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# Test and Treat or Treat and Test? Scientific and Ethical Issues in Neuropsychological Approaches to Learning Disabilities

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# Disclosures

- 1. Author of *Texas Primary Reading Inventory* (Paul F. Brookes)
- 2. Author of *Learning Disabilities: From Identification to Intervention* (Guilford Press, 2007; in press)
- 3. Research supported by NICHD grant, **P50 HD052117**, Texas Center for Learning Disabilities ([www.texasldcenter.org](http://www.texasldcenter.org))
- 4. Presentation not intentionally aligned with any standards. I am a neuropsychologist and scientist
- 5. Father of two grown (?) children who can read



# Objectives

1. Evidence-based approaches to neuropsychological assessment and intervention of learning disabilities
2. Current scientific research on LDs, including cognitive, neurobiological, and educational perspectives
3. Potential ethical issues that may emerge when clinical practice is not aligned with research
4. Prescribe effective interventions for children with LDs and comorbid conditions



## Major Shifts 1967-2017 (Fletcher & Grigorenko, in press)

- Assessment of brain-related functions was considered a primary basis for identifying LDs
- Identify the brain-related pattern independently of academic assessments; know the etiology to plan treatment
- Rourke (1975): importance of profile interpretations for inferring brain dysfunction in LDs



# Major Shifts

- Benton (1978): eight neuropsychological correlates of reading difficulties (finger agnosia, right-left confusion, auditory-visual integration, color naming, language problems)
- Doehring (1978): neuropsychological research on LDs is a “tangled web of behavioral research”
- 1980s: Subtypes research (multivariate profiles): some reliability, but weak validity



# Major Shifts

- Separate academic and behavioral deficits (comorbidity)- essential for treatment
- Cognitive skills are linked to academic skills (phonological awareness and word reading; Liberman et al., 1967; Liberman, 1971)
- Structural and functional MRI
- Behavioral and structural genetics
- Instructional response and RTI



# Controversy: Role of Cognitive Process Assessment for LD

1. Statutes defining LD in legislation mandate cognitive assessments (Hale et al., 2010).
2. Cognitive assessments are correlated with achievement domains (Johnson, 2014)
3. Subtypes: Cognitive assessments discriminate LD from non-LD "slow learners" (Fenwick et al., 2015); or brain-based from environmental LDs
4. Better treatment planning and intervention outcomes (Reynolds & Shaywitz, 2009).
5. Clinicians using cognitive tests make more informed decisions (Kaufman)



# Problems with Cognitive Process Assessment

1. Statute does not mandate that cognitive skills be assessed- just their manifestations
2. Correlation does not validate underlying classification or add unique variability to prediction or diagnosis (Stuebing et al., 2015; Torgesen, 2002)
3. Empirical research does not show validity of classifications/diagnosis based on cognitive/NP profiles. Extremely poor agreement for individual decisions (Francis et al., 2005; Macmann et al., 1989; Miciak et al., 2015)
4. Little evidence of cognitive attribute X treatment outcomes (Pashler et al., 2009; Melby-Lervag, 2016)





# 1. What Does the Federal LD Statute Say?

## 1968 Federal Statutory Definition

- "The term "specific learning disability" means a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, which may manifest itself in an imperfect ability to listen, speak, read, write, spell, or to do mathematical calculations" (U.S. Office of Education, 1968, p. 34).



# Federal Regulatory Guidance

- “The Department does not believe that an assessment of psychological or cognitive processing should be required in determining whether a child has an SLD. There is no current evidence that such assessments are necessary or sufficient for identifying SLD. Further, in many cases, these assessments have not been used to make appropriate intervention decisions” (Individuals with Disabilities Education Act (IDEA) regulations, 2006, p. 46651).



## 2. Cognitive processes are correlated with achievement

- Demonstrating that cognitive measures and achievement are correlated does not establish that cognitive measures are related to intervention outcomes or provide value-added information to identification
- What causes what? Implicit causal direction just as easily in the opposite direction

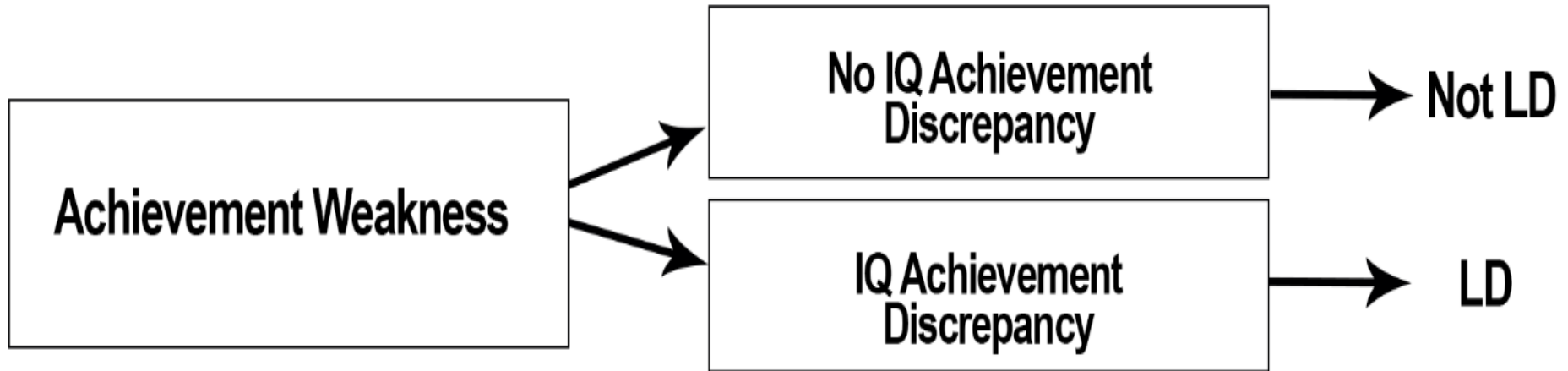


### 3. Cognitive Subtype Hypotheses

- Difficult to demonstrate external validity of rational or empirical subtypes
- Presence of a profile does not mean that it is reliable or valid (Morris & Fletcher, 1988)
- Enormous difficulties with the psychometrics of extreme scores, especially on normally distributed variables
- No validity of aptitude-achievement methods or slow learner concept or of cognitive referencing in general (Pashler et al., 2009)



# **IQ-Achievement Discrepancy Method**





## What's Wrong With IQ- Discrepancy?

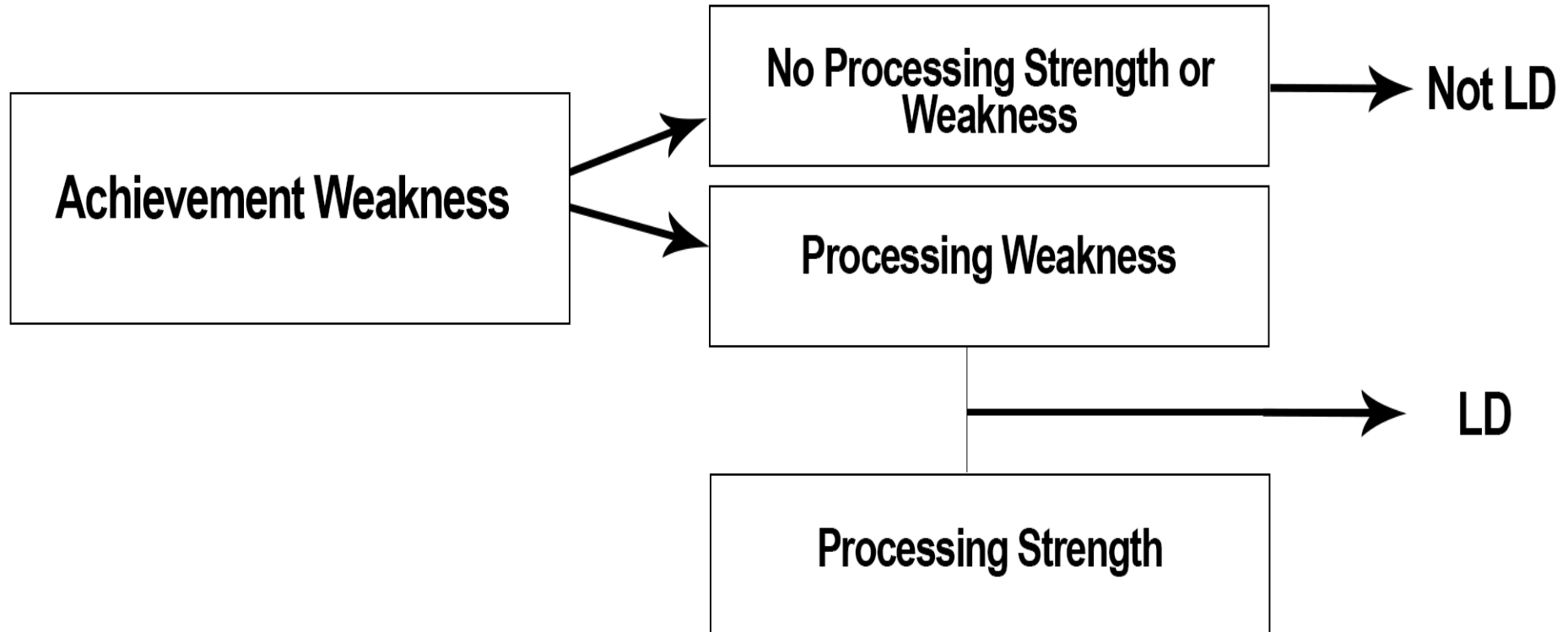
- IQ- discrepant and non- discrepant low achievers do not differ significantly in behavior, achievement, cognitive skills, response to instruction (Siegel, 1992; Stuebing et al., 2002).
- IQ does not predict intervention response (Stuebing et al., 2009).
- No difference in brain activation profiles (Tanaka et al., 2011; Simos et al., 2014)
- Identification may not be reliable based on a single assessment or cut point (Francis; Macmann)

## Alternative Views: The “Third Method”

- Evaluate strengths and weaknesses in cognitive processes for inadequate responders to determine best TX
- “Research-based” methods based on cognitive and achievement batteries:
  - Cross Battery Assessment Method (Flanagan);
  - Concordance-Discordance (Hale);
  - Discrepancy/Consistency (Naglieri)
- Hale et al. (2010) survey of LD professionals: PSW methods needed not just for diagnosis, but also for treatment; mandated by statute



# PSW Methods







# Simulation of PSW Methods (Stuebing et al., SPR, 2012)

- Created data sets where LD status of child is known; asked how well 3 PSW methods identified those children known to demonstrate LD at the observed level.
- Based on the idea that cognitive assessments should occur after Tier 2
- For all 3 methods, number of children identified as LD low (about 2-3% depending on size of discrepancy)
- For “not LD,” highly accurate (high specificity and few false negatives), but if “yes LD”, many false positives (low PPV)



## Of 10,000 assessments:

- CDM: 1,558 identified as LD (8,436 as not LD); 25 correct, so 1,533 are false positives and **get the wrong treatment**
- DCM: 362 identified as LD (9,638 not LD); 89 correct, so 273 are false positives and **get the wrong treatment**
- XBA: 678 would be identified as LD (9,322 not LD); 353 correct, 325 are false positives and **get the wrong treatment**



# Empirical Studies

- Kranzler et al., 2016
- Used WJIII normative sample (cognitive and achievement batteries) and XBA computer program to estimate sensitivity and specificity of LD identification (3 age groups; 900 participants)
- Identified very few children as LD-about 2%



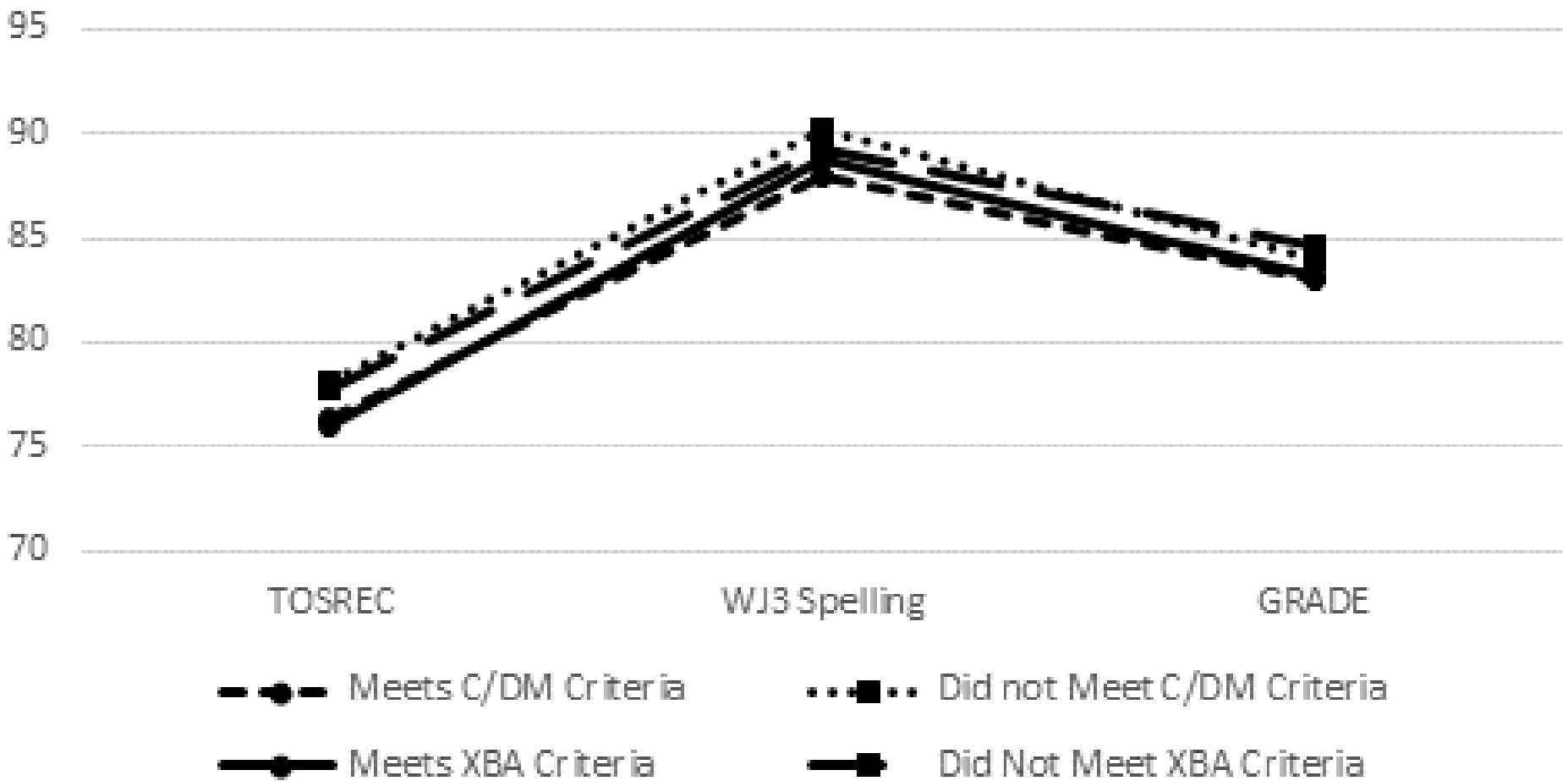
# Kranzler et al., 2016

- Very accurate for "not LD" assessments: Specificity = .92; Negative predictive Value = .89
- Very Inaccurate for "Yes LD": Sensitivity = .21; Specificity = .34
- *"In sum, results of this study do not support the use of the XBA method for identifying SLD."*



# Performance on external reading variables of groups that met and did not meet PSW LD identification criteria (Miciak et al., 2014)

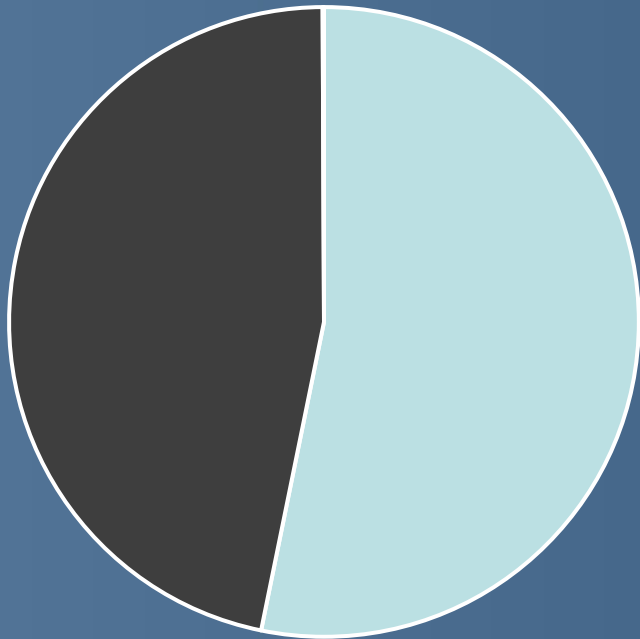
## Academic Profiles





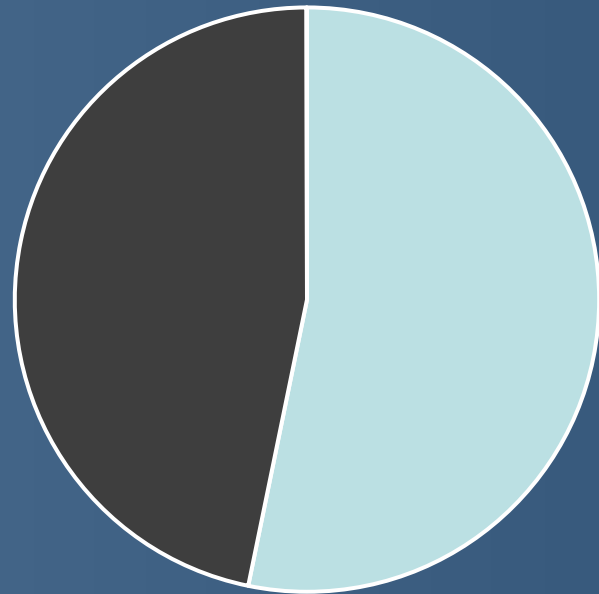
# Reading Comprehension at Posttest (Miciak et al., 2015)

Variability Explained in Passage Comprehension at Posttest



■ Pretest ■ Error ■ C/DM LD

Variability Explained in Passage Comprehension at Posttest



■ Pretest ■ Error ■ XBA LD



## 4. Treatment Validity

- Child attribute by treatment interactions observed for achievement, but not for cognition
- Stuebing et al (2009; 2015): meta-analysis of treatment studies examining unique prediction of IQ, phonological awareness, rapid naming, verbal working memory, and oral language/vocabulary: *"The small size of the effects calls into question the practical significance and utility of using cognitive characteristics for prediction of response when baseline reading is available"*



## 4. Treatment Validity

- Training cognitive skills in isolation of academic content does not generalize to better reading, math, and writing (Mann, 1979; Kearns & Fuchs, 2013; Melby-Lervag et al., 2016)
- “working memory training programs appear to produce short-term, specific training effects that do not generalize to measures of “real-world” cognitive skills. These results seriously question the practical and theoretical importance of current computerized working memory programs as methods of training working memory skills.” (Melby-Lervag et al., 2016)





# Does PSW Predict Treatment (Miciak et al., 2016)?

## Misclassifications

Identify students as LD  
or "not LD" by C/DM  
and XBA

Intensive  
Intervention in  
Reading

Evaluate Posttest  
Performance

**Pretest Only**  
**152/1,000**

**Pretest + PSW**  
**147/1,000**



# PSW Empirical Research Summary

- PSW Methods do not overcome problems of poor reliability at the individual level
- Different PSW Methods identify different kids as LD and not LD and do not discriminate LD and non-LD low achievers
- Generally, PSW Methods identify few students. Lots of testing for every 1 student.
- PSW status does not predict differential treatment response
- Cognitive assessments do not answer "why." Correlational data with no established treatment implications.



# What About Executive Functions?

- Cirino: Studies of over 900 Grade 3-5 children before and after reading intervention
- Bifactor framework for executive function (Cirino et al., *Neuropsychology*, in press)
- Executive Function predicts reading and math, even amongst very strong known predictors, and interacts with simple view variables (Cirino et al., in review); general factor adds 3% unique variance
- Training executive function (as self-regulation): difficult to move needle relative to cogent reading intervention (Cirino et al., 2017; Jacobs & Parkinson, 2014)
- Executive function weak predictor of intervention response (Miciak, Cirino et al., in press)



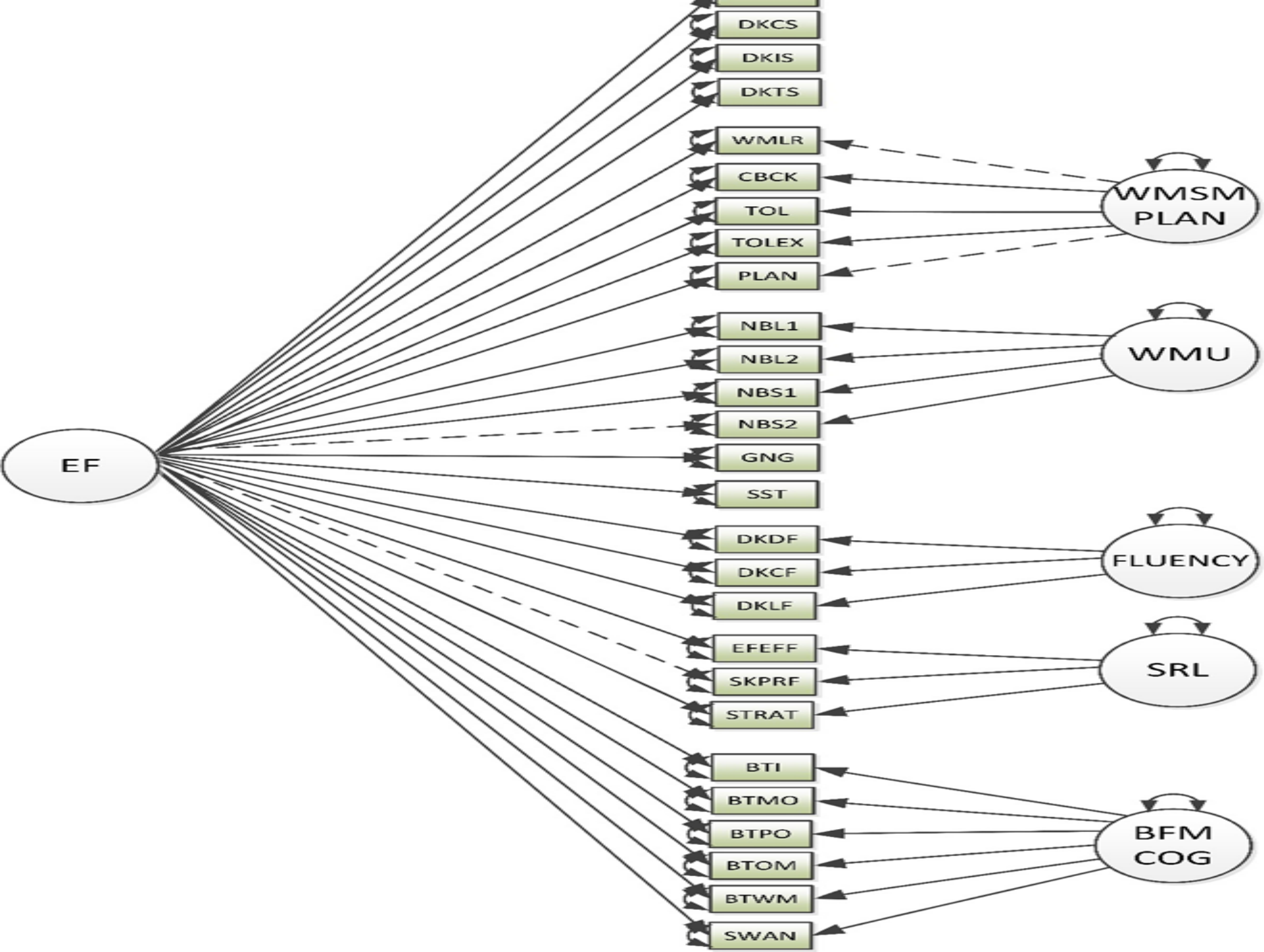
# Constructs and Measures

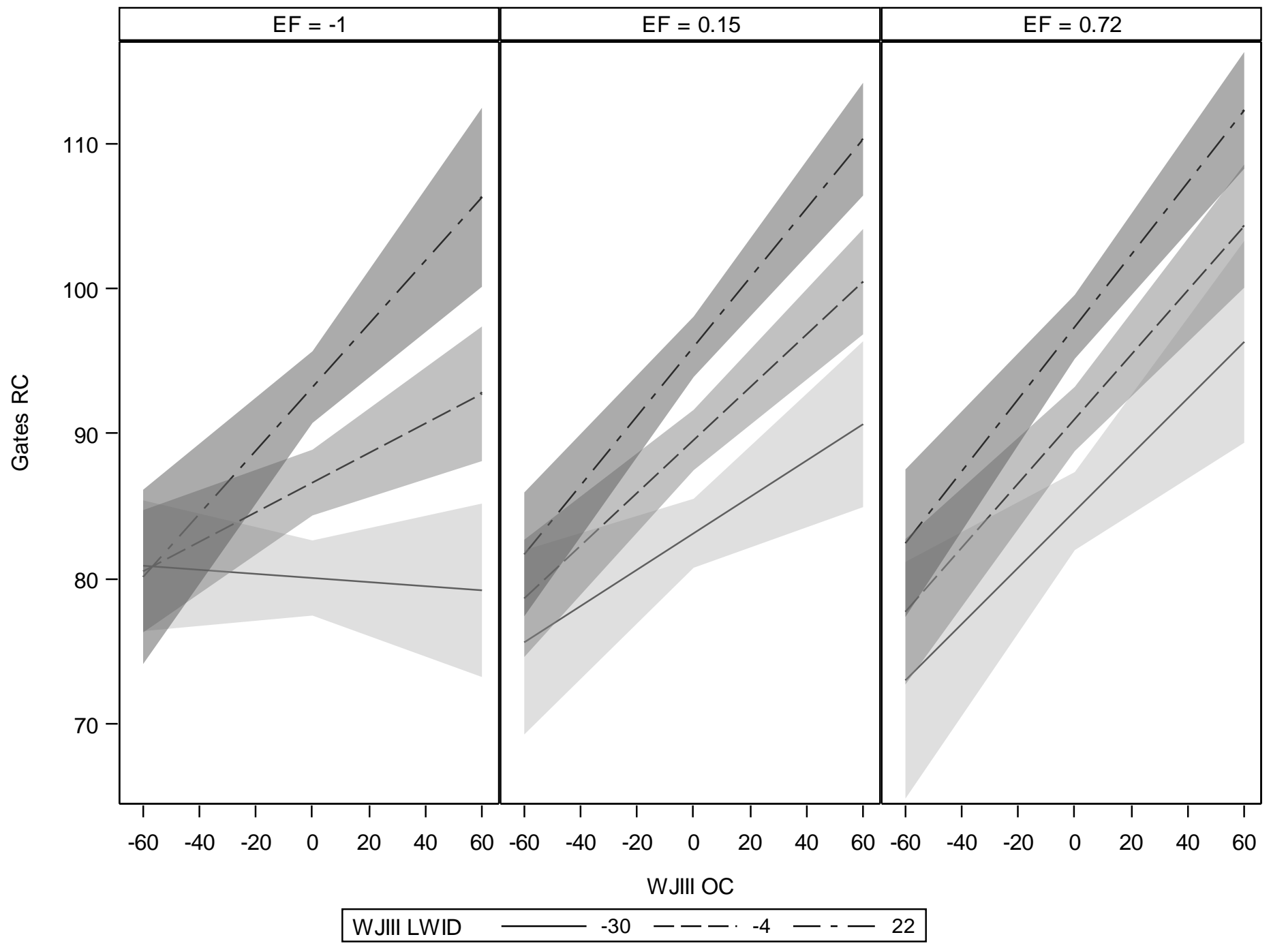
1. Working memory: Listening Recall subtest; Corsi Blocks; 4 n-back measures
2. Inhibition: Cued Go-noGo; Stop Signal
3. Shifting: DKEFS alternating Design Fluency, Verbal Fluency, Color-Word Identification; Trail Making Test
4. Planning: Tower of London, WJIII Planning
5. Generative Fluency: DKEFS non-alternating Letter, Category, Design Fluency



# Constructs and Measures

6. Self-Regulated Learning: self reported self-efficacy and effort, strategies, and perceived skill and preference for reading
7. Metacognition: Brief Metacognition, SWAN Inattention
8. Behavioral Inhibition: Brief Inhibit, Shift, Emotional Control; SWAN Hyper-Impulsivity







# fMRI: Executive Functions: SST and Sentence Comprehension (Church, Juranek)

1. SST engages anterior cognitive control regions; activation not related to reading performance or Group
2. Sentence comprehension engages reading network and cognitive control regions
3. Degree of engagement of cognitive control regions is related to reading performance and to positive intervention response at baseline (on SC)
4. Improvement over time associated with degree of engagement of left ventral fusiform and anterior cognitive control regions



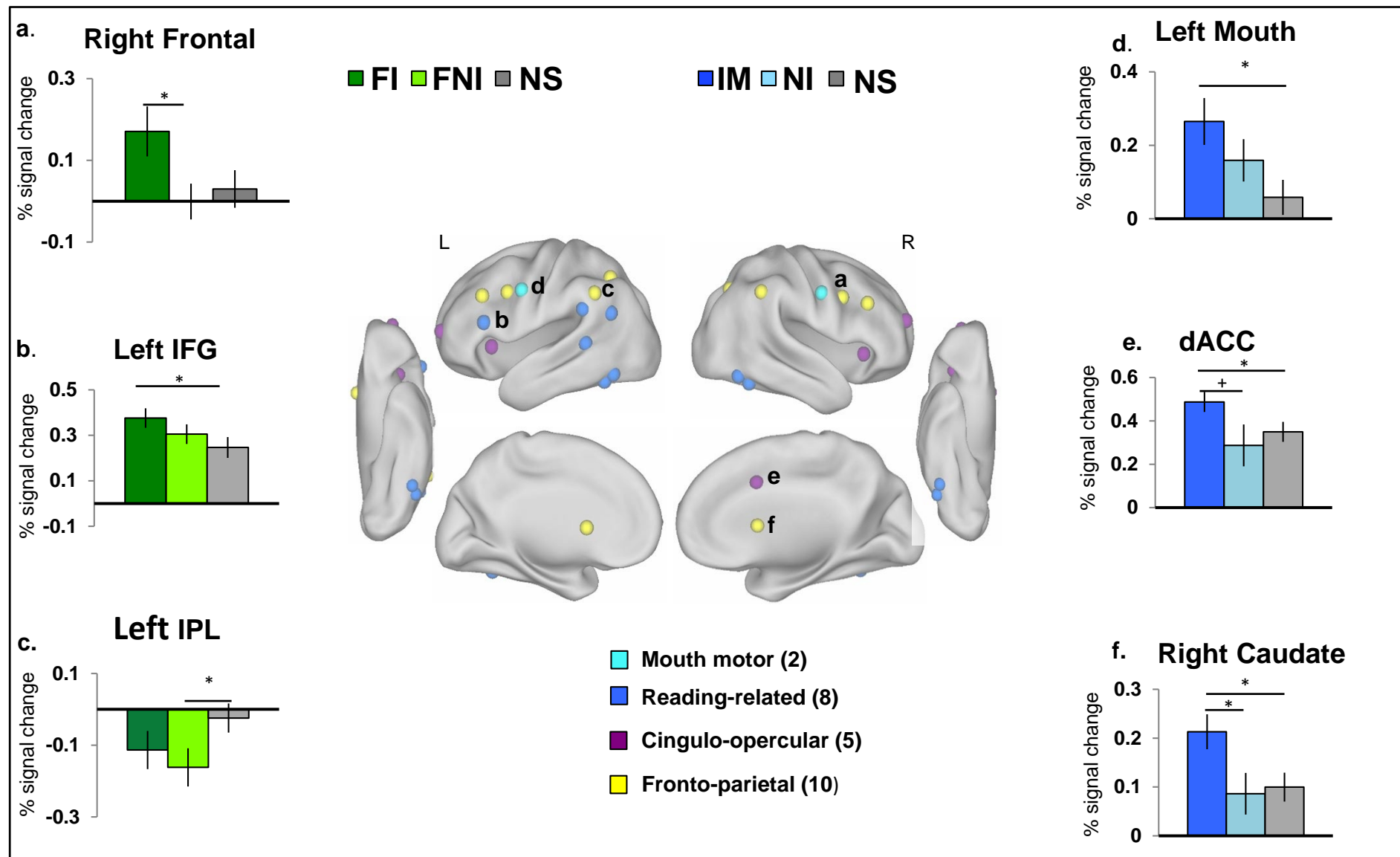


Figure 4. Literature-derived ROI and BOLD % signal change results from scan 1 and scan 2. FI = future improvers; FNI = future non-improvers; IM = improvers; NI = non-improvers; NS = non-struggling readers; \*  $p < .05$ , +  $p < .10$ .; a. right frontal; b. left inferior frontal gyrus. c. left inferior parietal lobe; d. left mouth e. dorsal anterior cingulate cortex; f. right caudate; not pictured from scan 2, significant group differences in left anterior pre-frontal cortex and left caudate (see text).



## 5. Clinicians

- No evidence that clinicians who use cognitive tests or profiles make better judgements (just the opposite: (Macmann, 1997: The myth of the master detective"))
- Separate cognitive tests from comprehensive evaluation: history, observation, context, direct assessment of achievement and behavior
- What needs to be observed? memorizing lists of words, drawing, or connecting numbers and letters vs. reading, writing, and completing math problems...



# What I didn't say

- IQ and NP tests are useless: Depends on the question, but not if issue is LD unless early screening; not clear about adults. I use IQ tests for autism and ID and NP tests for brain injury.
- Neuropsychological evaluations are not useful: Person, not the test, make it NP and useful
- The brain is not related to LD
- LD is not real
- Accept the null hypothesis. We need more research, but who should do it?



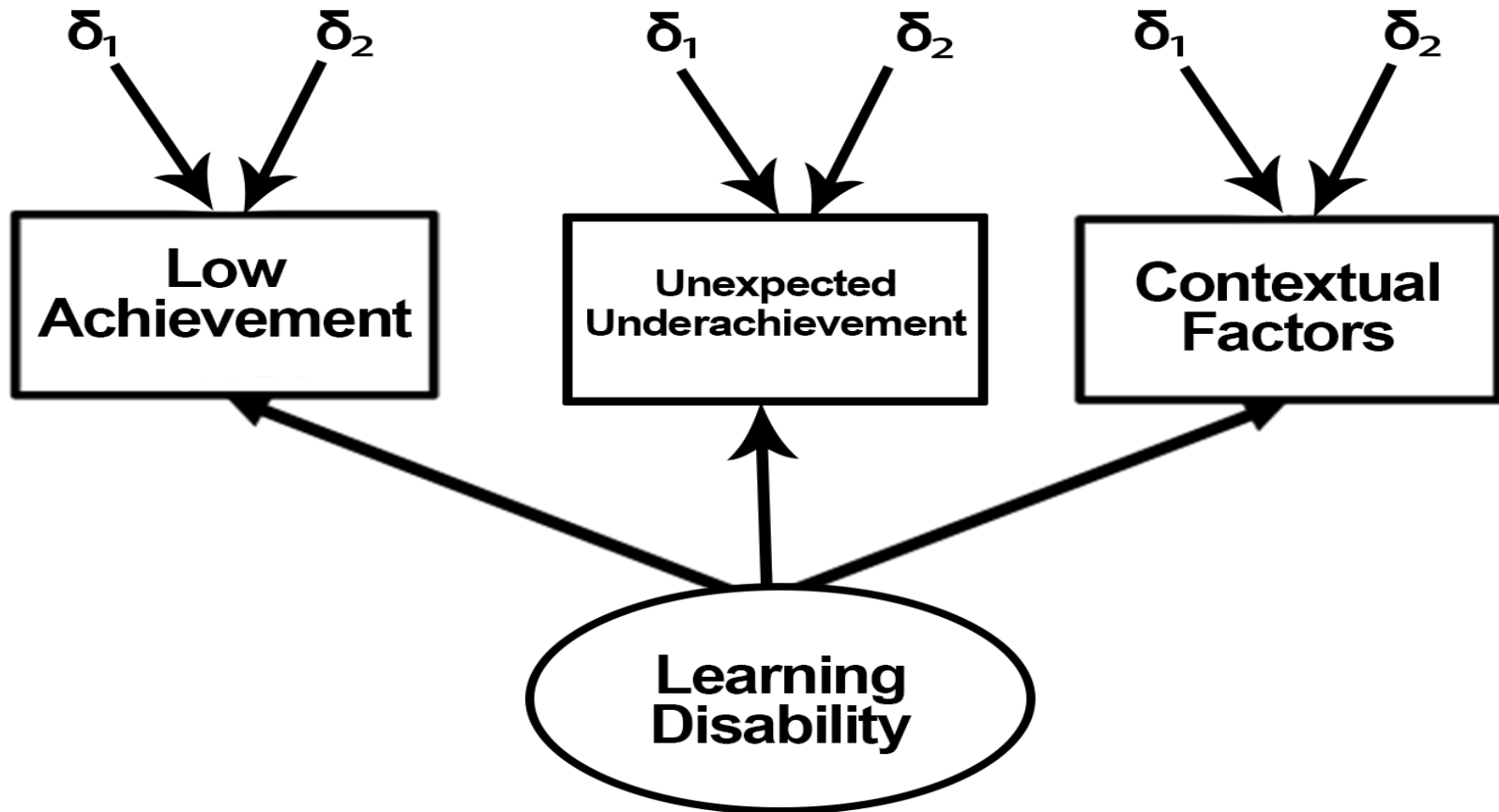
# Schneider and Kaufman (2017)

“Proponents of comprehensive cognitive assessments for learning disability identification must do more to rigorously evaluate their beliefs or else concede the argument to those with better evidence (p. 7).”

On the need for comprehensive cognitive assessment: “After rereading dozens of papers defending such assertions, including our own, we can say that this position is mostly backed by rhetoric in which assertions are backed by citations of other scholars making assertions...”

p. 8

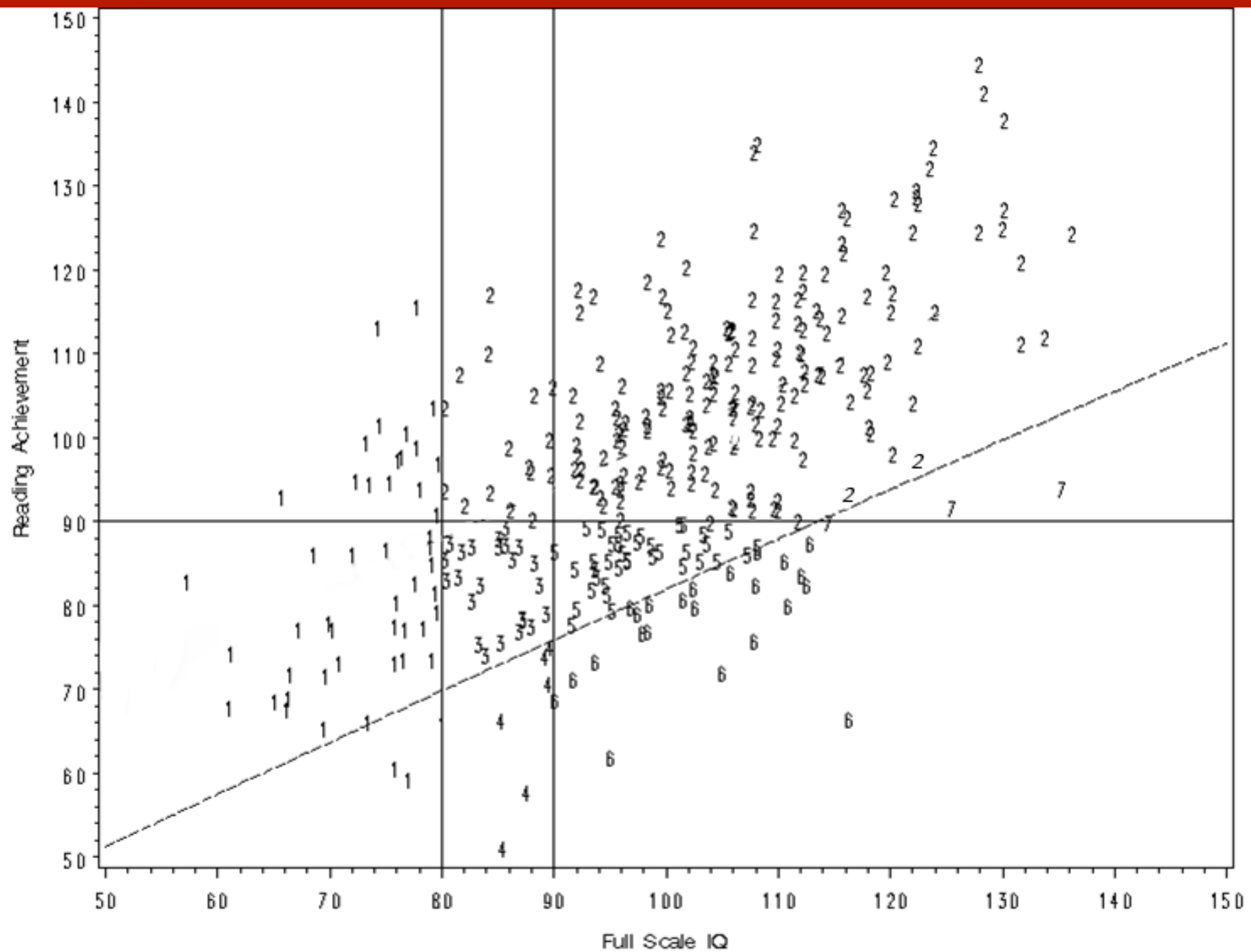
# LD is a Hypothetical Construct





# Identification issues are universal across methods

- No qualitative markers of LD (dimensional disorder)
- Measurement error (why do we persist with rigid cut points?)
- Instructional response may be a continuum; no qualitative markers of inadequate responders
- How does the field move to informed decision making using multiple criteria and stop relying on psychometric methods?





## 9.02 Use of Assessments

- a) Psychologists administer, adapt, score, interpret, or use assessment techniques, interviews, tests, or instruments in a manner and for purposes that are appropriate **in light of the research on or evidence of the usefulness and proper application of the techniques.**





## 9.02 Use of Assessments

- (b) Psychologists use assessment instruments whose validity and reliability have been established for use with members of the population tested. When such validity or reliability has not been established, psychologists describe the strengths and limitations of test results and interpretation.



## 9.06 Interpreting Assessment Results

- When interpreting assessment results, including automated interpretations, psychologists take into account the purpose of the assessment as well as the various test factors, test-taking abilities, and other characteristics of the person being assessed, such as situational, personal, linguistic, and cultural differences, that might affect psychologists' judgments or reduce the accuracy of their interpretations. They indicate any significant limitations of their interpretations



## 9.08 Obsolete Tests and Outdated Test Results

- (a) Psychologists do not base their assessment or intervention decisions or recommendations on data or test results that are outdated for the current purpose.
- (b) Psychologists do not base such decisions or recommendations on **tests and measures that are obsolete and not useful for the current purpose.**



# Best Practice

- Use assessments that are reliable, well-normed on same sample, and valid
- Assess multiple domains and consider comorbidity
- Assess in relation to treatment
- Use confidence intervals
- Multiple criteria; comprehensive data gathering process



# LD Summit: Hybrid Method (Triangle Approach) to Identification (Bradley et al., 2002)

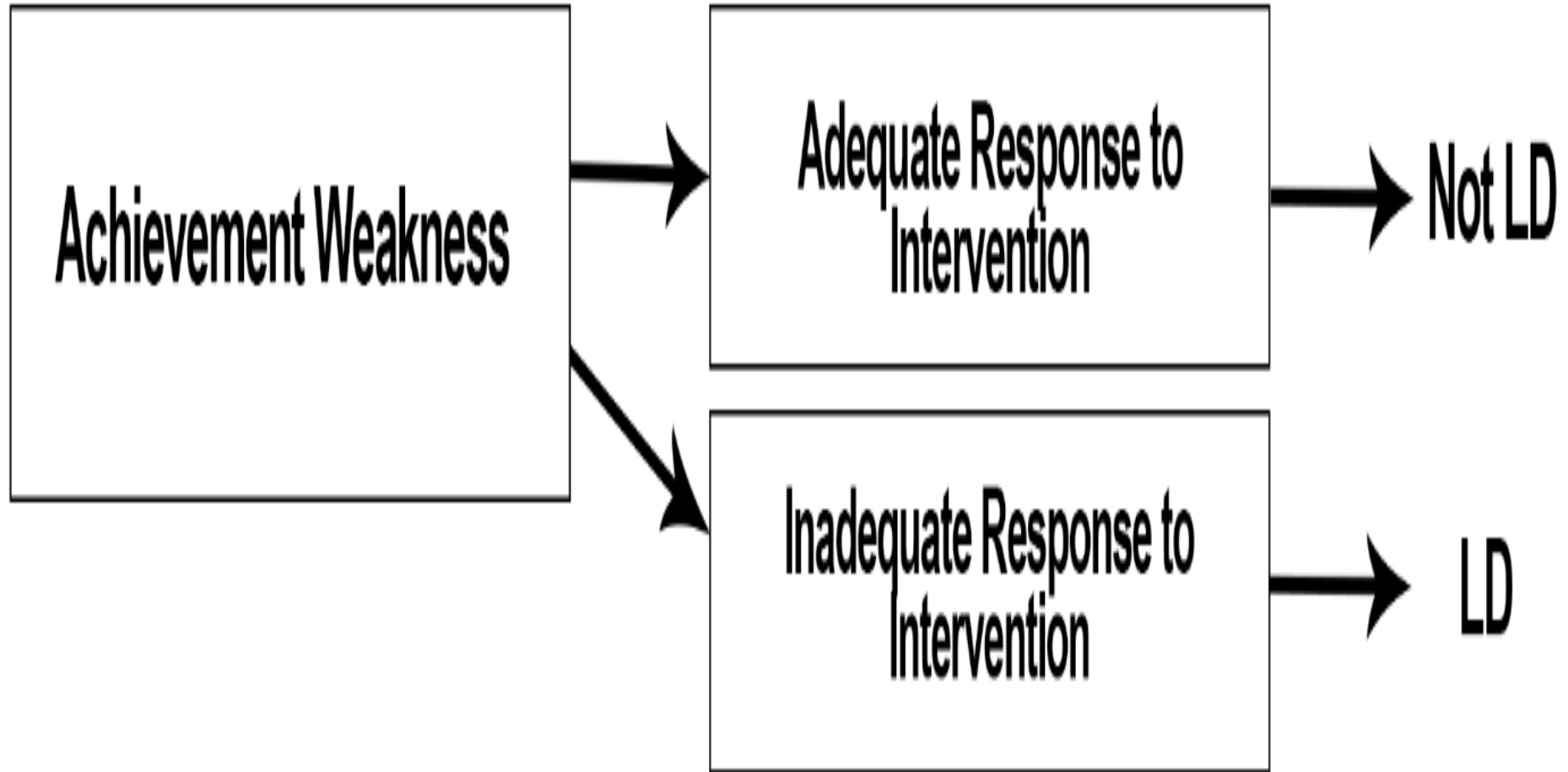
1. Establish Low Achievement
2. Evaluate Response to Instruction  
(Is underachievement expected?)
3. Apply the Exclusions

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

- [www.air.org/ldsummit](http://www.air.org/ldsummit)

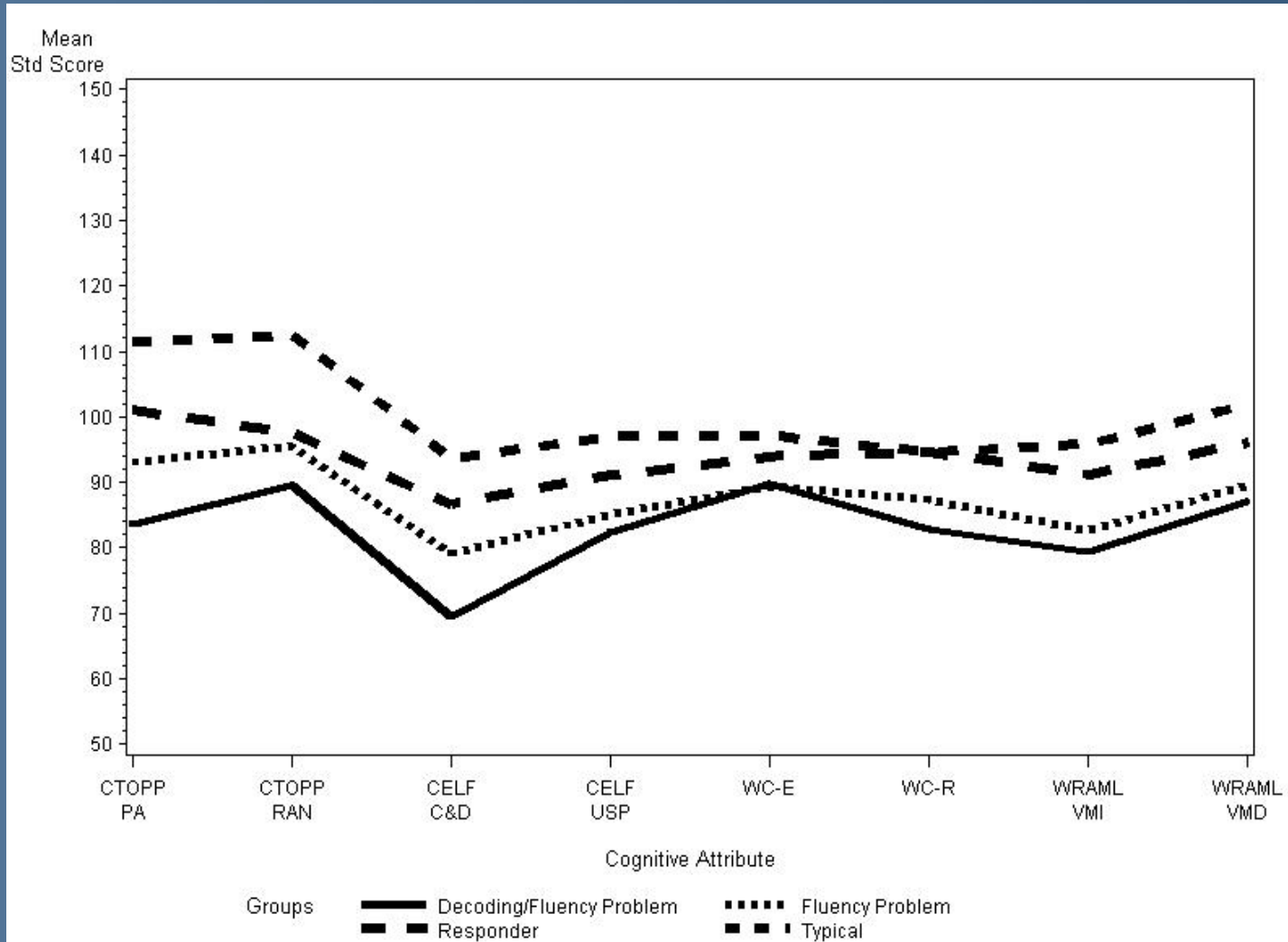


# Instructional Response

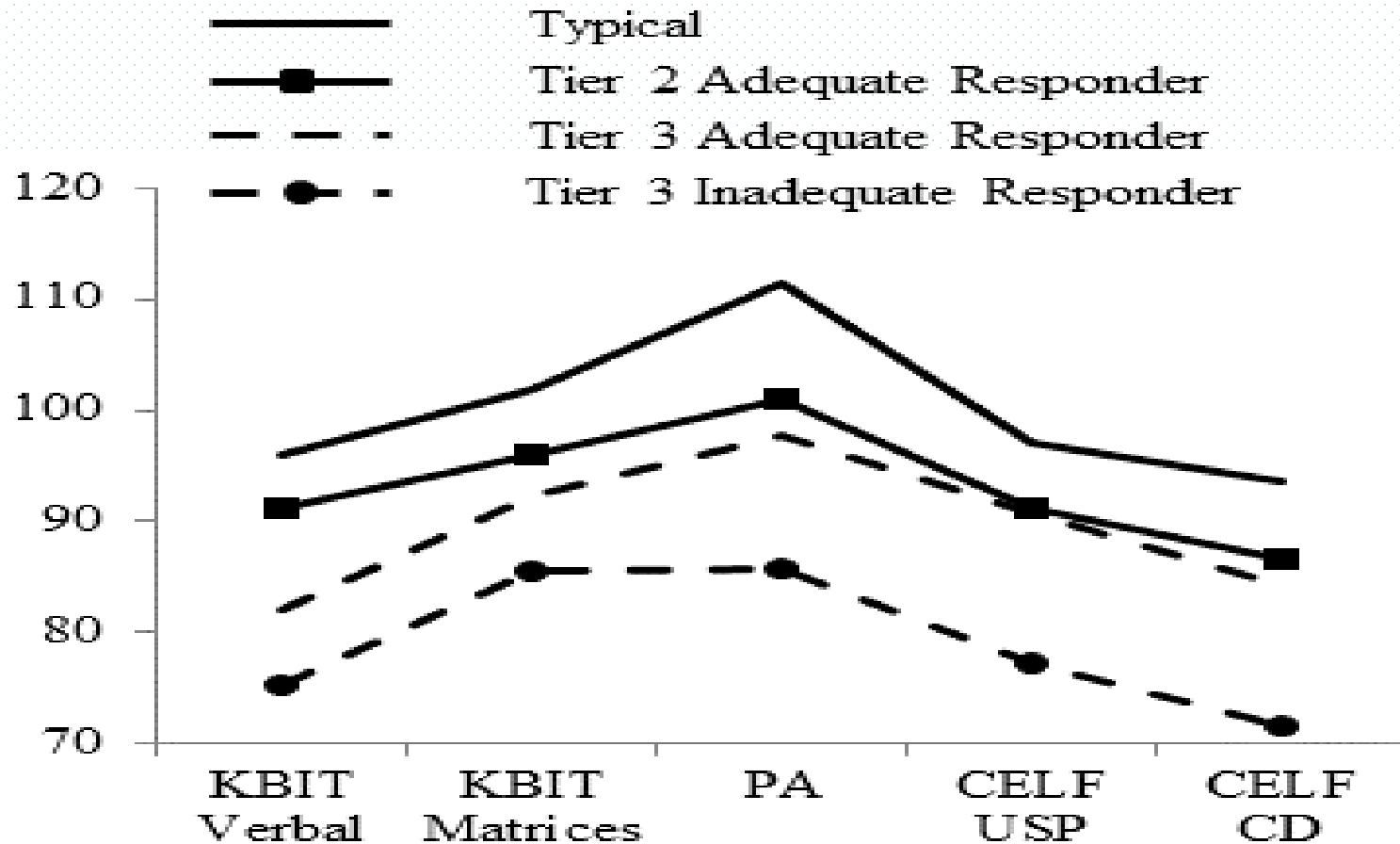




# Validity of the hybrid method (Fletcher et al., SPR, 2011)

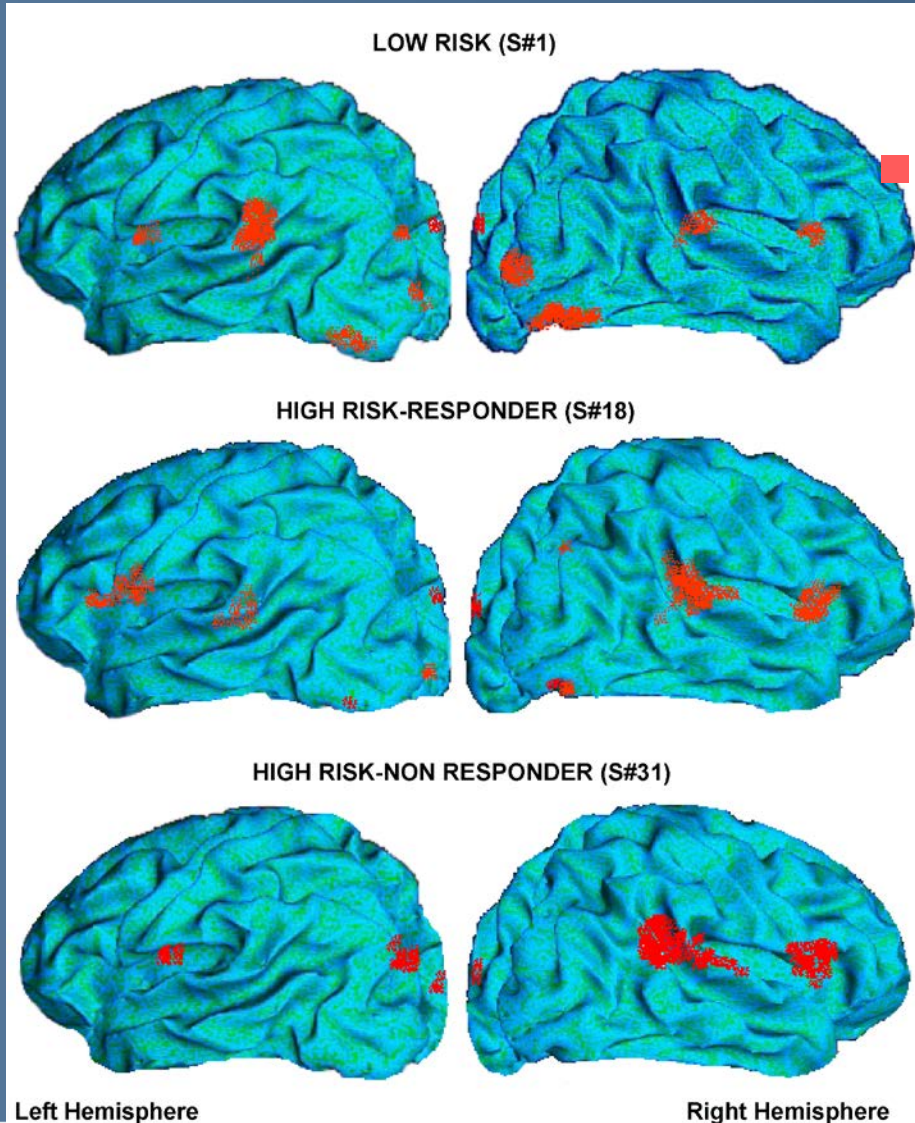


# Inadequate Responders: Tier 3 (baseline cog characteristics) Denton et al., 2012



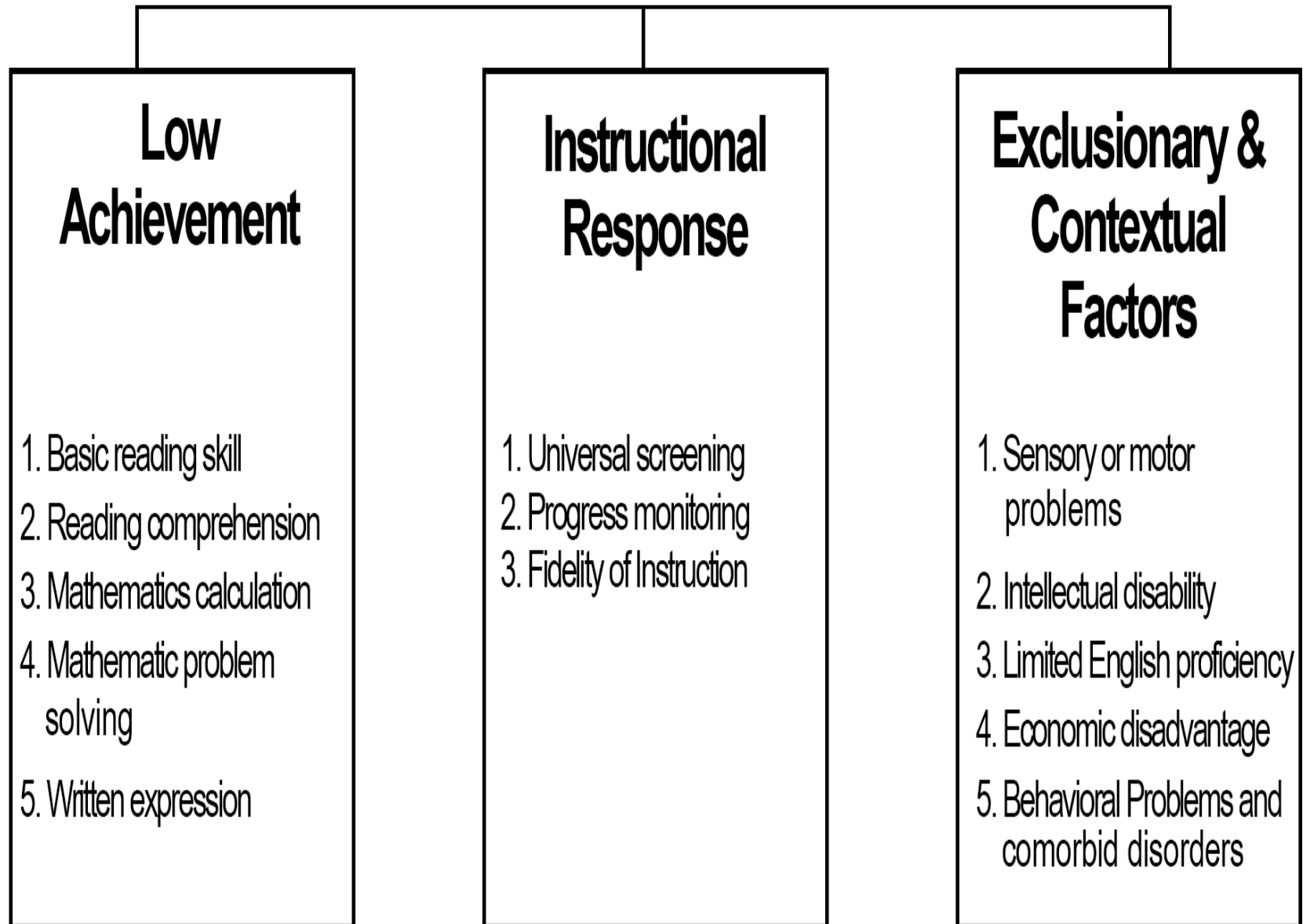


# Grade 1 Intervention (pseudoword task)



Simos et al (Neuropsychology, 2007)- after Grade 1 intervention in Mathes et al. (RRQ, 2005)

# Hybrid Approach to Evaluating Learning Disabilities





# 1. Establish Low Achievement: Domains of SLD

- Hypothetical classification of LD: Marker variables involving:
  - 1. Word Recognition (Dyslexia)
  - 2. Reading Comprehension
  - 3. Math Computations (Dyscalculia)
  - 4. Math Problem Solving
  - 5. Written Expression (Handwriting, Spelling, Text Generation?)
- AUTOMATICITY IN ALL DOMAINS

Occur in isolation and concurrently, but basis for interventions and differentiated instruction

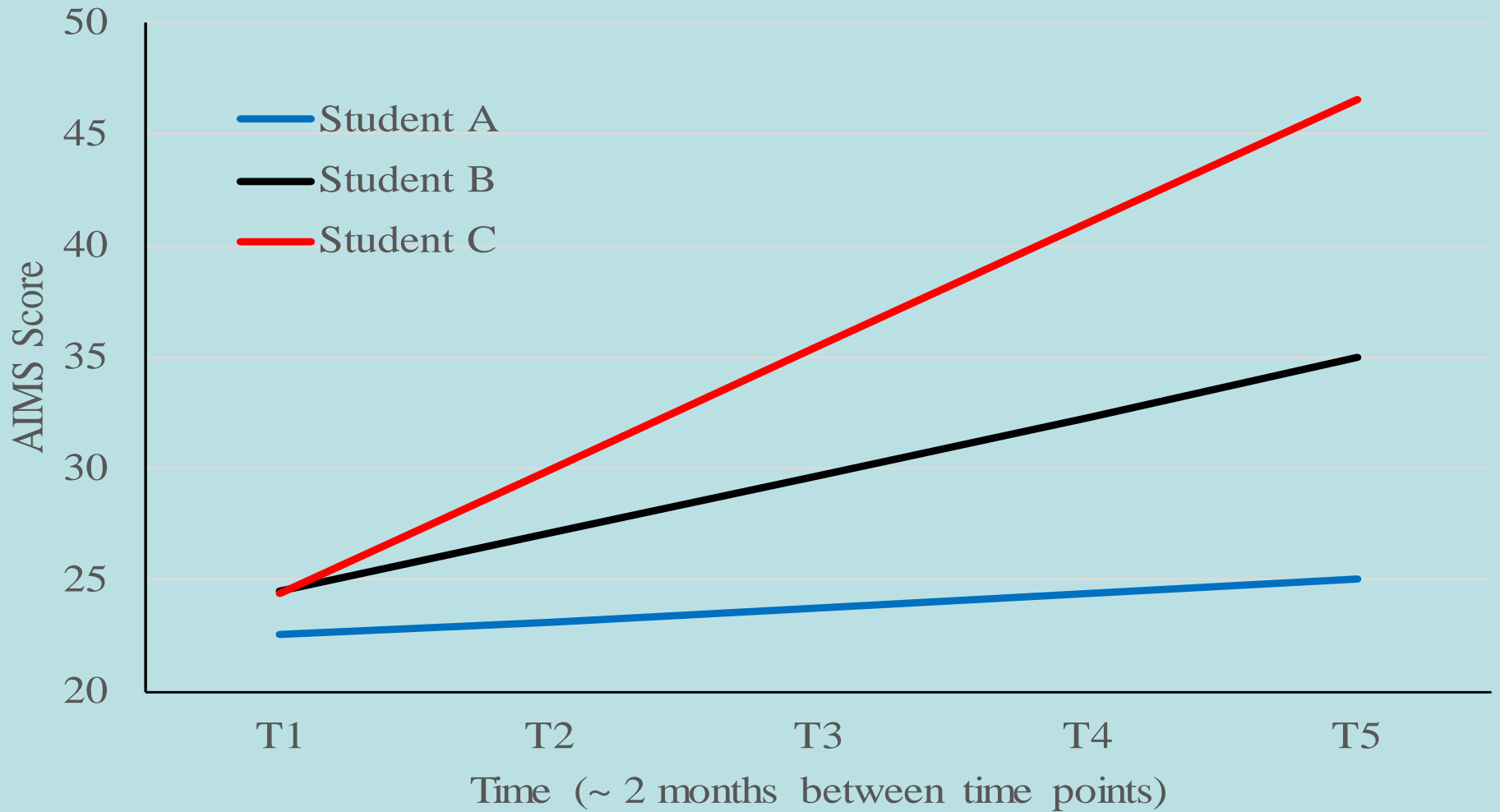
<b>Construct</b>	<b>WJ</b>	<b>WIAT</b>	<b>KTEA</b>
Word Recognition	Word Identification	Word Reading	Letter & Word Recognition
	Word Attack	Pseudoword Decoding	Nonsense Word Decoding
Reading Fluency	Word Reading	Oral Reading	Silent Reading
	Sentence Reading		
Reading Comprehension	Passage Comp	Reading Comp	Reading Comp
Math Computations	Calculation	Numerical Operations	Computation
Math Problem-Solving	Applied Problems	Problem-Solving	Concepts & Applications
Written Expression	Spelling	Spelling	Spelling
<i>Supplemental tests</i>			
Math Fluency	Math Facts	Math Fluency	Writing Fluency
Writing Fluency	Sentence Writing	Alphabet Writing	Writing Fluency
Written Expression	Writing Samples	Essay Composition	Written Expression



# Assess Response to Instruction (Kovaleski et al., 2013)

- Universal screening of all students for reading (and behavior) problems
- Monitor progress of at-risk students:
- Introduce multi- tiered intervention programs that begin in the classroom
- Evaluate the fidelity instructional programs (should be at least 80%)
- Increase intensity for those who show inadequate response

# Intervention Response





# Assess Response to Instruction

- Review history of identification and intervention programs
- Evaluate previously attempted interventions for explicitness, comprehensiveness, and degree of differentiation
- Is the program named and does it have an empirical validation? How strong? Fidelity?
- Consider time on task, intensity, and format (individual, small group, etc.)
- If needed, prescribe an intense intervention if it is apparent that the person has never had the opportunity; ensure at least 70 hours of intervention and formally evaluate progress



# Evaluate Contextual Factors and Related Disorders (Waber, 2010)

- General principle: assess in the same way that the factors and conditions would be assessed in the absence of concerns about LDs
- Assessments depend on the question
- Routine use of behavior rating scales (home and school): BASC, CBCL (broadband), Connors, SNAP-IV (narrowband for ADHD: [www.adhd.net](http://www.adhd.net))
- Consider oral language and limited English proficiency (Bateria-3 is best instrument)





# Why focus on achievement?

- *The most important markers of learning disabilities are achievement related*
- Classification hypotheses are validated **only** at the level of achievement
- Cognition and brain function are intrinsically linked to LD, but the path is through academic deficits
- If components of reading, math, and written expression are assessed, what else is needed for identification and intervention? Conner et al (2007, Science): child *achievement* characteristics and outcomes interact

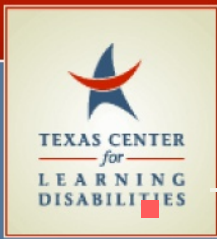
**Achievement, adaptive behavior, and behavior differentiate children with high incidence disabilities**



# 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**



# Effective Intervention: Dyslexia

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)



# Intervention Must Begin in General Ed

- **Explicit:** teachers use direct explanations, model the skill or strategy, and formally present new knowledge and concepts. Children are taught to mastery with cumulative practice and opportunities for applications in real text or math problems with teacher guidance and feedback (Fuchs et al., 2014).



- **Differentiated:** Instruction is tailored to the student's strengths and weaknesses within the academic domain
- **Comprehensive:** Teach multiple components underlying proficient skill development
- Students with or at risk for dyslexia need to be taught like other students based on what we know about learning to read, but with more explicitness and differentiation



## Connor: Differentiated Core Reading Instruction

- **Code vs. meaning-focused instruction interacts with child characteristics:** helping teachers provided 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

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



# Connor: Differentiated Core Reading Instruction

- Measure child attributes involving reading decoding and vocabulary/comprehension
- Input into algorithm (using any reliable and valid measures- standardized test, inventory, CBMs)
- Algorithms determine amount of time and grouping strategies
- 7 large randomized trials in Grades 1-6 have supported improved outcomes in reading comprehension in classrooms where instruction is differentiated.



# Early Intervention is Mandatory

- Prevention studies show that 70- 90% of at risk children (bottom 20%) in K- 2 can learn to read in average range. Prevents automaticity problems.



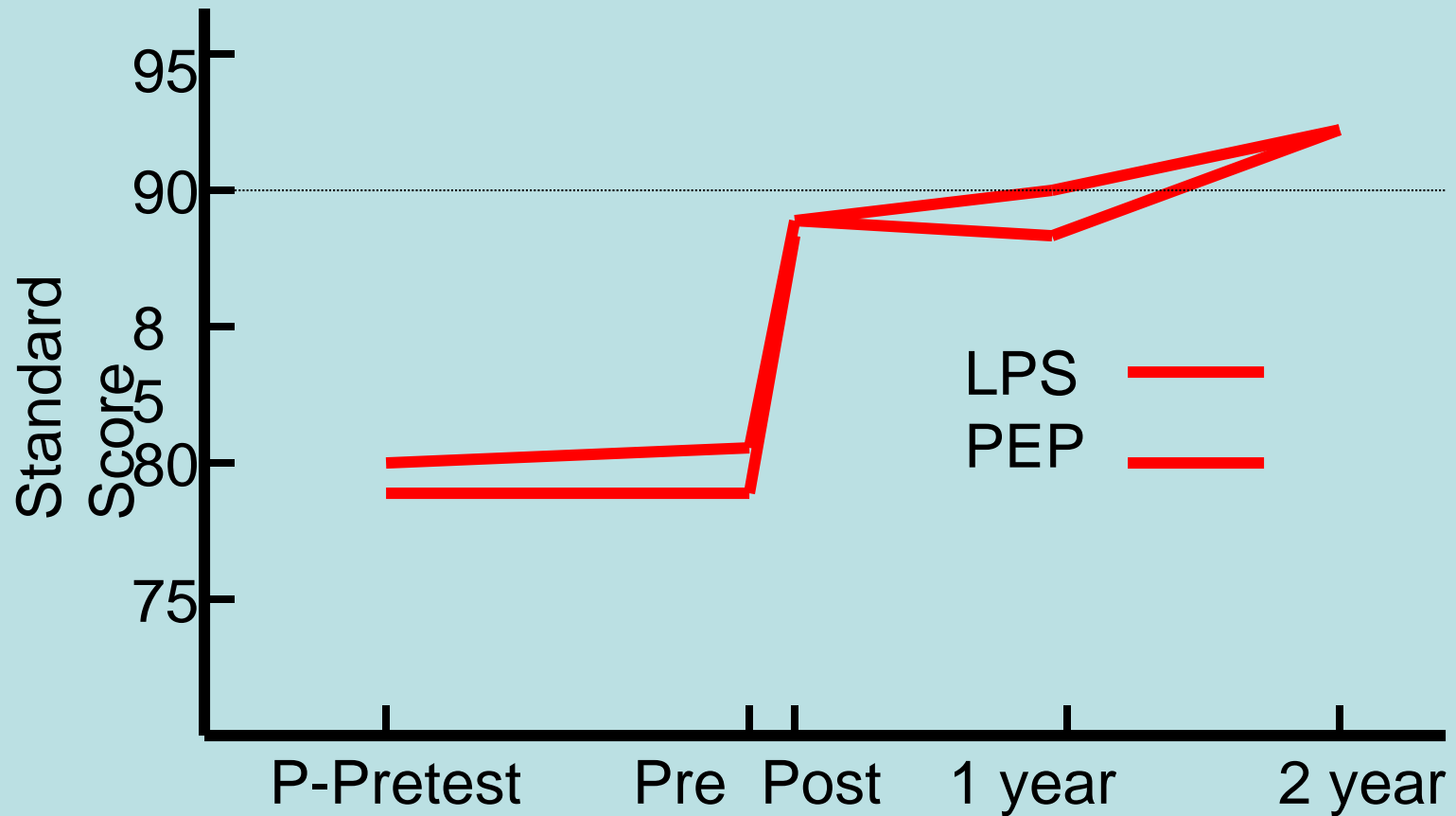




# *Remediation is not a solution!*

- Decoding usually teachable at any age with sufficient intensity, but automaticity problems persist
- 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 (exposure and experience, not age)?

# Growth in Total Reading Skill Before, During, and Following Intensive Intervention

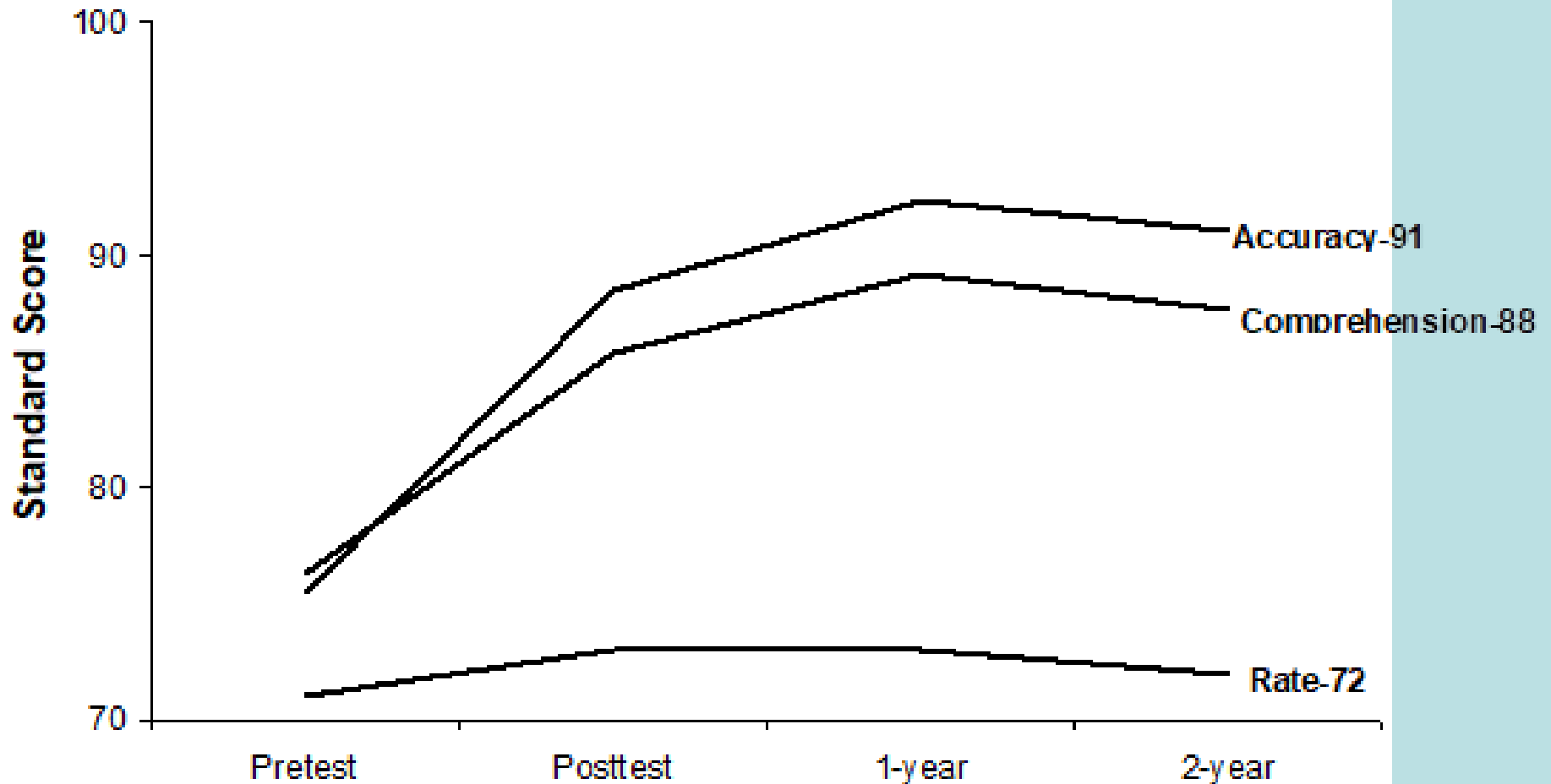


Torgesen et al., 2001

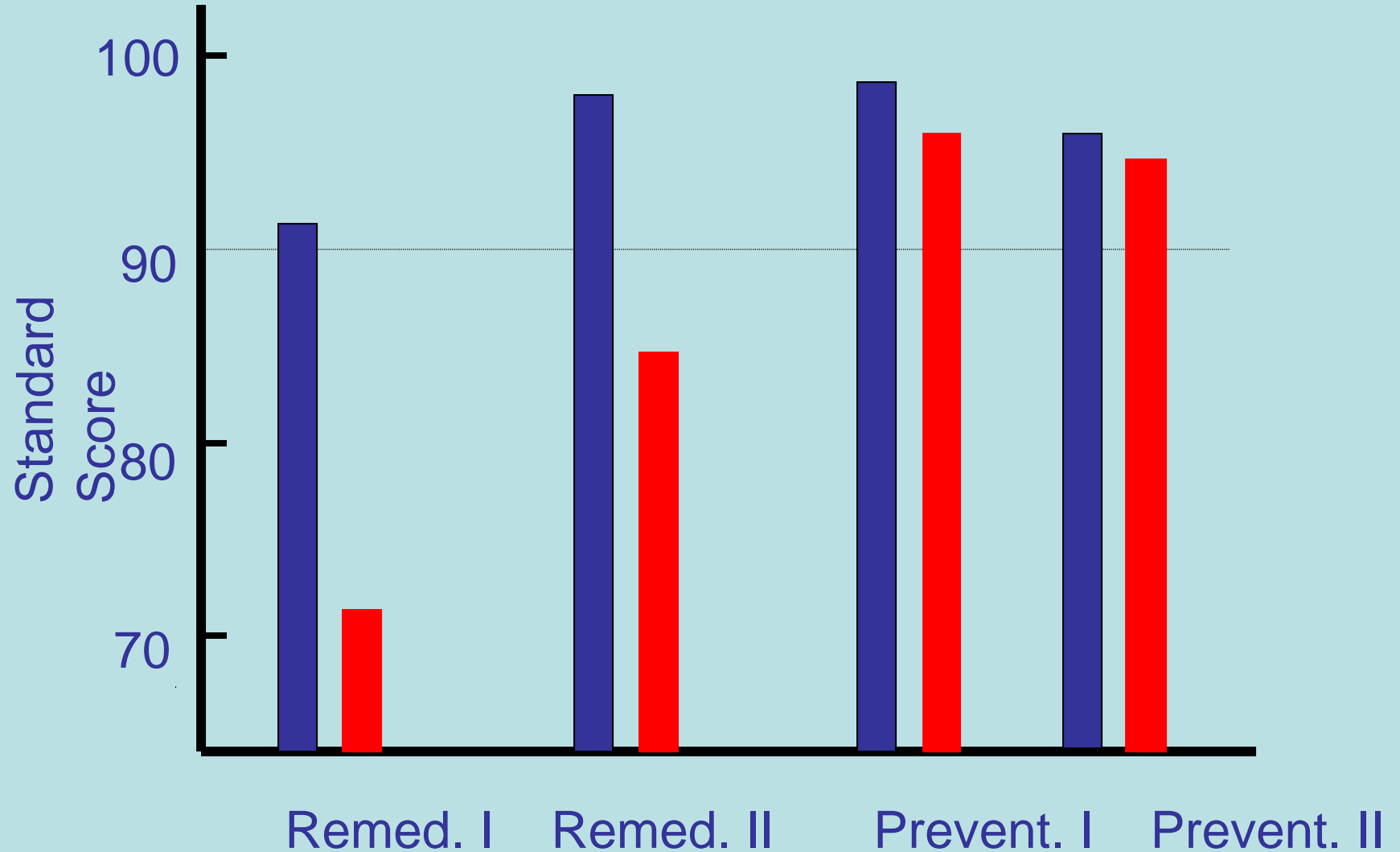
# Time x Activity Analyses for the Two Intervention Approaches

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

# Automaticity!



# Differences in outcomes for Basic Reading Skills and Rate in Prevention vs. Remediation Studies





# Neuroscience explains why

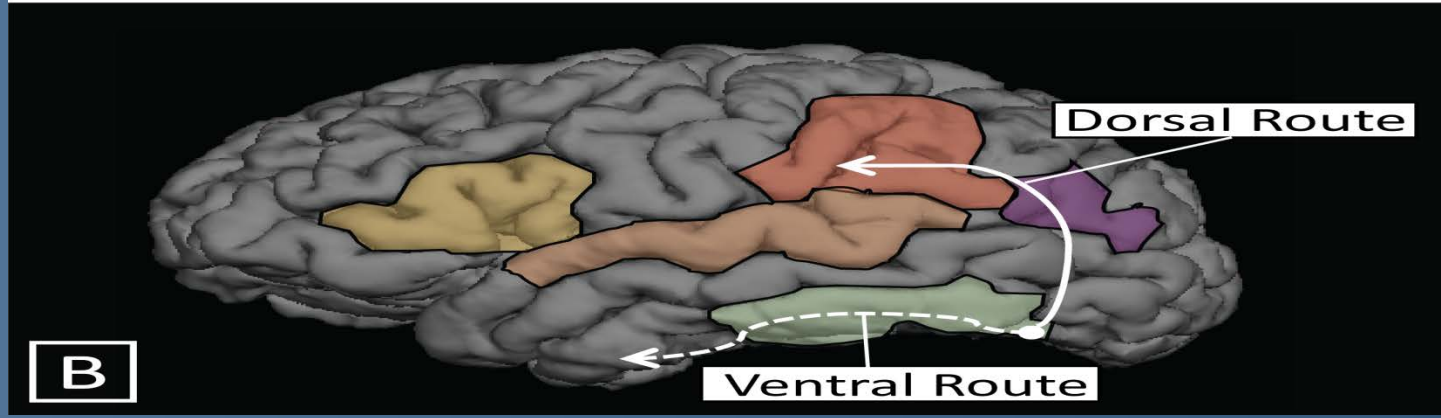
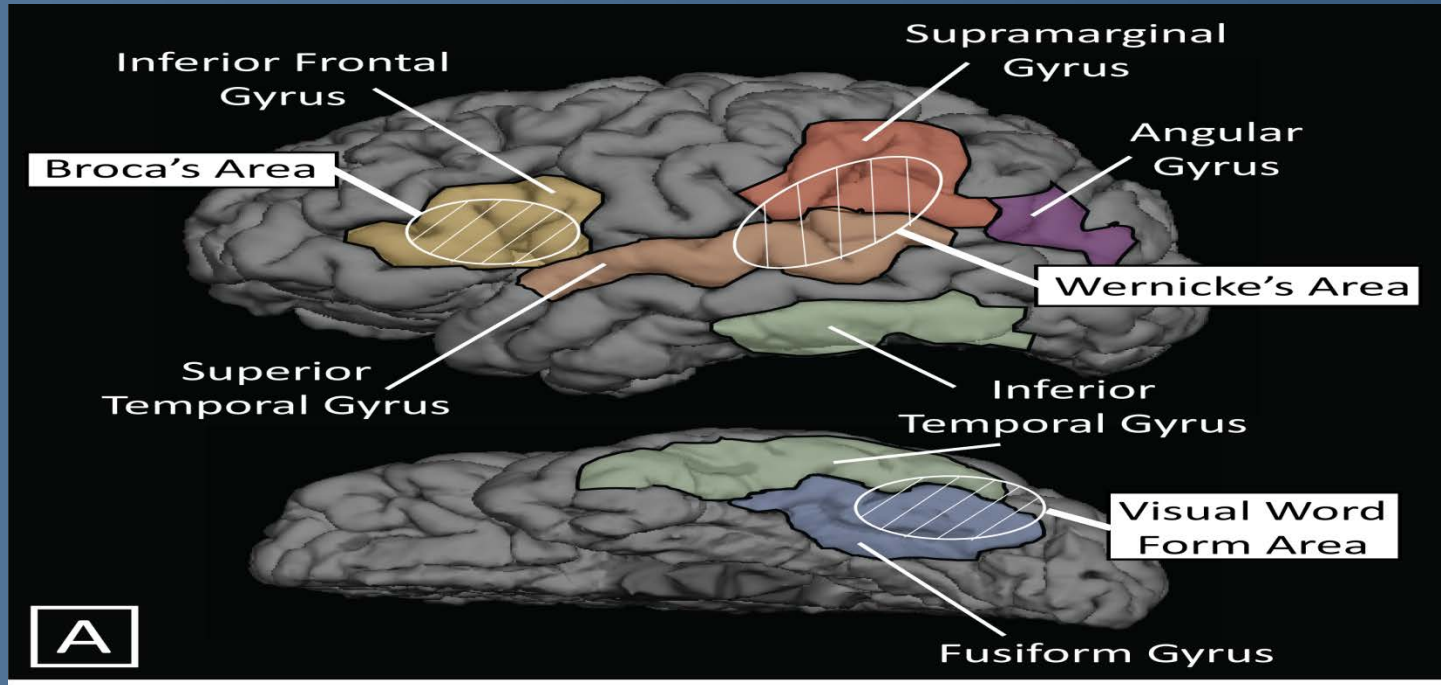
- Two metaphors
  1. Language is parasitic on speech (Liberman; sublexical, dorsal system)
  2. Reading is unlocking language from vision (Dehaene, 2009) or language at the speed of sight (Seidenberg, 2016)
- Malleability in development and in instructional response, but access and experience is key for automaticity
- What does “word blindness” mean?



# Dual Route Theory (Taylor et al., 2013)

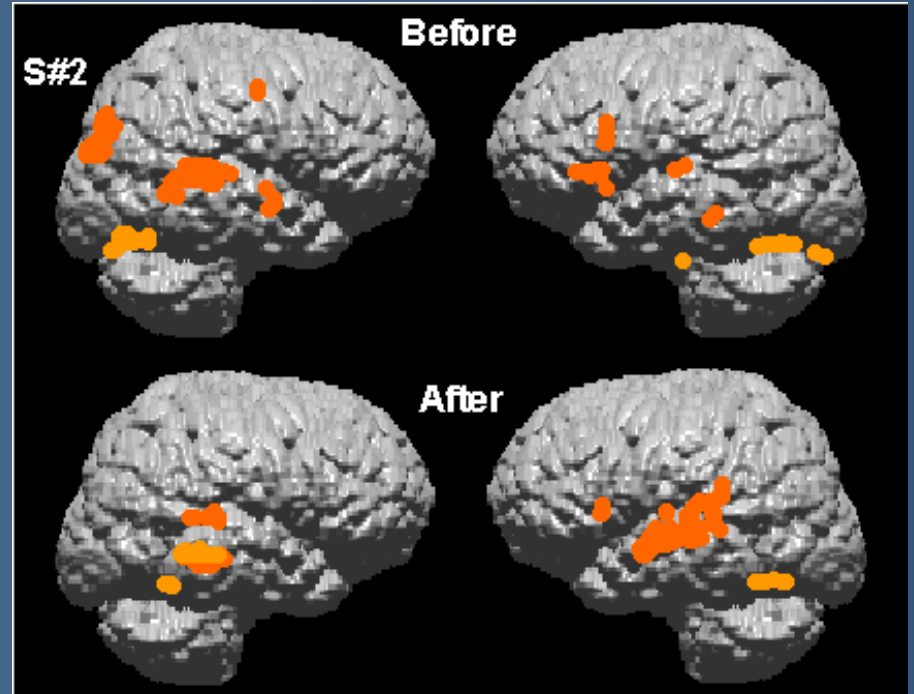
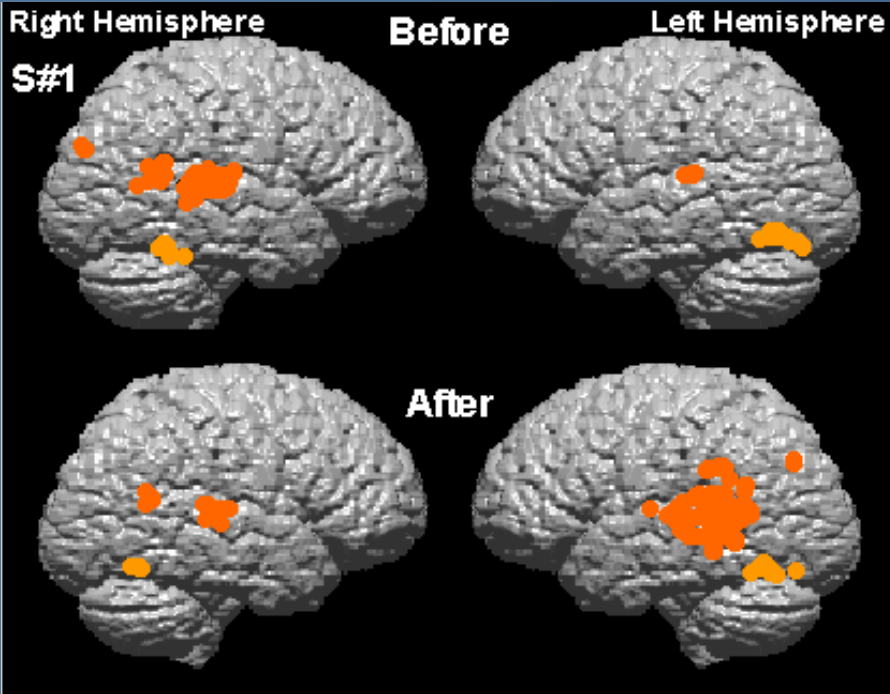
- Dorsal (assembled) route: sublexical, must access phonological representation and identify substituent parts (indirect)- reading is parasitic on language
- Ventral (stipulated or addressed) route: lexical, directly from word form to pronunciation (Reading is unlocking language from vision; language at the speed of sight)
- Operate in parallel depending on the properties of the word

# The Reading Brain





# Neural response to intervention; (Pseudoword Task; Simos et al., 2002)

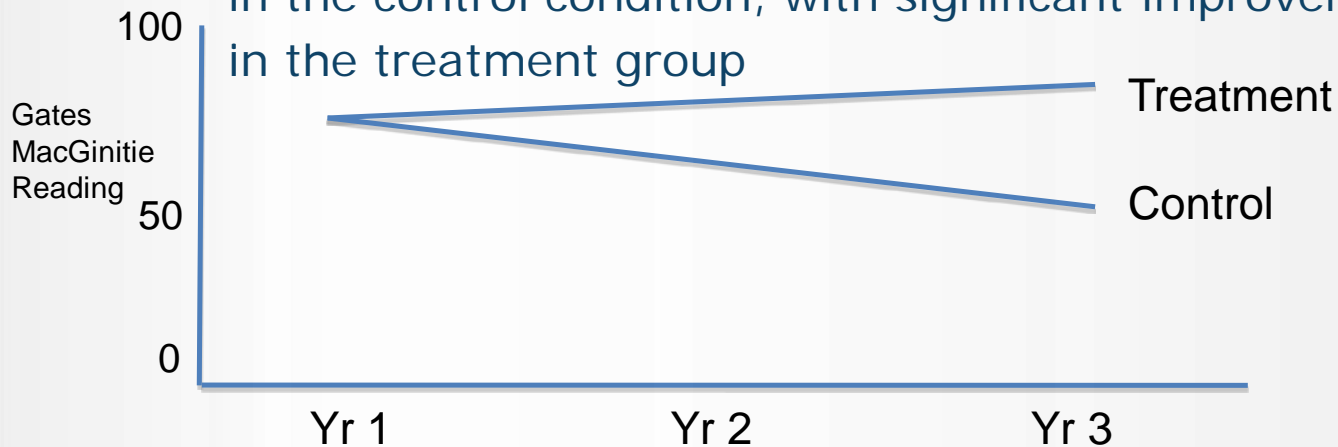


Vaughn et al. 2010; 2011; 2014)

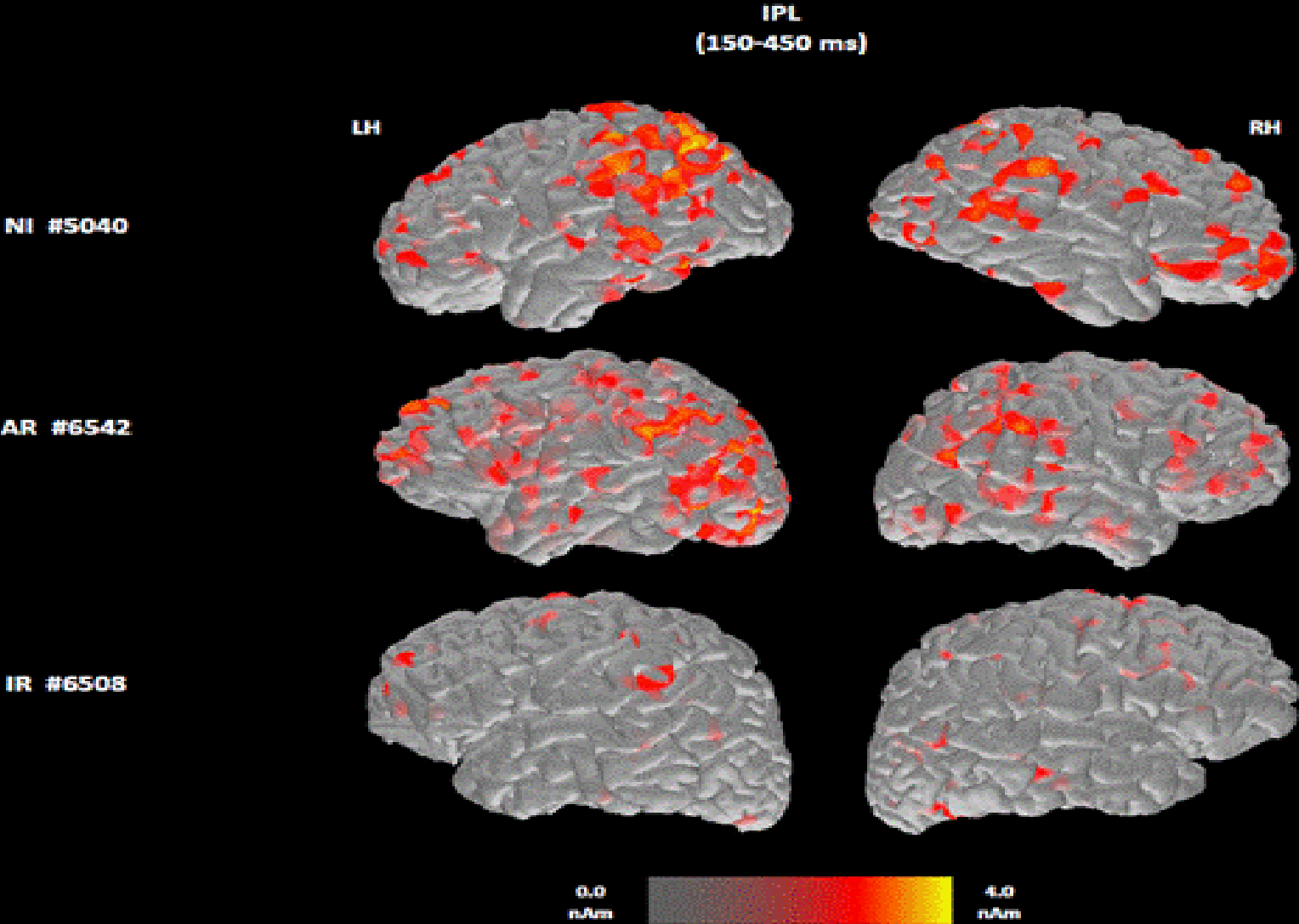


- NICHD middle school studies – intensive interventions for adolescents with severe reading difficulties

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



# Baseline MEG Scans (Rezaie et al., 2011)





# Reading Comprehension Disabilities

- Most children with word level disorders have comprehension problems
- Subset with intact word recognition and deficient comprehension estimated as high as 5-10%
- More apparent in older children



# Important Research Findings

*Disabilities related to comprehension are related to oral language.*

"The comprehension deficit experienced by the poor comprehender is clearly not specific to reading, but rather represents a general language comprehension limitation."

-Stothard & Hulme, 1996



# Interventions: Reading Comprehension

- Teach comprehension strategies explicitly
- Work on oral language development, esp. vocabulary
- Teach learning adjuncts in content: graphic organizers, summarization
- Provide organizational support (works for everyone)



# Three types of interventions

- Structured Cognitive Strategies (summarizing, activating background knowledge, self-monitoring, questioning)
- Text enhancement (highlighting, illustrating, embedded questions)
- Skills reinforcement (reinforcement, repeated reading, vocabulary instruction)
- Usually in small groups with peer leadership (Vaughn et al., 2011)
- Passive reading does not improve comprehension (or fluency). Osmosis doesn't



# Eight strategies that can be effectively taught (NRP)...

- Comprehension monitoring
- Question answering with feedback & correction
- Cooperative learning
- Question generation
- Graphic & semantic organizers
- Summarization
- Story structure questioning (who, what, where, when and why)
- Multiple strategy – using several interactively with teacher





# Written Expression

- Transcription versus generation (Berninger, 2004)
  1. Transcription: production of letters and spelling that is necessary to translate ideas into a written product.
  2. Generation: translation of ideas into language representations that must be organized, stored, and then retrieved from memory



# Intervention

- For transcription difficulties, teach handwriting and spelling; permit adjuncts- word processors, keyboards, spell checks, and minimize demands for motor output- in older students
- For generation problems, teach written expression as a self regulation strategy; permit oral expression (if it really is specific to writing) and dictation as compensatory approaches for older students who have not responded to instruction



# Interventions: Generation (Harris et al., 2008)

## Self- Regulated Strategy Development

- Pick a topic
- Organize a plan
- Modify the plan while writing
- Self regulation- set goals and monitor progress (use graphs)
- Harris et al: Powerful Writing Strategies for All Students (Paul Brookes)



# Graham et al. (2012) meta-analysis: Google Writing Next

1. Overall efficacy of writing interventions: .55
2. Strategy instruction: 1.02  
---SRSD: 1.17; other approaches: .59
4. Peer Assistance: .89
5. Teaching transcription: .55
6. Teaching text structure: .59
7. Product goals: .71



# Graham et al. meta-analysis

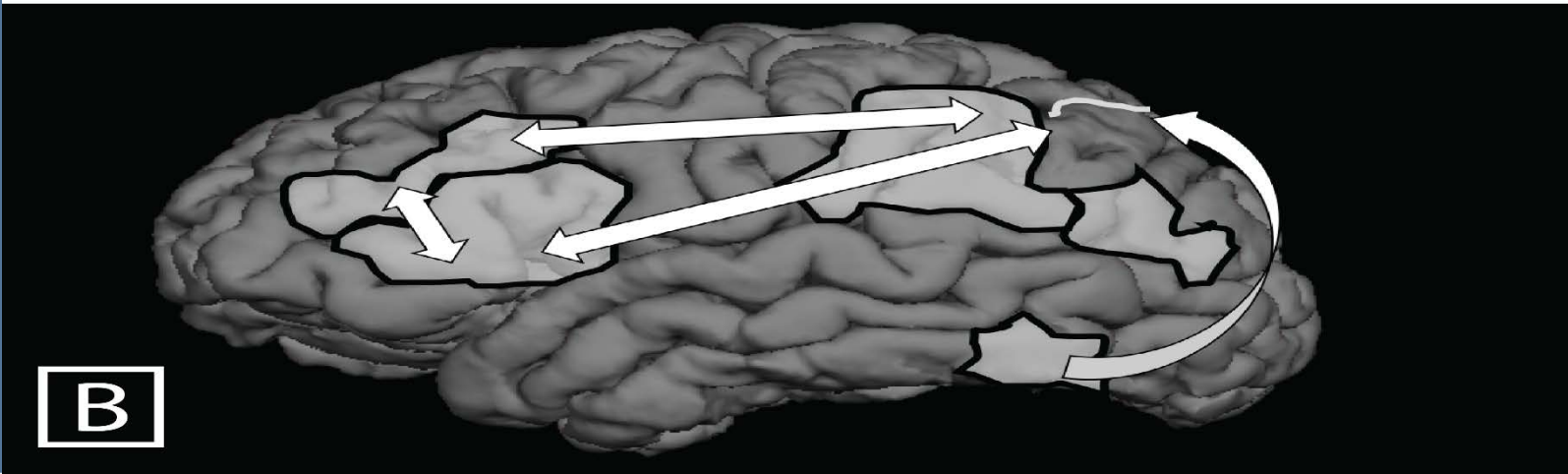
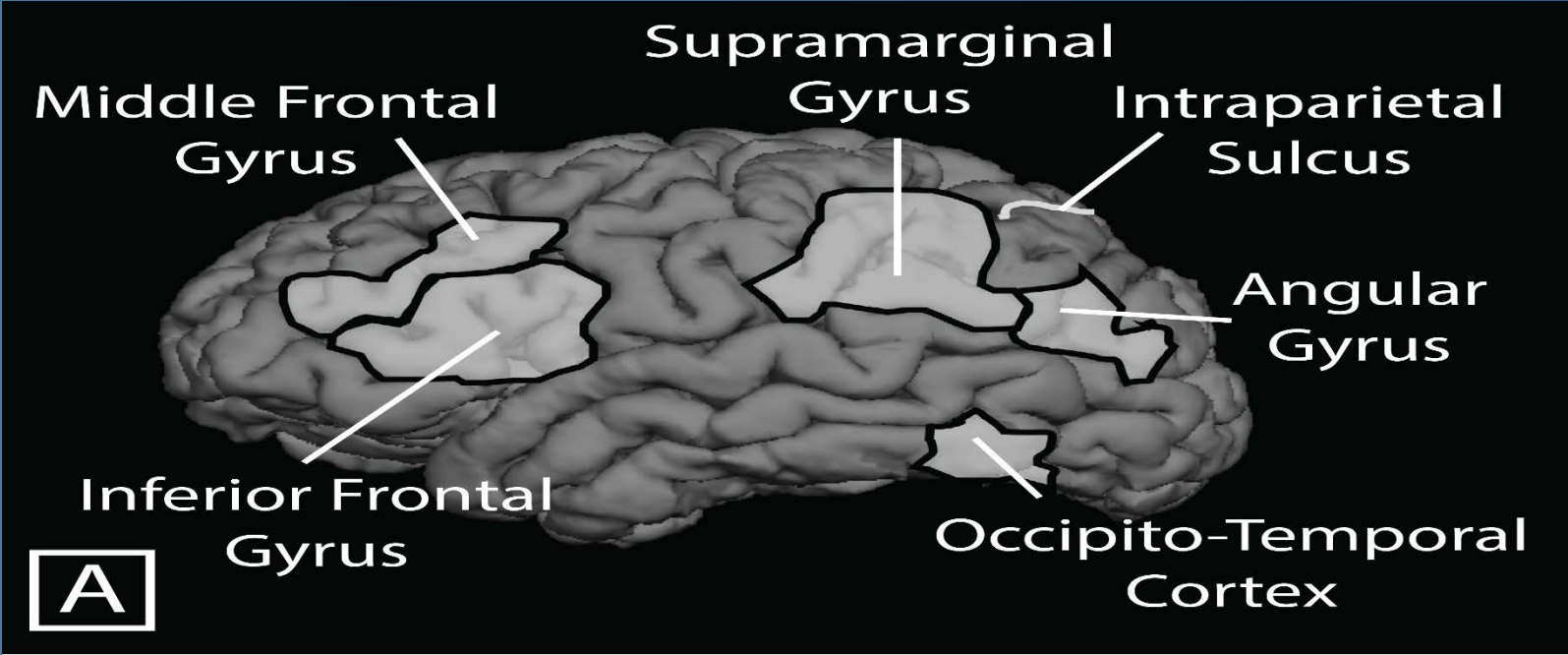
- 8. Word processing: .43
- 9. Process approach: .40
- 10. Prewriting activities: .54
- 11. Composing: .30
- 12. Imagery/Creativity instruction: .70
- 13. Assessment and feedback: .42  
(adult: .80; peer/self: .37)
- 14: Comprehensive programs: .70
- 15. Teaching grammar -.41



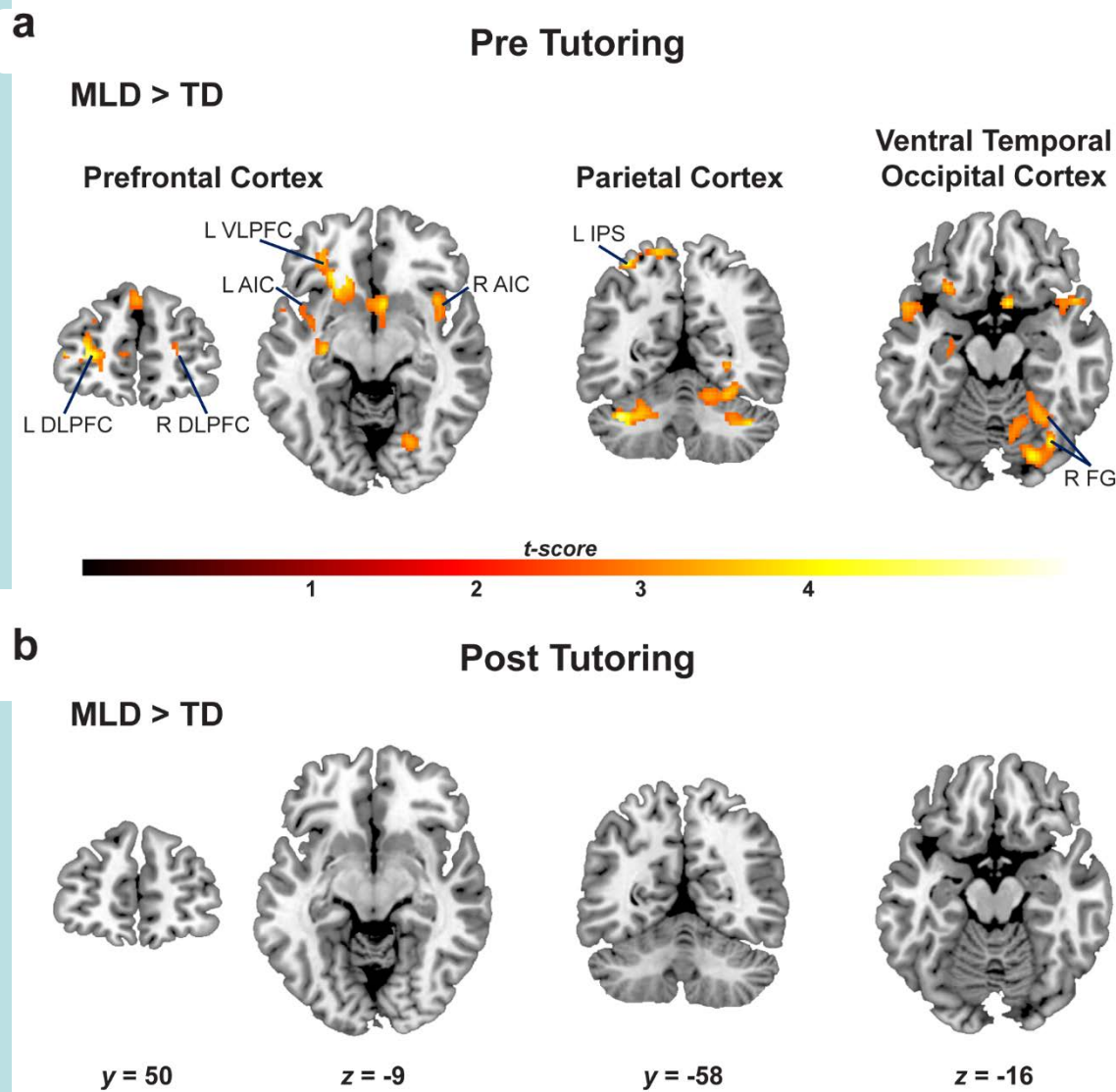
# Math Disabilities (Ansari; Geary; Fuchs)

- Computations vs. Problem Solving
- When problem solving is involved, language (and reading) is more of an issue

# Math and the Brain



# Functional normalization of math with tutoring (Luculano et al., 2015; Stanford Cognitive and Neurosciences Lab, V. Menod, PI)



Before tutoring children with **MLD** showed **over-activation** in multiple brain areas of the PFC, PPC, and VTOC, **compared to TD** children

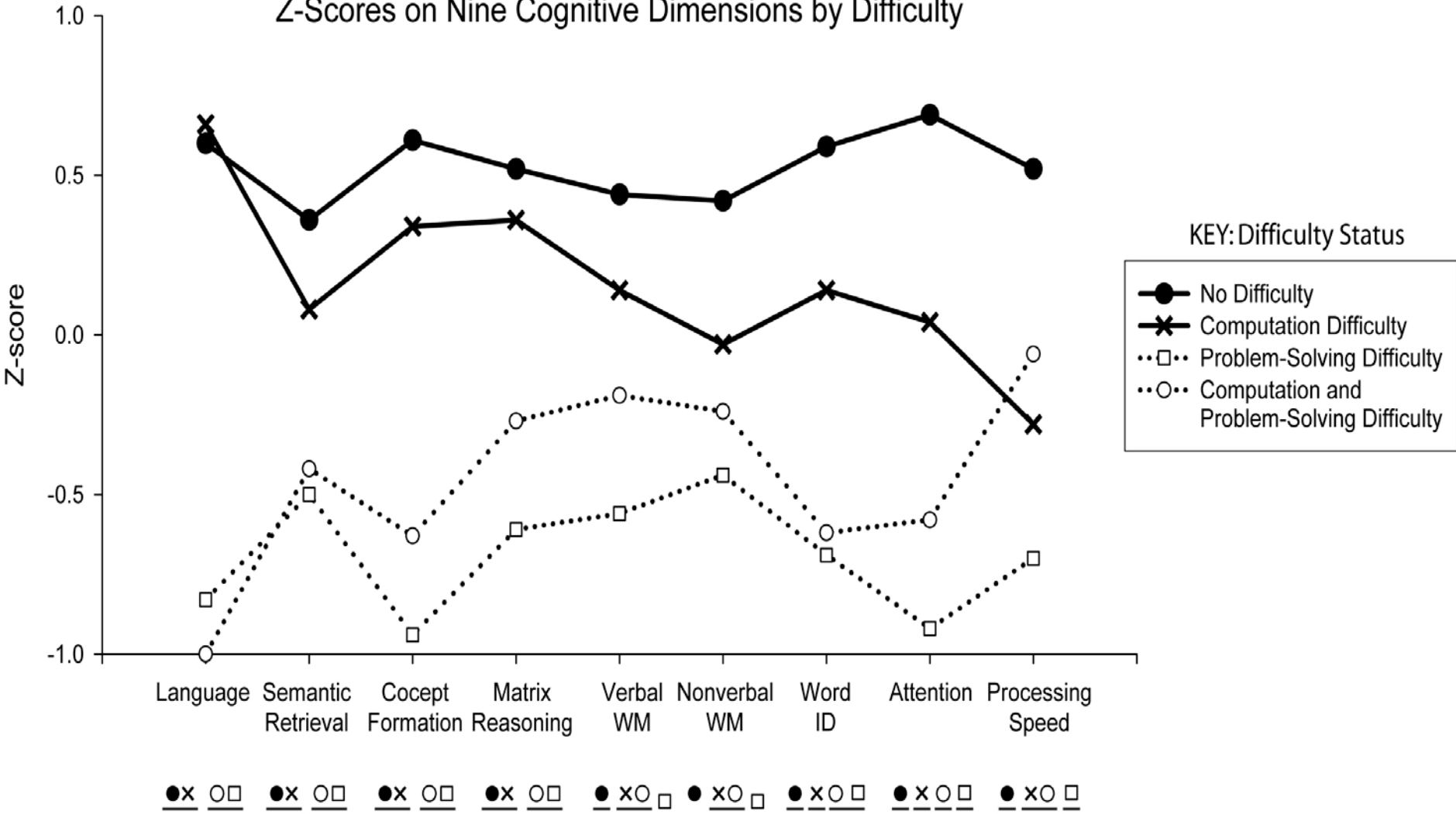
After tutoring **no differences** were evident between MLD children and their TD peers





# Computations vs. Problem Solving (Fuchs et al., 2008)

Z-Scores on Nine Cognitive Dimensions by Difficulty





# Intervention

- For computations, make math as verbal and concrete as possible; teach algorithms as rules; rehearse; practice
- For PS, work on problem solving strategies in content, esp. word problems; teach as a strategic process
- Teach math facts to automaticity (better if in the context of problem solving; Fuchs et al. 2012)
- Permit adjuncts (calculators, graph paper) for older students
- Teach different components explicitly- fact retrieval, procedures, problem solving, estimation
- Promote self- regulation and independence; control attention



# Fuchs et al. (2012)

- No evidence of differential responsiveness to intervention as a function of difficulty status on any outcome.
- Across tutoring conditions and sites, students with MD outperformed students with MDRD at pre- and posttest (severity).
- MF tutoring enhanced fluency with MFs with transfer to procedural calculations but without transfer to algebra or WPs.
- For comparable amount of tutoring time, WP tutoring (with work on foundational skills) enhances WP skill, fluency with MFs, procedural calculations, and algebra.



# Automaticity is a General Issue

- Cumulative practice is key in and out of intervention
- Reading: Repeated Reading and Wide Range of Reading (not just exposure)
- Math: Math facts and procedures
- Writing: Transcription
- Not just processing speed



# Intervention: Some Conclusions

- Effective interventions for reading, numeracy, and written expression are **complex cognitive** therapies more closely tied to domains, and less to disorders; continuum with little evidence of qualitative markers (dimensional view)
- Strong evidence of efficacy for comprehensive and less comprehensive interventions in preschool and Grades K-3 for with effects often moderate to large (.40-.80) **against best practice**
- Generalization to comprehension and other distal measures weaker (outcome measures not sensitive to far transfer?)



# Complex Therapies in Reading and Numeracy

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



# Not every intervention is effective

Pennington et al., 2011, IDA Perspectives, Winter: Reviews of alternative treatments

- Older version of Fast ForWord®, exercise and movement training, low level vision and oculomotor training show little evidence of efficacy for children with reading problems



# Some General Remedial Principles

- Prevent
- Remedial interventions must increase intensity and differentiation: increase time on task, reduce group size, and differentiate
- Whenever possible, interventions should supplement, not supplant
- No intervention is effective outside the academic skill (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
- Progress must be assessed at all levels





# 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



# All professionals must...

- Focus on assessment of academic skills and move students to intervention as soon as possible- look at progress and *academic* strengths and weaknesses
- Address comorbid disorders and other factors
- Become experts on intervention
- Evaluate progress
- Reserve comprehensive evaluations for clearly inadequate responders
- Don't get hung up on process- focus on results



# Who is LD?

- 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



# THANKS

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