The Science of Dyslexia and Implications for Teacher Education

Presentation to the Connecticut Dyslexia Task Force

Devin Kearns, Ph.D. & Fumiko Hoeft, M.D. Ph.D.

University of Connecticut

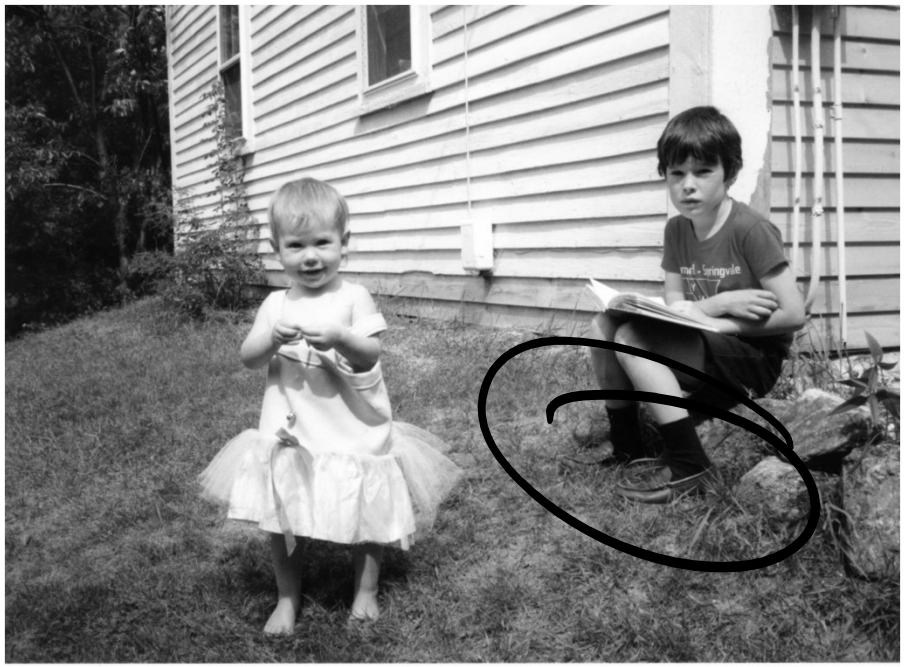
Overview

- Background about us
- Understanding reading comprehension
- Understanding word recognition

Background about us

Why you would possibly want to hear us talk about dyslexia

Cabrie's older brother



Mr. Kearns

teacher, literacy coach, and reading remediation specialist

Lourdes, Sergio, Rosa, Francisco

Adolfo, Jaime, Maggie, Blake

Dr. Kearns

reading researcher, intervention designer, teacher educator

Devin Kearns (devin.kearns@gmail.com)

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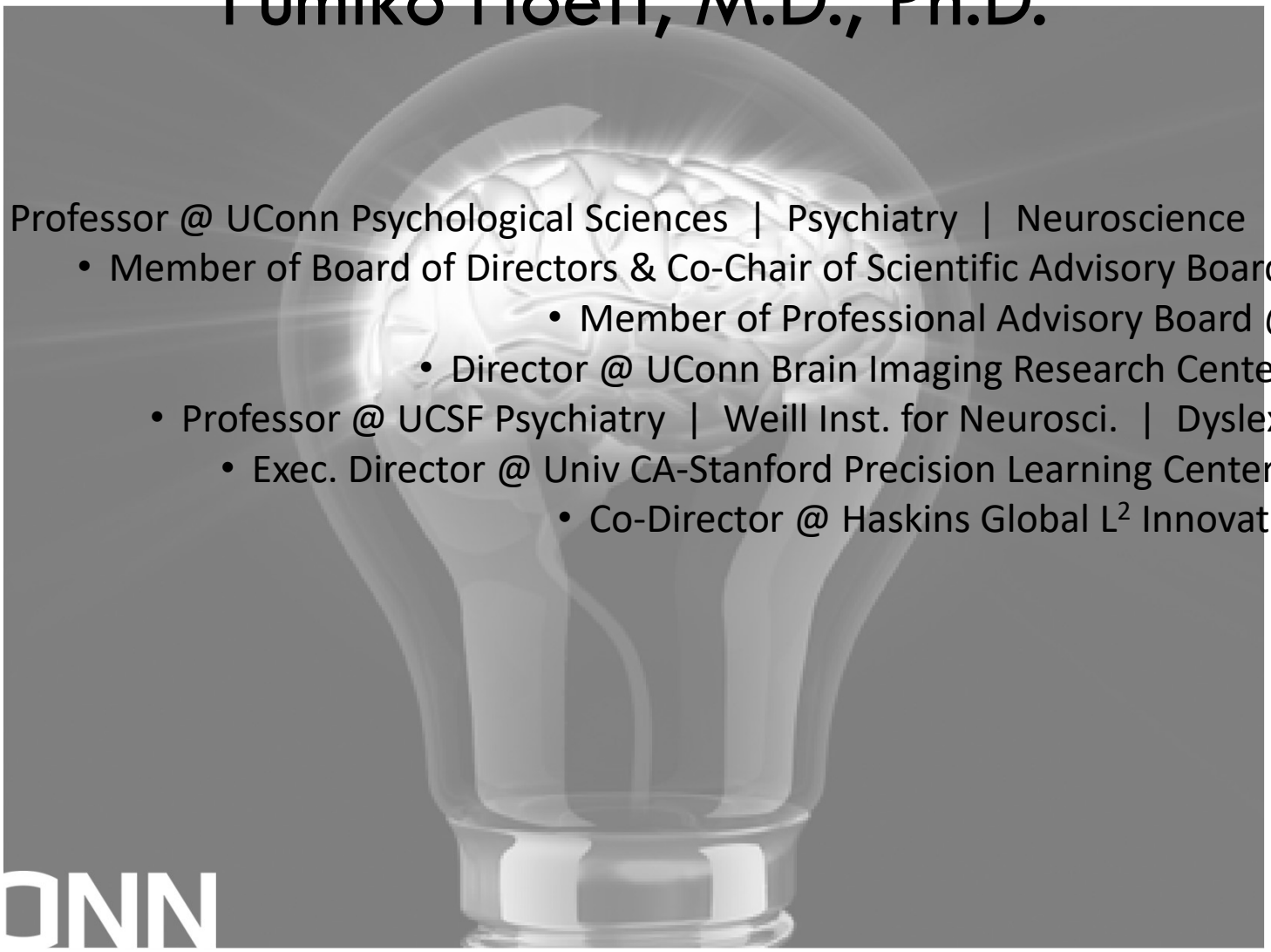


- Professor @ UConn Psychological Sciences | Psychiatry | Neuroscience | IBACS
- Member of Board of Directors & Co-Chair of Scientific Advisory Board @ IDA
- Member of Professional Advisory Board @ NCLD
- Director @ UConn Brain Imaging Research Center (BIRC)
- Professor @ UCSF Psychiatry | Weill Inst. for Neurosci. | Dyslexia Cntr.
- Exec. Director @ Univ CA-Stanford Precision Learning Center (PrecL)
- Co-Director @ Haskins Global L^2 Innovation Hub

professor & director

board member, advisor

Understanding Reading Comprehension

Fitting dyslexia into the big picture

The Tale of Peter Rabbit
by Beatrix Potter

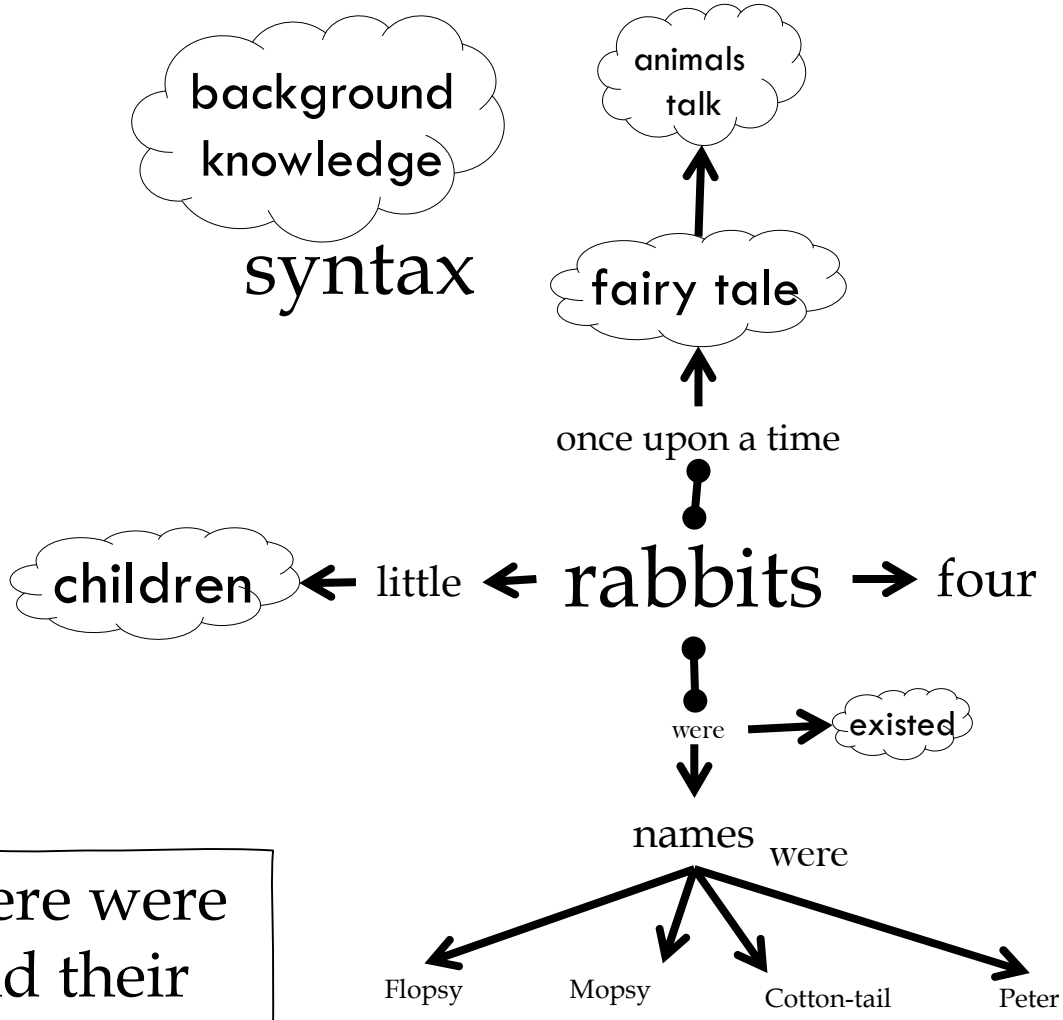
Once upon a time there were four little Rabbits, and their names were Flopsy, Mopsy, Cotton-tail, and Peter. They lived with their Mother in a sand-bank, underneath the root of a very big fir-tree.

"Now my dears," said old Mrs. Rabbit one morning, "you may go into the fields or down the lane, but don't go into Mr. McGregor's garden: your Father had an accident there; he was put in a pie by Mrs. McGregor."

Reading Comprehension

- Constructing a situation model from the textbase

Textbase



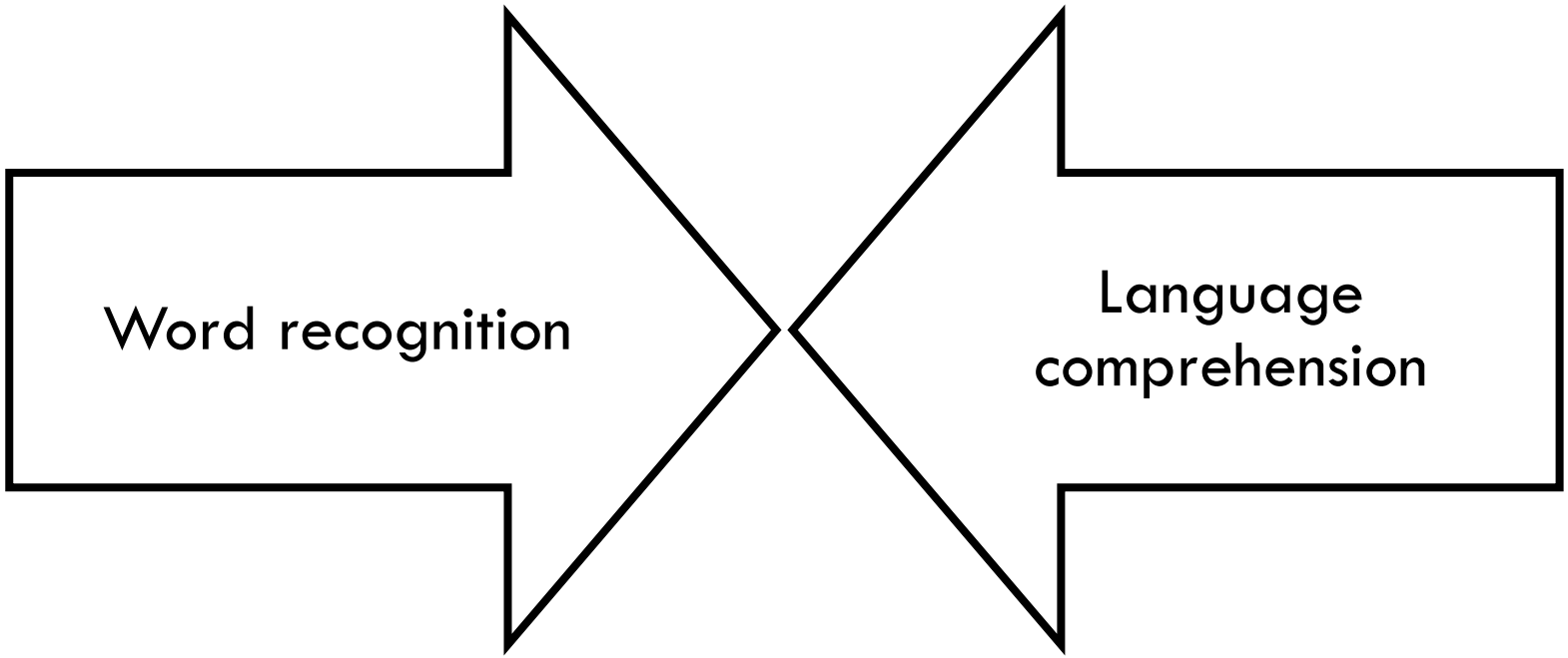
Once upon a time there were four little Rabbits, and their names were Flopsy, Mopsy, Cotton-tail, and Peter.

Situation model

fairy tale four rabbits children

This is a fairy tale about four bunnies

Tools to construct the situation model: The simple view of reading



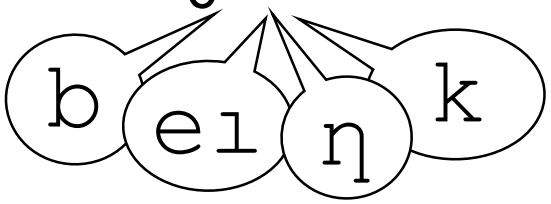
Hoover & Gough, 1990

Word recognition

Reading Comprehension

Language comprehension

Phonological awareness



Decoding skill

rabbits

Recognizing words by sight

there root

Devin Kearns (devin.kearns@gmail.com)

adapted from Scarborough (2001): Scarborough, H. (2001). Connecting early language and literacy to later reading (dis)abilities: Evidence, theory, and practice. In S. Neuman & D. Dickinson (Eds.), *Handbook for research in early literacy* (pp. 97-110). New York, NY: Guilford Press

Word recognition

Reading Comprehension

Language comprehension

Background knowledge

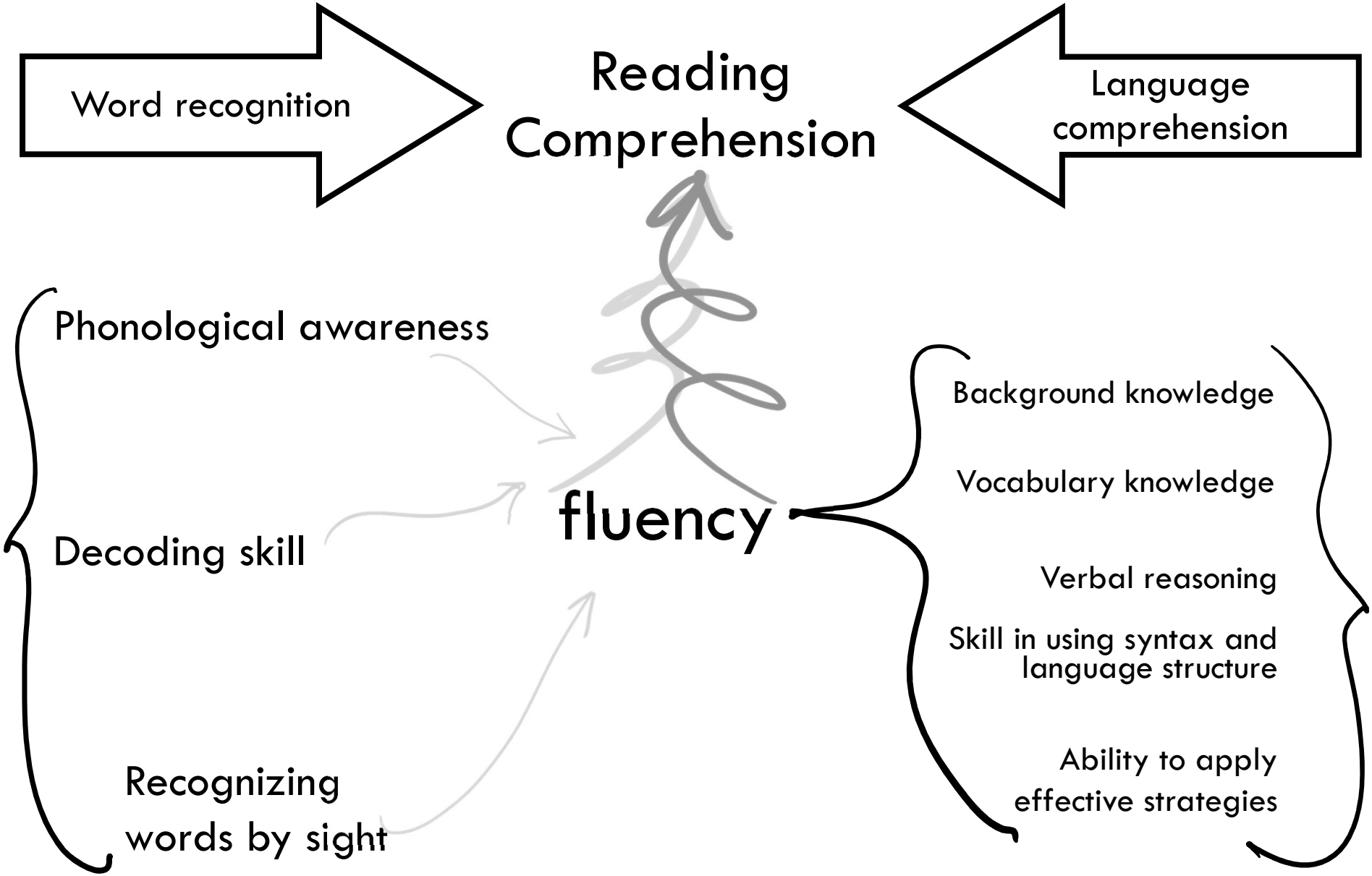
Vocabulary knowledge

Verbal reasoning

Skill in using syntax and language structure

Ability to apply effective strategies

adapted from Scarborough (2001): Scarborough, H. (2001). Connecting early language and literacy to later reading (dis)abilities: Evidence, theory, and practice. In S. Neuman & D. Dickinson (Eds.), *Handbook for research in early literacy* (pp. 97-110). New York, NY: Guilford Press



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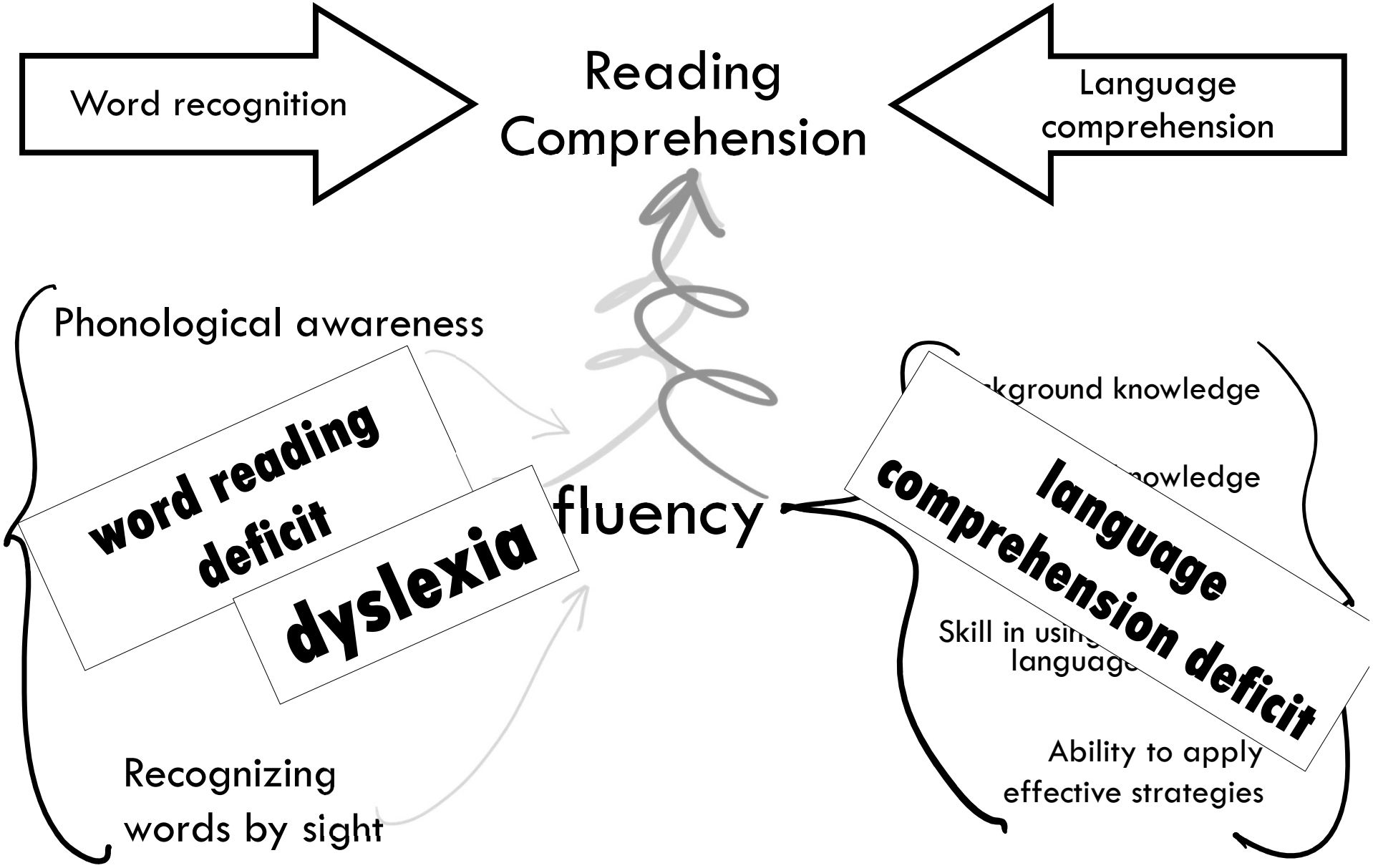

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Key Idea

Concept

- Dyslexia prevents the reader from constructing the situation model because they cannot access the print

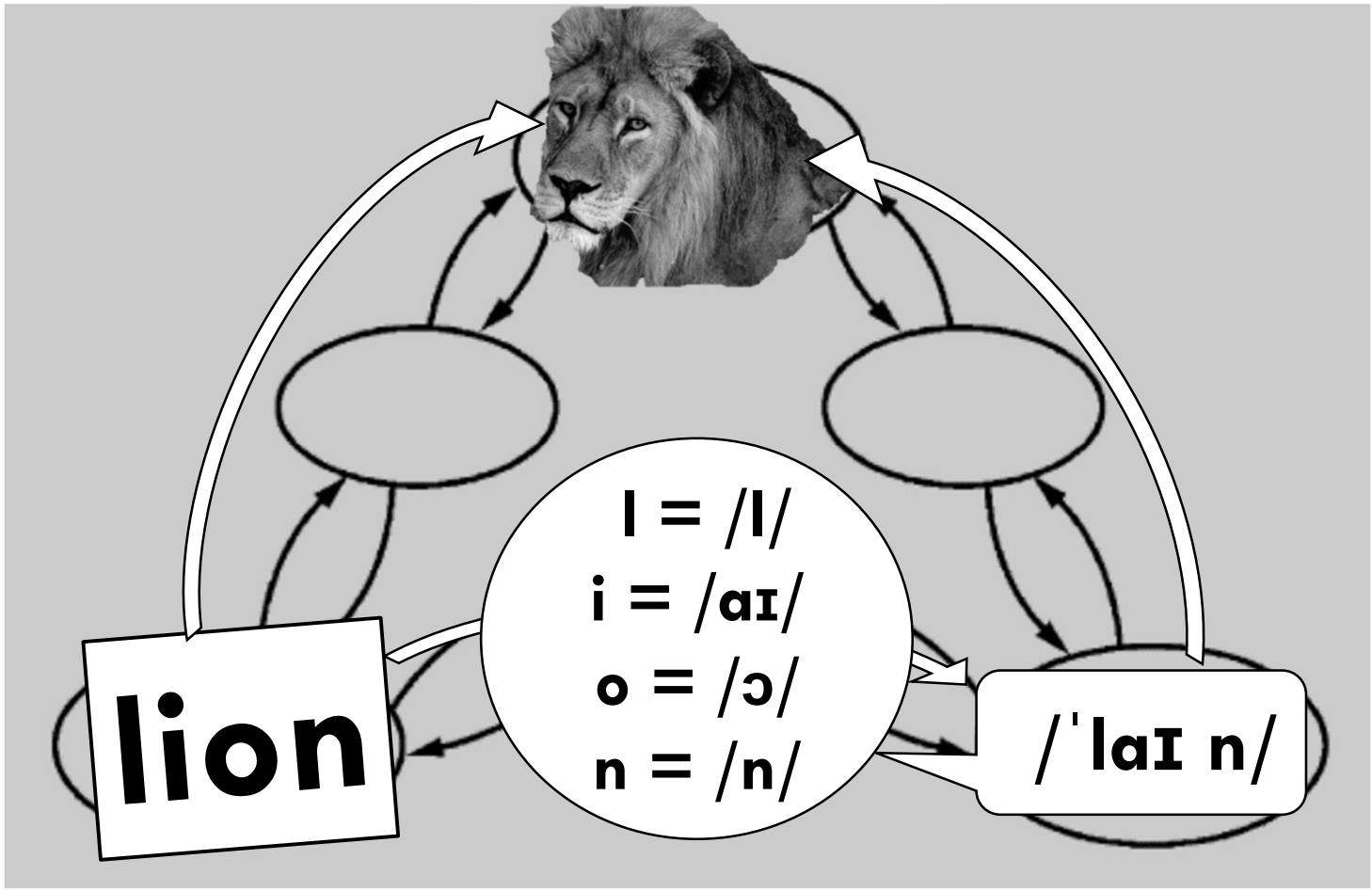
Instructional Implication

- Students with dyslexia require instruction that focuses on helping them access print

Individual Differences in Word Recognition Development

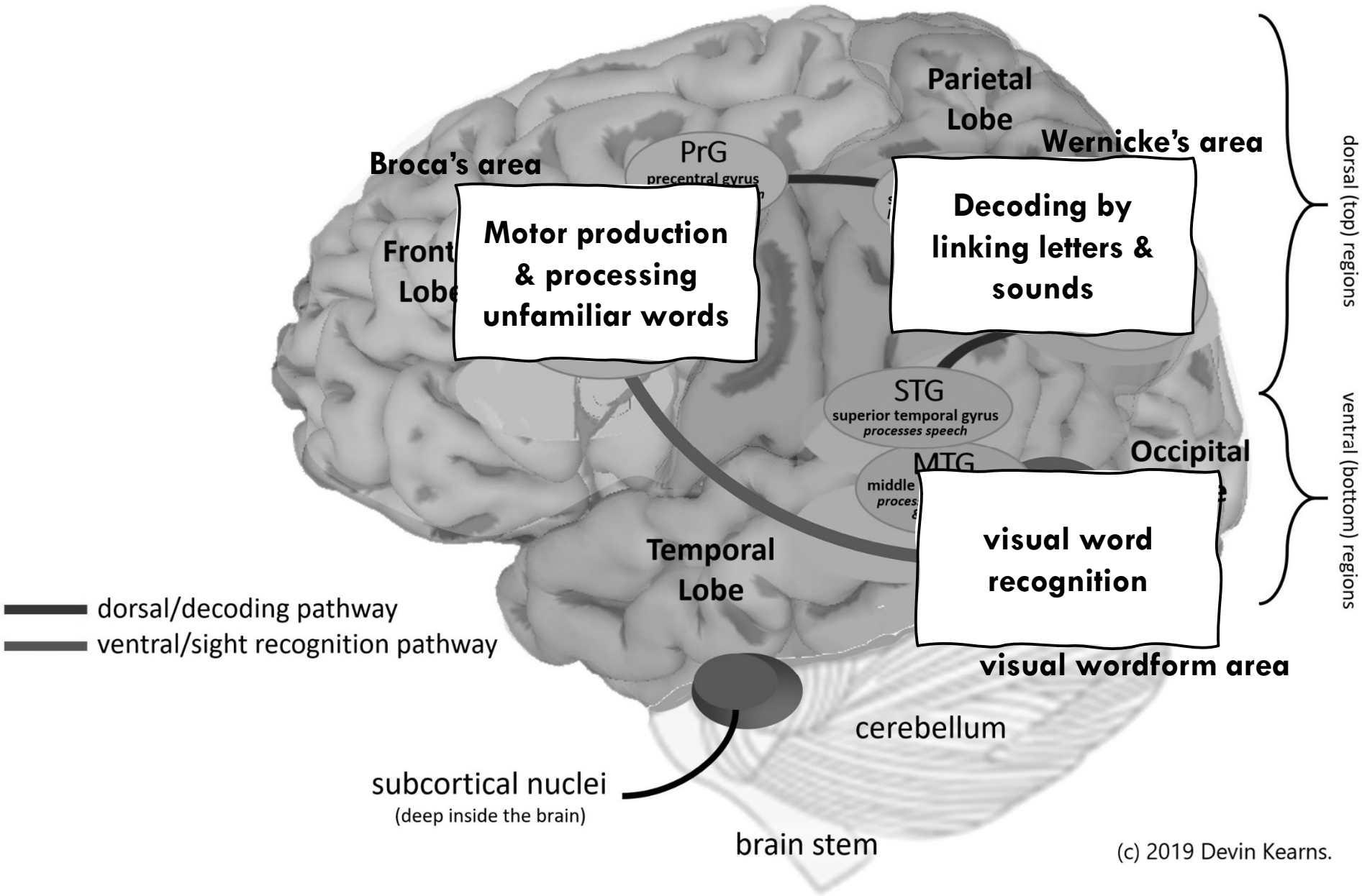
Value of differing degrees of emphasis

Connectionist framework for word recognition



Seidenberg & McClelland (1989)

Word recognition in the brain



Implications of connectionist framework

- Saying the word correctly depends on
  - Early in reading acquisition: Phonological awareness and decoding

    letters to sounds
  - Later: Sight recognition

    letters to meaning

- Strong vocabulary knowledge supports word recognition
  - This knowledge is especially useful once readers have established decoding skills
  - This can provide some support for students with reading difficulty

Individual differences in word recognition

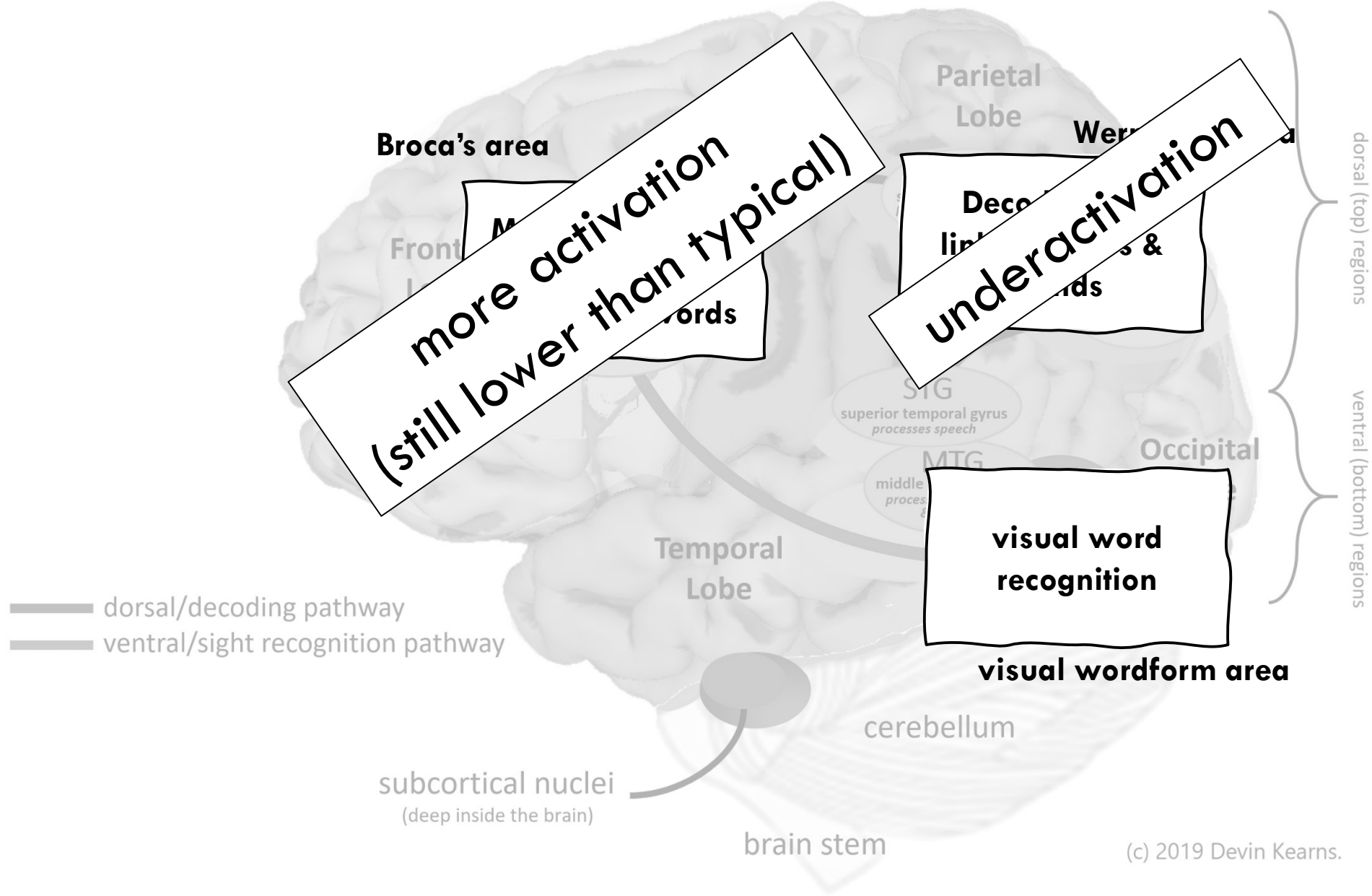
In a connectionist framework

- The value of different ways of learning depends on the learner
- This raises the questions:
  - Should we include meaning instruction in phonics instruction?
  - Should we teach students less about phonics?

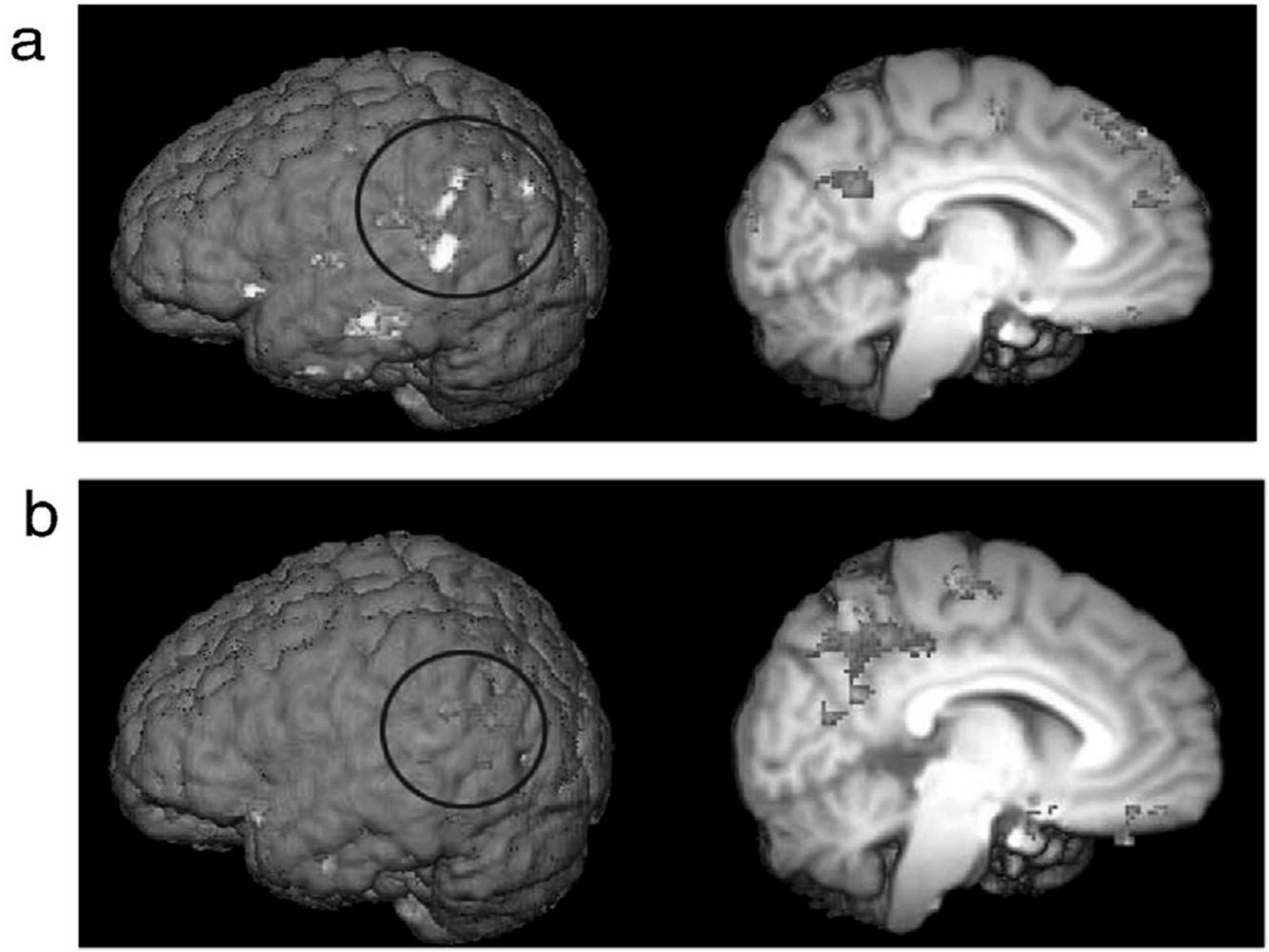
Some students will learn to read without extensive phonics instruction

- Foorman et al. (1998) found that in first-grade classrooms
- with explicit phonics instruction, 84% of students made reading progress
- without explicit phonics instruction, 56% of students made reading progress

Processing in dyslexia



Underactivation in the temporo-parietal region



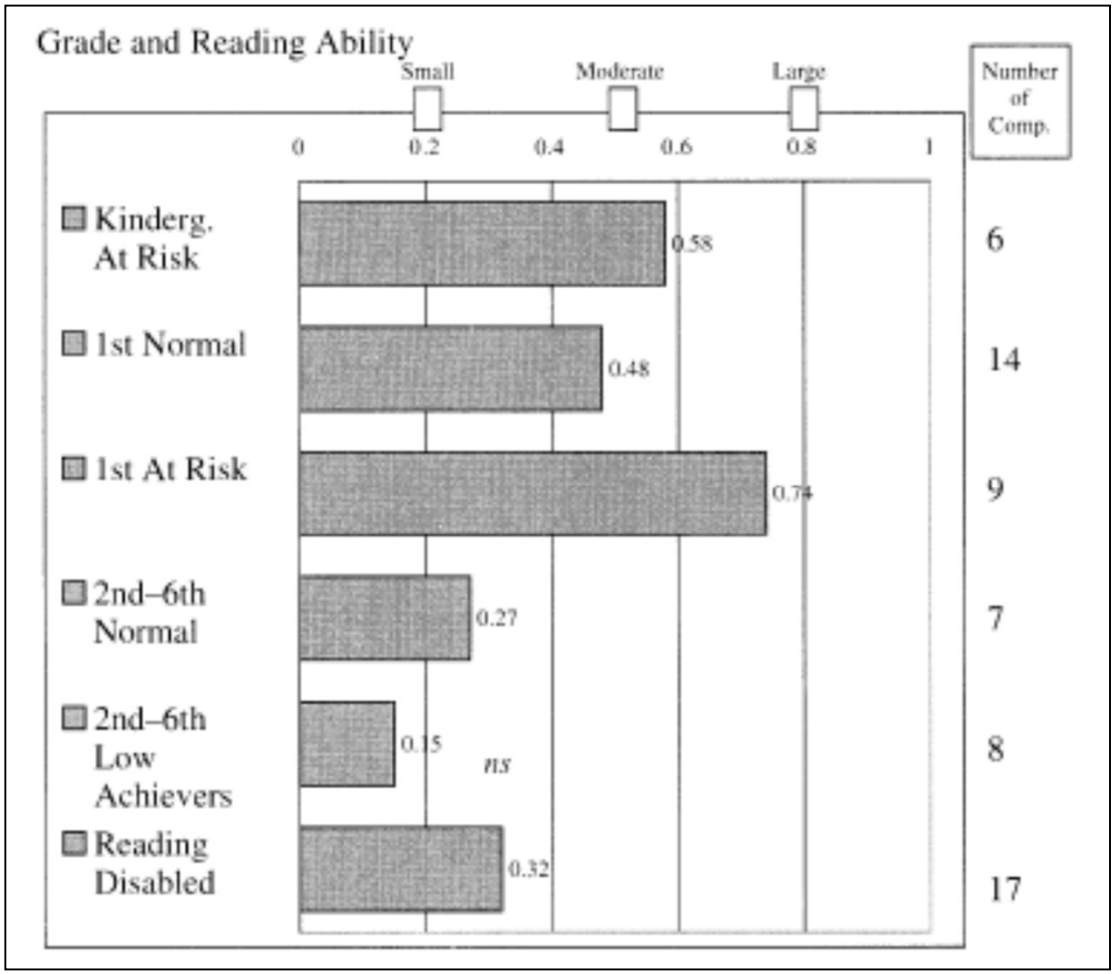
Successful adult readers

Kindergarteners at-risk for dyslexia

Adapted from presentations by Trynia Kaufman & Joanna Christodoulou

Yamada et al. (2011)

Not all learners with reading difficulty need the same kinds of intervention



Not all readers need the same kind of tasks

Group 1
Grade Equivalent: 0.94

	TEACHER MANAGED		CHILD MANAGED		GROUP	
	Meaning-focused	Code-focused	Meaning-focused	Code-focused	Recommended	Actions
Connor, Carol	11	15	37	23	Group 1	Student Actions
Farris, Anna	12	17	36	23	Group 1	Student Actions
GaGa, Lady	13	17	35	22	Group 1	Student Actions
Imahara, Grant	12	18	36	24	Group 1	Student Actions
Pitt, Brad	13	21	36	27	Group 1	Student Actions
Group Minutes	**12**	**18**	**36**	**24**		

Group 2
Grade Equivalent: 1.38

	TEACHER MANAGED		CHILD MANAGED		GROUP	
	Meaning-focused	Code-focused	Meaning-focused	Code-focused	Recommended	Actions
Fey, Tina	10	10	38	14	Group 2	Student Actions
Kidman, Nicole	13	16	35	22	Group 2	Student Actions
Pratt, Chris	11	12	37	16	Group 2	Student Actions
Smith, Will	13	14	35	16	Group 2	Student Actions
Travolta, John	11	11	37	14	Group 2	Student Actions
Group Minutes	**12**	**13**	**36**	**16**		

Matching instruction and student is important

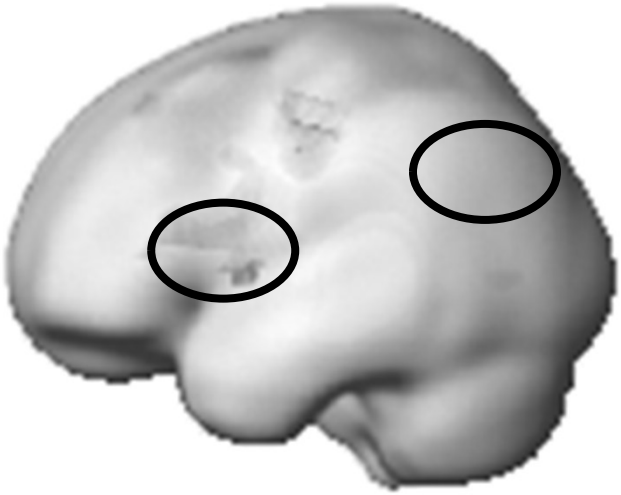
- National RTI Evaluation did not show success
  - Students at the 40th percentile were given additional phonics instruction
  - This may have been less effective for them
- Leveled Literacy Intervention is a good example
  - It is controversial when considered for teaching students with dyslexia because it has less focus on explicit systematic phonics
  - It has some evidence of success in randomized controlled trials
  - The effects appear to be best for students with less difficulty

Students with dyslexia need intensive phonics

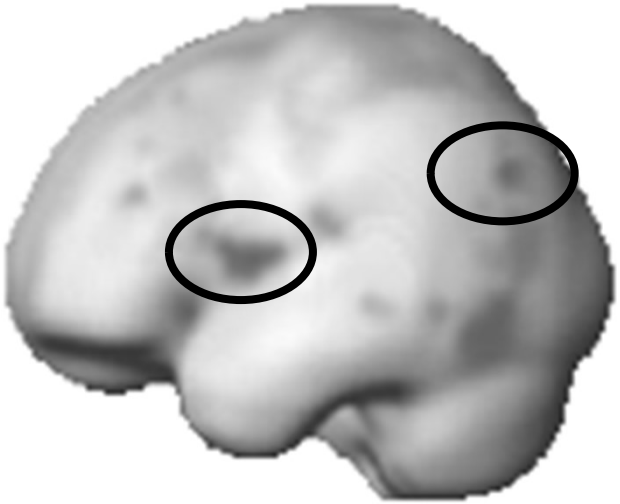
- Examination of long-term effects of phonics (Suggate, 2015) showed the greatest long-term benefits for students with the most serious reading difficulty
- Value of phonics for students with serious reading difficulty has been shown repeatedly (e.g., Wanzek, 2013)

Neural effects of phonological intervention in children with dyslexia

Pre-Intervention



Post-Intervention



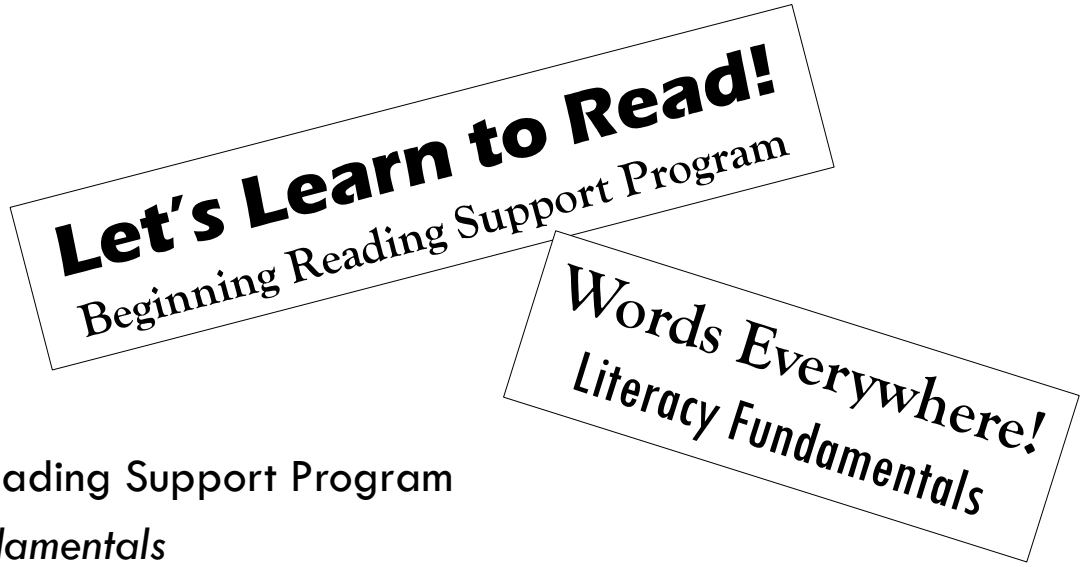
After intervention, metabolic brain activity of children with dyslexia more closely resembles that of typical readers.

Adapted from presentations by Trynia Kaufman & Joanna Christodoulou

Temple et al. (2003) PNAS

What are intervention programs?

- Standardized, research-based interventions designed for students who do not meet grade-level expectations
- Programs referred to as
  - Strategic interventions
  - Word reading interventions
  - Basic-skills program
  - Foundational skills programs
- "Examples"
  - *Let's Learn to Read:* Beginning Reading Support Program
  - *Words Everywhere: Literacy Fundamentals*
- The key is for programs to meet the criteria

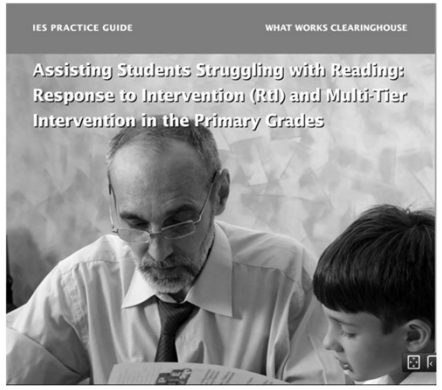


Characteristics of a *standardized* program

- Research-based:
  - Has been studied using rigorous methods
  - Has been shown to be effective in those studies
- Explicit:
  - provides instructions for the teacher (maybe scripted)
  - uses a model and practice instructional approach
- Systematic:
  - reflects the entire continuum of target skills
  - has enough lessons to be valuable
- Focused on foundational skills:
  - addresses standards *or* skills underpinning standards
  - supports (but is likely not the same as) grade-level standards

Research-based:
Has good evidence of good effects

- If a program is really research-based
  - It has evidence of working
  - There are programs that have been research-based
  - The Institute for Education Sciences Practice Guide provides guidance
- But maintain healthy skepticism
  - These days, every program has a tab on their website that says "research" or "evidence"
    - An evidence review saying this type of instruction works
    - Testimonials from educators or families
    - Unpublished internal studies
    - Poorly designed studies presented somewhere (not found in a journal)



Explicit

Clear Objective
• Important focus • Specific learning outcome

I Do

Modeling	Practice
Clear Explanation	Guided Practice
Planned Examples	Independent Practice

We Do

You Do

Supporting Practices
• Using effective methods to elicit frequent responses • Providing immediate specific feedback • Maintaining a brisk pace

Explicit

A Tapping and Sounding Out

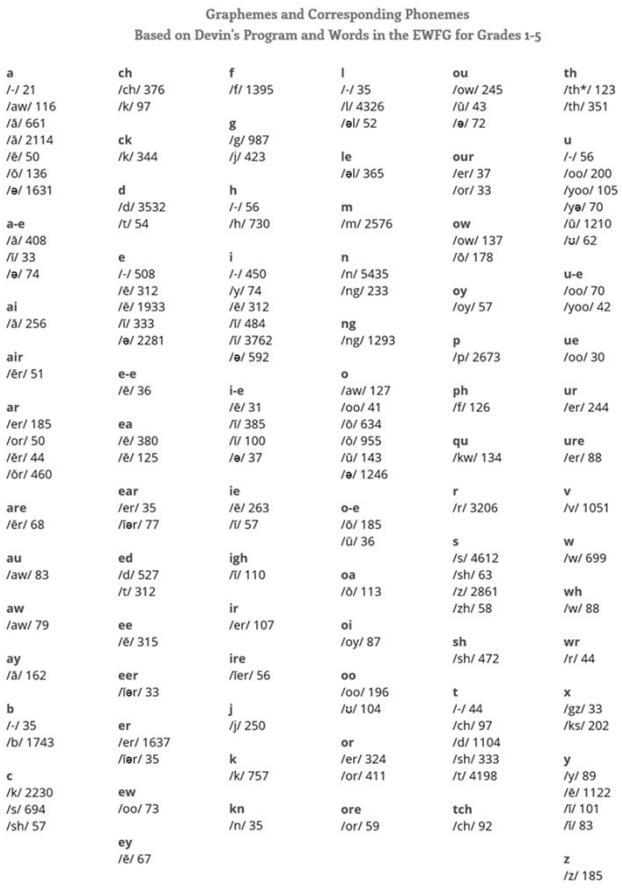
Direct the student to the Decodable Words section of the lesson page. **We're going to tap and sound out words together. We'll tap once for each dot. Me first.** Give this instruction only for the first word. Mat is used in this example; substitute with the different words given for each lesson.

I'll tap the sounds in this word *(point to mat)*.
Tap one finger under the first dot. **/m/**
Tap under the next dot with the same finger. **/a/**
Tap under the last dot. **/t/**

I'll sound it out. Slide your finger slowly under the word in an arc. **/maaaat/**

I'll say it fast. Slide your finger quickly under the word in a straight line. **mat**

Systematic



Graphemes and Corresponding Phonemes
Based on Devin's Program and Words in the EWFG for Grades 1-5

a
/-/ 21
/aw/ 116
/ā/ 661
/ă/ 2114
/ē/ 50
/ŏ/ 136
/ə/ 1631

a-e
/ā/ 408
/ĭ/ 33
/ə/ 74

ai
/ā/ 256

air
/ĕr/ 51

ar
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/or/ 50
/ĕr/ 44
/ŏr/ 460

are
/ĕr/ 68

au
/aw/ 83

aw
/aw/ 79

ay
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Focused on foundational skills

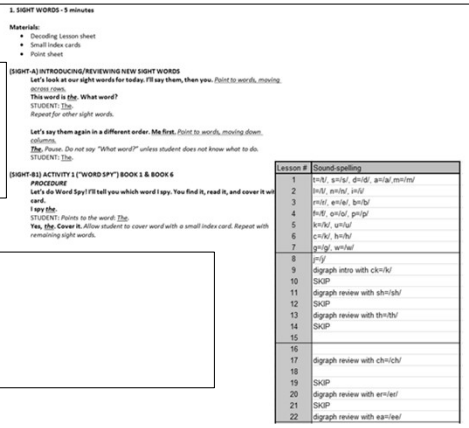
- Phonics skills underlie all other English Language Arts standards in the Common Core State Standards
- For students with dyslexia, the critical foundation is phonics

An example:
The Nashville Early Reading Project

Designed by Fuchs, Kearns et al. (2012) for first graders

Tested in a large-scale randomized control trial
Had positive effects on word reading and comprehension

Included structured lessons with scripts and materials



1. SIGHT WORDS - 5 minutes

Materials:
- Decoding Lesson sheet
- Small index cards
- Point sheet

[SIGHT-A] INTRODUCING/REVIEWING NEW SIGHT WORDS
Let's look at our sight words for today. I'll say them, then you. *Point to words, moving across rows.*
This word is the. What word?
STUDENT: The.
Repeat for other sight words.

Let's say them again in a different order. Me first. *Point to words, moving down columns.*
The. *Pause. Do not say "What word?" unless student does not know what to do.*
STUDENT: The.

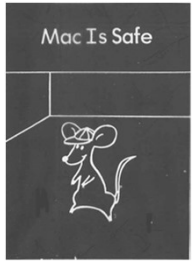
[SIGHT-B1] ACTIVITY 1 ("WORD SPY") BOOK 1 & BOOK 6
PROCEDURE
Let's do Word Spy! I'll tell you which word I spy. You find it, read it, and cover it wi
card.
I spy the.
STUDENT: *Points to the word* The.
Yes, the. Cover it. *Allow student to cover word with a small index card. Repeat with remaining sight words.*

Lesson #	Sound-spelling
1	/m/, /s/=/s/, /d/=/d/, /a/=/a/ /m/=/m/
2	/n/, /r/=/r/, /n/=/n/
3	/t/=/t/, /e/=/e/, /b/=/b/
4	/f/, /o/=/o/, /p/=/p/
5	/k/=/k/, /u/=/u/
6	/c/=/k/, /h/=/h/
7	/g/=/g/, /w/=/w/
8	/j/=/j/
9	digraph intro with ck=/k/
10	SKIP
11	digraph review with sh=/sh/
12	SKIP
13	digraph review with th=/th/
14	SKIP
15	
16	
17	digraph review with ch=/ch/
18	
19	SKIP
20	digraph review with er=/er/
21	SKIP
22	digraph review with ea=/ee/

Organized in a linear way reflective of development and the nature of English

Tested with students needing intensive intervention one-to-one

Involves instruction in…
Decoding and sight word reading
Spelling
Reading level-appropriate texts



Checklist:
The Nashville Early Reading Program

- ❑ Research-based
- ❑ Explicit
- ❑ Systematic
- ❑ Focused on foundational skills

- We did the research and it worked ✓
- We used very structured lessons ✓
- We created a clear sequence ✓
- It focuses on foundational skills ✓

Students with dyslexia—but perhaps not always others—need intensive phonics instruction

- Students with less severe reading difficulty benefit from less intensive interventions focused somewhat less on phonics
- Students with dyslexia benefit from more intensive interventions focused specifically on word recognition skills

Key Idea

Concepts

- Word recognition skills develop as a result of letter, sound, and meaning knowledge
- The need for word recognition instruction varies by degree of difficulty

Instructional Implication

- Students with dyslexia should receive highly explicit systematic phonics instruction

Thank you

Dyslexia is *not* a visual processing problem

Hebrew speakers	Non-Hebrew speakers	
good readers	poor readers	good readers
Hebrew words were shown briefly on a screen. Then, children drew/wrote the words from memory		
~~best memory~~	~~worst memory~~	~~good memory~~
best memory	same memory	

wrong

visual prediction

actual data

Vellutino, Steger, DeSetto, & Phillips (1975)

Dyslexia is ***not*** a visual processing problem

Good readers
few errors

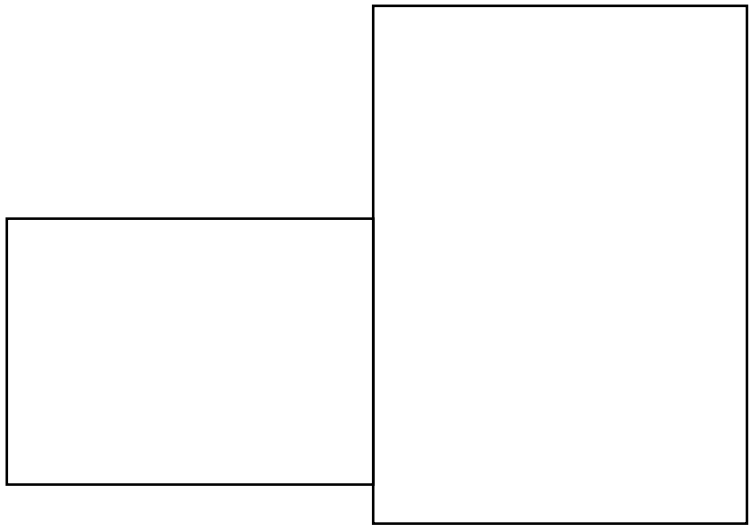
reversals

b d p q g

Poor readers
many errors

Fischer, Liberman, & Shankweiler (1978)

Errors Made



■ All errors □ Reversals

But…it's a similar **percentage** of errors