Understanding Dyslexia: A Scientific Approach

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Things We Know

- Dyslexia is real. People with dyslexia often have other problems (ADHD, math, written expression). Not the only type of RD
- Many children at-risk for dyslexia can be taught to read with early identification and explicit, comprehensive reading instruction
- Remediation of dyslexia after Grade 2 requires high intensity and explicit, comprehensive reading instruction
- We know lots about brain function, malleability (plasticity in development and in relation to intervention) and the heritability of dyslexia
Things We Don’t Know

- **Exactly** how many people have dyslexia
- The level of intensity required to remediate dyslexia
- How “dyslexia” differs from “other” word level disorders
- How to scale effective identification and intervention and translate what’s known from science
- How to use the research on brain function and heredity to identify and intervene with dyslexia (no dyslexia genes)
- Accommodations and adjuncts for people with intractable reading problems
Misunderstandings About Dyslexia

- Definition and Prevalence
- Role of IQ
- Specificity
- Effective Interventions
- Methods of Service Delivery
- Brain Structure and Function
Definition: Word Level Reading Difficulties

Most common and best understood form of LD (Dyslexia)

- A common problem: Largest single group of students in special education: almost 2/5 of all children identified for special education
- Many children not identified for special education have word level difficulties
- Addressed in IDEA as “basic reading” domain and often through 504
Dyslexia is a specific learning disability that is neurological in origin. It is characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities. These difficulties 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. Secondary consequences may include problems in reading comprehension and reduced reading experience that can impede the growth of vocabulary and background knowledge.

Adopted by the Board of Directors: November 12, 2002
1. Dyslexia occurs primarily at the level of the single word and involves the ability to decode and spell printed words in isolation (accurately and automatically). It leads to problems reading text, but is not a text level disability.
2. Single word decoding problems in reading and spelling are strongly associated with problems segmenting words and syllables into phonemes.
• Print represents speech through the alphabet or other visual symbol
• Regardless of surface appearance (orthography), words represent internal units based on sound (phonemes)
• In learning to read, the child makes explicit an implicit understanding that words have internal structures linked to sounds (phonological awareness)
• **Reading is parasitic on language**
3. Dyslexia occurs as part of a natural, unbroken continuum of ability—what causes good reading also causes poor reading (Shaywitz et al., 1992).

The attributes of dyslexia are dimensional: variations on normal development. One theory explains success and failure in reading. Prevalence depends on the threshold...
What Is the Prevalence?

- Most estimates are 3-7% (often assume effective intervention, exclusions, no comorbidity), but still depends on threshold.
- Snowling and Melby-Lervag (2015) meta-analysis of genetically sensitive designs:
  + family risk < 10\textsuperscript{th} %tile (34%); > 10\textsuperscript{th} %tile (53%); about 45% overall
  - family history <10\textsuperscript{th} %tile (11%); > 10\textsuperscript{th} (16%)
4. Dyslexia is best identified through assessments of reading and spelling skills, and instructional response.

IQ tests are not necessary (Dyslexia is uncoupled from IQ): Methods for identification of LD based on IQ-discrepancy or patterns of cognitive strengths and weaknesses lack validity.
5. Children Do NOT Outgrow Dyslexia

- Over 70% identified as dyslexic in Grade 3 remained dyslexic as adults
- Without adequate intervention, dyslexia is a lifelong, chronic disorder
- IQ is weakly related to intervention outcomes (Stuebing et al., 2009; 2014)
6. People with dyslexia have problems outside phonology

- *Comorbidity* - academics, ADHD, oral language
- Word recognition not the only type of RD (text level disorders are not dyslexia)
Specificity

• Dyslexia is real; consensus definition is narrow
• Dyslexia is often part of a complex presentation; generalist genes affect multiple LDs and ADHD (continuity hypothesis)
• Comorbidity: ADHD common; if language and working memory problems significant, math impaired; anxiety is common. Written expression and reading comprehension almost always impaired
• Phonological processing/decoding presentation shines through the glare of complexity
7. Dyslexia can (often) be prevented. Remediation requires much more intensity. Skills that prevent dyslexia must be taught early in school. Remediation after Grade 2 demonstrably less effective (Connor; Lovett): diminishing returns.
Some children placed in special education are instructional casualties because they did not get the needed instruction early in development.

Dyslexia (or any LD) should not be identified in the absence of documentation of adequate instruction (IDEA 2004).

We know very little about effective accommodations and adjuncts for children and adults with severe reading problems.
8. Effective Intervention

- Teach phonics EXPLICITLY with an approach that includes comprehension and fluency components (NRP about explicitness, not phonics). **Differentiate** based on student needs
- No specificity of appropriate interventions. Research supports **explicit, comprehensive, differentiated** approaches at classroom and supplemental level
- Research does not support **multisensory** (in traditional sense), **balanced** systematic, **manualized**, **multiple cuing systems**, discovery or constructionist or rule-based approaches
- Traditional service delivery models ineffective; **Screen, prevent, remediate, accommodate** (MTSS: opposite of typical sequence)
Text Reading in the Content Areas

- Science
- Social Studies

- No Text Reading
- Text Reading
How can we address both goals?

- Content Knowledge
- Comprehend Information Presented in Text

PACT
We Started With Four Strands of Research

- Intervention Design Experiments
- Cognitive Processing Studies
- Motivation Studies
- Reading Engagement Studies
Continued With Interwoven Experimental Studies

- Intervention Design Experiments
- Cognitive Processing Studies
- Motivation Studies
- Reading Engagement Studies
PACT Components

1. Comprehension Canopy
2. Explicit Vocabulary Instruction
3. Text-Based Classroom Discourse
4. TBL Comprehension Check
5. TBL Knowledge Application
Grade 7

Life Science Sample Lessons

Ecology

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Comprehension Canopy Routine  7–10 minutes

Materials
Springboard images: marine ecosystem, desert ecosystem, Amazon rainforest

Introduction and Prior Knowledge

When you see a picture of a forest or desert, it can look calm and peaceful, as if nothing is happening. But forests, deserts, and other ecosystems are full of life and activity.

In this unit, we will learn about relationships between living things and the environment.

Springboard

• Introduce the springboard images.

  I will show you some pictures of different places.

• Provide a purpose for viewing the images.

  As you look at each image, write one thing you know about the place just by looking at the picture.

• Display the springboard images one at a time. After showing each image, have students begin a “turn and talk” activity by using one of the following prompts.

  • Tell your partner what kinds of plants and animals might live here.

  OR

  • How does the weather affect what lives in this environment?

Comprehension Question

State the comprehension question that will guide students’ learning throughout the unit.

How do interactions between living and nonliving things affect ecosystems?
interact
When two or more things have an effect on one another

Related Words: interaction, influence, relate, connect

Example Usage:
Ecology is the science of how living things interact with their environment.

Example: A deer eating the flowers in your neighborhood because the forest where it lived burned down
Nonexample: Watching a news report about a forest fire

Turn and Talk:
In what different ways do you interact with members of your family?

ecosystem
A community of organisms that live and interact in a particular area

Related Words: ecology, environment, habitat

Example Usage:
Rainforest ecosystems rely on tropical bats to pollinate flowers and disperse seeds for trees and shrubs.

Example: A stream with fish, insects, frogs, and water grasses
Nonexample: A puddle on the sidewalk from a recent rain shower

Turn and Talk:
is our classroom an ecosystem? Why? Why not?
Ask an Amazon Expert:
Why Can't We Afford to Lose the Rainforest?

You've worked in the Amazon for more than 50 years. How have you seen the region change?

Fifty years ago, there were 3 million people and one highway in the entire Amazon basin. That's an area as large as the United States! Today, there are between 30 million and 40 million people, countless roads, and up to 20% deforested. The combination of new roads and deforestation has fragmented the rainforest and affected the region's biodiversity. Species lose their habitat or can no longer subsist in the small fragments of forests that are left. We know that ecosystems with a lot of biodiversity are generally stronger and more able to adapt than those with fewer species.

But on the plus side, 50 years ago there was only one national park—in Venezuela—and one national forest and one reserve in Brazil. Today, more than 50% of the Amazon is under the protection of national parks and reserves. The real challenge is to move toward a much more unified approach to managing the Amazon.

1. What changes have humans made in the Amazon region over the past 50 years?

2. What effects have those interactions had on the region's biodiversity?

3. How is climate change connected to the health of the Amazon rainforest?
Comprehension Check #1

Individual Directions: Mark your answer to each of the following questions.

Team Directions: For each question, (1) read, (2) discuss, (3) justify your answer, and (4) scratch off your card.

21. The Proclamation of 1763 angered colonists because it:
   A. Placed duties, or import taxes, on various goods brought into the colonies
   B. Imposed taxation without representation
   C. Tried to prevent colonists from forming representative governments
   D. Tried to prevent colonists from moving west in search of land

   Team Explanation of #21: Why is ___ the correct answer?

22. The Sons of Liberty and other angry colonists protested the Stamp Act by:
   A. Sending a petition to the House of Burgesses
   B. Destroying three ship loads of tea by throwing it into Boston Harbor
   C. Throwing rocks and ice balls at troops guarding the Boston Commons
   D. Attacking customs officials and organizing a boycott of British goods

23. The British decided to tax the colonists in an effort to raise revenue. They needed this revenue to pay off debt caused by:
   A. The high price of sugar
   B. Loans to failing banks during the early 1750s
   C. The high cost of fighting the French and Indian War
   D. Mercantilist trade policies

24. The Sons of Liberty used news of the killings in the Boston Massacre as propaganda to:
   A. Encourage colonists to organize and fight the British
   B. Discourage colonists from boycotting taxed goods
   C. Discourage colonists from meeting in public places
   D. Encourage colonists to follow British law more carefully

Procedure
1. Complete the Comprehension Check individually.
2. Turn in the Comprehension Check.
3. Move into teams.
4. Complete the Comprehension Check as a team, using scratch-off cards. For each question, group members
   a. suggest an answer;
   b. cite evidence from unit text or notes;
   c. agree on an answer; and
   d. scratch off the answer—if incorrect, repeat the process.
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Competition of Causes of the American Revolution

Round 1: Early Causes
- The French and Indian War
- Colonists Moving Into the Ohio River Valley
- Patrick Henry’s Speech to the House of Burgesses
- The Stamp Act

Semifinalist
- is more important because:

Finalist
- is the most important cause of the American Revolution because:

Round 2: Late Causes
- The Boston Massacre
- The Boston Tea Party
- The Intolerable Acts
- The First Continental Congress

Semifinalist
- is more important because:

Round 3: The Most Important Cause

The French and Indian War
- is more important because:

The Boston Massacre
- is more important because:

The Stamp Act
- is more important because:

The Intolerable Acts
- is more important because:

The First Continental Congress
- is more important because:
### Randomized Control Design Blocked on Teacher With Classes Assigned to T or BAU

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<tr>
<th>Vaughn et al., 2013</th>
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## Sample Sizes

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### Fidelity of Implementation

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# Results From RCTs

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# Studies With Struggling Readers

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Study Highlight: Vaughn et al., in press

• Summary: PACT students consistently demonstrate:

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<td>Broad Reading</td>
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<tr>
<td>Comprehension</td>
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• How important is heterogeneity in classrooms?
  • When high achievers are present teachers have higher expectations and they alter instruction accordingly.
  • All students benefit from participation of peers with a range of achievement levels.
  • Academic engagement and motivation to learn are higher when there is a range of achievement levels.
What happens to intervention effects as heterogeneity decreases?

Research Questions:

- How do students with reading difficulties perform on reading outcomes after participating in PACT instruction?
- To what extent does the proportion of students with reading difficulties in a class moderate outcomes?
Design and Intervention Procedures

Vaughn et al., 2017

18 teachers
1,629 students
94 classes

PACT
845 students
49 classes

BAU
784 students
45 classes

PACT Instructional Practices
• Across 6-8 weeks
• 50 minutes daily or 90 minutes every other day
Proportion of Struggling Readers Per Classroom

[Bar chart showing the distribution of struggling readers per classroom in percentage.]

- Proportion of struggling readers per classroom (%)
- Frequency
- 10 20 30 40 50 60 70 80 90 100

The Meadows Center
FOR PREVENTING EDUCATIONAL RISK
Identify areas along the continuum of class proportion of struggling readers where intervention status & struggling reader status interact significantly.
Identify areas along the continuum of class proportion of struggling readers where intervention status & struggling reader status interact significantly.
For each 10% increase in proportion of struggling readers, posttest scores decreased by .78 points.

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<tr>
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<th>Intercept</th>
<th>Pretest</th>
<th>Intervention</th>
<th>Struggling reader</th>
<th>Class % of struggling readers</th>
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<th>Intervention X class % of struggling readers</th>
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THANK YOU!

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