Working towards a definition and guidance for Dyscalculia and Maths Difficulties

Janet Goring, Chair,

Dyscalculia and Maths Difficulties Working Group 2023-24

With thanks to the Dyscalculia Working Group particularly Pete Jarrett, Rachel Simpson, and Kate Blundell

Aims of session

- To reassure assessors and to give more confidence and clarity
- To share progress of the Dyscalculia and Maths Difficulties Working Group so far including:
  - Similarities with Delphi Study
  - Factors specific to Dyscalculia and maths difficulties and the implications for assessment
  - Number sense
  - Fluency
  - Key factors of a proposed Dyscalculia definition

Background and context

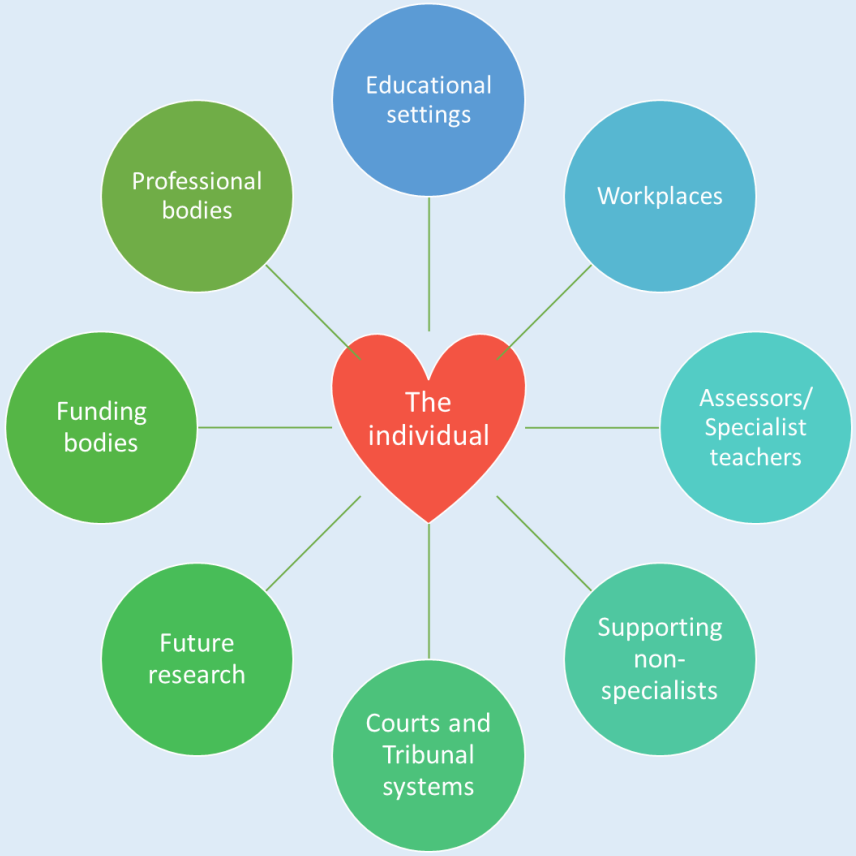
Establishment of Working Group:

- To address potential over-identification of DD vs more general maths difficulties
- To consider new research
- To update the STEC list of tests
- To reach consensus on a definition and guidance on Dyscalculia
- To support stakeholders, particularly people with maths difficulties
- To ensure assessment and identification is accurate and rigorous
- To consider how Maths Anxiety and language fit into the definition and guidance

Maths Difficulties and Dyscalculia Update (sasc.org.uk)

Challenges

- Reaching consensus
- Achieving consistency
- Defining number sense and fluency
- Balancing the needs of all stakeholders
- Establishing a definition and guidance which have longevity
- Defining persistence and resistance



Similar messages to the Delphi Study

- Early support for all learners with mathematical difficulties
- Identification of needs prioritised over detailed diagnostic assessment for younger students
- Employing a probabilistic “at risk” framework using a hypothesis-based approach
- Evaluating persistence
- Importance of gaining information from multiple sources
- No simple recipe

Adapted from Caroline Holden’s The Dyslexia Delphi study: implications for assessment, May 2024 PowerPoint Presentation (sasc.org.uk)

Key Research

- **Dowker, A. (2020) Arithmetic in developmental cognitive disabilities. *Research in Developmental Disabilities 107*, 1 – 9**
- **De Smedt, B. (2022) Individual Differences in mathematical cognition: a Bert's eye view. *Behavioural Sciences 46*, 1 – 10**
- **Gilmore, C (2023) Understanding the complexities of mathematical cognition: a multi-level framework**,
- Astle, D. E, Holmes, J. Kievit, R. and Gathercole, S. (2022) Annual Research Review: The transdiagnostic revolution in neurodevelopmental disorders
- Fletcher-Watson, S. (2022) Transdiagnostic research and the neurodiversity paradigm: commentary on the transdiagnostic revolution in neurodevelopmental disorders by Astle et al.

The factors having the greatest impact on Maths learning

Domain specific	Domain general
Numerical magnitude processing	Working memory
Mathematical vocabulary	Inhibitory control
Mathematics anxiety	Task shifting
Home mathematics environment	Phonological processing
	Language
	Spatial skills
	Fluid intelligence

De Smedt (2022)

Impact on assessment process

- Do we need to cover all aspects in an assessment?
- What will be the impact on the length of the assessment and the individual being assessed?
- Do we have standardised assessment tools to cover all these areas?
- What about areas that are not cognitive processes?

Domain specific	**Domain general**
Numerical magnitude processing	Working memory
Mathematical vocabulary	Inhibitory control
Mathematics anxiety	Task shifting
Home mathematics environment	Phonological processing
	Language
	Spatial skills
	Fluid intelligence

Difficulties in defining number sense

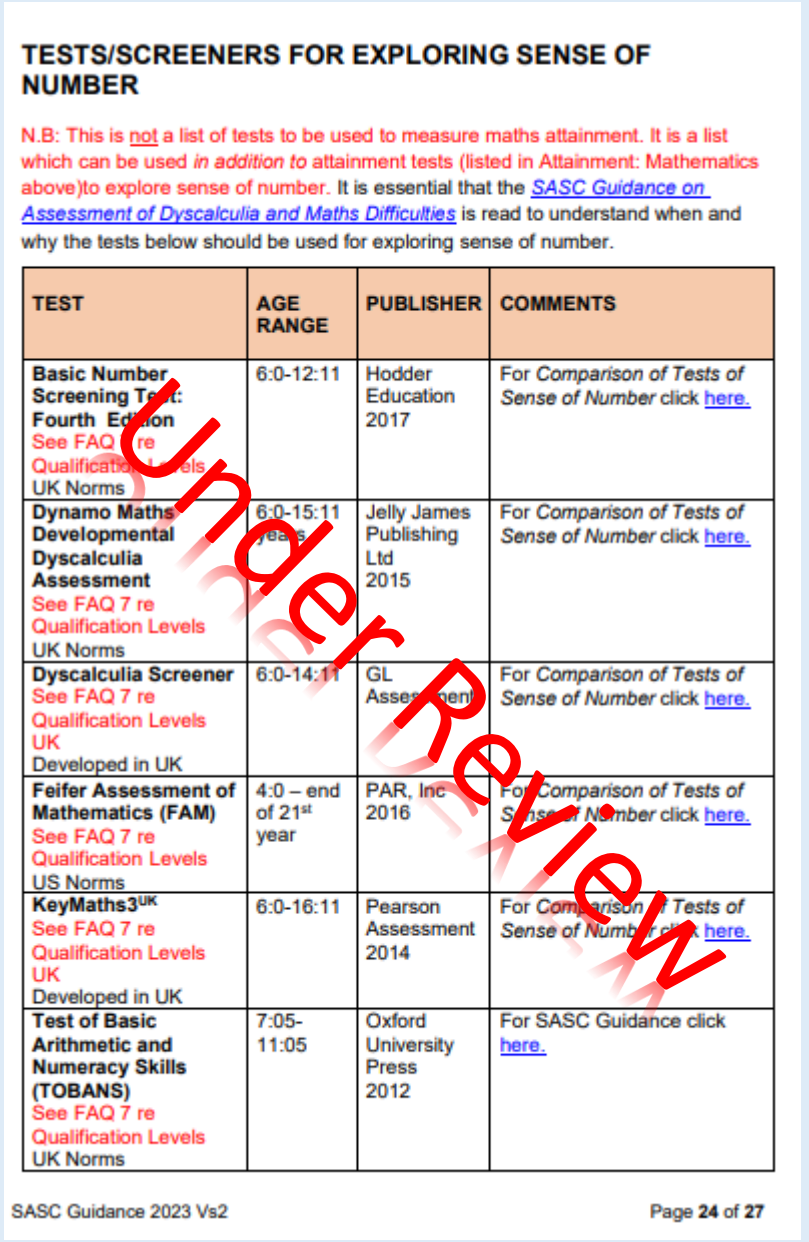
- Similar debate in Dyslexia re: phonological awareness
- Still perceived as the defining feature of dyscalculia but Number sense considered too limited or problematic as the key criterion of Dyscalculia
- Current over-reliance on subitising in assessments to identify Dyscalculia but subitising
- Presents differently at different ages and stages

Number sense - Lack of consistency

- Between cognitive science and maths education with further differences within the fields
- Different models of measuring
- A genetic vs an acquired (acquirable) skill
- Very few specific definitions vs lists of components/topics
- Essential for success in all higher-level maths vs the possibility of mitigating through training/compensatory strategies
- Different representations according to age and level of the individual

Consideration when assessing sense of number

- Current guidance misunderstood/ misleading
- Increased availability of standardised assessment tools to measure numeric processing
- Changes to test list
  - Sense of number to move to a new “Mathematics Cognition section” within Cognitive Profile section
  - Tests which don’t meet standardisation criteria of SASC to be removed
- How should informal assessments and qualitative information be used/reported?

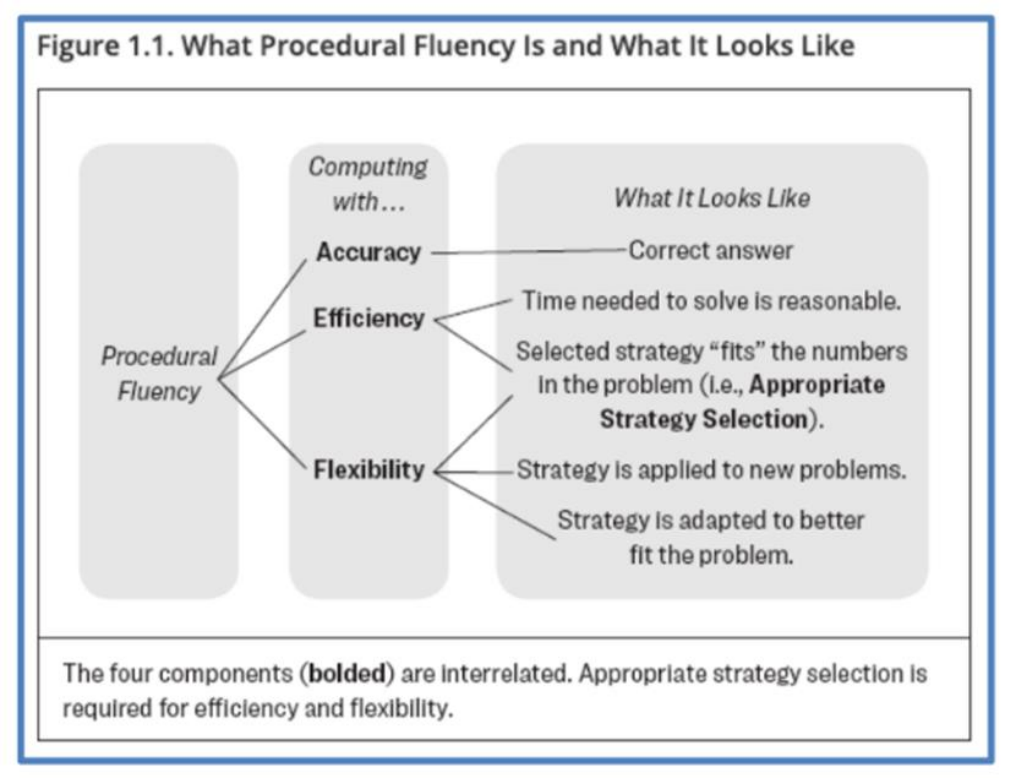


TESTS/SCREENERS FOR EXPLORING SENSE OF NUMBER

N.B: This is not a list of tests to be used to measure maths attainment. It is a list which can be used *in addition to* attainment tests (listed in Attainment: Mathematics above)to explore sense of number. It is essential that the *SASC Guidance on Assessment of Dyscalculia and Maths Difficulties* is read to understand when and why the tests below should be used for exploring sense of number.

TEST	AGE RANGE	PUBLISHER	COMMENTS
Basic Number Screening Test: Fourth Edition See FAQ 7 re Qualification Levels UK Norms	6:0-12:11	Hodder Education 2017	For *Comparison of Tests of Sense of Number* click here.
Dynamo Maths Developmental Dyscalculia Assessment See FAQ 7 re Qualification Levels UK Norms	6:0-15:11 years	Jelly James Publishing Ltd 2015	For *Comparison of Tests of Sense of Number* click here.
Dyscalculia Screener See FAQ 7 re Qualification Levels UK Developed in UK	6:0-14:11	GL Assessment	For *Comparison of Tests of Sense of Number* click here.
Feifer Assessment of Mathematics (FAM) See FAQ 7 re Qualification Levels US Norms	4:0 – end of 21st year	PAR, Inc 2016	For *Comparison of Tests of Sense of Number* click here.
KeyMaths3UK See FAQ 7 re Qualification Levels UK Developed in UK	6:0-16:11	Pearson Assessment 2014	For *Comparison of Tests of Sense of Number* click here.
Test of Basic Arithmetic and Numeracy Skills (TOBANS) See FAQ 7 re Qualification Levels UK Norms	7:05-11:05	Oxford University Press 2012	For SASC Guidance click here.

Defining/describing Fluency



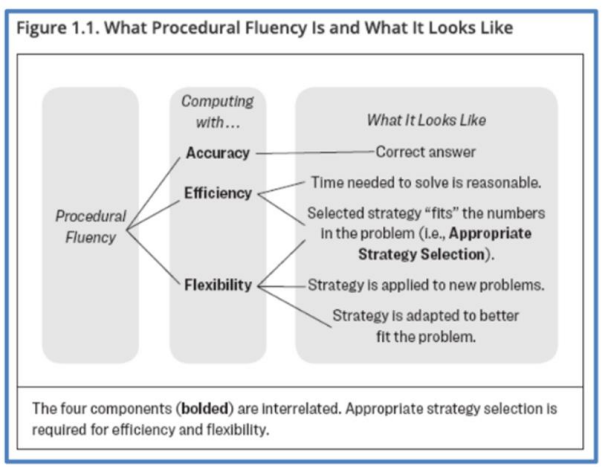
Low level of arithmetic fluency is a characteristic of Dyscalculia, yet

- No agreed definition – different approaches and topics
- Conceptual vs Procedural

Key factors: Accuracy, Efficiency, Flexibility (appropriate)

A Position of the National Council of Teachers of Mathematics - Reasoning and Decision-Making, Not Rote Application of Procedures Position

Implications for assessment



Assessors need to have a clear understanding of fluency:

- Appropriate to age and level of the individual e.g. how typical is it for a student to resort to finger counting at a particular age.
- Which areas of fluency are presenting as difficulties (accuracy, efficiency, flexibility, appropriateness of strategies)

Assessment tools that purport to measure fluency tend to measure automaticity. Therefore,

- Standardised tests are just one part of the picture
- Supplementary qualitative approaches are needed which can be subjective

Forthcoming definition

- Mapped to Dyslexia definition as closely as possible
- Emphasis on specific and persisting difficulty affecting most areas of maths.
- Prevalent cognitive factor is numerical magnitude processing
- Outcomes – difficulties with arithmetical knowledge, skills and fluency
- Lifelong but different manifestations and trajectories at different ages and stages
- Co-occurrence is the norm rather than the exception

Domain-specific factors of the Proposed Definition

- A specific and persistent difficulty in understanding number(s)

- Key cognitive impairment - numerical magnitude processing:
  - Symbolic and non-symbolic magnitude recognition and comparison,
  - estimating,
  - numerical order processing,
  - spatial numerical associations,
  - place value understanding
  - numerical problem solving.

- Numerical magnitude processing does not fully explain variability.
- Difficulties in the acquisition of arithmetical knowledge, skills, fluency and flexibility

Similar to Dyslexia definition

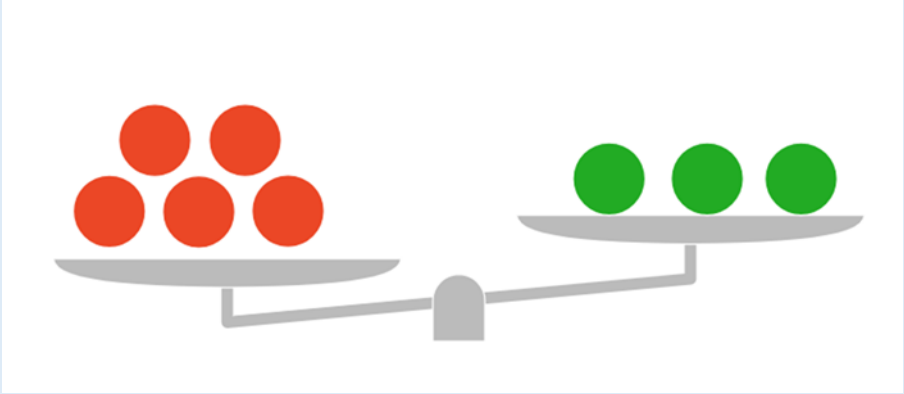
- A lifelong condition
- Presentation and developmental trajectory of Dyscalculia depends on multiple genetic and environmental influences
- Can vary in severity and impact at different ages and stages of in an individual’s life.
- Frequently co-occurs with one or more other developmental difficulty, including ADHD, dyslexia, developmental language disorder and developmental coordination disorder.

Considerations

- Co-occurrence with other conditions is the norm rather than the exception
- Domain general variables are as crucial as domain specific variables such as number sense.
- Variables can interact to create cumulative risk.

Differentiating between Dyscalculia and other maths difficulties

1. Dyscalculia – core feature difficulty with numerical magnitude processing
2. A Maths Learning difficulty but numeric processing is not impaired but still significant, persistent difficulties with mathematical skills in daily life due to:
    a. The cumulative effect of domain-general cognitive processes including Executive Functions, visual processing etc
    b. Biological or chronic medical conditions
    c. Environmental factors
    d. The complex interplay of the above



Maths Anxiety

Needs to be acknowledged, as an associated problem, within any definition.

- *Likely* that if maths difficulties are present there will also be maths anxiety
- No strict threshold to be described as having maths anxiety.
- It is a secondary factor, but nonetheless hugely important.
- In some cases, maths anxiety can be so severe assessment not appropriate
- A working group is being set up to consider maths anxiety further

Content of assessment?

1. A framework for a thorough & appropriate history taking
2. Tests of verbal, visual and visual-spatial reasoning and cognitive processing
3. Tests of understanding of number
4. Tests of literacy and mathematics skills
5. Standardised measures of Arithmetic (+, -, x, ÷). Timed and untimed; Mathematics reasoning and problem solving, including worded problems
6. Qualitative analysis of performance within these tests
7. Recommendations for interventions and reasonable adjustments

SASC Guidance on assessment of Dyscalculia and Maths Difficulties 2019

Background information	Risk	Resilience
Health and Dev. History	Relevant medical history; Vision and Hearing	
	Preterm Birth (No of weeks)	
Familial history	Close family members have similar diffs.	Confidence and positive experiences of maths.
Linguistic History	English as an additional language	
Early experiences of maths	Limited access to early education. A persistent difficulty in acquiring early number skills. Not reaching EYFS goals	Good quality early maths education. Opportunities to explore mathematical concepts both within and outside school.
School progress	Below age expectations in Maths or not making commensurate progress	At or above age expectations and making sustained progress in Maths/other subjects
Stability in education	Low attendance/punctuality; Disruptions due to moving school/home	
Intervention	Limited or no access	An embedded approach to quality interventions
Co-occurring diffs	Dyslexia/ADHD/DLD/DCD/ASD	May be compensated.
Confidence/ Enjoyment levels At home/school	General/specific Anxiety, and/or issues. with confidence and self-esteem	Positive approaches to maths including Growth Mindset, anxiety reduction strategies.

Standardised Maths Attainment: What should be included?

- ✓Arithmetic (+, -, x, ÷). Timed and untimed to establish what difference time pressure makes upon performance
  - ✓Timed Arithmetic fluency (sic) tests
  - ✓Written test of graded computation across four operations

- Mathematics reasoning and problem solving
  - Need an assessment that includes progression – what areas should this cover?
  - Need to consider the variations between tests.
  - Do these standardised tests exist for all age groups?

ATTAINMENT: MATHEMATICS

For information on the range and type of tests to use for assessing mathematics difficulties, please see *SASC Guidance on Assessment of Dyscalculia and Maths Difficulties.*

TEST	AGE RANGE	PUBLISHER	COMMENTS
Academic Achievement Battery (AAB) See FAQ 7 re Qualification Levels US Norms	4:0 – 85:11	PAR Inc 2014	For SASC Guidance click here.
Feifer Assessment of Mathematics (FAM) See FAQ 7 re Qualification Levels US Norms	4:0 – 21:11	PAR, Inc 2016	For SASC Guidance click here.
Feifer Assessment of Mathematics (FAM) Screening Form See FAQ 7 re Qualification Levels US Norms	4:0 – 21:11	PAR, Inc 2016	For SASC Guidance click here.
Kaufman Test of Educational Achievement: Third Edition (KTEA-3) See FAQ 7 re Qualification Levels US Norms	4:0 – 25:11	Pearson Assessment 2014	For SASC Guidance click here.
Key Maths3^{UK} See FAQ 7 re Qualification Levels UK UK Norms	6:0 - 16:11	Pearson Assessment	Includes a numeracy subtest that uses dot arrays, pictures, counting, and numbers to explore subitising, symbolic and non-symbolic magnitude comparisons, and ordering and basic addition.

Who can assess for dyscalculia? Current guidance

Assessors should have:

- Knowledge/training and experience of holistic diagnostic assessment
- Training in/experience of, applying this knowledge to the assessment of maths.

Can be acquired through:

- Level 7 qualification (explicit training and assessment of extensive coverage of diagnosing difficulties with mathematics or mathematical cognition)
- A top-up Level 7 course in mathematics and dyscalculia (60 credits plus 20 hours maths teaching)
- Or extensive CPD training, mentoring, personal research and experience. Can demonstrate competence in applying to diagnostic assessments of maths.

Acquiring knowledge without a specific level 7

Knowledge acquired through:

- Experience of teaching mathematics skills
- And/or a Bachelor Degree or Postgraduate qualification which explicitly and extensively covers how maths skills and/or maths cognition develop
- A postgraduate qualification in SpLD Tutoring including maths difficulties

- Assessors should work within their range of expertise, use appropriate assessment tools, and be fully up to date in their professional development.
- Should refer on when beyond an assessor's professional boundaries

- Is this robust enough?
- How should this be evaluated?

Online Remote assessment

Difficult to replicate all the elements and features of in-person assessment via online platform

Should only be considered in exceptional circumstances where:
- it is in the best interests of the individual assessed
- there is no option for a face to face assessment.

The assessment should cover all elements of in-person assessment using assessment tools approved for online delivery by the relevant publisher.

Unlikely a diagnostic label decision can be made.

Next steps - Timeline

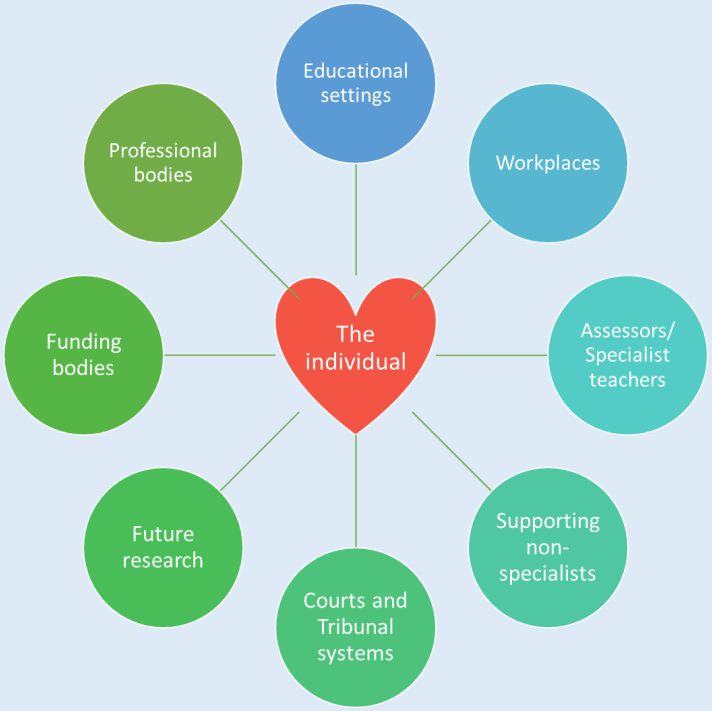
June/July
Draft guidance completed and circulated
Further discussion on assessment content, qualification routes
Remote assessment via online platform
Opportunity to discuss/feedback on the definition and guidance

September/October
Test list finalised

By the end of the year
Report format
Revised test list
Dyscalculia and Maths Difficulties Guidance finalised

Key Messages

- Making good progress
- Need an update asap but important to get the definition and guidance right to ensure some longevity
- Assessors need to have appropriate experience and qualifications to best meet the needs of the individual
- Number sense and arithmetic fluency are key
- Co-ordination with Dyslexia/Delphi Group to ensure consistency



Sources

1. Maths Difficulties and Dyscalculia Update (sasc.org.uk)
2. SASC Guidance on assessment of Dyscalculia and Maths Difficulties 2019
3. Rousselle, L. & Noël, M.-P. Basic numerical skills in children with mathematics learning disabilities: A comparison of symbolic vs non-symbolic number magnitude processing. Cognition 102, 361-395 (2007)
4. De Smedt B. Individual differences in mathematical cognition: a Bert's eye view. *Curr Opin Behav Sci*. 2022;46:1-10. doi:10.1016/j.cobeha.2022.101175
5. Dyscalculia | Resources | Education Scotland
6. OFSTED (2023) Co-ordinating mathematical success
7. Gilmore C. Understanding the complexities of mathematical cognition: A multi-level framework. *Q J Exp Psychol*. Published online 2023. doi:10.1177/17470218231175325
8. SEND code of practice: 0 to 25 years - GOV.UK (www.gov.uk)
9. Dowker A. Arithmetic in developmental cognitive disabilities. *Res Dev Disabil*. 2020;107(April):103778. doi:10.1016/j.ridd.2020.103778

Thank you!

Contact details: janetsgoring@gmail.com