Dyscalculia, Causes, Consequences, & Creative solutions

Dr Anneke Schreuder
Dyscalculia Services
www.DyscalculiaTrainingCenter.org
Dyslexia

- starts to talk late
- difficulty with blending and segmenting sounds
- rhyme patterns are hard
- reads letter by letter or word by word slowly
- forgets sight words
- struggles with grammar
- copies letters out of order
- forgets/loses info: dates, names, address

Dyscalculia

- starts to count late
- difficulty with composing and decomposing numbers
- number patterns are hard
- counts tally marks or one by one slowly
- forgets math facts
- struggles with algorithms
- copies numbers out of order
- forgets/loses info: log ins, numbers, deadlines
Subitizing:

The ability to quickly identify the number of items in a small set without counting
Number Sense:

The universal ability to represent and manipulate numerical magnitudes nonverbally on a spatially oriented mental number line.
Dyscalculia

Δισκαλκυλία
**DSM V** *(most recent)*

**Specific learning disorder**
A neurodevelopmental disorder of biological origin manifested in learning difficulty and problems in acquiring academic skills markedly below age level and manifested in the early school years, lasting for at least 6 months; not attributed to intellectual disabilities, developmental disorders, or neurological or motor disorders

*Specify if:*
- 315.00 With impairment in reading.
- 315.2 With impairment in written expression
- 315.1 With impairment in mathematics

*Specify current severity:*
- Mild
- Moderate
- Severe
3 main centers for math

- Number Sense Center
- Verbal Centers
- Visual Centers
**Pre-frontal region executive function**

- Fine motor skills
- Various types of memory
- Visual spatial processing
- Temporal processing
- Rythm
Gerstmann Syndrome

• Writing
• Arithmetic
• Finger Agnosia
• Left-Right coordination
Dr. Ladislav Kosc named Developmental Dyscalculia
Dyslexia

Adolph Kussmaul: "wordblindness"
Rudolf Berlin: "Dyslexia"
Dr. Dejerne: Reading difficulty is brain issue
Dr. Hinselwood: "back to Word blindness"
Dr. Orton: "developmental Alexia"
Anna Gillingham & Bessie Stillman: "Dyslexia teaching"
Gerstmann Syndrome

ICAA "Wordblind Centre"
Orton Dyslexia Society
Doman Delacato Method
Dannison (US)

Dr. Ansari
Fischer Subitzing
Grafman

Silverman: "Dyslexia Learning difference"
Turkeltaub MRI
Dr. Guen Dyslexia Gene
Hoeft: Predict success based on MRI

Dyscalculia

Ladislav Kosc
Stanislas DeHaene
Brian Butterworth

Dyscalculia Services

International Dyslexia Association

Brian Butterworth
Dannison (US)
“This math learning disability is nearly as common as dyslexia, however it’s studied far less, understood far worse, and diagnosed inconsistently.”

Daniel Ansari
Brain areas that have been identified to be active during numerical processing / arithmetic

Kaufmann & Nuerk (2007; Abb. 1)
Theories of deficits in dyscalculia: domain specific

- Access deficit: no **links** with number sense center
- Core deficit **is** the number sense center

[Diagram showing brain regions for verbal 'two', visual 2, and quantity]
Number Sense Mental number Line
Sometimes the arabic numbers are the culprit
Pre-frontal region
executive function

Fine motor skills
Various types of memory
Visual spatial processing

Temporal processing
Rythm

Various types of memory
Visual spatial processing
Diagnostic criteria a work in progress
Not based on a single test, rather combination of instruments
• Math difficulties for a period time (6 months or more)
• Across several areas in math
• Severity
• Not resolved by simple scaffolding
• Needs help with gaps
• Needs more practice
“This provides strong evidence that dyscalculia is caused by malformations in the right parietal lobe and provides solid grounds for further study on the physical abnormalities present in dyscalculics’ brains. It’s an important step to the ultimate goal of early diagnosis through analysis of neural tissue, which in turn will lead to earlier treatments and more effective remedial teaching.”
Not live up to potential

Works slowly

Acting out

Daydreaming

Mistakes copying from board

Confuses assignments

Missing homework

Sick on test days
How do we detect dyscalculia
SASC/STEC Dyscalculia Working Group

Areas crucial for the determination of number sense
• Subitizing
• Non-symbolic magnitude comparison
• Symbolic magnitude comparison
• And ordering (cardinal and ordinal)
Screening /Checklists

- Dyscalculia Services  Grade 1 - 12  
  (dyscalculiaservices.com)
- Panamath  Grade 8 - adult  
  (Panamath.org)
- The Numeracy Screener  KG – Grade 3  
  (numeracyscreener.org)
- Early Numeracy Indicators  KG – Grade 2  
  (progressmonitoring.org)
- Math Reasoning Inventory  Grade 4 -8  
  (mathreasoninginventory.com)
Further Testing

• The Dyscalculia Screener

• The Dyscalculia Assessment (not online) by Jane Emerson and Patricia Babtie
Panamath test
• **Tests That Assess Computation Skills**
  Woodcock-Johnson-IV (WJ IV) Calculation subtest
  WIAT-III Numerical Operations

• **Tests That Assess Math Fluency**
  WJ-IV Math Fluency subtest
  WIAT-III Math Fluency subtest

• **Tests That Assess Mental Computation**
  WISC-V Arithmetic subtest

• **Tests That Assess Quantitative Reasoning**
  WIAT-III Math Problem Solving subtest
  WJ-IV Applied Problems
The Math and Dyscalculia Screening Test

15 modules

Checks Number Sense and calculational adequacy

Good match of calculation subtest with standardized tests

Casts a wider net, goes beyond coping by counting

Respects Keypoints from SASC/STEC

Affordable and worldwide available
MATH AND DYSCALCULIA TESTING

TRY THE NEW MATH AND DYSCALCULIA SCREENING TEST

DIRECTLY TO THE TEST

https://DyscalculiaTesting.com
Give it a try

https://DyscalculiaTesting.com

coupon code LDA57
to get a complimentary test.
The Overlapping Nature of Specific Learning Differences/Difficulties

Attention Deficit Disorder/Attention Deficit Hyperactivity Disorder

Dyslexia

Dyscalculia

Asperger’s Syndrome

Dysgraphia

Dyspraxia

(Thanks to Dr Amanda Kirby, Medical Director of the Dyscovery Centre, Cardiff)
• Making change when shopping is nerve-racking.
• I rarely know what the sale price is.
• Scheduling takes all my focus
• I often arrive way too early.
• Directions like north and south don’t click for me.
• I bump my head—on everything.
• When it comes to driving, I’ll be a late bloomer.
“While dyscalculia is less debilitating than dyslexia, it still has a negative effect on the lives of sufferers. Many dyscalculics find ways to compensate for their dyscalculia, such as using a calculator wherever possible, however this can only help to some extent. Others simply do their best to avoid maths. Having dyscalculia limits academic and career possibilities for children and adults, as well as affecting everyday life (for example management of finances).”

Anna Wilson:
Dyscalculia affects about 5% of the population, just like dyslexia. And it has an even bigger effect on life chances.

Brian Butterworth:
The Pattern is clear
Famous people with Dyscalculia
Resistance to change strategies

- Parents need info, communication
- Compare with other children
- Emphasize regular development steps
- Create awareness of learning disabilities
- Suggestions for help, follow-up
Riddle me this:

It is unclear why we give children physical tests, check their lungs, eyes and ears but ignore their neurological/mental development unless there is a very visible problem going on.

Ideally all children would be screened for learning disabilities at an early stage.
Let’s focus on what we can do
Legal Framework

Rehabilitation Act, section 504 (1973)
Individuals with Disabilities Education Act (IDEA 2004)
Individual Education Plan (IEP)
Section 504, rehab. act 1973

- preferential seating
- extended time on test and assignments
- reduced homework or class work
- verbal, visual, and technology aids
- modified textbooks, audiovisual material
- behavior management support
- adjusted class schedules and grading
- verbal testing
- excused lateness, visit nurse, occup./phys. therapy
diagnosis of a Learning Disability (LD)

- not required to use a severe discrepancy between intellectual ability and achievement
- appropriate to use a process based on the child’s response to scientific, research-based intervention
- appropriate to use alternative research-based procedures
- indicate a LD if child does not achieve adequately for age
- indicate a LD if child does not meet grade-level standards
- important to have input from child’s parents and qualified professionals: teacher, diagnostician
LD areas mentioned in section IDEA

- Oral expression
- Listening comprehension
- Written expression
- Basic reading skills
- Reading fluency skills
- Reading comprehension
- **Mathematics calculation**
- **Mathematics problem solving**
Three Intervention Levels

**Tier 3**
- Specialized tutoring done by Dyscalculia Specialists, one on one, working on gaps that may go back many years, objective is not homework help or keeping up with the regular curriculum but re-mediation of the Dyscalculia.

**Tier 2**
- Tutoring typically done by special ed teachers, objective is to boost knowledge, re-teach topics and help with homework and to keep up with the curriculum.

**Tier 1**
- Classroom instruction following the regular curriculum.
teamwork

flexibility, patience

lots of encouraging
Child: the 3 main centers for Math

2 real objects, subitizing, estimating
basic number sense
innate in humans and animals

“two” the number word

visual input

2 the numeral
School: 3 centers for Math develop

number sense: subitizing and estimation
count real objects, internal number line,
small and larger quantity comparison

“two” the number word,
rote memory number facts

2 visual input numerals, signs, and written calculation
Establish the link between 3 centers

Draw, show, and tell **simultaneously**:
- Real life quantity,
- Number words/definitions
- Written numerals, math signs, formulas
separate first, combine later

Math facts practice

Problem solving
multi-sensorial instruction asks for actual manipulation by the child
Graph paper is indispensable

• One number or sign per square
• Match for hand writing size: do2learn.com, printablepaper.net
• Keep numbers aligned
• Helps with regrouping
• Place holder zeros don’t get lost
• Shows concept of place value
• Draw rectangles to multiply, to do area and perimeter etc.
Math Talks

Think - Pair - Share
Go full circle to see math makes sense!

1. Word problem
2. What do I need to find out?
3. Find the key numbers
4. Round and estimate
5. Calculate
6. Check: does it make sense?

Go full circle to see math makes sense!
Accommodations:

- Physical
- Whole class instruction
- Individual
- Test/quiz additional time
- Alternative homework
Sitting close, good eye contact
cover – copy - compare
Wall charts with real life pictures

Perimeter
- Add all sides
- The distance around

Area
- Amount of space inside the boundary of a flat (2D) object such as a triangle or circle.
- Town to town, wall to wall, floor to floor.

Volume
- How much water to fill the pool?
- How much flour in the bag?
- How much coke in the can?
Graphic organizer for calculation 1: make numbers

From working with actual base ten blocks to written calculations: draw base ten shapes and write the numbers in the columns to practice place value, use the words above the column to help you read it out.
Thumbs up

- Prevent math anxiety: only call on student when s/he signs to be ready to volunteer an answer.

insert
Golden Rules
Golden Rules

Working one on one
Golden Rules

Work in the Student’s pace
Golden Rules

Start at a very comfortable level
Golden Rules

Provide Immediate feedback
Use real life examples, manipulatives and models
Never Drill something that is not yet conceptually understood
Golden Rules

The cycle is:
- Estimate
- Calculate
- Check
when doing Math problems
Golden Rules

Reinforce Process and Hard Work
Golden Rules

Never say anything the student can say
Golden Rules

Make repeated practice fun with games
Golden Rules

Work on self confidence
show their progress
Online programs for dyscalculia

• The Number Race, The Number Catcher (France) free
  http://thenumberrace.com/nr/home.php and
  http://thenumbercatcher.com/nc/home.php

• Meister Cody www.meistercody.com

• Calcularis, focus on number lines (Zwitserland)
  http://www.calcularis.ch/int/

• Dynamo Maths (UK) free trial
  http://www.learning-works.org.uk/product-focus/dynamo-maths
Count on It: Born to Estimate

From the time we are born, we have some concept of number. Children with deficits in this innate skill often end up struggling in later life. Stanislas Dehaene and his colleagues have created a game, the Number Race, intended to bolster our natural-born ability to estimate quantity. A preschooler judges which group of gold pieces is larger before the computer’s animal avatar can steal the bigger pile (top left). A correct guess by the child advances his or her avatar a comparable number of spaces from its previous position; the loser moves ahead by a number equal to the smaller quantity of coins (bottom right). The winner is the one to reach the end of the number line first.
Meister cody
• Number line training, 15 min./day for 5 weeks
• DD use frontal regions for number liner line instead of parietal
• Both DD and controls improved
• DD improved more on MRI and math level

*Neuroimage*, 57, Kucian, K. 2011
Apps for math CallScotland.org.uk
Games are the new worksheets

• Element of surprise
• Several calculations to find the next move
• Students like to win and stay focused longer
• Playing with adults/teachers means getting extra guidance / explanations: ask students to explain their strategy and correct
• Students can play together
Visualize number bonds of 9
‘Slope’ house where Mr. Slope Guy lives

- Vertical chimney has no slope.
- Parallel lines have the same slope (horizontal slope = 0).
- Up 3, over 1: slope = 3/1 = 3
- Down 3, over 1: slope = -3/1 = -3

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Q & A

Thank you for attending and please join me in raising awareness for dyscalculia!