The Pediatric Brain, Learning Disabilities, and Screening Tools for Literacy Milestones and Dyslexia

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GAAB LAB

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GRADUATE SCHOOL OF EDUCATION

# When does reading development start?

(Frederico Clapis)

Learning to read is a process that requires the mastering of a series of developmental stages in response to environmental input, starting with language processing in utero and ending with proficient reading years later (e.g., Chall, 1983).

Learning to read is **NOT** a natural process
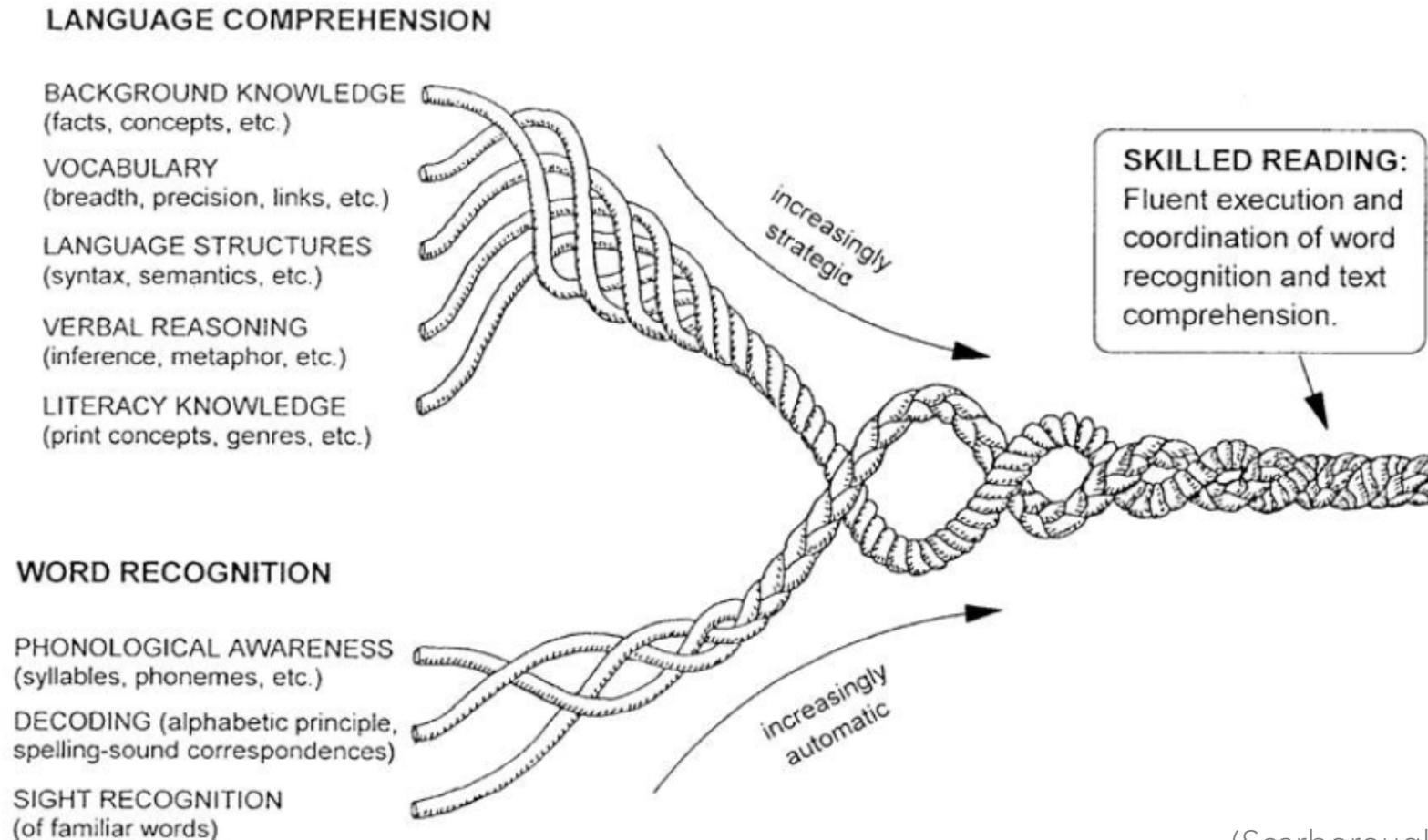
Typical reading development
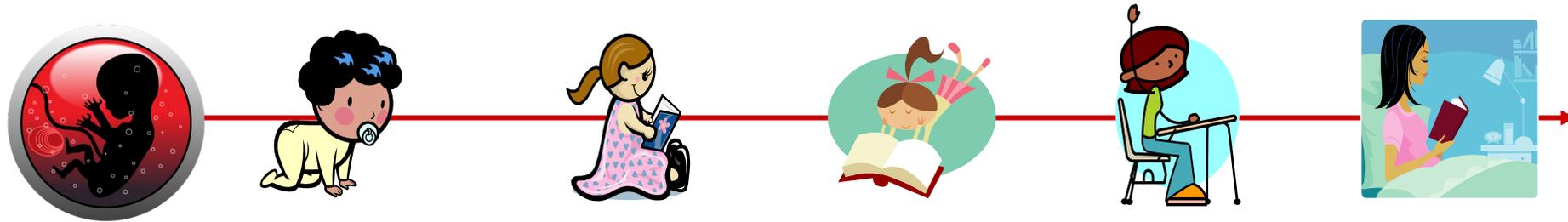
Learning to read $\longrightarrow$ Reading to learn

Theoretical models suggest a dynamic interplay between lower-level foundational and cognitive-linguistic skills

LANGUAGE COMPREHENSION

BACKGROUND KNOWLEDGE
(facts, concepts, etc.)

VOCABULARY
(breadth, precision, links, etc.)

LANGUAGE STRUCTURES
(syntax, semantics, etc.)

VERBAL REASONING
(inference, metaphor, etc.)

LITERACY KNOWLEDGE
(print concepts, genres, etc.)

increasingly strategic

SKILLED READING:
Fluent execution and coordination of word recognition and text comprehension.

WORD RECOGNITION

PHONOLOGICAL AWARENESS
(syllables, phonemes, etc.)

DECODING (alphabetic principle, spelling-sound correspondences)

SIGHT RECOGNITION
(of familiar words)

increasingly automatic

(Scarborough, 2001)

The "Science of Reading"

- Evidence to inform how proficient reading and writing develop; why some have difficulty; and how we can most effectively assess and teach and, therefore, improve student outcomes through prevention of and intervention for reading difficulties.

- The science of reading is NOT:

- an ideology or philosophy,

- a fad, trend, new idea, or pendulum swing,

- a political agenda,

- a one-size-fits-all approach,

- a program of instruction

- a single, specific component of instruction such as phonics

Every child has the right to learn to read well, but...

NAEP NATIONAL ASSESSMENT OF EDUCATIONAL PROGRESS

a congressionally mandated large-scale assessment administered by the National Center for Education Statistics (NCES).

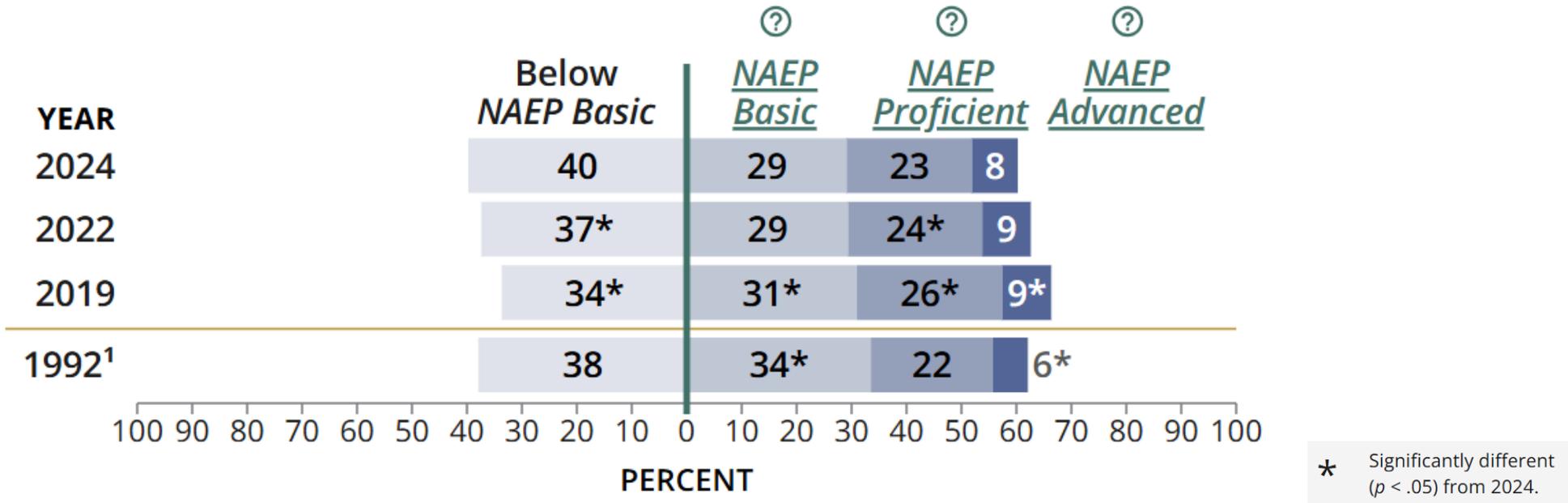| YEAR	Below NAEP Basic	NAEP Basic	NAEP Proficient	NAEP Advanced
2024	40	29	23	8
2022	37*	29	24*	9
2019	34*	31*	26*	9*
1992[1]	38	34*	22	6*

100 90 80 70 60 50 40 30 20 10 0 10 20 30 40 50 60 70 80 90 100

PERCENT

* Significantly different (*p* < .05) from 2024.

FIGURE | Trend in fourth-grade NAEP reading achievement-level results

National Center for Education Statistics (2024)

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Low reading skills are tied to

→low self-esteem, feelings of shame, inadequacy, and helplessness (e.g., Valas, 1999).

→greater risk for developing internalizing or externalizing symptoms (e.g., Hendren et al., 2018).

→lower education levels, less income, increased health issues, higher incarceration and poverty rates (e.g., Moody et al 2000).

The National Council for Adult Learning estimates that low literacy skills cost the U.S. at least $225 billion each year.

What is Developmental Dyslexia?

Affects 7-12% of children in English-speaking countries (**about 2-3 in each classroom**)

- difficulties with accurate and/or fluent word reading
- poor spelling and decoding abilities

Heritability estimates are 40-60%

(Grigorenko et al., 2020)

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Recognizing Psychiatric Comorbidity With Reading Disorders

Robert L. Hendren[1,2*], Stephanie L. Haft[1], Jessica M. Black[3], Nancy Cushen White[2,4] and Fumiko Hoeft[1,2,5,6,7]
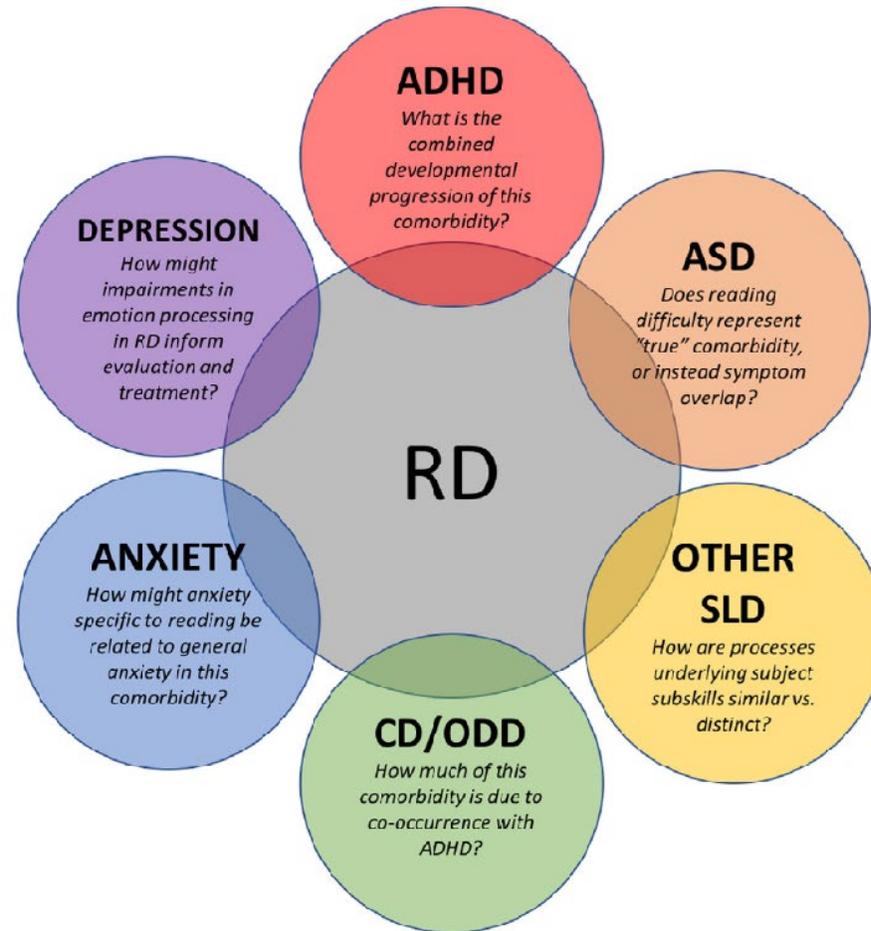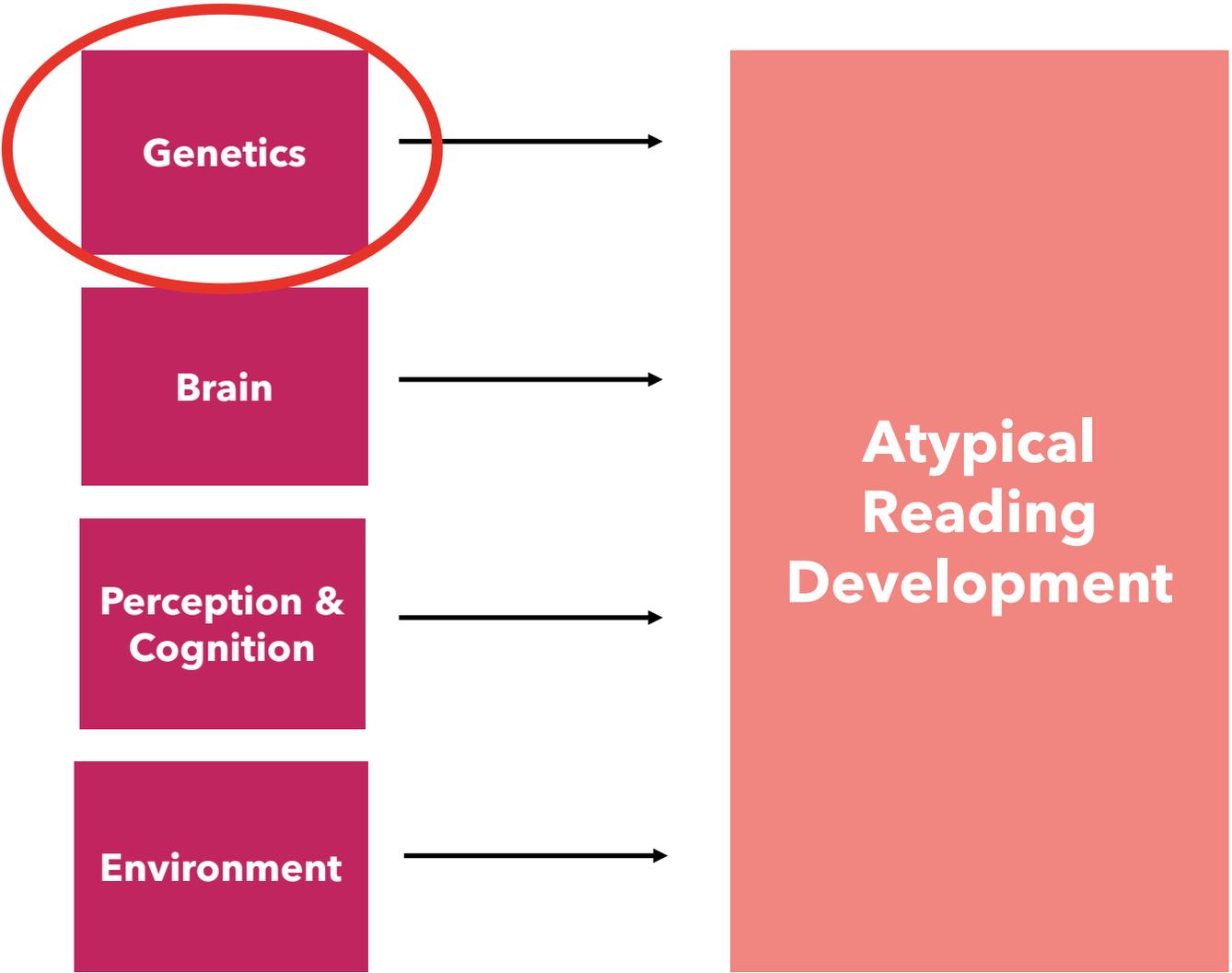

FIGURE 1 | Current issues, areas of investigation, and suggestions for future research in conditions commonly occurring with RD in children. RD, reading disorder; ADHD, attention deficit hyperactivity disorder; ASD, autism spectrum disorder; SLD, specific learning disorder; CD, conduct disorder; ODD, oppositional defiant disorder.

Factors contributing to reading disabilities

Genetics

Brain

Perception & Cognition

Environment

Atypical Reading Development

nature genetics

Discovery of 42 genome-wide significant loci associated with dyslexia

Catherine Doust[1], Pierre Fontanillas[2], Else Eising[3], Scott D. Gordon[4], Zhengjun Wang[5], Gökberk Alagöz[3], Barbara Molz[3], 23andMe Research Team*, Quantitative Trait Working Group of the GenLang Consortium*, Beate St Pourcain[3,6,7], Clyde Francks[3,6], Riccardo E. Marioni[8], Jingjing Zhao[5], Silvia Paracchini[9], Joel B. Talcott[10], Anthony P. Monaco[11], John F. Stein[12], Jeffrey R. Gruen[13], Richard K. Olson[14,15], Erik G. Willcutt[14,15], John C. DeFries[14,15], Bruce F. Pennington[16], Shelley D. Smith[17], Margaret J. Wright[18], Nicholas G. Martin[4], Adam Auton, Timothy C. Bates[1], Simon E. Fisher[3,6] and Michelle Luciano[1]✉

Reading and writing are crucial life skills but roughly one in ten children are affected by dyslexia, which can persist into adulthood. Family studies of dyslexia suggest heritability up to 70%, yet few convincing genetic markers have been found. Here we performed a genome-wide association study of 51,800 adults self-reporting a dyslexia diagnosis and 1,087,070 controls and identified 42 independent genome-wide significant loci: 15 in genes linked to cognitive ability/educational attainment, and 27 new and potentially more specific to dyslexia. We validated 23 loci (13 new) in independent cohorts of Chinese and European ancestry. Genetic etiology of dyslexia was similar between sexes, and genetic covariance with many traits was found, including ambidexterity, but not neuroanatomical measures of language-related circuitry. Dyslexia polygenic scores explained up to 6% of variance in reading traits, and might in future contribute to earlier identification and remediation of dyslexia.
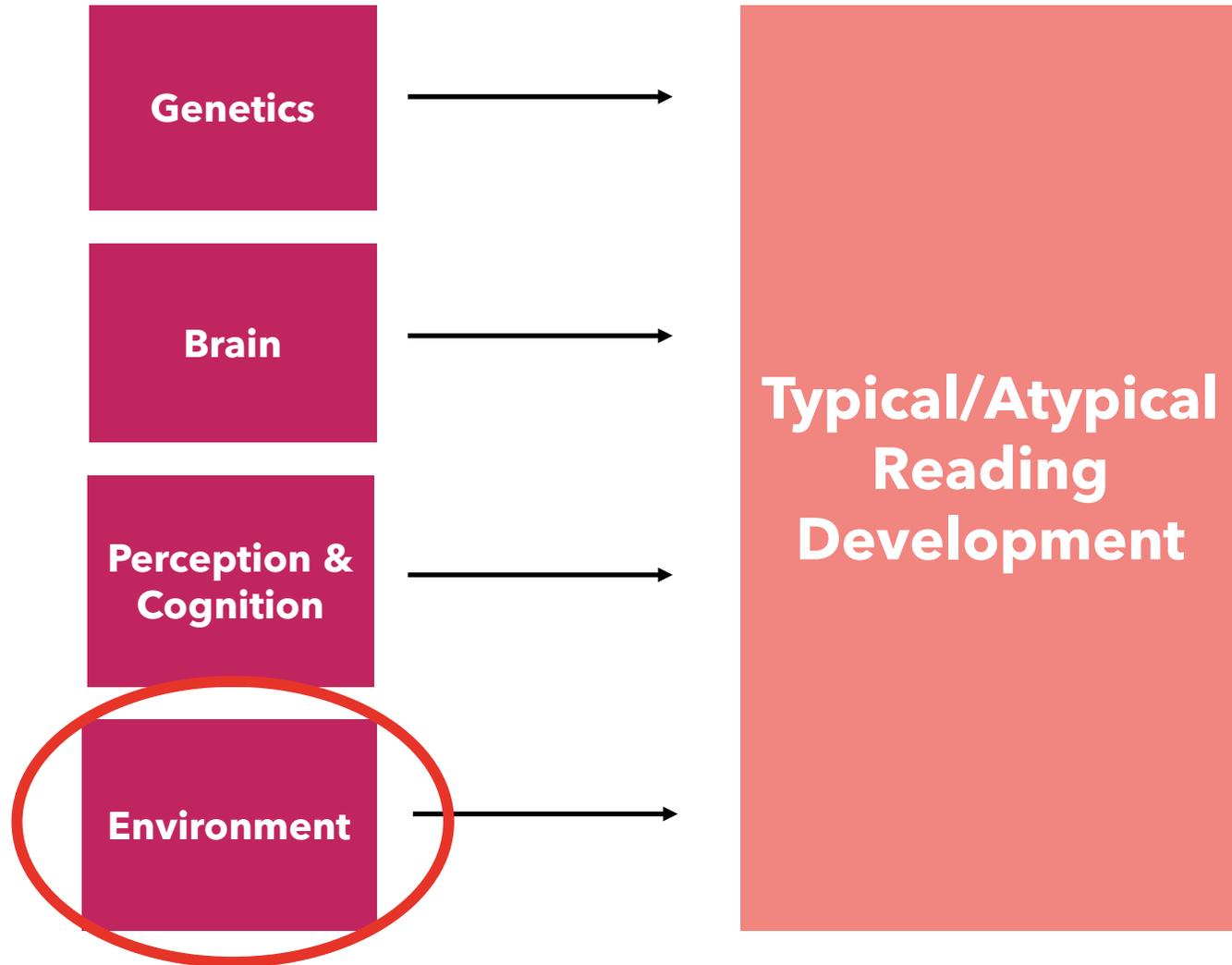
PNAS

Genome-wide analyses of individual differences in quantitatively assessed reading- and language-related skills in up to 34,000 people

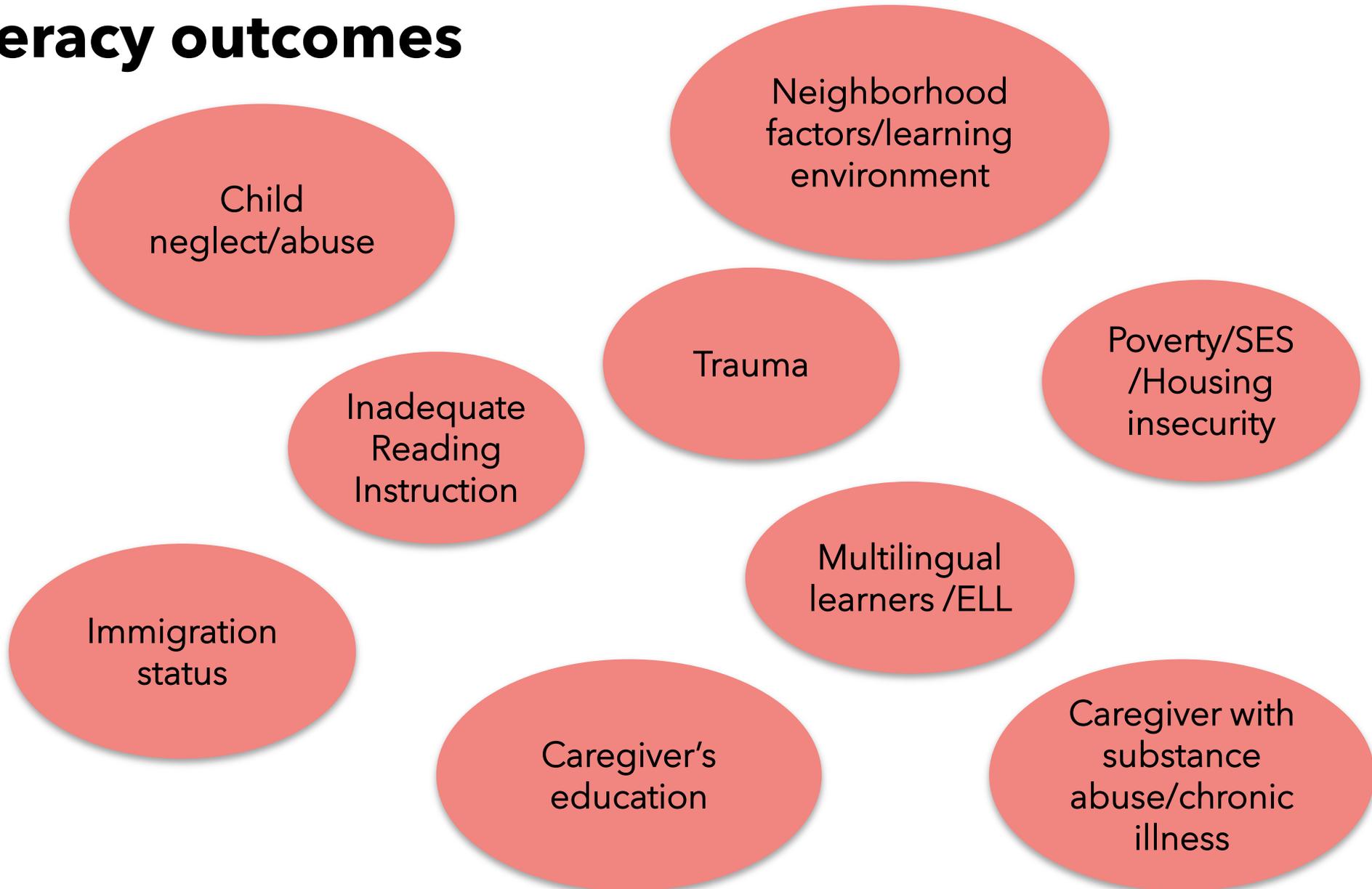Else Eising[a], Nazanin Mirza-Schreiber[b], Eveline L. de Zeeuw[c], Carol A. Wang[d,e], Dongnhu T. Truong[f], Andrea G. Allegrini[g], Chin Yang Shapland[h,i], Gu Zhu[j], Karen G. Wigg[k], Margot L. Gerritse[a], Barbara Molz[a], Gökberk Alagöz[a], Alessandro Gialluisi[l,m,n], Filippo Abbondanza[o], Kaili Rimfeld[g,p], Marjolein van Donkelaar[a], Zhijie Liao (廖志洁)[q], Philip R. Jansen[r,s,t], Till F. M. Andlauer[u], Timothy C. Bates[v], Manon Bernard[w], Kirsten Blokland[x], Milene Bonte[y], Anders D. Børglum[z,aa,bb], Thomas Bourgeron[cc], Daniel Brandeis[dd,ee,ff,gg], Fabiola Ceroni[hh,ii], Valéria Csépe[jj,kk], Philip S. Dale[ll], Peter F. de Jong[mm], John C. DeFries[nn,oo], Jean-François Démonet[pp], Ditte Demontis[z,aa], Yu Feng[k], Scott D. Gordon[j], Sharon L. Guger[qq], Marianna E. Hayiou-Thomas[rr], Juan A. Hernández-Cabrera[ss], Jouke-Jan Hottenga[c], Charles Hulme[tt], Juha Kere[uu,vv], Elizabeth N. Kerr[qq,ww,xx], Tanner Koomar[yy], Karin Landerl[zz,aaa], Gabriel T. Leonard[bbb], Maureen W. Lovett[x,xx], Heikki Lyytinen[ccc], Nicholas G. Martin[j], Angela Martinelli[o], Urs Maurer[ddd], Jacob J. Michaelson[yy], Kristina Moll[eee], Anthony P. Monaco[fff], Angela T. Morgan[ggg,hhh,iii], Markus M. Nöthen[jjj], Zdenka Pausova[w,kkk], Craig E. Pennell[d,e,lll], Bruce F. Pennington[mmm], Kaitlyn M. Price[k,x,nnn], Veera M. Rajagopal[z,aa], Franck Ramus[ooo], Louis Richer[ppp], Nuala H. Simpson[qqq], Shelley D. Smith[rrr], Margaret J. Snowling[qqq,sss], John Stein[ttt], Lisa J. Strug[uuu,vvv], Joel B. Talcott[www], Henning Tiemeier[r,xxx], Marc P. van der Schroeff[yyy,zzz], Ellen Verhoef[a], Kate E. Watkins[qqq], Margaret Wilkinson[x], Margaret J. Wright[aaaa], Cathy L. Barr[k,x,nnn], Dorret I. Boomsma[c,bbbb,cccc], Manuel Carreiras[dddd,eeee,ffff], Marie-Christine J. Franken[yyy], Jeffrey R. Gruen[f], Michelle Luciano[v], Bertram Müller-Myhsok[u,gggg], Dianne F. Newbury[ii], Richard K. Olson[nn], Silvia Paracchini[o], Tomáš Paus[hhhh], Robert Plomin[g], Sheena Reilly[ggg,iiii], Gerd Schulte-Körne[eee], J. Bruce Tomblin[jjj], Elsje van Bergen[c,bbbb,kkkk], Andrew J. O. Whitehouse[llll], Erik G. Willcutt[oo], Beate St Pourcain[a,h,mmmm,1], Clyde Francks[a,mmmm,nnnn,1], and Simon E. Fisher[a,mmmm,2]

Factors influencing the development of Reading Disabilities

Genetics

Brain

Perception & Cognition

Environment

Typical/Atypical Reading Development

Environmental risk factors for poor literacy outcomes

Child neglect/abuse

Neighborhood factors/learning environment

Poverty/SES /Housing insecurity

Trauma

Inadequate Reading Instruction

Multilingual learners /ELL

Immigration status

Caregiver's education

Caregiver with substance abuse/chronic illness
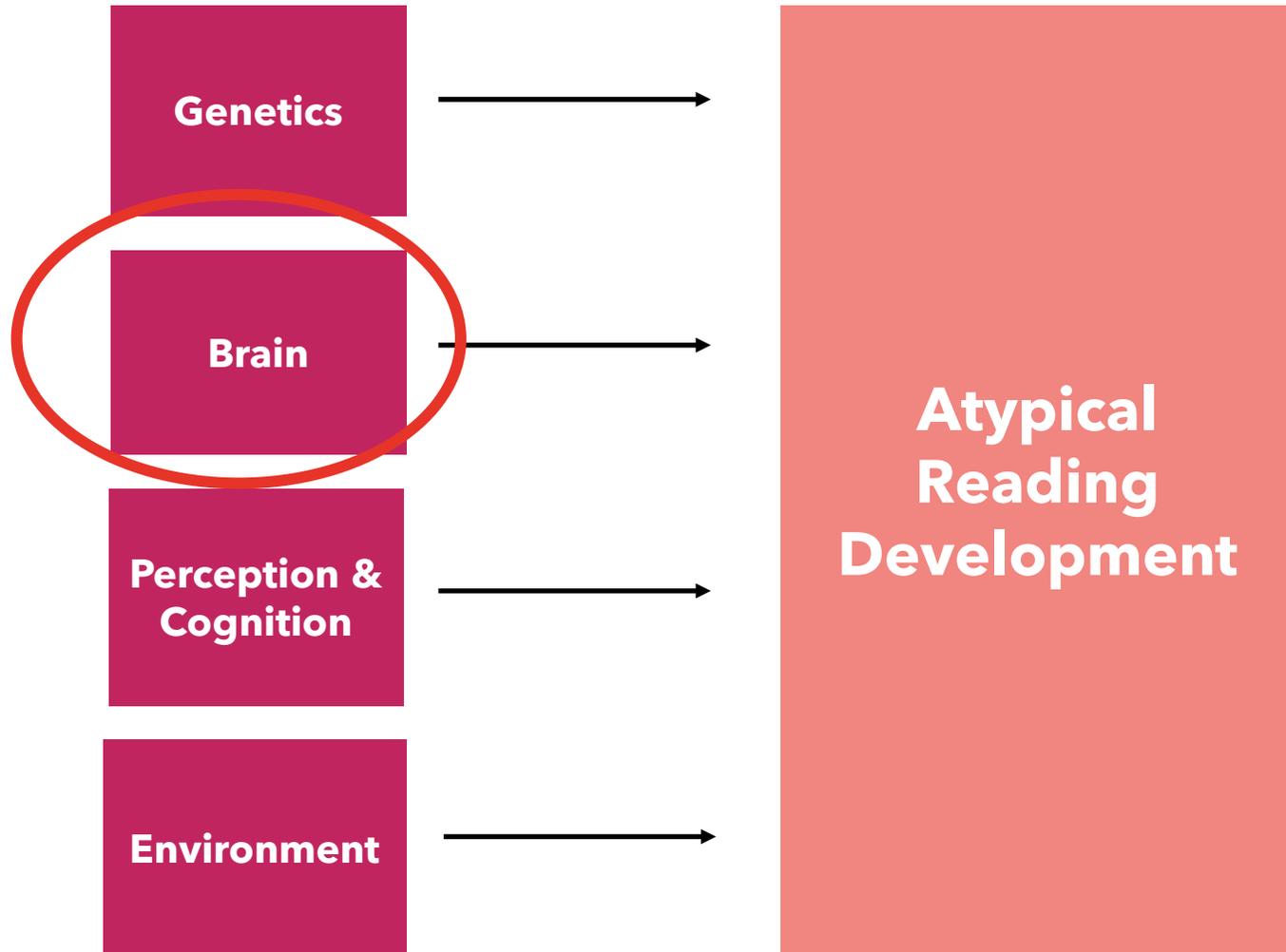
Brain studies in school-age children and adults have demonstrated critical mechanistic support for multifactorial models of reading

Reading fluency & comprehension

Sound-symbol connection

Oral Language Processing

Print and Word recognition
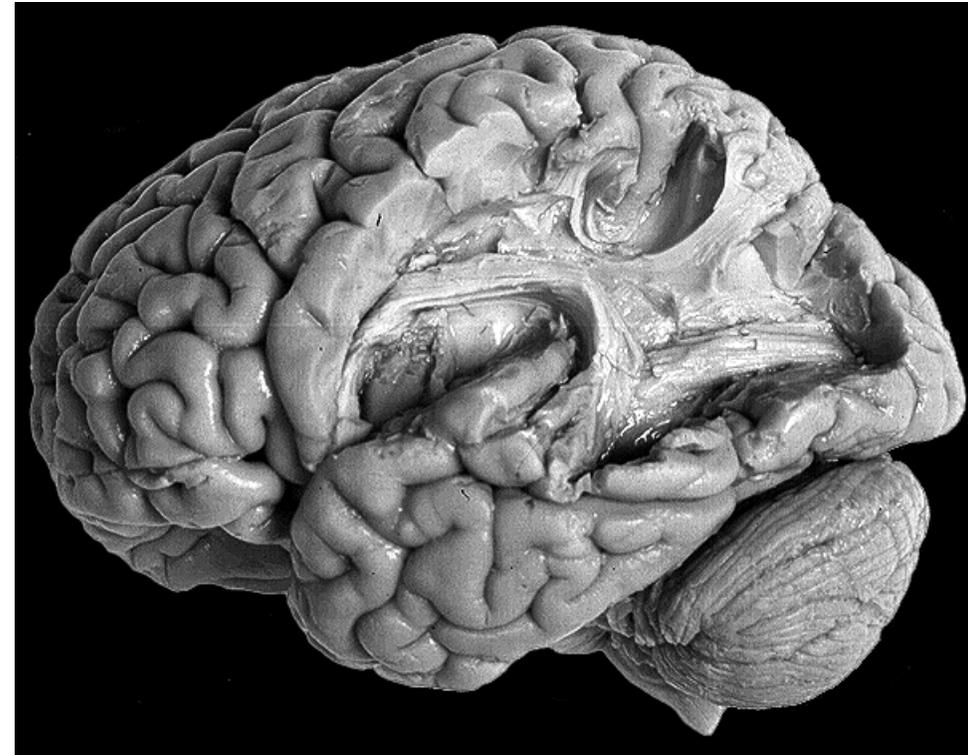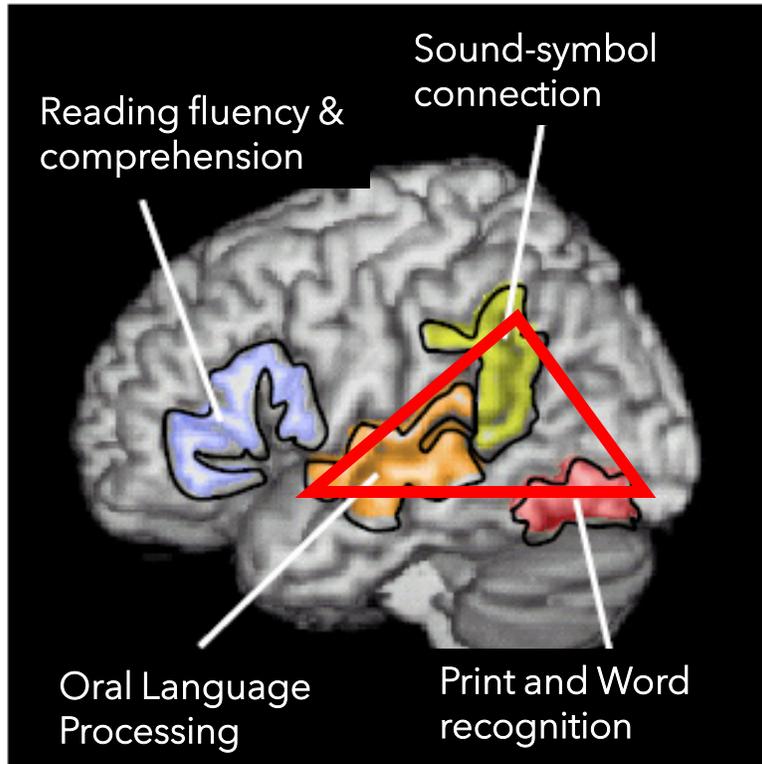
Reading words...
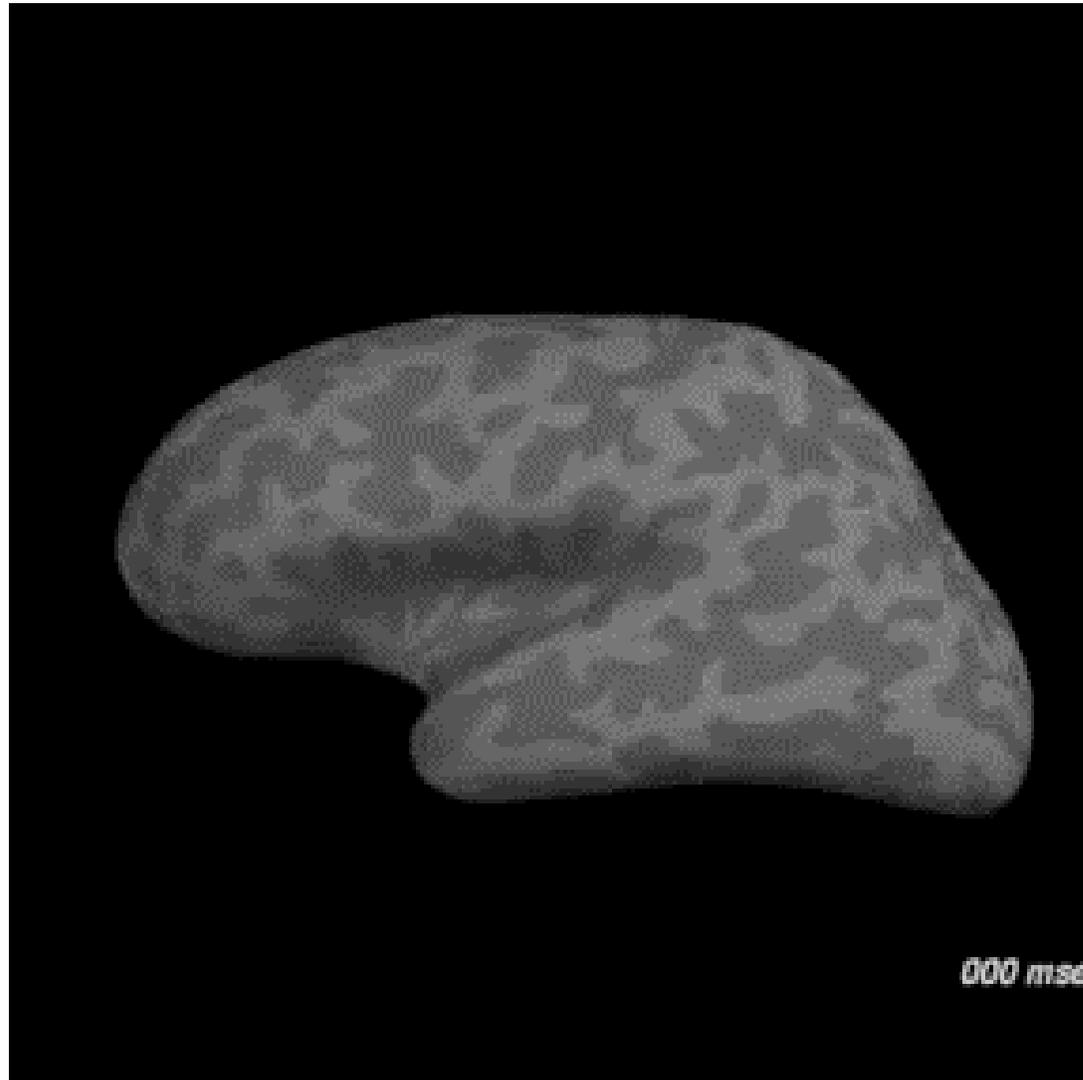
[Video: Showing brain activation while an adults is reading a word]

(Dale et al., 2000)

Universal brain signature of proficient reading: Evidence from four contrasting languages
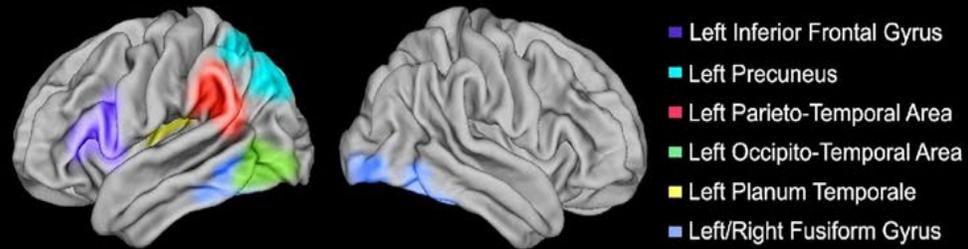
2015

Jay G. Rueckl[a,b], Pedro M. Paz-Alonso[c], Peter J. Molfese[a,b], Wen-Jui Kuo[d], Atira Bick[e], Stephen J. Frost[a,1], Roeland Hancock[f], Denise H. Wu[g], William Einar Mencl[a], Jon Andoni Duñabeitia[c], Jun-Ren Lee[h], Myriam Oliver[c], Jason D. Zevin[a,i,j], Fumiko Hoeft[a,f], Manuel Carreiras[c,k], Ovid J. L. Tzeng[l,m,n], Kenneth R. Pugh[a,b,o], and Ram Frost[a,c,e]
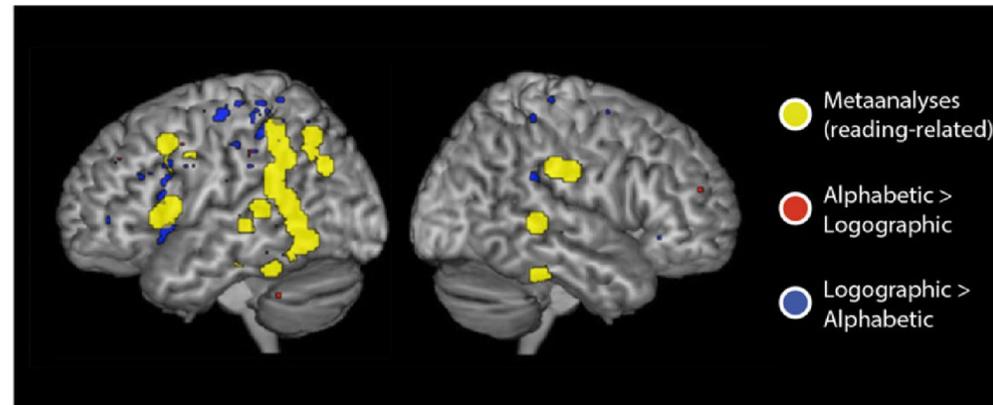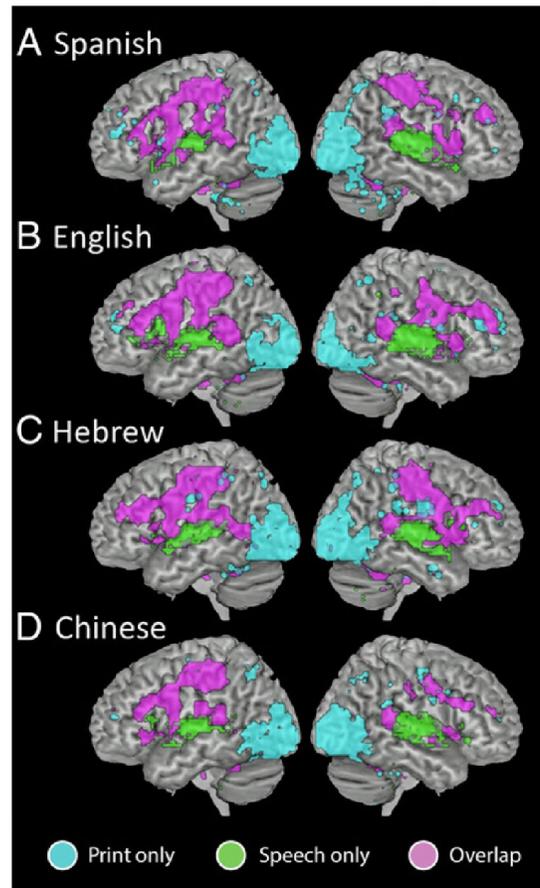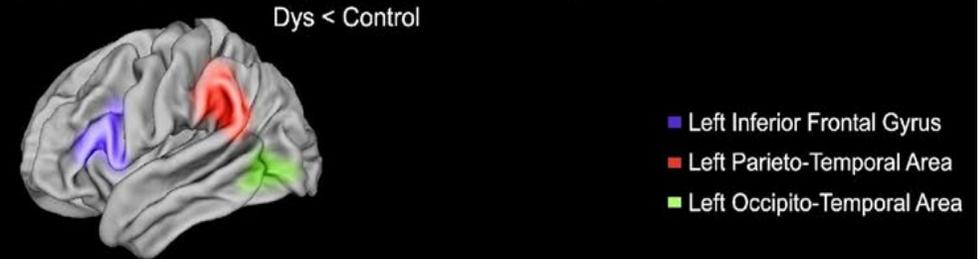
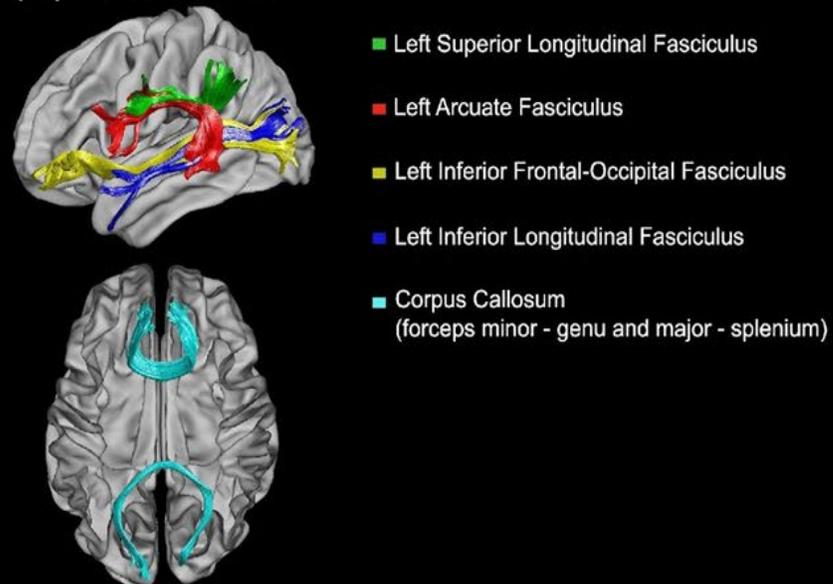# Structural and functional brain alterations in individuals with dyslexia

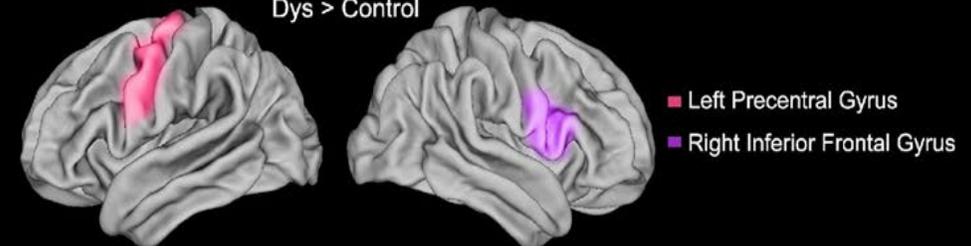(A) Gray matter (volumetric analyses)
- Left Inferior Frontal Gyrus
- Left Precuneus
- Left Parieto-Temporal Area
- Left Occipito-Temporal Area
- Left Planum Temporale
- Left/Right Fusiform Gyrus

(B) Gray matter (functional analyses)
Dys < Control
- Left Inferior Frontal Gyrus
- Left Parieto-Temporal Area
- Left Occipito-Temporal Area

Dys > Control
- Left Precentral Gyrus
- Right Inferior Frontal Gyrus

(C) White matter
- Left Superior Longitudinal Fasciculus
- Left Arcuate Fasciculus
- Left Inferior Frontal-Occipital Fasciculus
- Left Inferior Longitudinal Fasciculus
- Corpus Callosum (forceps minor - genu and major - splenium)

(D) Sulcal pattern
- Left Parieto-Temporal and Occipito-Temporal Areas
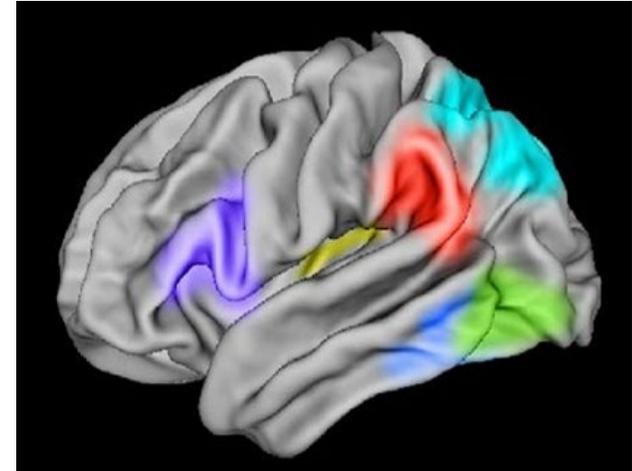
(Ozernov-Palchik, … & Gaab, 2016; Curr Opin. Behav. Sci)

Cause or consequence?
An important question for practice and policy

Birth   Pre-K   K   1   2   3   4   5
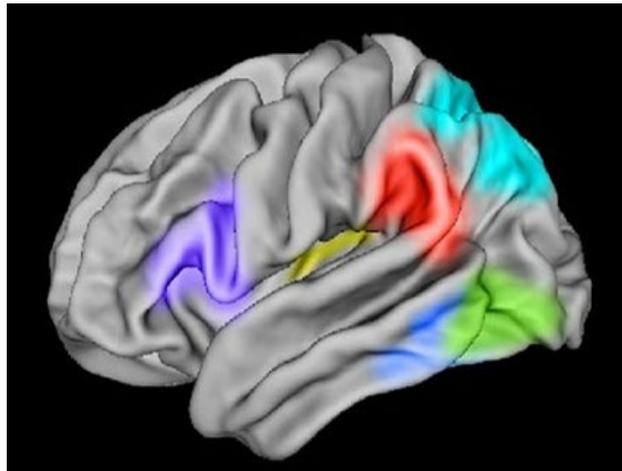
Some of the brain alterations in struggling readers predate formal reading instruction
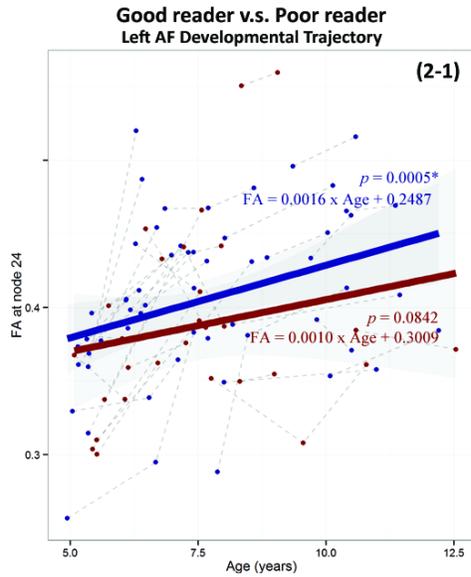
Wang,…Gaab, 2017; Cerebral Cortex
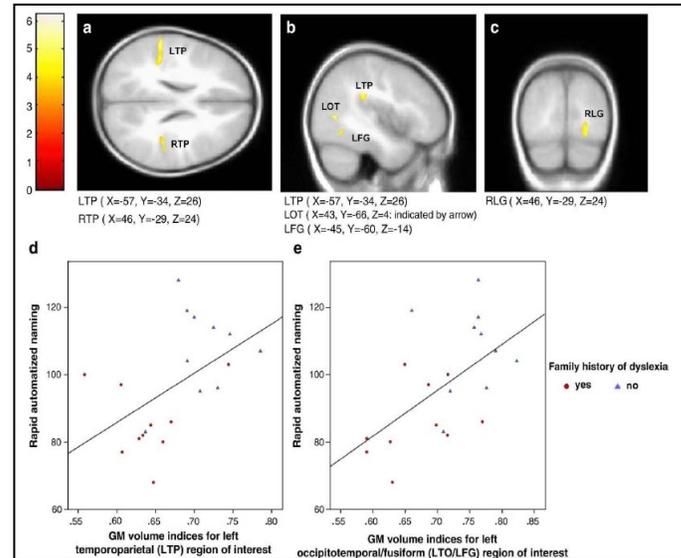
Raschle, …Gaab, 2010; Neuroimage
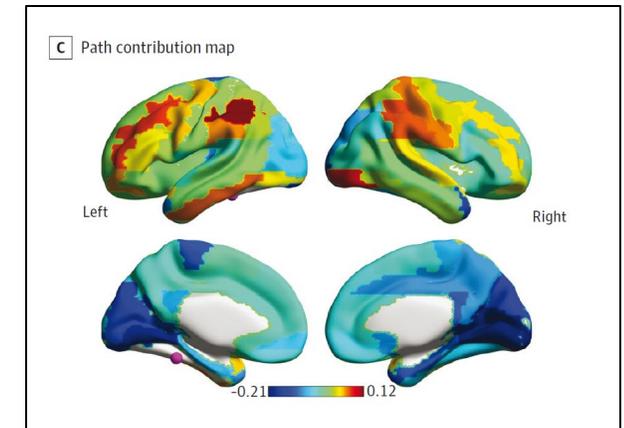
Yu, …Gaab, 2022; JAMA Pediatrics

Raschle, … Gaab, 2012; PNAS
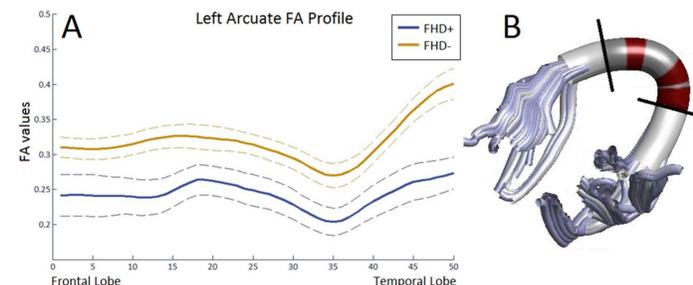
Langer, …Gaab, 2016; Cerebral Cortex

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Early Infancy:
Rapid Period of Brain Development
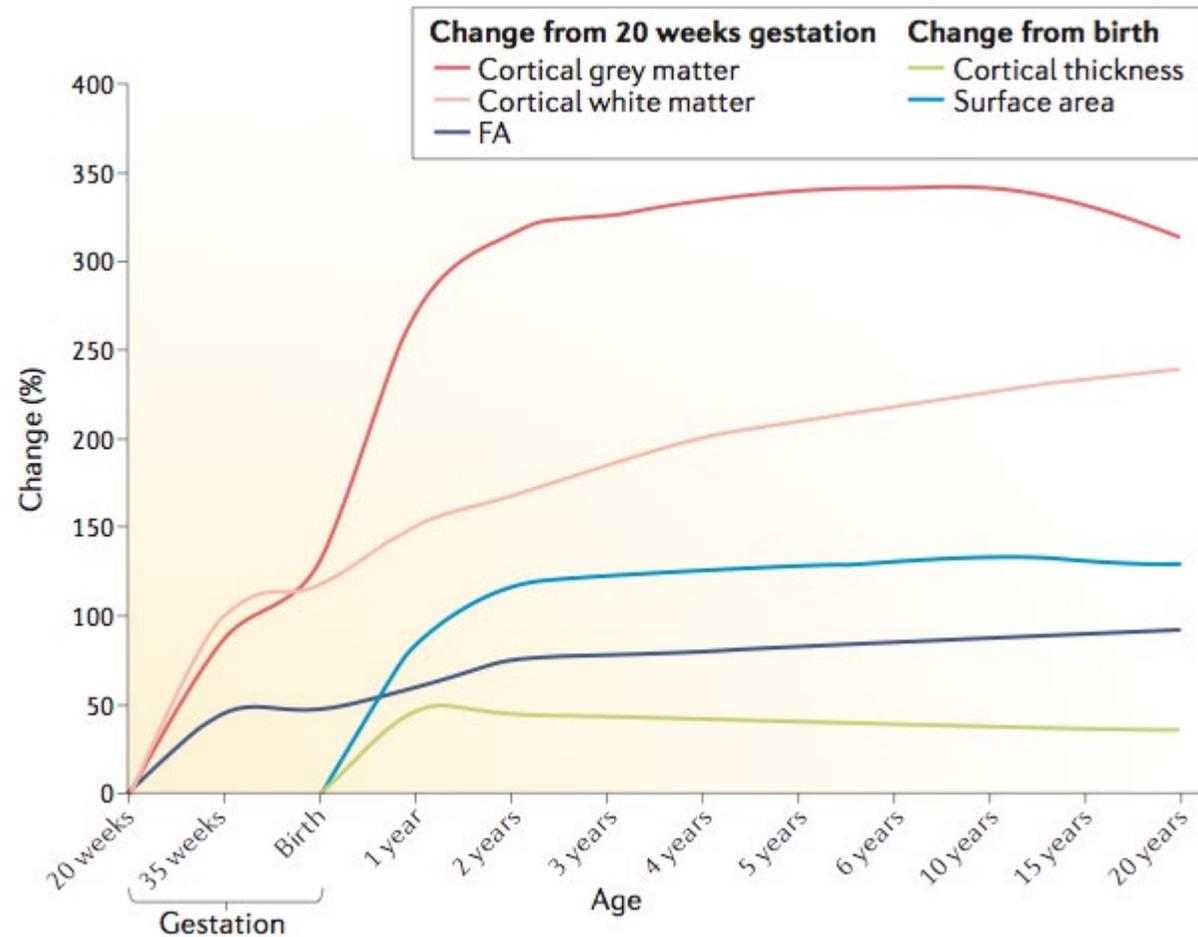
(Gilmore, Knickmeyer, & Gao, 2018)

Neuroimaging the rapidly developing brain

(Turesky, … & Gaab, 2021; Dev. Cog. Neur.)

Examples of variability in brain structure

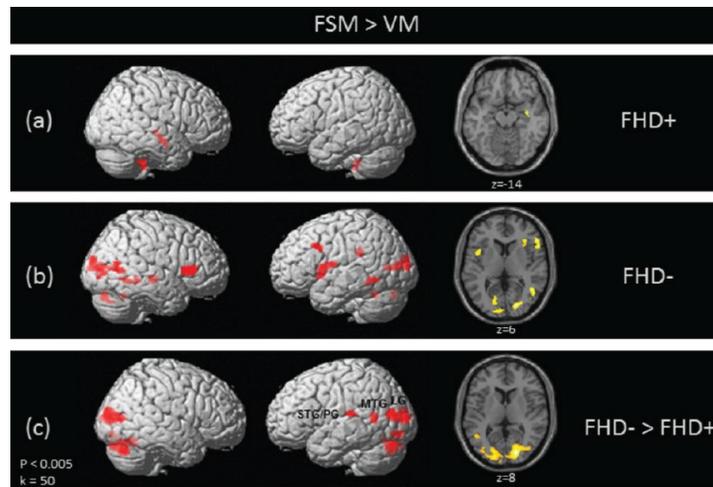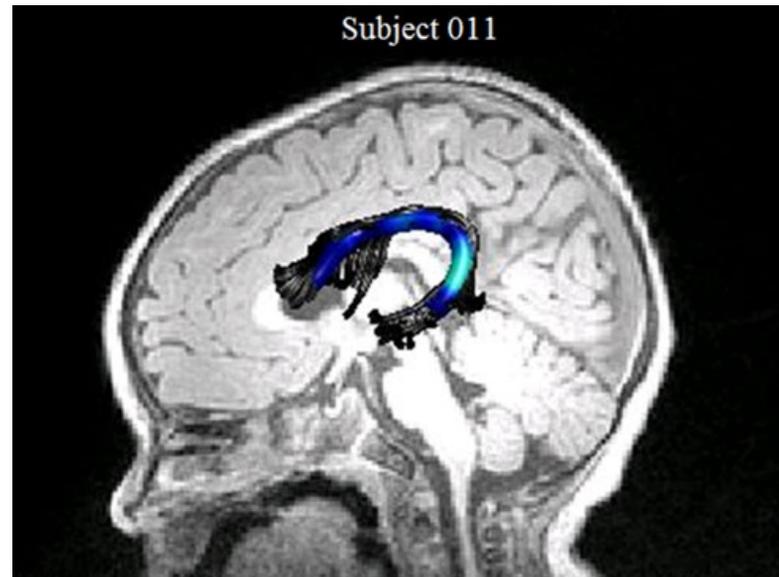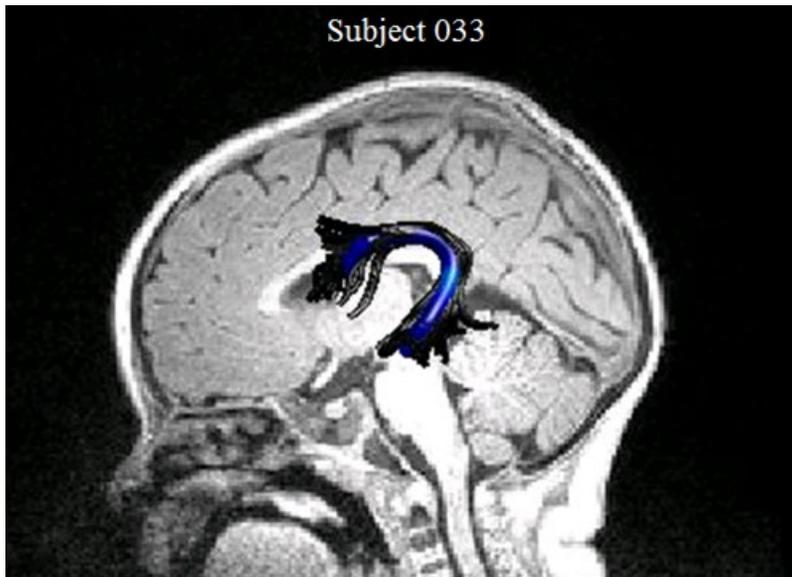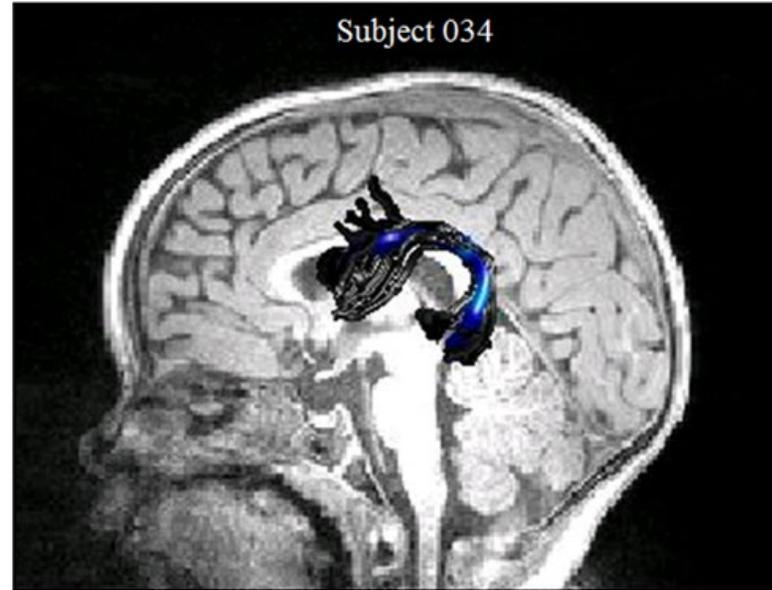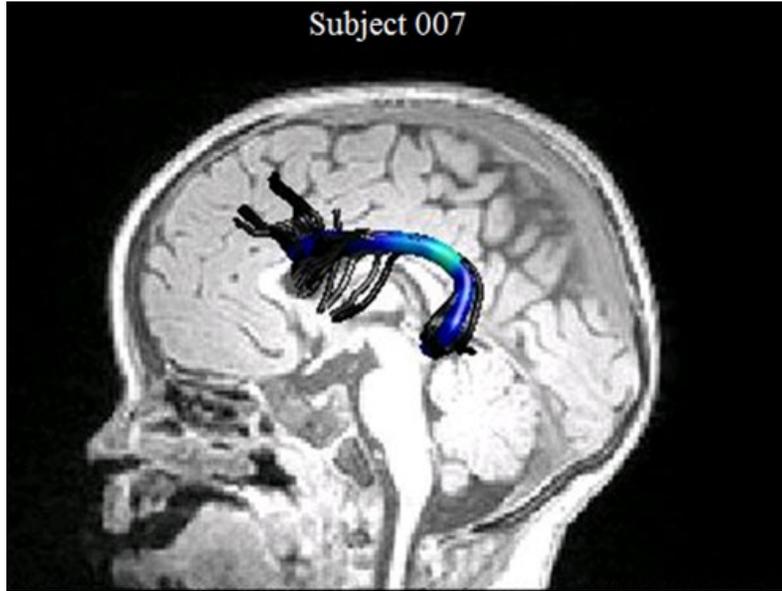# White matter in infancy is prospectively associated with language outcomes in kindergarten

(Zuk, … & Gaab, 2021; Dev. Cog. Neur.)
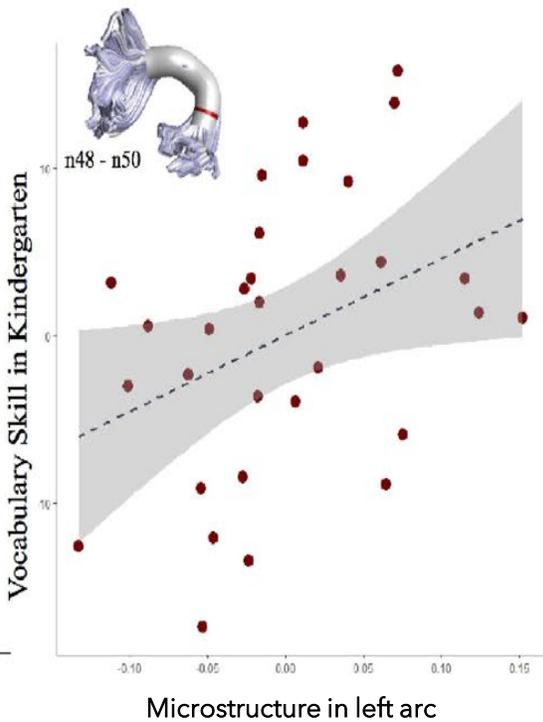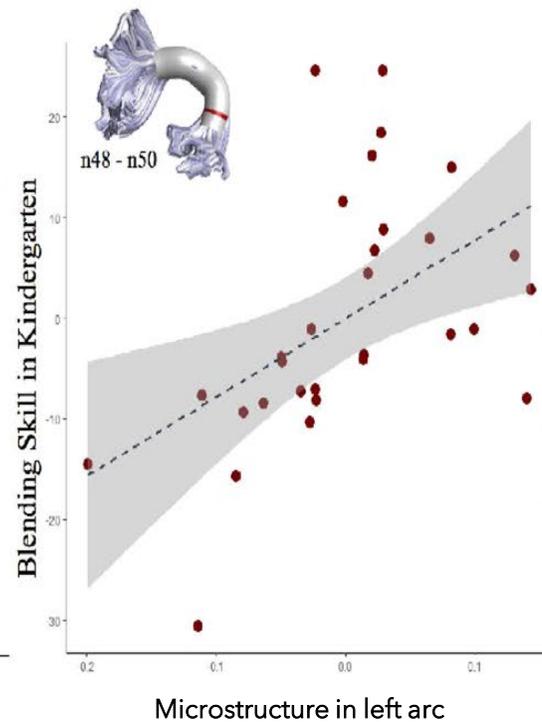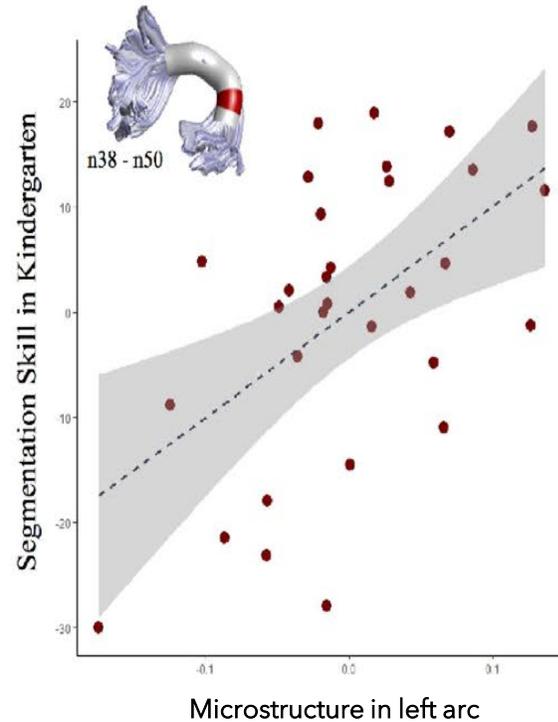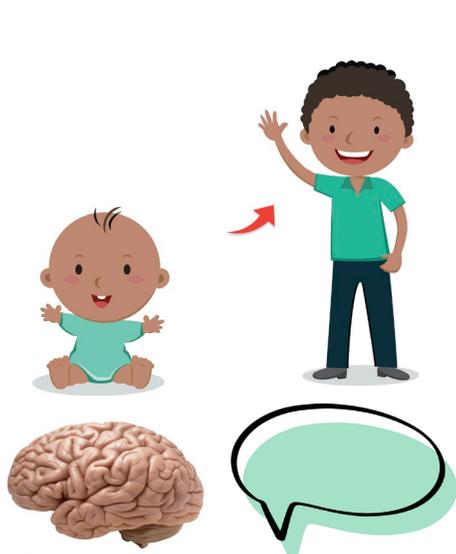
Microstructure within the left arcuate fasciculus is prospectively associated with phonological awareness and vocabulary skills
(controlling for age and the home language/literacy environment)

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Longitudinal trajectories of brain development from infancy to school age and their relationship to literacy development

Turesky et al., in press; PNAS)
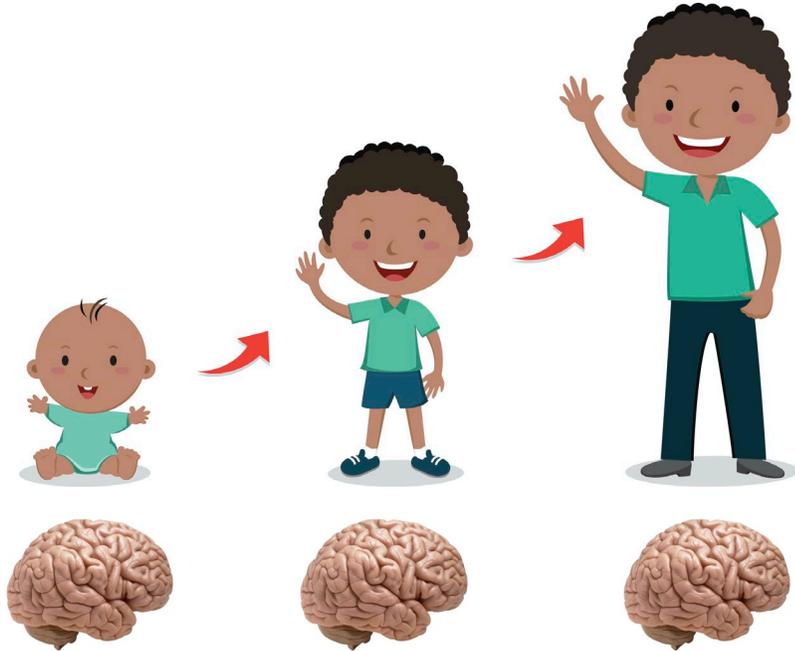
n ≈ 137

with 441 observations
controlled for biological sex,
maternal education and cohort.

→ Further assessed whether familial
risk or home literacy environment
show influences
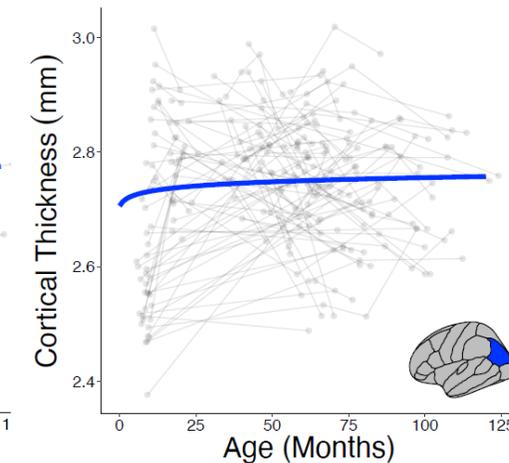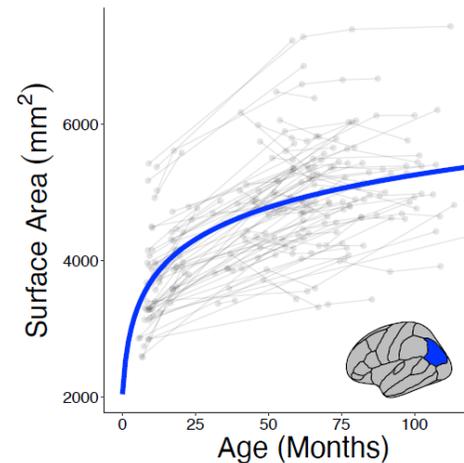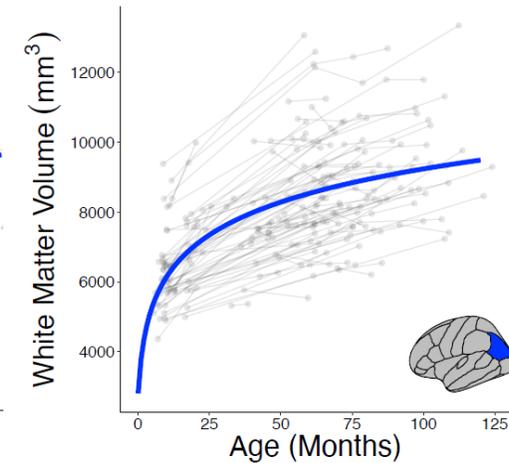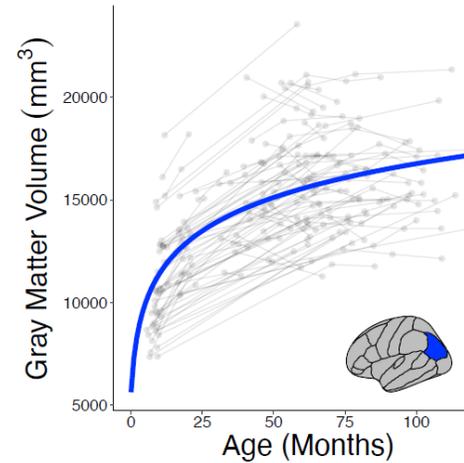
Growth curves differ depending on pre-literacy outcomes

Turesky et al., in press; PNAS)
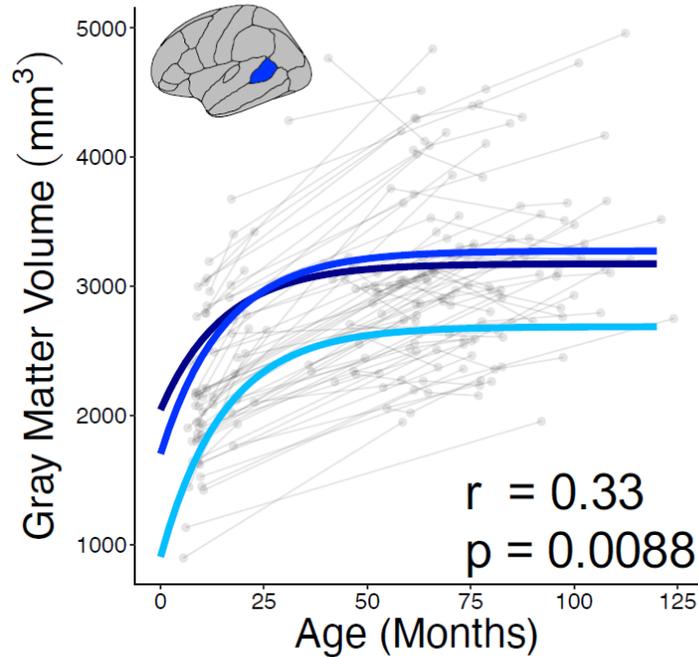
Different intercepts
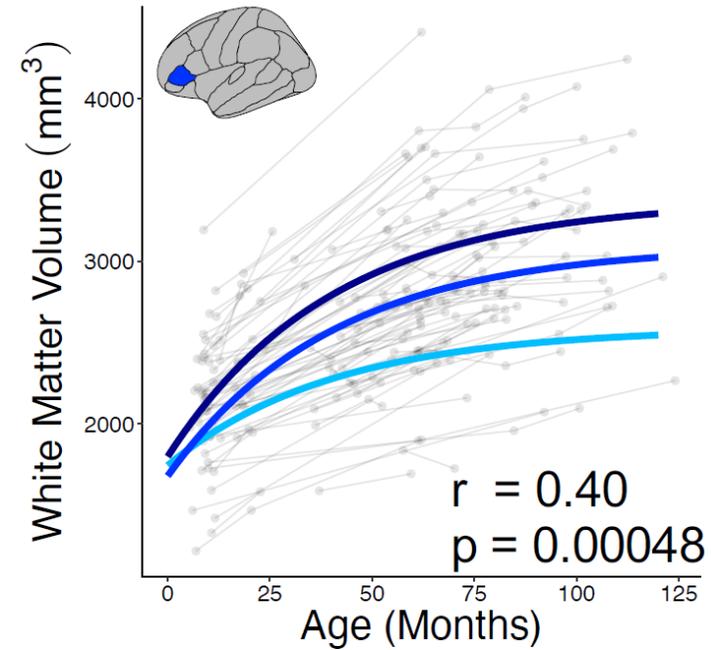
Different slopes

Phonological Processing at 60 months:

Low   Average   High

As a society, we embrace preventative medicine, but we have not prioritized preventative education strategies to the same extent.
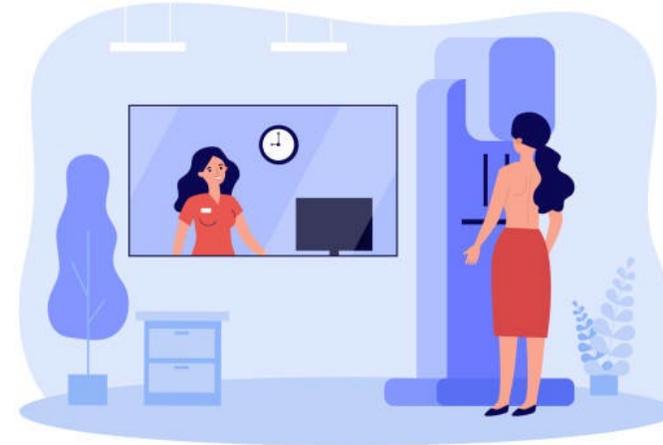
The dominant approach has been a reactive, deficit-driven, "wait-to-fail" model
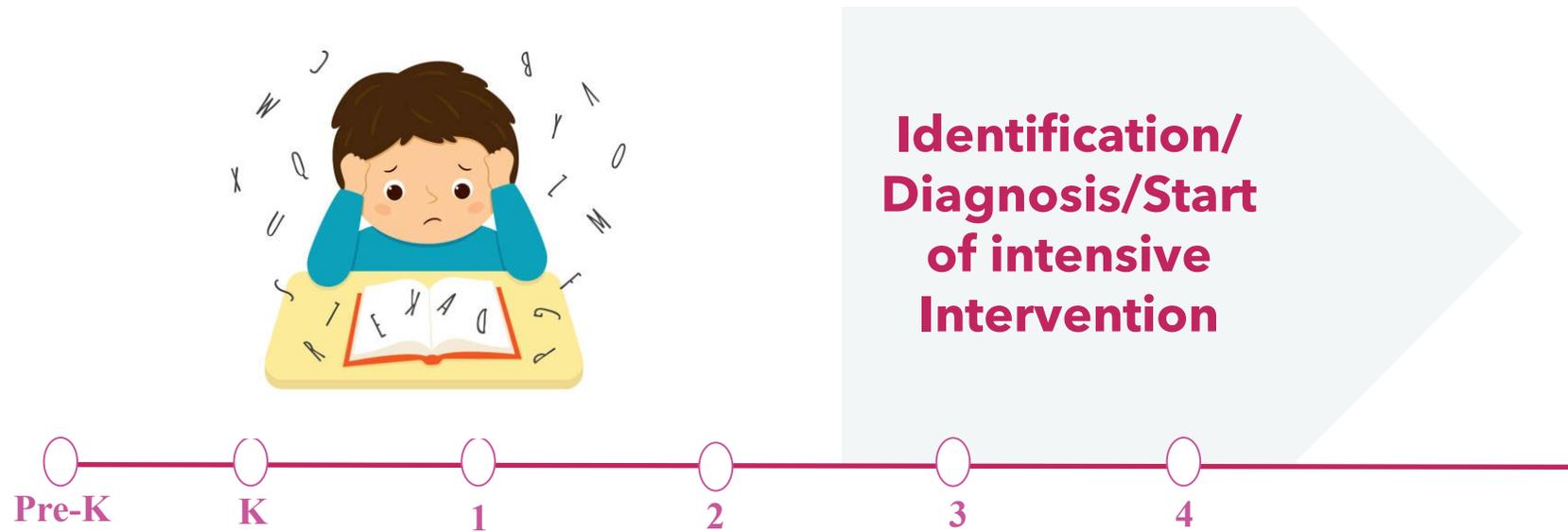
Identification/ Diagnosis/Start of intensive Intervention

Pre-K　　K　　1　　2　　3　　4

As outlined in
(Ozernov-Palchik, … & Gaab, 2016; Curr Opin Behav Sci)
(Ozernov-Palchik & Gaab , 2016; Wiley Interdiscip Rev Cogn Sci)

The "Dyslexia Paradox"
A reading disability is generally identified after the most effective intervention window
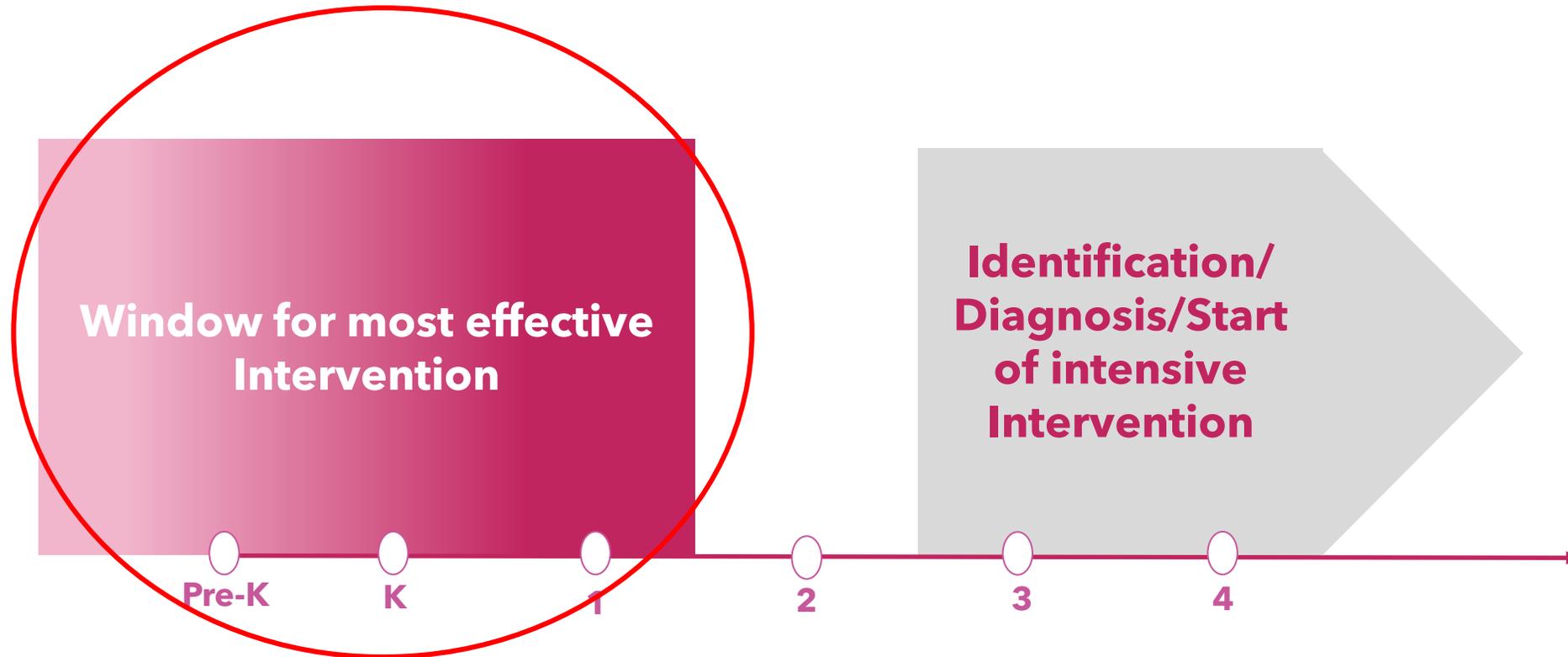
Window for most effective Intervention

Identification/ Diagnosis/Start of intensive Intervention

Pre-K   K   1   2   3   4

As outlined in
(Ozernov-Palchik, … & Gaab, 2016; Curr Opin Behav Sci)
(Ozernov-Palchik & Gaab , 2016; Wiley Interdiscip Rev Cogn Sci)

Early versus late intervention

- A meta-analysis comparing intervention studies offering at least 100 sessions, reported larger effect sizes in kindergarten/1st grade than in 2nd and 3rd grades (Wanzek & Vaughn, 2007; Wanzek et al., 2013; Wanzek et al., 2016) .

- When "at risk" beginning readers receive intensive instruction, 56% to 92% of at-risk children across six studies reached the range of average reading ability (Torgesen, 2004).

- Overall, converging research points to the importance of _early interventions_ for at-risk students for improving the effectiveness of remediation (Connor et al., 2013; Catts, et al., 2015; Denton & Vaughn, 2008; Connor et al., 2009; Shaywitz, Morris, & Shaywitz, 2008, Torgesen, et al., 1999; Flynn, Zheng, & Swanson, 2012; Vellutino et al., 1996; Morris, Lovett, Wolf et al., 2012; Morris et al., 1997).

Replacing the wait-to-fail model with a preventative support model

Comprehensive early risk screening and evidence-based response to screening

Lower rates of dyslexia and improved reading outcomes in children with a diagnosis / better mental health

Birth   Pre-K   K   1   2   3   4

Latent profile analysis shows six distinct profiles of early reading and long-term stability

[n = 1,215 children]

(Ozernov-Palchik, … & Gaab, 2017; Developmental Science)
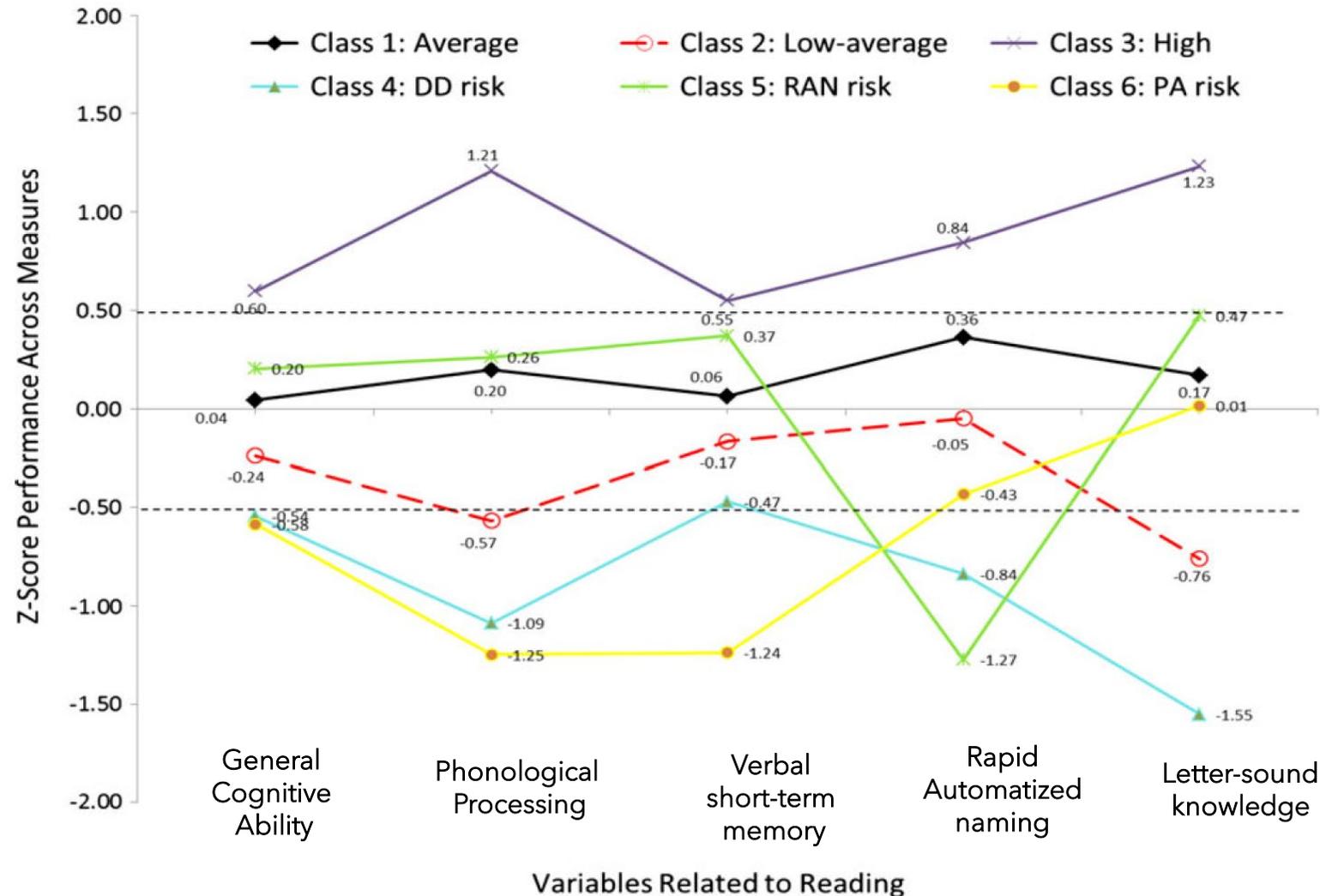
Early behavioral predictors of reading difficulties/dyslexia

Key childhood predictors of reading problems (e.g., Landerl, et al., 2013; Elbro et al., 1998; Scarborough, 1998, O'Connor & Jenkins, 1999; Lyytinen et al., 2001; Catts et al., 2001, 2015; Schatschneider et al., 2004, Pennington et al., 2001; Compton et al., 2006; Stanley et al., 2018):

- Phonological awareness

- Pseudoword repetition

- Rapid automatized naming

- Expressive/receptive vocabulary

- Letter (sound) knowledge

- Oral listening comprehension

Familial risk of dyslexia and language delay

The Many Strands that are Woven into Skilled Reading
(Scarborough, 2001)

LANGUAGE COMPREHENSION

BACKGROUND KNOWLEDGE (facts, concepts, etc.)
VOCABULARY (breadth, precision, links, etc.)
LANGUAGE STRUCTURES (syntax, semantics, etc.)
VERBAL REASONING (inference, metaphor, etc.)
LITERACY KNOWLEDGE (print concepts, genres, etc.)

increasingly strategic

SKILLED READING: Fluent execution and coordination of word recognition and text comprehension.

WORD RECOGNITION

PHONOLOGICAL AWARENESS (syllables, phonemes, etc.)
DECODING (alphabetic principle, spelling-sound correspondences)
SIGHT RECOGNITION (of familiar words)

increasingly automatic

Do vision problems cause dyslexia?

No. **Although vision is fundamental for reading, there is no current evidence that suggests visual problems cause dyslexia.** Dyslexia is a specific learning disability that is neurobiological 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 growth of vocabulary and background knowledge.[2]

What about convergence issues?

Convergence insufficiency, a reduced ability to turn the eyes towards each other, is uncommon in children. Incidences typically peak in high school or college-aged individuals, or early middle-aged individuals.[3] **According to the American Academy of Ophthalmology, treatment for convergence issues will not improve decoding or comprehension.[1]**

Dyslexia and learning disabilities are complex problems without simple solutions and there is no evidence to suggest that visual interventions remediate them. **However, through early detection and language-based individualized instruction that is systematic, explicit, and cumulative, children can develop appropriate word reading skills.**

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[1]American Academy of Ophthalmology (2009). Learning Disabilities, Dyslexia and Vision. San Francisco, CA: Author.

[2]International Dyslexia Association (2002). Definition consensus project. Retrieved from https://dyslexiaida.org/definition-consensus-project/

[3]Mazow M. The Convergence Insufficiency Syndrome. J Pediatr Ophthalmol Strabismus. 1971; 8: 243-244. doi: 10.3928/0191-3913-19711101-07

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Scientific Studies of Reading

Prevention and Remediation of Severe Reading Disabilities: Keeping the End In Mind

Joseph K. Torgesen, Richard K. Wagner & Carol A. Rashotte (1997)
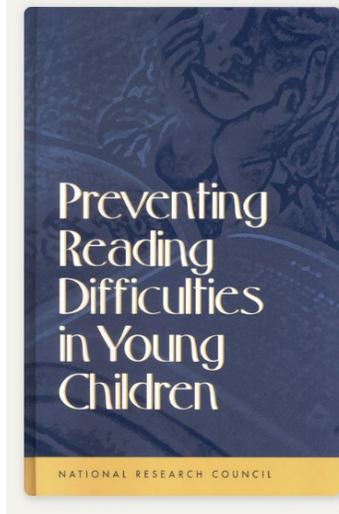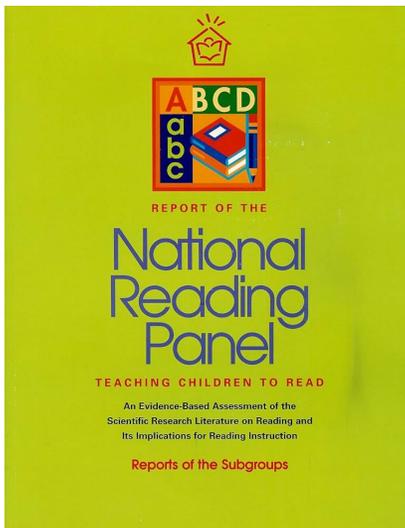
National Research Council. 1998.
Preventing Reading Difficulties in Young Children.
Washington, DC: The National Academies Press

An Evidence-Based Argument for Early Identification, Prevention, and Early Intervention

Good readers understand how print represents the sounds of speech, can apply phonemic and phonics skills in a rapid and fluent manner, and possess sufficient vocabularies and other language abilities to actively connect what they are reading to their background knowledge and experiences. Conversely, children who are most likely to have reading difficulties enter kindergarten lacking sufficient phonological processing skills and fail to develop adequate word reading ability. This bottleneck in word reading skills limits their ability to learn how to read text in a fluent fashion. Their text reading is typically slow and laborious, which impedes their comprehension of what is read. Among these children, the effort exerted in reading is frequently not rewarded by enjoyment and learning. Frustration on the part of the child and a decrease in reading behavior are often observed. Limited reading practice and experience result in weak vocabulary development and difficulties in learning other academic subjects. And the cycle goes on.[33]

> **Special education professionals and programs should become a source for preventative interventions.**

Given that the underlying causes of most early reading difficulties are similar for children regardless of whether they are currently served in special or compensatory education programs, we argue that the most valid and efficient way to deliver this early intervention in reading is through regular education. This approach allows limited funds to be targeted at intervention rather than expensive eligibility determination practices. Initially, however, the specialized instructional approaches that will be necessary for some children are typically not within the purview of general education teachers. Thus, special education professionals and programs should become a source for preventative interventions. Regardless of the approach to classification, we contend that it is critical to provide this instruction as early as possible in a child's school career to avoid the reading failure that will otherwise occur. That is the major message of this chapter.

Lyon, G. R., Fletcher, J. M., Shaywitz, S. E., Shaywitz, B. A., Torgesen, J. K., Wood, F. B., Schulte, A., & Olson, R. (2001). Rethinking Learning-Disabilities. In C. E. Finn Jr., A. J. Rotherham, & C. R. Hokanson Jr. (Eds.), Rethinking Special Education for a New Century (pp. 259-287). Washington DC: Thomas B. Fordham Foundation.
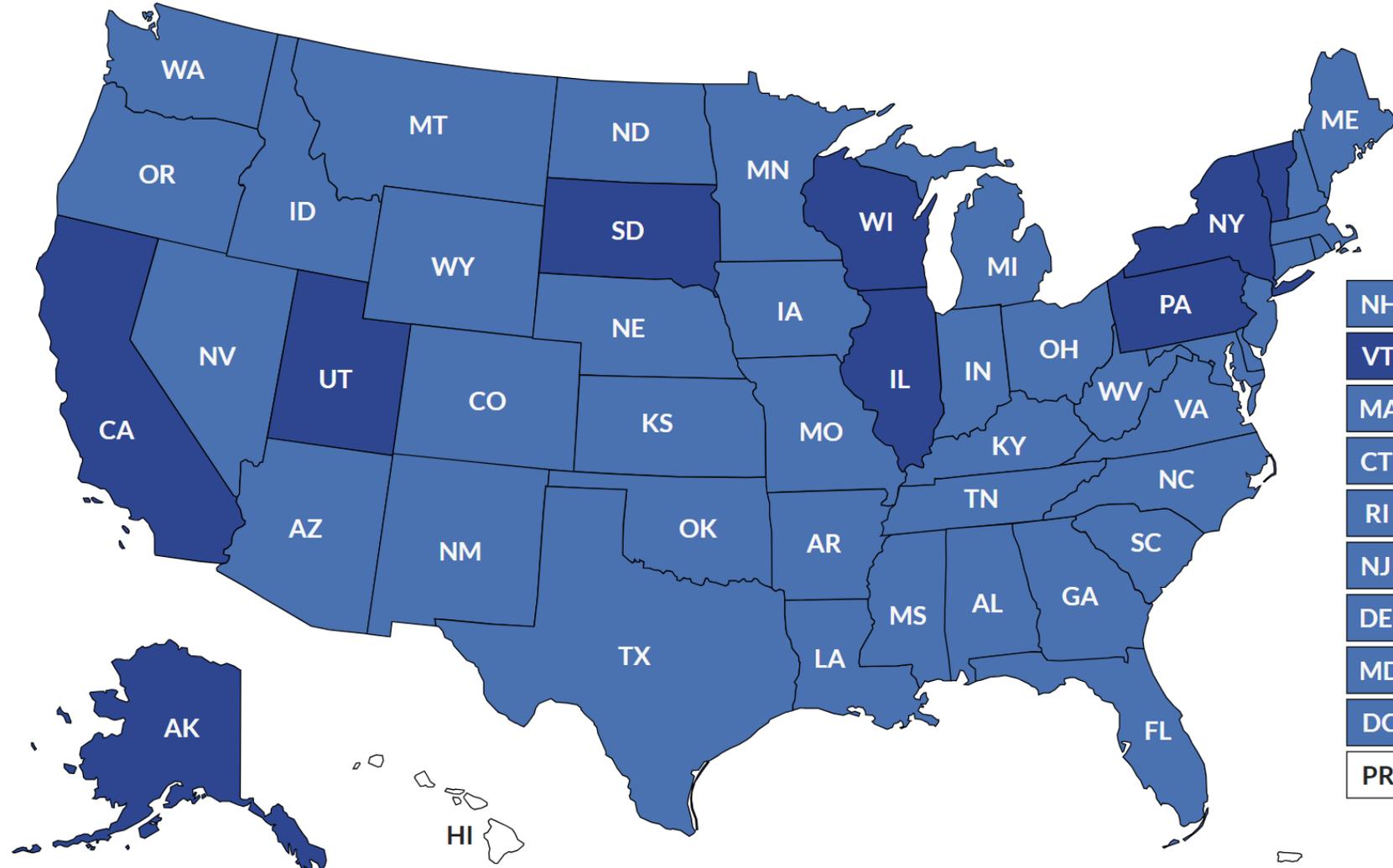
Screening for Early Literacy Milestones and Reading Disabilities
The Why, When, Whom, How, and Where

by Nadine Gaab and Yaacov Petscher

International Dyslexia Association, 2022

BOLD

Development   Learning & Education   Technology   Society

Identifying risk instead of failure

3 April 2019

Reading impairments: Moving from a deficit-driven to a preventive model

MASSACHUSETTS
DYSLEXIA GUIDELINES

MASSACHUSETTS DEPARTMENT OF ELEMENTARY AND SECONDARY EDUCATION

Ontario Right to Read Inquiry Report, 2022
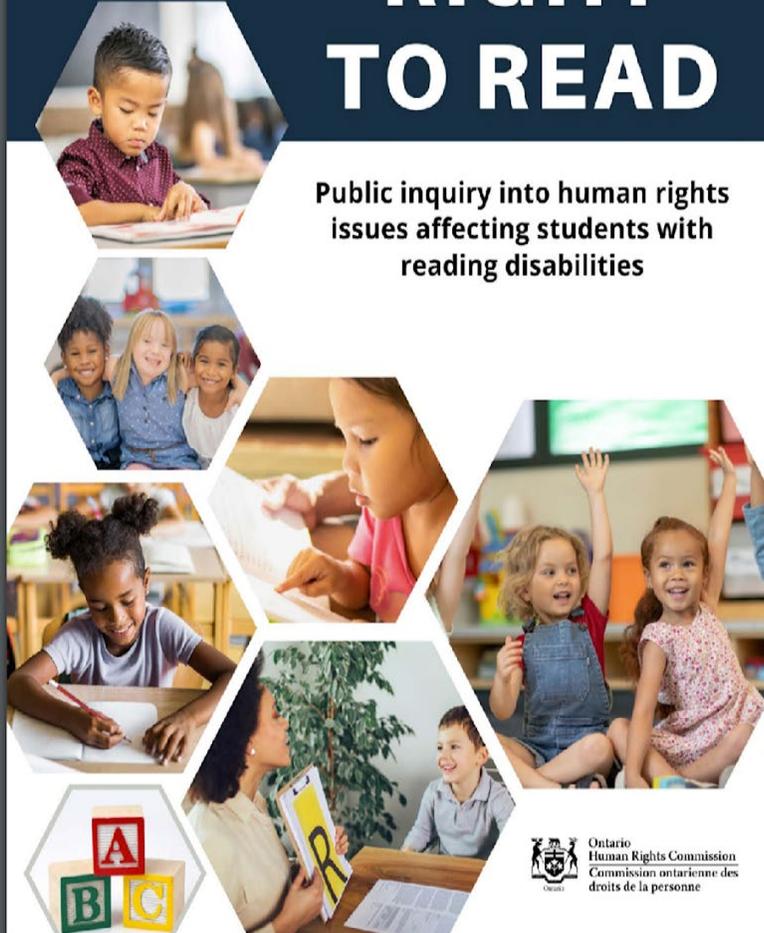
Core Considerations for Selecting a Screener

Decision Making
All of these components should be considered in the decision-making process

Classification
Tells you how well the screener correctly classifies individuals. What percentage of students were:
- Correctly classified as at risk?
- Correctly classified as not at risk?
- Incorrectly classified?

Validity
Tells you how well a screener measures what it intends to measure.
- Is the screener correlated with similar assessments?
- Is the screener correlated with future performance?

Reliability
Tells you how consistent a set of scores are for a measure.
- What types of reliability are reported?
- Is the reliability at an appropriate level?

Scope of Assessment
Tells you what and how content is measured.
- Does the assessment measure accuracy or fluency?
- Does the assessment cover multiple reading skills?
- What outcome is the screener predicting?
- How is risk defined on the outcome the screener is predicting?

Population of Interest
Tells you for whom a screener is intended to be used.
- What is the intended age range?
- Who is the intended individual you want to identify?

The HOW of Screening: Considerations and Practical Tips

HOW you screen is, in many ways, a complicated proposition. The very nature of HOW implies a process, and there are a number of processes to consider in screening. Two of these in particular that are minimally necessary are how to *choose* a screener and how to *use* a screener.

How to Choose a Screener

Based on conversations with test (assessment) takers, test developers, and test choosers, there is a core set of five question types that are typically asked:

1. Is this screener appropriate for my students/children?

2. Does this screener measure the right things?

3. Are the screening scores reliable?

4. Are the screening scores valid?

5. How well does the screener classify students/children as at-risk?

SCREENING AND ASSESSMENT

Assessment is a process for collecting information. Assessment of learning can happen in many ways, like when teachers ask a question in class or give a unit test.

Screening is a type of assessment that helps teachers identify students who are at risk for academic difficulties or not meeting grade-level learning goals.
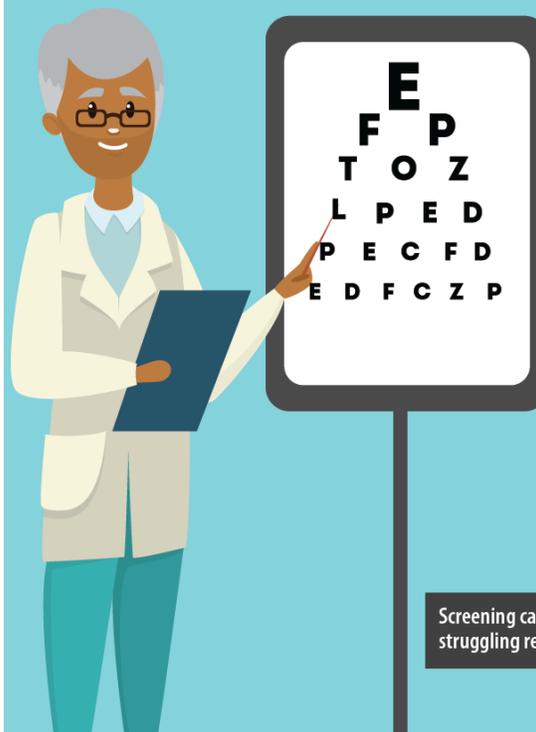
Screening assessments in the classroom are like health screenings at a doctor's office.

They check for warning signs to see if you might be at risk. For example, if you can't read the chart then the doctor is likely to give you contact lenses or glasses so that you can see more clearly. If you can read the chart, then the doctor will send you on your way until your next eye screening.

Screening can provide valuable information to teachers to help struggling readers or those who are likely to struggle in the future.

Parents and caregivers: Talk with teachers about the screening process in your child's school to learn more. If you have questions about your child's progress or results, ask to have them explained to you.

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National Center on Improving Literacy

https://improvingliteracy.org/brief

SAMPLE REPRESENTATIVENESS

WHAT IS SAMPLE REPRESENTATIVENESS?

Sample representativeness is an important aspect of high-quality instruments used to measure academic progress. It is ensuring that the sample used to validate the tool is representative of your population of interest.

For example, if a sample's scores are compared to a national benchmark, then the sample's demographics should look like that of the nation. If a sample's scores are compared to a state's population, then the sample's demographics should look like that of the state.

The same principles apply when you are evaluating the quality of a screening assessment.
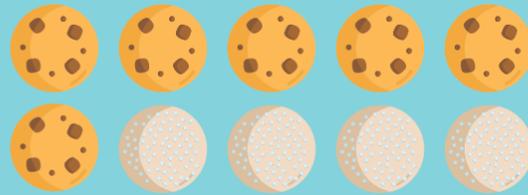
A population could be as large as a country or as small as a district or school.

A sample is a smaller group drawn from the larger population.

Sample representativeness is like a jar of cookies.

A baker has a jar of 100 cookies, where 60% of them are chocolate chip and 40% are sugar. He wants to sell batches of 10 cookies that are representative of all the cookies in the jar. So, he creates batches with 6 chocolate chip and 4 sugar cookies. This proportion of cookies in his sample accurately represents all the cookies in the jar.

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[3] Mazow M. The Convergence Insufficiency Syndrome. J Pediatr Ophthalmol Strabismus. 1971; 8: 243-244. doi: 10.3928/0191-3913-19711101-07

Word reading in the early years

- Initially, word reading abilities are characterized by floor effects and these effects reduced the predictive validity of the measures (Catts et al., 2009)

Figure 1.
Frequency histograms for each of the DIBELS measures at each of the time points.

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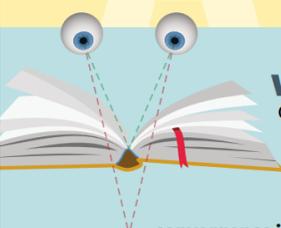5. How well does the screener classify students/children as at-risk?

RELIABILITY

WHAT IS RELIABILITY?

Reliability is an important aspect of high-quality instruments used to measure academic progress. It is the consistency of a set of scores that are designed to measure the same skills.

Reliability is like using the produce scale at the supermarket

A child and his mother decide to weigh a watermelon on five different produce scales to figure out how much it costs. They want to know the reliability, or consistency, of the scales in providing the same weight for the watermelon.

When reading screeners are administered, there is typically an assumption that the scores are reliable, that they accurately reflect a student's ability and there is little to no error in the scores.
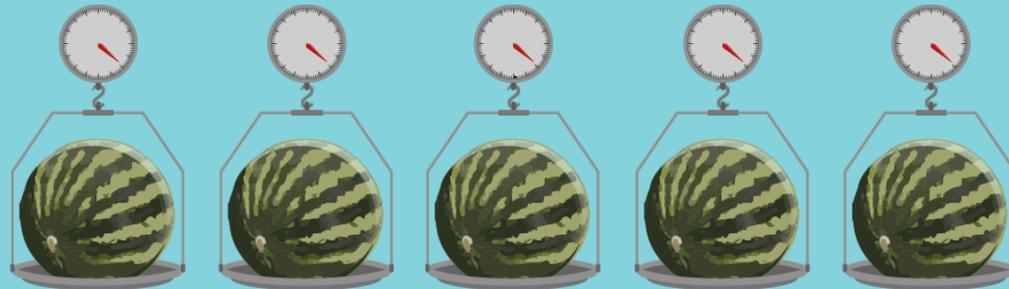
There are many kinds of reliability in reading screeners:

Internal consistency, or how well a set of item scores relate to each other.

Alternate form, or how well two different sets of items in a screener relate to each other.

Test-retest, or how stable two sets of scores are over a fixed period.

Inter-rater, or how two different people observe a behavior and rate it in the same way.

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VALIDITY

WHAT IS VALIDITY?

Validity is an important aspect of high-quality instruments used to measure academic progress. It is how well a tool measures what it's supposed to measure.

The concept of validity may be illustrated with a simple example of the ice cream personality test

In the test, individuals first select their top ice cream preference from a list of six flavor options. Then, they identify which of the six personality descriptions bests fits their personality.

If ice cream preference is associated with personality description, a moderate to strong correlation between ice cream and personality preference would provide evidence that the test is valid.

Six forms of construct validity

Content validity: The characterizations of the screener content's relevance, the overall representativeness of the content, and the quality of the test items or stimuli.

Structural validity: How well the grouping of scores within a screener aligns with the theoretical grouping of what the item content measures.

External validity: Related to the degree to which the screener may be used in practical ways in a variety of settings.

Substantive validity: How well the screener items are theoretically linked to and reflective of the construct(s) of interest.

Generalizability: The interpretation of scores and how well they cohere with different samples at different time points.

Consequential validity: The implications for what happens when correct decisions or decision errors occur based on screener scores.

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https://improvingliteracy.org/brief

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Classification accuracy tells us how good a tool is at correctly distinguishing students who have a reading difficulty from students who do not. Classification accuracy is often the hallmark indicator for the quality of a screener.

Gaab& Petscher, 2022

https://improvingliteracy.org/brief

Challenges with existing literacy screening tools

Widely used dyslexia/literacy screening tools often

→ have poor psychometric properties (e.g., not being sensitive enough to correctly identify who has a reading disability)

→ do not measure the child's abilities directly

→ rely on single measures of language or (pre-)literacy skills

→ fail to account for cultural or linguistic diversity

→ require 1:1 administration

→ do not provide enough information for comprehensive "intervention" planning.

These widespread challenges can lead to misdiagnoses and misguided resource allocations in educational settings.

National Center on **INTENSIVE INTERVENTION** at American Institutes for Research ■

Search

Intensive Intervention ▾   Tools Charts ▾   Implementation Support ▾   Intervention Materials ▾   Information For... ▾   Resource Library

National Center on Intensive Intervention Mission and Approach

NCII builds the capacity of state and local education agencies, universities, practitioners, and other stakeholders to support implementation of intensive intervention in literacy, mathematics, and behavior for students with severe and persistent learning and/or behavioral needs, often in the context of their multi-tiered system of support (MTSS) or special education services. NCII's approach to intensive intervention is **data-based individualization (DBI)**, a research-based process that integrates the systematic use of assessment data, validated interventions, and intensification strategies.

Validated Intervention Program (e.g., Tier 2, Standard Protocol, Secondary Intervention)

Progress Monitor

https://charts.intensiveintervention.org/chart/academic-screening
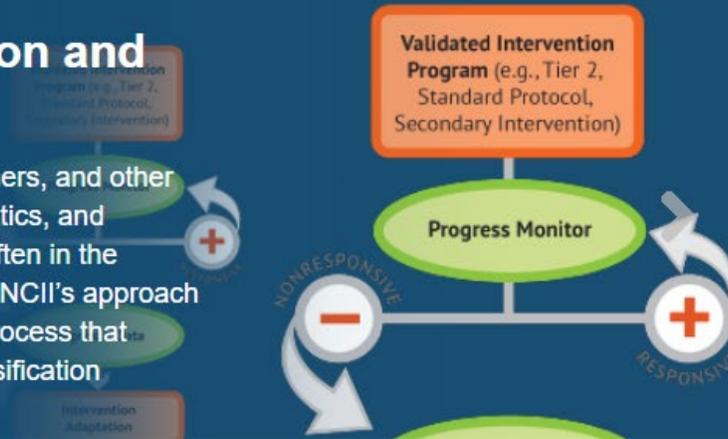
Academic Screening Tools Chart

This tools chart has three tabs that include ratings on the technical rigor of the tools: (1) Classification Accuracy, (2) Technical Standards, and (3) Usability Features.

The presence of a particular tool on the chart <u>does not constitute endorsement</u> and should not be viewed as a recommendation. All tools that meet the criteria for review are posted on the chart, regardless of results. The chart represents all tools that were reviewed, not those that were "approved."

Last updated: July 2021. Click here for a brief summary of the new and improved tools we've released.

View Chart Resources

Print Current Chart View

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Legend

⬤ Convincing evidence ◐ Partially convincing evidence ◯ Unconvincing evidence ▬ Data unavailable

FILTER RESULTS

Subject
☑ Reading
☐ Mathematics

Grade
☐ Pre-K
☑ Elementary (K-5)
☐ Middle School (6-8)
☐ High School (9-12)

Purchasing Considerations
☐ Free
☐ One time cost
☐ Annual cost
☐ Training cost

Training Considerations
☐ Training not required
☐ Training required and offered
☐ Training required and not offered

Administration Format
☐ Computer/tablet administered individually
☐ Computer/tablet group administered
☐ Educator administered individually
☐ Educator group administered

Admin & Scoring Time
☐ 1 – 5 minutes
☐ 6 – 10 minutes
☐ 11 – 30 minutes
☐ 31+ minutes

Technology Requirements
☐ Computer or tablet required
☐ Internet required
☐ Additional tech required
☐ No tech required

Subgroup Information
☐ Disaggregated data available

Apply Filters | **Hide Advanced Filters**

Compare Tools | **Reset Chart** | Classification Accuracy | Technical Standards | Usability Features

All ☐	Title	Area	Grade	Classification Accuracy Fall	Classification Accuracy Winter	Classification Accuracy Spring
	Edition	Fluency				
☐	DIBELS 8th Edition	Oral Reading Fluency	Grade 5	◐	⬤	▬
☐	DIBELS 8th Edition	Phonemic Segmentation Fluency	Kindergarten	◐	◐	◐
☐	DIBELS 8th Edition	Phonemic Segmentation Fluency	Grade 1	◯	◯	◯
☐	DIBELS 8th Edition	Word Reading Fluency	Kindergarten	▬	◐	◐
☐	DIBELS 8th Edition	Word Reading Fluency	Grade 1	◐	◐	◐
☐	DIBELS 8th Edition	Word Reading Fluency	Grade 2	⬤	⬤	⬤
☐	DIBELS 8th Edition	Word Reading Fluency	Grade 3	◐	◐	◐
☐	EarlyBird Education	EarlyBird Dyslexia and Early Literacy Screener	Kindergarten	◐	◐	▬
☐	easyCBM	Passage Reading Fluency	Grade 3	◯	◯	◯

https://charts.intensiveintervention.org/chart/academic-screening

EarlyBird, an evidence-based, self-administered game – engages students, saves teachers time

DEVELOPED & TESTED AT | Boston Children's

- Computer adaptive screening to provide the most precise results in the least amount of time
- Incorporates AI voice technology and auto-scoring to save teachers time and to remove bias, training, fatigue, and inconsistencies in scoring
- Easily administered in groups by any adult after only a brief training
- Extensive end-to-end support to intuitively, efficiently and cost-effectively support educators in targeting instruction
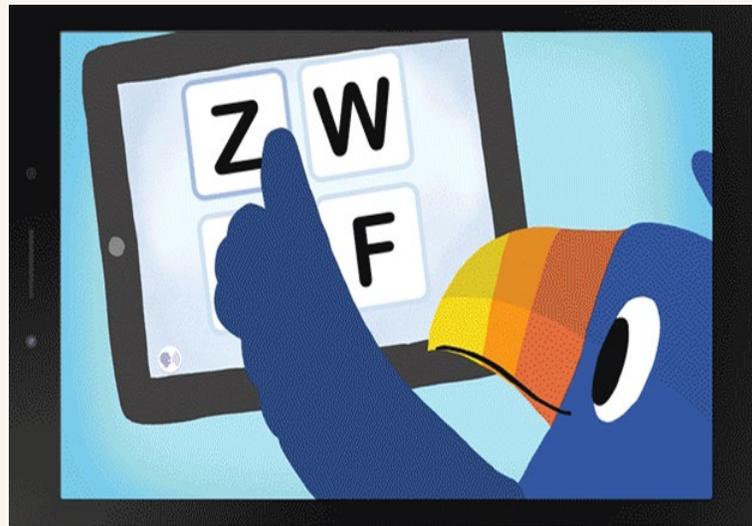
www.earlybirdeducation.com

https://www.imaginelearning.com/products/assessment/#screener
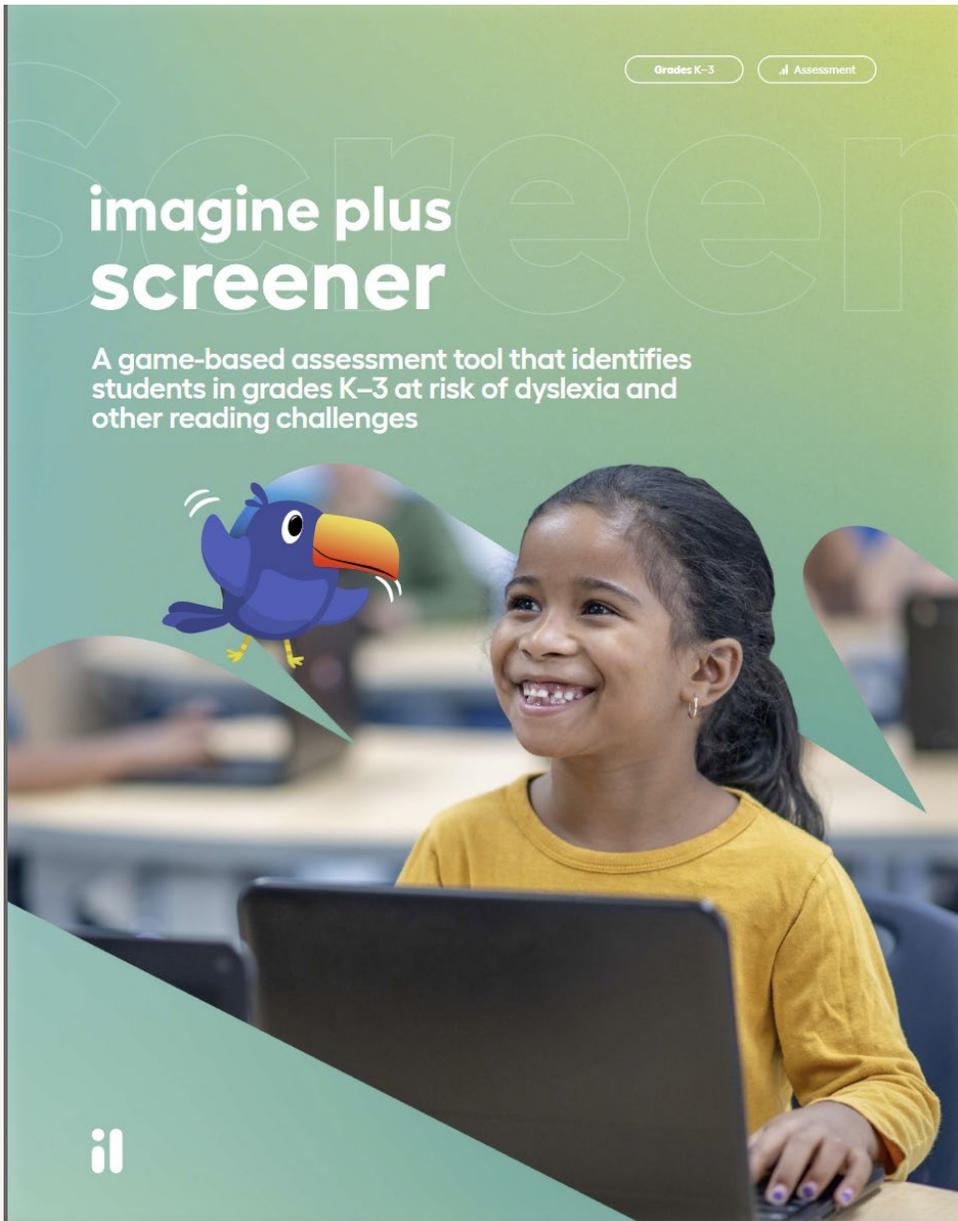
Introducing Sprout Labs

An early literacy program for at-home reading instruction

What's included

- Exclusive access to a comprehensive, validated assessment (Earlybird/Imagine Learning)

- Virtual Tutoring with an Orton-Gillingham trained Reading Specialist

- Personalized daily practice to reinforce skills between sessions

- Progress monitoring every 6–8 weeks on skills and oral reading fluency

Available Nationwide for children ages 4-12!

Know a family that could benefit? Visit sproutlabs.com/asha or scan the QR code learn more

Where should we screen?

- Pediatrician's offices (e.g. at 4 or 5 year well visit)

- Social Workers

- Preschools/Day Cares

- Libraries

- Children's Museum

- Speech and Language Therapy/Occupational Therapy sessions

- Children's homes

Embracing literacy as a community

Reintroducing Dyslexia: Early Identification and Implications for Pediatric Practice

(Sanfilippo, …Gaab, 2020; Pediatrics)

64

Screening Pediatric Patients for Reading difficulties Test: Draft (SPRouT-D)
Developed by Eric Q. Tridas, Yaacov Petscher, Christopher Stanley, Jospeh Sanfilippo, and Nadine Gaab

English: https://osf.io/hdxgf
Portuguese: https://osf.io/preprints/osf/4hscz
Spanish: https://osf.io/8k5de

Dyslexia in the Context of Social Work: Screening and Early Intervention

Lisa Schelbe[1] iD, Jessica Pryce[2], Yaacov Petscher[3], Hank Fien[4], Christopher Stanley[5], Brian Gearin[6], and Nadine Gaab[7]

Families in Society, 2022

Abstract

Dyslexia, the most common learning disability, is associated with poor academic, economic, vocational, and health outcomes. Disproportionately, dyslexia is undiagnosed and untreated in children who are Black, Indigenous, and people of color (BIPOC) or who live in poverty. Early identification of and subsequent interventions for children at risk for dyslexia can effectively mitigate poor outcomes. While screening and interventions largely occur in schools, social workers across practice contexts have responsibilities to address dyslexia: identifying, referring, educating, and advocating. Social workers should address dyslexia to promote equity and improve quality of life and various outcomes across the life course. This article describes dyslexia, early screening, and interventions; dyslexia as a social justice issue; and social workers' roles in addressing dyslexia.

| Genetic Factor | Variant function in any number of **Generalist genes**, such as COMT, VAL/MEL, FOXP2 **Dyslexia susceptibility genes**, such as ROBO1, DCDC2, DYXICI, KIAA0319 |

Brain Level
Atypical neuronal migration, and/or synaptic/cell development

Atypical axonal growth, glutamatergic transmission, subtle cortical malformations, atypical sulcal pattern, atypical neural response characteristics, and/or neurometabolites Cho and Glu

Atypical development of cortical thickness, myelination, functional activity pattern, and/or functional connectivity

Atypical development of structural and functional connectivity of the reading circuitry

Perceptual/Cognitive Level
Atypical sensorimotor (vision and hearing) and/or perceptual functions

Atypical development of language and/or attention functions

Atypical phonological awareness, verbal working memory, rapid automatized naming, letter knowledge, vocabulary, and/or executive functions

Environmental Factor
Low home literacy, low parental educational background and socioeconomic status, adverse neighborhood characteristics, and/or cultural influences

Ineffective schooling, limited instructional resources, and/or insufficient involvement of parents

Atypical reading performance

Prenatal — **Birth** — **Postnatal**

(Ozernov-Palchik, … & Gaab, 2016; Curr Opin. Behav. Sci)

The development of reading proficiency is a public health issue:

The right to equal education includes the right to read

Literacy is a widely recognized determinant of health outcomes and is associated with many indices of academic, social, vocational, and economic success
(Irwin et al., 2007)

National Academy of Medicine summary highlights that duration of education, which is highly dependent on reading proficiency, is a significant predictor of health and longevity (Johnston, 2019)

The Pediatric Brain, Learning Disabilities, and Screening Tools for Literacy Milestones and Dyslexia

NADINE GAAB, PHD

PROFESSOR OF EDUCATION

HARVARD UNIVERSITY

www.gaablab.com

Home Literacy Environment (HLE)

Aspects of HLE that are most predictive of future language and literacy skills include (e.g., Hamilton, 2013; Payne, Whitehurst, & Angell, 1994; Bus et al., 1995; Rodriguez et al., 2011):

- Age of onset of shared reading

- Frequency and quality of book reading

- Frequency of library visits

- Parental knowledge of storybook titles

- Parental mediating style during shared reading

- Parental language during shared reading

- …

→ …but there are large cultural differences….
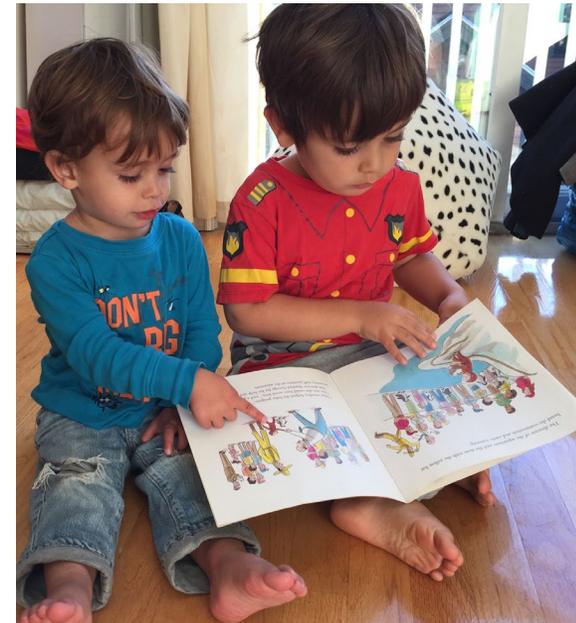
Home language and literacy environment and its relationship to socioeconomic status and white matter structure in infancy

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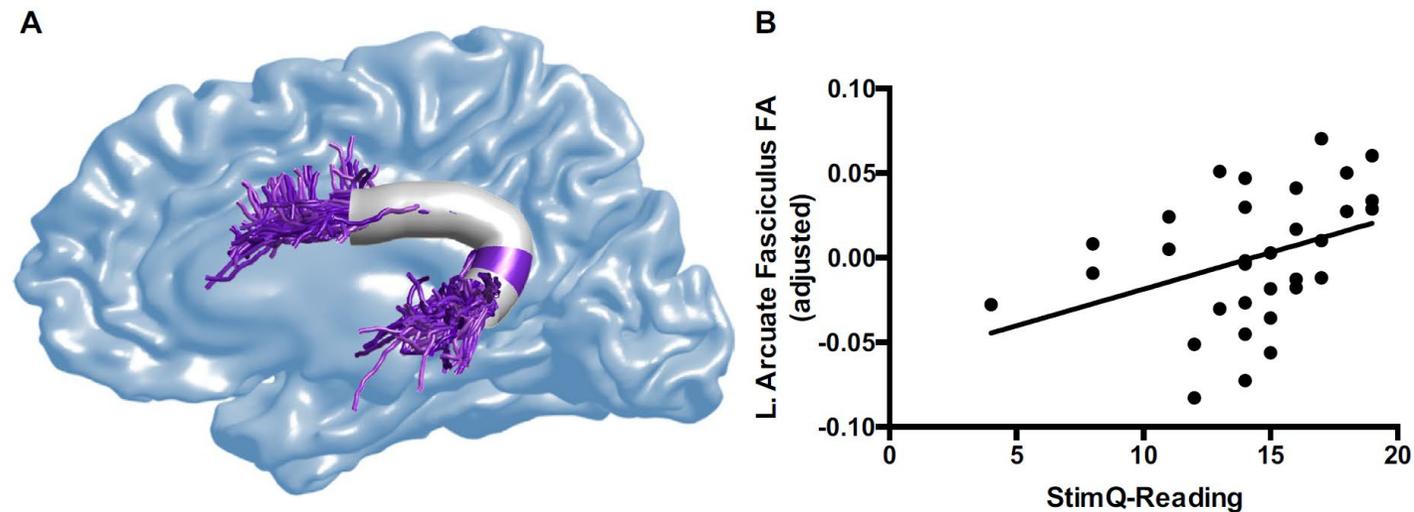
Fig. 2 Association between StimQ-Reading and white matter organization in the left AF. **A** Nodes exhibiting significant associations between StimQ-Reading and FA (after FWE correction for multiple comparisons), superimposed on a midsagittal slice of one infant (purple). **B** Scatterplot depicting average FA from nodes represented in A in relation to StimQ-Reading. FA was adjusted for infant age, sex, and self-reported maternal reading ability

10 <u>MYTHS</u> about dyslexia screening

1. Sings of dyslexia can only be seen after 2-3 years of reading instruction

2. A screening is expensive and has low sensitivity and low specificity

3. The screening test will only add more testing to the kindergarten age

4. Most districts/kindergarten teacher do screening anyway.

5. All at-risk children will be referred to 'Special Education'

6. A screening will give children a diagnosis at age 4.

7. Second language learners cannot be screened for DD until they are fluent in English

8. Even if you screen early, you won't be able to intervene effectively that early anyway

9. Children will grow out of their dyslexia on their own and catch up

10. Screening can only be completed by neuropsychologists

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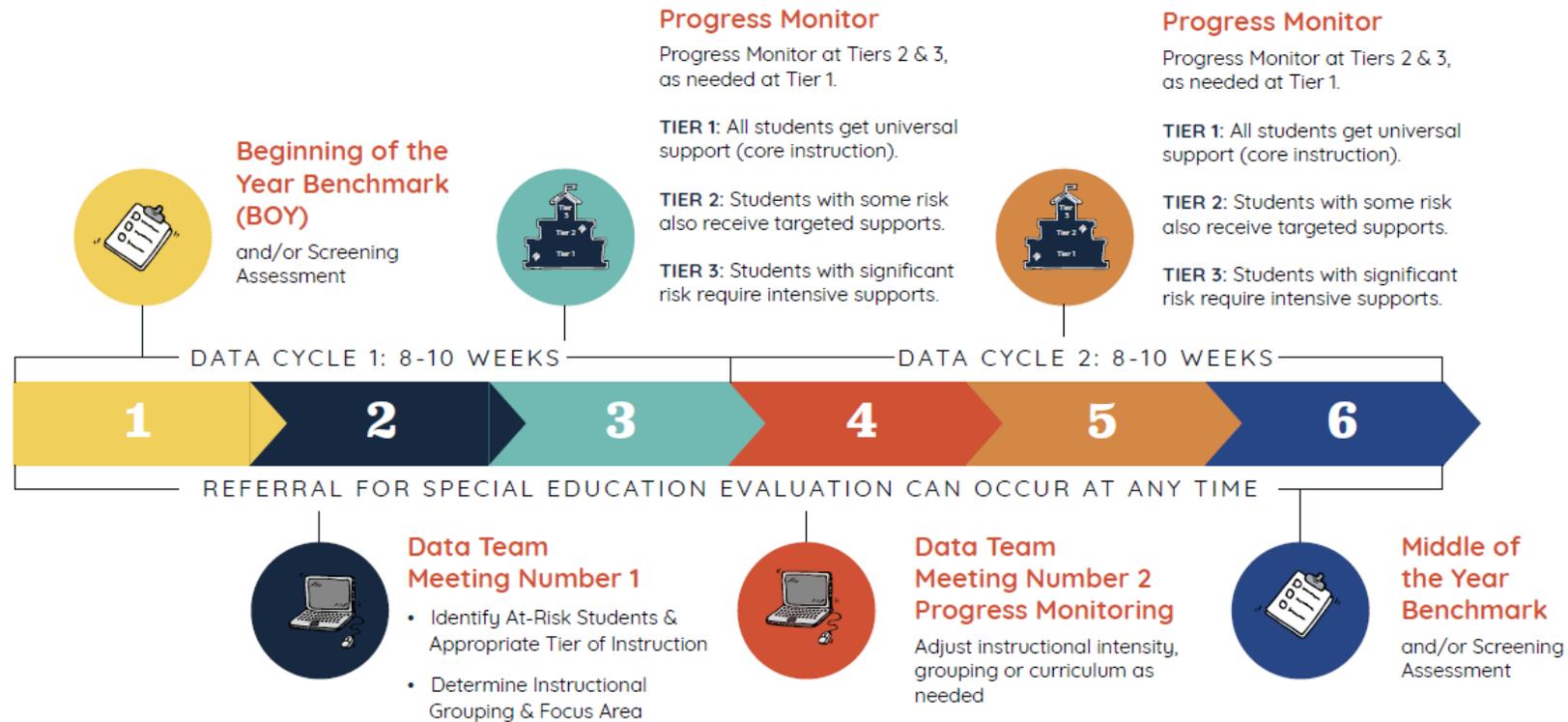10. Screening can only be completed by neuropsychologists

Figure 1: How to Integrate Screening, Intervention and Progress Monitoring within a Multi-Tiered System of Support (MTSS) Framework: Supporting Students At-Risk for Dyslexia

By organizing data into cycles, teams create formal timeframes by which to monitor student

Beginning of the Year Benchmark (BOY)

and/or Screening Assessment

Progress Monitor

Progress Monitor at Tiers 2 & 3, as needed at Tier 1.

TIER 1: All students get universal support (core instruction).

TIER 2: Students with some risk also receive targeted supports.

TIER 3: Students with significant risk require intensive supports.

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DATA CYCLE 1: 8-10 WEEKS   DATA CYCLE 2: 8-10 WEEKS

1   2   3   4   5   6

REFERRAL FOR SPECIAL EDUCATION EVALUATION CAN OCCUR AT ANY TIME

Data Team Meeting Number 1

- Identify At-Risk Students & Appropriate Tier of Instruction
- Determine Instructional Grouping & Focus Area

Data Team Meeting Number 2 Progress Monitoring

Adjust instructional intensity, grouping or curriculum as needed

Middle of the Year Benchmark

and/or Screening Assessment

performance and adjust instruction. Rather than strictly relying on informal conversations with colleagues and data from varied sources and tools, practitioners can feel confident about a protocol that has allocated shared planning time to data-driven decision-making.

(Massachusetts Dyslexia Guidelines)

Establishing a screening team

Your Screening Team

An effective universal screening process for risk of dyslexia across three grade levels (K-2) will involve a team of practitioners who hold various roles within the school and district. A screening team often includes:

➡ General educators who have established relationships with the students and are committed to offering targeted instruction and educational supports across the MTSS tiers.

➡ An administrator or district leader responsible for understanding and allocating the financial, personnel, and professional development resources needed to implement universal early literacy screening.

➡ Instructional experts in evidence-based reading instruction (especially the foundational components in phonemic awareness and phonics) who also have an understanding of the current screener and instructional systems for literacy. Reading specialists and special educators are often trained in these areas.

➡ Other specialists, such as school psychologists and English language development (ELD) or English as a second language (ESL) teachers, whose expertise and knowledge are relevant.

(Massachusetts Dyslexia Guidelines)