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Webinar 04/02/2025: The Effect of Maths Difficulties on Exam Performance

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The Effect of Maths Difficulties on Exam Performance

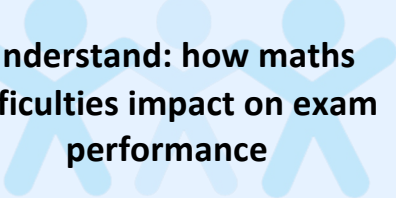
The Effect of Maths Difficulties on Exam Performance

Course Tutor: Rebecca Thompson
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1 


SESSION OUTCOMES YOU WILL BE ABLE TO...

Understand: how maths difficulties impact on exam performance

2 

Importance of maths

- DfES, 2001 states that 'poor numeracy skills are a greater impediment to life chances than poor literacy skills.'

3 

The Effect of Maths Difficulties on Exam Performance

On the screen:

Handout 1

- ‘Disadvantaged pupils further behind in maths since Covid, English study finds’
- This document can be found at:
<https://tinyurl.com/3tjm7xac>
- Numbered handouts are found in your Course Materials, after the PP slides

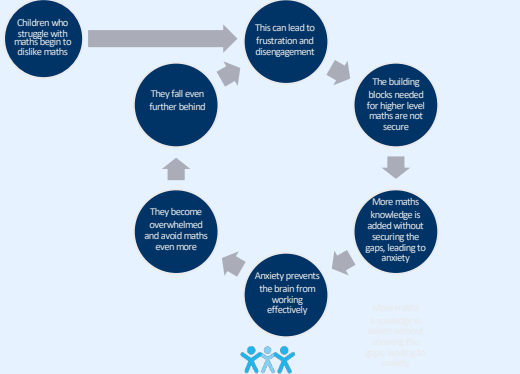
4

ACTION POINT

Read through the article:
‘Disadvantaged pupils further behind in maths’ about the attainment gap. (Handout 1)

5

“Matthew Effect”



6

The Effect of Maths Difficulties on Exam Performance

How maths difficulties impact

Motivation

- students who struggle with maths may feel discouraged
- and*
- have lower motivation to prepare for and perform well in exams with a maths component

7



How maths difficulties impact

Reduced Confidence

- This lack of confidence can spill over into other subjects, especially during exams, and hindering performance

8



How maths difficulties impact on exam performance

- Mathematical skills are cross-curricular
- Maths is interwoven into academic subjects in a variety of ways

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The Effect of Maths Difficulties on Exam Performance

Why do people struggle with maths?

- Working memory
- Maths anxiety
- Executive functioning
- Language of maths
- Spatial skills
- Magnitude skills

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Working memory

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Working memory - definition

- Working memory is the cognitive system that allows people to retain access to a limited amount of information, in the service of complex cognition (Shipstead et al, 2014)

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The Effect of Maths Difficulties on Exam Performance

Impact of poor working memory

Problem-Solving

- Maths skills like logical reasoning, critical thinking, and algorithmic thinking are essential for problem-solving

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Science and Working Memory

- Science problems frequently require breaking down complex activities into smaller, manageable steps

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Science and Working Memory

c) The 'laws of football' require the ball to have a circumference between 680 mm and 700 mm. The pressure of the air in the ball is required to be between 0.60×10^5 Pa and 1.10×10^5 Pa above atmospheric pressure.

A ball is inflated when the atmospheric pressure is 1.00×10^5 Pa and the temperature is 17 °C. When inflated the mass of air inside the ball is 11.4 g and the circumference of the ball is 690 mm.

Assume that air behaves as an ideal gas and that the thickness of the material used for the ball is negligible.

Deduce if the inflated ball satisfies the law of football about the pressure.

molar mass of air = 29 g mol^{-1}

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<https://tinyurl.com/ye276tkz> (Access Tuition)

The Effect of Maths Difficulties on Exam Performance

Science and Working Memory

Formulas and Equations

- A strong foundation in maths helps students to manipulate these equations to solve problems or understand the relationships

16



Business studies and Working Memory

Premium Motors has received a booking for a wedding in Manchester that requires four cars. Premium Motors will make £50 profit per car.

The costs will be as follows:

- driver £50 per car
- petrol £20 per car
- £200 payment towards fixed costs.

Calculate Premium Motors' revenue for this booking.

[5 marks]

17

<https://tinyurl.com/2buay3mu> (AQA)

Business studies and Working Memory

- VC per car = £50 + £20 = £70 (1)
- Total variable cost = £70 × 4 = £280 (1)
- Total costs = £280 OFR + 200 = £480 (1)
- Total profit = £50 × 4 = £200 (1)
- Revenue = £480 OFR + £200 = £680 (1)


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The Effect of Maths Difficulties on Exam Performance

Economics and working memory

Problems of	Requiring calculations
<ul style="list-style-type: none"> • resource allocation • market behaviour • economic policy 	<ul style="list-style-type: none"> • Percentages • Ratios • Elasticities • Basic algebra

19 


Economics and working

05 If UK GDP in 2012 was \$2375 billion, use the data in **Extract D** to calculate, to the nearest \$billion, the difference in forecast UK GDP between the IMF's initial and revised growth forecasts. [2 marks]


Calculation:
 The initial forecast is for a 0.9% growth therefore \$2396.375bn; however the new forecast is 1.4%, giving \$2408.25bn. The difference is therefore \$11.875bn (\$12bn to the nearest bn).

Response	Marks
For the correct answer with the units specified (ie \$bn) and to the nearest \$bn	2 marks
For a correct answer but without the units and/or not to the nearest \$bn	1 mark

MAXIMUM FOR QUESTION 05: 2 MARKS

20 <https://tinyurl.com/5d3v58s5> (AQA) 

Executive functioning

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Executive functioning - definition

- Executive functioning is a set of mental skills including
 - working memory
 - flexible thinking
 - self-control

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Executive functioning skills

Shifting

- adapt thinking to new information
- switching between operations

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Executive functioning

Fractions


- 4 is larger than 2
- We must shift our perception that 4 is larger than 2 when comparing $\frac{1}{4}$ and $\frac{1}{2}$

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The Effect of Maths Difficulties on Exam Performance


Maths anxiety

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Maths anxiety - definition


- 'A negative emotional reaction to maths, leading to varying degrees of helplessness, panic and disorganisation'

(<https://mathsanxietytrust.com>)

26 

Maths anxiety

- Maths anxiety can have a significant negative impact on working memory, which, as we have seen, can hinder maths performance

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The Effect of Maths Difficulties on Exam Performance

Maths anxiety

- Working memory acts like a mental scratchpad with limited capacity
- Anxiety about maths uses up space in this scratchpad
 - leaving less room for the actual maths tasks

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Maths anxiety

- People with high working memory capacity can rely on strategies that require holding more information in mind at once
- Maths anxiety can disrupt these strategies
 - making it harder to solve problems effectively

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Maths anxiety

- Maths anxiety can be like having a second, distracting task running in your head while you are trying to do maths
- This divided attention makes it harder to hold all the information you need in working memory at once

30



The Effect of Maths Difficulties on Exam Performance

Maths anxiety

31 <https://mathsanxietytrust.com>

Maths anxiety

- When taking timed tests, students who are fast usually remain fast while students who are slow remain slow—and become slower as maths anxiety sets in

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“Matthew Effect”

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Maths anxiety – further information

- <https://educationaccess.co.uk/toasty-tips/>
- <https://educationaccess.co.uk/maths-anxiety/>
- <https://dyscalculianetwork.com/dyscalculia-maths-anxiety/>

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Maths anxiety

- Pass on a positive attitude
 - ‘I can’t do it... yet’ attitude
 - a growth mindset
 - and supporting a ‘growth zone’ attitude

<https://tinyurl.com/3925k6hp>
(Derby University)

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The language of maths

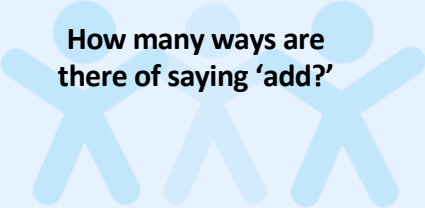
36



The Effect of Maths Difficulties on Exam Performance

ACTION POINT

How many ways are there of saying 'add?'




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The language of addition

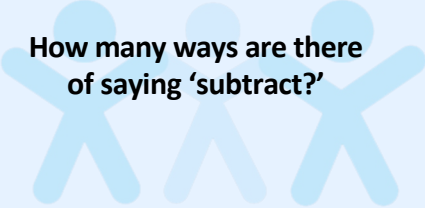
And	Sum	Add	Made larger
In excess	Greater	More than	Added to
Increased by	In addition	Plus	Raised by

38



ACTION POINT

How many ways are there of saying 'subtract?'



39

The Effect of Maths Difficulties on Exam Performance

The language of subtraction

Decreased by	Diminished by	Subtract	Reduce
Difference	Less than	From	Minus
	Made smaller by	Take away	

40



The language of maths

Bubble

The diagram shows 15 identical circles arranged as a rectangle, and a shaded triangle.

The vertices of the triangle are at the centre of circles.

Not drawn accurately

35 cm

Calculate the area of the shaded triangle.

41

<https://tinyurl.com/yds5u4mx> (AQA)

The language of maths

Cuboid Ratio

Not drawn accurately

The ratio of the length : height : depth of this cuboid is 1 : 2 : 3

The total surface area is 4950 cm².

Find the length, height and depth of the cuboid.

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<https://tinyurl.com/yds5u4mx> (AQA)

The Effect of Maths Difficulties on Exam Performance

Language of maths: Economics

- 1.2.3
Price, income and cross elasticities of demand
- a) Understanding of price, income and cross elasticities of demand
 - b) Use formulae to calculate price, income and cross elasticities of demand
 - c) Interpret numerical values of
 - o price elasticity of demand: unitary elastic, perfectly and relatively elastic, and perfectly and relatively inelastic
 - o income elasticity of demand: inferior, normal and luxury goods; relatively elastic and relatively inelastic
 - o cross elasticity of demand: substitutes, complementary and unrelated goods
 - d) The factors influencing elasticities of demand
 - e) The significance of elasticities of demand to firms and government in terms of:
 - o the imposition of indirect taxes and subsidies
 - o changes in real income
 - o changes in the prices of substitute and complementary goods
 - f) The relationship between price elasticity of demand and total revenue (including calculation)

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<https://tinyurl.com/34xtpar3> (Edexcel)

Language of maths: Architecture

- The number of faces is two more than the number of sides in the cross section. Why?
- The number of edges is three times the number of sides in the cross section. Why?
- The number of vertices is two times the number of sides in the cross section. Why?

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Language of maths: Architecture

- Use plans from different viewpoints to represent 3D objects
- Draw isometric drawings of 3D objects.
- Create nets for polyhedra
- Interpret the above representations to create a model of the 3D object

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ACTION POINT

Have a think about your own specific teaching subject.
What technical vocabulary may pose a problem for your students in exams?

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Spatial skills

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Spatial skills - definition

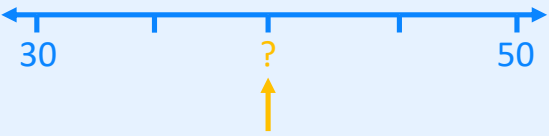
- The ability to mentally manipulate, organise, reason about and make sense of spatial relationships
- Required when reading and interpreting graphs, using a number line, lining up calculations and comparing visual quantities

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Spatial skills




A horizontal blue number line with arrows at both ends. It has tick marks at 30 and 50. A yellow question mark is positioned above a tick mark between 30 and 50. A yellow arrow points upwards from below the number line to the question mark.

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Spatial skills and music

- The notes have a position on the staff
- Treble clef or bass clef give different meanings



A musical staff with a bass clef and a key signature of one sharp (F#). The notes are G2, A2, B2, C3, D3, E3, F#3, G3. A triplet bracket is under the last three notes (D3, E3, F#3).


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Spatial skills and Geography

- Geography relies heavily on spatial reasoning, for example:
 - The relationships between locations on Earth
 - Latitude and longitude

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Spatial skills and Geography

- This can involve interpreting maps, globes, and satellite imagery
- Difficulty with scale (e.g. understanding distances on a map) can make it challenging to visualise geographical concepts

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Spatial skills and design technology

- Students might need to calculate angles for stability, visualise 3D objects from 2D drawings, or factor in geometric constraints when designing mechanisms

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Magnitude

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The Effect of Maths Difficulties on Exam Performance

Magnitude - definition

- In maths, the magnitude or size of a mathematical object is a property which determines which is larger or smaller

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Magnitude and Music

Examples of notes to show length

Note values (beats)

Rest values (beats)

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Magnitude and Music

ABRSM

Prev Nav Next

Select the correct time signature for the bar.

9/8

4/4

7/8

57




The Effect of Maths Difficulties on Exam Performance

Magnitude and PE

Performance Tracking

- Setting personal goals for improvement
 - running speed
 - jump distance
- keeping track of data
- using it to measure progress

58 


Video clip Adelle Tracey
<https://tinyurl.com/yh7z94y5>
(Sky Sports)

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Magnitude and PE – Adelle Tracey

Impact on:

- Numbers
- Distance she has run
- How far a distance is when training
- Telling the time


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The Effect of Maths Difficulties on Exam Performance

Magnitude and History

Chronology and Timelines


- Understanding historical sequences and creating timelines relies on a grasp of numbers and scales

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Magnitude and History

Map Analysis and Distances

- Difficulty understanding scale or interpreting maps can make it challenging to visualise the geographical context of historical events, like troop movements or trade routes

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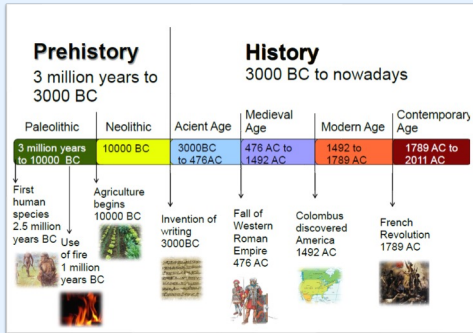
Magnitude and History

- Students struggling with maths might find it difficult to place events in proper chronological order or visualise the vast timescales involved in historical processes

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The Effect of Maths Difficulties on Exam Performance

Historical timeline



<https://tinyurl.com/msprk37c> (pinterest)

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Magnitude and Design Technology

Scale and Proportion

- Scaling up or down designs requires understanding ratios and proportions
- Calculating the dimensions of a miniature model based on a full-sized design
 - or vice versa

65



Magnitude & Design Technology

2 | 0 | Figure 7 shows a structure made from a number of material lengths cut and bent to shape.

Figure 7

Each hoop is of a diameter 90 mm

Each leg is 120 mm in total length

2 | 0 | 1 | Calculate the length of material required to make one hoop to the nearest whole millimetre.

Show your working. [3 marks]

<https://tinyurl.com/3fhnv6ra> (AQA)

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The Effect of Maths Difficulties on Exam Performance

Magnitude and Geography

Latitude and Longitude

- The global coordinate system is defined in terms of latitude and longitude
- Difficulty understanding these systems can make it challenging to interpret maps

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Magnitude and Food Technology

Recipe Scaling and Conversions

- Following recipes precisely often involves scaling ingredients or converting between measurement units (grams to cups, ounces to millilitres).

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Magnitude and Food Technology

- If a recipe is for 4 people but there are 6 people coming, it will be difficult to work out how much will be required
- A difficulty with reading numbers may make it difficult to know how much the recipe is asking for

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The Effect of Maths Difficulties on Exam Performance

On the screen:

Handout 2

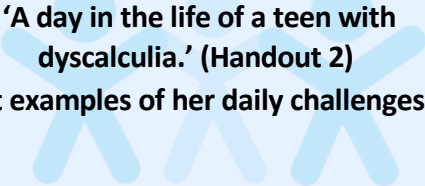
- 'A day in the life of a teen with dyscalculia'
- This document can be found at: <https://tinyurl.com/yh7z94y5>

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ACTION POINT

Read through the article:
'A day in the life of a teen with dyscalculia.' (Handout 2)
List examples of her daily challenges.

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A day in the life of a teen

- Timing and estimating
- Self-esteem
- Working with money
- Maths anxiety
- Gauging speed and distance
- Measuring
- Visual-spatial

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Data analysis

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Data analysis and History


- Identify Trends and Patterns from historical data such as:
 - population statistics
 - economic indicators
 - military casualties

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Data analysis and Geography

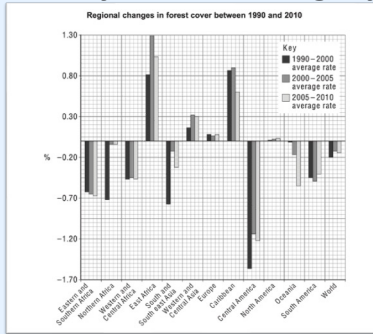
Data Analysis and Statistics

- Modern geography utilises a lot of data analysis, looking at demographics, climate patterns, or economic indicators

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The Effect of Maths Difficulties on Exam Performance

Data analysis and Geography



<https://tinyurl.com/t6ychbmd> (AQA)

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Data analysis and Economics

- Economists use a vast amount of data to analyse trends, measure economic performance, and test hypotheses
- This data is often presented in tables, charts, and graphs

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Data analysis and Economics

- Difficulty with interpreting these visualisations and graphs can hinder a student's ability to draw meaningful conclusions from data

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The Effect of Maths Difficulties on Exam Performance

Summary

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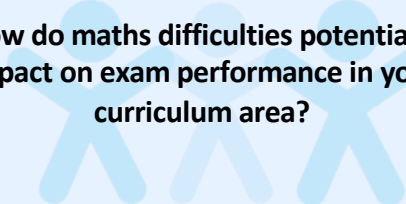
Why do people struggle with maths?

- Working memory
- Maths anxiety
- Executive functioning
- Language of maths
- Spatial skills
- Magnitude skills

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ACTION POINT

How do maths difficulties potentially impact on exam performance in your curriculum area?




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The Effect of Maths Difficulties on Exam Performance


In summary

- Data handling as part of a survey in a Geography exam
- Using graphs to show deaths as part of the Plague in a History exam
- Linking timing in athletics with accuracy in a PE practical exam
- All science qualifications

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In summary

- Answering questions in a music exam, (both theoretical and practical) on areas such as counting, rhythm, scales, intervals, patterns, harmonies, time signatures, overtones, tone and pitch (BDA, 2019)

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On the screen:

Handout 3

- Maths difficulties in exams

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The Effect of Maths Difficulties on Exam Performance

In conclusion

- Maths occurs in more places than we realise across the curriculum and in the exams used to assess
- It is not surprising that maths difficulties will impact on exam performance

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In conclusion

- By understanding the impact of maths difficulties and implementing supportive measures, educators can help ensure that all students have a fair chance of succeeding in exams

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Access Arrangements

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The Effect of Maths Difficulties on Exam Performance

Maths Fluency: Access Arrangements

- The time taken to process mathematical concepts
- A timed assessment of mathematical computation or attainment is not acceptable

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Maths Fluency: Access Arrangements

- The mathematical fluency score is only valid for 25% extra time in maths exams
- Maths fluency scores must be below average
- One other below/ low average score in another area is also required

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Tests assessing mathematical fluency

Mathematical processing

Note:

A score from this row must be below average and, accompanied by a below or low average score in a different area of speed of working, can provide evidence for 25% extra time in maths exams only.

- **Feifer Assessment of Mathematics (FAM)**
 - Addition Fluency
 - Subtraction Fluency
 - Multiplication Fluency
 - Division Fluency
- **Kaufman Test of Educational Achievement 3rd Edition (KTEA-3)**
 - Math Fluency
- **Wechsler Individual Achievement Test 3rd UK Edition (WIAT-III UK)**
 - Maths Fluency (composite)
 - Maths Fluency – Addition
 - Maths Fluency – Subtraction
 - Maths Fluency – Multiplication
- **Woodcock-Johnson IV Tests of Achievement (WJ IV ACH) UK and Ireland Edition**
 - Maths Facts Fluency

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Disadvantaged pupils further behind in maths since Covid, English study finds

Union criticises education recovery funding as attainment gap in primary school pupils grows to 8.7 months

<https://tinyurl.com/3tjm7xac> (sourced 10/08/2024)

Emily Dugan

The Guardian

Mon 4 Mar 2024

Children from low-income families in England are further behind their peers in maths than they were before the pandemic, research suggests.

The attainment gap for disadvantaged primary school pupils in maths has grown from an average of 6.9 months to 8.7 months, the study by the thinktank the Education Policy Institute (EPI) and the software firm Renaissance Learning has found.

Outcomes in maths are also down on average for pupils overall, the study of primary and secondary school assessments in years 3 to 9 found. The problem equates to an average of four months of lost learning at secondary schools and two months in primary schools, the study said.

The study was conducted by comparing Renaissance's Star Reading and Star Maths assessments from 2017-18 and 2022-23. It gives further evidence of the profound impact of Covid on vulnerable children whose support had already been cut back by austerity.

Geoff Barton, the general secretary of the Association of School and College Leaders (ASCL), said: "Schools have moved heaven and earth to support children in catching up with lost learning from the pandemic but as these results show this has not been an easy task, and in terms of maths that is likely to be because missing key elements of numeracy at an early stage makes later progress much more difficult.

"This analysis makes it even more frustrating that the government not only failed to provide sufficient investment in education recovery in the first place but is now pulling the plug on the national tutoring programme – which was its

flagship recovery programme ... Unfortunately, the government has decided that it is a case of job done when this is very clearly not the case at all.”

The study also looked at numbers of pupils eligible for free school meals for at least 80% of their time in school, which it classed as “persistently disadvantaged”. The proportion of primary-age pupils in this category grew from 8.9% before the pandemic to 13.3% in 2022-23.

Jon Andrews, the head of analysis and director for school performance and systems at the EPI, said: “This latest analysis shines further light on the disproportionate impact that the Covid-19 pandemic had on the outcomes of disadvantaged pupils, worsening already stark inequalities. These inequalities should be a significant concern for policymakers and education providers.

“The far lower outcomes for pupils who experience persistent disadvantage is a reminder of the importance of tackling child poverty as a root cause of the gap in academic outcomes.”

A Department for Education spokesperson said: “We know the pandemic had a significant impact on education globally, which is why we have made £5bn available since 2020 for education recovery initiatives, including the national tutoring programme.

“We are constantly seeing the success of our reforms. England ranked 11th in the world for maths, up from just 27th in 2009, and in May our primary-age children came fourth in the world for reading – making them the best readers in the western world.”

A day in the life of a teen with dyscalculia

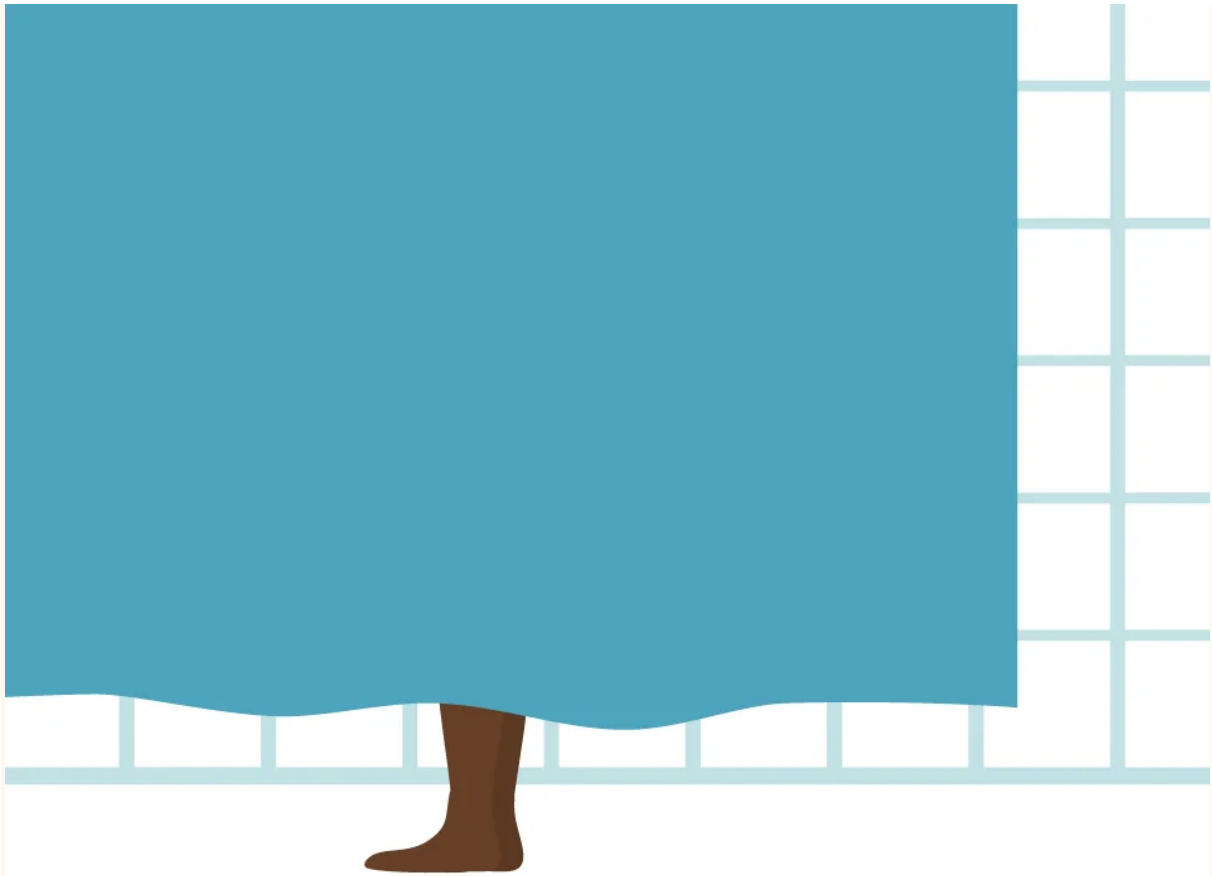


By [The Understood Team](#)

<https://tinyurl.com/yh7z94y5> (Accessed 10/08/2024)



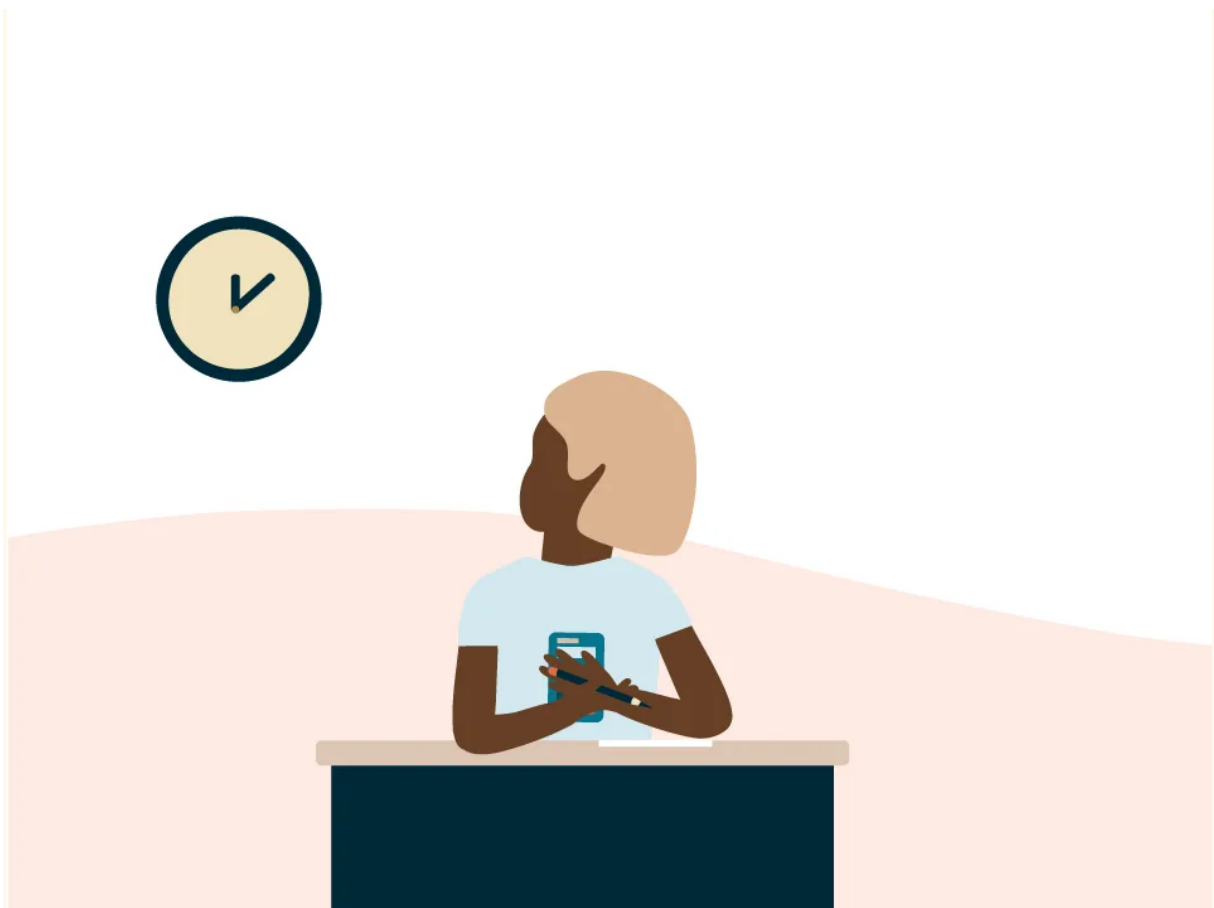
Meet Ava, a ninth grader with [dyscalculia](#). She's a bright kid, but her struggles with math are often misunderstood by teachers and family members. To see how trouble with numbers can affect kids outside of math class, take a look at a typical day in Ava's life.



6 a.m.

Ava knows she needs to take a quick shower and get ready for school. She thinks she's only been in the bathroom for a few minutes when her little brother bangs on the door. "Come on, you've been in there for 20 minutes already!" he yells.

Challenges related to dyscalculia: Keeping track of time, estimating



11 a.m.

Ava loves history and she studied hard for today's test. But after answering the first question, she starts to worry about how much time she has left. Her confidence sinks as she looks at the clock and thinks about how long it would take her to try to read it. She feels even worse as she tells herself she'd probably read the time wrong anyway.

Challenges related to dyscalculia: Telling time, self-esteem



Noon

At lunch, Ava wants to buy a \$2 muffin for herself and a \$5 box of cookies for her stepdad. She's not sure if she'll have enough money to buy both. But she doesn't want her friends to see her using her fingers to count. She hands over all the dollar bills she has and hopes it's enough.

Challenges related to dyscalculia: Basic math facts, working with money



2 p.m.

Ava looks at tonight's math homework and starts to panic. Even though she knows how to do some of the steps, her heart starts racing. "I'm never going to be good at this, so why bother?" she thinks. Ava tucks the worksheet into her locker before she leaves school — she doesn't want her stepdad to find the incomplete assignment.

Challenges related to dyscalculia: Maths anxiety



4 p.m.

At track practice, Ava runs the first lap so quickly that she has trouble finishing the second lap. The coach seems frustrated that Ava can't remember the pacing they practiced yesterday. Why is it so hard for her to remember *one minute and 25 seconds*?

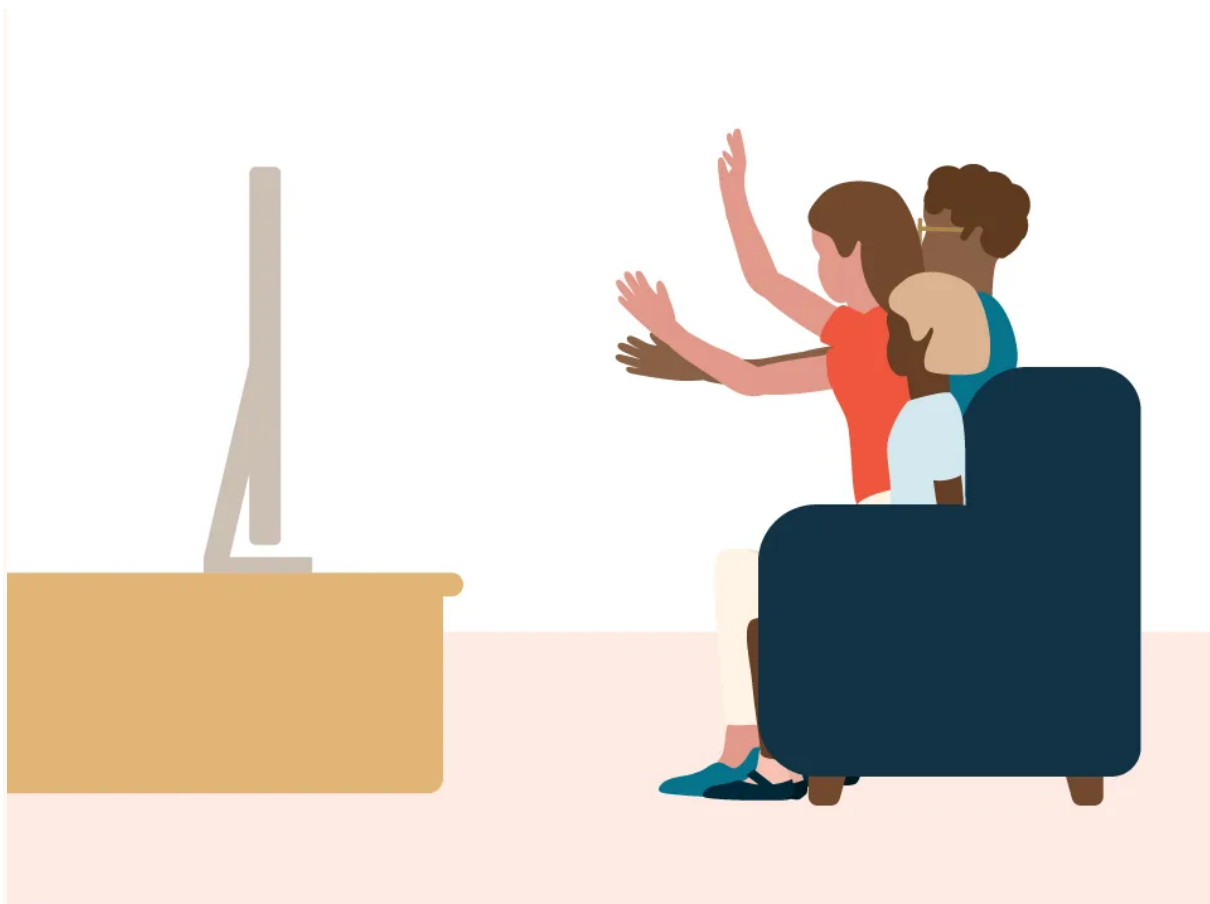
Challenges related to dyscalculia: Gauging speed and distance, remembering sequences of numbers



6 p.m.

Ava needs to feed the pets before her family eats dinner. She knows Bowzer gets two-thirds of a cup of dog food, and Meowzer gets one-third of a cup of cat food. Did Ava measure it right? Which of the bowls has more? If Ava gives the cat too much food, he'll throw up. But how much is too much?

Challenges related to dyscalculia: Understanding quantities, measuring



8 p.m.

Ava is excited about the big game on TV, but she has trouble telling which team is winning. If the point guard gets the next two free throws, will that be enough to go into overtime? Asking too many questions about the game embarrasses her, so she leaves to hide in her room.

Challenges related to dyscalculia: Solving word problems, social trouble



10 p.m.

Ava finally got the bookcase she really wanted. She unpacks the box and takes out the directions. She gets through the first step, but then she gets confused because the pieces aren't fitting together the right way. By the time her stepdad is free to help her, Ava is so frustrated that she shoves the parts away and tells her stepdad she doesn't want it.

Challenges related to dyscalculia: visual-spatial processing

About dyscalculia

Dyscalculia makes it hard to make sense of numbers and concepts like *bigger* and *smaller*. For example, people may have trouble telling if a group of five apples is bigger than a group of three apples.

This involves a set of skills called number sense. Experts say it's like colour blindness. Just like some people are born having trouble telling the difference

between colours, some people are born having trouble telling the difference between quantities.

Having dyscalculia doesn't mean people aren't smart. And there are lots of [ways to help with dyscalculia](#). With the right support, kids like Ava can get better at working with numbers in school and in everyday life.

Handout 3

