

How can we help students like Amy, who are struggling in Math?

Adam Scheller, Ph.D.



How can we help students like Amy, who are struggling in Math?



Adam Scheller, Ph.D.
Senior Educational Consultant
Pearson

If you to go to the store...

- You buy a few groceries for the week.
- They cost \$19.90.
- You have a \$20 bill.
- Do you have enough to pay?
- How much change should you expect?

S. Parson et al. 2005, J. Gross et al. 2009
Dixielee AG, a Swiss company, is the owner of Calculus and Orthograph.
Pearson Clinical Assessment, a business unit of NCS Pearson, Inc., is the authorized distributor of Calculus and Orthograph within the United States.



Sometimes you write numbers...

- Swapped 64
- Out of order 132 for 123

S. Parson et al. 2005, J. Gross et al. 2009
Dixielee AG, a Swiss company, is the owner of Calculus and Orthograph.
Pearson Clinical Assessment, a business unit of NCS Pearson, Inc., is the authorized distributor of Calculus and Orthograph within the United States.



When you look at a math problem...

- The first time you solve it like this...

$$13 + 15 = 10$$

$$1 + 3 + 1 + 5 = 10$$

- The second time you solve it like this...

$$13 + 15 = 46$$

S. Parson et al. 2005, J. Gross et al. 2009
Dixielee AG, a Swiss company, is the owner of Calculus and Orthograph.
Pearson Clinical Assessment, a business unit of NCS Pearson, Inc., is the authorized distributor of Calculus and Orthograph within the United States.



How do we define a math learning disability?

1. Individuals with Disabilities Education Act (2004)(§ 300.8):
 - ... a disorder in **one or more of the basic psychological processes involved in understanding or in using language**, spoken or written, that may manifest itself in an imperfect ability to listen, think, speak, read, write, spell, or to do **mathematical calculations**, . . .
2. Dyscalculia
 - Medical/Clinical term for the "condition."
 - Term not often used in American Public Schools

S. Parson et al. 2005, J. Gross et al. 2009, www.understood.org (8/17/16), Joonkoo Park, Denise C. Park, and Thad A. Poik, **Pairing functional connectivity in Numerical Cognition**. Cereb. Cortex (2013) 23 (9): 2127-2135 first published online July 10, 2012 doi:10.1093/cercor/bhs193



What is Dyscalculia?

- Affects approximately 6% of population
- Brain-Based Condition
 - Evidence showing poor communication between brain hemispheres (Integration of multiple skills)
 - Difficulty making sense of numbers and math concepts (Often can't grasp basic number concepts).
 - Children may know *what* to do in math class but don't understand *why* they're doing it.
 - Less developed mental number line leads to a reduced number sense
 - The brain areas that specialize in processing of numbers are underdeveloped by approx. 4 to 6 years in children with difficulties compared to those without difficulties.

S. Parson et al. 2005, J. Gross et al. 2009, www.understood.org (8/17/16), Joonkoo Park, Denise C. Park, and Thad A. Poik, **Pairing functional connectivity in Numerical Cognition**. Cereb. Cortex (2013) 23 (9): 2127-2135 first published online July 10, 2012 doi:10.1093/cercor/bhs193



How can we help students like Amy, who are struggling in Math?

Adam Scheller, Ph.D.

Link to Affected Life Functioning

- People with dyscalculia:
 - Have difficulty functioning in daily life skills (paying bills, getting correct change)
 - Earn less and spend less money
 - Fall ill more often
 - Are more often in conflict with the law
 - Need more assistance at school
 - May be more anxious than others

S. Parson et al. 2005, J. Gross et al. 2009



Related Conditions



Math Anxiety

- Children may become so worried about doing math that fear and nervousness can lead to poor performance on math tests.
 - Anxiety can lead to math "performance" problems, not typically "understanding" problems.
- Some children may have both math anxiety and dyscalculia.
 - Poor performance and underlying disability in the presence of increased expectations often lead to academic related emotional conditions, such as anxiety.
- Anxiety also inhibits the neurotransmission and hence reduces the capacity for learning

www.understood.org (8/17/16).



Dyslexia

- ... **neurobiological** in origin... characterized by difficulties with **accurate and/or fluent word recognition** and by **poor spelling and decoding abilities**... typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction...
- Children often receive diagnoses of both **dyslexia** and **dyscalculia**.
 - Approximately 43–65 percent of children with math disabilities also have reading disabilities.

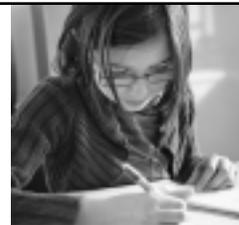
International Dyslexia Association (2002). Definition of dyslexia. Retrieved from dyslexiaida.org.
Barbareis, William, et al. "Math Learning Disorder: Incidence in a Population-Based Birth Cohort, 1976–82, Rochester, Minn." *Ambulatory Pediatrics* 5.5 (2005): 281–89. www.understood.org (8/17/16).



ADHD

- Some children exhibit characteristics of both dyscalculia and **ADHD**.
 - Often diagnosed with both
- However, care needs to be taken when analyzing math errors in these cases.
 - These children exhibit impulse dyscontrol and inattention in math, often better explaining their errors.
 - Best practice is to evaluate math after ADHD symptoms are controlled

Developmental Dyscalculia, Pg. 768. www.understood.org (8/17/16).



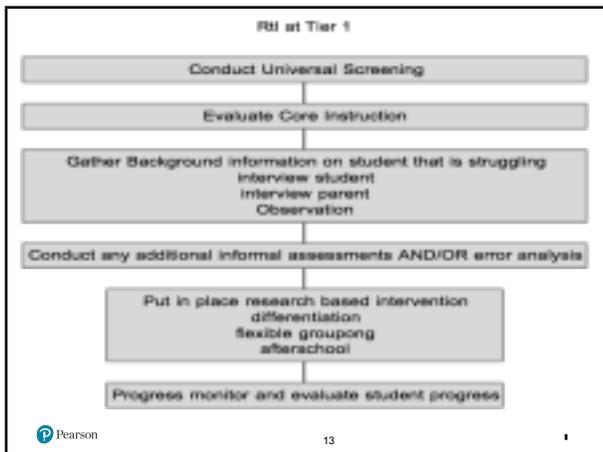
Let's review this in the form of a case study.

4th grader named Amy...



How can we help students like Amy, who are struggling in Math?

Adam Scheller, Ph.D.



What areas should you screen for Math?



- Oral Reading Fluency
- Comprehension
- Early Literacy
- **Early Numeracy**
- **Math Computation**
- **Math Concepts**
- Written Language
- Behavior

Limitations of a Screener

- Can not be used to provide a diagnosis
- Is not designed to identify the degree of impairment
- Can not be used to identify pattern of strengths or weaknesses

What do I do with the students who are “at-risk?”

- Check/collect additional “body of evidence” to ensure that student is genuinely at-risk in that skill area. For example:
 - Ensure that core instruction has:
 - been delivered with fidelity
 - a research base to address concerns
 - Does the student have underlying attendance, home, language, or behavioral concerns that may be impacting academics.
- If everything checks out, you will most likely need to move to Tier 2 for additional supports

Conduct Universal Screening

- Amy’s classroom teacher administered the:
 - AIMSweb Math Computation
 - MCOMP
 - AIMSweb Math Concepts and Applications
 - MCAP

Target: 77

Student	Score	Target	Notes
Student 1	78	77	Consider Need for Individualized Instruction
Student 2	76	77	Consider Need for Individualized Instruction
Student 3	75	77	Consider Need for Individualized Instruction
Student 4	74	77	Consider Need for Individualized Instruction
Student 5	73	77	Consider Need for Individualized Instruction
Student 6	72	77	Consider Need for Individualized Instruction
Student 7	71	77	Consider Need for Individualized Instruction
Student 8	70	77	Consider Need for Individualized Instruction
Student 9	69	77	Consider Need for Individualized Instruction
Student 10	59	77	Consider Need for Individualized Instruction

How can we help students like Amy, who are struggling in Math?

Adam Scheller, Ph.D.

Gather Additional Information for Amy:

1. Interview teacher
2. Interview parents
3. Interview and observe student

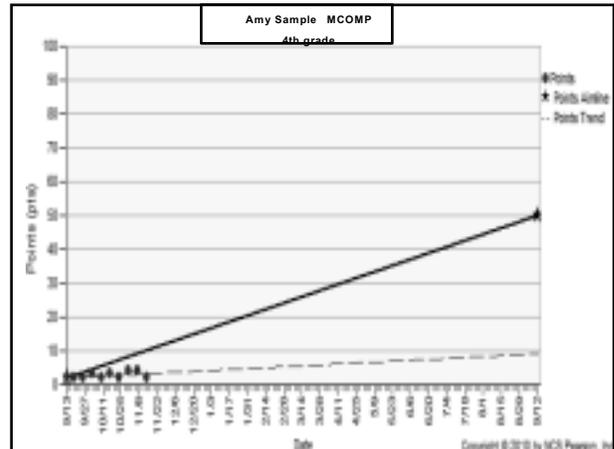
Who is Amy?

- Amy is a 10 yr. old student living in the southeastern US.
- Amy is the daughter of an author and chemical engineer; her family history is academically very strong except for some admitted math weaknesses on the maternal side.
 - Nothing throws up a red flag when it comes to learning or cognitive disabilities in the family.
- Higher than average ability, but has not been successful in her pursuit to acquire and apply math knowledge.
 - Frequently fails her 4th grade math tests and homework is a constant struggle.
 - Not only is math tough, but she recently began exhibiting anxiety any time the subject is addressed.
 - Attended math summer school 2nd and 3rd grades
 - Below the 20th% on both MCAP and MCOMP

• How can Amy's school help her learn?

Tier 1 intervention: Trial 1

- Mrs. Smith works with Amy in a small group for 10 minutes each day reviewing the day's lesson.
- During this time, she was encouraged to ask questions.
- Her performance was erratic, she may know the concept one day and not the next.



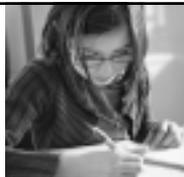
Tier 1 intervention

Trial 2:

- Beginning in December, Amy goes to after school tutoring twice weekly for 30 minutes each.
- Her tutor helped her complete assignments and did progress monitoring weekly
- Evaluate her progress...

Trial 3:

- Due to slow progress and lack of response, tutoring was increased to three times per week, 30 minutes per session.
- Evaluate Progress...



Analyze Screening and Class artifacts

$\begin{array}{r} 17 + 19 = \\ \underline{+27} \\ 216 \checkmark \end{array}$	$\begin{array}{r} 16 - 12 = \\ \underline{-12} \\ 4 \end{array}$	$\begin{array}{r} 9 \\ \times 1 \\ \hline 10 \checkmark \end{array}$	$\begin{array}{r} 756 \\ + 73 \\ \hline 7127 \checkmark \end{array}$
$\begin{array}{r} 7 \\ \times 5 \\ \hline 12 \checkmark \end{array}$	$\begin{array}{r} 51 \\ \times 3 \\ \hline 54 \checkmark \end{array}$	$\begin{array}{r} 441 \\ + 56 \\ \hline 497 \end{array}$	$\begin{array}{r} 8 \\ \times 8 \\ \hline 16 \checkmark \end{array}$

•What errors are being made?

How can we help students like Amy, who are struggling in Math?

Adam Scheller, Ph.D.

Observation and Interview Info

- Amy appeared engaged during lesson
- Did not volunteer to answer or ask questions
- Students were assigned 5 problems in 10 minutes
 - Amy did not complete any of them
- She was not impulsive but was limited by the number of alternative strategies she used.
- She relied on verbal rehearsal to recall information
- She was unable to explain reasoning for strategies, even when response was correct.

Pearson

Where to next?

Pearson

Additional Assessments

- Every academic concern needs more information to better plan a way to fix it.
- For a math difficulty is it?
 - Computation
 - Addition
 - Subtraction
 - multiplication
 - Problem solving
 - Concepts
 - Etc.

Pearson

Moving into Tier 2: Some Assessment Questions:

- Why has Amy not shown adequate progress to Tier 1 Interventions?
- How do we make intervention more productive?
- Does she have specific needs/strengths that can the focus to improve skill acquisition?

Pearson

Tier 2 Standardized Testing

KeyMath 3 Diagnostic Assessment

Domains	Score	Percentile Rank	Range
Basics Concepts	79	8 th	Below Average
Operations Score	78	7 th	Below Average
Applications Score	83	13 th	Below Average
Total Composite	79	8 th	Below Average

Pearson

Interventions

Pearson

How can we help students like Amy, who are struggling in Math?

Adam Scheller, Ph.D.

Challenges for Schools in Helping Students with Math Difficulties

- Helping children with difficulties:
 - Hardly any efficient material
 - Little time of professionals
 - No means to train independently
- “Practice makes perfect”:
 - Math skills are automated
 - Automation requires practice (like a piano artist)
 - But: Regular training hard to organize

S. Parson et al. 2005, J. Gross et al. 2009



Calcularis Overview

- Dybuster Calcularis is mathematical learning software for school and home.
- Assists the brain in essential learning and maturation processes.
- Combines cutting-edge findings from neuroscience and neuropsychology with tried-and-tested principles from the field of computer science



Calcularis Overview

Features and Benefits:

1. Personalization
2. Game based learning
3. Independent training
4. Video tutorials
5. Reward System
6. Progress Monitoring
 - Personal Progress
 - Teachers



Content & Administration

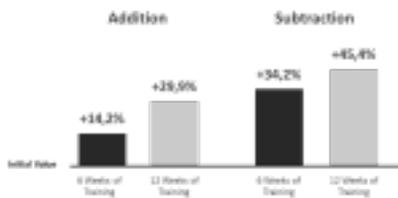
- Calcularis is divided into four number ranges of progressively increasing width: 0-20, 0-200, 0-1000, 0-10000. In each of the number ranges, the user works in three different areas: number processing, addition and subtraction, and multiplication and division.
- Dybuster Calcularis trains the following mathematical skills:

Skill	0-10	0-20	0-100	0-1000
Subitizing	X			
Estimating	X	X	X	X
Comprehension of numbers - verbal, Arabic, analogue	X	X	X	X
Conversion verbal - Arabic - analogue	X	X	X	X
Number line	X	X	X	X
Bigger/smaller	X	X	X	X
Intervals	X	X	X	X
Addition	X	X	X	X
Subtraction	X	X	X	X
Multiplication		X	X	X
Division		X	X	X



Calcularis Outcomes

Increase of number of correctly solved mental tasks in 10 minutes after 6 and 12 weeks (same type of tasks – different numbers)

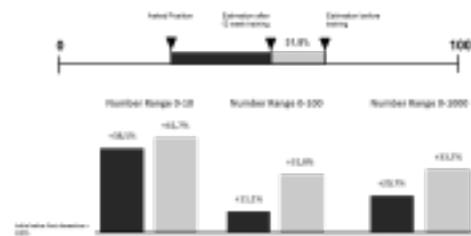


Köller T., et al., 2012



Calcularis Outcomes Continued

Improved internal number line



How can we help students like Amy, who are struggling in Math?

Adam Scheller, Ph.D.

Teaching Recommendations



37

Improving Automaticity

To help Amy to commit math facts to automatic recall, allow her to practice them with different combinations of input (looking or listening) and output (writing or saying).

- Present the math fact visually. Amy looks at the math fact and then writes the sum, difference, product, or quotient.
- Present the math fact visually. Amy looks at the math fact and then says the sum, difference, product, or quotient.
- Present the math fact audibly. Amy listens to the math fact and then writes the sum, difference, product, or quotient in writing.
- Present the math fact audibly. Amy listens to the math fact and then says the sum, difference, product, or quotient in writing.

(Berninger, 2007).



Executive Working Memory Interventions

Dual Encoding

- Strategies utilizing concurrent visual and verbal encoding.
- Some dual encoding occurs naturally (e.g., number naming).
- In the classroom, visual and verbal materials should be utilized.



Executive Working Memory Interventions

Organizational Strategies

- Fitting existing information into an organized structure (semantic category).
- Structuring and organizing information reduces the processing load on WM, thereby allowing more efficient encoding.
- Organizing information involves rehearsal and the processing of information at a deeper level.



**Monitor Progress
"Re-assess"**

- Calculators: built in
- KeyMath 3 ER
- KeyMath 3 DA
 - GSV
 - Standard Score
- Answer the following questions:
 - How much gain?
 - Is that gain significant?



**Further down the diagnostic
testing rabbit hole...**



How can we help students like Amy, who are struggling in Math?

Adam Scheller, Ph.D.

Referral for Comprehensive Evaluation

- Process of Hypothesis Generation
 - Gather relevant data to form diagnostic and/or strengths and weaknesses hypotheses
- Process of Hypothesis Testing
 - Given hypothesis, begin to systematically test
 - Rule out to rule in...
- This might come before or help to inform interventions like Calcularis.



WIAT-III Results

Subtest	Standard Score	Percentile
Math Problem Solving	76	5 th
Numerical Operations	79	8 th
Math Fluency	68	2 nd



Pattern of Strengths and Weaknesses Analysis

Comparison	Relative Strength Score	Relative Weakness Score	Diff.	Critical Value .05	Sign. Diff. Y / N	Supports SLD hypothesis? Yes / No
A Processing Strength / Achievement Weakness	114 (VCI)	79 (NO)	35	8.82	Y	Yes
B Processing Strength / Processing Weakness	114 (VCI)	80 (WMI)	34	10.18	Y	Yes

- The PSW model is intended to help practitioners generate hypotheses regarding clinical diagnoses.
- This analysis should always be used within a comprehensive evaluation that incorporates multiple sources of information.



Amy's Assessment Summary

- Strengths: verbal fluid reasoning, lexical and semantic knowledge, and oral expression
- Needs:
 1. Math-related processing deficits
 2. Math-specific skill deficits
 3. Behavior impacting math performance - Anxiety
- Error patterns



Thanks for attending this webinar!!

www.pearsonclinical.com

For customers in Canada

1-866-335-8418

www.pearsonclinical.ca

Adam Scheller, Ph.D.
 Pearson Training and Consultation
adam.scheller@pearson.com



Pearsonclinical.com/DybusterCalcaris
 Sales/Info: Dybusterinfo@pearson.com
 1-888-988-8048