – most notably Pasifika and Māori (Young-Loveridge, 2010). At the national level, policy is directing attention to monitoring student achievement and progress levels, lifting student achievement through the use of National Standards, and developing teachers' pedagogical content knowledge (Ministry of Education, 2009). However, to date, there is little policy direction concerning the affective and social outcomes of learning mathematics, especially in relation to those students who are most vulnerable in our classrooms. The most recent National Education Monitoring Project (NEMP) results (Crooks, Smith & Flockton, 2010) assert that mathematics rates highly in popularity stakes for Year 4 and Year 8 students, with at least 85 percent of students in both years being positive about doing mathematics at school. At the secondary level, the Program for International Student Assessment (PISA) also reveals positive ratings for measures of maths self-concept and self-efficacy by New Zealand students in comparison to students from a range of other countries (Lee, 2009). But do these positive results mean that *all* students in New Zealand classrooms are free from mathematics anxieties and fears? The response to that question must be 'highly unlikely'.

In the New Zealand educational context, it is argued that in times of mathematics reforms that advocate public sharing of one's mathematical thinking, collaborative group inquiry processes, and standards-based

assessment and accountability, it is critical that teachers monitor students' dispositions towards mathematics and mathematics learning (Hunter & Anthony, 2011). Essentially, teachers must have an awareness and understanding of maths anxiety, and develop an ability to assist maths anxious students.

Mathematics anxiety, considered a fear or phobia, produces 'a negative response specific to the learning, or doing, of mathematical activities that interferes with performance' (Whyte, 2009, p. 4). Closer examination of maths anxiety reveals two general forms of anxiety: trait and state (Miller & Bischel, 2004). Trait anxiety describes the vulnerability to stress that an individual brings to a situation. State anxiety refers to the actual situational stress experienced that is specific to personally stressful or fearful circumstances. Research also notes that maths anxiety can affect individuals in varying ways, inducing a cognitive, affective, or physical reaction. For example, a cognitive reaction may involve negative self-talk, 'blanking out', and avoidance; an affective reaction may be characterised by distrust of ability, fear of looking stupid, and loss of self-esteem; and a physical reaction may be evidenced by perspiring, a boost in one's heart rate, tenseness, or nausea (Freiberg, 2005). 'If mathematics makes a student feel anxious … [the learning and teaching of mathematics] will be marked with negative emotions and bodily sensations' (Zambo & Zambo, 2006, p. 15) and these may have a powerful and long-lasting effect on learning mathematics (ibid).

This literature review will highlight the potential origins of maths anxiety, and how teachers might mitigate maths anxiety within their classroom and for their students.

## POTENTIAL ORIGINS OF MATHS ANXIETY

Maths anxiety can have multiple origins and, as noted by Shields (2005), can be perpetuated in the home, society, and the classroom.

### The home

In the home, parents who themselves suffer maths anxiety can unintentionally transfer such anxiety to their children. In the context of doing mathematics, the emotions expressed by one will inevitably and reciprocally shape the other within parent-child interactions (Else-Quest, Hyde, & Hejmadi, 2008). For example, children who are reproached for their errors may develop a fear of taking risks and exploring new possibilities, and may start hating mathematics. Parental disappointment and despair are especially demoralising due to the value placed on the high positive regard of parents by children (Dossel, 1993), while parents giving mathematics low status or applying pressure to children may also contribute to the development of maths anxiety (Fraser & Honeyford, 2000). Stolpa (2004) also identifies how parents may unintentionally raise maths anxiety in their children by providing them with an excuse to stop trying when they are frustrated or upset due to difficulties with a mathematical task. A response from parents, such as 'Don't worry, I've never understood fractions' or 'Never mind, maths was always tricky for me at school too', plants a seed that may grow into a strong belief for children that they are incapable of learning mathematics. High achievers are not immune to pressures from parents. Over-bearing parental pressure for success or concern about the

difficulty of mathematics for their children (Bernstein, Coté-Bonanno, Reilly, Carver, & Doremus, 1995) may contribute to maths anxiety in high achievers.

**Society**

Social factors such as mathematical myths may also induce or reinforce maths anxiety for some students. For example, the myth that boys are better than girls in maths and that only some people have a 'maths mind' can undermine positive self-efficacy beliefs. Too often, situations are encountered in which it is 'cool' to hate mathematics, with people readily stating, with some pride, 'I'm no good at maths', as though displaying a badge of honour or promoting membership to the I Hate Maths 'Facebook' group. As a subject mathematics is unique as embarrassment often does not result from failure. A study involving over 1000 undergraduate students in the United States affirms the view that failure at mathematics is socially acceptable – the participants were less embarrassed in relation to lack of mathematical skills compared with language skills (Latterell, 2005).

**The classroom**

Despite young children starting school having, for the most part, a well-developed, informal competence in mathematics, it is apparent that the classroom is also a place where maths anxiety can develop and flourish. Research studies (e.g., Vinson, 2001) suggest that, in combination with the parental and societal factors, maths anxiety may have its roots in teaching and teachers, with maths anxious teachers resulting in maths anxious students at times. Teaching by maths anxious teachers is characterised by an over-reliance on traditional instructional activities such as: drills, flash cards, and work sheets; assigning the same work for everyone; teaching to the textbook; insisting on only one correct way to complete a problem; concentrating more on basic skills rather than concepts; and, whole class instruction (Gurganus, 2007). Despite New Zealand's systemic attempts to reform primary mathematics programmes (Higgins & Parson, 2009), we have 'a long tail of underachievement in mathematics' (Neill, Fisher, & Dingle, 2010, p. 1) and traditional ways of learning mathematics continue to be present within our schools (Young-Loveridge, Taylor, Sharma, & Hāwera, 2006).

While traditional instruction may contribute to maths anxiety, so too does the culture of the classroom. Classroom culture can be defined as the behaviours and norms that guide classroom interactions. Experiences of learning mathematics in structured, rigid classrooms include little opportunity for debate or discussion, focus on searching for the one right answer, offer limited encouragement to reflect on thinking, expect quick answers, and emphasise timed tests (Shields, 2005). In such classrooms, it is likely both overt and covert teacher behaviours are implicated in fostering students' maths anxiety (Breen, 2003). These behaviours include: unrealistic expectations of students; gender bias; giving poor explanations; hostility, anger or intimidation; embarrassing students in front of peers if a concept is not understood; and, an insensitive or uncaring attitude (Shields, 2005).

With the advent of National Standards, New Zealand teachers are encouraged to integrate a range of assessment practices that support students' learning. However, we know from the research that implementing effective assessment for learning practices is challenging. Watson's (2000) study of

informal assessment practices in classrooms, found that teachers were more prone to ask students to report mathematics already done. Limited attendance to, and probing of children's thinking means judgments are more likely to be based on written work. Unfortunately, written tests, in particular, are often the primary source for students' anxiety (Shields, 2005). Other types of assessment that might also contribute to maths anxiety are timed assessments or activities within competitive environments. Students who do not perform well on these types of assessment are often left feeling embarrassed and with the belief they cannot do mathematics.

While the classroom and the experiences provided can contribute to maths anxiety, so too can a 'dropped stitch'. These stitches can be described as a gap in a student's prior mathematics learning that prevents more advanced concept learning (Farrell, 2006) and can arise when students miss learning access to particular concepts due to shifting schools, illness, or other personal reasons (Freiberg, 2005).

## MITIGATING MATHS ANXIETY

Current reforms in mathematics education that put the 'spotlight squarely on the social and cultural aspects of mathematical development' (Walshaw & Anthony, 2008, p. 516) require teachers to ensure that all students have opportunities to develop mathematical proficiency that includes a positive mathematical disposition. As maths anxiety is a learned condition (Nolting, 2011), one hopes it can be unlearned. Consequently, teachers have an important role in the reduction or prevention of student maths anxiety. The research literature points to several promising ways teachers can assist in the unlearning, or even prevention, of maths anxiety in students. The variety of ways available to teachers discussed here include: building positive attitudes towards mathematics; utilising journal writing, autobiography, metaphors, drawing, thought bubble pictures, bibliotherapy, and maths related fiction books; promoting an appropriate classroom culture; utilising effective teaching practices; working to reduce one's own maths anxiety; and, involving parents in school mathematics.

To begin, the need to attend to the affective needs of students is discussed. Because emotions drive and intensify thinking in mathematics in profound and powerful ways, identifying students' emotions concerning mathematics is as important as identifying any cognitive skill (Zambo & Zambo, 2006). There is a range of ways in which teachers might first identify student emotions before bringing them out into the open through a classroom discussion of maths anxiety. Journal writing, while typically utilised to create opportunities for students to express their understandings of mathematical concepts, can also be used for sharing and reflecting on feelings about, and experiences with mathematics (Furner & Berman, 2003). Autobiographies (Ellsworth & Buss, 2000) in which students are encouraged to explain their personal mathematics background in writing, including family experiences of mathematics, may also provide students with the opportunity to express their feelings about mathematics.

Metaphors can also be used to identify students' feelings and opinions about mathematics (Wolodko, Willson, & Johnson, 2003). For example, teachers can encourage students to imagine mathematics as an object, thing,

or experience (e.g., a type of food or weather, or an out of school activity) and to explain their choice through writing (see Gibson, 1994). Filling in thought bubbles, as seen in cartoons and comic books, has also been successfully used to reveal students' feelings about participating in mathematics (Zambo & Zambo, 2006). These pictures can be analysed by looking at the faces drawn for physical or emotional clues as well as the symbols, signs and words drawn in the thought bubble itself.

Appropriate children's literature can also provide a way past the obstructions to understanding and engagement that are erected by those who experience maths anxiety. Stories can bring mathematics to life, explaining mathematics concepts visually and providing models for visual interpretation of concepts. More specifically, bibliotherapy, where people are helped to solve problems through the use of books (Aiex, 1993), offers affective strategies to caring teachers for dealing with maths anxiety (Furner, 2004). For example, in the book *Maths Curse* (Scieszka & Smith, 1995), the main character experiences tremendous discomfort when told by Mrs Fibonacci that you can think of almost everything as a maths problem, though comes to realise maths is a means for making life easier. As the character shares their anxiety about maths, students may relate and so be prompted to talk about their own feelings regarding mathematics (Furner & Berman, 2003).

As discussed earlier, classroom culture may, even unwittingly, promote the development of maths anxiety. To prevent or reduce maths anxiety, first and foremost requires a safe environment where students are secure in taking risks and where student thinking is respected. Classroom cultures found to be successful in reducing maths anxiety include asking questions and exploring ideas, thinking to make sense, and taking time for reflection (Haylock, 2007). Also, when assessment activities allow time for anxious students to use such strategies as pausing, looking back, and reading aloud to maintain accuracy, students may be able to successfully compensate for working memory limitation associated with maths anxiety (Hoffman, 2010).

Overriding any pedagogical and participation practices within the classroom is a teacher's attitude. For those teachers that bring maths anxiety with them into the classroom, it is imperative that their own fears and insecure feelings are confronted and controlled (Martinez, 1987). To minimise maths anxiety, teachers need to demonstrate and model a positive attitude, including: portraying an optimistic disposition and a love for mathematics that shows mathematics as a cultural tool; promoting the value of maths by the way it contributes to society; and, getting beyond mathematical myths.

Likewise, supplanting negative attitudes outside the classroom may mean that teachers need to deliberately involve parents in school mathematics. Efforts to mitigate the family/societal impact on maths anxiety might include the organisation of family maths meetings where activities present opportunities to discover mathematical content along with information about teaching and reporting approaches (Furner & Berman, 2003). Another way is to invite parents to be directly involved with students in classroom learning activities, to share how they use mathematics in their careers, or to participate as a coach or mentor for particular students (Ellsworth & Buss, 2000). Regular mathematics 'snippets' in school newsletters or email communications explaining the mathematics learning occurring in classrooms and ways to support and

encourage interest in their children may also prompt greater positive parental involvement in school mathematics (ibid).

## CONCLUSION

Statistical analysis of student's questionnaire data for the PISA 2003 study (see Lee, 2009) confirm that maths anxiety is an important construct, distinguishable from maths self-concept and maths self-efficacy. Lee's analysis suggested that New Zealand students fare well in maths anxiety stakes in that our relatively high maths achievement scores, and positive maths self-concept and self-efficacy scores, are matched by relatively low levels of maths anxiety. Whilst Lee argues that 'academic-motivation constructions such as maths self-concept, maths self-efficacy, and mathematics are inevitably related to the societal and educational environment' (p. 363), the negative impact of maths anxiety on both our students' short-term learning and long-term relation with mathematics, and for prospective teachers within the educational system, remains significant.

Although there is no accurate measure of the number of students within our classrooms that experience maths anxiety, Jennison and Beswick's (2009) recent survey of 40 Year 8 boys in Australia noted that eight students recorded high ratings on maths anxiety measures. Conservatively estimating the level as 10 percent means that there are several students in each of our classes experiencing extreme levels of discomfort with mathematics learning. Not many negative experiences are needed for students to begin a pattern of mathematics avoidance that lingers for the rest of their lives (Middleton & Jansen, 2011). In order to redress this pattern of avoidance and the pervasive attitudes towards mathematics that can frighten and debilitate, maths anxiety is another layer within the diversity of our students that surely needs our attention. To that end, this paper has reopened a discussion that has laid largely silent in New Zealand literature in recent years, and in doing so provides some evidence-based strategies that are worthy of further teacher investigation.

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