

The experience of Mathematics Anxiety in primary schools: A case study

Heidi Kirkland

University of Leicester

Mathematics Anxiety, defined as ‘feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of ordinary and academic situations’ (Richardson and Suinn, 1972, p.551) has been sparsely researched within primary schools in the UK. The phenomenon often develops at primary school age (Sheffield & Hunt, 2006), yet with conflicting literature, research needs to identify the individual experiences of children with Mathematics Anxiety in a qualitative manner in order to move our understanding forward. This pilot study aimed to identify the individual experience of Mathematics Anxiety within primary schools. A case study method was used, focusing upon a 9 year old pupil at a small primary school in the East Midlands, with the pseudonym ‘Lucy’. Findings suggest that her experience of Mathematics Anxiety involved self-comparison to peers and family, avoidance, a lack of self-belief and confidence, as well as consistent worry, embarrassment and uncertainty.

Key Words: Mathematics Anxiety, affective factors, primary school

Introduction

Whilst research into Mathematics Anxiety is increasing, there are still evident gaps in literature. The majority of research is conducted with adolescents or adults (Ashcraft, 2002), predominantly in the USA, using quantitative methodology to measure levels of Mathematics Anxiety. Comparatively, little research qualitatively depicts young children’s experiences of Mathematics Anxiety in-situ within the UK. Researching how Mathematics Anxiety impacts young children has been stated as vital, as this is when it can develop, or more positively, be prevented (Harari, Vukovic & Bailey, 2013).

Aims and Research Questions

The aim of this pilot study was to identify the experience of Mathematics Anxiety in primary school children. This was achieved through answering the following research questions using a case-study design:

- 1. How is Mathematics Anxiety presented in primary school children?*
- 2. How does Mathematics Anxiety affect mathematical learning in primary school children?*

Literature Overview

A well-documented behavioural factor of Mathematics Anxiety is avoidance, which in turn leads to weakened competency (Ashcraft, 2002). Being anxious in Mathematics is also related to poor motivation, a lower perception of Mathematical abilities and a lack of appreciation for how Mathematics is useful in everyday life (Ashcraft, Krause, Hopko, Berch & Mazzocco, 2007). Additionally, anxiety, feelings of helplessness,

dread and worry are regularly identified as emotional traits of Mathematics Anxiety (Ashcraft & Faust, 1994), which can also manifest themselves physically (Ashcraft, 2002). Whilst these may appear similar to other anxieties, such as Test Anxiety, research has shown it to be a separate construct (Jackson, 2008).

However, with no clear criteria for identifying a 'high level' of Mathematics Anxiety, as well as differing measures used to ascertain data, determining the prevalence of mathematics anxiety and related factors is highly problematic (Dowker, Sarkar & Looi, 2016).

The gender of participants may affect the prevalence of Mathematics Anxiety within studies, as literature postulates that females experience a greater degree of anxiety in situations involving Mathematics (Yüksel-Şahin, 2008). However, this is not always agreed upon (Harari et al., 2013).

A further factor that may impact the prevalence of Mathematics Anxiety is the age of participants, as although Mathematics Anxiety can develop early, it increases with age (Dowker, 2005). Mathematics Anxiety is often harder to identify in younger participants, as the effects may be smaller in children compared to adults, or not anticipated and go unnoticed (Chinn, 2009). Mathematics Anxiety can occur in pupils as young as 6 years old (Ramirez, Chang, Maloney, Levine & Beilock, 2016), with the majority of research evidencing the phenomenon in pupils aged between 8 and 12 years old (Wu, Amin, Barth, Malcarne & Menon, 2012). More research needs to be conducted into the experience of Mathematics Anxiety in primary schools, as it appears to be more complex than occurring at one point in time; rather, it evolves and changes over its development (Mishaelides, 2008).

Documented causes of Mathematics Anxiety are the role and influence of parents (Scarpello, 2007) and peers (Stuart, 2000). Teachers have also been identified as influential in the development of Mathematics Anxiety (Shields, 2005). Poor attainment in Mathematics has also been found to lead to the development of Mathematics Anxiety (Deficiency Theory; Tobias, 1986) However, the Cognitive Interference Theory (Wine, 1980) suggests the inverse; Mathematics Anxiety interferes with an individual's ability to recall prior knowledge, leading to weaker Mathematical attainment.

This highlights an issue with current research, as Mathematics Anxiety is a multifaceted phenomenon. By focusing upon one factor related to Mathematics Anxiety, whilst disregarding the evident multitude of factors, data becomes conflicting and difficult to synthesise. Rather, it appears worthwhile to research Mathematics Anxiety from a social inquiry perspective, utilising in-situ data that reflects an individual's own experience of the phenomenon in a rich and meaningful manner.

Methodology

A case-study design was used to conduct the research. The purpose of this research was explanatory, as it aimed to illuminate the connection between different factors of Mathematics Anxiety and thematically identify key aspects that an individual may experience. This was a single case-study for the pilot investigation as only one participant was involved. However, the full-scale research will be a multiple case study with parallel participants.

This investigation occurred in a small primary school in the East Midlands, England, where I work as a Key Stage 2 Teacher. To select a participant for the case study, children who appeared to display symptoms of Mathematics Anxiety were initially identified through discussions with teachers and teaching assistants. These

children then completed the Scale for Early Maths Anxiety (SEMA; Wu et al., 2012), due to its strong reliability and relevance to children aged between 7 and 11 years. This 5-point Likert scale created a numerical score of Maths Anxiety (minimum score 0; maximum score 100), for each participant and aided understanding of how they experience Mathematics lessons and everyday situations involving Mathematics.

This selection process led to a 9 year old girl being asked to participate in the pilot research with the pseudonym of 'Lucy'. Lucy lives with her mother, father and older brother (11 years old) in the East Midlands. Lucy was in Year 4 and she was meeting 'expected attainment' for her age in Mathematics. Her attainment in other subjects, however, was slightly higher, yet still identified as 'expected attainment' for her age.

Lucy was observed weekly in Mathematics lessons to identify her behavioural reaction to learning Mathematics and any discussions she had with their peers, teacher or teaching assistant that reflected her emotional and cognitive reaction as well.

Lucy also had five small, informal interviews with myself. These interviews encompassed topics such as what she liked or disliked about Mathematics, Mathematics outside of school, how she felt during lessons and different situations and how she believed her family and friends perceived Mathematics. Lucy's teacher and teaching assistant were also interviewed one-on-one. These interviews discussed their own attitudes, behaviours and emotions towards Mathematics and how they perceived Lucy's reactions to Mathematical learning and situations.

Results

Scale of Early Mathematics Anxiety (SEMA)

Lucy's score resulting from the SEMA was 62. Whilst this does not identify whether she has a high or low level of Mathematics Anxiety, her responses indicated that she would feel anxious answering questions about: word problems, time and counting in multiples aloud. She also rated her response to the following Mathematical situations as 'highly anxious': learning something new, work on fractions, Mathematics tests, working on the board in front of the class and working on subtraction problems.

Observations

The topics covered in the observed Mathematics lessons were the short formal method of multiplication, multiplying and dividing by 10, 100 and 1000 and telling the time to the nearest minute on analogue and digital clocks. Across all observations, Lucy showed a lack of self-belief, such as copying her partner's answers rather than relying on herself, often rubbing out her work and redoing it and answering questions in the form of an answer, such as "Is it 17 minutes past?". Uncertainty was also seen in all observations, through language such as "I don't get it, I don't get what to do now", "I don't know what I'm doing" and again, answering questions in the form of another question; "Is it in the left column, is it a 7?".

Avoidance was witnessed in all observations through behaviour such as not putting her hand up to answer questions, looking down to avoid eye contact and turning her body away from the teacher during class discussions. Lucy demonstrated reluctance in all but one of the observations, as she often waited for the other children on her table to start work before beginning herself, or waiting for the teacher or teaching assistant to prompt her to begin her work.

Interviews with Lucy

The first interview with Lucy identified that she “sometimes [enjoys] Maths” due to finding some lessons hard and some lessons easy. She found lessons based on the “column method, bus stop method and any formal methods” easy, but she did not enjoy “when we do tests and we haven’t learnt that yet... I’m worried I’m not going to get one mark or anything”. She also indicated that when she is learning something new she feels “really nervous” and that when she has learnt something, she feels “probably more confident, because I know a bit about it”. Outside of school, Lucy shared that her father “gives me sheets of Maths” and she also goes shopping with her parents weekly.

The second interview with Lucy focused upon the results of the SEMA. When speaking about word problems, Lucy stated that she “wouldn’t be able to do it. It would just like block and I would feel panic”. When asked questions about telling the time, Lucy said “I struggle doing it, it’s like being put on the spot. I just have no clue” and “I just feel nervous, especially in front of people”. In relation to the situations discussed in the questionnaire, when learning something new Lucy said she would feel nervous because “I wouldn’t know anything about it. I look at others around me and it makes you feel scared like they can see my work...”. After saying that she doesn’t put her hand up to ask questions, she explained “I hate it like when, when everyone sees you and looks at you because I’ll probably get it wrong”.

The following interview focused on Mathematics at home and at school. Lucy felt that she was not good at Mathematics “because I’m not confident and when [the teacher] asks me to do something I always say to myself I’m not going to be able to do this... I panic first and worry it just stops me understanding it quicker”. Lucy said that she enjoyed counting money in her piggy bank “because no one else is involved or watching”, but when talking about her parents, she stated “they show me the clock and ask me to work it out but I hate it so I just don’t ask them what the time is anymore”.

The last interview focused on parental and peer thoughts about Mathematics. Lucy felt that her Father wanted her to do the best in Mathematics as “he gives me lots of practice papers especially over summer holidays so I can get better at Maths”. She felt that her brother is “really confident in Maths. He finds it easy like he works a lot on Maths at home and he tries really hard... He’s really confident at it and I’m not”. She also said in relation to discussing Mathematics with her friends “I avoid it now... I just feel different to them”.

Interviews with Lucy’s Teacher and Teaching Assistant

Lucy’s teacher stated that he did not feel any anxiety when answering Mathematical questions or being involved in Mathematical situations. When discussing Lucy, he felt that “she is very timid, much more so than in other lessons. She doesn’t put her hand up to answer questions... She looks downwards a lot”. When asked about Lucy’s language that she uses to express herself in Mathematics, he said “She doubts herself a lot. So, rather than being assertive, she poses it more as a question. She doesn’t have the belief that she’s right”. He also identified that Lucy may receive pressure from home due to “expectations, maybe. I know she compares herself to other children in the class so maybe she does that at home”.

Lucy’s teacher assistant identified that when she was at school herself, she “didn’t understand [Maths]. I struggled, I just didn’t get it”. When discussing Lucy’s behaviour in Mathematics lessons, she stated “she’s capable but she’s just doubtful all

the time... she doesn't like failure". She also identified that "she often says she can't do it, or she doesn't understand it".

Discussion

Through coding the all data individually, themes emerged. These individual themes that were drawn from the different aspects of the collected data were then compared to create themes that were seen across the data. These themes were; self-comparison to family and peers, emotions such as lack of confidence and self-belief, worry, embarrassment and uncertainty, as well as behaviour such as reluctance and avoidance.

Whilst these key factors were prevalent in Lucy's experience of Mathematics Anxiety, it is understood that each individual's experience of Mathematics Anxiety is different and these factors may not be applicable to all. It is also noted that Lucy stated that she only felt these emotions during certain Mathematical topics and situations, leading to the need for more observations during lessons where she felt they were 'easy' to identify any difference in behaviour.

This data does, however, support previous literature that Mathematics Anxiety is related to peers (Stuart, 2000) and parents (Scarpello, 2007). It also supports literature stating that emotions such as embarrassment, worry and a lack of confidence and self-belief occur when individuals experience Mathematics Anxiety (Ashcraft & Faust, 1994), as well as behaviour such as avoidance (Ashcraft, 2002).

There is currently little literature surrounding uncertainty and reluctance in Mathematics Anxiety, yet these terms may not be used specifically as they are similar to other emotions, such as low motivation (Ashcraft et al., 2007). Additionally, due to the majority of research involving adolescents and adults, feelings of uncertainty and reluctance to work in Mathematics lesson may not have been applicable to participants in these studies.

This pilot study is limited in generalisability due to only one participant's experience of Mathematics Anxiety being identified. However, this enabled the analysis of rich data that aids understanding of the individual nature of Mathematics Anxiety.

For the full-scale research, there will be three participants recruited within Key Stage 2 and it will be conducted in two stages. The first stage will reflect the pilot study in identifying the individual experience of Mathematics Anxiety. The participant's parents will also be interviewed to aid understanding further. The participants' experiences of Mathematics Anxiety will be thematically analysed on an individual basis, as well as compared to each other in order to identify whether there are factors experienced by all participants.

The second stage will be action-based research, which will focus upon the development and impact of personalised interventions to decrease Mathematics Anxiety in participants. These interventions will be tailored to each participant's needs and their Mathematics Anxiety will be re-assessed immediately afterwards, as well as after another three months, to identify any short or long term impacts. It is hoped that this will provide a much-needed insight into the nature of Mathematics Anxiety in primary schools and provide individualised support and understanding for those children who truly need it.

References

- Ashcraft, M. H. (2002). Math anxiety: Personal, educational, and cognitive consequences. *Current Directions in Psychological Science*, *11*(5), 181-185.
- Ashcraft, M. H., & Faust, M. W. (1994). Mathematics anxiety and mental arithmetic performance: An exploratory investigation. *Cognition & Emotion*, *8*(2), 97-125.
- Ashcraft, M. H., Krause, J. A., Hopko, D. R., Berch, D. B., & Mazzocco, M. (2007). Is math anxiety a mathematical learning disability. In Berch, D. B., & Mazzocco, M. (Eds.), *Why is math so hard for some children* (329-348). Baltimore: Brookes.
- Chinn, S. (2009). Mathematics anxiety in secondary students in England. *Journal of Dyslexia*, *15*(1), 61 – 68.
- Dowker, A. (2005). Early identification and intervention for students with mathematics difficulties. *Journal of learning disabilities*, *38*(4), 324-332.
- Dowker, A., Sarkar, A., & Looi, C.Y. (2016). Mathematics anxiety: What have we learned in 60 Years? *Frontiers in psychology*, *7*, 508.
- Harari, R., Vukovic, R., & Bailey, S. (2013). Mathematics anxiety in young children: an exploratory study. *The Journal of Experimental Education*, *81*(4), 538-555.
- Jackson, E. (2008). Mathematics anxiety in student teachers. *Practitioner Research in Higher Education*, *2*(1), 36-42.
- Mishaelides, M. (2008). Emerging themes from early research on self-efficacy beliefs in school mathematics. *Electronic Journal of Research in Educational psychology*, *6*, 219-234.
- Ramirez, G., Chang, H., Maloney, E. A., Levine, S. C., & Beilock, S. L. (2016). On the relationship between math anxiety and math achievement in early elementary school: the role of problem solving strategies. *Journal of Experimental Child Psychology*, *141*, 83-100.
- Richardson, F. C., & Suinn, R. M. (1972). The mathematics anxiety rating scale: Psychometric data. *Journal of Counseling Psychology*, *19*(6), 551.
- Scarpello, G. (2007). Helping Students Get Past Math Anxiety. *Techniques: Connecting Education and Careers*, *82*(6), 34-35.
- Sheffield, D., & Hunt, T. (2006). How does anxiety influence maths performance and what can we do about it? *MSOR Connections*, *6*(4), 19.
- Shields, D. J. (2005). Teachers have the power to alleviate math anxiety. *Academic Exchange Quarterly*, *9*(3), 326-331.
- Stuart, V. (2000). Math curse or math anxiety? *Teaching Children Mathematics*, *6*(5), 330.
- Tobias, S. (1986). Anxiety and cognitive processing of instruction. *Self-related Cognition in Anxiety and Motivation*, *2*, 35-54.
- Wine, J. (1980). Cognitive-attentional theory of test anxiety. In I. G. Sarason (Ed.), *Test anxiety: Theory, Research, and Applications* (349-385). Hillsdale, NJ: Erlbaum.
- Wu, S., Amin, H., Barth, M., Malcarne, V., & Menon, V. (2012). Math anxiety in second and third graders and its relation to mathematics achievement. *Frontiers in Psychology*, *3*, 62.
- Yüksel-Şahin, F. (2008). Mathematics anxiety among 4th and 5th grade Turkish elementary school students. *International Electronic Journal of Mathematics Education*, *3*(3), 179 – 191.