

MATHEMATICS DIFFERENCES IN THE CLASSROOM

***Seminar for Cascia Hall Preparatory
School***

Tulsa, Oklahoma

August 11-12, 2008

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Tucson, Arizona

Mathematics

“Unlike reading, which needs to be taught, children have a biologically based propensity to acquire arithmetic skills (eg, counting, adding, and comparing and understanding quantities) without formal schooling. Interestingly, the computational basis for numeric abilities is not exclusive to *Homo Sapiens* and has been demonstrated in monkeys as well.” (p. 766)

Infants can tell small quantities from large ones.

Shalev, R.S. (October, 2004). Developmental Dyscalculia. Journal of Child Neurology, 19 (10), pp. 765-771.

Mathematics Disorder

“Unlike reading, math is a discipline. It is the only discipline that is taught kindergarten through 12th grade. It is varied (think of measurement, geometry, data analysis, algebra, and rational numbers), cumulative in nature, and as you move across grade levels, it becomes increasingly complex.” (p. 10)

Woodward, J.P. (Spring, 2008). Theme Editor's Summary - Dialogue is Important: Language in Mathematics Classrooms. Perspectives, 24 (2), p. 9-10.

Mathematics Disorder

- Today as students advance in grades they are expected to be able to use and understand the vocabulary of mathematics more and more. Many students have difficulty with math vocabulary; especially those with Learning Disorders.

Woodward, J.P. (Spring, 2008). Theme Editor's Summary - Dialogue is Important: Language in Mathematics Classrooms. Perspectives, 24 (2), p. 9-10.

What Math Involves

“Any successful execution of math competencies requires the person is attentive, organized, able to switch sets, and work quickly enough to avoid overloading working memory stores that retain information needed for on-line access of different kinds of information.”
(p. 210)

Fletcher, J. M., Lyon, G. Reid, Fuchs, L.S., and Barnes, M.A. (2007). Learning Disabilities: From Identification to Intervention. New York, NY: Guilford.

What Math Involves

“Mathematics involves computation, itself the product of knowledge and retrieval of facts, and application of procedural knowledge. Problem solving, particularly solving word problems, involves computation, language, reasoning, and reading skills and perhaps visual-spatial skills as well.” (p. 210)

Fletcher, J. M., Lyon, G. Reid, Fuchs, L.S., and Barnes, M.A. (2007). Learning Disabilities: From Identification to Intervention. New York, NY: Guilford.

Mathematical Intuition

- **What is Mathematical Intuition?**

- Even in elementary arithmetic multiple cognitive areas are used for different tasks.
- Exact arithmetic uses specific language areas in the left inferior frontal lobe which generates associations between words.
- Symbolic arithmetic was dependent on improvement of number notations and is a cultural invention specific to humans.

Dehaene, S., Spelke, E. , Pinel, P., Stanescu, R., and Tsivkin, S. (May 7, 1999). Sources of Mathematical Thinking: Behavioral and Brain-Imaging Evidence. Science, 284, pp. 970-974.

Mathematical Intuition

- Approximate arithmetic relies on non-verbal quantity representation implemented in visual-spatial areas of the right and left parietal lobes.
- It is possible this non-verbal representational numeral quantifying ability has a long evolutionary history dating back to pre-humans.

Dehaene, S., Spelke, E. , Pinel, P., Stanescu, R., and Tsivkin, S. (May 7, 1999). Sources of Mathematical Thinking: Behavioral and Brain-Imaging Evidence. Science, 284, pp. 970-974.

Number Sense

- **Number Sense**

“Gersten wrote, “Number sense is an emerging construct...that refers to a child’s fluidity and flexibility with numbers, the sense of what numbers mean and an ability to perform mental mathematics and to look at the world and make comparisons.”
(p. 3)

Gersten, R. (1999). Number Sense: Rethinking Arithmetic Instruction for Students with Mathematical Disabilities. Journal of Special Education, 44, pp. 18-28./From website: http://www.ldonline.org/ld_indepth/math_skills/gersten_dyscalculia.html (July 11, 2002).

Not all Students Who get the Correct Answer but Cannot Show Their Work Are Cheating

- Some synaesthetes (60%) calculate by seeing numbers in space around them often in a number line.
- The correct answer just appears to them; they cannot explain why, or how it does. It just does.
- They are not cheating. Test and proctor them by themselves.

Author (June, 2008). Derek Tastes of Earwax. BBC-Home. Science and Nature Follow-up: http://www.bbc.co.uk/sn/tvradio/programmes/horizon/derek_qa.shtml

Mathematics Disorder/Hyperlexia/Asperger's Disorder

- Some with Hyperlexia/Asperger's Disorder may have a fascination with numbers and math.
- Volkmar spoke of a man who solved all WAIS Block Design items using matrix algebra as verbal mediation.
- This man with Asperger's Disorder also tried to make an algebraic equation to predict other's feelings.

Volkmar, F. (April 23, 2003). Asperger Syndrome: Clinical Features, Assessment, and Intervention Guidelines. Seminar Presented by the New England Educational Institute, Phoenix, AZ.

Mathematics Disorder

Typical Symptoms

- Frequently malformed or reversed numbers and symbols
- Reading Disorder-Dyslexia
- Inability to sum integers
- Inability to recognize operation signs
- Because of their spacing and order, inability to read accurately the correct value of multi-digit numbers

Gaddes, W.H., and Edgell, D. (1994). Learning Disabilities and Brain Function: A Neuropsychological Approach (Third Edition). New York, NY: Springer-Verlag, pp. 422.

Levine, M. (1987). Developmental Variation and Learning Disorders. Cambridge, MA: Educator Publishing Service.

Mathematics Disorder

- Poor memory for basic number facts
- Failure to carry numbers
- Inaccurate ordering and spacing of numbers in problems
- Also working memory and simultaneous processing problems

Gaddes, W.H., and Edgell, D. (1994). Learning Disabilities and Brain Function: A Neuropsychological Approach (Third Edition). New York, NY: Springer-Verlag, pp. 422.

Levine, M. (1987). Developmental Variation and Learning Disorders. Cambridge, MA: Educator Publishing Service.

Mathematics Disorder

- Geary indicated there are 3 subtypes of Mathematics Disorder
 1. Semantic Memory Problems: This includes inconsistent retrieval from memory of math facts, and inconsistent processing time.
 2. Procedural Problems: students use, “...immature procedures...frequent errors in the execution of procedures...potential delay in the understanding of concepts underlying procedural use...” (p. 6)

Geary, D.C. (2000). Mathematical Disorders an Overview for Educators. Perspectives, 26 (3), pp. 6-9.

Mathematics Disorder

3. Visuospatial Problems: "...include the misalignment of numerals in multi-column arithmetic problems, numerical omissions, numeral rotation, misreading arithmetical operation signs and difficulties with place value and decimals...Other studies suggest that spatial deficits will also influence the ability to solve other types of mathematical problems, such as word problems and certain types of geometry problems." (p. 9)

Geary, D.C. (2000). Mathematical Disorders an Overview for Educators. Perspectives, 26 (3), pp. 6-9.

Mathematics Disorder

- Those with Semantic Memory Problems tend not to remember as many math facts as their non-disabled peers.
- They will not outgrow problems.
- At first they have trouble encoding math facts into long term memory; later they have problems retrieving such information.
- Trouble inhibiting unneeded math facts

Geary, D.C. (July 11, 2002). Mathematical Disabilities: What We Know and Don't Know.

From website:

http://www.ldonline.org/ld_indepth/math_skills/geary_math_dis.html , pp. 1-7.

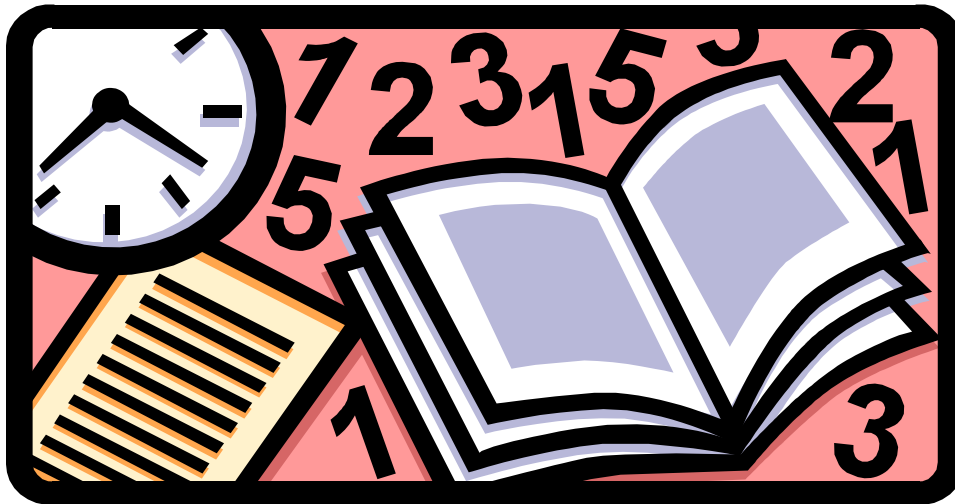
Mathematics Disorder

- Some of this may be related to the Rapid Automated Naming problems in those with Reading Disorder-Dyslexia

Geary, D.C. (July 11, 2002). Mathematical Disabilities: What We Know and Don't Know.

From website:

http://www.ldonline.org/ld_indepth/math_skills/geary_math_dis.html , pp. 1-7.



Mathematics Disorder



- Those with Mathematics Disorder tend to use immature problem solving strategies with math.
- This may be due to developmental delays.

Geary, D.C. (July 11, 2002). Mathematical Disabilities: What We Know and Don't Know.

From website:

http://www.ldonline.org/ld_indepth/math_skills/geary_math_dis.html , pp. 1-7.

Mathematics Disorder

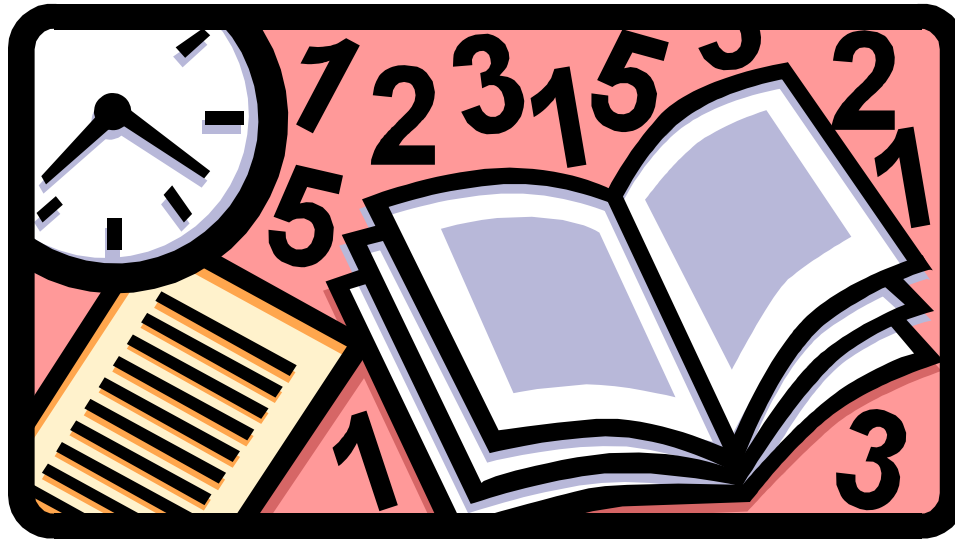


- Comorbidities:
- 50% Reading Disorder-Dyslexia (Geary, 2000)
- AD/HD
- NVLD
- Asperger's Disorder
- Synesthesias (Cytowic, 1999)

Geary, D.C. (2000). Mathematical Disorders an Overview for Educators. Perspectives, 26 (3), pp. 6-9.

Cytowic, R.E. (August 5, 1999). Synesthesia: Phenomenology and Neuropsychology-A Review of Current Knowledge. Psyche: An Interdisciplinary Journal of Research on Consciousness, 2 (10), July 1995, pp. 1-18/Available on web at: <http://www.Psyche.cs.monash.au/v2/psyche-2-10-cytowic.html>.

Mathematics Disorder



- Reading Disorder-Dyslexia may underlie many Mathematics Disorders.

Geary, D.C. (2000). Mathematical Disorders an Overview for Educators. Perspectives, 26 (3), pp. 6-9.

Mathematics Disorder



- Dyslexia and Mathematics Disorder
 - Dyslexics have different math problems than those with MD who are not dyslexic.
 - Dyslexics have trouble with:
 - Memorizing math facts
 - Comprehending word problems
 - Mis-sequencing numbers as they write

BUT

Pennington, B. (1991). Diagnosing Learning Disorders: A Neuropsychological Framework. New York, NY: Guilford.

Mathematics Disorder



- Dyslexics without MD do not tend to have trouble with:
 - Basic computational problems
 - Fundamental conceptual problems with math comprehension
 - No secondary right hemisphere deficit of spatial cognition

Pennington, B. (1991). Diagnosing Learning Disorders: A Neuropsychological Framework. New York, NY: Guilford.

Dyslexia and Mathematics Disorder

“Too frequently and too readily, individuals with dyslexia who have difficulty with mathematics are misdiagnosed as having *dyscalculia*-literally trouble with calculating, a neurologically based disability. True dyscalculia is rare...We know that for individuals with dyslexia, learning mathematical concepts and vocabulary and the ability to use mathematical symbols can be impeded by problems similar to those that interfered with their acquisition of written language.” (p. 14)

Tomey, H.A. (Fall, 1998). Mathematics and Dyslexia. Perspectives, 24 (4), pp. 14-15.

Mathematics Disorder

- “It is proposed that weak phonological processing abilities underlie the learning difficulties of MD/RD children, and that weak number sense is a causal factor in the math-fact learning of MD only and some MD/RD children.” (p. 81)

Robinson, C.S., Menchetti, B.M., and Torgesen, J.K. (2002). Toward a Two-Factor Theory of One Type of Mathematics Disabilities. Learning Disabilities Research & Practice, 17 (2). 81-89.

Mathematics Disorder

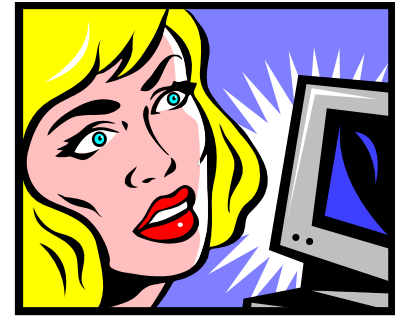
- ½ of those children have a Reading Disorder.
- 60 percent of those with learning disorders have significant problems with mathematics.
- There is no difference in prevalence by gender.
- They are persistent through life.
- Dyslexia and AD/HD make symptoms worse.

Geary, D.C. (2000). Mathematical Disorders an Overview for Educators. Perspectives, 26 (3), pp. 6-9.

Gersten, R. (1999). Number Sense: Rethinking Arithmetic Instruction for Students with Mathematical Disabilities. Journal of Special Education, 44, pp. 18-28./From website:
http://www.idonline.org/ld_indepth/math_skills/gersten_dyscalculia.html (July 11, 2002).

Fletcher, J. M., Lyon, G. Reid, Fuchs, L.S., and Barnes, M.A. (2007). Learning Disabilities: From Identification to Intervention. New York, NY: Guilford.

Mathematics Disorder



- Those with Combined Type AD/HD have significant difficulty with mathematical calculation and applied math.
- Those with Inattentive AD/HD have pervasive problems with mathematical calculations in particular.
- The Combined Type AD/HD tend to have problems with verbal sequences and mental calculations.

Marshall, R.M., Schafer, V.A., O'Donnell, I., Elliot, j. and Handwerk, M.L. (1999). Arithmetic Disabilities and ADD Subtypes: Implications for *DSM-IV*. Journal of Learning Disabilities, 32 (3), pp. 239-247.)

Barkley, R.A. (February 18-20, 2002). ADHD and Oppositional Defiant Children. Seminar presented in Phoenix, AZ The Institute for Continuing Education, P.O. Box 1269, Fairhope, AL 33633.

Mathematics Disorder & Nonverbal Learning Disabilities

- Most people who do not have Reading Disorder-Dyslexia but have Mathematics Disorder have symptoms similar to NVLD.
- NVLD is not the same as Mathematics Disorder.
- Those with Reading Disorder-Dyslexia represent the majority of those who have problems with arithmetic, but they usually do not meet criterion for Mathematics Disorder.
- Approximately 65% of those 9 to 15 years old with NVLD will have Mathematics Disorder.

Rourke, B.P. (2006). Question # 8: "Is "specific arithmetic disability" (SAD) the same as NLD? Do all persons with NLD exhibit SAD?" From Website: www.nld-bprourke.ca/BPR8.html .

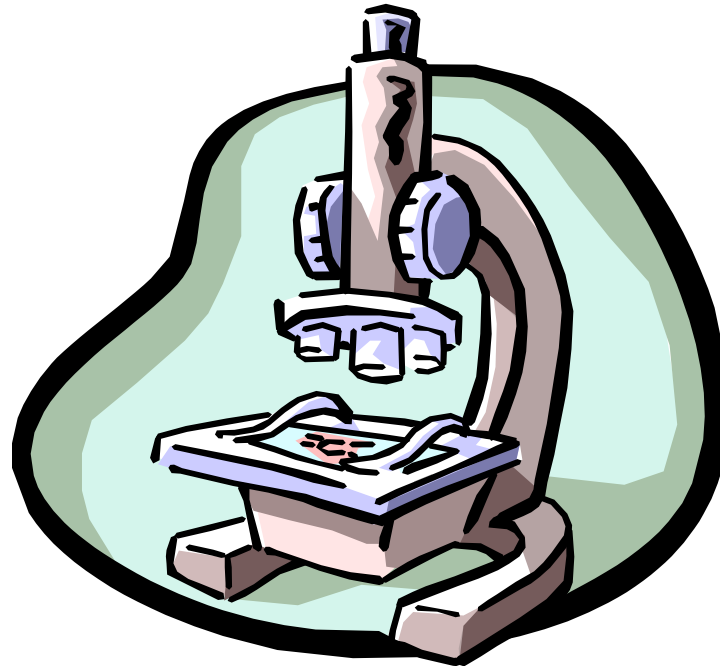
Mathematics Disorder

Rourke stated that deficits in math calculation and reasoning are highly related to weaknesses in visual-perceptual and visual-spatial reasoning. He indicated this could be related to Nonverbal Learning Disorders (NVLD).

Rourke, B.P. (1985). Neuropsychology of Learning Disabilities: Essentials of Subtype Analysis. New York, NY: Guilford.

Your Tax Dollars at Work

THE RESEARCH PROGRAM IN MATHEMATICS AND SCIENCE COGNITION AND LEARNING- DEVELOPMENT AND DISORDERS



Your Tax Dollars At Work

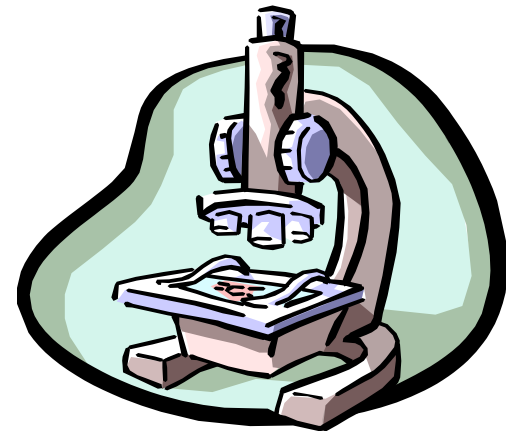
- Study the biology and genetics of math learning
- Longitudinal study of number estimation
- Study Subtypes of Math Disorders
- Study normative development of math abilities
- Study Classroom interventions for those with AD/HD, Reading Disorder, Turner Syndrome, Fragile X, Williams Syndrome and Mathematics Disorder

Lyon, G.R. (March 25, 2004). United States Department of Health and Human Services. Testimony on Headstart before the Subcommittee on Labor, HHS, & Education and Related Agencies. Committee on Appropriations, U.S. House of Representatives: www.hhs.gov/asl/testify/t040325.html .

THE RESEARCH PROGRAM IN MATHEMATICS AND SCIENCE COGNITION AND LEARNING- DEVELOPMENT AND DISORDERS

- Research into etiology, classification, diagnosis, prevention, treatment, genetics, longitudinal aspects and comorbidity of Mathematics Disorders
- Daniel B. Berch, Ph.D.:
berchd2@mail.nih.gov

www.nichd.nih.gov/CRMC/cdb/math.htm#interest



Mathematics Disorder: Prevalence

- 3 to 5% have Mathematics Disorder
- There is an equal number of males and females who have it.
- $\frac{1}{4}$ of those with Dyslexia and $\frac{1}{4}$ with AD/HD have Mathematics Disorder.
- Those with Reading Disorder-Dyslexia and Mathematics Disorder are the most impaired.

Shalev, R.S. (October, 2004). Developmental Dyscalculia. Journal of Child Neurology, 19 (10), pp. 765-771.

Dyslexia and The Neurology of Mathematics Disorders

- We do not know as much about the neurology of Mathematics Disorder as we do about Reading Disorder-Dyslexia because we haven't done as much research into Mathematics Disorder as we have into Reading Disorder-Dyslexia.

Gaddes, W.H., and Edgell, D. (1994). Learning Disabilities and Brain Function: A Neuropsychological Approach (Third Edition). New York, NY: Springer-Verlag, pp. 422.

Neurology of Mathematics

- Arithmetic: bilateral activation of prefrontal and inferior parietal cortices
- Multiplication: Activation in the left parietal cortex
- Estimation: Both parietal lobes
- Exact calculation: Left inferior frontal lobe
- Subtraction: Left intraparietal sulcus

Shalev, R.S. (October, 2004). Developmental Dyscalculia. Journal of Child Neurology, 19 (10), pp. 765-771.

Neurology of Mathematics Disorder

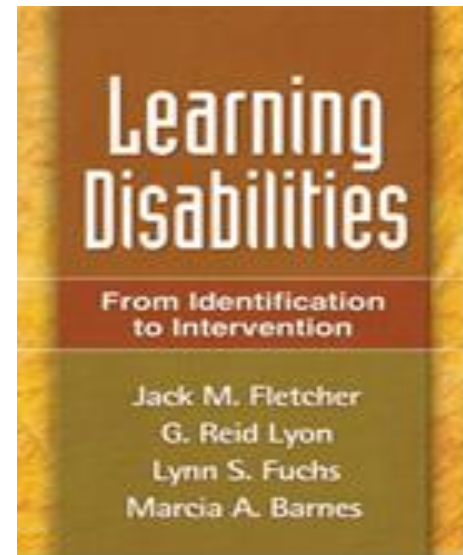
- Posterior right hemisphere: associated with deficits in math comprehension and written math
- Linguistic processing regions and areas that analyze relationships: math reasoning
- Frontal lobes: some problem solving
- Temporal lobes: auditory-verbal math

Lyon, G.R. (1996). The State of Research. In S.C. Cramer and W. Ellis (Eds.), Learning Disabilities: Lifelong Issues. Baltimore, MD: Brookes, p. 3-61.

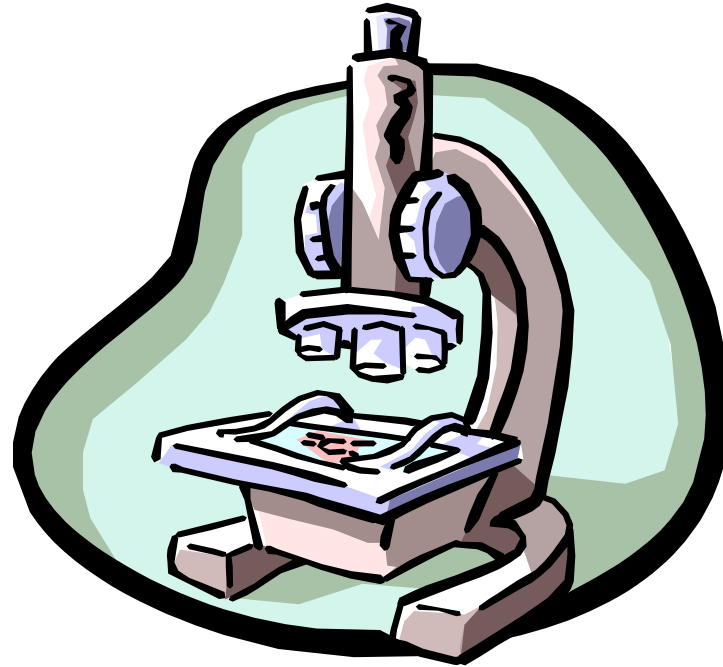
A Good Book That Summarizes this Research

- Fletcher, J.M., Lyon, G.R., Fuchs, L.S., and Barnes, M.A. (2007). Learning Disabilities: From Identification to Intervention. New York, NY: Guilford.

http://www.guilford.com/cgi-bin/cartscript.cgi?page=pr/fletcher.htm&dir=pp/neuropsych&cart_id=169929.5486



Your Tax Dollars At Work



National Mathematics Advisory Panel Final Report: March 13, 2008

National Mathematics Advisory Panel Final Report: March 13, 2008

“This report represents the first comprehensive analysis of math education to be based on sound science...The National Math Advisory Panel’s findings and recommendations make very clear what must be done to help our children succeed in math. We must teach number and math concepts early, we must help our students believe they can improve their math skills and we must insure...

National Mathematics Advisory Panel Final Report: March 13, 2008

...they fully comprehend algebra concepts by the time they graduate high school. The Panel's work will benefit generations of American students." (Margaret Spellings, U.S. Secretary of Education, March 13, 2008)

Spellings, M. (March 13, 2008). U.S. Secretary of Education Margaret Spellings Highlights Findings of the National Mathematics Advisory Panel (Press Release).
From: <http://www.ed.gov/news/pressrelease/2008/03/03132008.html>

National Mathematics Advisory Panel Final Report: March 13, 2008

- Testimony of over 200 scientists
- Over 150 organizations involved
- Reviewed over 16,000 research studies

Spellings, M. (March 13, 2008). U.S. Secretary of Education Margaret Spellings
Highlights Findings of the National Mathematics Advisory Panel (Press Release).
From: <http://www.ed.gov/news/pressrelease/2008/03/03132008.html>

National Mathematics Advisory Panel Final Report: March 13, 2008

- Needs of Math Students:
 - Rapid recall of arithmetic facts in elementary school
 - Mastering fractions in middle school
 - Rigorous algebra instruction in high school
 - The algebra instruction is most important to insure good college and career success.

Spellings, M. (March 13, 2008). U.S. Secretary of Education Margaret Spellings Highlights Findings of the National Mathematics Advisory Panel (Press Release).
From: <http://www.ed.gov/news/pressrelease/2008/03/03132008.html>

National Mathematics Advisory Panel Final Report: March 13, 2008

“There is not a sufficient number of studies with children of various ages and grades to draw strong conclusions about schooling and mathematical development, but the research that has been conducted thus far suggests a similar pattern, that is, decreased involvement of the prefrontal/working memory regions and increased involvement of the angular gyrus with increasing grade level and mathematical experience”.

Author (March 8, 2008). DRAFT Task Group Reports of the National Mathematics Advisory Panel: Report of the Task Group on Learning Processes. From: <http://www.ed.gov/about/bdscomm/list/mathpanel/report/learning-processes.pdf>

National Mathematics Advisory Panel Final Report: March 13, 2008

- Between 5 to 10 percent of students will be identified as having a Math LD before finishing high school.
- Most of the research on Math LD has been conducted with elementary aged children.

Author (March 13, 2008). DRAFT Task Group Reports of the National Mathematics Advisory Panel: Report of the Task Group on Instructional Practices. From: <http://www.ed.gov/about/bdscomm/list/mathpanel/report/ip.pdf>

National Mathematics Advisory Panel Final Report: March 13, 2008

- Several “chronic” Math LDs:
 - Inefficient retrieval of math facts
 - Inefficient counting strategies (i.e., do not use “counting-on strategies”)
 - Limited Working Memory Problems
 - Problems with Number Sense
 - Can’t quickly visualize number lines for magnitude comparison and transforming word problems into equations

Author (March 13, 2008). DRAFT Task Group Reports of the National Mathematics Advisory Panel: Report of the Task Group on Instructional Practices. From:
<http://www.ed.gov/about/bdscomm/list/mathpanel/report/ip.pdf>

National Mathematics Advisory Panel Final Report: March 13, 2008

- Contributions to Low Math Achievement:
 - Deficient math instruction
 - Limited informal math teaching in the home
 - Problems with sustained mental effort (i.e., AD/HD, etc.)
 - Weak motivation

Author (March 13, 2008). DRAFT Task Group Reports of the National Mathematics Advisory Panel: Report of the Task Group on Instructional Practices. From:
<http://www.ed.gov/about/bdscomm/list/mathpanel/report/ip.pdf>

National Mathematics Advisory Panel Final Report: March 13, 2008

- **Explicit Instruction for Math LD:**

“Explicit instruction involves step-by-step plans for solving a problem. The teacher demonstrates a specific plan for a set of problems (as opposed to a general problem-solving heuristic strategy) and students are asked to use the same procedures/steps demonstrated by the teacher to solve the problem.” (p. 4-69)

Author (March 13, 2008). DRAFT Task Group Reports of the National Mathematics Advisory Panel: Report of the Task Group on Instructional Practices. From:
<http://www.ed.gov/about/bdscomm/list/mathpanel/report/ip.pdf>

National Mathematics Advisory Panel Final Report: March 13, 2008

“Generally, clear consistent modeling of step-by-step strategies through teacher explanation, modeling and demonstration; planful sequencing of teaching and practice examples; and specified procedures for providing corrective feedback characterize explicit systematic instruction...In addition, this set of studies also demonstrates how explicit instruction has evolved over time to incorporate more innovative instructional features that support and encourage interaction, flexibility, and generalization.” (p. 4-73)

Author (March 13, 2008). DRAFT Task Group Reports of the National Mathematics Advisory Panel: Report of the Task Group on Instructional Practices. From:
<http://www.ed.gov/about/bdscomm/list/mathpanel/report/ip.pdf>

National Mathematics Advisory Panel Final Report: March 13, 2008

- Classroom strategies to help those with MLD:
 - Concrete and visual representations
 - Explanations by teachers
 - Problem solving aloud; individually and as a group
 - Student group work
 - Carefully orchestrated practice and feedback
 - High but reasonable expectations

Author (March 13, 2008). DRAFT Task Group Reports of the National Mathematics Advisory Panel: Report of the Task Group on Instructional Practices. From:
<http://www.ed.gov/about/bdscomm/list/mathpanel/report/ip.pdf>

National Mathematics Advisory Panel Final Report: March 13, 2008

Educational Benchmarks:

- By the end of 5th Grade:
 - Multiplication and division of whole numbers
 - Comparing fractions, decimals and common-percent plus: addition and subtraction of same
 - Solve problems related to perimeter and area of triangles and quadrilaterals having at least one pair of parallel sides

Author (March 13, 2008). National Mathematics Advisory Panel: Final Report. From:

<http://www.ed.gov/about/bdscomm/list/mathpanel/report/final-report.pdf>

National Mathematics Advisory Panel Final Report: March 13, 2008

- Benchmarks by the end of 6th Grade:
 - Multiplication of fractions and decimals
 - All operations with positive and negative integers
 - Analyze properties of two-dimensional shapes and solve problems of perimeter and area
 - Analyze properties of three-dimensional shapes and solve problems of surface area and volume

Author (March 13, 2008). National Mathematics Advisory Panel: Final Report. From:

<http://www.ed.gov/about/bdscomm/list/mathpanel/report/final-report.pdf>

National Mathematics Advisory Panel Final Report: March 13, 2008

- Benchmarks by the end of 7th Grade:
 - All operations of positive and negative fractions
 - Solve problems involving percent, ratio, and rate and extend this work to proportionality
 - Familiarity with the relationship between similar triangles and the concept of the slope of a line

Author (March 13, 2008). National Mathematics Advisory Panel: Final Report. From:
<http://www.ed.gov/about/bdscomm/list/mathpanel/report/final-report.pdf>

Habituation of Mathematics Disorder



Mathematics Disorder

- “It is suggested that assessment move away from a system that seeks only correct responses and move toward a system that seeks information concerning student ability to communicate mathematics principles, reason, prove and explain mathematics, and demonstrate connections between mathematics and other subjects.” (p. 47)

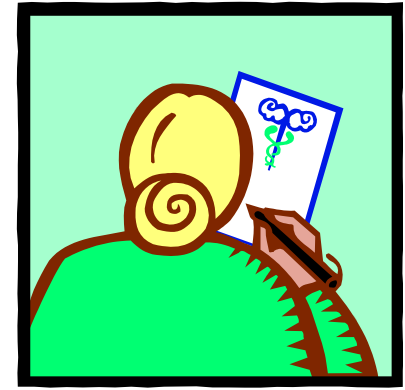
Cawley, J.F., and Foley, T.E. (2001). Enhancing the Quality of Mathematics for Students with Learning Disabilities: Illustrations from Subtraction. Learning Disabilities, 11 (2), pp. 47-59.

Mathematics Disorder



- Habituation:
 - Remedial work to help them master process and/or facts they have missed.
 - Work to overcome mathematics anxiety (counseling, etc.)
 - Teach them specific skills to solve problems.
 - Remedial work with math facts
 - Multi-sensory teaching
 - Use flash cards with math facts
 - When teaching math relate it to the ‘real world’.

Mathematics Disorder



- Use graph paper for calculations.
- Teach mnemonics.
- Use a pocket sized flip chart or Personal Data Assistant (i.e., PalmPilot, etc.) with basic math facts and/or procedures needed contained within it.
- Teach them to acknowledge their computational strengths and weaknesses and how to work with them.

Mathematics Disorder



- Teach them to self-monitor their work.
- Have them work with others who may be skilled in math.
- Encourage the student to do math orally and have them monitor for errors and questions as they do.
- For AD/HD consider medications

Mathematics Disorder



- Lerner made the following suggestions for Secondary Students with Mathematics Disorder:
 - “Provide many examples
 - provide practice in discriminating various problem types.
 - provide explicit instruction.
 - separate confusing elements.” (pp. 504-505)

Lerner, J. (1997). Learning Disabilities: Theories, Diagnosis, and Teaching Strategies (Seventh Edition). New York, NY: Houghton Mifflin.

Mathematics Disorder



- General Accommodations for College:
 - Allow calculator use in class.
 - Provide tutoring
 - Academic advisement with disability in mind
 - Multi-sensory teaching of math
 - Course substitution
 - Kerper added that students with MD should be allowed to take tests alone with professors to ask questions.

Kerper, C. (2002). Students with Dyscalculia May Need Additional Math Coaching. Disability Compliance for Higher Education. 7 (8), p. 7.

What Can I Do In The Classroom With Combined Type AD/HD Kids With Math Problems?

- They benefit less from practice, hence they are not as fluent.
- They need more novelty in the classroom.
- Touch Math (Multisensory Math) – Example: www.MakingMathReal.org; etc.
- Teach how to use an abacus/finger math.
- Use competition in the classroom.
- Allow them to think aloud. Remember they are delayed in internalized speech!

Zentall, S. (2006). Translating Your Student's Attentional and Behavioral Style into Academic and Social Success. Paper presented at the 18th Annual CHADD International Conference, Chicago, IL, October 25-28, 2006.

What Can I Do In The Classroom With Combined Type AD/HD Kids With Math Problems? (Continued)

- Don't waste time mastering basic skills since they do not tend to generalize:
 - They have a problem with fluency.
 - They have sequential memory problems.
- Focus on their problem solving in math.
- The higher level skills are the most important for them to learn.
- Use graph paper for written problems.
- Use calculators.
- Play music without lyrics.

Zentall, S. (2006). Translating Your Student's Attentional and Behavioral Style into Academic and Social Success. Paper presented at the 18th Annual CHADD International Conference, Chicago, IL, October 25-28, 2006.

Math Accommodations

- **Chisanbop Korean Finger Math, etc.**

<http://www.cs.iupui.edu/~aharris/chis/chis.html>

http://scienceblogs.com/goodmath/2006/10/no_abacus_handy_use_your_hands.php



Mathematics Disorder

- Technological Accommodation:
 - Talking Calculator – May need study a carol to prevent distracting others while using it.



<http://www.independentliving.com/prodinfo.asp?number=756206%20%20%20%20SILVER&cid=froogle>

Technological Accommodations

- **Abacus**

<http://en.wikipedia.org/wiki/Abacus>



- **Slide Rule**



http://www.google.com/imgres?imgurl=http://www.screensite.org/courses/Jbutler/T389/SlideRule.jpg&imgrefurl=http://www.screensite.org/courses/Jbutler/T389/ITHistoryOutline.htm&h=347&w=456&sz=19&tbnid=WkwTjHBc1EQJ:&tbnh=97&tbnw=128&prev=/images%3Fq%3DSlide%2Brule&sa=X&oi=image_result&resnum=1&ct=image&cd=2

Mathematics Disorder



- Broody and Ginsberg wrote of messages students with Mathematics Disorders hold. They are as follows:
 - “Only geniuses can understand mathematics. Just do as you are told. You are not really smart enough to understand it.”
 - Mathematics is a bunch of facts and procedures. Normal children memorize it quickly. You’re dumb if you can’t.”

Mathematics Disorder



- In mathematics, there is one correct method for doing things. Good children can follow directions. You're bad if you use an unacceptable procedure like counting.” (p. 193)

Broody, A.J., and Ginsburg, H.P. (1991). A Cognitive Approach to Assessing the Mathematical Difficulties in Children Labeled “Learning Disabled”. In H.L. Seanson (Ed.), Handbook on the Assessment of Learning Disabilities: Theory, Research and Practice. Austin, TX: ProEd. pp. 177-227.

"Solve It" Word Problem Solving Routine

1. Read for understanding
2. Paraphrasing or putting the problem into one's own words
3. Visualizing by drawing a schematic representation that shows the relationships among the problem parts
4. Hypothesizing or setting up a plan

"Solve It" Word Problem Solving Routine (Continued)

5. Estimating or predicting the answer
6. Computing or doing the arithmetic
7. Checking to make sure the problem was done correctly

Montague, M., Krawec, J., Sweeney, C. (Spring, 2008). Promoting Self-Talk to Improve Student's Mathematical Problem Solving. Perspectives, 34 (2), p. 15.

How to Solve Word Problems

- “Solve It”: A cognitive routine to solve word problems
 - Teacher thinks aloud while demonstrating a mathematical task.
 - Student verbalizes thought process while solving problems
 - Teacher monitors student’s thought process and gives encouragement and corrective feedback.

Montague, M., Krawec, J., Sweeney, C. (Spring, 2008). Promoting Self-Talk to Improve Student’s Mathematical Problem Solving. Perspectives, 34 (2), p. 13-17.

Solving Word Problems

LD students often need, “...intensive interventions that emphasize understanding the language and factual information in the problem, using relevant information to generate an adequate mathematical model or representation, devising and monitoring a solution plan, and executing procedural calculations.” (p. 20)

Jitendra, A. (Spring, 2008). Using Schema-Based Instruction to Make Appropriate Sense of Word Problems. Perspectives, 34 (2), p. 20-24.

Solving Word Problems

“Despite plenty of practice, student with LD continue to encounter difficulties solving word problems when they have learned the keyword approach. The keyword approach focuses on the solution strategy; hence, it requires less effort (of the teacher) than modeling or representing the problem situation.” (p. 20)

Jitendra, A. (Spring, 2008). Using Schema-Based Instruction to Make Appropriate Sense of Word Problems. Perspectives, 34 (2), p. 20-24.

Solving Word Problems

“Schema-based instruction addresses the weakness of the keyword and the general heuristic approaches by using a conceptual teaching approach that integrates mathematical problem solving and reading comprehension.” (p. 20)

Jitendra, A. (Spring, 2008). Using Schema-Based Instruction to Make Appropriate Sense of Word Problems. Perspectives, 34 (2), p. 20-24.

Schema Based Problem Solving

Jose and his father gathered 10 pounds of wool from a sheep. So far some of the wool has been used to make a sweater. Now there are 5 pounds of wool left. How many pounds of wool have been used?

Jitendra, A. (Spring, 2008). Using Schema-Based Instruction to Make Appropriate Sense of Word Problems. Perspectives, 34 (2), p. 20-24.

Schema Based Problem Solving

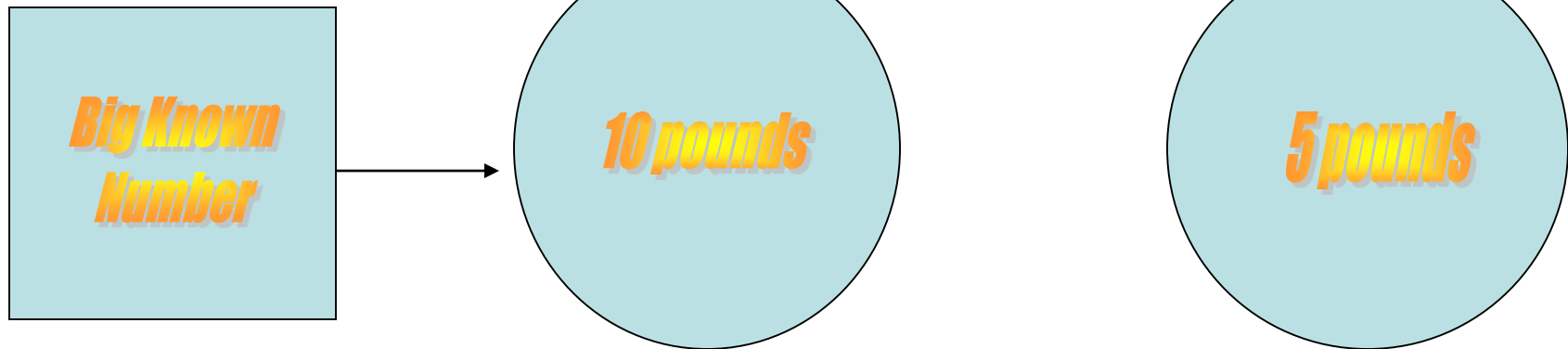
Jitendra, A. (Spring, 2008). Using Schema-Based Instruction to Make Appropriate Sense of Word Problems. Perspectives, 34 (2), p. 21.

$$10 - ? = 5$$

$$\text{So } ? = 10 - 5$$

$$? = 5$$

Whole Number



Solving Word Problems

“Problem compensation involves modeling or representing the problem situation, which requires going beyond direct translation of the problem text from words to equations (e.g., the keyword ***altogether*** is translated into addition) to understanding the mathematical problem structure. Understanding is evident when semantic cues (e.g., both red pens and blue pens are subsets, and all pens are supersets).”
(p. 21)

Jitendra, A. (Spring, 2008). Using Schema-Based Instruction to Make Appropriate Sense of Word Problems. Perspectives, 34 (2), p. 20-24.

Solving Word Problems

“Instruction is appropriately scaffolded so that a) teacher-mediated instruction is followed by paired partner learning and independent learning activities, b) tasks begin with story situations followed by word problems with unknown information, and c) visual diagrams and checklists are initially provided to support learning and are gradually removed or replaced by student constructed diagrams.” (p. 21)

Jitendra, A. (Spring, 2008). Using Schema-Based Instruction to Make Appropriate Sense of Word Problems. Perspectives, 34 (2), p. 20-24.

Solving Word Problems

- **FOPS**

- F: Find the type of problem
- O: Organize the information using problem diagram
- P: Plan to solve problem
- S: Solve problem

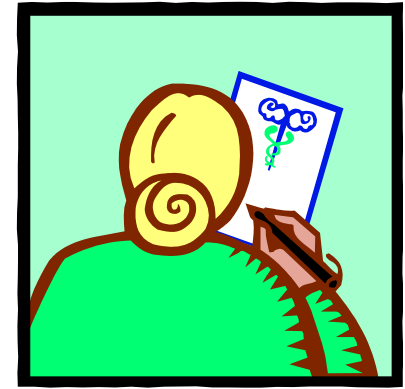
Jitendra, A. (Spring, 2008). Using Schema-Based Instruction to Make Appropriate Sense of Word Problems. Perspectives, 34 (2), p. 20-24.

Student-Teacher Math Diaries

- Have the students write a daily math diary of questions and comments about class, assignments, etc.
- This encourages “non-talkers in class” to interact with the teacher, so he/she can better monitor their progress.

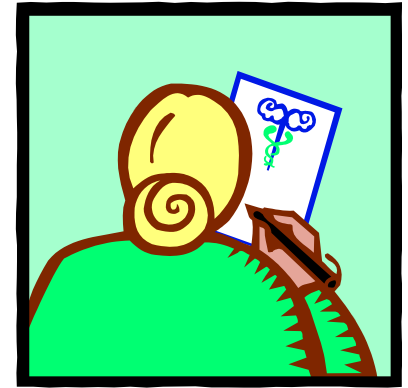
Baxter, J.A. (Spring, 2008). Writing in Mathematics: Alternative Form of Discourse for Academically Low-Achieving Students. Perspectives, 34 (2), p. 37-40.

Mathematics Disorder



- A Good Resource On Mathematics Disorder Is:
 - Marolda, M.R. (Summer, 2000). Challenger in Learning & Teaching Mathematics. Perspectives, 26 (3), entire issue. Available from: International Dyslexia Association, 8600 LaSalle Road, Chester Bldg., Suite 383, Baltimore, MD 21286-2044; 410-296-0232.

Mathematics Disorder



- For those with NVLD Problems:

- **Applied Research Knowledge Foundation**

- ARK Foundation (ARK)**

- Allenmore Medical Center**

- 1901 South Union Station, Suite A-311**

- Tacoma, WA 98405**

- Phone: 253-573-0211**

- Fax: 253-573-0211**

- E-mail: ARKfdn@aol.com**

- Web:**

- http://www.newhorizons.org/spneeds_arkspatial.html**

Mathematics Disorder

- For Those with NVLD Problems:
 - Nonverbal Learning Disorder Association (NLDA)
2446 Albany Avenue
West Hartford, CT 06117
Phone: 860-570-0217
E-mail: NLDResources@aol.com
Web: <http://www.nld.org>



Mathematics Disorder



- Good Resource on Treating Visual-Spatial Problems of NVLD:
- Neff, B., Neff-Lippman, J., and Stockdale, C. (2002). The Source for Visual-Spatial Disorders. East Moline, IL: LinguSystems.

Mathematics Disorder

- MAAP Services for Autism and Asperger Spectrum
 - MAAP Services, Inc.
P.O. Box 524
Crown Point, IN 46307
Phone: 219-662-1311
Fax: 219-662-0638
Website: www.maapservices.org



Helpful Websites NVLD and Asperger's Disorder

- www.nldontheweb.org
- Nonverbal Learning Disability Association: www.nlda.org
- LD Online: www.ldonline.org
- MAAP Services for Autism and Asperger's Disorder: www.maapservices.org
- UC Davis M.I.N.D. Institute: www.ucdmc.ucdavis.edu/MINDInstitute
- Yale Child Study Center: www.med.yale.edu/chldstdy/autism/aspergers.html

The What Works Clearing House

- <http://www.w-w-c.org>
 - Established by the U.S. Department of Education to provide, “...a central, independent and trusted source of scientific evidence of what works in education.”

From: Identifying and Implementing Educational Practices Supported by Rigorous Evidence: A User Friendly Guide - Appendix A: Where to Find Evidence-Based Interventions. www.ed.gov/rchstat/research/pubs/rigorousetid/guide_pg9.html

The Promising Practices Network

- <http://www.promisingpractices.net>
 - Highlights programs and practices that scientific research indicates works with children, adolescents and families.

From: Identifying and Implementing Educational Practices Supported by Rigorous Evidence: A User Friendly Guide - Appendix A: Where to Find Evidence-Based Interventions. www.ed.gov/rchstat/research/pubs/rigorousetid/guide_pg9.html

The International Campbell Collaboration

- <http://www.campbellcollaboration.org/frallbary.html>
 - “...Registry of systematic reviews of evidence on the effects of interventions in the social, behavioral, and educational arenas.”

From: Identifying and Implementing Educational Practices Supported by Rigorous Evidence: A User Friendly Guide - Appendix A: Where to Find Evidence-Based Interventions. www.ed.gov/rchstat/research/pubs/rigorousetid/guide_pg9.html

HELPFUL BOOKS FOR PROFESSIONALS AND LOVED ONES

- Mather, N. & Goldstein, S. (2001). Learning Disabilities and Challenging Behaviors. Baltimore, MD: Brookes.
- Reid, G. & Fawcett, A. (2004). Dyslexia in Context. Philadelphia, PA: Whurr
- ***Nosek, K. (1997). Dyslexia in Adults. Dallas, TX: Taylor.***
- Bartlett, D. & Moody, S. (2000). Dyslexia in the Workplace. Philadelphia, PA: Whurr.
- Goldstein, S. (1997). Managing Attention and Learning Disorders in Late Adolescence & Adulthood. New York, NY: John Wiley & Sons.
- ***Silver, L.B. (2006). The Misunderstood Child, 4th Edition. New York, NY: Crown.***

****BOOKS IN THIS FONT ARE GOOD FOR THE LAYPERSON***

HELPFUL BOOKS FOR PROFESSIONALS AND LOVED ONES

- ***Richards, R.G. (1999). The Source for Dyslexia and Dysgraphia. East Moline, IL: LinguSystems.***
 - ***Roffman, A.L. (2000). Meeting the Challenge of Learning Disabilities in Adulthood. Baltimore, MD: Brookes.***
 - Wren, C. & Einhorn, J. (2000). Hanging by a Twig: Understanding and Counseling Adults with Learning Disabilities. New York, NY: Norton.
 - ***Rodis, P., Garrod, A., & Boscardin, M.L. (2001). Learning Disabilities & Life Stories. Boston, MA: Allyn and Bacon.***
 - ***Shaywitz, S. (2003). Overcoming Dyslexia. New York, NY: Knopf.***
- *BOOKS IN THIS FONT ARE GOOD FOR THE LAYPERSON***

Helpful Organizations

- Learning Disabilities Association (LDA): www.lda.org
- International Dyslexia Association (IDA): www.interdys.org
- Children and Adults with Attention Deficit Disorders (CHADD): www.chadd.org
- National Attention Deficit Disorder Association (ADDA): www.add.org

Helpful Organizations

- Nonverbal Learning Disabilities Association (NLDA): www.nlda@nlda.org
- MAAP Services for Autism and Asperger Spectrum:
www.maapservices.org
- ADD WareHouse: www.addwarehouse.com
- LinguSystems: www.linguisystems.com