



Dyslexia Community of Practice Session 1: Neurobiological Underpinnings of Dyslexia

Jack Fletcher, Professor Emeritus, University of Houston

Sharon Vaughn, & Elizabeth Stevens

mimtsstac.org



Dyslexia Community of Practice Facilitators:



Sharon Vaughn, PhD
Professor, The University of Texas at Austin
Executive Director, Meadows Center for Preventing
Educational Risk



Elizabeth Stevens, PhD
Associate Professor, University of Kansas



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Our Esteemed Guest for Today's Presentation:

The content for this training day was developed based on the work
of:



Jack Fletcher, PhD
Professor Emeritus
The University of Houston

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A Note about Recording



- We are recording this session so the content may be available to:
 - Others in our Dyslexia Community of Practice who were unable to attend today
 - You! If you want to refer to this session later, it's available to you.
- Rest assured the recordings will not be made publicly available, so we hope you'll share your ideas freely within this safe space.

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Training Effectiveness

- At the end of the session, you will be asked to provide feedback on today's training
- Results will be used to make improvements to professional learning and for reporting to TA Center stakeholders
- One of the feedback questions you will see is related to promoting and positively portraying diversity among educators and learners (e.g., focus on asset-based language, positive representation of multiple identities)

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Group Agreements

We are Responsible

- Return on time from breaks
- Take care of our needs

We are Engaged

- Share what you know and ask questions
- Plan to participate in multiple ways
 - Chat, breakout rooms, polls, reactions, unmute
 - Ask questions

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We want to hear from you!

- ✓ We are committed to making this time engaging and meaningful to support your learning as a teacher and coach.
- ✓ When you see these icons, please join in the conversation via the chat or in your breakout sessions.



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MiMTSS Dyslexia CoP Session Schedule

Date	Time	Topic
→ September 9, 2025	2:00-3:30pm ET	The Neurobiological Underpinnings of Dyslexia
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March 26, 2026	3:00-4:30pm ET	Using Data to Inform Instruction
April 20, 2026	11:00am-12:30pm ET	Deliberate Practice and Feedback: The Secret Sauce

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Agenda

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2:10-2:50	Content presentation	
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Objectives

- 1 **Define** the Science of Reading (i.e., what it *is*, what it is *not*).
- 2 **Identify** myths or misconceptions about the Science of Reading.
- 3 **Explain** why these are misconceptions using your knowledge of the research.
- 4 **Identify** implications for practice.
- 5 **Explain** how you will apply today's learning in your teaching and/or coaching role.

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Neurobiological Correlates of Dyslexia: Effects of Reading Instruction on Brain Function

Jack M. Fletcher, Ph.D.
Department of Psychology, University of Houston

jackfletcher@uh.edu
www.texasldcenter.org

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Dyslexia, Reading, and the Brain

- 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, a word level reading problem
- 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)
- What is the relation of dyslexia and the brain?
- How does reading instruction affect brain function (and structure)?

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Dyslexia is a Word Level Disorder

Most common and best understood form of LD (Dyslexia)

- 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
- Key to overcoming dyslexia is to **prevent** it through MTSS, with intensive remediation for inadequate responders

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What is Dyslexia?

- Dyslexia occurs primarily at the **level of the single word**
- Involves the ability to **decode** and **spell** printed words in isolation (accurate)
- Leads to problems reading text, but is not a text level disability
- Word problems in reading and spelling are strongly associated with problems segmenting words and syllables into phonemes.

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Alphabetic Principle

- Print represents speech through the alphabet or other visual symbol
- Regardless of surface appearance (orthography), words represent internal units based on sound (phonemes)
- In learning to read, the child makes explicit an implicit understanding that words have internal structures linked to sounds (phonological awareness)
- Reading is parasitic on language

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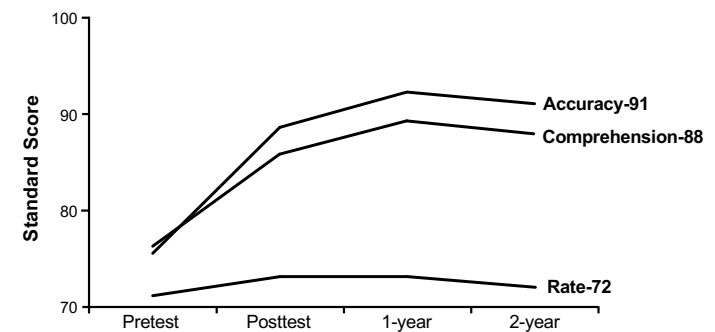
Identification (Science, not Policy)

- Dyslexia is best identified through **assessments of reading and spelling skills, and instructional response**. Cannot be identified independently of instruction
- IQ tests are not necessary (Dyslexia is uncoupled from IQ): Methods for identification of LD based on IQ-discrepancy or patterns of cognitive strengths and weaknesses lack validity.
- Documentation of processing deficits not required.

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Torgesen et al. (2001)



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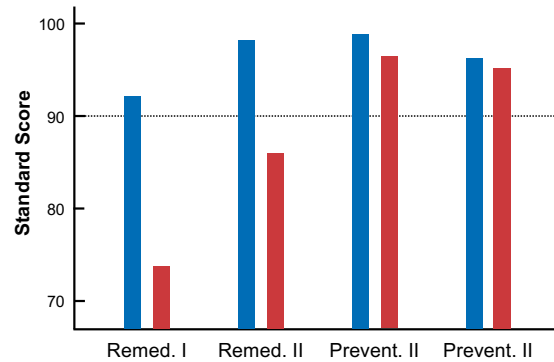


- ✓ Dyslexia can (often) be **prevented**.
- ✓ Remediation requires much more **intensity**
- ✓ Skills that prevent dyslexia must be taught **early** in school
- ✓ Remediation **after Grade 2** demonstrably less effective (Connor; Lovett): diminishing returns

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



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Remediation is Not a Solution to Overcoming Dyslexia!

- Decoding usually teachable at any age with sufficient intensity
- 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)?

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Neuroscience Explains Why

- Two metaphors
 1. Reading is parasitic on speech (Liberman; sublexical, dorsal system)
 2. Reading is unlocking language from vision (Dehaene) or language at the speed of sight (Seidenberg)
- Malleability in development and in instructional response, but access and experience is key for automaticity

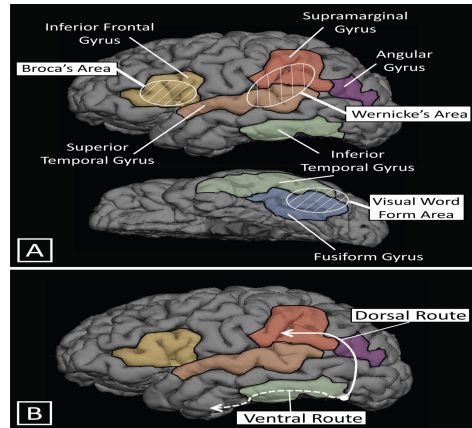
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Dual Route Theory

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

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The Reading Brain

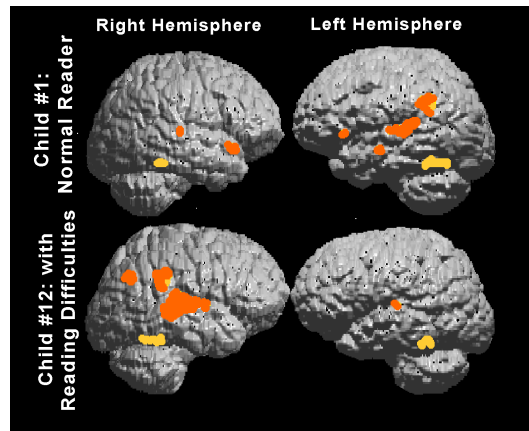


Functional and Structural Neuroimaging



Center for Clinical Neuroscience, Children's Learning Institute;
A.C. Papanicolaou, U of Texas Health Science Center- Houston
(P.G. Simos, Jenifer Juranek, Roozbeh Rezaie)

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)

Neural Response to Intensive Intervention

- Demographic Information

Child	Gender	Age (years/mo)	WJ-III Pre (%)	WJ-III Post (%)	IQ	Medication
1	M	15	13	55	103	Adderall
2	M	10	2	59	95	Ritalin
3	M	10	2	38	110	Ritalin
4	F	8	3	55	105	Ritalin
5	F	7	2	50	110	Ritalin
6	M	7	18	60	101	—
7	M	11	1	38	98	Ritalin
8	M	17	1	45	102	—

Simos et al., *Neurology*, 2002

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Early Development of Reading Skills: A Cognitive Neuroscience Approach (Jack M. Fletcher – PI)

Grade 1 Multi-tiered Intervention

- Patricia Mathes and Carolyn Denton: **Early Reading Intervention** (Mathes et al., *RRQ*, 2005; Denton et al., *JLD*, 2006)
- A. Papanicolaou and P. Simos: **Brain Activation Patterns** (Simos et al., *Neuropsychology*, 2005; 2007; *JLD*, 2007)



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The Core Sample

Children: two Grade 1 cohorts sampled across 2 years (2001–2002)

- 300 At-Risk Readers - assigned randomly to intervention in Grade 1 (two small group tutorial, one Enhanced Classroom Intervention); all programs in each school
- 100 Low Risk Readers

Teachers

- 6 Intervention teachers; 30 General education 1st-grade Teachers

Schools

- 6 elementary schools in a large urban school district

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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

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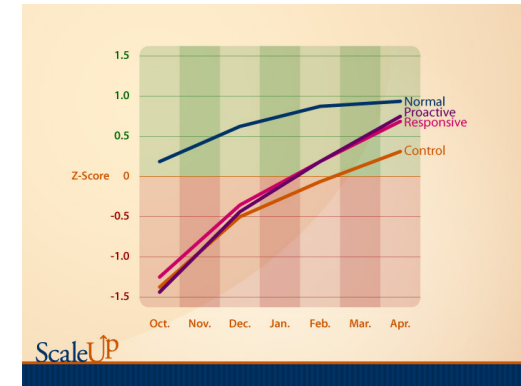
Comparison of Pullout Interventions

- 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



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Growth in Fluency by Intervention



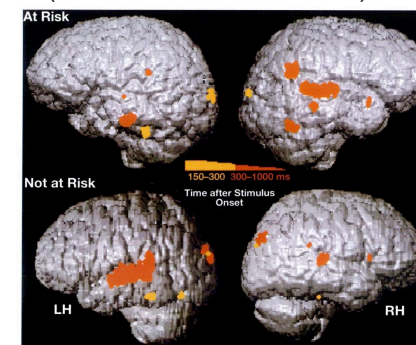
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What Percentage of Children Don't Respond Adequately to Quality Intervention?

- **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)

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Brain Activation Profiles Before Intervention (End K; Letter sound task)

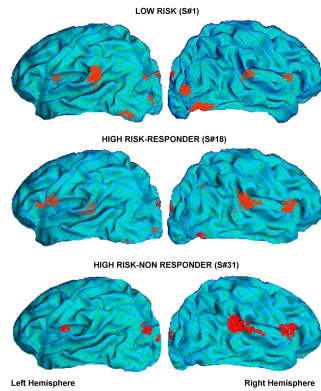


N = 45 children
(6 yrs old)

Simos et al., *J Child Neurology*, 2002

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After Grade 1 Intervention (pseudoword task)

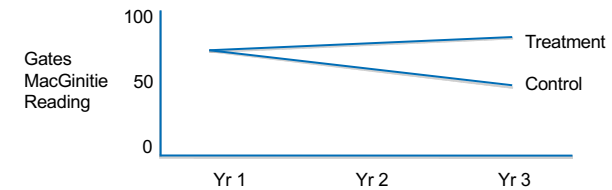


- Simos et al., *Neuropsychology*, 2005
– After Grade 1 intervention in Mathes et al. (RRQ, 2005)

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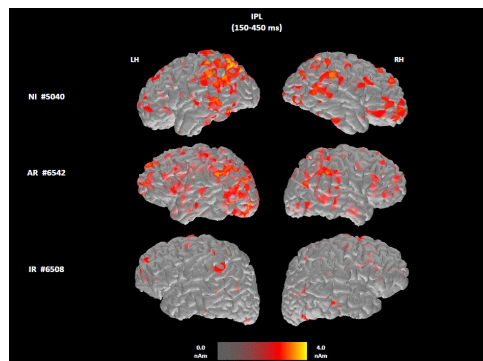
NICHD Middle School Studies – Intensive interventions for adolescents with severe reading difficulties

- 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



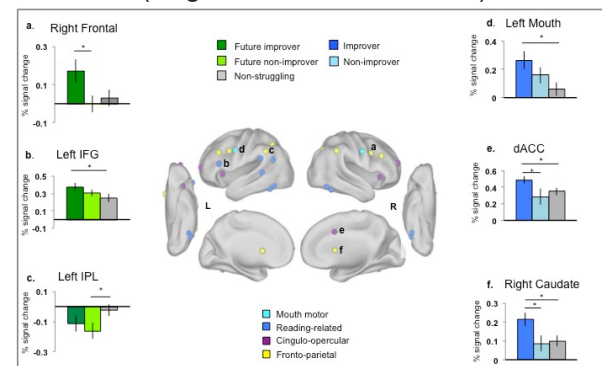
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Baseline MEG Patterns for Adolescent Adequate and Inadequate Responders



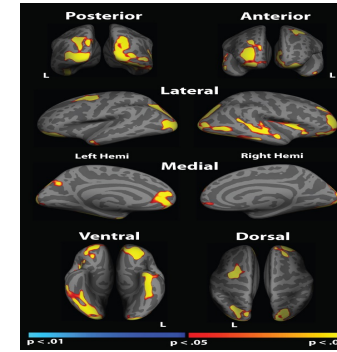
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What About Reading Comprehension? (Nugiel, Church et al., 2019)



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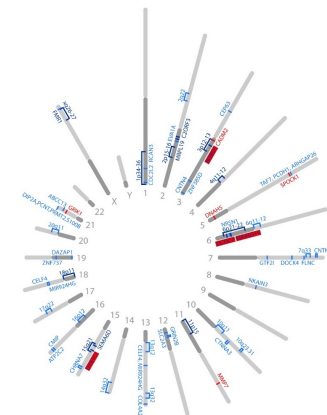
- Brain function is malleable—but some children do not respond to intervention
- Differences in brain structure and function apparent before instruction in children with familial risk (Gaab)
- Tend to correspond with areas identified in functional studies
- If a child is not adequately taught, their brain will appear “dyslexic”
- Must embrace the concept of RISK



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- Reading, math, and writing are heritable traits, but individual gene effects small
- In reading and math, heredity accounts for 50–80% of variance in outcomes
- No genes specific to poor development (e.g., no dyslexia genes)
- Genetic correlation increases with grade (Olson et al., 2014)-effect of schooling
- Move away from “bad- gene, bad brain” theory to the idea of genomic organizations that make brains at risk and risk modified by environment:

Biology is not destiny-risk/resilience models



Is Brain Plasticity an Issue?

- The neural systems underlying reading seem malleable, show plasticity across the age range, and are not disorder-specific; continuum of severity (Vellutino).
- Mostly normalizing, not compensatory
- Don't know enough about inadequate responders
- Need to tie functional results to structural correlates (gray matter increases with intervention (Eden) and parallels differences in literate and illiterate adults (Castro-Caldes); coregister across imaging modalities
- Are neuroimaging measures effective predictors of growth and intervention response?

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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 in development and instructional response

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Reading Sculpts the Brain (Eden), but Must Be Taught (Moats, Foorman, Vaughn)!!

We are all born with dyslexia... good at speech, but disabled as readers and writers; the difference among us in reading/writing is simply that some are fairly easy to cure and some are not. - Liberman, 1996

jackfletcher@uh.edu
Support: NICHD grant P50 HD052117

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Reminder: Our Breakout Room Norms

- Identify the **facilitator** who will lead discussion and keep the group moving forward
- Identify a **notetaker** who will document key ideas and share those with the larger group (in the chart or aloud)
- Identify a **timekeeper** who will keep track of time and support with making sure the group answers all questions



In your breakout rooms...



- In your break out room discuss the following and be prepared to bring your thoughts back to the group.

“Ms. Michaelson, a fourth grade teacher, indicated that she had several students in her class who were reading more than 2 grade levels below grade level. She asked you how she could determine if the students had dyslexia? How would you explain dyslexia to Ms. Michaelson?”

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Let's debrief!

What questions do you have for us related to...

- Lessons learned from today
- Action steps

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More Resources to Explore

Fletcher, J. M., & Miciak, J. (2019). The identification of specific learning disabilities: A summary of research on best practices. Austin, TX: Texas Center for Learning Disabilities.

Vaughn, S., & Fletcher, J. M. (2021). Identifying and Teaching Students with Significant Reading Problems. *American Educator*, 44(4), 4.

Fletcher, J. M., Francis, D. J., Foorman, B. R., & Schatschneider, C. (2021). Early detection of dyslexia risk: Development of brief, teacher-administered screens. *Learning Disability Quarterly*, 44(3), 145-157.

Fletcher, J. M. Identifying Students at Risk for Reading Difficulty - *This is not an article but Dr. Fletcher's webinar companion document.*



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What's coming up?

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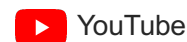
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