MATHS ANXIETY

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Overview

• Definition of maths anxiety and how it affects the brain

• What causes maths anxiety and what is the impact?

• Strategies for reducing maths anxiety in the classroom

• Strategies for supporting students with maths anxiety

• Interim results for our study on the effectiveness of several suggested strategies
Maths anxiety

• “feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of ordinary life and academic situations” Richardson and Suinn (1972).

• “an emotion that blocks a person’s reasoning ability when confronted with a mathematical situation” Spicer (2004).
Student X describes her first maths lesson

• “Well what can I say, after loosing [sic] sleep, worrying about maths my fear was true. I arrived this morning with complete brain block and anxiety. Nervous, scared and petrified of the maths lesson, even though I had read the class notes.”

• “Once the teacher started talking my mind went blank as if she was talking a different language, everything she said went in one ear and out the other…”

• “As she asked us to practise questions my mind went on shut down, I started sweating thinking o [sic] my god what if she asks me?”
Statistics anxiety

• “Statistics anxiety (SA) is the specific feelings of anxiety students experience when they encounter statistics, for example, gathering, processing, and interpreting data.” (Cruise et al., 1985)

• Strong relationship with maths anxiety

• Statistics anxiety highest predictor of poor performance in research methodology courses (Onwuegbuzie et al., 2000)

• Affects a student’s ability to fully understand research articles, as well as to analyse and to interpret statistical data (Onwuegbuzie, 1997)
Signs and symptoms

- **Anxiety**: Appears generally anxious and doesn’t appear to take anything in especially near exams
- **Panic**: Feeling of helplessness that will not go away
- **Paranoia**: Believing that they are the only person not capable of doing maths
- **Passive Behaviour**: Feeling there’s no point in trying/wanting to quit and go home
- **Lack of Confidence**: Don’t know where to start/expect to never know the answer to questions
Neuroscience of Maths Anxiety

• **Very recent research** (2012-2015) using brain scanners (fMRI) have shown that maths anxiety has measurable effects on brain function.

• We summarise some of these findings by explaining what happens in the brain when someone experiences maths anxiety.
“I just can’t think about maths”

- Maths anxiety eats away at your working memory (WM) because the brain is too busy worrying about maths rather than doing maths.

- This makes maths seem harder than it really is.

[Young et al., 2012]
“I can’t get started” / “I just can’t switch onto maths”

• Like an engine, the brain has an ‘idling state’ when it isn’t focusing on a task. This turns off when you focus on doing something.

• Maths anxiety prevents this ‘idling’ state from switching off, making it hard to focus on maths.

• Students may feel like they “don’t know where to start” to solve a problem.

[Pletzer et al., 2015]
“Maths hurts my brain”

• Thinking about maths actually activates the regions of the brain associated with pain.

  BUT

• Actually doing mathematics does NOT activate these pain regions.

  [Lyons & Beilock, 2012]
Maths avoidance

• Brain sees maths as a threat, so activates ‘fight or flight’.

Eyes see maths

Brain thinks “tiger!”

TEST

30 + 30 × 0 + 1 =

a) 1
b) 31
c) 61
Discussion

• Which factors do you think may lead to maths anxiety?

• How do you think maths anxiety impacts on students’ ability to study maths effectively, or their choices?
Negative maths experiences

- Insensitive/uncaring teachers
- Told “maths is easy/difficult” when struggling
- Overly traditional ‘Victorian’ teaching methods
- Parental maths anxiety / no help offered
- Embarrassment and humiliation
- Building blocks are missing
- Stereotypes about maths
- “Maths is not cool!”
Prevalence

- 85% of students in introductory math classes claimed to experience at least mild math anxiety (Perry, 2004).

- Jones (2001) found that 25.9% of 9000 American students had moderate to high levels of maths anxiety.

- Students with dyslexia (Jordan et al., 2014) and dyscalculia (Rubinsten & Tannock, 2010) have a greater risk of MA.

Results for 561 University of Sheffield students:

- 88% expect to study maths or statistics as part of their course (7% didn’t know and 5% do not).

- 48% of these students were worried about it.
Brains of students with MA have been conditioned to bias avoidance over approach when thinking about doing mathematics.

Poor performance in maths or stats modules can lead to failure and even dropping out.
Impact of Maths Anxiety

- Fear of failure when encountering maths/statistics
- Frustration from trying and not being successful
- Begin to shut down and stop listening in class

43% of those surveyed said a fear or dislike of maths had affected at least one of their A level, degree, module, or job choices.
Discussion

• How did you feel about maths when you last studied it? Do you have any anxiety about maths or have you noticed students with anxiety?

• What may contribute to maths anxiety at University?

• What do you think may help reduce maths anxiety and increase confidence?

• Think about teaching methods and additional support.
In the classroom

- What do you really want them to achieve from the course?
- **Constructivist** teaching rather than rote learning
- Students *construct their own methods* rather than memorising
- Start with what the students know and work from there (*scaffolding*)
- Activity-based courses – practice is essential
- Flipped classroom approach
- Peer learning – get students to work together in class
- Enthusiastic teachers with a good knowledge of maths

[Adapted from Finlayson, (2014)]
Relevance

• Students are more motivated if they see the relevance of studying maths/stats to their discipline or general life.

Offer a variety of learning resources

Online/ distance learning helps

http://www.bbc.co.uk/skillswise/topic
Real-life data / project-related

- Build up through stages of a project
- Use computer-based methods
- Humour and teaching gimmicks (Schacht & Stewart, 1990) such as using students as the source of data
- Concrete, real life problems that students can relate to (Finlayson, 2014)

More Britons than Americans died on Titanic 'because they queued' 

http://www.independent.co.uk/news/world/australasia/more-britons-than-americans-died-on-titanic-because-they-queued-1452299.html
Desensitisation

- Were Americans more likely to survive?
- Build on previous knowledge
- Spend more time on the basics
- Use graphs of relevant data and get students to explain them
Tests

- Having one test only means **anxiety builds up** as there’s no feedback to suggest students can do it.
- **Untimed, unassessed** tests decrease anxiety

**Diagnostic tests:** Identify weaker areas

**Self-check tests & retesting** (Juhler, 1998)

**Feedback** (Núñez-Peña et al., 2015)

**Untimed/open book exams**

Confidence increases
Online tests

- Online learning, unassessed tests with an option for retesting and feedback all reduce anxiety

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**Question 6**

If $x^3 \div x^5 = x^n$, what is the value of $n$?

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**Incorrect answer feedback**

Correct Answer: $-2 \pm 0\%$

Response Feedback: $xa \div xb = x a - b$

As an example, $x^{10} \div x^5 = x^{10 - 5} = x^5$

$n = 5$. Make use of the following resource(s) to revise if necessary:

- http://www.bbc.co.uk/education/guides/z4dp34j/revision/1
- http://www.mash.dept.shef.ac.uk/Resources/indices2.pdf

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Question student answered. 3 and 5 will be different if the test is repeated.

Example of how to do the question.

Additional online resources.
Benefits of one-to-one support

- Most effective method for overcoming maths anxiety but an estimated 33% of ‘at-risk’ students do not use MSC support (O’Sullivan et al., 2014)

- Quiet, relaxed, supported study area and encouragement of peer learning (Patel & Little, 2006)

- Tailoring to the individual, allowing enough time for inquiry and conceptual development (Woodard, 2004)

- Immediate feedback reduces the time it takes for students to achieve a desired level of understanding (Anderson, Conrad, and Corbett, 1989) and reduces the negative impact of MA (Núñez-Peña et al., 2015)
Student X on her first MASH visit

“I then went up to 301 where I discussed my maths worries with Ellen and Alex, and they gave me the support I needed. After calming down and relaxing with Alex I could understand how to do what was asked of me in 35 years I have never been able to do maths, yet once calm I sat there and was able to. My pulse rate slowed down my brain absorbed the maths questions and how to do it.”

“This made me more confident and made me believe in myself that I could do the questions alone. I am so thank full [sic] for a lesson learnt today was to ask for help and relax!”
Non-maths strategies

• **Maths anxiety awareness**: Becoming self-aware of one’s maths anxiety assists in its reduction (Uusimaki & Kidman, 2004)

• **Self belief**: Students need to accept that effort is needed, get help from peers or 1:1 support if needed and believe that they can pass (Perry, 2004)

• **Writing about anxiety**: 10-15 mins writing before a test means that the brain concentrates on writing rather than worrying (Ramirez & Beilock 2011)
Recommendations for support staff

- **Identify students** exhibiting signs of maths anxiety
- Make them aware of the **effect MA has on the brain**
- **Visit and liaise** with staff in the maths support centre (MSC)
- Take student to MSC and stay with them the first time
- Encourage students to use the MSC as **early/regularly** as possible in their course
- Encourage **peer learning** / group work
- Encourage students to use **online resources**
But the cycle can be BROKEN!

- Negative maths experience
- Maths avoidance and procrastination
- Awareness Feedback
  1:1 support
  Group learning
- Poor maths performance
- Poor preparation
But the cycle can be BROKEN!

- Positive maths experience
- Maths avoidance and procrastination
- Poor maths performance
- Poor preparation

Awareness Feedback 1:1 support Group learning
But the cycle can be BROKEN!

- Positive maths experience
- Maths engagement
- Awareness Feedback
  1:1 support
  Group learning
- Poor maths performance
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But the cycle can be BROKEN!

- **Positive maths experience**
- **Maths engagement**
- **Awareness Feedback**
  - 1:1 support
  - Group learning
- **Poor maths performance**
- **Good preparation**
But the cycle can be BROKEN!

Positive maths experience

Maths engagement

Awareness Feedback
1:1 support
Group learning

Improved maths performance

Good preparation
Case study discussion

• A student comes in for stats support
• She is visibly nervous and tells me that her coursework is due in a few days but she hasn’t started it yet
• She doesn’t appear to be taking anything in and repeatedly tells me that she failed GCSE maths 8 times

• What approaches do you think I should use?

• Which strategies do you think you could use to teach or support students with maths anxiety?
Desensitisation for stats

Student B
- Devised a plan of action – what’s realistic in a few days
- Covered data types, asking questions at each step
- Produced graphs in SPSS and discussed interpretation
- She started listening and was engaged
- Burst into tears at summary statistics so went back to graphs
- Attended several sessions and wished she had come earlier
Strategies used in project

**Main study:** All 83 DLL 2015-16 students are taking part in the study which involves evaluating the effectiveness of the following strategies.

1. Awareness of maths anxiety (workshop)
2. Receiving 1:1 maths support (MASH)
3. Unassessed tests with an option for repeating with different numbers (MOLE quizzes)
Maths anxiety workshop

• Workshop for ALL students in first maths lesson
• Discussion of what anxiety is, drawing on past experiences
• The causes and effects of maths anxiety
• Strategies for overcoming maths anxiety

How MASH can help

- Free 1:1 support for any aspect of maths/stats.
- Quiet relaxed space to work and ask for help.
- You are able to ask questions without fear of humiliation.
- Explanations tailored to your learning style.
- Additional workshops/resources/tests.
- Peer learning – why not do your maths/stats homework here?
- Complete the online weekly test on our computers.

2. Doing lots of tests increases anxiety **False**

- Having one test only means anxiety builds up as there’s no feedback to suggest you can do it.
- Untimed, unassessed tests decrease anxiety.

93% agreed it was interesting and 90% agreed it was useful
Outcomes from the workshop

78% of anxious group felt less anxious after the workshop

59% felt more confident

Excellent feedback given to DLL staff – asked to do session again next year

44% of 57 giving feedback classified their anxiety as moderate to very high
Outcomes from online resources

By week 6, 69% of all students had attempted at least one test and 52% had attempted at least 2.

Teacher comment: I've had several students commenting on the usefulness of the weekly MOLE quizzes, especially the ability to take them again and again.
Outcomes from MASH engagement

- Despite the encouraging feedback from the workshop, students were still not using MASH by week 6.

The success story: One student uses MASH every week to go over class material. She even managed to go through the week 10 material by herself.
Peer learning

- Student X is our first MA ambassador
- Encouraging others, via facebook, to study together, come to MASH, and use online tests
- Increased attendance at MASH
- Anxious students are seeing the benefits
- Explaining questions to others
- Will make a short video for us for next year’s cohort
Where next?

- Alternative methods for stopping maths avoidance and encouraging MASH use
- Roll out awareness workshop on academic skills programme
- Maths anxiety webpage http://www.sheffield.ac.uk/mash/anxiety
  - With staff and student hand outs
  - Useful references
  - Links to online test resources

- Stats for the terrified
- More collaboration
Contact details

- Email addresses
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Any questions or suggestions?
Key references


References


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