How Children Learn to Read and Evidence-Based Reading Instruction

Friday, April 12, 2013

G. Reid Lyon, Ph.D
The Center for Brain Health University of Texas, Dallas

Distinguished Professor Emeritus, Southern Methodist University
Reading Is Fundamental

Reading is a gateway to success
A Commitment To Four Research Questions:

• How Do Children Learn to Read?
• Why Do Some Children Have Difficulties Learning To Read?
• How Can Reading Failure Be Prevented?
• How Can Persistent Reading Difficulties be Remediated?
The Credibility of the Science of Reading:

How was the Scientific Evidence Obtained and Under What Conditions?
The NICHD Reading Research Program (1992)
## The NICHD Scientific Investment

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Research Sites</td>
<td>44 sites</td>
</tr>
<tr>
<td>Children and Adults Studied</td>
<td>57,000 studies</td>
</tr>
<tr>
<td>Proficient Readers</td>
<td>22,000 readers</td>
</tr>
<tr>
<td>At-Risk/Struggling Readers</td>
<td>35,000 readers</td>
</tr>
<tr>
<td>Average Years Studied/Followed</td>
<td>9 years</td>
</tr>
<tr>
<td>Max Longitudinal Span to Date</td>
<td>34 years</td>
</tr>
<tr>
<td>Current Prevention/Intervention Trials</td>
<td>12 trials</td>
</tr>
<tr>
<td>Schools Currently Participating</td>
<td>266 schools</td>
</tr>
<tr>
<td>Classrooms Currently Participating</td>
<td>985 classes</td>
</tr>
<tr>
<td>Classroom Teachers Participating</td>
<td>1,012 teachers</td>
</tr>
<tr>
<td>Annual Research Budget</td>
<td>$60,000,000 Million Dollars</td>
</tr>
</tbody>
</table>
Reading Comprehension And Critical Thinking

Language

Knowledge

Fluency

Metacognition

Life Experience
Content Knowledge
Activation of Prior Knowledge
Knowledge about Texts

Oral Language Skills
Knowledge of Language Structures
Vocabulary
Written Expression
Cultural Influences

Motivation
Engagement
Active Reading Strategies
Monitoring Strategies
Fix-Up Strategies

Prosody
Automaticity / Rate
Accuracy
Spelling
Decoding
Phonemic Awareness

Florida Reading Initiative
“Reading Is Parasitic on Language”

Learning to Read is Based on Proficient Language Skills
HOW DO CHILDREN LEARN TO READ?

VOCABULARY
Differences in vocabulary development start very early

Average child from a welfare family hears about 3 million words a year vs. 11 million from a professional family (Hart & Risley, 1995).

By age 4, the gap in words heard grows to 13 vs. 45 million
Practical Differences

Children enter school with a listening vocabulary ranging between 2500 to 5000.

First graders from higher SES groups know twice as many words as lower SES children (Graves & Slater, 1987)

Vocabulary differences at grade 2 may last throughout elementary school (Biemiller & Slonim, in press)

College entrants need about 11 to 14,000 root words (meter in thermometer or centimeter)
The Effects of Weaknesses in Oral Language on Reading Growth

Hirsch, 1996

The graph shows a comparison between high and low oral language in kindergarten. The ordinate (y-axis) represents the reading age level, and the abscissa (x-axis) represents the chronological age. The graph illustrates a 5.2-year difference between high and low oral language in kindergarten.
How Many Words Should Teachers Teach Per Day To Help Close The Gap?

- In 1st and 2nd grade, children need to learn **800+ words per year, about 2 per day**.
- Children need to learn **2,000 to 3,000 new words** each year from 3rd grade onward, **about 6–8 per day**.
- Research has shown that most typically developing children need to encounter a word about **12 times** before they know it well enough to improve their comprehension.

Biemiller; Nagy & Anderson
Tiers of words

**Tier 3 Words**
Rarely in text or are content specific.

**Tier 2 Words**
Appear frequently in many contexts.

**Tier 1 Words**
Words students are likely to know.

(Beck, McKeown, & Kucan, 2002)
## Vocabulary

<table>
<thead>
<tr>
<th>Successful Readers</th>
<th>Struggling Readers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are exposed to a breadth of vocabulary words in conversations and print at home and at school from a very early age.</td>
<td>Have limited exposure to new words. May not enjoy reading and therefore do not select reading as an independent activity.</td>
</tr>
<tr>
<td>Understand most words when they are reading (at least 90 percent) and can make sense of unknown words to build their vocabulary knowledge.</td>
<td>Read texts that are too difficult and thus are not able to comprehend what they read or to learn new words from reading.</td>
</tr>
<tr>
<td>Learn words incrementally, through multiple exposures to new words.</td>
<td>Lack the variety of experiences and exposures necessary to gain deep understanding of new words.</td>
</tr>
<tr>
<td>Have content-specific prior knowledge that assists them in understanding how words are used in a particular context.</td>
<td>Often have limited content-specific prior knowledge that is not sufficient to support word learning.</td>
</tr>
</tbody>
</table>

(Boardman et al., 2008)
HOW DO CHILDREN LEARN TO READ?

Phonemic and
Phonological Awareness!
I NEED TO KNOW MY SOUNDS TO READ!
How Do Children Learn To Read?

Phonological Awareness and The Alphabetic Principle

- Print represents speech through the alphabet
- Words are composed of internal units based on sound called “phonemes”
- When learning to read, children must make explicit and implicit understanding that words have internal structures linked to sounds
- Children vary considerably in how easily they master these principles
Patricia Kuhl – U. Washington
HOW DO CHILDREN LEARN TO READ?

PHONICS
The Alphabetic Principle:

Do We Know It?

Can We Teach It?

It is a kind of **knowledge**
Knowing what letters are used to represent which phonemes……..

It is a kind of **skill**
know how to pronounce this nonsense word. . . 
bilt fratchet
HOW DO CHILDREN LEARN TO READ?

FLUENCY

A common definition of reading fluency:

“Fluency is the ability to read text quickly, accurately, and with proper expression.”

National Reading Panel
Fundamental Discoveries:
The challenge of continuing growth in fluency becomes even greater after 3rd grade.

- 4th, 5th, and 6th graders encounter about 10,000 words they have never seen before in print during a year’s worth of reading.
- Furthermore, each of these “new” words occurs only about 10 times in a year’s worth of reading.
- Sadly, it's very difficult to correctly guess the identity of these “new words” just from the context of the passage.
READING FLUENCY AND AUTOMATICITY
Framework Questions

1. Is instruction explicit?
2. Is instruction systematic?
3. Does instruction integrate all literacy components?
4. Does instruction include coordinated instructional sequences and routines?
5. Is instruction scaffolded?
6. Does instruction include cumulative review?
7. Are assessments included to measure and monitor progress?
How Do Children Learn To Read?

READING

COMPREHENSION
Comprehension

Comprehension is the “process of simultaneously extracting and constructing meaning through interaction and involvement with written language. It consists of three elements: the reader, the text, and the activity or purpose for reading.”

(RAND, 2002, p. xiii)
Proficient comprehension of text is influenced by:

- Accurate and fluent word reading skills
- Oral language skills (vocabulary, linguistic comprehension)
- Extent of conceptual and factual knowledge
- Knowledge and skill in use of cognitive strategies to improve written expression and comprehension
- Reasoning and inferential skills
- Motivation to understand and interest in task and materials
A student must be able to read correctly approximately **95 percent** of the words accurately in text to comprehend what is read.

MOREOVER, to comprehend, a student must know the meanings of **90 to 95 percent** of the words being read.
1. Is instruction explicit?
2. Is instruction systematic?
3. Does instruction integrate all literacy components?
4. Does instruction include coordinated instructional sequences and routines?
5. Is instruction scaffolded?
6. Does instruction include cumulative review?
7. Are assessments included to measure and monitor progress?
The consensus view of most important instructional features for interventions

Interventions are more effective when they:

Provide **systematic and explicit** instruction on component skills within an integrated context

Provide a significant increased **intensity** of instruction

Provide ample opportunities for guided practice of new skills

Provide appropriate levels of scaffolding as children learn to apply new skills
How Can We Prevent Reading Failure?

- Development of Sensitive and Valid Screening Measures
- Professional Development and Use of a Professional Common Language
- Implementation of Three-Tier Models
- Continuous Assessment of Progress
- Appreciation of School Leadership and Capacity Factors
WHY FOCUS ON EARLY IDENTIFICATION AND PREVENTION?

- 88% of students reading poorly at the end of the first grade will read poorly at the end of the fourth grade (Juel, 1988)

- Unless effective reading instruction is provided, students reading poorly at the end of the fourth grade will have reading difficulties for the rest of their lives (Shaywitz et al.; 1992; Lyon et al., 2005)

- Preventing reading failure dramatically increases a student’s potential quality of life, occupational opportunities, economic status, and health outcomes
Early Intervention is Possible – AND EFFECTIVE

- Risk characteristics present in Kindergarten and G1
- Letter sound knowledge, phonological awareness, oral language development
- Assess all children and INTERVENE- first in the classroom and then through supplemental instruction
## NICHD INTERVENTION STUDIES

<table>
<thead>
<tr>
<th>Study</th>
<th>Amt. of instruction</th>
<th>Pre RX</th>
<th>Post RX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foorman</td>
<td>174 hrs.- classroom</td>
<td>35%</td>
<td>6%</td>
</tr>
<tr>
<td>Felton</td>
<td>340 hrs. - groups of 8</td>
<td>32%</td>
<td>5%</td>
</tr>
<tr>
<td>Vellutino</td>
<td>35- 65 hrs. 1:1 tutoring</td>
<td>46%</td>
<td>7%</td>
</tr>
<tr>
<td>Torgesen</td>
<td>88 hrs. 1:1 tutoring</td>
<td>30%</td>
<td>4%</td>
</tr>
<tr>
<td>Torgesen</td>
<td>80 hrs. 1:3 tutoring</td>
<td>11%</td>
<td>2%</td>
</tr>
<tr>
<td>Torgesen</td>
<td>91 hrs. 1:3 or 1:5 tutoring</td>
<td>28%</td>
<td>1.6%</td>
</tr>
<tr>
<td>Mathes</td>
<td>80 hrs. 1:3 tutoring</td>
<td>31%</td>
<td>0.02%</td>
</tr>
</tbody>
</table>
We Hold Our Kid’s Brains in Our Hands
ANATOMY OF A TODDLER'S BRAIN

WHINE CENTER

DELAY TACTICS

DEAD CENTER

PATIENCE CENTER

NEXTNESS CENTER

INADVERTENTLYCried CENTER

DIRTY CRY CENTER

DIRTY WORD

PERMANENT

STORAGE AREA

BARNEY'S THEME SONG

ABCs, 123s, ETC.

WAYS TO NEGOTIATE SUGAR

SHORT LIST OF EDIBLE MEALS

SPIEL REFLEX

IMPULSE TO CONTRADICT

EMBARRASSING QUESTIONS

WHAT TIME RUINS IS ON

SUPER-TURBO TANTRUM CENTER

DIRTY TANTRUM CENTER

FAKE CRY CENTER

EMBARRASSING QUESTIONS

WHAT TIME RUINS IS ON

ABILITY TO SHARE
ANATOMY OF A TEENAGER’S BRAIN

THE BIRDS AND THE BEES LOBE

- Rebellion Center
- Super Turbo Rebellion Center
- Self Image
- Fitting In Gland
- Internet Addiction
- Every Episode of the Simpsons
- Indestructibility Cortex
- Peer Pressure Resistance
- Ability to be seen in public with Parents

- Cool Gauge
- Slang Decoder
- Slang Organ
- Slam Door Reflex
- Car Keys Cowing
- Love for Parents
- Memory for Chores, Homework, etc.
- Memory for Parents
- Love for Parents
- Judgment Gland

MarkParisi@aol.com
What Areas of the Brain Do we Want to Develop for Reading?
Diffusion Tensor Imaging (DTI)

DTI is an advanced MR imaging technique based on the Brownian motion of water through tissues.

It measures how easy that water molecules move along the direction of white matter fibers versus the directions perpendicular to the fibers.

TBI causes tissue shearing in the white matter fibers that leads to reduction of DTI signal.
MRI: Magnetic Resonance Imaging
Typical Brain

Dyslexic Brain

LEFT

RIGHT

LEFT

RIGHT
Brain activation differences in dyslexia and its Treatment

Typically reading children

Children with dyslexia before remediation

Children with dyslexia after remediation
At risk

Not at risk
Weak activation pattern (Papanicalau, Fletcher et al)

Strong activation pattern

Child #1: Normal Reader

Child #12: with Reading Difficulties

Right Hemisphere

Left Hemisphere

(Papanicalau, Fletcher et al)
Leadership Within the District and in Each Building
What We Know About Leadership – Big Ideas:

• Next to teachers, education leaders have the most impact on student learning and achievement

• Even with the most effective teachers, the absence of a skilled and committed education leader will reduce student achievement

• Effective leadership in schools is an extraordinarily complex task

• Effective leadership requires traits beyond skills
FOUR “COMMON SENSE” QUESTIONS ABOUT LEADERSHIP

- DO WE HAVE A COMMON PROFESSIONAL LANGUAGE?

- DO WE KNOW WHAT WORKS?

- UNDER WHAT CONDITIONS DOES IT WORK?

- WHAT DO WE DO WHEN IT IS NOT WORKING?
Common Sense Characteristics of Instructional Leaders

- Proven expertise in the identification, implementation, sustaining, and scaling of evidence-based and effective curricula.
- Sufficient knowledge of academic content knowledge to ensure relevant and informed instructional leadership.
- Ensures the development of a common professional language.
- Implements required time periods for teacher collaboration.
- Implements a system for continuous evaluation and accountability.
- Set non-negotiable student learning and achievement.

“Things are only impossible until they’re not.”
Key Findings:

Previous research has identified a set of core practices underlying the work of successful school- and district-level leaders. About 15 in total, these practices can be classified as:

- Setting Directions
- Developing People
- Redesigning the Organization
- Managing the Instructional Program
An Example Of Conditions Essential To The Implementation of RtI

- Implementation w/ fidelity
- Team-based data decision-making & problem solving
- Continuum of evidence-based practices
- Regular universal screening
- Content expertise & fluency
- Continuous progress monitoring
- Prevention & early intervention
Barriers to Implementation

• Failure to develop a common language
• Ineffective instructional leadership
• Taking on too many grade levels and schools the first year
• Beginning the implementation without a comprehensive plan
• Failure to view the implementation as a systems wide change
Barriers to Implementation

Information dissemination alone (research literature, mailings, promulgation of practice guidelines) is an ineffective implementation method.

Training (no matter how well done) by itself is an ineffective implementation method.

Focusing too many resources on administering and collecting assessment data rather than ensuring that the data are used to inform instruction.

Confusing awareness training with implementation training.

(Fixen et al., 2005; Ellis, et al., 2003 and Greenhalgh, et al., 2004; Hall, 2007)
Thank you for your attention and your deep commitment to children!

G.R. Lyon

Center for Brain Health, University of Texas, Dallas
Distinguished Scientist in Cognition and Neuroscience

Distinguished Professor Emeritus,
Southern Methodist University