



# DEVELOPMENTAL DYSCALCULIA

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# ACTIVITY

4 groups -> 4 different definitions of Developmental Dyscalculia

Find definitions in the hallway. On the back side of the paper there are calculations. Solve the calculations and the results should tell you in which place certain piece of paper is in the definition.

Try to figure out to which country this definition belongs (USA, UK, CZECH REPUBLIC/SLOVAKIA, SLOVENIA)



# AMERICA

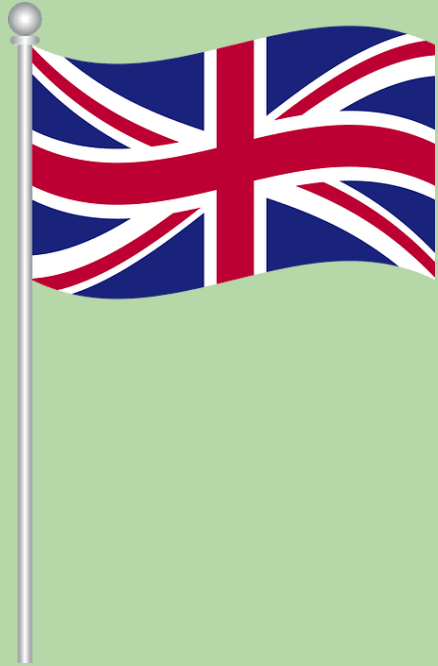
Dyscalculia is defined as a **failure to achieve in mathematics commensurate with chronological age, normal intelligence, and adequate instruction.**

It is marked by difficulties with:

visualization; visual-spatial perception, processing and discrimination; counting; pattern recognition; sequential memory; working-memory for numbers; retrieval of learned facts and procedures; directional confusion; quantitative processing speed; kinesthetic sequences; and perception of time.



UK



Dyscalculia is a specific and persistent **difficulty in understanding numbers** which can lead to a diverse range of difficulties with mathematics.

It is easy to recognise due to the severity of difficulties with number sense: subitising, symbolic and non-symbolic magnitude comparison, and ordering

# CZECH REPUBLIC/SLOVAKIA

Developmental dyscalculia is a **developmental structural disorder of mathematical abilities** which has its origin in a **genetic or congenital disorder** of those parts of the brain that are the direct anatomico-psychological substrate of the maturation of the mathematical abilities adequate to age, without a simultaneous disorder of general mental functions.

(L.Košč, 1974)



# ICD 10 - WHO

- section F81.2
- “Specific disorder of arithmetical skills”

This disorder involves a **specific impairment in arithmetical skills** that is **not** solely explicable on the basis of **general mental retardation** or of **inadequate schooling**. The deficit concerns mastery of **basic computational skills** of addition, subtraction, multiplication, and division rather than of the more abstract mathematical skills involved in algebra, trigonometry, geometry, or calculus.

# SLOVENIA

Developmental dyscalculia is a genetic cognitive deficit, that causes, average or above-average intelligence child, **great difficulty coping with most maths problems.**

The other term we use is 'AKALKULIJA' and it is an inability to use mathematical symbols and the cause of it is brain damage.







# Basic description and etiology

- problems in numerical/arithmetic understanding
- prevalence: 3-6% X prevalence in the UK at least 25% (mathematical learning difficulties)
- affects more females than males, but it is still inconsistent
- persistent into adulthood
- possible causes: hereditary and environmental components
- often co-occurs with other specific learning disabilities and mathematics anxiety



# BRAIN OF DYSCALCULICS

Dyscalculic boy, 11 years, 5th grade

<b>Stimuli</b> number / presentation time	<b>Answer</b>
9 dots / 2 sec 	"9 dots"
14 dots / 2 sec 	"10 dots"
57 balls / 5 sec 	"900 balls"
89 cups / 5 sec 	"10'000 cups"

<b>Verbally given number by experimenter</b>	<b>Written number by child</b>
503	<u>5003</u>
169	<u>40 169</u>
4658	<u>40006058</u>
756	<u>7056</u>
689	<u>6089</u>

Dyscalculic girl, 8 years, 3rd grade

# Diagnosis

Early diagnosis and treatment is very important

Problems in:

- Numerical and arithmetical processes

- Domain-general abilities

- Neurological, sensory, and motor processes

- Socio-emotional and social functioning

- Medical, educational, and family history

Difficulties must be long-term

Even pre-schooled children may be diagnosed

# Risks, brain, cognition

## RISKS

- genetic predisposition
- epigenetic factors
- organic risk factors (e.g. premature birth)
- domain-independent maturation deficits

## BRAIN

- deficient development of fronto-parietal network

## COGNITION

- impaired non-symbolic quantity and symbolic number representation, impaired transfer between representations

# Behaviour

## SPECIFIC

### Number sense

- quantity discrimination
- counting skill
- “more/less” comparisons
- transcoding
- place-value system

### Calculation

- mental calculation
- multi-digit arithmetic
- numeric fact retrieval
- calculation procedures
- calculation concepts

## **COMORBIDITIES**

- attentional problems (ADHD)
- impaired language development
- dyslexia
- anxiety, depression, aggression etc.

# Factors serving math abilities

## ENVIRONMENTAL FACTORS:

- education
- teaching style
- experience
- practice
- motivation
- encouragement
- age



## DOMAIN-GENERAL FACTORS:

- **visuospatial skills** (magnitude discrimination, mental number line, size concepts)
- **attention** (focus on problem solving mental number line)
- **language** (counting, mental calculation, fact retrieval, number system)
- **working memory** (mental calculation, multi-digit arithmetic, procedures)
- **executive functions** (planning, control)
- **reasoning** (text problems)
- **social and emotional factors** (attitude to mathematics, learning and coping strategies)

# FEATURES

- Impaired innate number sense
- Forget mathematical procedures especially as they become more complex (long division)
- Counting difficulties, like backward counting
- No understanding of the place-value system and the role of the zero
- Impaired development of or access to the mental number line
- Stick to counting strategies by the usage of their fingers
- Lack of understanding how to decompose difficult problems into easier ones
- No understanding of calculation procedures and concepts



# Signs of Dyscalculia for teachers

- combines numbers and symbols while reading, thinking, counting and remembering
- struggles with telling time, tracking and managing time
- have huge effort with disappointing results
- unreliable memory of numbers, math facts, rules and procedures
- have weak mental arithmetic skills
- has difficulty imagining abstractions, quantities, layouts, clocks, faces, numbers, and figures
- avoid difficult tasks

# EDUCATIONAL APPROACHES

CLASSIFICATION AND GROUPING (understanding of basic concepts necessary for mathematical operations)-> sorting games, matching and sorting (big-small, same, smaller-bigger, more-less, etc.),

ORDERING (understanding of the symbol and its meaning)-> numerals (more-less, what comes after 5), numeral lines (orientation on numerical line, comparison of numbers), arraying by size or length

RECOGNITION OF NUMBERS (learn to recognize both printed numbers and words expressing them, their graphics form and understand their meaning) -> reading of numbers, recognition of figure and background, division of numbers into units and tens, graphic representation of numbers.

COMPUTATION SKILL -> Use of simple numbers so that the student can focus on the mathematical operation not the number itself.

# INTERVENTION

- adapted to individual profile of performance levels and difficulties
- one-to-one training
- structured and hierarchically built
- basic non-curricular and curricular numerical topics
- many repetitions
- motivation is stimulated by reward and reduction of math anxieties

# RESOURCES

<https://www.dyscalculia.org/dyscalculia>

<https://www.bdadyslexia.org.uk/dyslexia/neurodiversity-and-co-occurring-differences/dyscalculia-and-maths-difficulties>

Kucian, K. and von Aster, M. (2014). *Developmental dyscalculia*. Eur. J. Pediatr. 174, 1–13 (2015)

BUTTERWORTH, Brian. *Dyscalculia: from science to education*. New York, NY: Routledge, 2019. ISBN 978-1-138-68861-2.