## DSM-5 and ADHD ADHD and Math Difficulties

Kevin T. Blake, PH.D., P.L.C. June 8, 2011 CHADD of Tucson All Rights Reserved

## 2011 DSM-5 AD/HD Changes

- Attention-Deficit/Hyperactivity Disorder:
- Specify based on current presentation-
  - Combined Presentation
  - Predominately Inattentive Presentation
  - Predominately Hyperactive/Impulsive
     Presentation
  - Inattentive Presentation (Restrictive)
- Other Specified Attention-Deficit/Hyperactivity Disorder

## 2011 DSM-5 ADHD Changes

- Need to have symptoms of AD/HD prior to age 12
- 22 symptoms (age relevant); up from 18 child based
- 9 symptoms of Inattention: Need 6 up to age 17; need 4 over age 17
- 13 symptoms of Hyperactivity/Impulsivity: Need 6 prior to age 17; need 4 over age 17
- Inattentive Presentation (Restrictive): Must meet Inattentive criteria and have no more than 2 Hyperactive/Impulsive symptoms
- Author (2010). Attention-Deficit/Hyperactivity Disorder . Washington, DC: American Psychiatric Association:

http://www.dsm5.org/ProposedRevision/Pages/proposedrevision.aspx?rid=383.

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, <u>19</u> (10), pp. 765-771.

"Unlike reading, math is a discipline. It is the only discipline that is taught kindergarten through 12<sup>th</sup> 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. <u>Perspectives</u>, <u>24</u> (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). <u>Learning Disabilities: From</u> <u>Identification to Intervention</u>. 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. <u>Science</u>, <u>284</u>, 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. <u>Science</u>, <u>284</u>, pp. 970-974.

#### Number Sense

<u>Number Sense</u>

"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. <u>Journal of Special Education</u>, <u>44</u>, pp. 18-28./From website: <u>http://www.ldonline.org/ld\_indepth/math\_skills/gersten\_dyscalculia.html</u> (July 11, 2002).

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). <u>Learning Disabilities and Brain Function: A Neuropsychological Approach</u> (<u>Third Edition</u>). New York, NY: Springer-Verlag, pp. 422.

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

- 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 <u>Approach (Third Edition)</u>. New York, NY: Springer-Verlag, pp. 422.
 Levine, M. (1987). <u>Developmental Variation and Learning Disorders</u>. Cambridge, MA: Educator Publishing Service.

- Geary indicated there are 3 subtypes of Mathematics Disorder
  - Semantic Memory Problems: This includes inconsistent retrieval from memory of math facts, and inconsistent processing time.
  - 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.

**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. <u>Perspectives</u>, <u>26</u> (3), pp. 6-9.

- Those with Semantic Memory Problems tend not to remember as many math facts as their nondisabled 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). <u>Mathematical Disabilities: What We Know and Don't Know</u>. From website: <u>http://www.ldonline.org/ld\_indepth/math\_skills/geary\_math\_dis.html</u>, pp. 1-7.



- 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. <u>Perspectives</u>, <u>26</u> (3), pp. 6-9.

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

- <sup>1</sup>/<sub>2</sub> 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. <u>Perspectives</u>, <u>26</u> (3), pp. 6-9.

Gersten, R. (1999). Number Sense: Rethinking Arithmetic Instruction for Students with Mathematical Disabilities. Journal of Special Education, <u>44</u>, pp. 18-28./From website: http://www.ldonline.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: FromIdentificationto Intervention. New York, NY: Guilford.



- 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, <u>32</u> (3), pp. 239-247.)
Barkley, R.A. (February 18-20, 2002). <u>ADHD and Oppositional Defiant Children</u>. Seminar presented in

Phoenix, AZ The Institute for Continuing Education, P.O. Box 1269, Fairhope, AL 33633.

# Willcutt, Chhabildas and Pennington's Sluggish Cognitive Tempo Symptoms

- More problems with math achievement than Combined Type and 'Normals'.
- More Internalizing Problems than Combined Type/Few, if any Externalizing Problems
- Significant Processing Speed Problems
- Willcutt, E.G., Chhabildas, N. and Pennington, B.F. (2001). Validity of the DSM-IV Subtypes of ADHD. <u>ADHD Report</u>, 9 (1), pp. 2-5.





#### 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: <u>www.hhs.gov/asl/testify/t040325.html</u>.

# 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). <u>Learning Disabilities and Brain Function: A Neuropsychological</u> <u>Approach (Third Edition)</u>. 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. <u>Journal of Child Neurology</u>, <u>19</u> (10), pp. 765-771.

Natíonal Mathematics Advisory Panel Final Report: March 1.3, 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). <u>DRAFT Task Group Reports of the National Mathematics Advisory Panel:</u> <u>Report of the Task Group on Instructional Practices</u>. From: <u>http://www.ed.gov/about/bdscomm/list/mathpanel/report/ip.pdf</u>

#### Natíonal 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). <u>DRAFT Task Group Reports of the National Mathematics Advisory Panel:</u> <u>Report of the Task Group on Instructional Practices</u>. From: <u>http://www.ed.gov/about/bdscomm/list/mathpanel/report/ip.pdf</u>

• 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'.

- 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.



- 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



- 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). <u>Learning Disabilities: Theories, Diagnosis, and Teaching Strategies (Seventh Edition)</u>. New York, NY: Houghton Mifflin.

- 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. <u>Disability Compliance</u> <u>for Higher Education</u>. <u>7</u> (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: <u>www.MakingMathReal.org</u>; 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). <u>Translating Your Student's Attentional and Behavioral Style into Academic and</u> <u>Social Success</u>. Paper presented at the 18<sup>th</sup> 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). <u>Translating Your Student's Attentional and Behavioral Style into Academic and Social Success</u>. Paper presented at the 18<sup>th</sup> 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



- 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=ima ge result&resnum=1&ct=image&cd=2



- 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."



 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 theMathematicalDifficulties in Children Labeled "Learning Disabled". In H.L. Seanson (Ed.),Handbook onthe 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
- 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
- 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. <u>Perspectives</u>, <u>34</u> (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. <u>Perspectives</u>, <u>34</u> (2), p. 13-17.

## Zentall on AD/HD and Math

- "...ADHD students may perform better on applied problems than on fact retrieval, indicating that difficulties with computation do not preclude math problem solving" (p. 236)
- Use color, non-vocal music, computer games, etc. to enhance sustained mental effort and attention.
- Use medication as needed to active the frontal lobe.
- Zentall, S.S. (2007). Math Performance of Students with ADHD. In D.B. Berch and M.M. Mazzocco (Eds.), <u>Why Is Math So Hard For Some Children</u>. Baltimore, ML: Paul H. Brookes, 219-244.