From the Laboratory to Congress; from the White House to the Classroom

The NICHD Reading Research Program and the Birth of Evidence Based Reading Instruction

G. Reid Lyon, Ph.D.
Department of Education Policy and Leadership, SMU

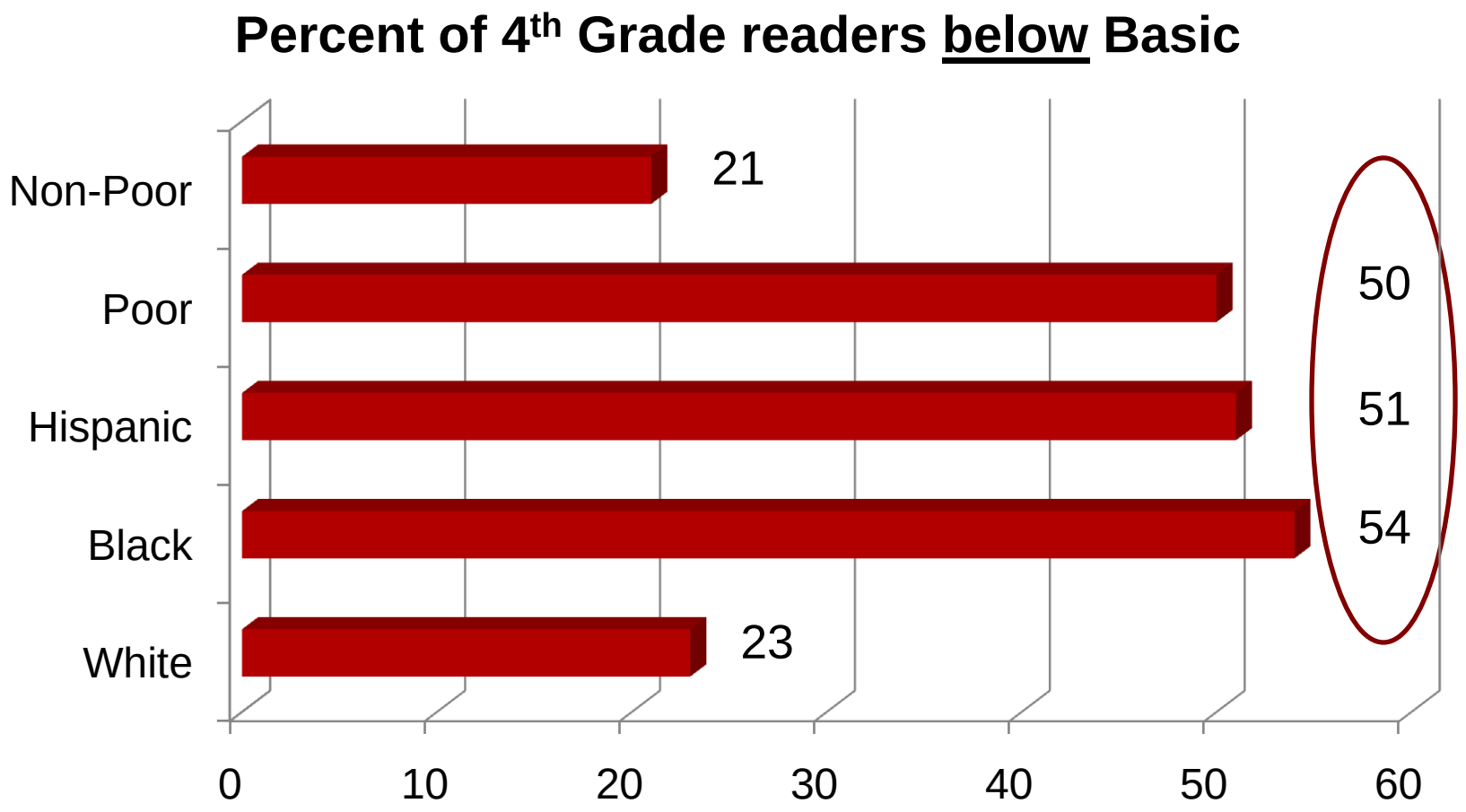
The Profession Through the Ages

- “The history of the profession has never been a particularly attractive subject in professional education, and one reason for this is that it is so deplorable a story.
- For century after century all the way into the remote millennia of its origins, the profession got along by sheer guesswork and the crudest sort of empiricism. It is hard to conceive of a less scientific enterprise among human endeavors.

The Profession Through the Ages (cont.)

- Virtually anything that could be thought up for treatment was tried out at one time or another, and once tried, lasted decades or even centuries before giving it up.
- It was, in retrospect, the most frivolous and irresponsible kind of human experimentation, based on nothing but trial and error, and usually resulting in precisely that sequence."
- Lewis Thomas (1983)

2007 National Assessment of Educational Progress



PISA 2003: US 15 Year-Olds Rank Near the End of the Pack Among 29 OCED Countries

	U.S. RANK
READING	20TH
MATH	24TH
SCIENCE	19TH

Source: NCES, 2005, International Outcomes of Learning in Mathematics, Literacy and Problem Solving: 2003 PISA Results. NCES 2005-003

Does it Have to Be This Way?

NO!

We now know enough about Reading Development, Reading Difficulties and Reading Instruction to Significantly Decrease Reading Failure

SMU

The Science

The NICHD Reading Research Program

Initiated in 1963

- A Commitment to Focus on Four Research Questions (Reid's 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 NICHD Reading Research Program
Research Directors (1963-)

D. Grey

R. Lyon

P. McCardle

B. Miller

Not Pictured: James Kavanaugh

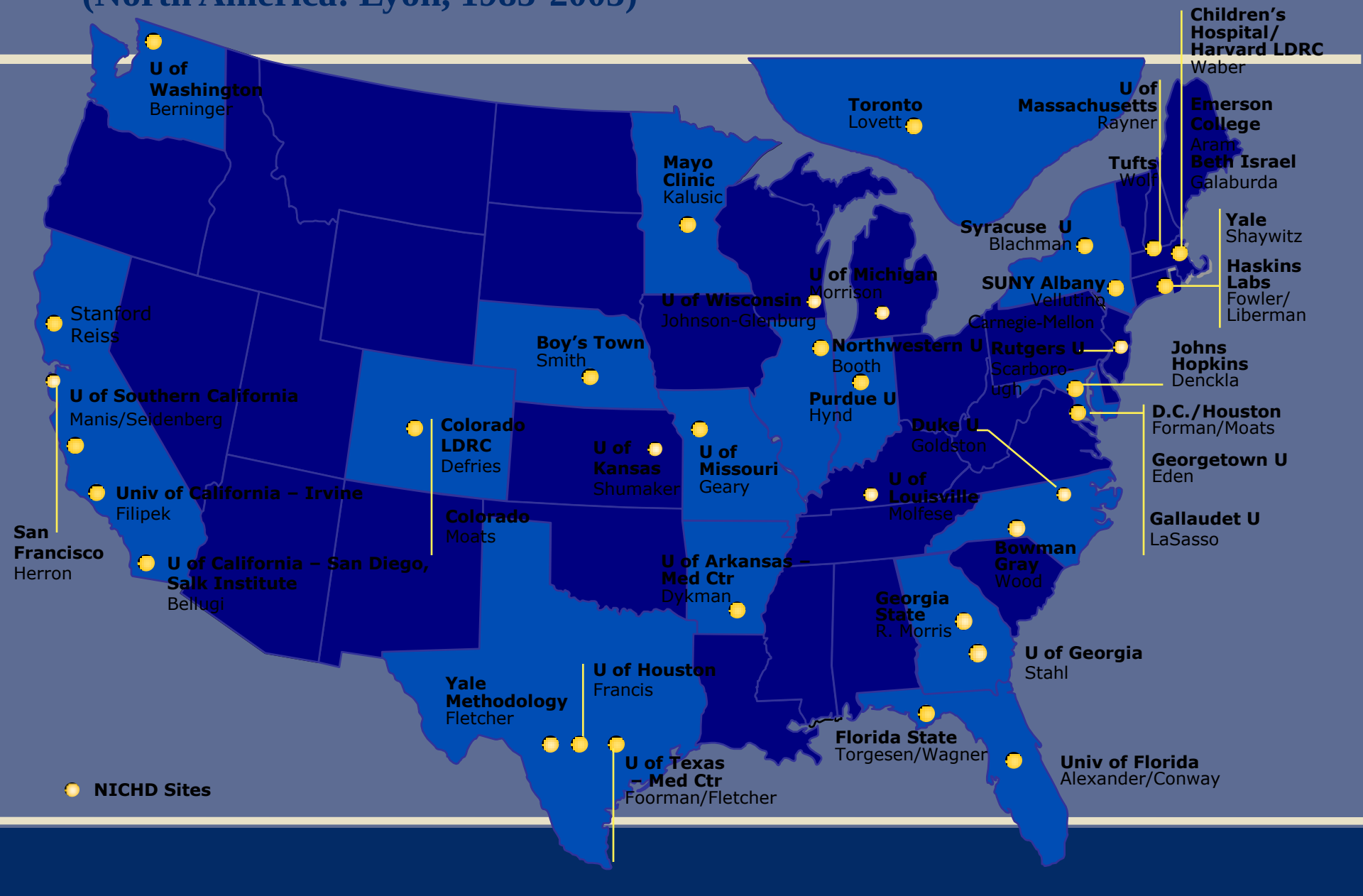
The NICHD Reading Research Program (1992)

The NICHD Scientific Investment

Number of Research Sites	44
Children and Adults Studied	57,000
Proficient Readers	22,000
At-Risk/Struggling Readers	35,000
Average Years Studied/Followed	9
Max Longitudinal Span to Date:	34 Years
Current Prevention/Intervention Trials	12
Schools Currently Participating	266
Classrooms Currently Participating	985
Classroom Teachers Participating	1,012
Annual Research Budget	**$60 Million**

NIH-NICHD Multidisciplinary Research Program

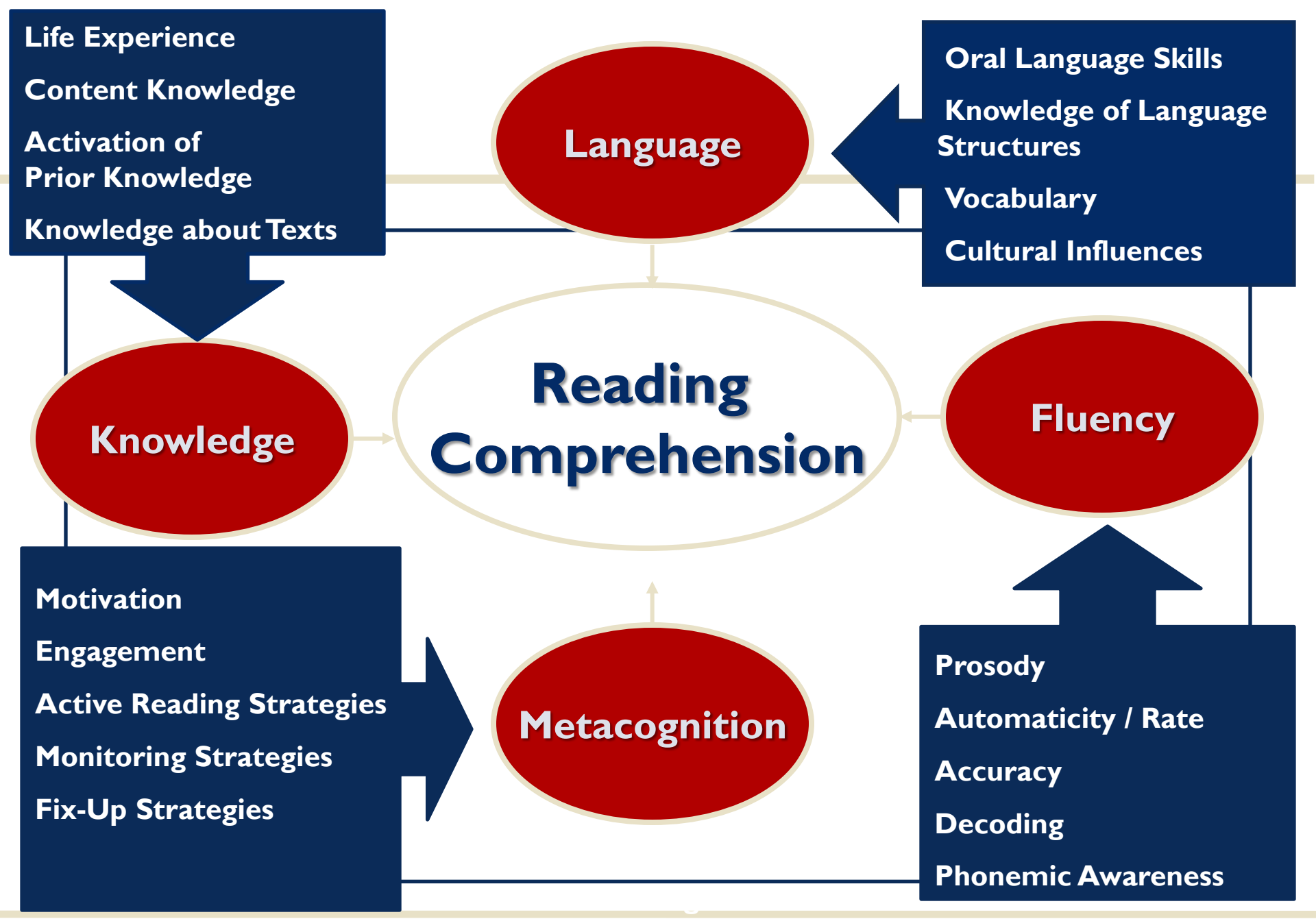
(North America: Lyon, 1985-2005)



Quoted from “The Nature of Evidence”

- Americans are overwhelmingly interested in science but don’t understand it and know even less about how it is done…. Without a grasp of scientific ways of thinking, the average person cannot tell the difference between science based on real data and something that resembles science – at least in their eyes – but is based on uncontrolled experiments, anecdotal evidence, and passionate assertions.
- They like it all.

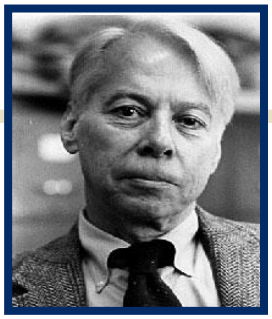
- Boyce Rensberger, “The Nature of Evidence”, *Science,* July 2000, p. 61


Life Experience
Content Knowledge
Activation of Prior Knowledge
Knowledge about Texts
Language
Oral Language Skills
Knowledge of Language Structures
Vocabulary
Cultural Influences
Knowledge
Reading Comprehension
Fluency
Motivation
Engagement
Active Reading Strategies
Monitoring Strategies
Fix-Up Strategies
Metacognition
Prosody
Automaticity / Rate
Accuracy
Decoding
Phonemic Awareness

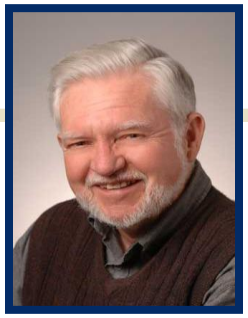
What We Know About the Factors that Affect Reading Comprehension (Toregesen)

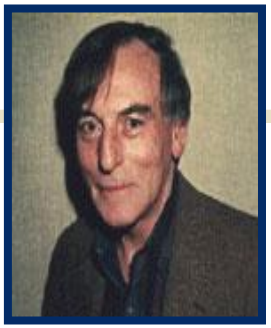
- Proficient Comprehension of text is influenced by:
  - Accurate and fluent word reading skills
  - Oral Language Skills (vocabulary, linguistic comprehension)
  - Extent of conceptual and factual knowledge
  - Knowledge and skill in use of cognitive strategies to improve comprehension or repair it when it breaks down.
  - Reasoning and inferential skills
  - Motivation to understand and interest in task and materials

The Haskins Group


Al Liberman

I. Mattingly


D. Shankweiler


M. Studdert-Kennedy

C. Fowler

K. Pugh

M. Turvey

H. Scarborough

S. Brady

P. Rubin

R. Frost

L. Katz

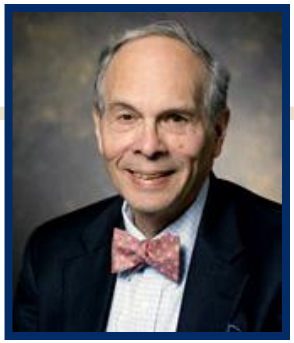
E. Mencl

M. Gillis

Not Pictured:
P. Simos

The Yale Group

S. Shaywitz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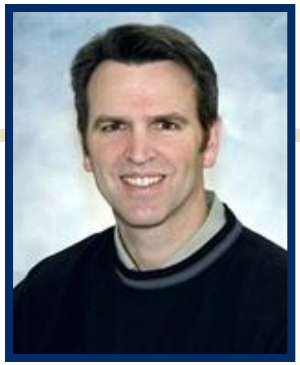
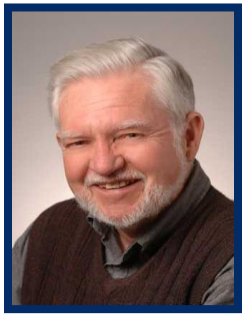

R. Fulbright

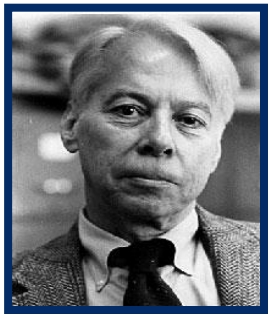
J. Gore


D. Shankweiler

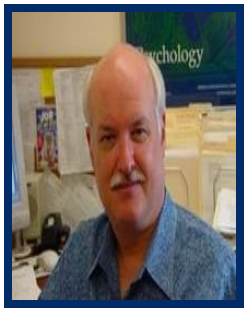
J. Fletcher

K. Pugh

E. Mencl

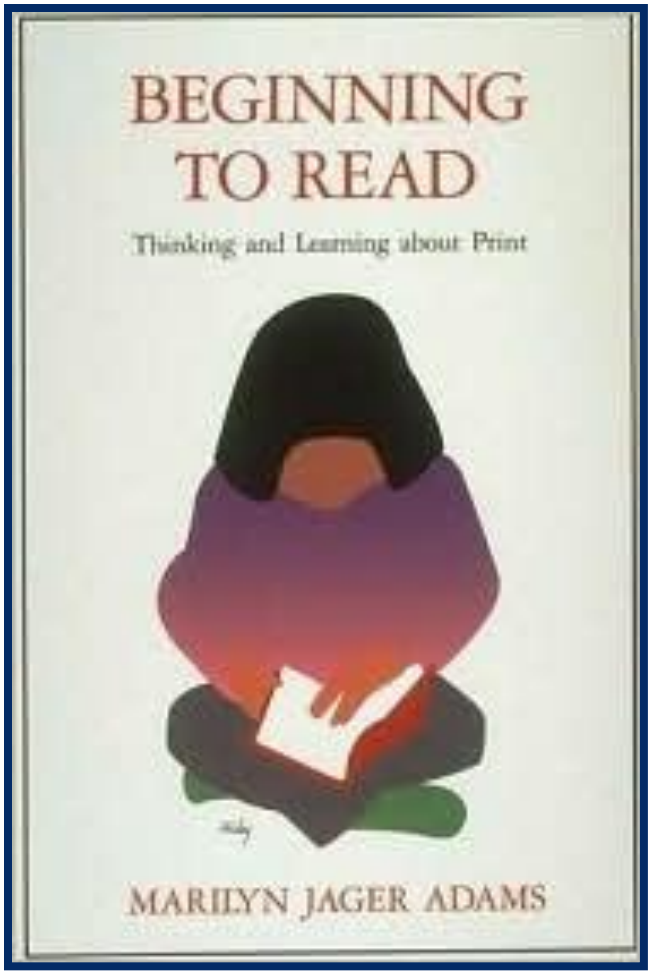

Al Liberman

L. Katz


R. Morris

B. Blachman

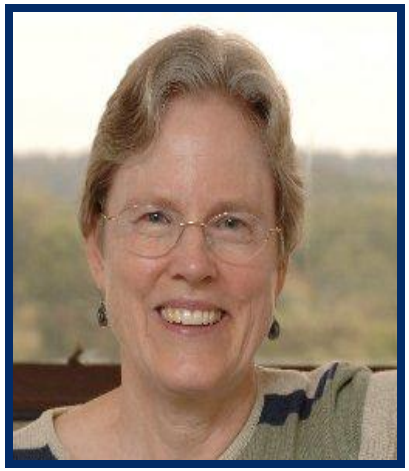
Marilyn Adams



The Florida State Group

J. Torgesen

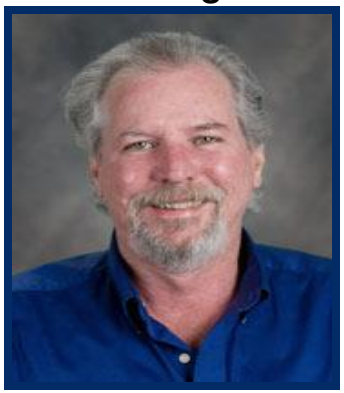
B. Foorman



R. Wagner

C. *Schatschneider*

C. Lonnigan



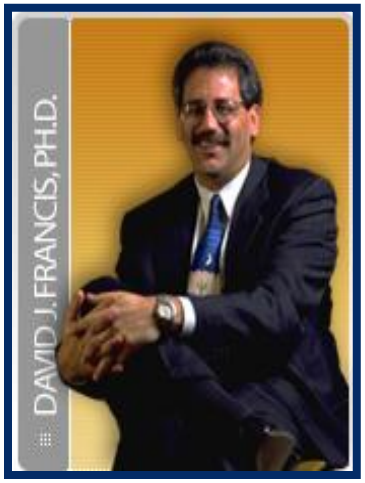
P. Mathes

The UT Health Science Center - Houston

B. Foorman

J. Fletcher

D. Francis



K. Steubing

L. Moats

A. Papanicalaou

P. Mathes

Not Pictured:
P. Simos

The University of Washington Group

G. Berninger

R. Abbott

W. Raskind

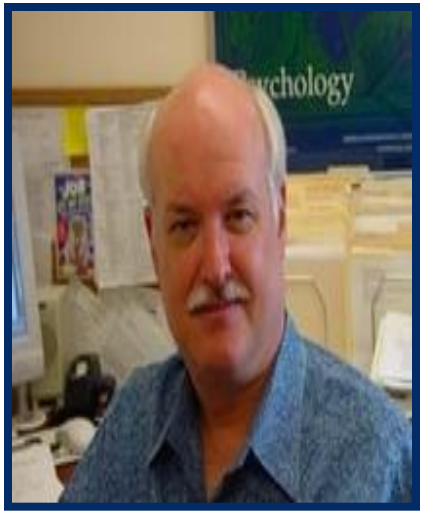
T. Richards

D. Corina

E. Aylward

Georgia State/U. Toronto/Tufts Group

R. Morris



M. Lovett

M. Wolf

The John Hopkins Group

M. Denckla

A. Reiss

L. Cutting

K. Pugh

H. Scarborough

D. Speece

The SUNY/Albany Group

F. Vellutino

D. Scanlon

The Bowman Gray – Wake Forest Group

F. Wood

R. Felton

L. Flowers

G. Eden

The Harvard - Beth Israel Group

A. Galaburda

Hortense

G. Sherman

The Georgetown Group

G. Eden

C. Vaidya

C. LaSasso

F. Wood

L. Flowers

B.Fischl

P.Turkeltaub

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”
- In learning to read, children must make explicit an implicit understanding that words have internal structures linked to sounds.
- Children vary considerably in how easily they master this principle

I NEED TO KNOW MY SOUNDS TO READ!

The Alphaetic Principle:

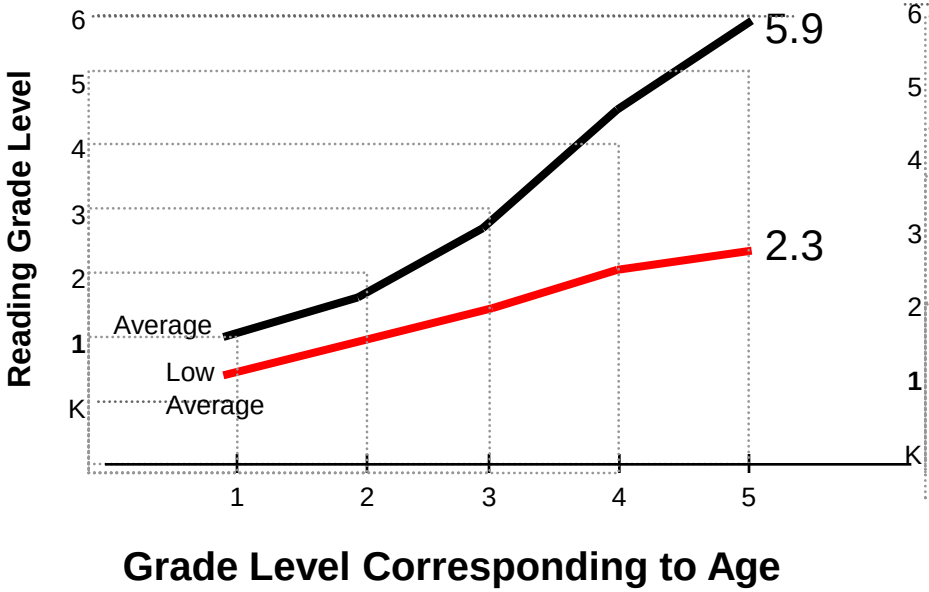
Do we Know it?

Do we Teach it?

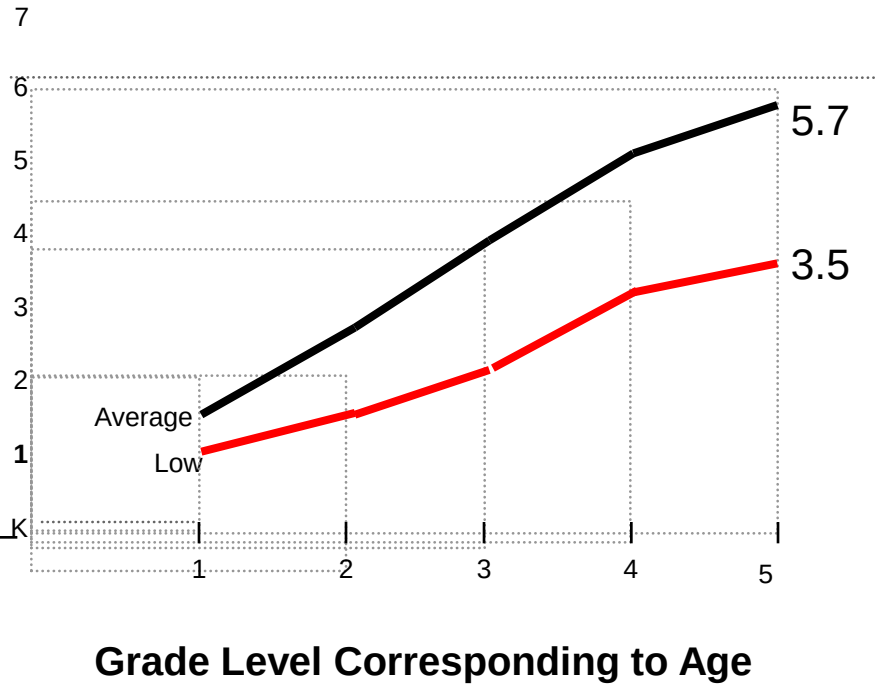
- It is a kind of **knowledge**
  - Knowing what letters are used to represent which phonemes….
- It is a kind of **skill**
  - Know how to pronounce this nonsense word….
    - **bilt**
    - **fratchet**

How Do Children Learn to Read

Effects of Growth in Phoneme Awareness and Letter Knowledge



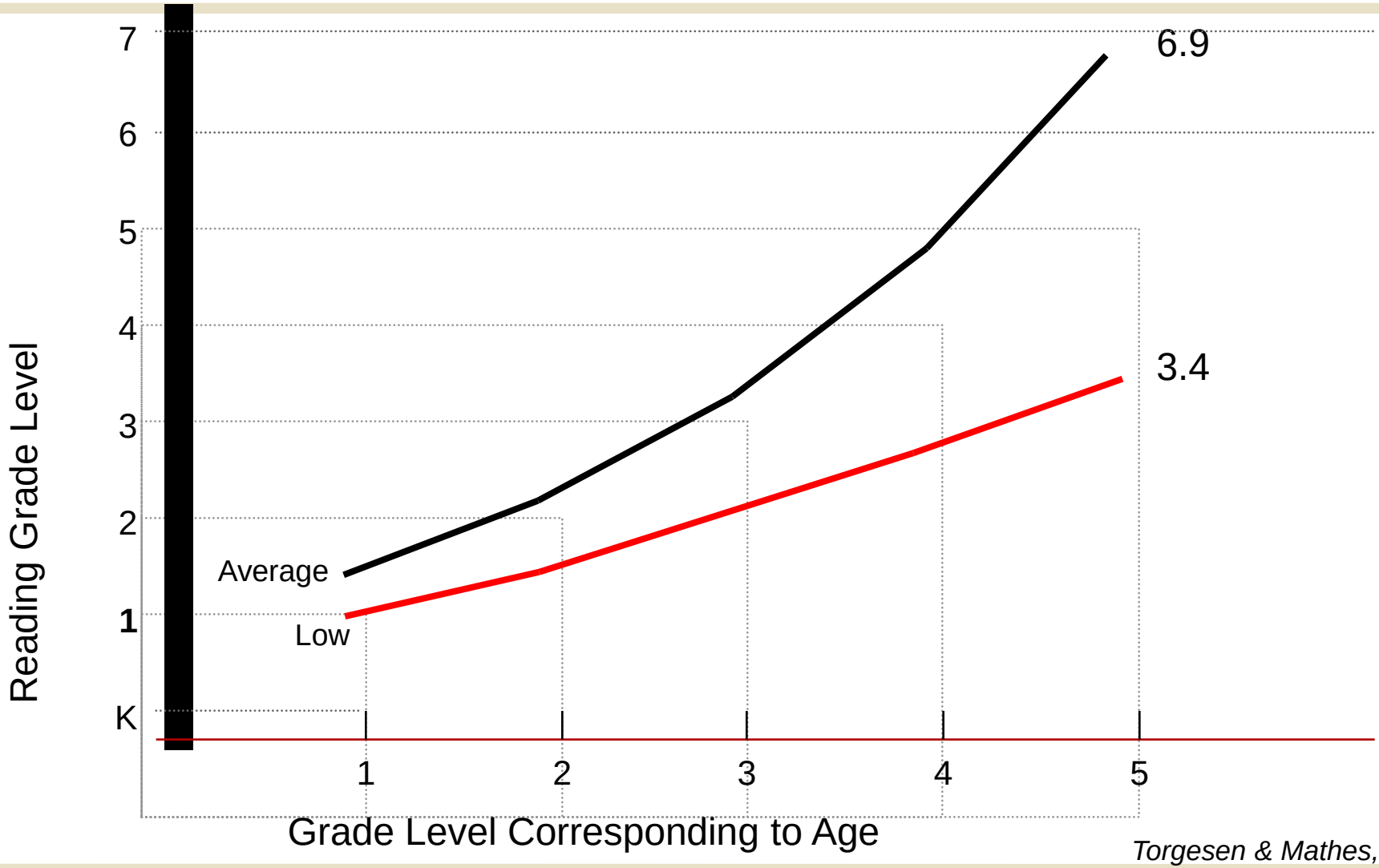
Growth in “phonics” ability



Growth in word reading ability

Torgesen & Mathes, 2000

Effects of Phonemic Awareness and Phonics on Growth in Reading Comprehension



Torgesen & Mathes, 2000

The Alphabetic Principle

- Print represents speech through the alphabet
- Words are composed of internal units based on sound called “phonemes”
- In learning to read, children must make explicit an implicit understanding that words have internal structures linked to sounds.
- Children vary considerably in how easily they master this principle.

Reading Fluency

- Reading fluency encompasses the speed or rate of reading, as well as the ability to read materials with expression.
- The ability to read connected text rapidly, smoothly, effortlessly, and automatically with little conscious attention to the mechanics of reading, such as decoding.
- The concept of automaticity refers to a student's ability to recognize words rapidly with little attention required to the word's appearance.
- The ability to read words by sight automatically is the key to skilled reading.

Reading Fluency

- 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
- It is very difficult to correctly guess the identity of these "new words" from the context of the passage

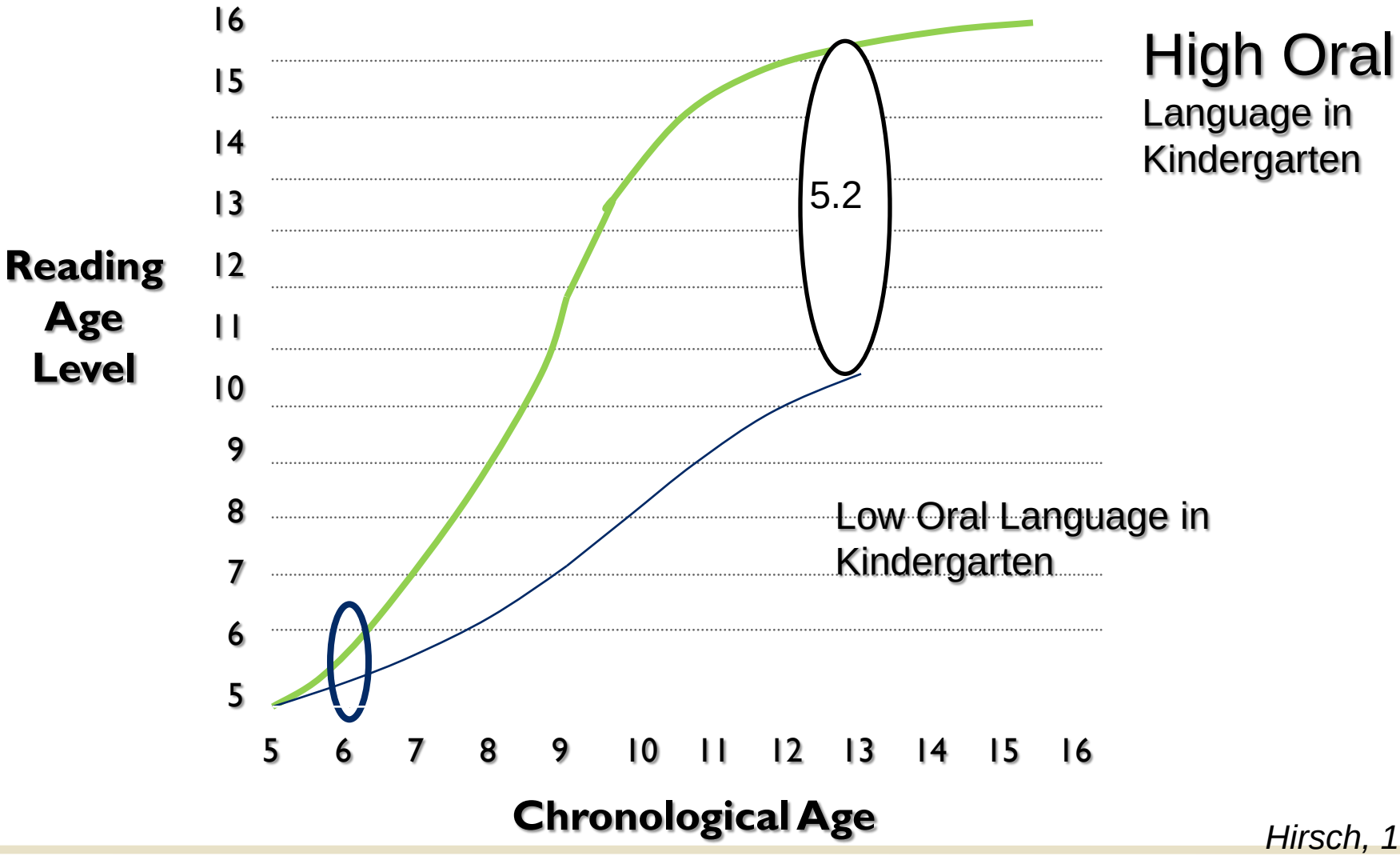
Torgesen

Oral Language and Vocabulary

Most Poor Children:

1. Are delayed in the development of phonemic awareness
2. Have had less exposure to print and the alphabet
3. Have vocabulary that are usually less well developed – ½ in poor children compared to other children
4. Have a range of experience and conceptual knowledge that is often limited or different compared to other students
5. Frequently do not have good models of reading or support for academics in their homes.

The Effects of Weaknesses in Oral Language on Reading Growth



Hirsch, 1996

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 <u>two</u> 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

Are You Really Serious About Closing the Achievement Gaps?

- 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 meaning of 90-95 percent of the words being read.

What the National Reading Panel Says About the Role of Vocabulary in Reading Instruction

- Learning in rich contexts is valuable for vocabulary learning. Vocabulary words should be those that the learner will find useful in many contexts
- When vocabulary items are derived from content learning materials, the learner will be better equipped to deal with specific reading matter in content areas.

What the National Reading Panel Says About the Role of Vocabulary in Reading Instruction

- There is a need for direct instruction of vocabulary items required for each specific text.
- Repetition and multiple exposure to vocabulary items are important. Students should be given items that will be likely to appear in many contexts.

(Reprinted from National Reading Panel, 2000, p.4-4)

Reading Comprehension

Reading Comprehension Non-Negotiables

- 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 90-95 percent of the words being read.

What Does it Take to Understand What you Read?

- Good readers are active readers
- They have clear goals in mind for their reading
- They constantly evaluate whether the text, and their reading of it, is meeting their goals.
- Good readers typically look over the text before they read, noting such things as the structure of the text and text sections that might be most relevant to their reading goals.

What Does it Take to Understand What you Read?

- As they read, good readers frequently make predictions about what is to come
- They read selectively, continually making decisions about their reading – what to read carefully, what to read quickly, what not to read, what to re-read, and so on.
- Good readers construct, revise, and question the meanings they make as they read.
- They draw upon, compare, and integrate their prior knowledge with material in the text.

What Does it Take to Understand What you Read?

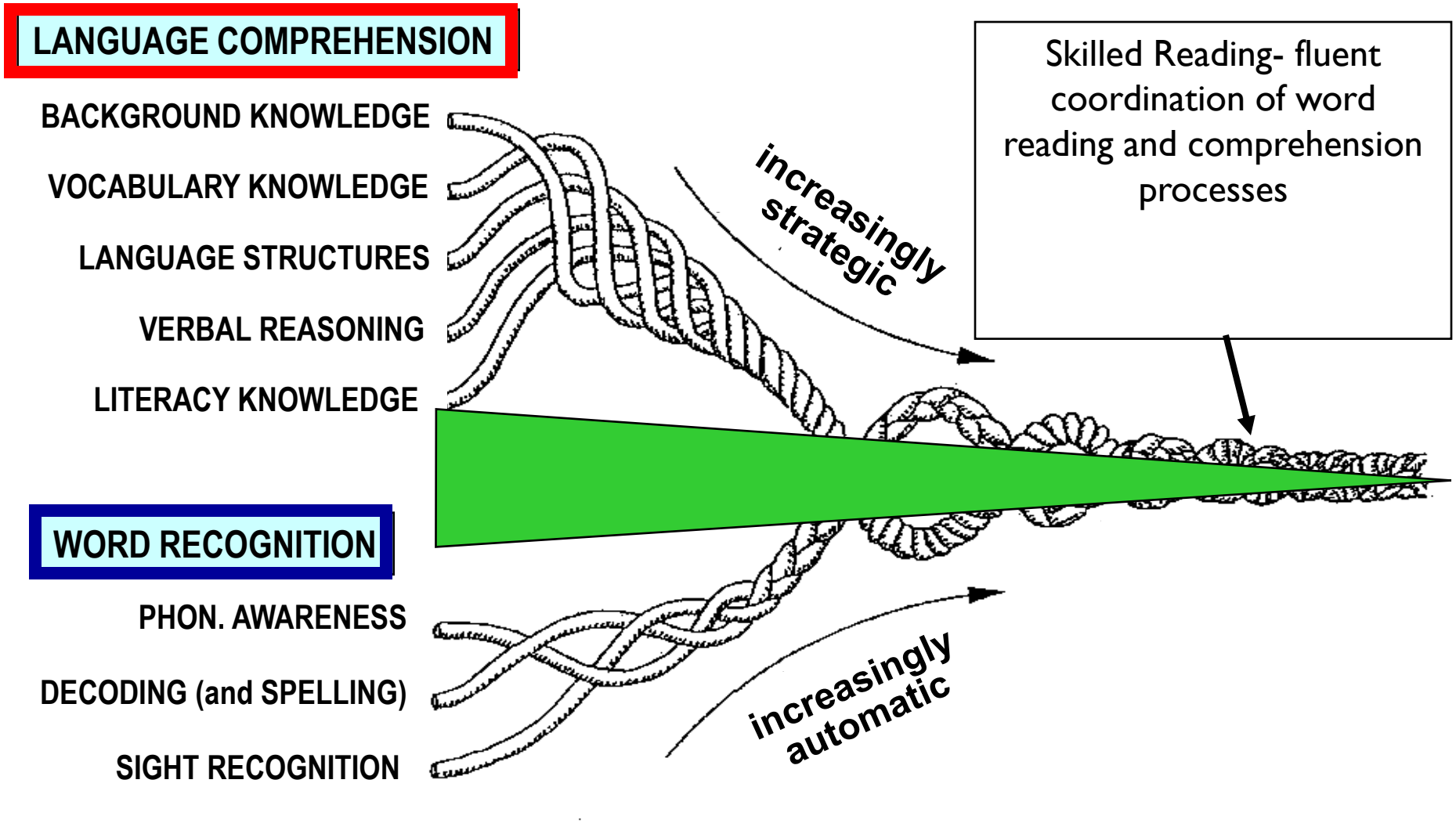
- They think about the authors of the text, their style, beliefs, intentions, historical milieu, and so on.
- They monitor their understanding of the text, making adjustments in their reading as necessary. Good readers try to determine the meaning of unfamiliar words and concepts in the text, and deal with inconsistencies or gaps as needed.
- They evaluate the text's quality and value, and react to the text in a range of ways, both intellectual and emotional.

What Does it Take to Understand What you Read?

- Good readers read different kinds of texts differently. For example, when reading narrative, good readers attend closely to the setting and characters.
- When reading expository text, they frequently construct and revise summaries of what they have read
- For good readers, text processing occurs not only during ‘reading’ as we have traditionally defined it, but also during short breaks taken during reading, and even after the ‘reading’ itself has commenced.

The Many Strands that are Woven into Skilled Reading

(Scarborough, 2001)



Intervention and Remediation

Early Intervention is Effective

- Prevention studies in reading (and behavior) commonly show that 70-90% of at risk children (bottom 20%) in K-2 can learn to read in average range
- (Fletcher, Lyon, et al., 2007)

Early Intervention is Possible

- 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.

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

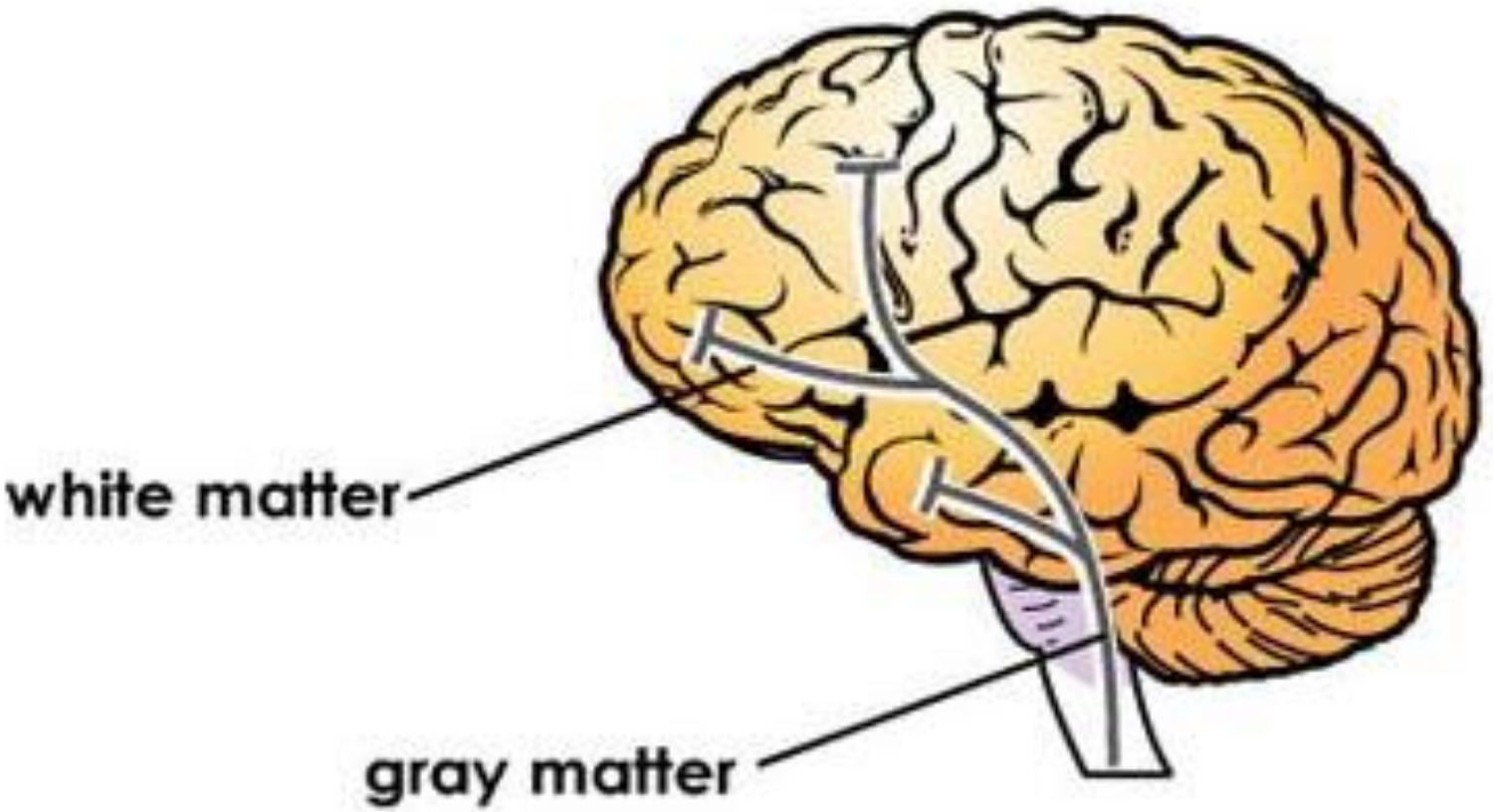
NICHD Intervention Studies
Children Scoring Below the 30th Percentile

Study	Amt. of instruction	Pre RX	Post RX
Foorman	174 hrs.- classroom	35%	6%
Felton	340 hrs. - groups of 8	32%	5%
Vellutino	35- 65 hrs. 1:1 tutoring	46%	7%
Torgesen	88 hrs. 1:1 tutoring	30%	4%
Torgesen	80 hrs. 1:3 tutoring	11%	2%
Torgesen	91 hrs. 1:3 or 1:5 tutoring	28%	1.6%
Mathes	80 hrs. 1:3 tutoring	31%	.02%

The Consensus View of Most Important Instructional Features for Interventions

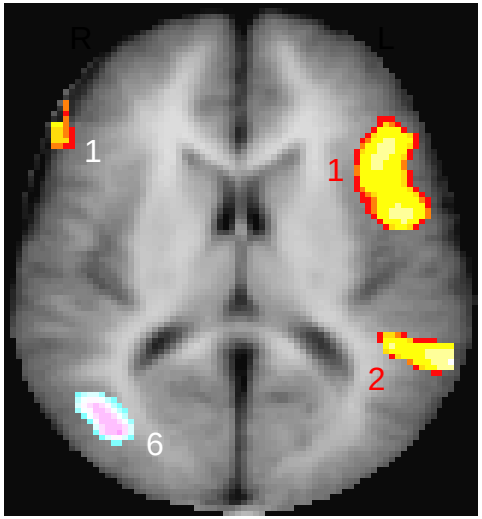
- Interventions are more effective when they are:
  - Provide systematic and explicit instruction on component skills that are deficient.
  - Provide a significant increase in intensity of instruction
  - Provide ample opportunities for guided practice of new skill
  - Provide appropriate levels of scaffolding as children learn to apply new skills.

Application of Neuroimaging Modalities and Protocols to Reading and Reading Disabilities: Cortex

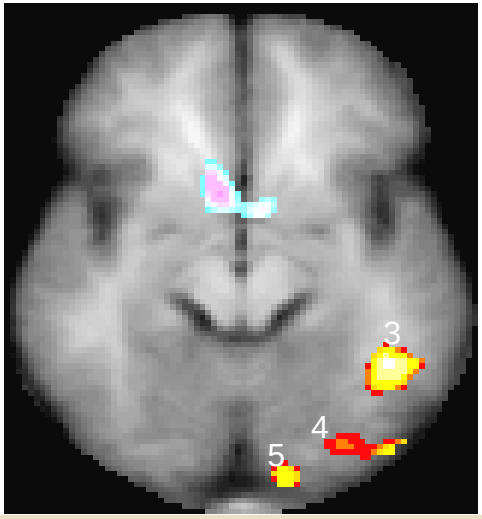

white matter
gray matter

One Year After Intervention

Z=+12

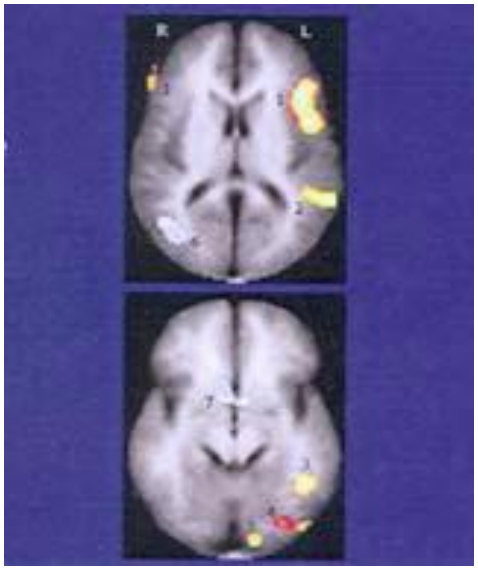


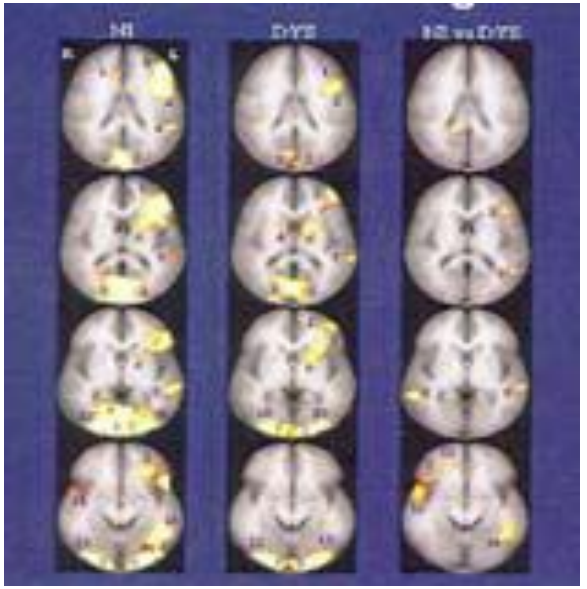
Z=-4



Shaywitz et al., Biol. Psychiatry, 2004

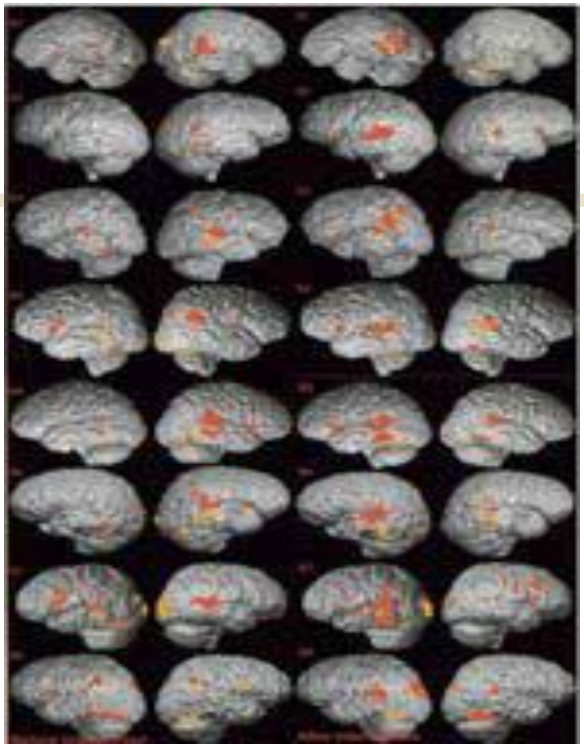
“I didn’t know it was impossible when I did it” -Anonymous





NI DYS NI > DYS R L
Nonword Reading

Shaywitz, B.A., et al 2002
Shaywitz et al., 2004.



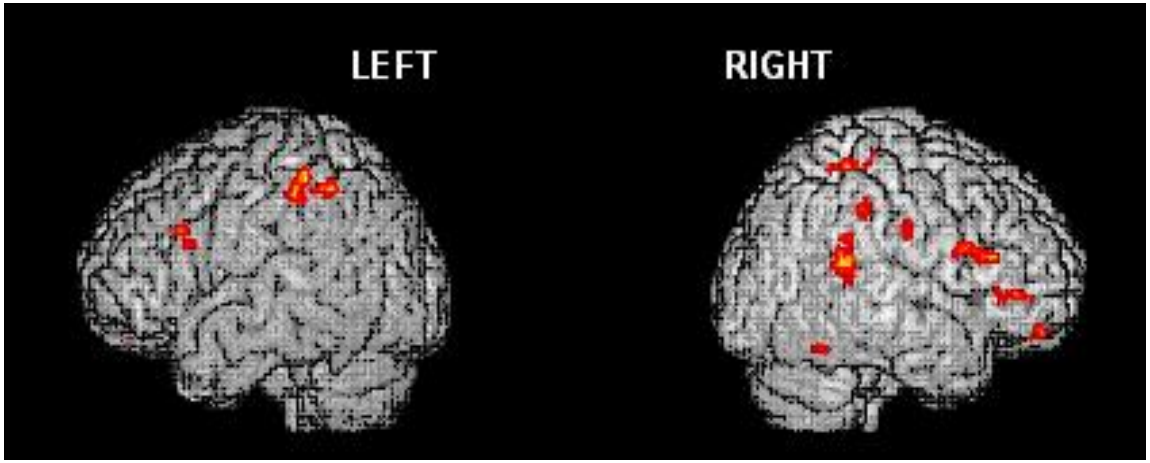
L R L R

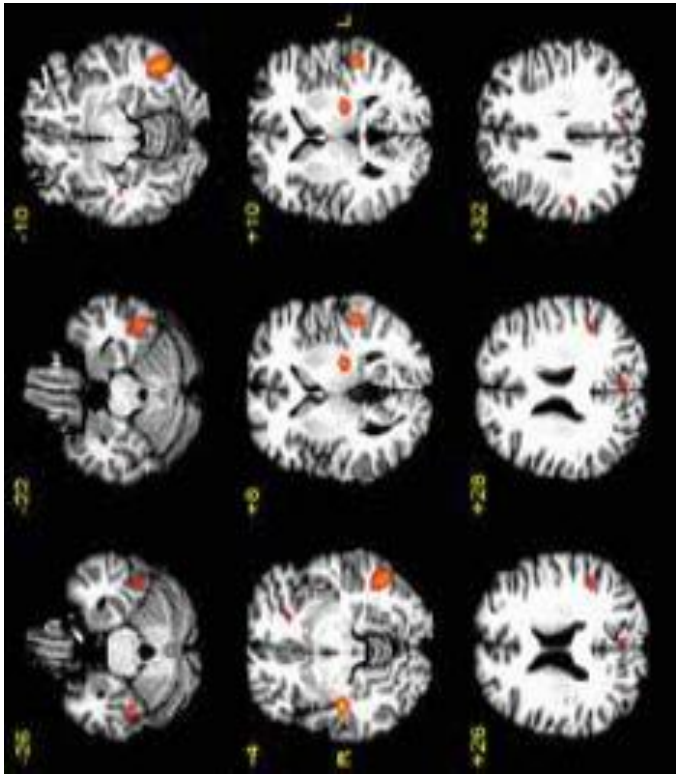
Before After

Magnetic Source Imaging (MSI)

Source: Simos, Fletcher et al., 2002. Fig 1.

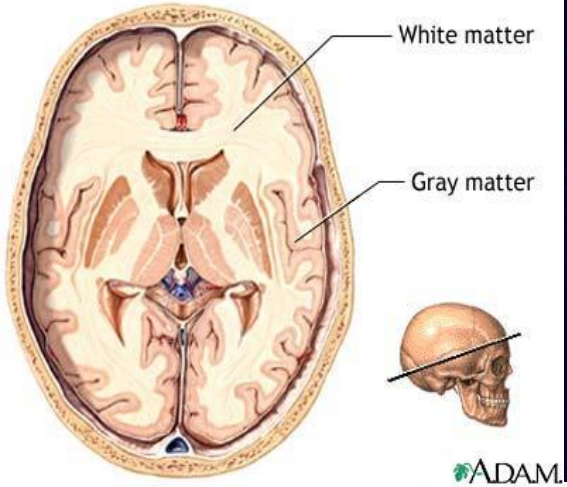
Changes in Brain Activity Following Reading Intervention in Adults with Developmental Dyslexia
(Eden et al., Neuron, 2004)



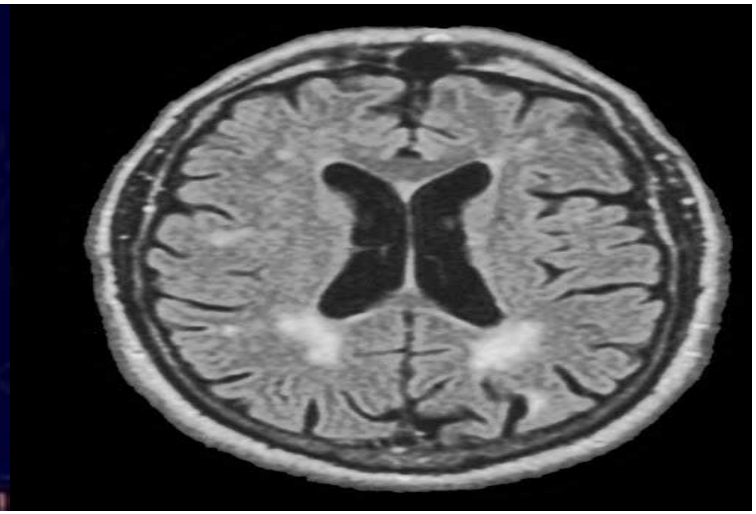


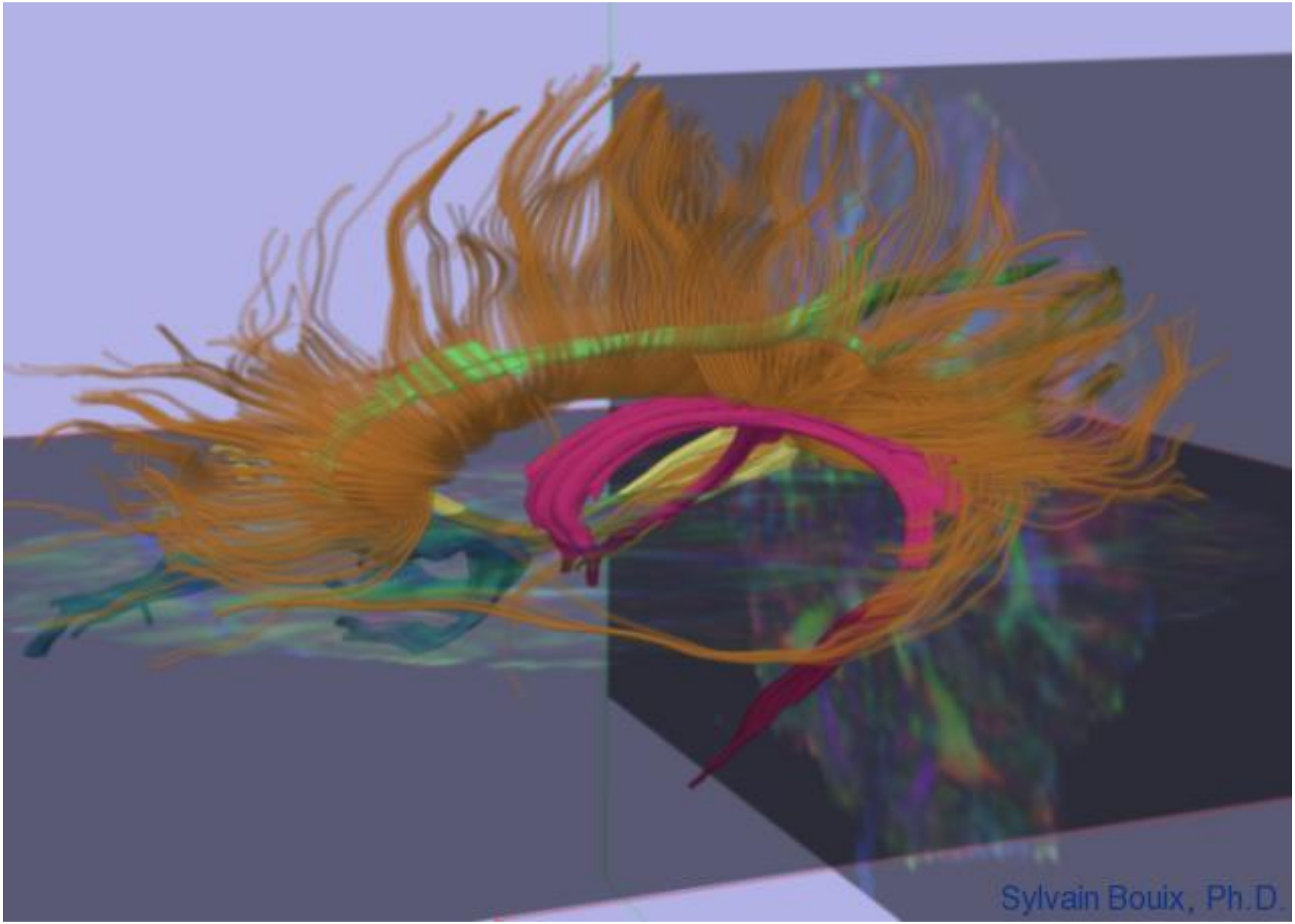
Application of Neuroimaging Modalities and Protocols to Reading and Reading Disabilities

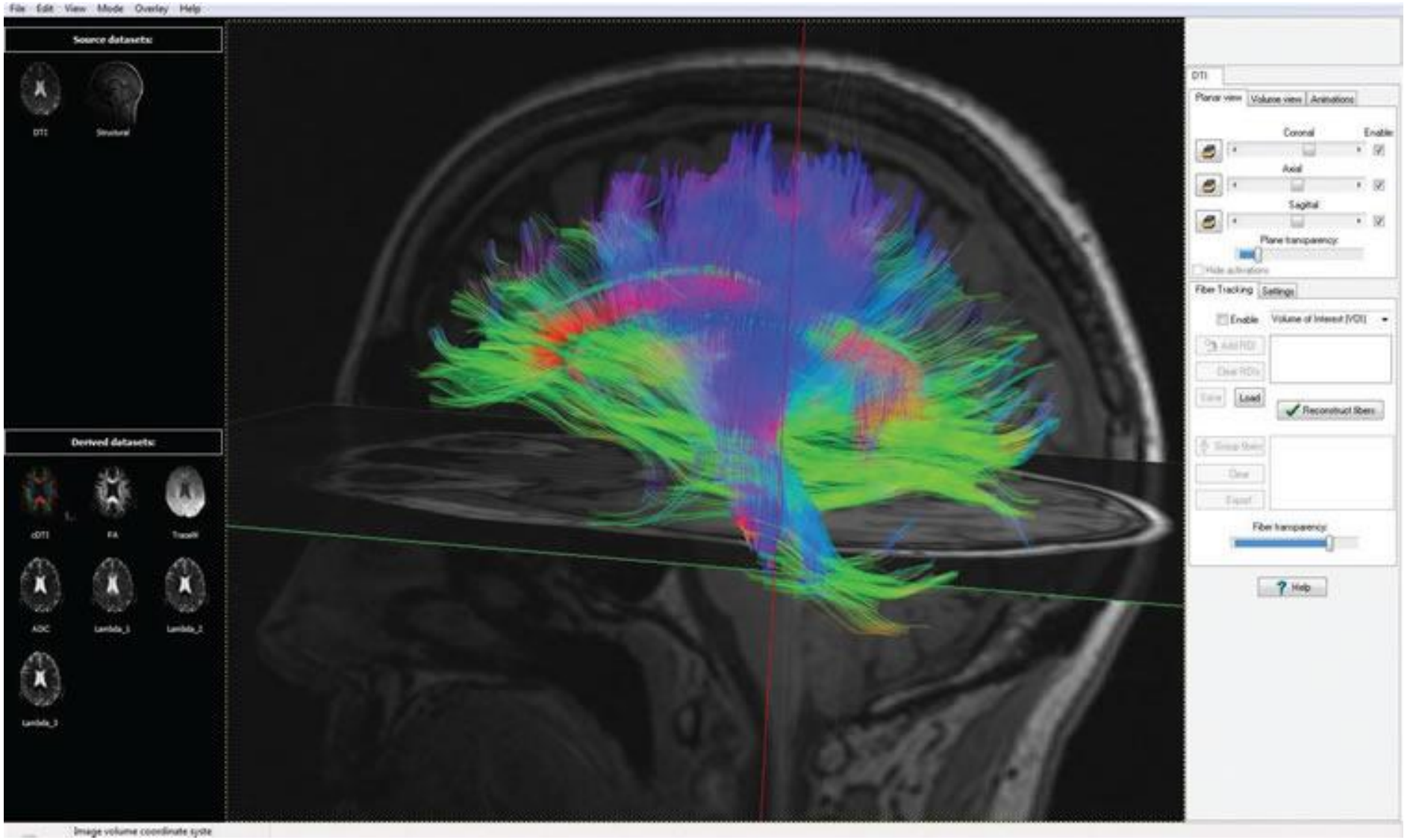
White Matter


White matter
Gray matter
A.D.A.M.

white matter
Coronal section




Sylvain Bouix, Ph.D.


File Edit View Mode Overlay Help
Source datasets:
DTI
Structural
Derived datasets:
cDTI
FA
Trace/W
ADC
Lambda_1
Lambda_2
Lambda_3
Image volume coordinate syste
DTI
Planar view
Volume view
Annotations
Coronal
Enable
Axial
Sagittal
Plane transparency:
Hide activations
Fiber Tracking
Settings
Enable
Volume of Interest (VOI)
Add ROI
Clear ROIs
Save
Load
Reconstruct fibers
Group fibers
Clear
Export
Fiber transparency:
Help

Genetics

Genetic Factors in Reading Disability

- Sites on chromosomes 1, 2, 6, 15, -6, and 15 replicated in 3-5 labs
- Little evidence for genes specific to poor reading – “generalist genes”
- 50-80% of the variability explained by genetic factors

Science, Policy, and Politics

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

Jean-Luc Picard

“Courage is the power to let go of the familiar.”

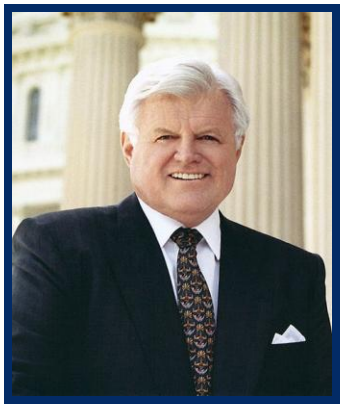
Raymond Lindquist

The Feds

W. Goodling

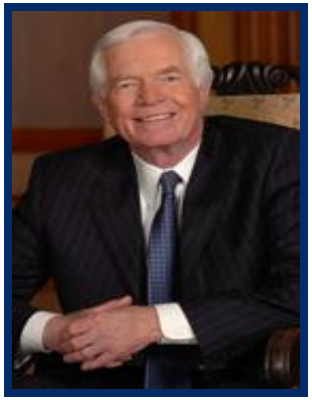
B. Clinton

E. Kennedy



A. Northup

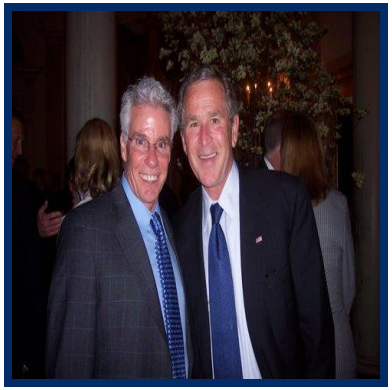
T. Cochran



R. Sweet

L. Bush-R. Lyon

POTUS-R. Lyon



Reid's Daily Rounds (2002-2005)

NIH

I am so tired of the #!@**)# metro ↔ Congress

↕ ↔The White House ↕

↕ ↔ HHS

↕ ↔ Dept. Of Ed ↕

Congressional, NICHD, and DoED Collaborative Initiatives

- Reading Excellence Act (1998)
- NRC Report on Beginning Reading (1998)
- National Reading Panel Report (2000)
- Reading First Legislation (2001)
- Partnership for Reading (2001)
- What Works Clearing House (2001)
- NRC Report on Scientific Research in Education (2002)
- Education Sciences Reform Act – IES (2002)

“It is not the critic who counts: not the man who points out how the strong man stumbles or how the doer of deeds could have done better. The credit belongs to the man who is actually in the arena, whose face is marred by dust and sweat and blood, because there is no effort without error of shortcoming, but who knows the great enthusiasms, the great devotions, who spends himself for a worth cause; who, at the best, knows, in the end, the triumph of high achievement, and who at the worst, if he falls, at least hje falls while daring greatly, so that his place shall never be with those cold and timid souls who neither victory or defeat”.

Theodore Roosevelt
April, 1910

Moving Forward

“We are not where we want to be,

We are not where we are going to be,

But we are not where we were.”

-Rosa Parks

Questions?

- Thank You for your attention!
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  Distinguished Scholar in Neuroscience and Cognition
  Center for Brain Health, UT Dallas
- www.reidlyon.com