Dyscalculia

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Dyscalculia

• Definition
• Prevalence
• Comorbidity
• Etiology
• Assessment
• Evaluation
• Remediation
Definition

• Dyscalculia is an impairment specific to mathematical cognition.
• Difficulty with mathematical cognition must not be attributable to any other disability.
• Dyscalculia falls under the heading of a Learning Disability under IDEA.
Types of Dyscalculia

• Developmental Dyscalculia – Inherited &/or acquired during prenatal or early developmental period.
• Post-Lesion Dyscalculia – Acquired during an incident of Traumatic Brain Injury affecting relevant areas of the brain.
• Pseudo-Dyscalculia – The result of inadequate instruction.
Prevalence

• Dyscalculia is estimated to affect 3-6% of the population.
• This statistic is consistent with international estimates (Shalev, et al., 2004; Ramaa & Gowramma, 2002).
• Boys and girls show equal susceptibility.
Comorbidity

- Dyscalculia exhibits an exceedingly high comorbidity with ADHD: 15-26%
- As well as with dyslexia: 17-64% (Wilson, 2008)
- [The range of these statistics demonstrates the infancy of study of dyscalculia – a full 30 years behind the study of dyslexia.]
Yet Distinct from ADHD

- A study by Shalev, et al. (2001), has determined that dyscalculia is a family learning disability – “shows significant familial aggregation” (p. 59).
- A study by Monuteaux, et al. (2005), has determined that ADHD and dyscalculia exhibit “independent familial transmission.”
Yet Distinct from Dyslexia

• An Italian study (Tressoldi, et al., 2007) and an Israeli study (Rubenstein, et al., 2006), both relying on a battery of mathematical tests, have determined that dyscalculia and dyslexia are functionally different.

• “The dyscalculia group has problems in automatically associating Arabic numerals with their internal representation of magnitudes but has no problems in automatically associating letters with their phonemes, whereas the dyslexia group shows the opposite pattern” (ibid., p. 863).
Etiology

- The etiology of developmental dyscalculia is not well understood.
- The genetic component is inferred in familial prevalence - 10x higher than the general population (Shalev, et al., 2001).
- May occur with or as a result of Fetal Alcohol Syndrome, Turner’s Syndrome, Fragile X Syndrome, and premature birth or low birth weight.
Different areas of the brain are responsible for different mathematical functions.

Sums (left), Approximations (right)
BBC News
Dyscalculia is Brain-Related

- An experiment (Kadosh, et al., 2007) produced “virtual dyscalculia” by stimulating the right intraparietal sulcus.

- Research has show (Rotzer, et al., 2008) that children with dyscalculia have “significantly reduced gray matter volume in the right intraparietal sulcus (IPS)” as well as less white matter in “the left frontal lobe and in the right parahippocampal gyrus” (abstract).
Assessment

- Delayed/impaired ability to count.
- Delayed/impaired ability to problem solve.
- Difficulty reading numbers.
- Difficulty recalling numbers in sequence.
- Difficulty with specific operations.
- Difficulty with organizational skills.
- Low ability in estimation or approximation (including time).
- Poor sense of direction and disorientation. (NCLD, 2008)
A study carried out in Mexico (Rosselli, et al., 2006) demonstrated that Working Memory tests (digits backwards and sentence repetition) were best predictors of math scores and “may represent a major cognitive defect in children with specific defects in mathematics” (p. 801).
Evaluation

• Interviews and Paper & Pencil tests (reading, math, attention, and IQ) must determine that the disability is specific to mathematical cognition.

• Mathematical ability must be significantly lower than expected (i.e. compared to IQ).

• Math tests should determine the child’s strengths and weaknesses.
Tests

- **Neuropsychological Test Battery for Number Processing and Calculation in Children (NUCALC)** - contains 11 subtests with categories of number processing and calculation.
- Piagetian test of number conservation, classification (sets), and seriation.
- *The Rey-Osterrieth’ Complex Figure Test* – copy geometric figures and draw from memory.
- Many educators are developing tests.
Diagnoses

- Quantitative Dyscalculia - “A deficit in the skills of counting and calculating.”
- Qualitative Dyscalculia - “The result of difficulty in comprehension of instructions or the failure to master the skills required for an operation.” (Vaidya, 2004, p. 718)
- Visuospatial Dyscalculia. (Geary, 1993)
- Number Fact Dyscalculia. (dyscalculiaforum.com, 2008)
- There is no official consensus on types.
Remediation

• It is *hoped* that early detection and remediation will work through BRAIN PLASTICITY to fix dyscalculia.

• Example: CAPD & auditory training

• Example: Dyslexia & auditory training
The Harrow Dyscalculia Project

- A research project at Britain’s Harrow schools (Messenger, et al., 2007) is working to develop modules (games and activities) to help dyscalculic children learn numbers and operations.
Classroom Adaptations

• Dyscalculic children will need more time to perform math work.
• Math work should be at the appropriate level.
• Written instructions are helpful.
Focus on Understanding

- Concrete-to-Abstract strategies
- Problem-solving strategies other than memorization
- Frequent questions to promote metacognition
Individual Tutoring

- Tutoring is recommended by the NCLD (2008) and Dyscalculia Forum (2008).
- Tutors can target the specific trouble area.
- The child will not catch up without special assistance.
Resources

- Wilson (2007) recommends Butterworth and Yeo, but many resources are available.
Sources


