

Reading, Math and the Brain

Connecting the Research & Practices That Work

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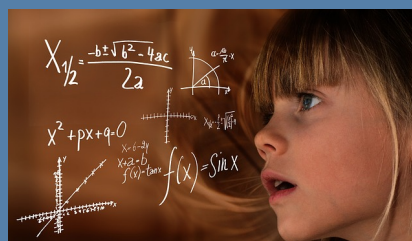


Symposium Themes

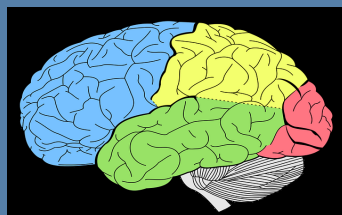
Reading



Math



The Brain



Difficulties Exhibited by Children with Reading Disabilities

DOMAIN-SPECIFIC SKILLS	Pertaining Specifically to Reading Processes
Decoding	Difficulties translating words from print to speech by applying knowledge of grapheme-phoneme (letter-sound) correspondences
Phonemic Awareness	Problems hearing, identifying, and manipulating sounds in spoken words
Automaticity	Deficient in being able to read without devoting conscious effort or attention to decoding
Spelling	Confusing letters that sound alike; problems noticing, remembering, and recalling the features of language that letters represent
Fluency	Unable to read text quickly, accurately, and with proper expression
Vocabulary Knowledge	Lacking knowledge of the meanings of words necessary for communication
Reading Comprehension	Difficulties processing text, understanding its meaning, and integrating this with their own relevant background knowledge
DOMAIN-GENERAL PROCESSES	Deficits in working memory, attention, processing speed (RAN), language, or executive functions (e.g., cognitive flexibility, inhibitory control)

Mathematical Disabilities

- A specific learning disorder affecting the ability to acquire numerical and arithmetic skills
- Prevalence rate: 3% – 8% of school children
- You may be thinking: “Why is this such a big deal? I know a number of adults who had difficulties learning math in school but were still able to lead a reasonably successful life.”
- Quote from an adult describing his/her ‘dyscalculia experiences.’ (<https://www.dyscalculia.org>):
- Students who still have deficiencies in basic math skills by the end of high school will be at significantly higher risk for:
 - lower wages
 - unemployment
 - mental health problems
 - physical illness
 - arrest and incarceration

Difficulties Exhibited by Children with Mathematical Disabilities

DOMAIN-SPECIFIC SKILLS	Pertaining Specifically to Mathematics Skills
Magnitude Processing	Difficulties with non-symbolic magnitude comparisons or estimation
Counting Skills	Lacking one-to-one correspondence of numbers and objects; no understanding of irrelevance of counting order
Transcoding (translating)	Between number words, digits, and quantities
Spatial Number Representation	Problems in number-line tasks and immature spatial representation of numbers
Arithmetic	Immature and inefficient calculation procedures, such as counting or calculating with fingers
Arithmetic Fact Knowledge and Fluency	Deficits in acquiring math facts and then retrieving them fluently
Procedural Knowledge	Mistakes in executing written calculations; deficits in the use of arithmetic symbols
Rational Number	Difficulty rank ordering fractions
DOMAIN-GENERAL PROCESSES	Deficits in working memory, attention, proc. speed, executive functions, language

Number Line Estimation Task

78

“This is 78. Where does it go on the line?”



Co-occurring Mathematical Disability (MD) and Reading Disability (RD)

- Prevalence rates of co-morbid math and reading disabilities (MD+RD) are higher than would be expected by chance. Several plausible explanations have been proposed.
- Reported prevalence rates of MD+RD vary considerably, ranging from 11% to 70%.
- Moll et al. (2018) recently found that the rate of MD+RD was *four times higher than expected by chance* when MD was measured by a math subtest that required language (arithmetic fluency); but the prevalence rate *did not even exceed chance* when MD was assessed by a subtest not requiring language (non-symbolic comparisons)

Techniques for Measuring Brain Activity

Magnetic Resonance Imaging

Positron Emission Tomography

Electroencephalography/Event-Related Potential

functional Magnetic Resonance Imaging

Diffusion Tensor Imaging

Single-Photon Emission Computed Tomography

functional Near-Infrared Spectroscopy

Magnetoencephalography