TEXAS CENTER for LEARNING DISABILITIES

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The Texas Center for Learning Disabilities (TCLD) investigates the classification, early intervention, and remediation of learning disabilities.

Texas Center *for* Learning Disabilities

Understanding Dyslexia: A Scientific Approach to Reading and Reading Disabilities

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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

- Dyslexia has specific cognitive correlates that predict as part of early screening (letter sounds and naming, phonological awareness); these skills don't need to be routinely assessed after Grade 2

- Many children eventually identified with dyslexia can be taught to read with early identification and explicit, comprehensive reading instruction

- Remediation of dyslexia after Grade 3 requires high intensity and a comprehensive, differentiated approach to reading instruction

- We know lots about brain function and the heredity of dyslexia

Things we don't know

- How many people have dyslexia

- How to scale effective identification and intervention and translate what's known from science

- The level of intensity required to remediate dyslexia

- How to use the research on brain function and heredity to identify and intervene with LDs (no brain or genetic tests or interventions)

- How to get policy makers to stay the course and follow science as a basis for decision making in education and child development

Misunderstandings About Dyslexia

- Definition and Prevalence

- Role of IQ

- Specificity

- Effective Interventions

- Methods of Service Delivery

- Brain Structure and Function

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

- Cannot be effectively addressed solely by special education or as a remedial problem

IDA DEFINITION OF DYSLEXIA

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
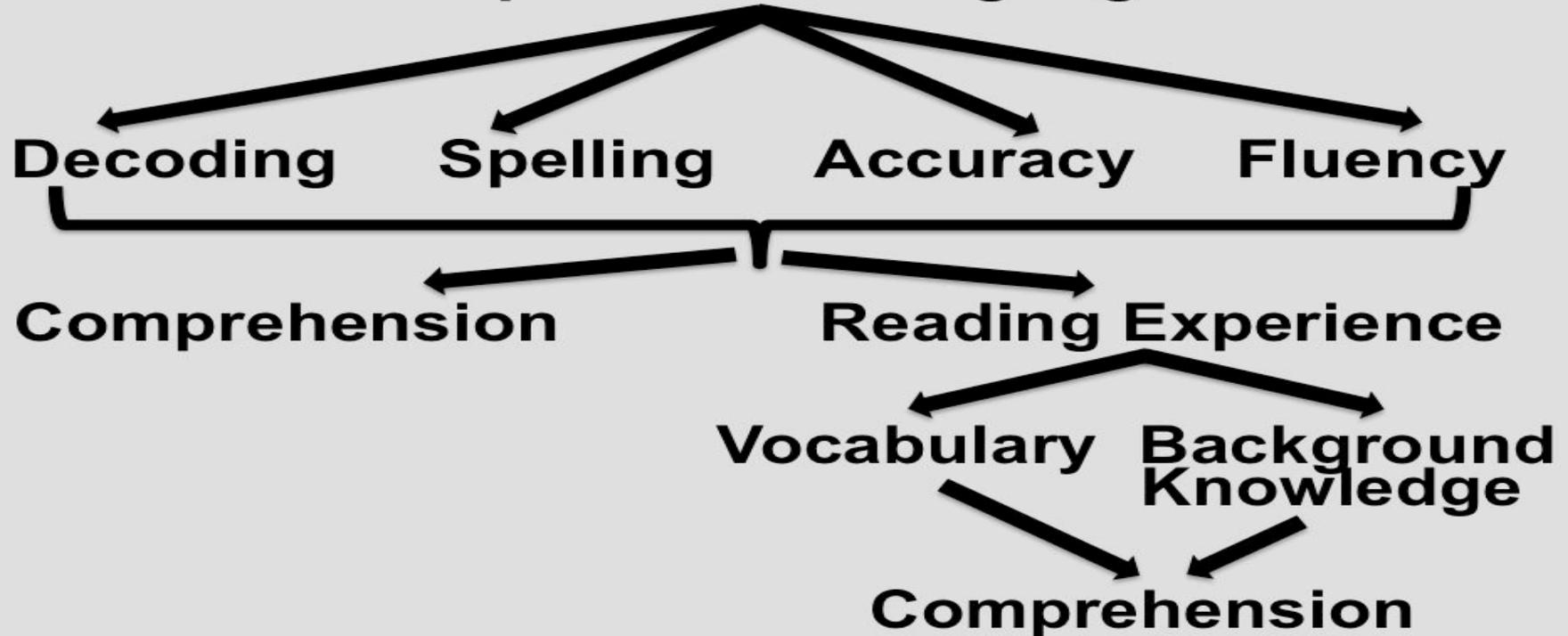
Is a New Definition Needed?

- Thirty well-known researchers and practitioners took part in the discussion: "no compelling reason to change the definition of dyslexia. The definition remains meaningful for research and for practice. It includes inclusionary criteria, which is critical. It does not specify operational criteria, which is impossible (i.e., thresholds for severity or eligibility). There should be no equating of dyslexia as a diagnosis and eligibility for special education because there must be a demonstration of educational need."

- A diagnosis of dyslexia does not mandate eligibility for special-education services. Depending on severity, a student with dyslexia may be appropriately served in general education or may require special education services. Dickman, IDA Examiner, March, 2017

This Definition Works!

2002 DYSLEXIA DEFINITION

Deficit in the Phonological
Component of Language

Decoding   Spelling   Accuracy   Fluency

Comprehension   Reading Experience

Vocabulary   Background Knowledge

Comprehension

DSM-V Criteria SLD

- Must show <u>all</u> of the following (based on consistent evidence from historical data, real life, and test scores):

1. Persistent difficulties in learning & using academic skills

2. Affected skills are substantially and quantifiably below age (and significantly interfere with major life activities relative to the average person)

3. Onset is in the early school years, although may become more fully expressed as child progresses through elementary school.

 * Specifically notes that *"learning difficulties persist despite provision of targeted classroom instruction"*

DSM-V Criteria

4. Exclusionary criteria. Not better accounted for by:

- Intellectual disability

- Global developmental delay

- Vision or hearing problems

- Other mental/neurological disorders

- Psychosocial adversity

- ESL/FSL

- Inadequate education

DSM-V Criteria

- Descriptive Feature Specifiers
    - Specify from which academic domain(s) the subskills are impaired AT TIME OF ASSESSMENT

Reading

Word reading accuracy (dyslexia, a disorder at the level of the single word that affects accuracy and fluency of decoding and encoding (spelling)

Fluency

Reading comprehension

Written Expression

Spelling

Grammar & punctuation

Clarity or organization

Mathematics

Memorization or recall of arithmetic facts

Accurate or fluent calculation

Math reasoning

Important Research Findings

1. Dyslexia occurs primarily at the level of the single word and involves the ability to decode and spell printed words in isolation. It leads to problems reading text, but is not a text level disability.

What is Dyslexia ?

All disabilities have biological and social realities that vary with "disorder" and "person"

Dyslexia is a dimensional disorder- the attributes are variations on normal development

Model is obesity or hypertension, not measles and mumps

Essential aspect is "unexpected underachievement"

How LD is Identified and Treated Depends on the Conceptual Model for Unexpected Underachievement

- Neurological: *"Disorder of constitutional origin"': special signs*

- Cognitive Discrepancy:

  - IQ-achievement discrepancy: cognitive discrepancy

  - Processing strengths and weaknesses: cognitive discrepancy

- Instructional Discrepancy

  - Low achievement: age-based discrepancy

  - Instructional response: intractability, persistence

Important Research Findings

2. Single word decoding problems in reading are strongly associated with problems segmenting words and syllables into phonemes, but phonological awareness has multiple causes (Pennington, 2006; multiple deficit model).

Alphabetic Principle

- Print represents speech through the alphabet or other visual symbol

- Words are composed of internal units based on sound called "phonemes"

- In learning to read, the child makes explicit an implicit understanding that words have internal structures linked to sounds (phonological awareness)

- Word reading also involves unlocking language from vision (orthographic processing)

Important Research Findings

3. Dyslexia occurs as part of a natural, unbroken continuum of ability-- what causes good reading also causes poor reading (Shaywitz et al., 1992).

We only need one theory to explain success and failure in reading.

How to get to 1 in 5

- Low achievement definition: 25th percentile and/or

- 1.5 SE regression-based discrepancy relative to IQ

- Get a sample with average reading and IQ scores about 110, so only 17.4% and not 33%

Prevalence of dyslexia?

- Most estimates are 3-7% (Pennington & Petersen, 2012); often assume effective intervention, exclusions, no comorbidity, but thresholds arbitrary

- Snowling and Melby-Lervag (2015) meta-analysis of genetically sensitive designs:

+ family risk < 10th %tile (34%); > 10th %tile (53%); about 45% overall

-family history <10th %tile (11%); > 10th (16%)

Important Research Findings

4. Dyslexia is best identified through domain-specific assessments of reading and reading-related skills (i.e., achievement and instructional response).

   IQ tests are not necessary and models for identification of LD based on IQ-discrepancy or patterns of cognitive strengths and weaknesses lack validity.

Achievement Markers and Processing Correlates

- Word Recognition (Real Words, Pseudowords)

- Phonological Processing: Phonological Awareness, Rapid Naming, Verbal Short- Term Memory

- Cognitive skills are precursors and important to assess in KG and grade 1 for screening; questionable after that point and do not lead to more reliable identification or improved intervention outcomes. By grade 2, best screener is word reading

Important Research Findings

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**

  - *Connecticut Longitudinal Project-* Shaywitz et al., Pediatrics, 1999

Francis et al. (1996)
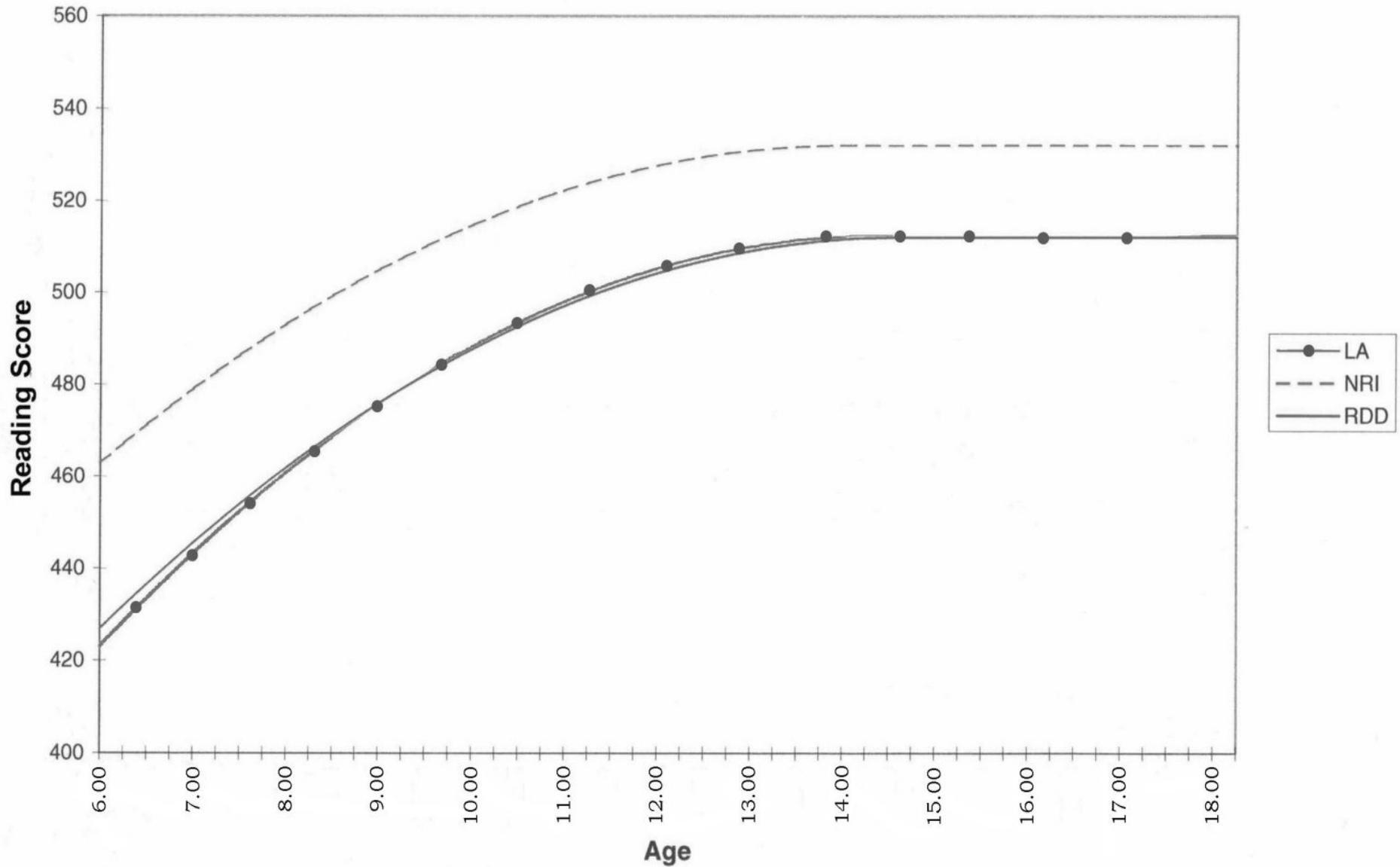
Important Research Findings

6. **Children with dyslexia have problems outside phonology (Willcutt et al.)**

- *Comorbidity*- academics, ADHD, oral language

- Word recognition not the only type of RD

Specificity

- Dyslexia is real; IDA consensus definition is narrow

- Dyslexia is often part of a complex presentation; generalist genes affect multiple LDs and ADHD (Plomin & Kovacs, 2005))

- 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

Important Research Findings

7. Causes of Dyslexia & Poor Reading

- **Neurobiological**

- **Familial, including heredity**

- **Economic disadvantage**

- **Instructional**

Dyslexia, Reading, and and Neural Plasticity

- Reading is not a natural process and is not constructed as a result of simple exposure to language or words (Liberman)

- Good reading instruction is always brain-based and involved in the development of reading proficiency and in dyslexia

- The process of learning to read *rewrites* the organization of the brain (Eden), which varies depending on the structure and transparency of the language (Zigler)

- Strong understanding of neural systems, which are malleable and mostly normalizing

- Field has moved away from "bad- gene, bad brain" theory to the idea of genes that make brains at risk and risk is modified by environment

- No simple biological test for LD, but biology is not destiny

Dual Route Theory

- Ventral (stipulated or addressed) route: lexical, directly from word form to pronunciation

-look up in a mental dictionary of sight words

- Dorsal (assembled) route: sublexical, must access phonological representation and identify substituent parts (indirect)

- Operate in parallel depending on properties of the words

Dorsal vs. ventral pathways
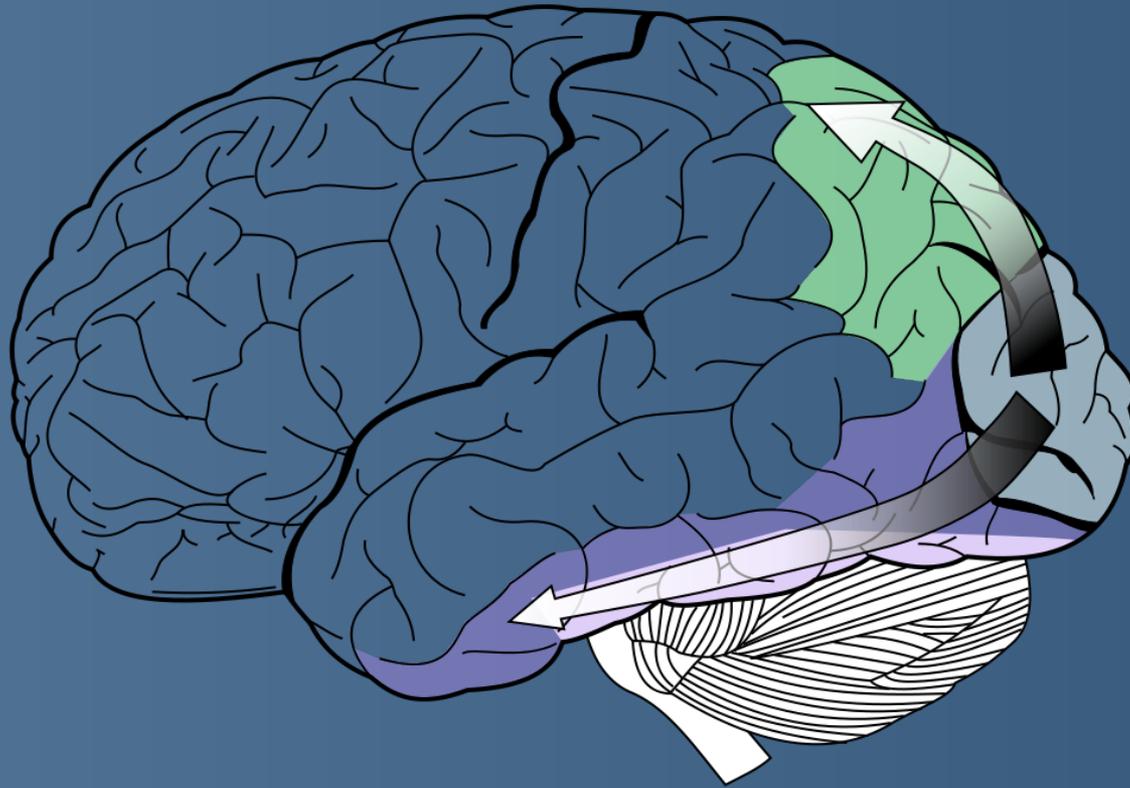
Learning to read consists in:
- creating an **invariant visual representation** of written words
- **connecting it** to brain areas coding for **sound** and **meaning**

Access to pronunciation and articulation

Top-down attention and serial reading

Visual inputs

Access to meaning

Visual word form area (the brain's letterbox)
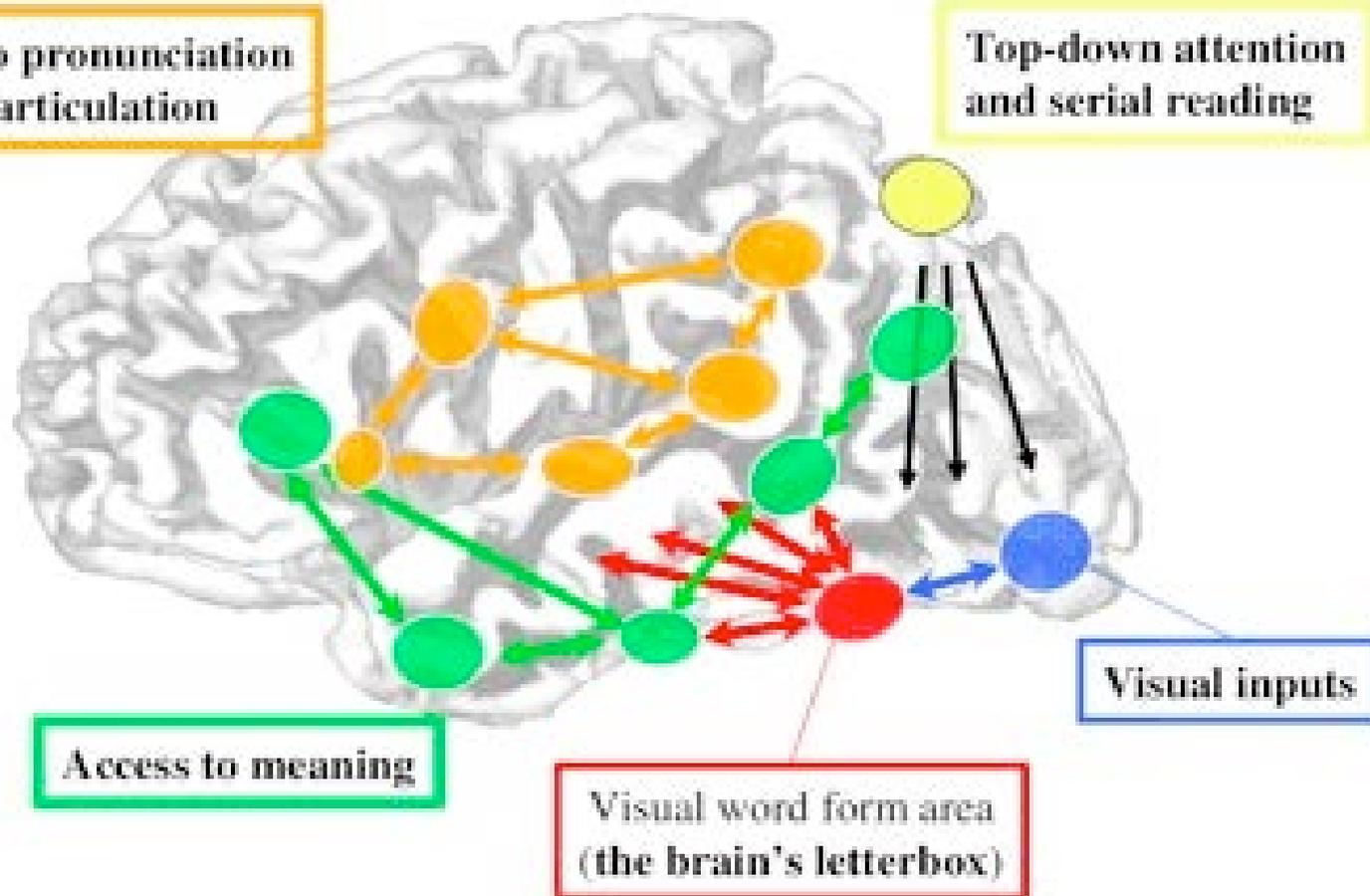
Functional and Structural Neuroimaging

Brain Function in Dyslexia (Simos et al., 2001; Pseudowords)
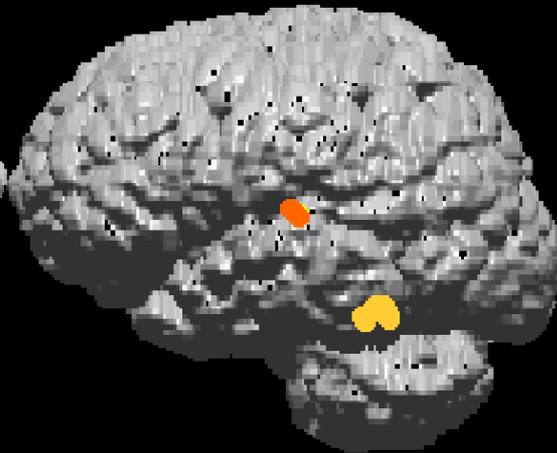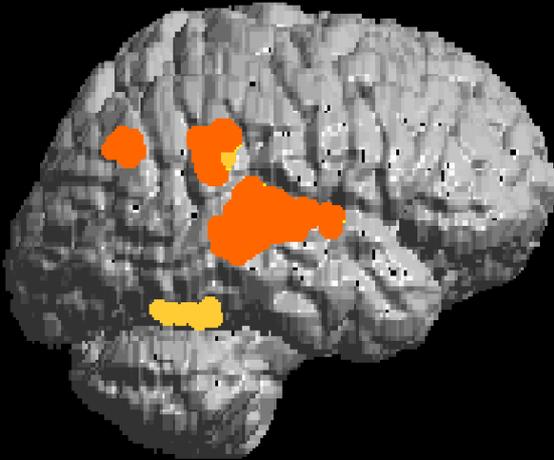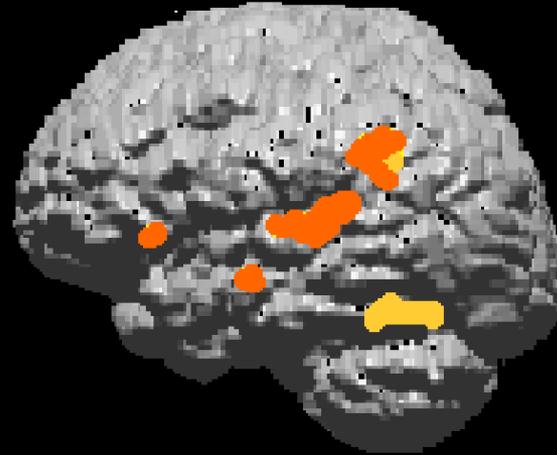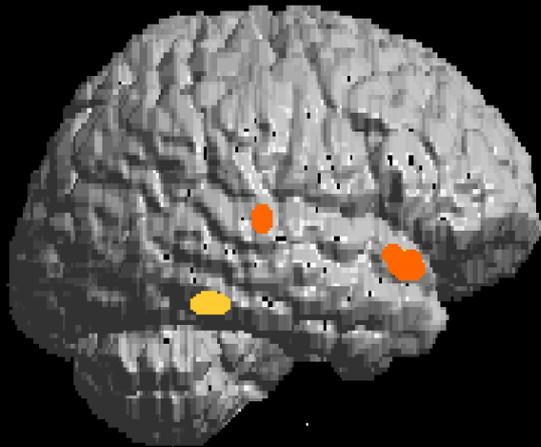
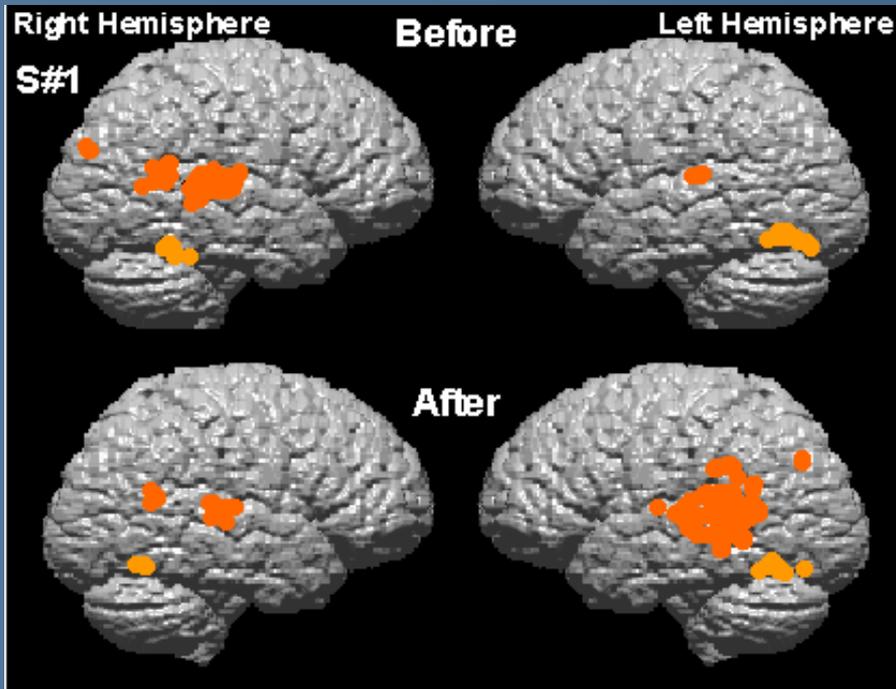# Neural Response to Intensive Intervention

Does the pattern of brain activation change in response to intervention?

8 children with severe dyslexia

8 week intense phonologically- based intervention (2 hours a day= up to 80 hours of instruction)

Simos et al., *Neurology*, 2002

Neural response to intervention; (Pseudoword Task; Simos et al., 2002)
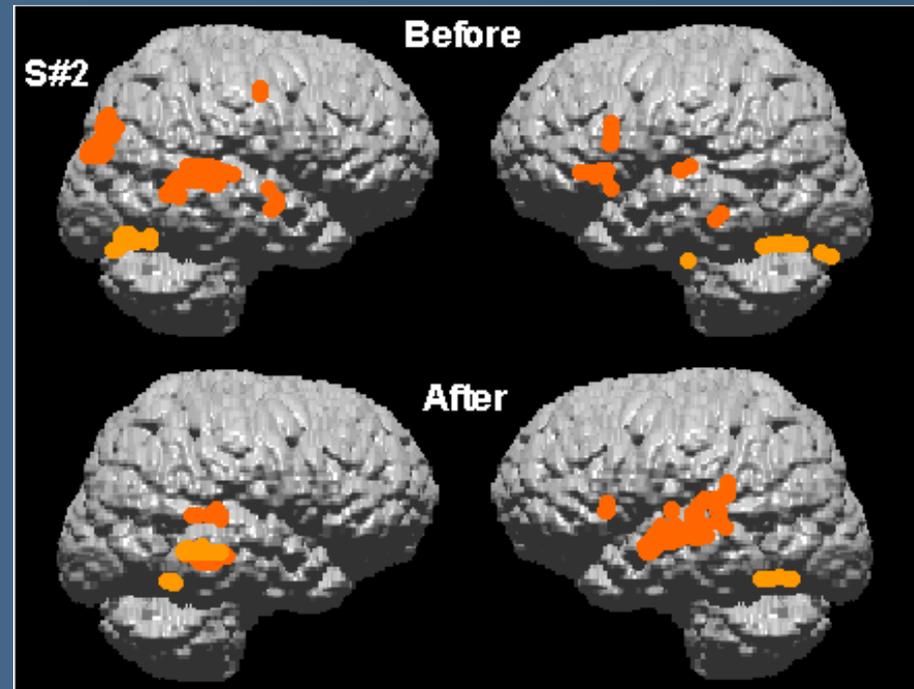
Genetic Factors in Reading Disability (Colorado LDRC)

- Reading, math, and writing are heritable traits, but individual gene effects small

- Little evidence for genes specific to poor reading

- 9 candidate genes: chromosomes 1, 2, 6, 15; 6 and 15 replicated in 2- 5 labs

- 50- 70% of the variability explained by genetic factors, but increases with age (Olson)

Important Research Findings

**8.** *Instructional factors are underestimated*

- **Skills that prevent dyslexia and poor reading can be taught- must be taught early**

- **Some children placed in special education are instructional casualties because they did not get the instruction they needed**

- **Dyslexia should not be identified in the absence of adequate reading instruction and should be a persistent problem**

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Effective Intervention

- Teach phonological awareness and phonics EXPLICITLY with an approach that includes comprehension and fluency components (NRP about explicitness, not phonics)

- Prevent word recognition problems because remediation is difficult and requires considerable intensity, especially for automaticity

- Older students and adults can be taught word recognition if the approach is sufficiently intense. Fluency more difficult.

- No "dyslexia specificity" of appropriate interventions. Traditional service delivery models ineffective

Change in Reading Skill for Children with Reading Disabilities who Experience Growth in Reading of .04 Standard Deviations a Year
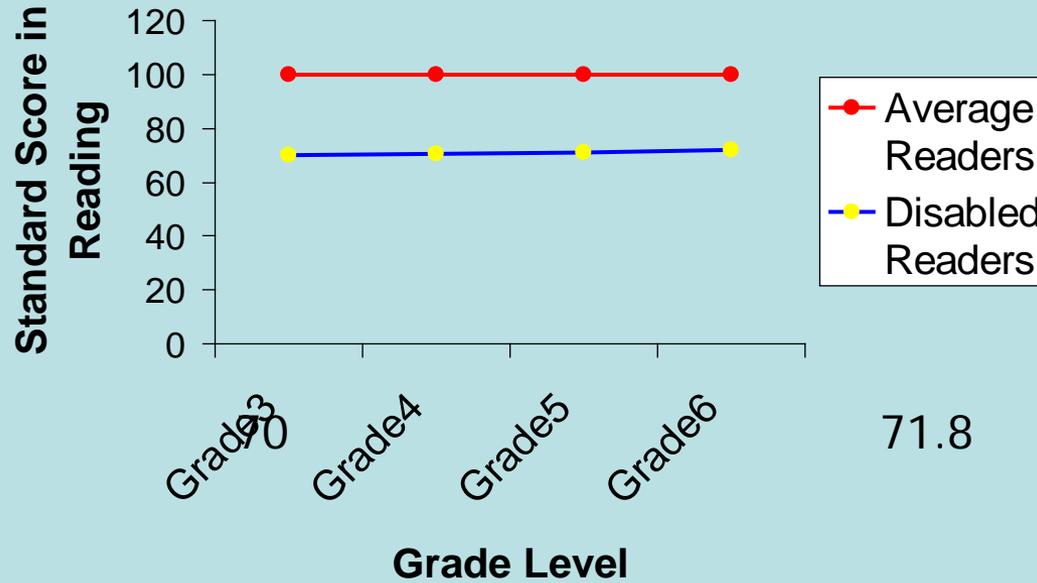
Growth in Total Reading Skill Before, During, and Following Intensive Intervention
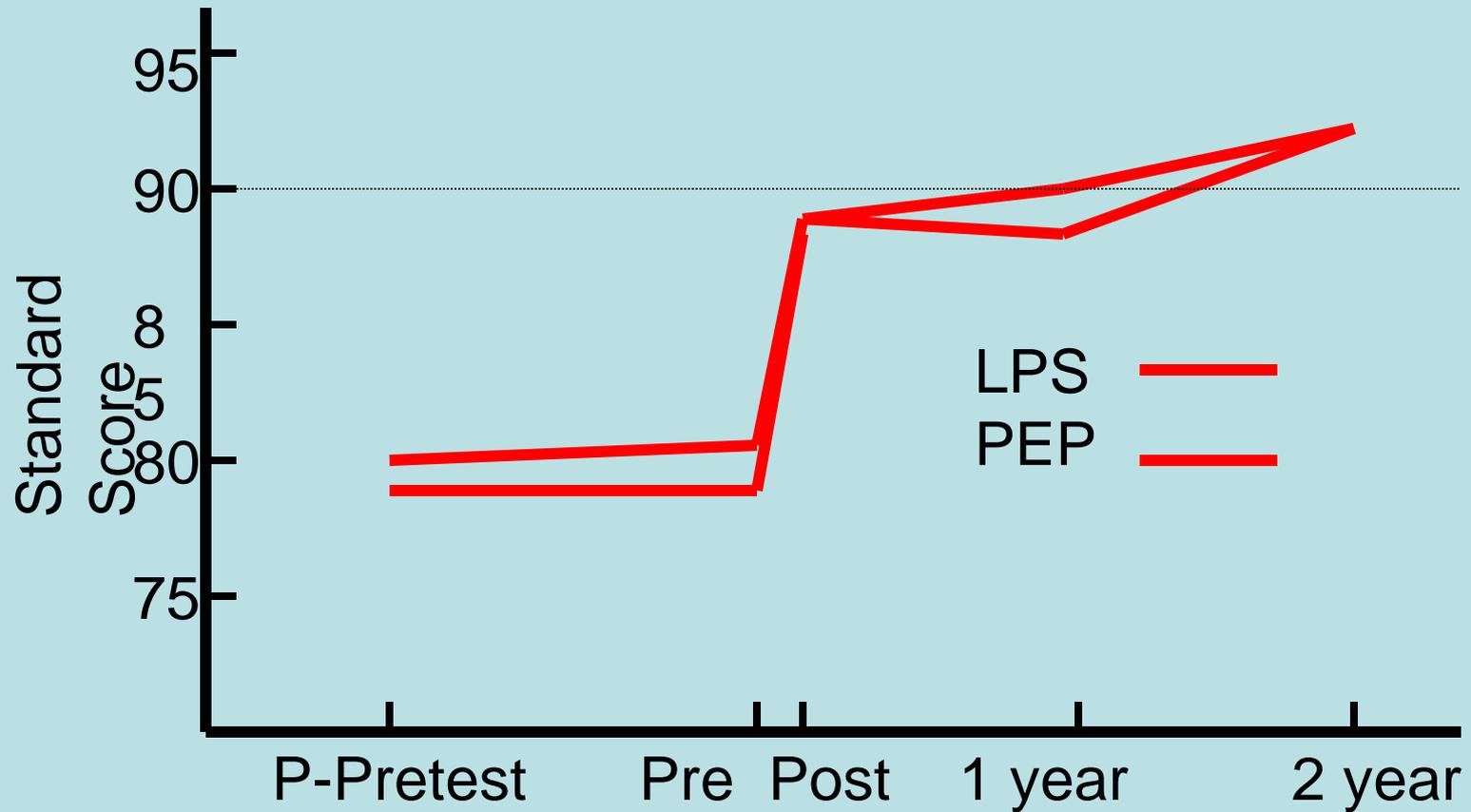
Torgesen et al., 2001

Time x Activity Analyses for the Two Intervention Approaches

	LIPS	EP
Phonemic Awareness and Phonemic Decoding	85%	20%
Sight Word Instruction	10%	30%
Reading or writing connected text	5%	50%

Reading rate remained quite impaired

Standard Score

100

90

80

70

Accuracy-91

Rate-72

Pretest
year

Posttest

1-year

2-
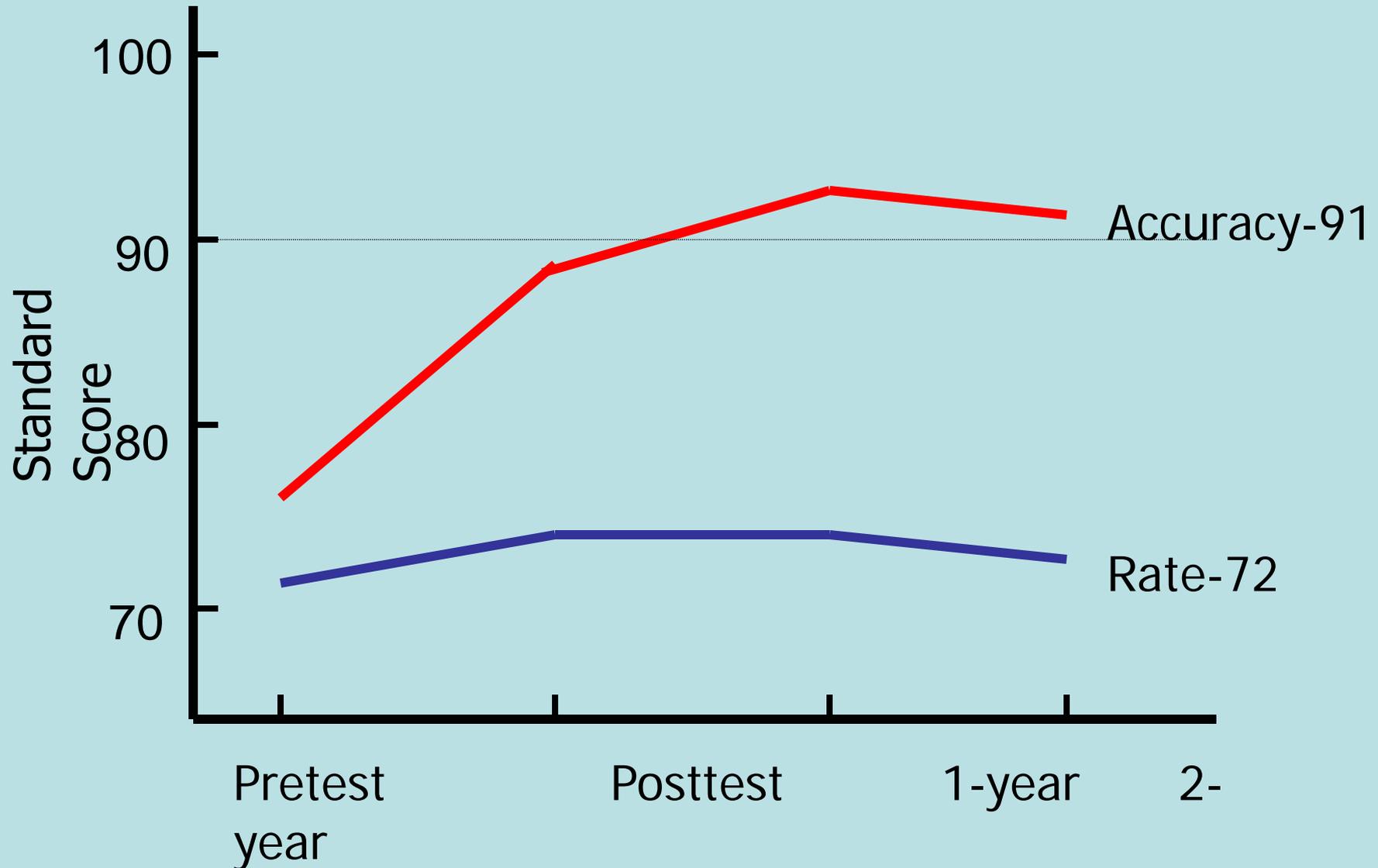
Remediation is not a solution!

Reading rate is limited because the proportion of words in grade level passages that children can read "by sight" is less than for average readers.

How do you close the gap when the student is already 3- 5 years behind?

Some Questions?

- Why take young students who are struggling out of the classroom environment, especially in elementary school, when they need more time on task?

- Why not use additional instructional opportunities to supplement and differentiate instruction?

- How can we know who is disabled in the absence of adequate opportunity to learn?

- Why not integrate classroom and remedial instruction, and use response to instruction to determine level of intensity and degree of differentiation?

Linking Prevention and Remediation: A 3-Tier MTSS Framework

If progress is inadequate, move to next level.

Tier 1: Primary Intervention

Enhanced general education classroom instruction for all students.
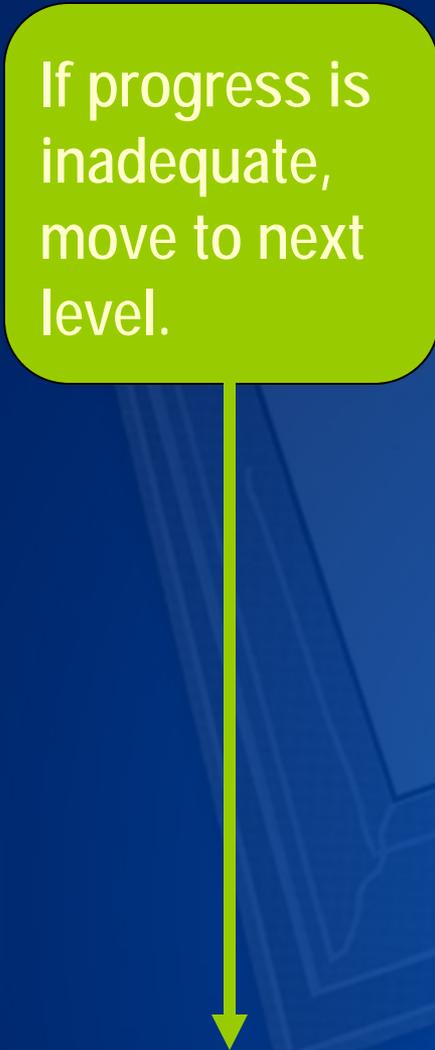
Tier 2: Secondary Intervention

More intense intervention in general education, usually in small groups.

Tier 3: Tertiary Intervention .

Intervention increases in intensity and duration. Child could be considered for special education

Content: 1998 NRC Report 2000 NRP Report

- **Consensus documents**

- **Instruction can prevent reading difficulties**

- **Emphasized integration of:**

  - Explicit alphabetic instruction: *word recognition*

  - Reading for meaning: *comprehension*

  - Active engagement: *fluency*

In an integrated, comprehensive approach to reading instruction

# Connor: Tier 1 best practices differentiate instruction

- **Code vs. meaning-focused instruction *interacts* with child characteristics:** providing more code- focused instruction for students weak in word reading and more meaning-focused instruction to students weak in vocabulary/comprehension resulted in significantly higher reading comprehension scores compared to controls. Accumulates in Grades 1-3

Connor et al., *Science*, 2007, 315, 464-5.

Reading Instruction Must be Integrated from KG- G12

- If a critical component is missing, students who at risk will not develop the component

- Success and failure in reading are opposite sides of the same coin- it's the same theory, not two theories, one for success and another for failure

- Instruction is the key, but not all students respond to quality instruction
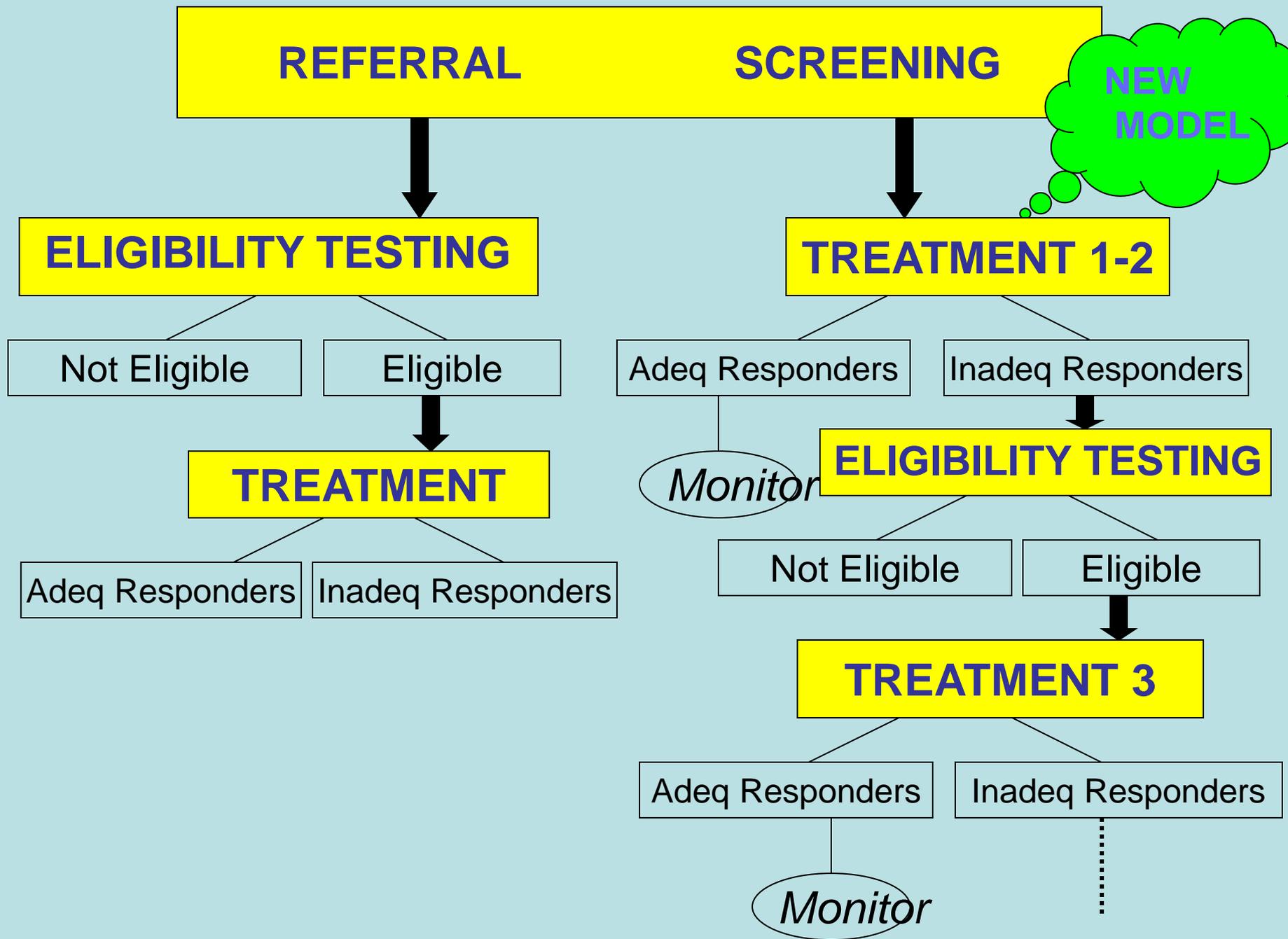
LD Summit: Hybrid Method (Triangle Approach) to Identification (Bradley et al., 2002)

1. Establish Low Achievement

2. Evaluate Response to Instruction (Is underachievement expected?)

3. Apply the Exclusions

What is the validity of this hypothetical classification? (Low achievement is necessary, but not sufficient).

- www.air.org/ldsummit

Can We "Psychometrize" Individual Identifications of LD? Not a New Question!

"Even though the psychometric difficulties may never be completely resolved, classification systems should at least be based on a coherent psychology of helping...there is no shortage of children who experience problems...Assessments and classifications can be guided by principles of intervention design with *expected errors of judgment* and measurement partially moderated through a recursive {sequential} system of recursive and empirical practices... (Macmann et al., 1988, p. 146)

- *Extensive testing does not increase accuracy of diagnosis: Treat and test, not test and treat; reduce false negative errors*
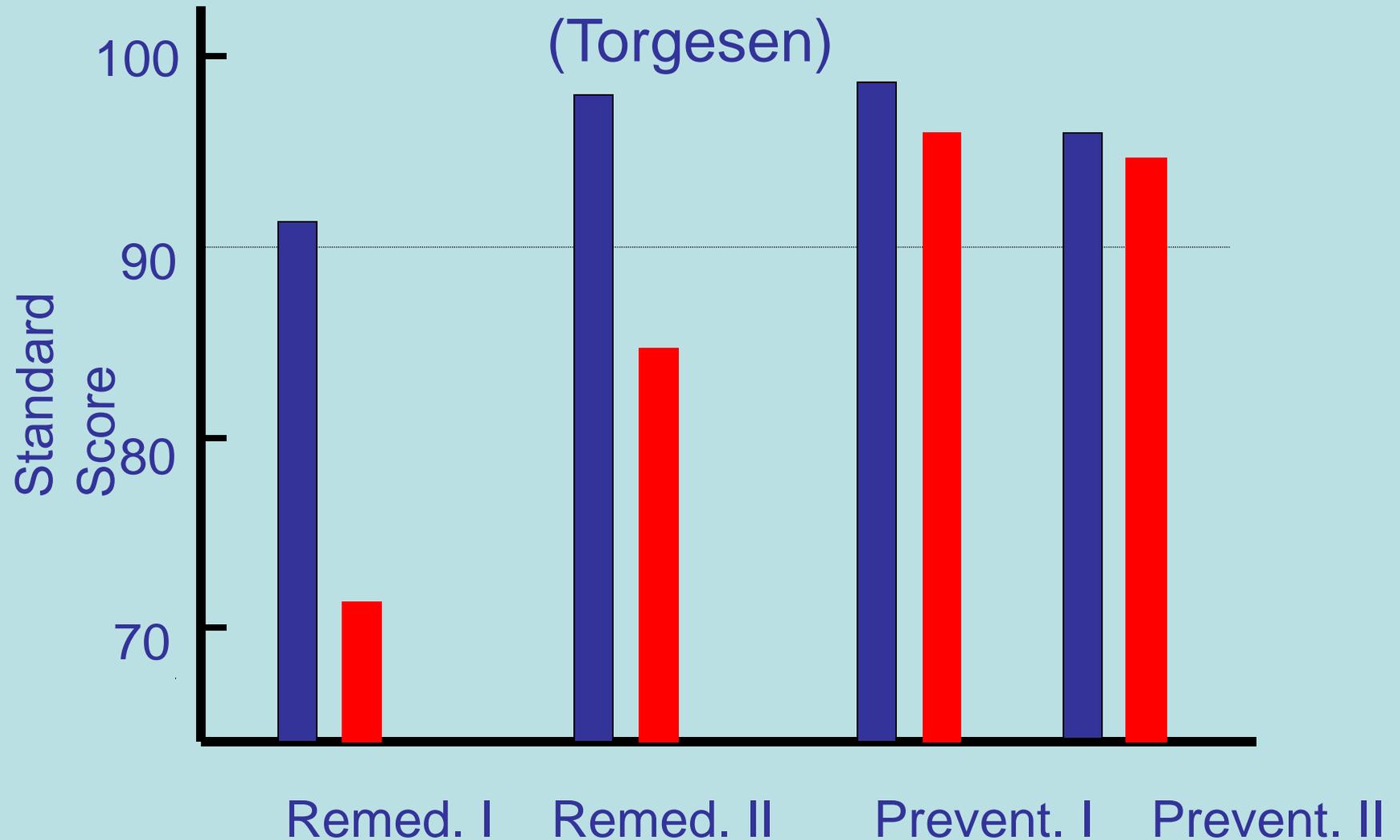
Early Intervention is Clearly Effective

➢ **Prevention studies commonly show that 70- 90% of at risk children (bottom 20%) in K- 2 can learn to read in average range. Prevent automaticity problems.**
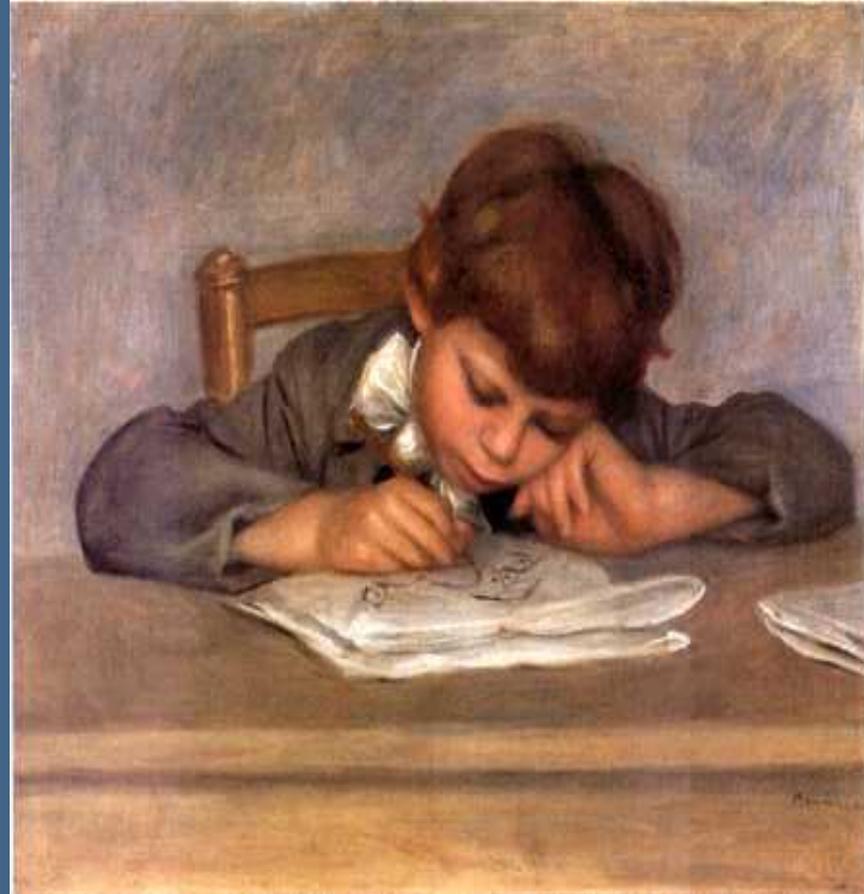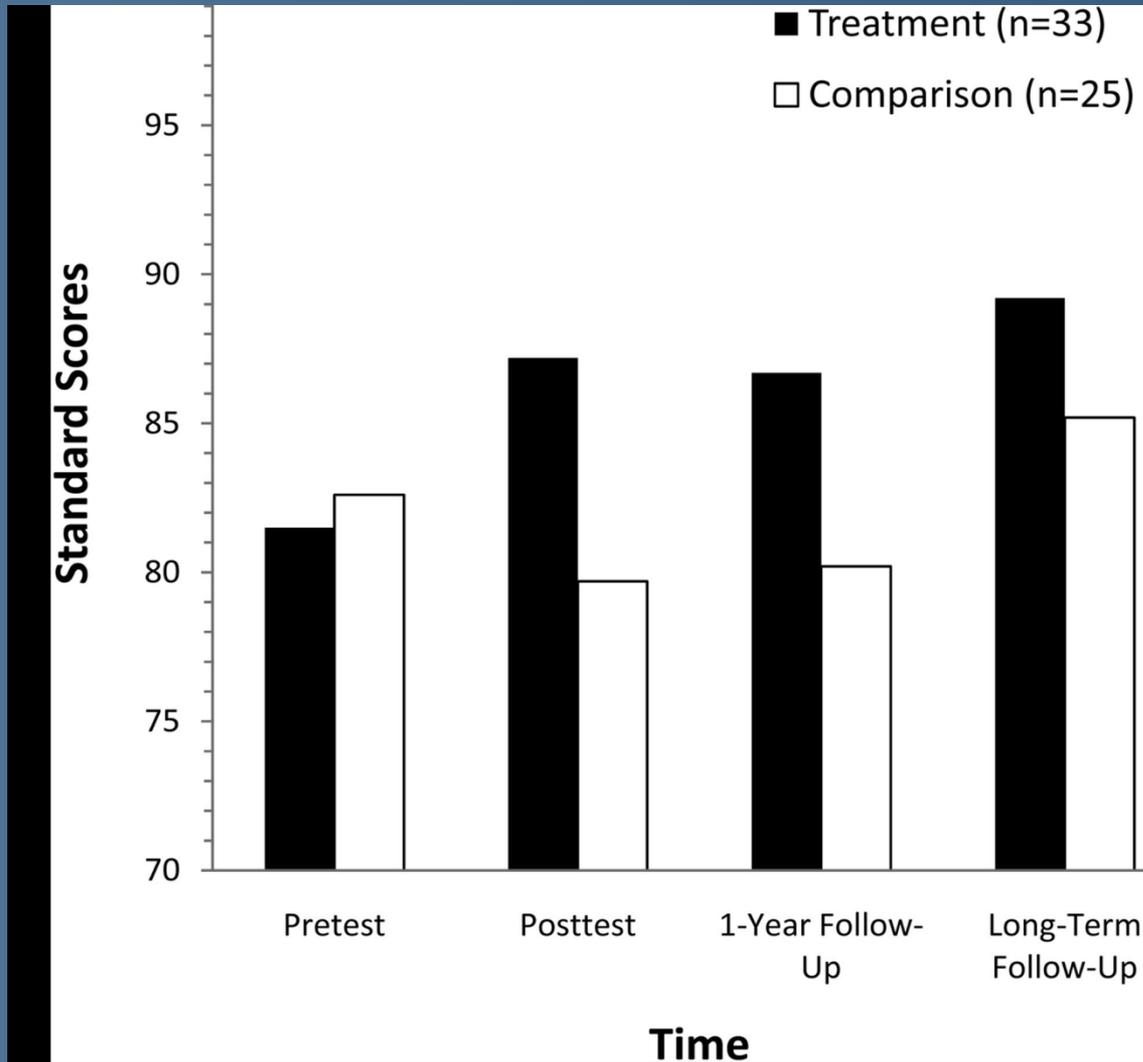
Differences in outcomes for Basic Reading Skills and Rate in Prevention vs. Remediation Studies (Torgesen)
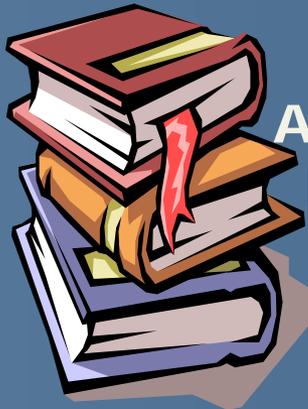
Persistence: Blachman et al., 2014: 10 Year Follow-up

Early Development of Reading Skills: A Cognitive Neuroscience Approach (Jack M. Fletcher – PI) : Grade I Multi-tiered Intervention

Patricia Mathes and Carolyn Denton - P1: Early Reading Intervention (Mathes et al., RRQ, 2005; Denton et al., 2006)*

Andrew Papanicolaou - P2:Brain Activation Patterns (Simos et al., Neuropsychology, 2005; JLD, 2007)

*Albert J. Harris award, IRA, 2006

The Interventions

Enhanced Classroom Instruction

- District provided extensive professional development and new materials

- All children identified as at-risk for principal, teachers, and parents

- Progress monitored with feedback to principal, teachers, and parents

Supplemental Instruction

- About 200 children also received an additional 40′ of daily small group instruction for 30 weeks

The Interventions

Enhanced Classroom Instruction (Comparison; typical practice)

- District provided extensive professional development and new materials

- All children identified as at-risk for principal, teachers, and parents

- Progress monitored with feedback to principal, teachers, and parents

- Some children tutored

Comparison of Pullout Interventions

- **Proactive/ Responsive**

- **40 minutes, 5 days per week, for 30 weeks**

- **1:3 teacher-student ratio**

- **Taught by certified teachers: school employees supervised and trained by our group**

- **Supplemented enhanced classroom instruction**

- Explicit instruction in synthetic phonics, with emphasis on fluency.

- Integrates decoding, fluency, and comprehension strategies.

- 100% decodable text

- Carefully constructed scope and sequence designed to prevent possible confusions.

- Every activity taught to 100% mastery everyday.

Responsive Intervention (Denton)

- Explicit instruction in synthetic phonics and in analogy phonics

- Teaches decoding, using the alphabetic principle, fluency, and comprehension strategies in the context of reading and writing

- No pre-determined scope and sequence

- Teachers respond to student needs as they are observed.
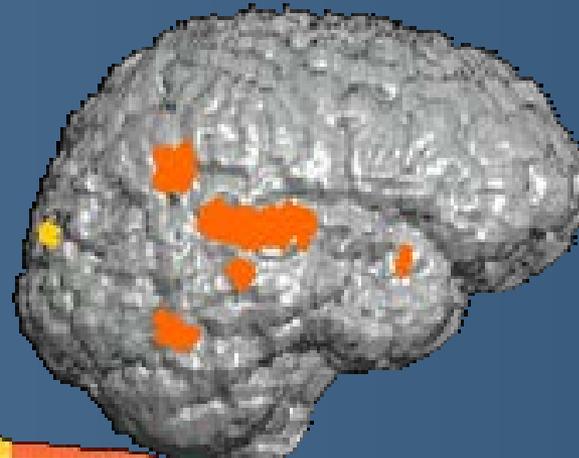
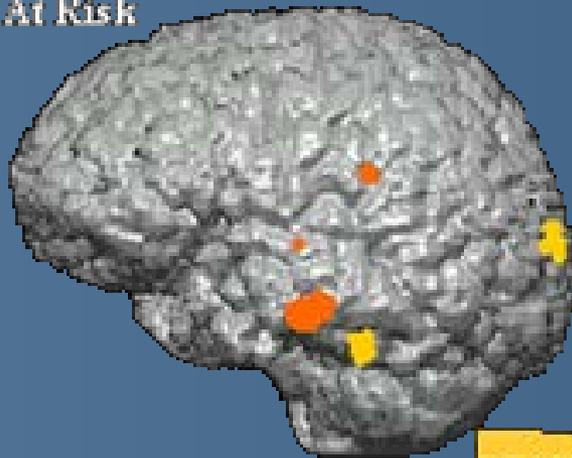- Leveled text not phonetically decodable
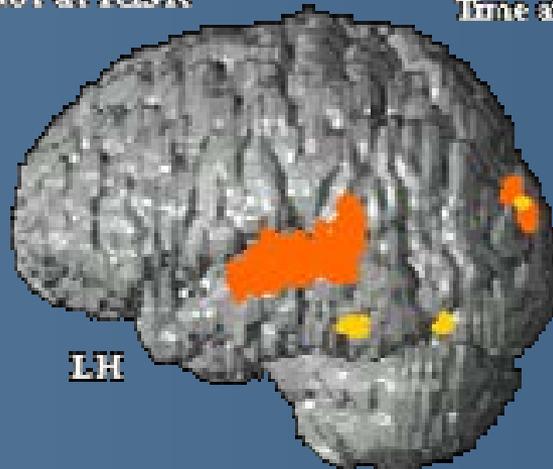
Growth in Fluency by Intervention
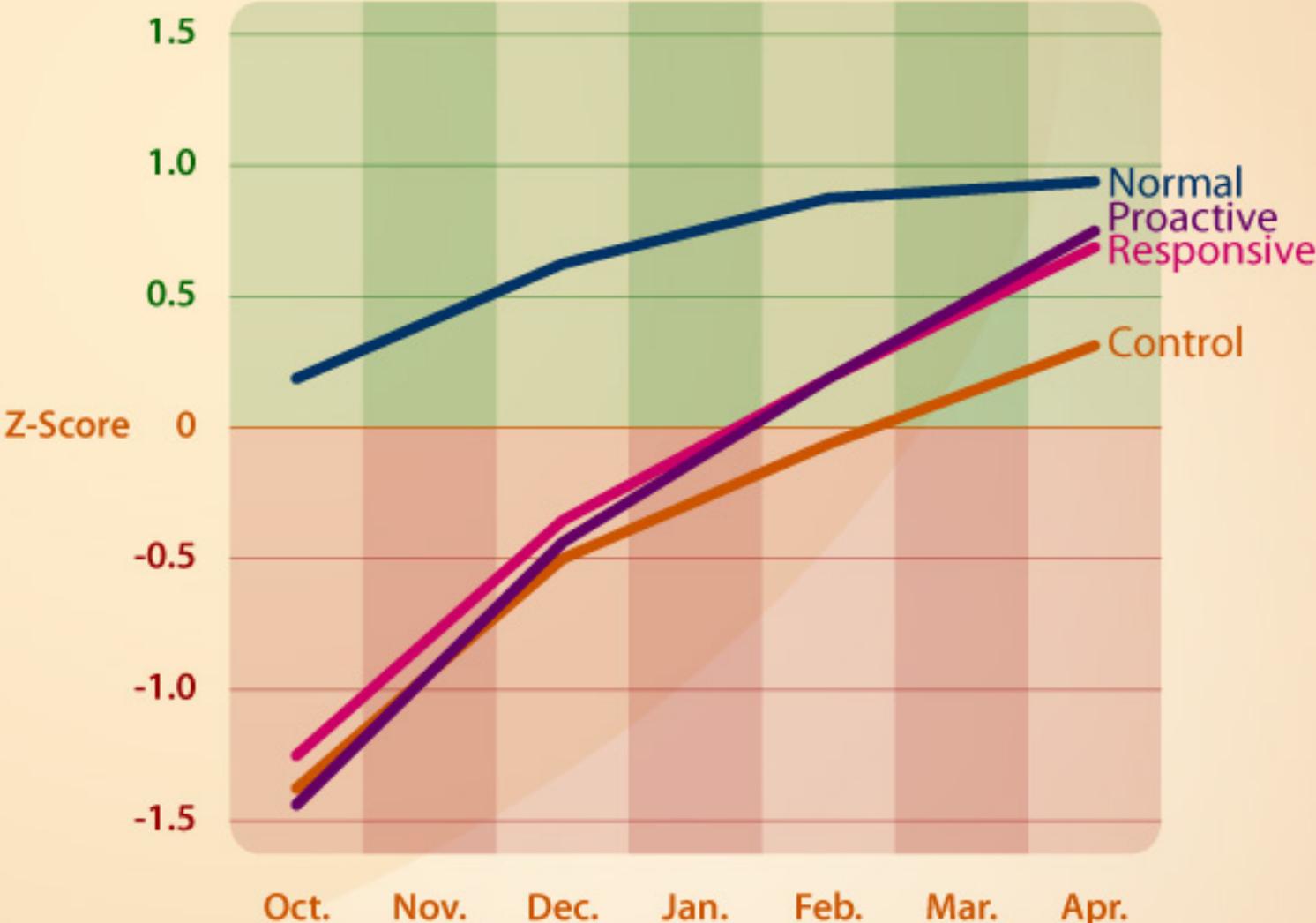
Early Detection of Aberrant Brain Activation Profiles for Reading (end K)

At Risk
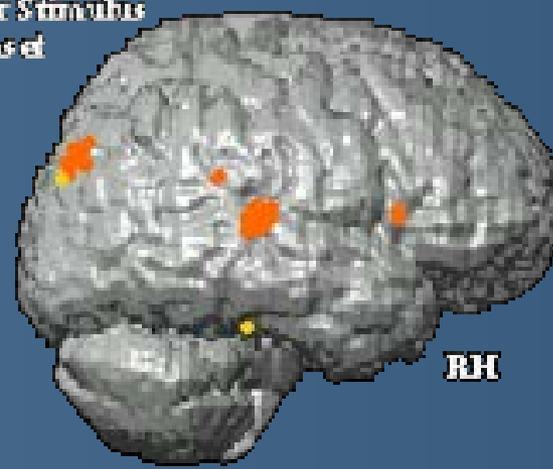
Not at Risk

150-300   300-1000 ms
Time after Stimulus Onset

LH

RH

N= 45 children 6 yrs old

Simos et al., J Child Neurol, 2002

What percentage of children don't respond adequately to quality intervention?
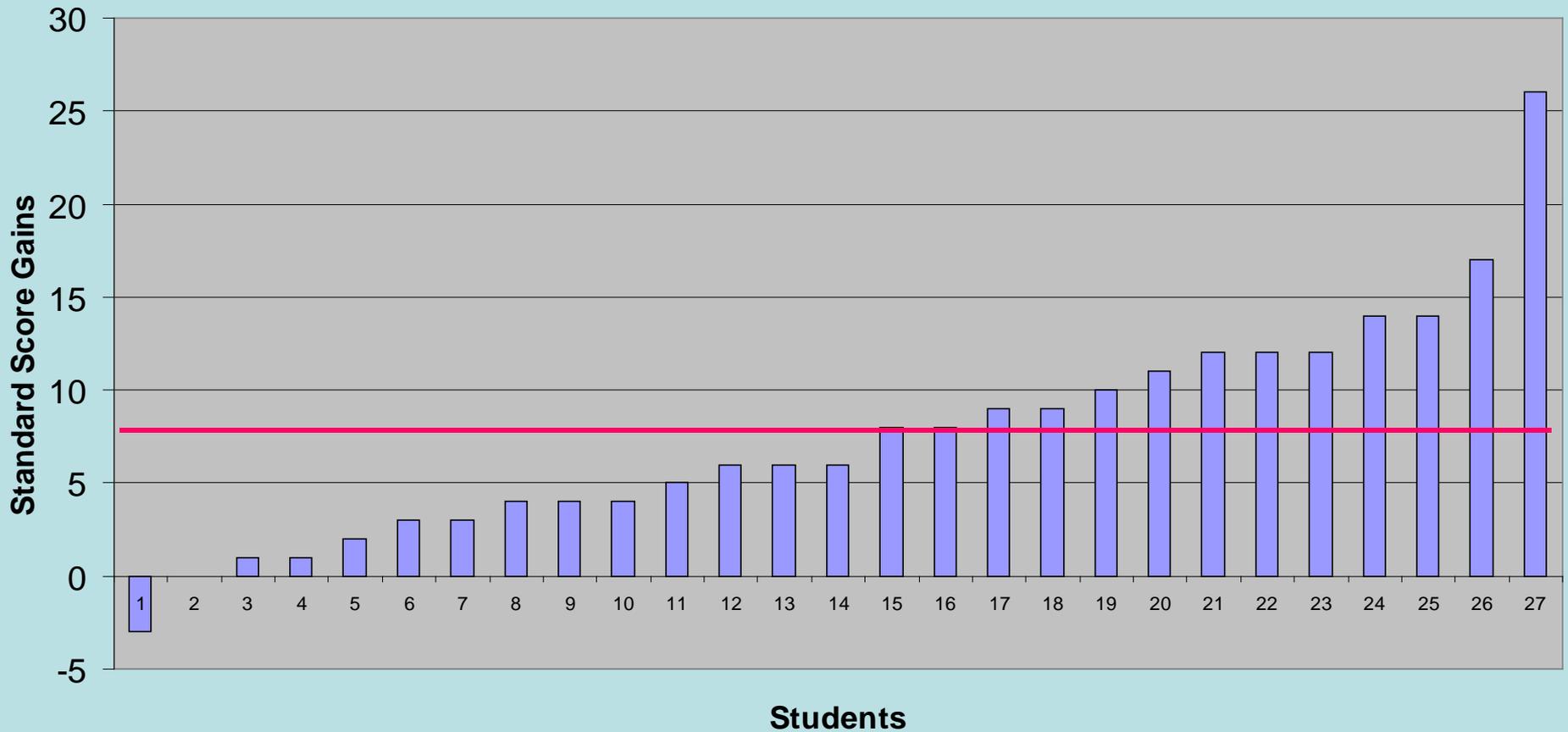
ECI only: 15/92 = 16% (3.2% of school population)

ECI + Tutoring:

- 7/163 = 4% (<1% of school population)

(Basic Reading < 30th percentile) (5 others did not meet fluency benchmarks)

Gains in Basic Skills Standard Score Points During 16-Week Intervention

(Denton et al., JLD, 2006)

Response to Tertiary Instruction
Simos et al., JLD, 2007)

Adolescent Studies (Vaughn et al., 2010; 2011; Wanzek, 2011)

- Sample selected on the basis of reading comprehension performance in grades 6-8 and randomized to typical practice or different reading interventions over 3 years

- **Typical Readers** (pass state test), n=974:

- **Struggling Readers** (don't pass or don't take state test), n=1032:

  - 81% decoding/fluency problems; 19% primarily comprehension

# Adolescent Studies (Vaughn et al., 2010; 2011; Wanzek, 2011)

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# Results

- Year 1: Small effects generally not statistically significant; no effect of group size

- Year 2: Moderate effects on decoding, fluency, and comprehension; no difference in standardized vs. individualized instruction exception for children identified with special needs (better with standardized intervention)

- Year 3: Moderate to large effects on decoding, fluency and comprehension

- NICHD middle school studies – intensive interventions for adolescents with severe reading difficulties

Cohort of minimal responders followed for three years indicated a decline in performance for the participants in the control condition, with significant improvement in the treatment group

Gates MacGinitie Reading

100

50

0

Yr 1   Yr 2   Yr 3

Treatment

Control
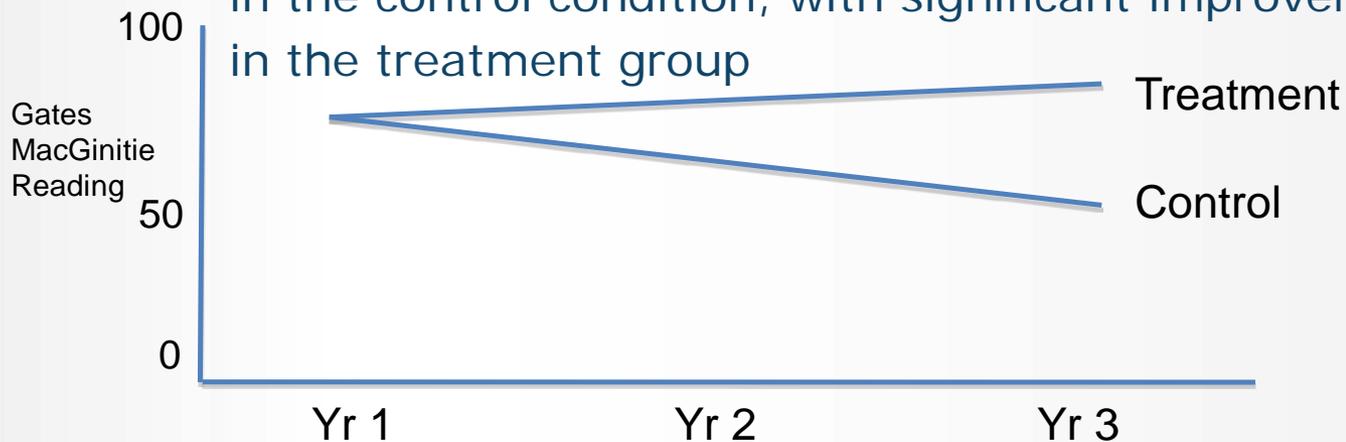
Baseline MEG Patterns for Adolescent Adequate and Inadequate Responders
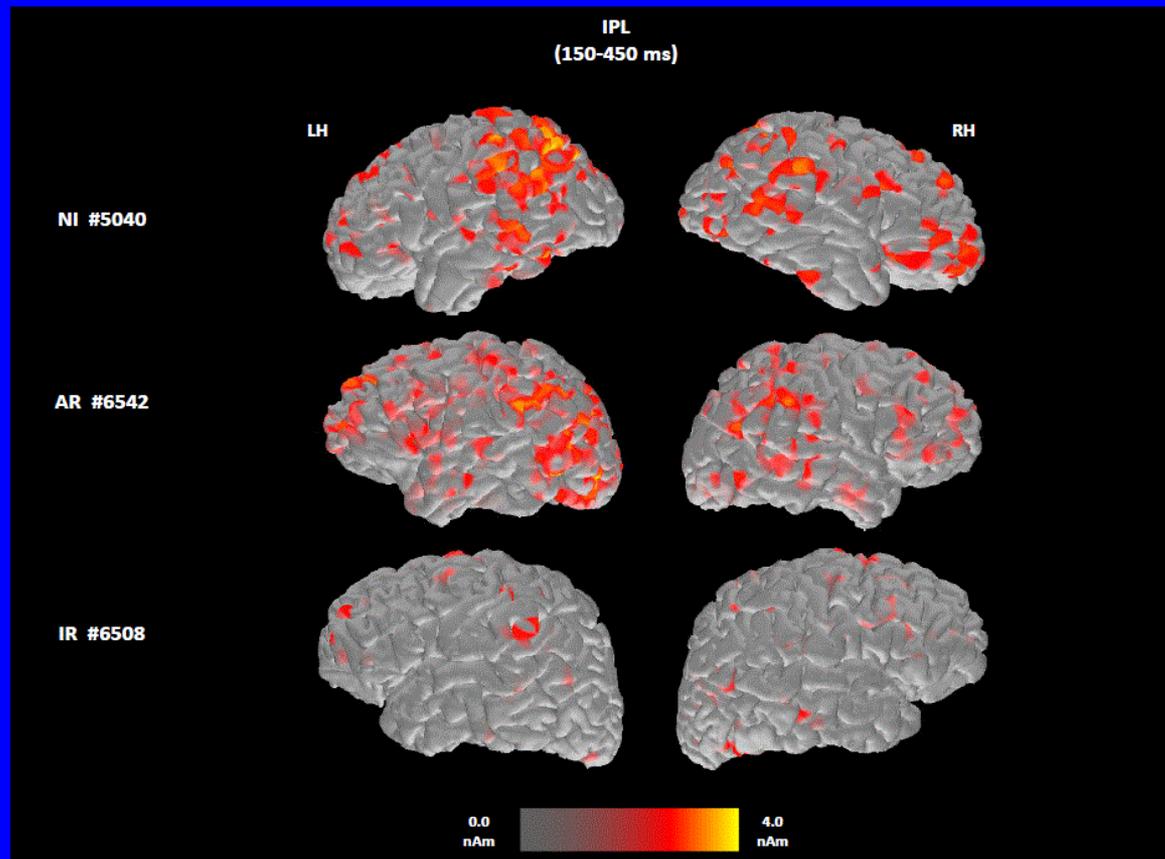
Denton et al. (2014): Grade 1

Guided Reading

- Use of multiple strategies to identify words, including the use of pictures and context

- Minimal phonics instruction with little time devoted to decontextualized practice

- Leveled text, not decodable

- More time discussing text

Explicit Intervention

- Sounding out was the primary strategy for word identification

- Daily phonics instruction with more time devoted to decontextualized practice

- Decodable and non-decodable text

- Comprehension strategy instruction

Guided Reading or Explicit Instruction?

- Grade 1, small group pullout 4 times weekly X 25 weeks, 45' Tier 2
- No statistically significant differences between the two interventions, but substantively important effect sizes favored explicit instruction in decoding, oral reading fluency, & both measures of comprehension
- Both researcher programs more effective than school-based guided reading programs
- Explicit instruction demonstrably more effective with lower performing readers (see Foorman et al., 1998)

Complex Therapies in Reading and Dyslexia

Effects stronger if interventions are:

- more explicit

- increase time on task (i.e., supplement, not supplant; Vaughn)

- reduce size of instructional group (small group, not 1:1; Vaughn)

- More comprehensive (multi-component; Mathes, Denton) and include self-regulation component

- differentiate according to instructional needs in the domain of interest (Connor)

- Teach in the context of academic content

Some General Remedial Principles

- Remedial interventions must increase intensity and differentiation, so the first steps are to increase time on task, reduce the size of the instructional group, and differentiate

- Whenever possible, interventions should supplement, not supplant

- No intervention is effective if it does not involve the academic skill itself (must read, do math, and write)

- The longer intervention is delayed, the slower the response (on average) and the greater the need for intensity

- Intervention always begins in the general education classroom

- Effective interventions include a self- regulation component

- Progress must be assessed at all levels

Not every intervention is effective

Forness (2001)

- Perceptual training: .08

- Dietary interventions: .12

- Modality training: .14

Melby- Lervag & Hulme (DP, 2012) on Cogmed:

- Working memory: .55

- Math: .07

Pennington et al. (2011, IDA Perspectives): Fast Forword, optometric exercises and lenses, exercise ineffective

Ineffective Intervention…

- Doesn't focus on academic skills

- Defines academic proficiency narrowly

- Doesn't increase instructional time, intensity, or differentiation

- Doesn't continually monitor progress and adjust instruction or change program

- Teaches for the sake of learning rules, not to master principles

- Doesn't engage the child in reading instructional level material or practice in math and writing

- Waits for the child to fail; leaves the child behind

There are different viewpoints

- *Pay attention to the evidence*

- Some believe IQ is essential and discrepancies are inclusionary; support extensive diagnostic testing and reject instructional response as a criterion

- Some believe reading proficiency is just a matter of engaging the child and exposing them to literature

- Some believe that there are special dyslexia-specific interventions or that we can directly change the brain through games

- Some believe that there should be special classes or even schools for dyslexia- let general ed off the hook?

- Some don't believe that dyslexia is real or that science is informative

- *What about high IQ kids, adults who need accommodations...other less clear issues?*

Who is Dyslexic?

- The student who does not respond to quality instruction*: hard to teach, not unable to learn*

- Low achievement and inadequate instructional response

- Often preventable with early intervention

- Heritable, but neural systems are malleable

Reading Sculpts the Brain, But Must Be Taught!!

- "We are all born with dyslexia. The difference among us is that some are easy to cure and others are not."

  - Liberman, 1996

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