

Dyscalculia, Causes, Consequences, & Creative solutions

Dr Anneke Schreuder

Dyscalculia Services

www.DyscalculiaTrainingCenter.org

Dyslexia

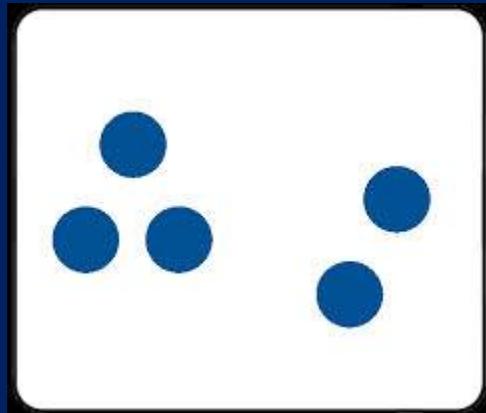
- starts to **talk** late
- difficulty with **blending** and **segmenting** sounds
- **rhyme patterns** are hard
- reads **letter by letter** or **word by word** slowly
- forgets **sight words**
- struggles with **grammar**
- copies **letters** out of order
- forgets/loses info: **dates, names, address**

Dyscalculia

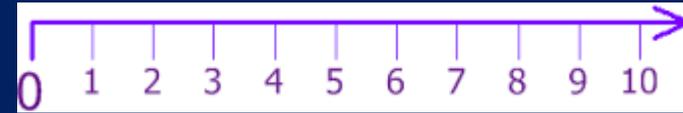
- starts to **count** late
- difficulty with **composing** and **decomposing** numbers
- **number patterns** are hard
- counts **tally marks** or **one by one** slowly
- forgets **math facts**
- struggles with **algorithms**
- copies **numbers** out of order
- forgets/loses info: **log ins, numbers,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

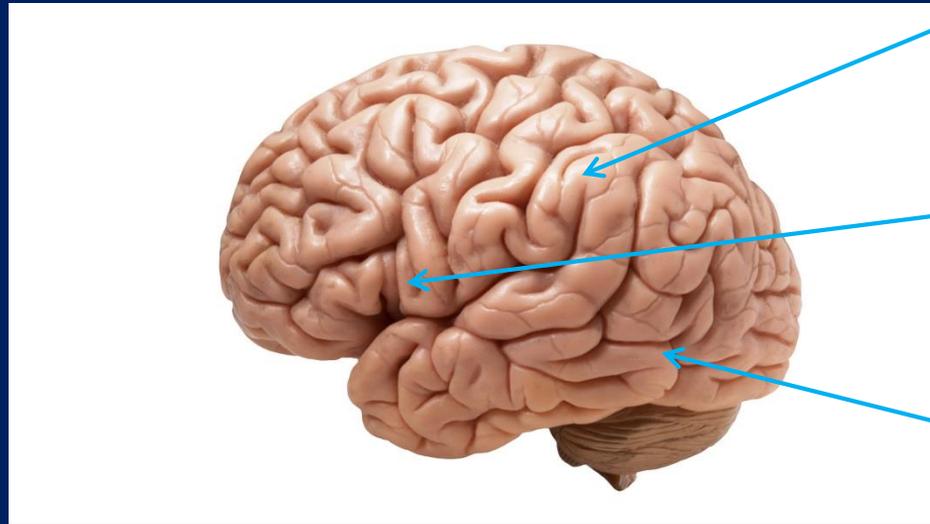
Specify current severity:

Mild

Moderate

Severe

3 main centers for math



**Number Sense
Center**

Verbal Centers

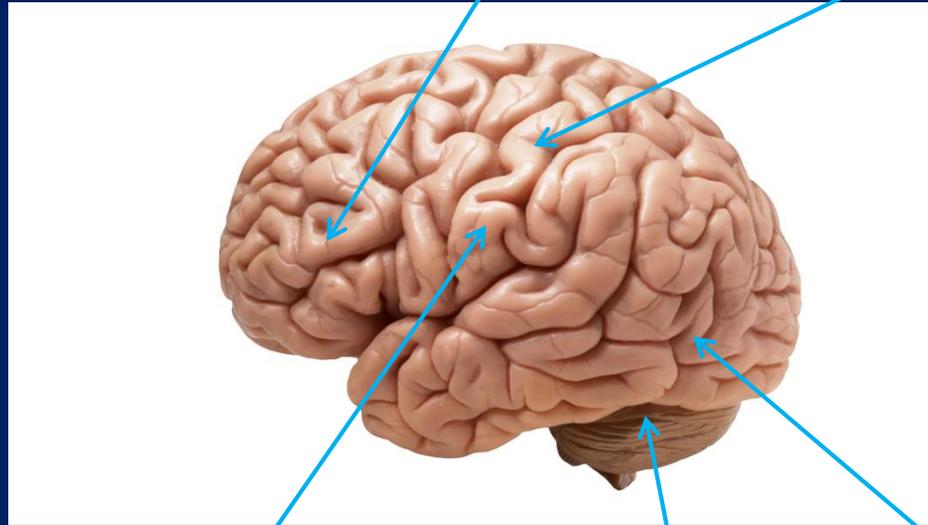
Visual Centers

**Pre-frontal region
executive function**

**Fine motor
skills**

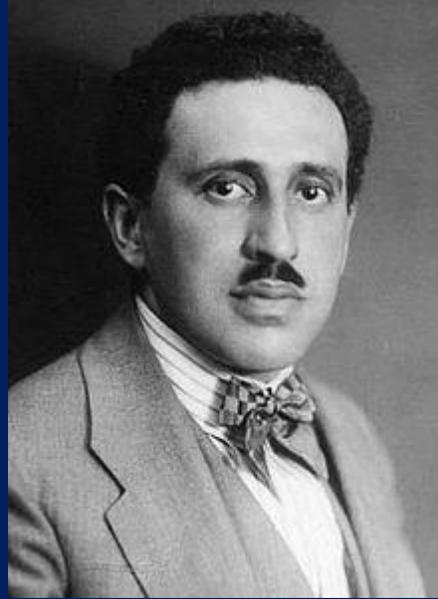
**Various types
of memory**

**Visual spatial
processing**



**Temporal
processing**

Rythm



Gerstmann Syndrome

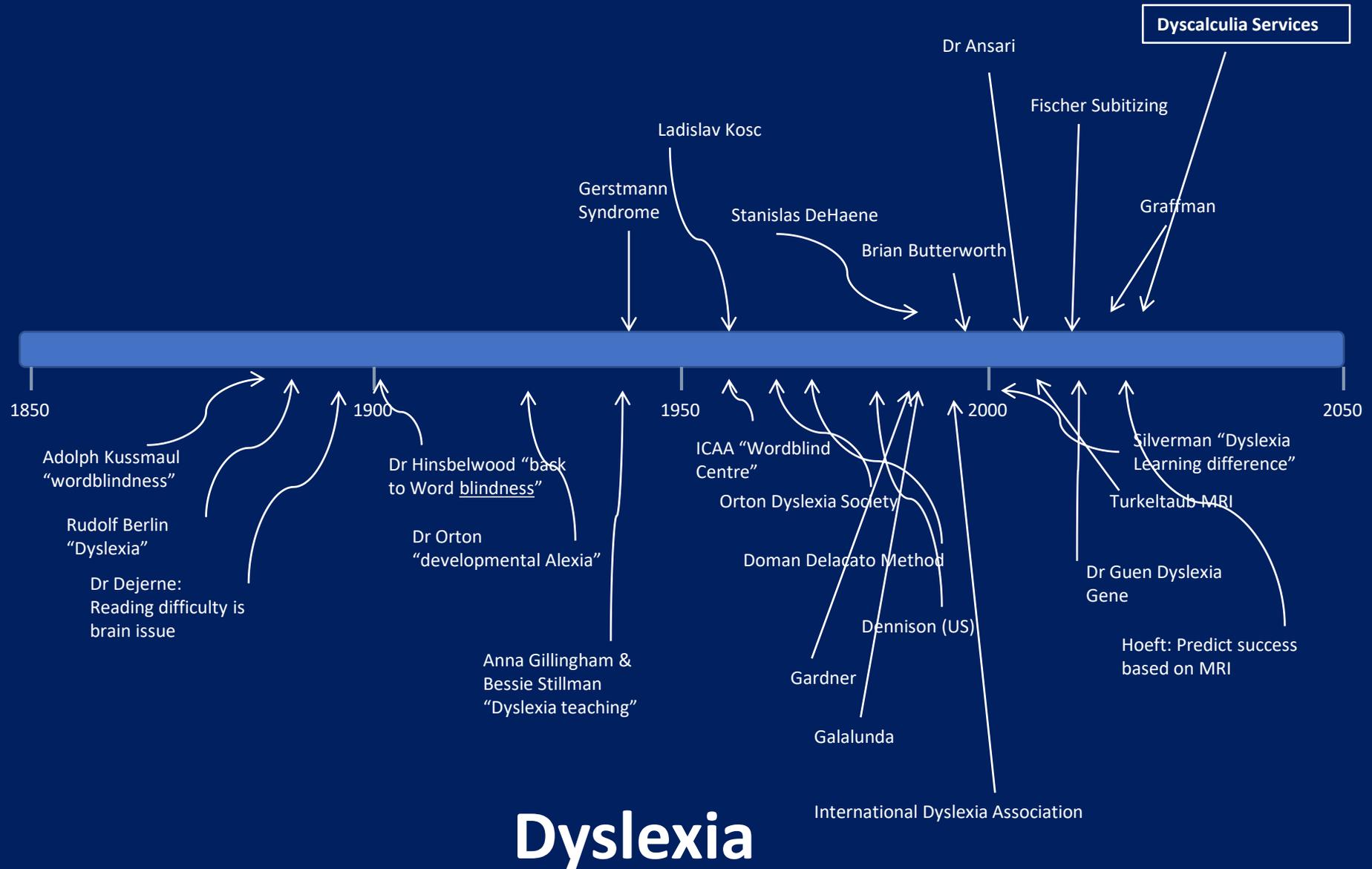
- Writing
- Arithmetic
- Finger Agnosia
- Left-Right coordination

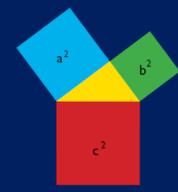


Dr. Ladislav Kosc named
Developmental Dyscalculia

Research

Dyscalculia





dyslexia

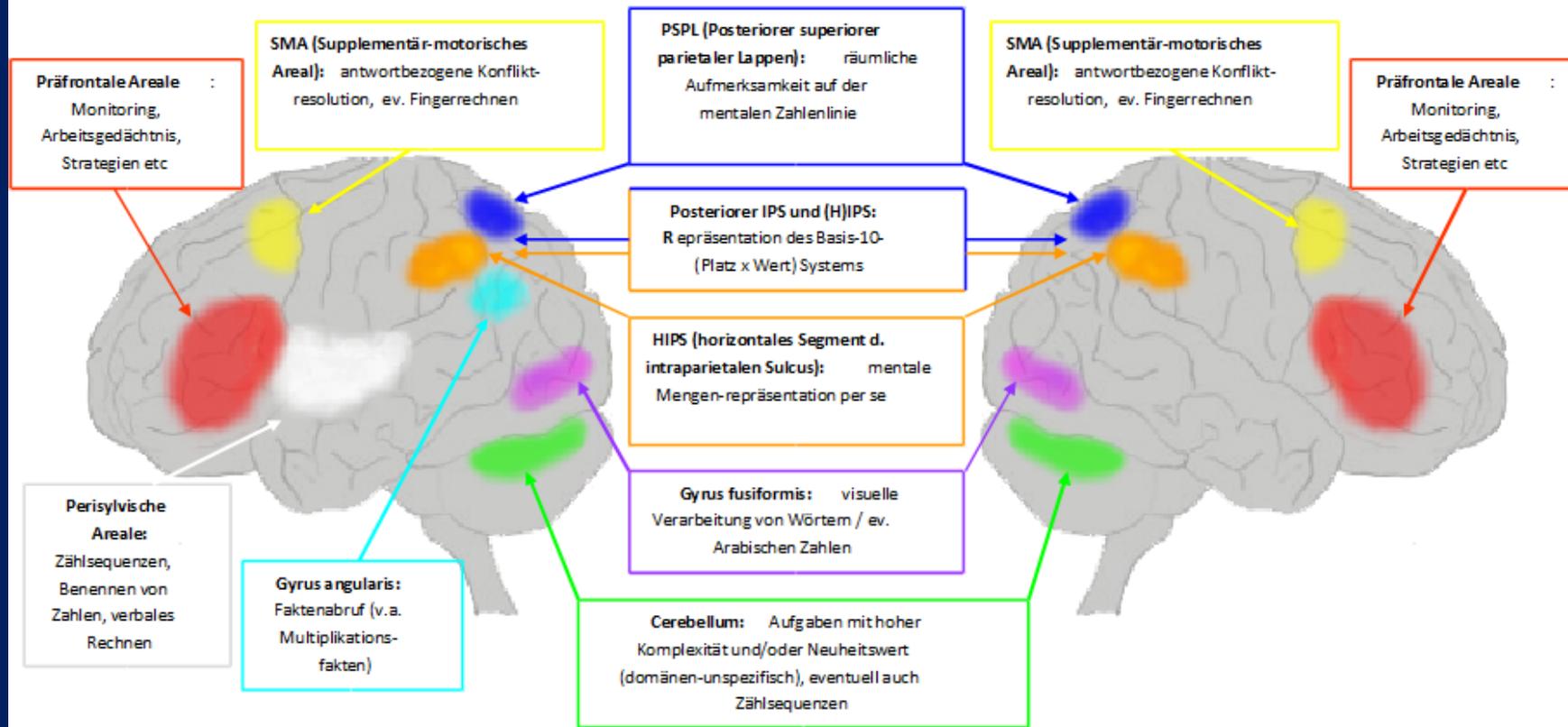


dyscalculia

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

Daniel Ansari

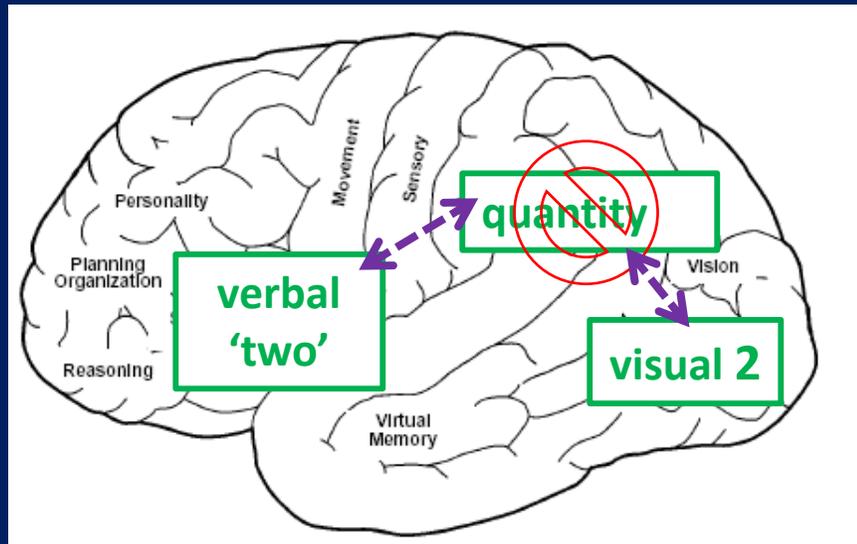
Brain areas that have been identified to be active during numerical processing / arithmetic



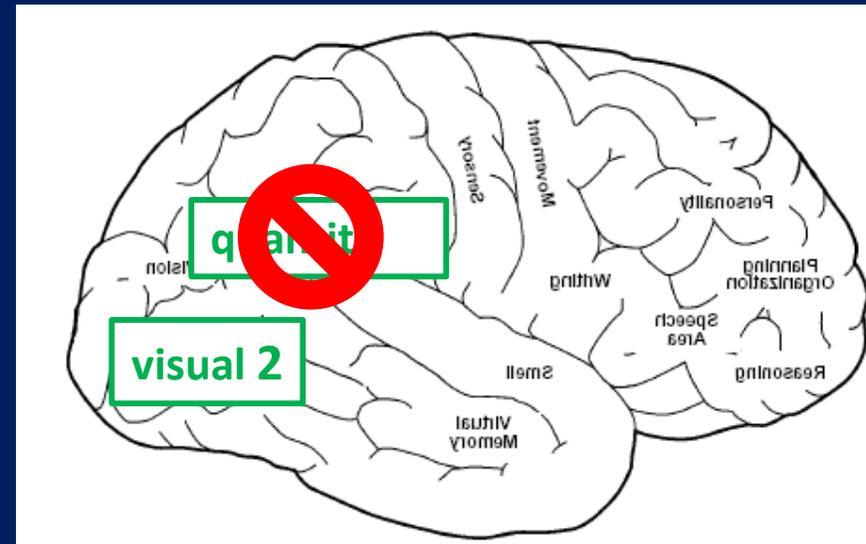
Theories of deficits in dyscalculia: domain specific

- Access deficit: no links with number sense center

- Core deficit is the number sense center

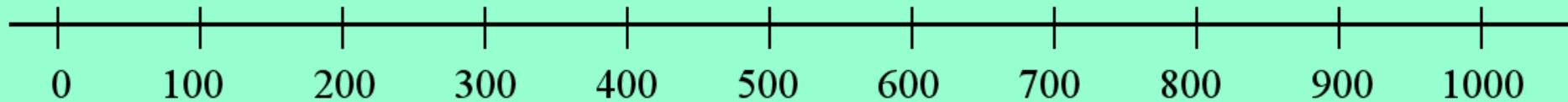
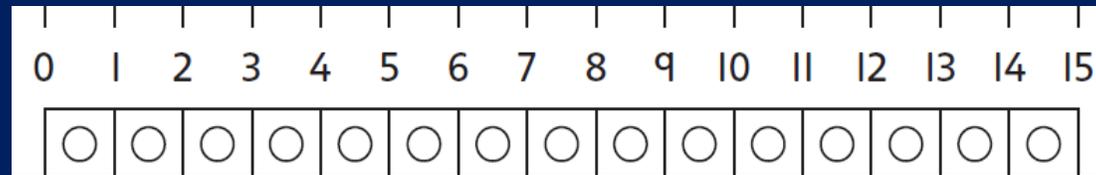


Left



Right

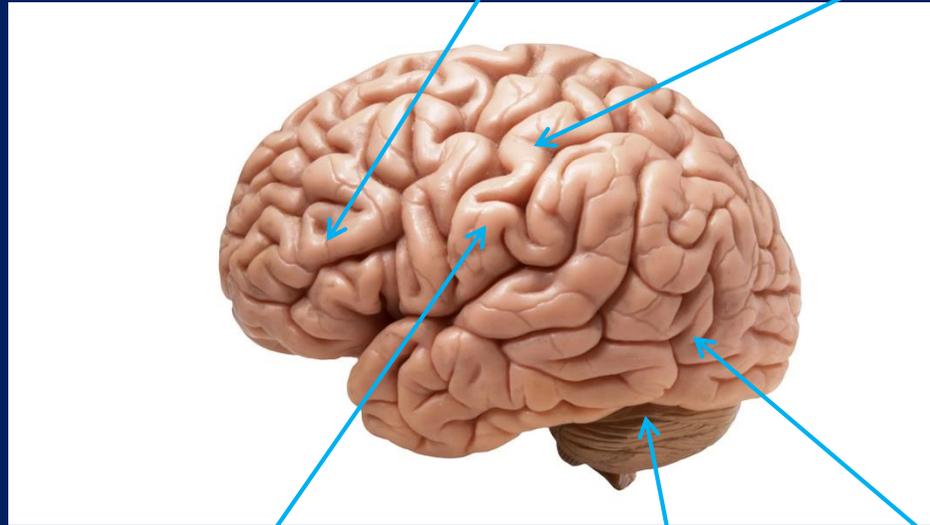
Number Sense Mental number Line



**Sometimes the arabic numbers are
the culprit**



**Pre-frontal region
executive function**



**Fine motor
skills**

**Various types
of memory**

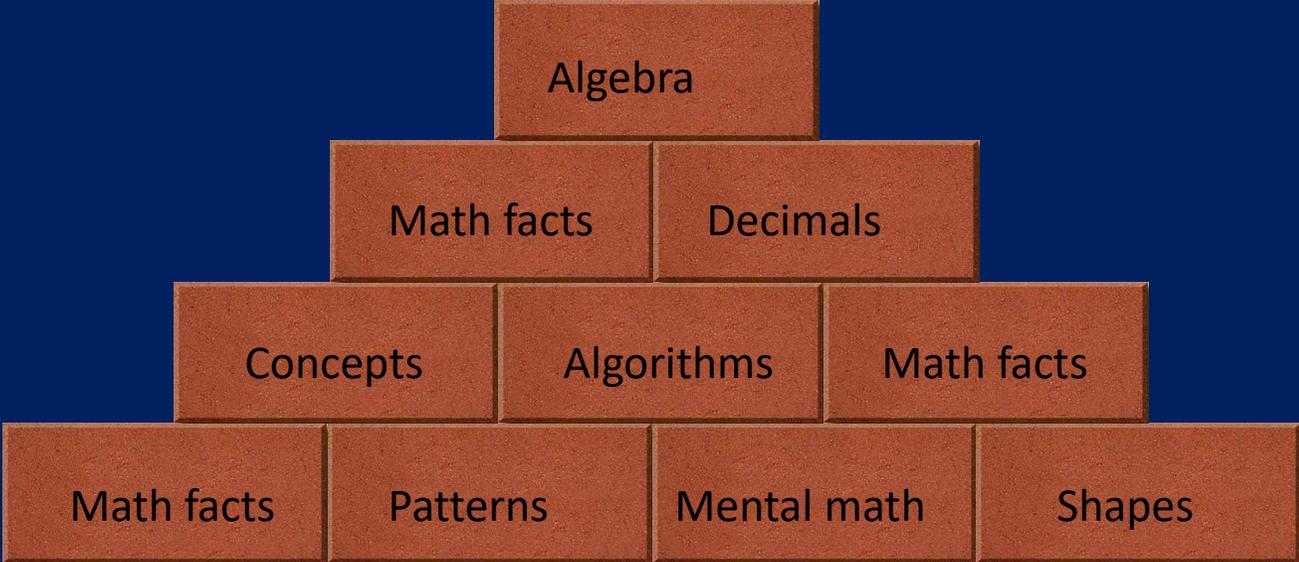
**Visual spatial
processing**

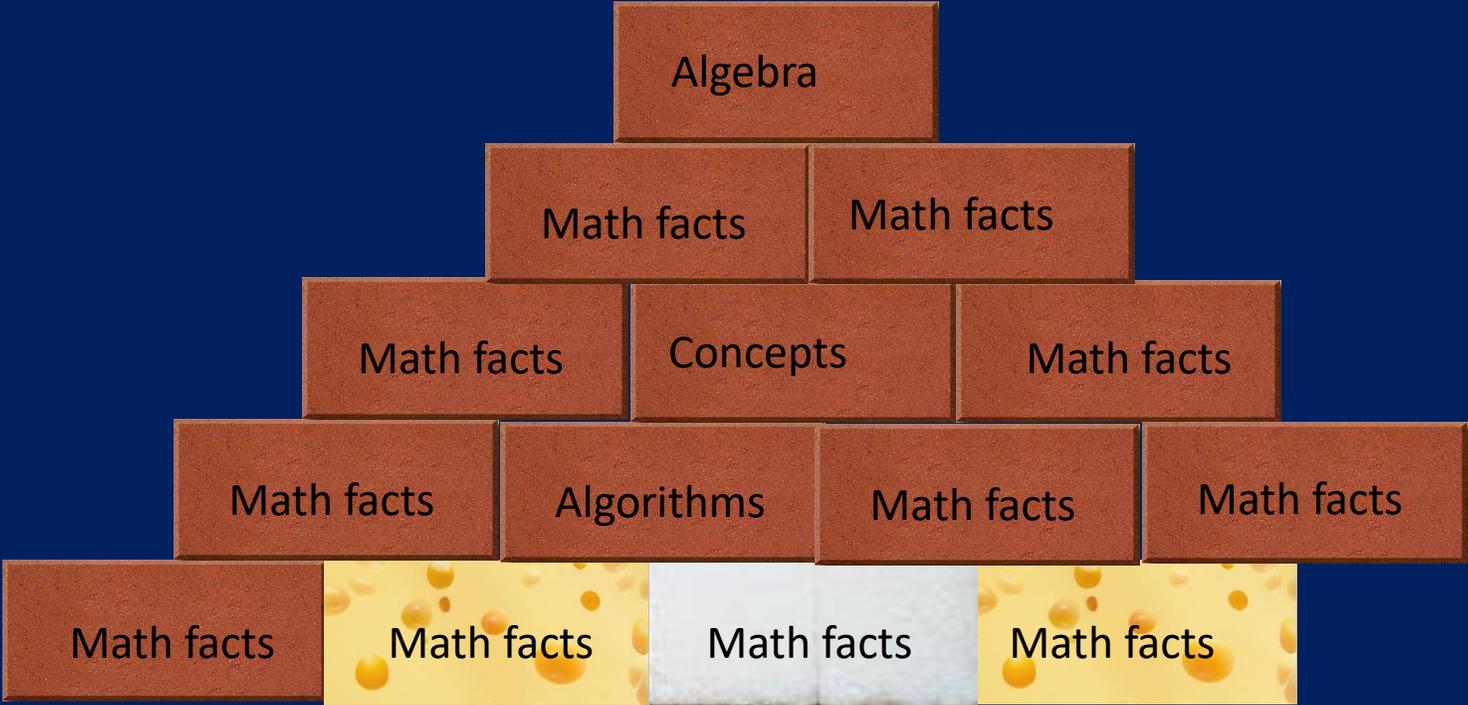
**Temporal
processing**

Rythm

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**

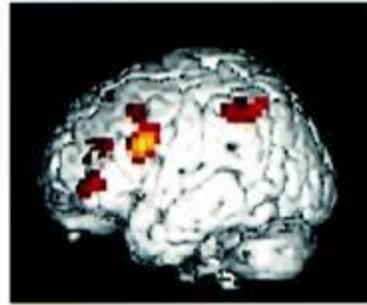




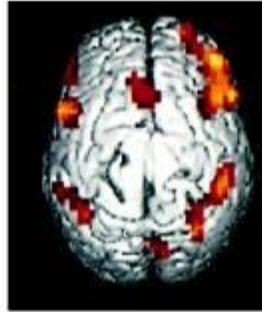
University College London

“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.”

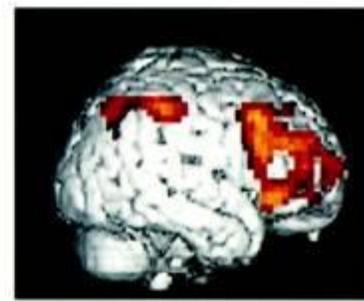
Calculation



Left hemisphere

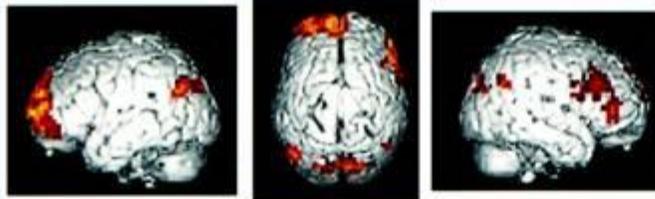


Top view

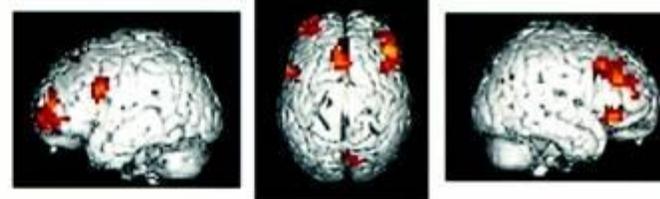


Right hemisphere

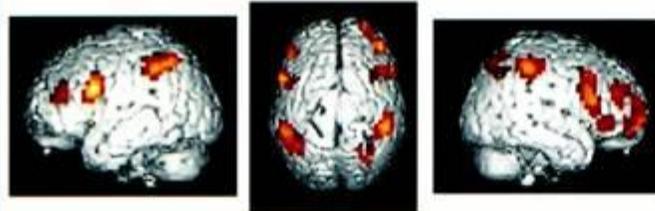
Exact calculation, small problems



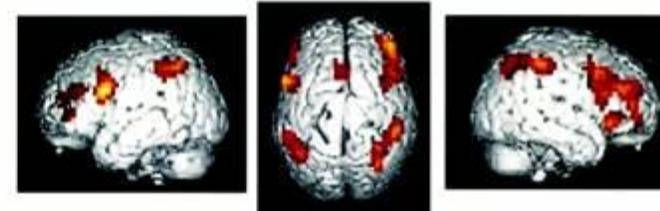
Exact calculation, large problems

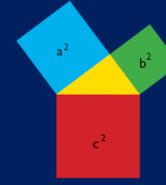


Approximation, small problems



Approximation, large problems





Not live up to potential

Does not try or hides exposure

Mistakes copying from board

Confuses assignments

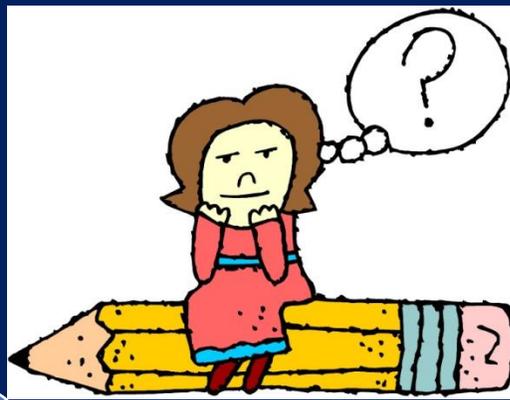
Sick on test days

Missing homework

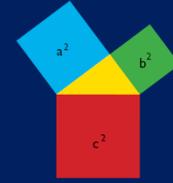
Daydreaming

Acting out

Works slowly



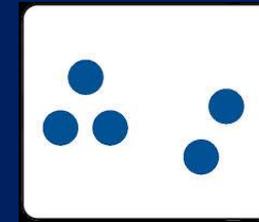
How do we detect dyscalculia



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)



WHICH NUMBER IS LARGER?

These tests are used to determine whether a person's problems with numbers are due to dyscalculia or to other cognitive deficits.

3 8

WHICH IS TALLER?

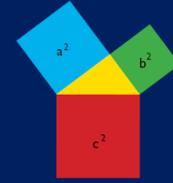
People with dyscalculia answer this question just as quickly and accurately as people without a learning disability.

7 9

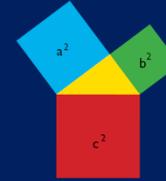
WHICH IS GREATER?

Dyscalculics take longer and are less accurate at answering this question. They have even more trouble when the difference between the two numbers is small.

Screening /Checklists

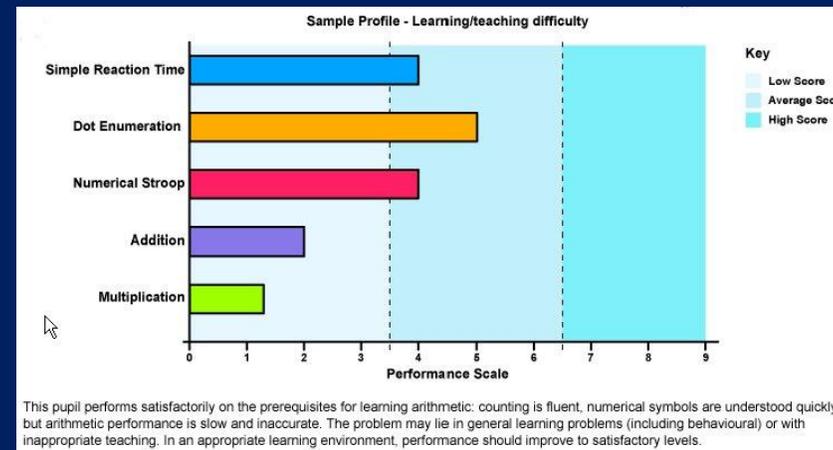
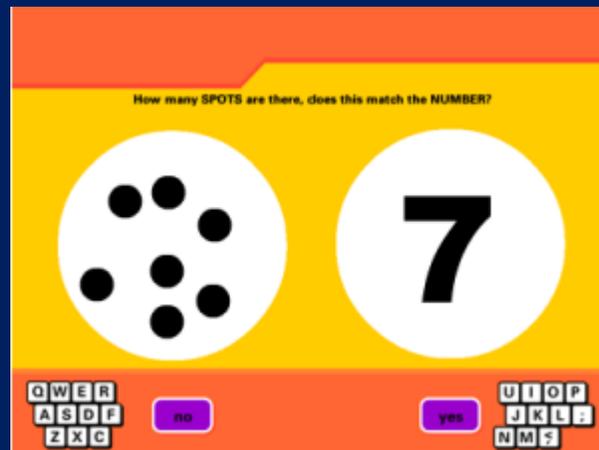


- Dyscalculia Services
(dyscalculiaservices.com)
Grade 1 - 12
- Panamath
(Panamath.org)
Grade 8 - adult
- The Numeracy Screener
(numeracyscreener.org)
KG – Grade 3
- Early Numeracy Indicators
(progressmonitoring.org)
KG – Grade 2
- Math Reasoning Inventory
(mathreasoninginventory.com)
Grade 4 -8



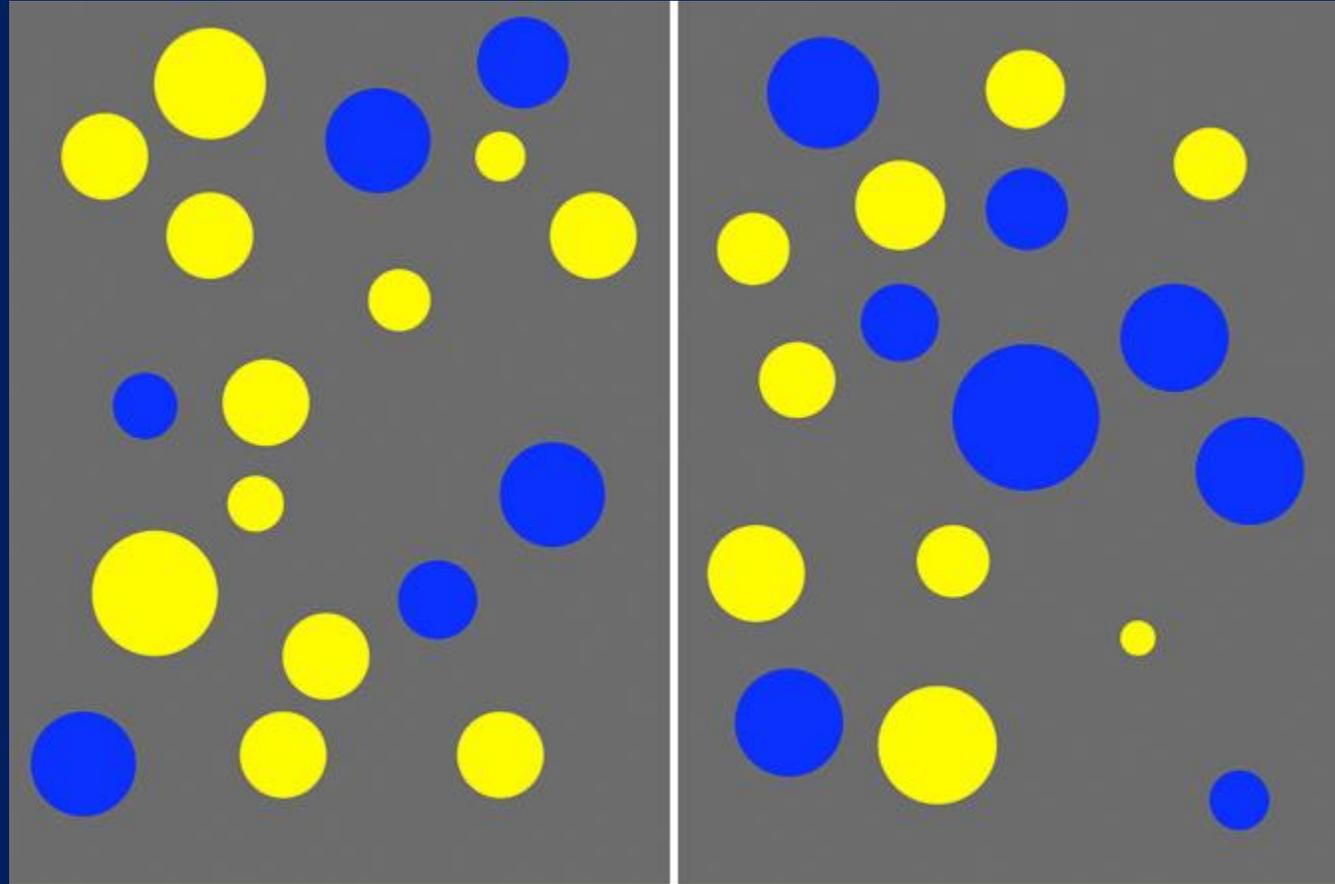
Further Testing

- The Dyscalculia Screener

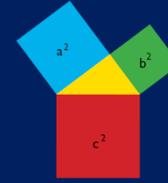


- The Dyscalculia Assessment (not online) by Jane Emerson and Patricia Babbie

Panamath test



From the Understood website



- ***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

Call: +1 (832) 377-8373 |
Email: communications@dyscalculiatesting.com



MATH AND DYSCALCULIA TESTING

<https://DyscalculiaTesting.com>

- Home
- The Math and Dyscalculia Screening Test
- What is Dyscalculia
- Sample Test Report
- Brochure
- About us



**TRY THE NEW MATH AND DYSCALCULIA
SCREENING TEST**

**DIRECTLY TO THE
TEST**

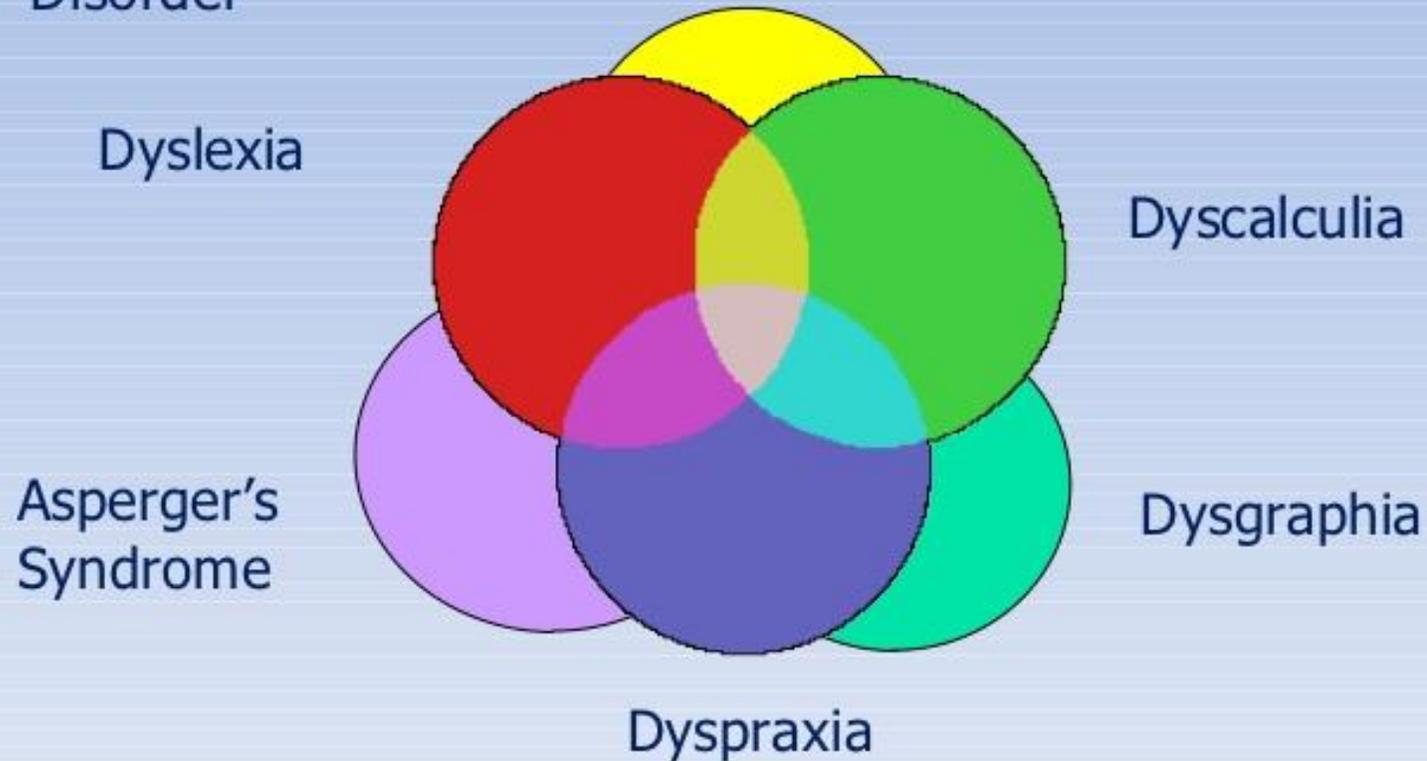
Give it a try

<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



(Thanks to Dr Amanda Kirby, Medical Director of the Dyscovery Centre, Cardiff)

CONSEQUENCES



- 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.

Anna Wilson:

“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).”

Brian Butterworth:

“Dyscalculia affects about 5% of the population, just like dyslexia.

And it has an even bigger effect on life chances.”

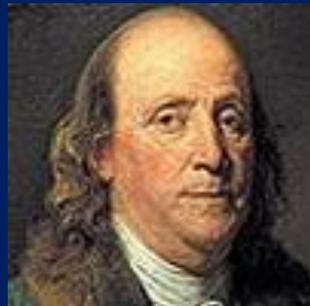
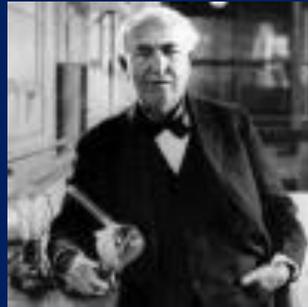
The Pattern is clear





MAR 25 052-0439374-000 MEME
FDGL LEASE PYMT 08032
052-0300936-000 WALTER
MAR 26 FLORIST
MAR 26 NSF RETURN ITEM FEE
MAR 26 OVERDRAFT FEE
MAR 26 OVERDRAFT FEE
MAR 31 OVERDRAFT FEE
MAR 31 OVERDRAFT FEE
MAR 31 FDGL LEASE PYMT 080331
MAR 31 FLORIST
MAR 31 FDGL LEASE PYMT
MAR 31 052-0425252-000 WALTER'S
MAR 31

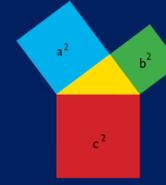
Famous people with Dyscalculia



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



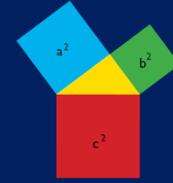
Riddle me this:

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 Frame work

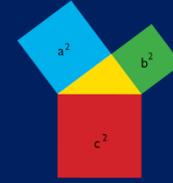


Rehabilitation act, section 504
(1973)

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

IDEA 2004 www.idea.ed.gov 34 CFR 300.8(c)(10)

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

03

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

5%

02

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

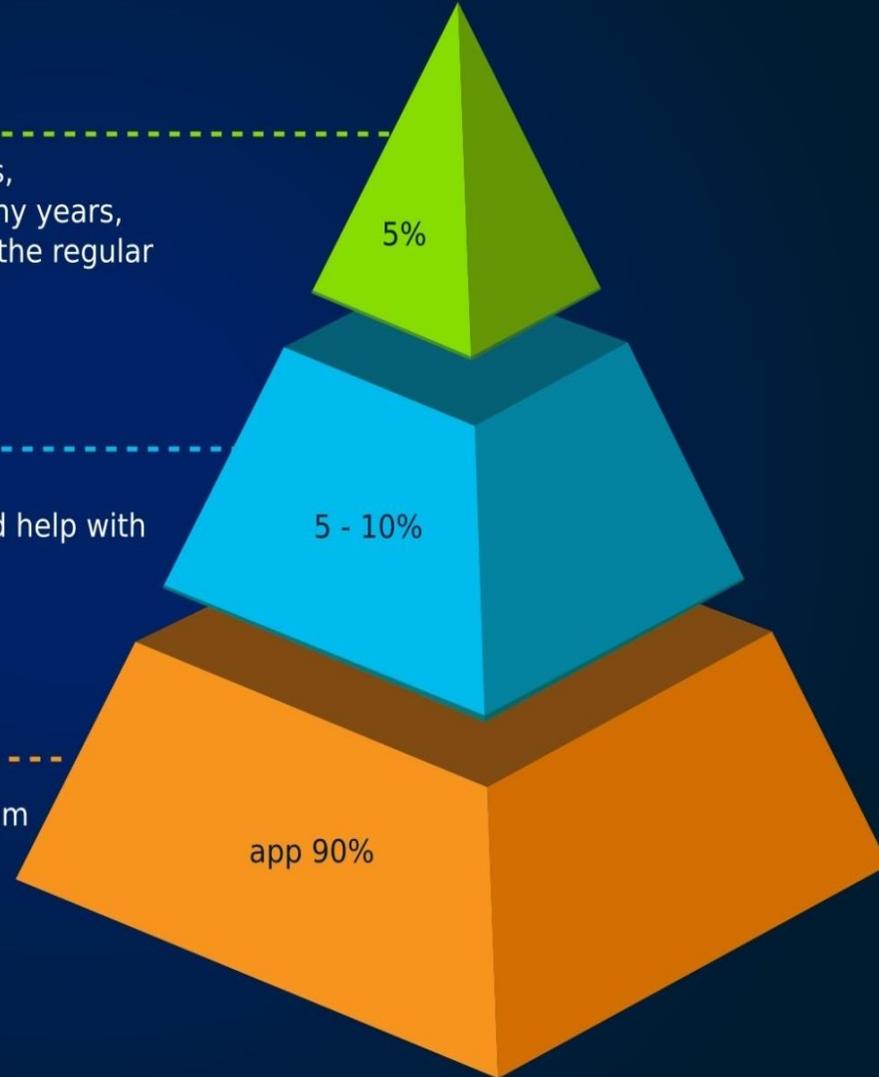
5 - 10%

01

Tier 1

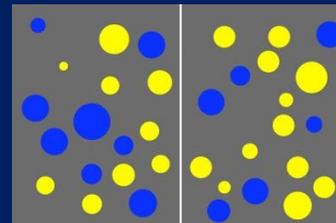
Classroom instruction following the regular curriculum

app 90%



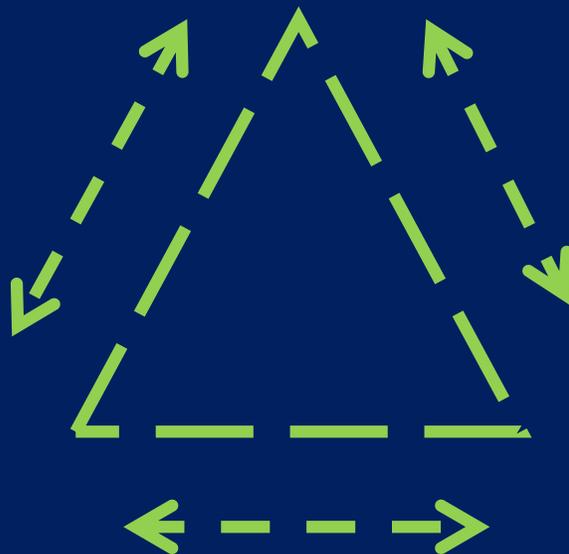


Child: the 3 main centers for Math



**2 real objects, subitizing, estimating
basic number sense**

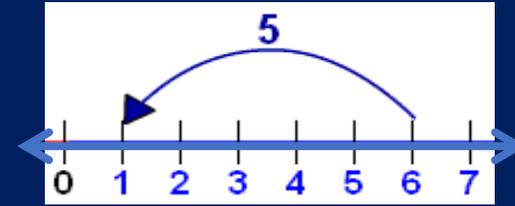
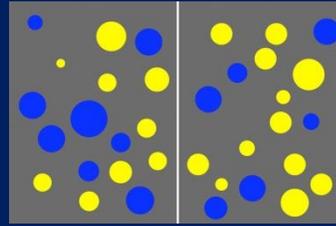
innate in humans and animals



**“two” the
number word**

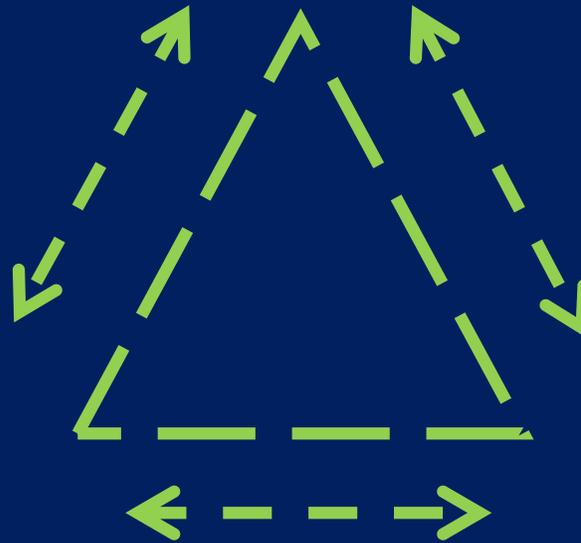
**visual input
2 the numeral**

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

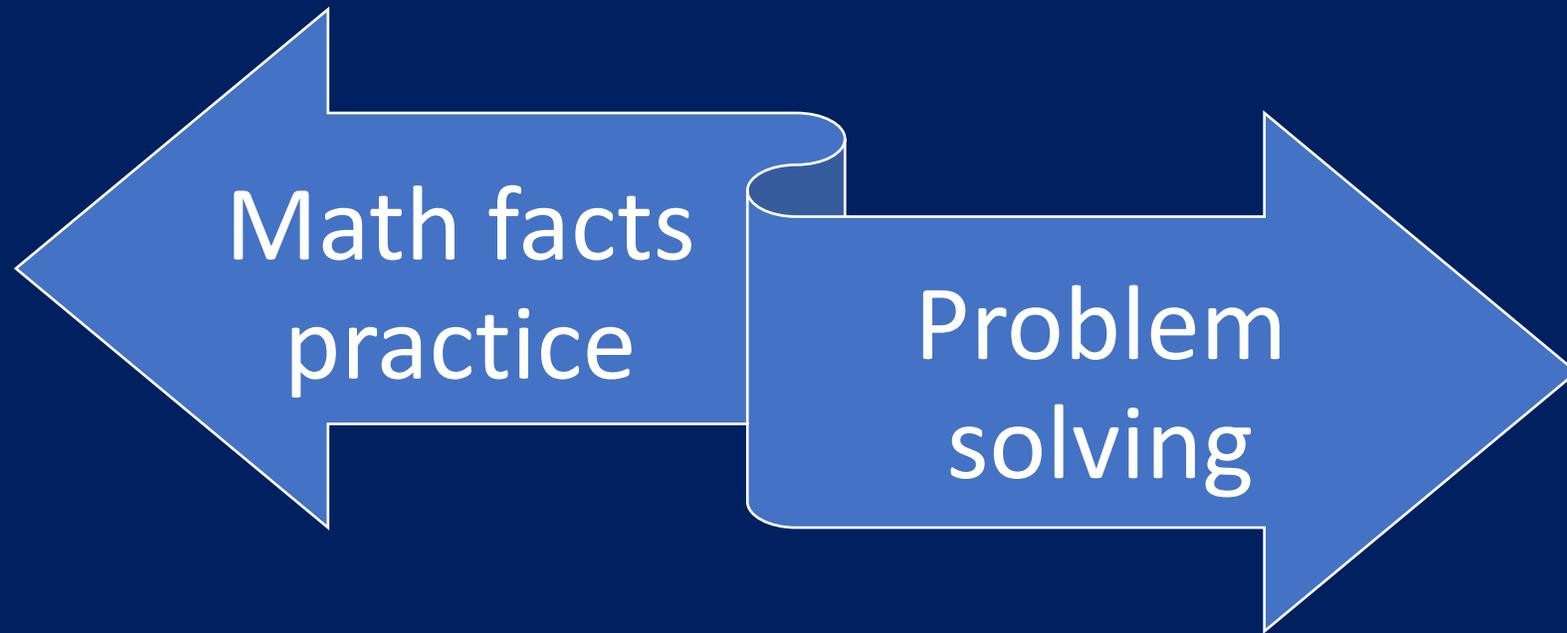
Establish the link between 3 centers



Draw, show, and tell **simultaneously**:

- Real life quantity,
- Number words/definitions
- Written numerals, math signs, formulas

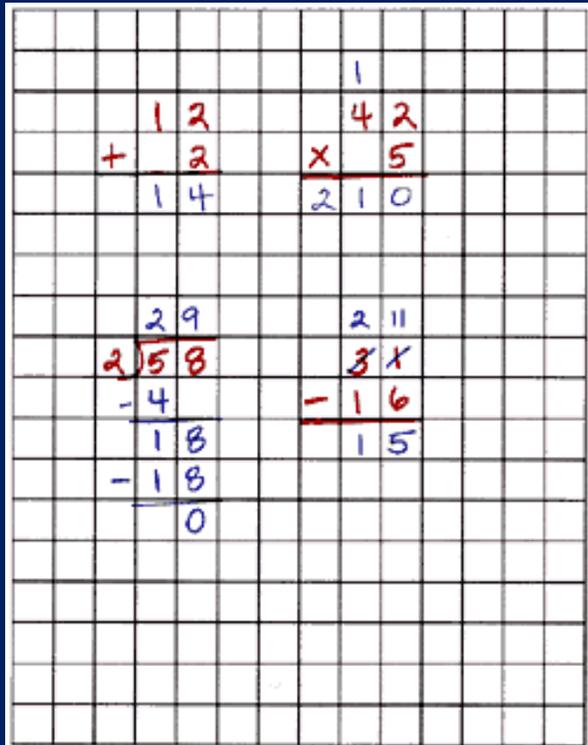
separate first, combine later



multi-sensorial instruction asks for actual manipulation by the child

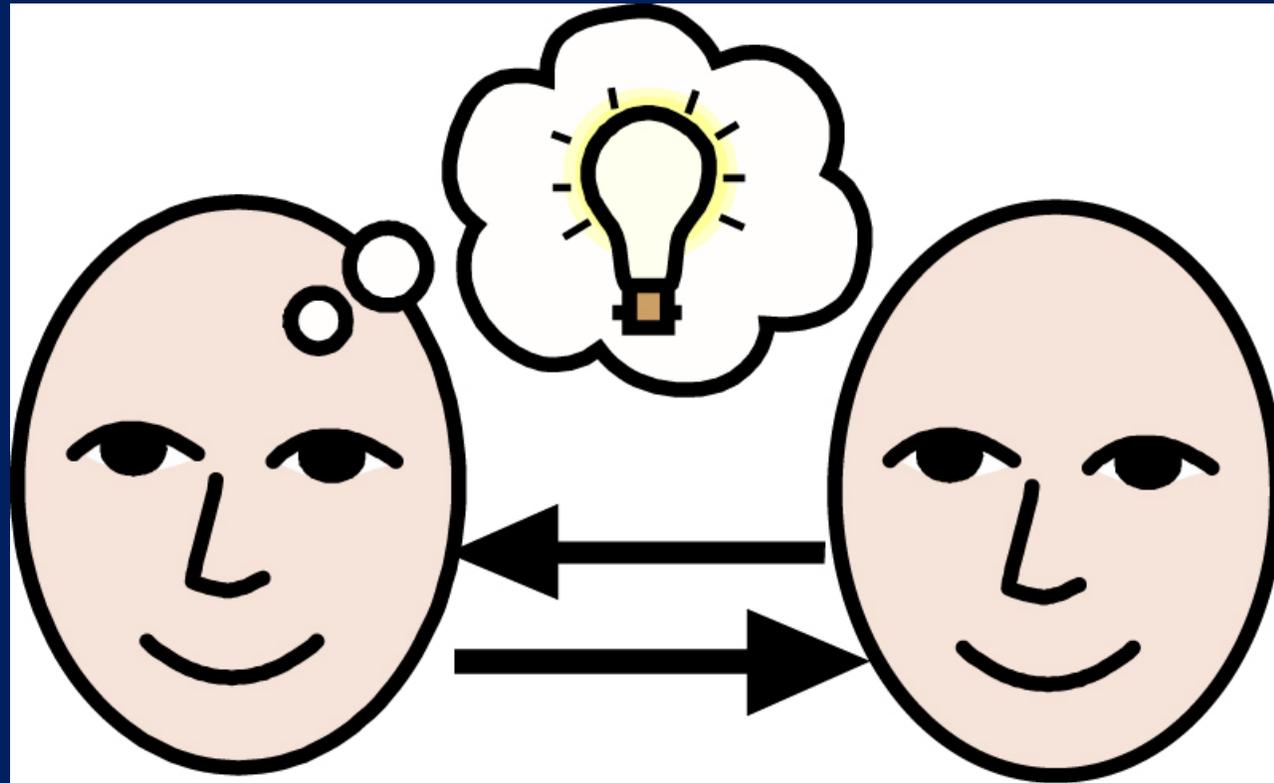


Graph paper is indispensable



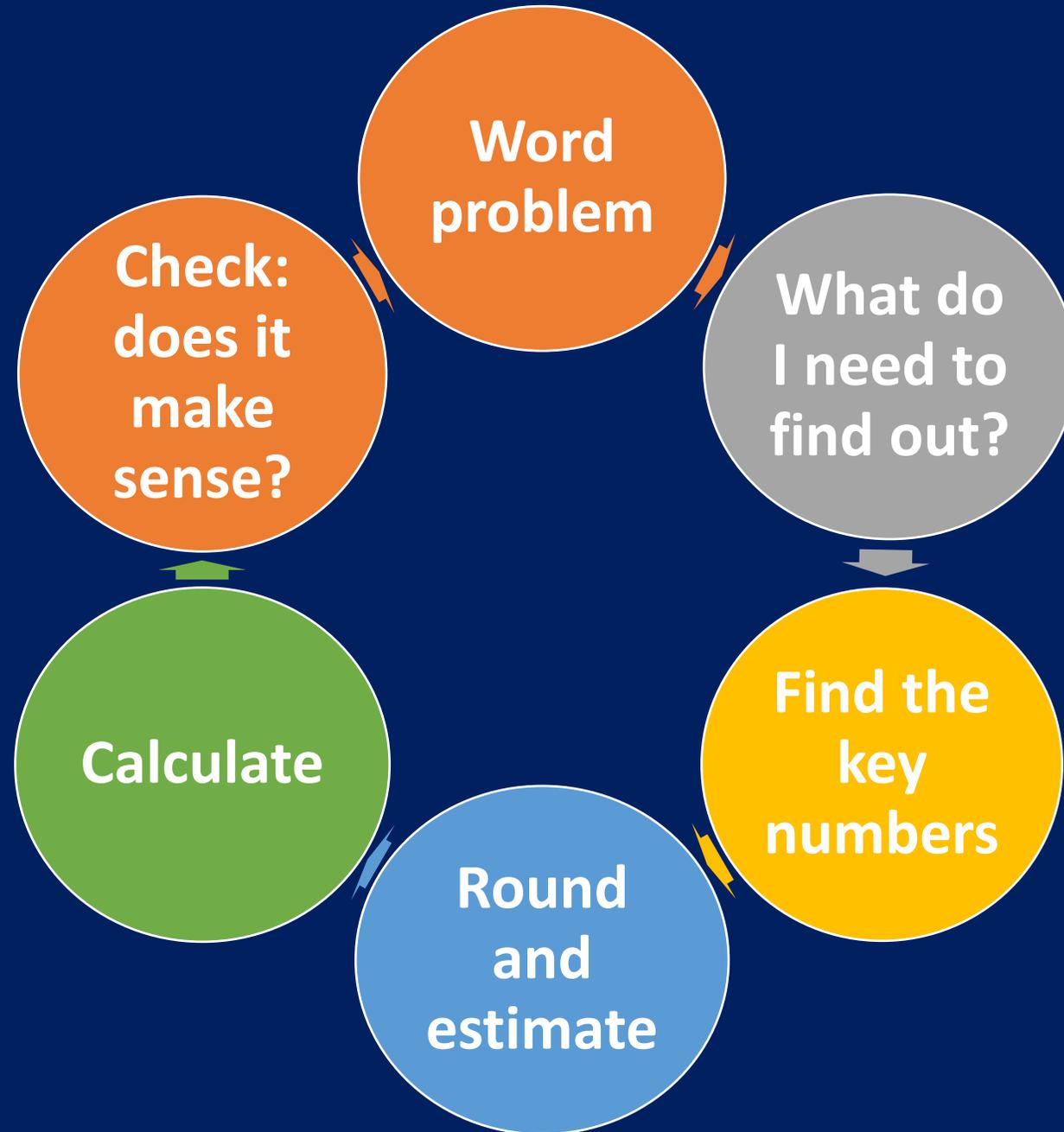
- One number or sign per square
- Match for hand writing size:
do2learn.com, printablepaper.net
- Keep numbers aligned
- Helps with regrouping
- Place holder zeros don't get lost
- Shows concept of place value
- Draw rectangles to multiply, to do area and perimeter etc.

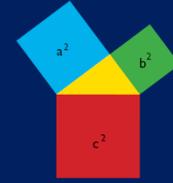
Math Talks



Think - Pair - Share

Go full circle to see math makes sense !



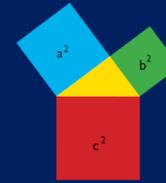


Accommodations:

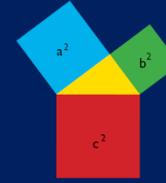
- Physical
- Whole class instruction
- Individual
- Test/quiz additional time
- Alternative homework

Sitting close, good eye contact

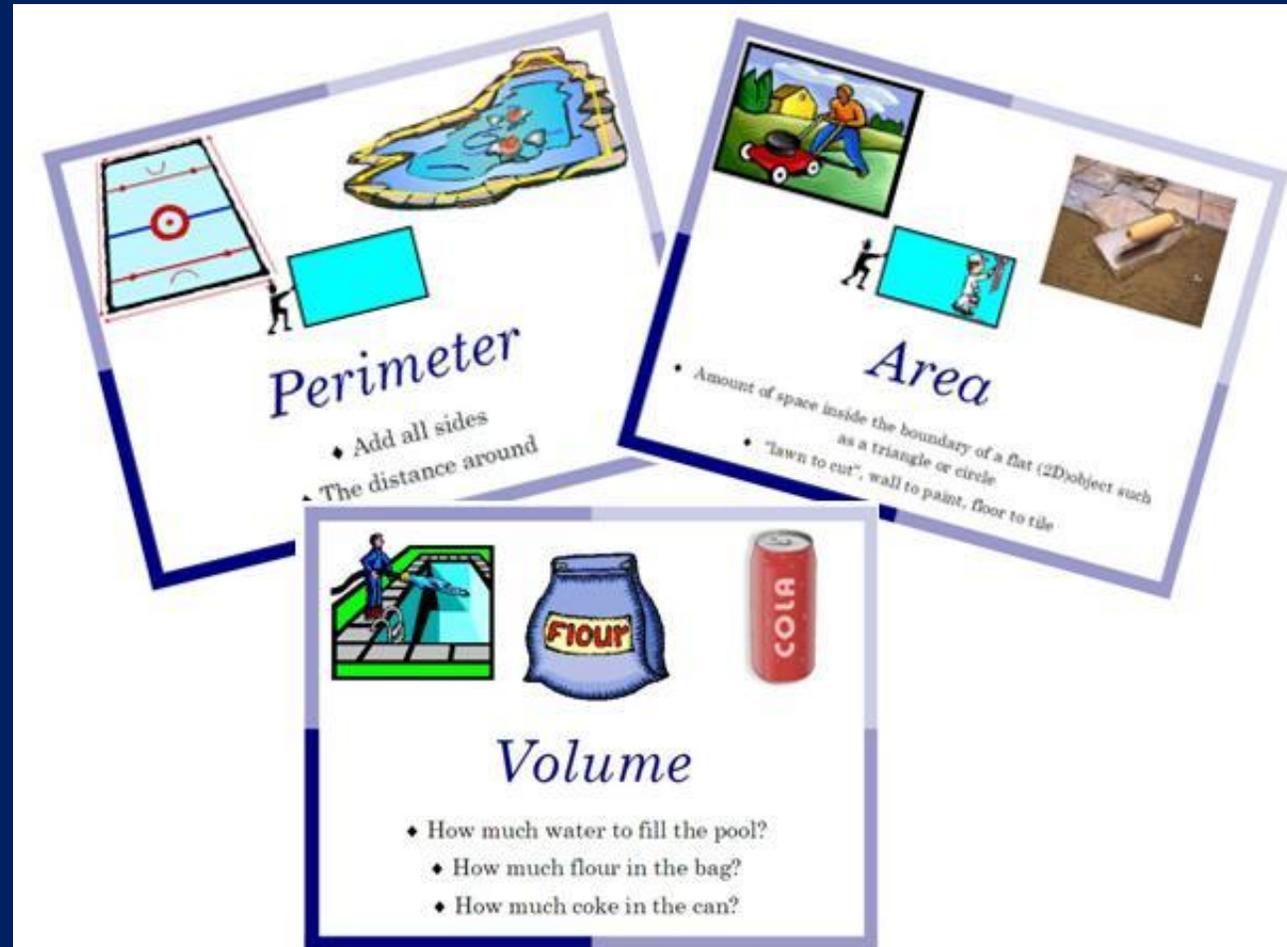


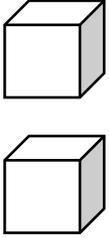
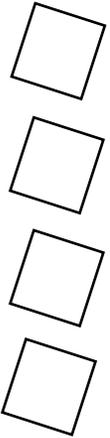


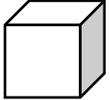
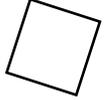
cover – copy - compare

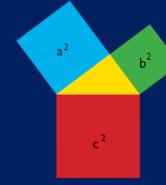


Wall charts with real life pictures



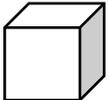
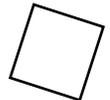
thousands	hundreds	tens	ones
			
2	4	7	6

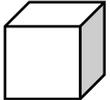
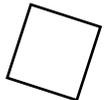
thousands	hundreds	tens	ones
			



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

thousands	hundreds	tens	ones
			

thousands	hundreds	tens	ones
			

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**



Golden Rules

**Use real life examples,
manipulatives and
models**



Golden Rules

**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**



Available on the
App Store

GET IT ON



Google play

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>

The Number Race and The number Catcher

A NUMBER GAME

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



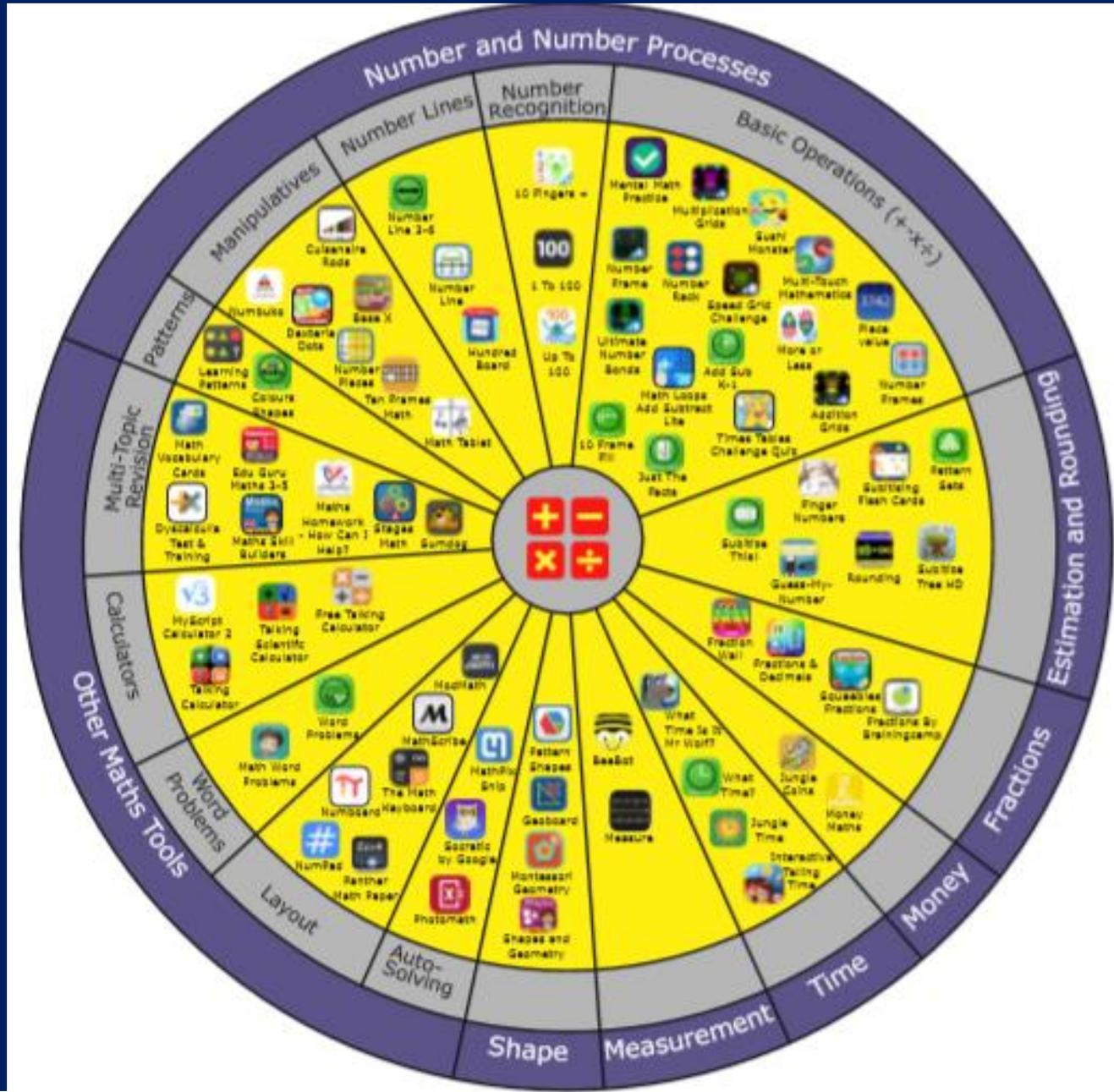


Calcularis

- Number line training, 15 min./day for 5 weeks
 - DD use frontal regions for number line instead of parietal
 - Both DD and controls improved
 - DD improved more on MRI and math level
- Neuroimage, 57*, Kucian, K. 2011

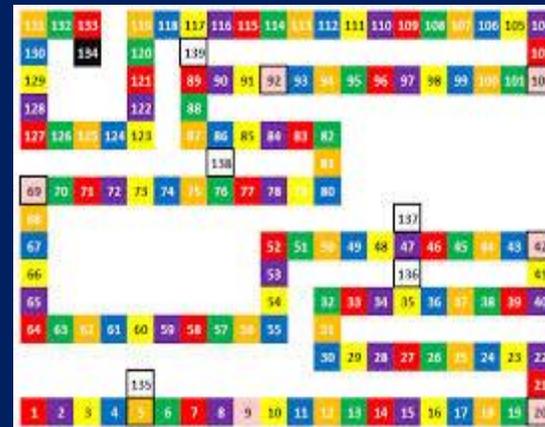
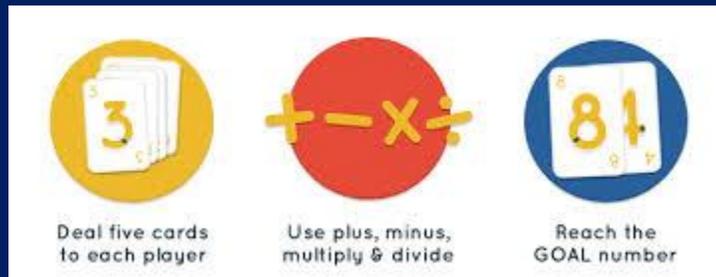


Apps for math CallScotland.org.uk

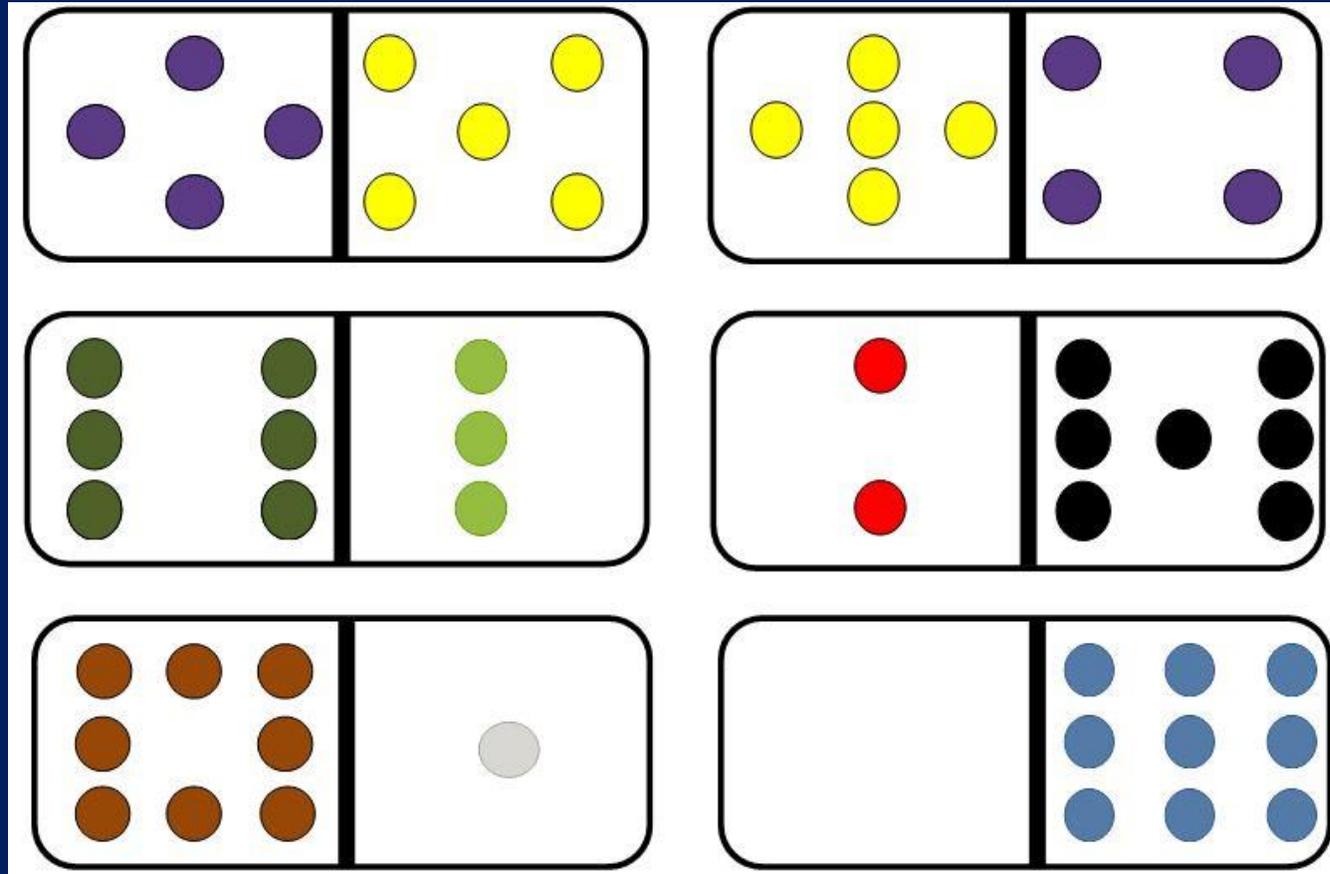


Games are the new worksheets

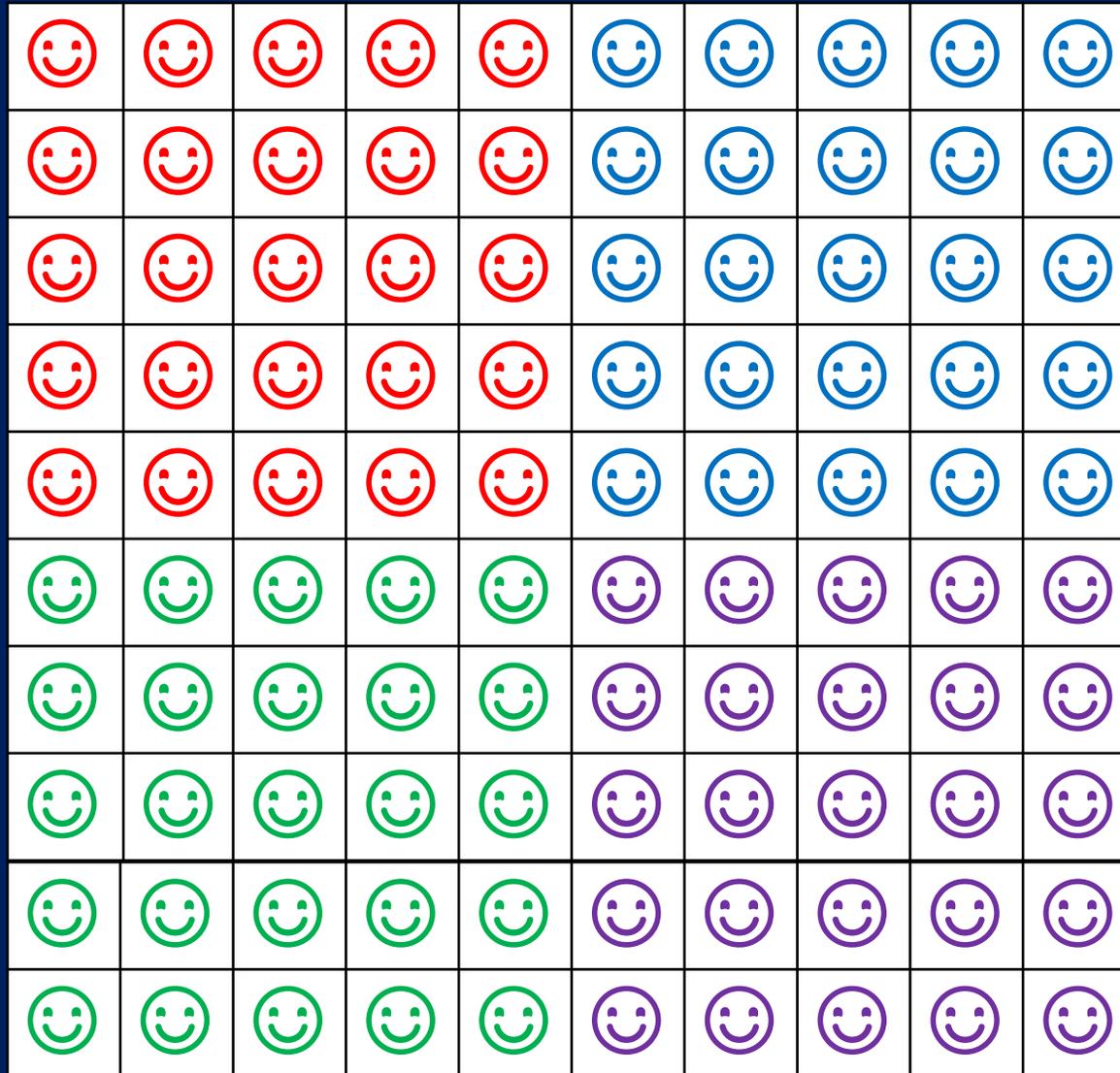
- Element of surprise
- Several calculations to find the next move
- Students like to win and stay focused longer
- Playing with adults/teachers means getting extra guidance / explanations: ask students to explain their strategy and correct
- Students can play together



Visualize number bonds of 9



Happy.DyscalculiaServices.com



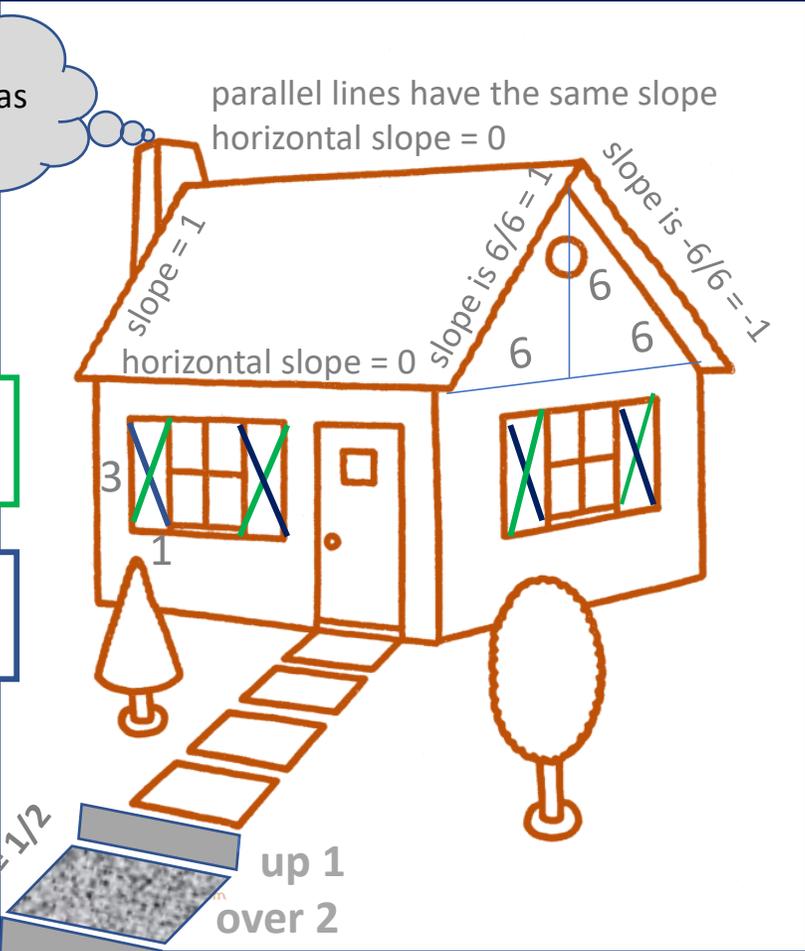
'Slope' house where Mr. Slope Guy lives

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 = $-3/1 = -3$



Q & A



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