The Science of Reading: Why All The Fuss?

acadience

SUPER INSTITUTE

Education Consulting and Professional Development
95 percent of students reading at grade level… an achievable goal
95%

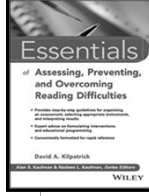## Agenda

- Alternative views about word reading
- How skilled readers read
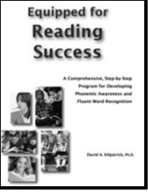- What is the science of reading?
- Key Insights from scientific studies

Slide 2
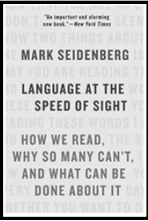

Key Presentation Resources

Essentials of Assessing, Preventing, and Overcoming Reading Difficulties
By Kilpatrick

Equipped for Reading Success
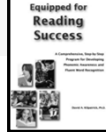By Kilpatrick

Reading in the Brain
by Dehaene

Language at the Speed of Sight
By Seidenberg

Slide 3

Skilled Readers

According to David Kilpatrick:

- Instantly and effortlessly recognize known words
  - 1/20th of a second
- Read 150-200 words per minute
- Immediately recognize 30-70K words
- Learn new words very quickly
- Remember words they've learned

Kilpatrick, D., Equipped for Reading Success: A Comprehensive, Step-by-Step Program for Developing Phonemic Awareness and Fluent Word Recognition. (Casey & Krisch, 2016.) p 4

Slide 4

3 Views About Word Reading

Agreement

WHAT skilled reading looks like

Disagreement

The disagreement is **HOW** to get there

3 Views

1. Readers make sense of print with cues from the text
2. Recognizing words is a visual task – word memory
3. Word identification requires a phoneme-grapheme approach

Slide 5

Readers make sense of print with cues from the text

Slide 6

Phonics vs. 3 Cueing System

Phonics

- Teaches patterns to build sight bank
- Encourages sounding out of unfamiliar words

3 Cueing System

- Encourages students to use context to guess words

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3 Cueing System

- "In contrast to skilled readers, weak readers rely heavily on context for word reading... This is likely due to their limited pool of familiar words, as well as their poor phonic decoding skills."

- "Some research suggests that with weak readers, contextual guessing actually hinders word learning (Landi et al., 2006). If weak readers can correctly guess a word from context, they do not have to carefully notice the letter sequence of that word to assist them in making it a familiar sequence for later recognition." Kilpatrick, D. A. (2015). *Essentials of Assessing, Preventing, and Overcoming Reading Difficulties.* John Wiley & Sons. p.38-39
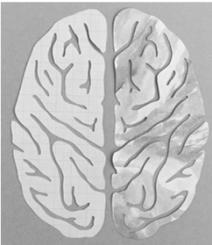
Bypasses Orthographic Mapping

Slide 8

Training the Wrong Hemisphere **1**

"Learning with the whole word method is much slower and trains the wrong brain area in the right hemisphere. Systematic grapheme to phoneme correspondences has the upper hand in making the fastest change."

Dehaene, S. (2017). *How the Brain Learns to Read.*
https://www.youtube.com/watch?v=25GI3-kiLdo. 13:13, 36:47

Phonics vs. 3 Cueing System **1**

Reminder!
Some educational practices are based on belief systems -- NOT science.

2 Recognizing words is a visual task
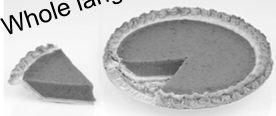
Whole Word Reading **2**

Called many names over the past 40 years

Whole language

Balanced literacy
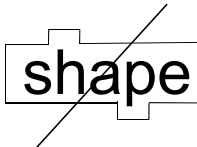
Whole Word Reading is a Myth — 2

Myth Buster

"As adults we have forgotten how we were as children. The adults have the illusion of whole word reading but the brain processes every single letter and does not look at the whole shape."

Dehaene, S. (2017). Reading in the Brain.
https://www.youtube.com/watch?v=MSy685vNqYk. 12:44,13:13

shape

Word recognition requires a phoneme-grapheme approach — 3

Torgesen on Fluent Reading

"The most important key to fluent reading of any text is the ability to automatically recognize almost all of the words in the text."
(Torgesen et al., 2003, p. 293)

Definition of Sight Word — 3

For this presentation, a **sight word** is

a word that an individual can instantly and effortlessly recognize without sounding it out.

Size of Sight Word Vocabulary 3

Reader A

integrity   eloquent

miniscule

remedy

Reader B

articulate

indemnify

sad   the
was

efficient

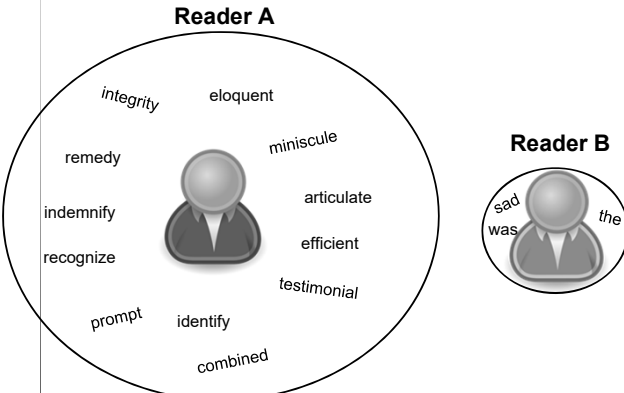recognize

testimonial

prompt   identify

combined
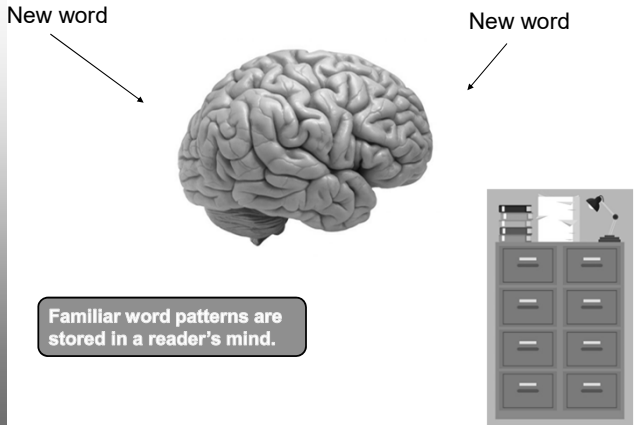
Think About the Impact on Fluency and Comprehension

How Are Words Learned? 3

New word   New word

Familiar word patterns are stored in a reader's mind.

Exposures Required 3

How many exposures does it take?
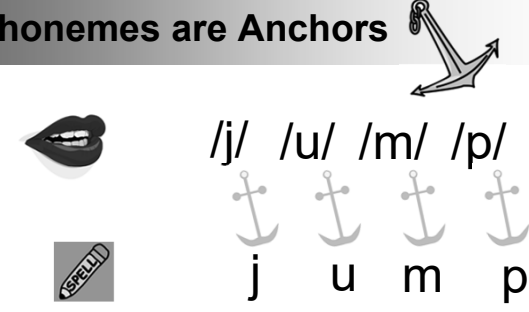
For typical developing readers,

1. Display
2. Display
3. Display
4. Display

It takes 1 to 4 exposures

Phonemes are Anchors 3

/j/ /u/ /m/ /p/

j   u   m   p

"Phoneme skills are needed for BOTH sounding out new words AND remembering the words we read."

Building Language Knowledge 3

"Every time we read we update our knowledge of language. At a conscious level we read a text for its content: because it is a story or a textbook or a joke. At a subconscious level our brains automatically register information about the structure of language."

Seidenberg, M. (2017). *Language At the Speed of Sight: How We Read, Why So Many Can't, and What Can Be Done About It.* (New York: Basic Books). p 82-83

Skilled readers:
- Know more about language structures
- Know about words that occur in print but not speech
- Have greater background knowledge

Based on Seidenberg (2017). p. 82

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Orthographic Statistics 3

Skilled readers have learned to:

- Identify the legal patterns of letters that are used frequently (THR, STP, etc.)

- Recognize strings of letters that cannot occur in English (for example, TSIP, SITP, XPLK)

- Build neural structures that represent the permissible patterns

- Tune the structures every time a text is read

Seidenberg, M. (2017). *Language at the Speed of Sight. How We Read, Why So Many Can't and What Can Be Done About It.* Basic Books, p 89
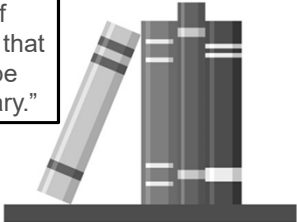
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Reading Practice 3

"Reading progress cannot be accelerated unless readers develop the ability to quickly add words to their sight vocabularies."

"Once the capacity to efficiently store new words has developed, student require a great deal of reading practice. Only words that have been encountered can be added to one's sight vocabulary."

Kilpatrick, D. A. (2015). *Essentials of Assessing, Preventing, and Overcoming Reading Difficulties.* John Wiley & Sons. p 287

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Decodable Text 3

Once a student knows a pattern, he/she must practice seeing that pattern in reliable text

Decodable text:

- Allows students to practice phonic patterns that have been taught

- Transitions students from seeing the pattern in isolation to seeing it in text

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6

3

"Orthography refers to our knowledge of the correct way to write words."

Kilpatrick, D., *Equipped for Reading Success: A Comprehensive, Step-by-Step Program for Developing Phonemic Awareness and Fluent Word Recognition. (Casey & Krisch, 2016.) p 4*

Slide 25

Orthographic Experts

3

"Readers become orthographic experts by absorbing a lot of data, which is one reason why the sheer amount and variety of texts that children read is important…The path to orthographic expertise begins with practice, practice, practice but leads to more, more, more."

Seidenberg, M. (2017). *Language at the Speed of Sight. How We Read, Why So Many Can't and What Can Be Done About It.* Basic Books, p 92.

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Orthographic Memory

3

Focus in this presentation:

Spell the Word

Recognize the Word

integrity, eloquent, remedy, miniscule, indemnify, articulate, recognize, efficient, prompt, identify, testimonial, combined

Sight Vocabulary = the pool of words recognized without sounding out or guessing

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Orthographic Mapping

3

- Occurs when students connect sounds with spellings of words
- Creates a memory for known word patterns
- Creates a base of chunks that are not easily read letter by letter: ould, ing, tion

Mapping patterns to memory is essential for fluent word reading.
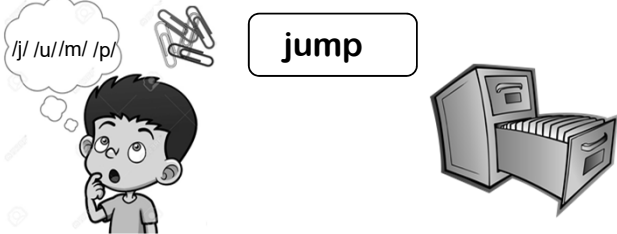
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Mapping Sounds to Letters

3

Readers use the **pronunciations** of words already stored in LT memory as anchoring points for **letters** used to represent the pronunciations

- Step 1 – attach phonological sound in memory to letters

- Step 2 – anchor the sequence of letters in memory

/j/ /u/ /m/ /p/

jump

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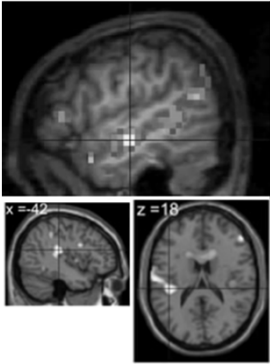
Where Reading Takes Place in the Brain

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Scientific Studies about Reading
Brain Imaging Technologies

PET Technology (Positron Emission Tomography)

- Inject volunteers with radioactive water

- Spreads through body in bloodstream

- Accumulates where blood flow is fastest (shown in yellow and red)

- Reflects brain's "hot spots"

x = -42   z = 18

Video from DeHaene at Peter Wall ... - Timestamp 6:41/59:36
Timestamp 54:51/59:36

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Brain Imaging Technologies

fMRI and MEG
(and other more recent technologies)

Dr. Stanislas Dehaene

- Watch the time course of reading a word

- Starts in the back of the brain where the letters are processed

- Moves to the phonological and meaning areas

https://www.youtube.com/watch?v=25GI3-kiLdo
Start at 3:27 and end at 4:13

Video: *How the Brain Learns to Read*, by Professor
Stanislas Dehaene – World Innovation Summit for
Education (WISE), October 25, 2013

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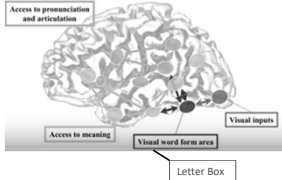
Brain Architecture

The brain architecture for reading

Learning to read consists in:
- creating an **invariant visual representation** of written words
- **connecting it** to brain areas coding for **speech sounds** and **meaning**

Access to pronunciation and articulation

Access to meaning

Visual inputs

Visual word form area

Letter Box

Dehaene, S. *How the Brain Learns to Read*
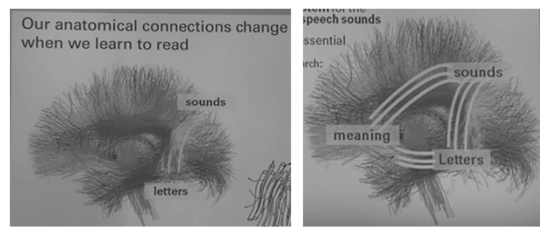https://www.youtube.com/watch?v=25GI3-kiLdo.5:58

"Our brains were hardwired for speaking, not reading. We **"recycle"** the part of the brain (visual word form area) where we recognize faces and objects and substitute it for letters and sounds. As the faces and objects move to the right side of the brain, an interface must be created between vision and language systems."

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Reading Words Requires Connections
(according to DeHaene)

Connections Between Letters and Sounds and Meaning

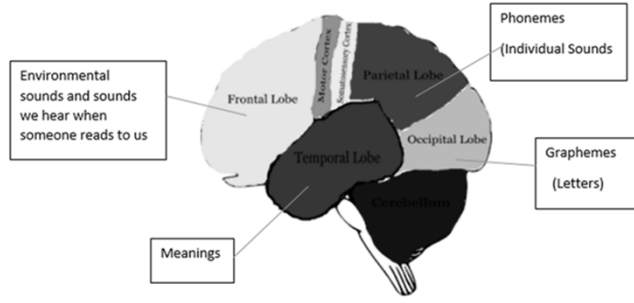Our anatomical connections change when we learn to read

sounds

letters

speech sounds

sounds

meaning

Letters

Timestamp: 8:47 of 33:29   Timestamp 15.22 of 33:29

https://www.youtube.com/watch?v=25GI3-kiLdo - *How the Brain Learns to Read*, by Professor Stanislas DeHaene – World Innovation Summit for Education (WISE), October 25, 2013.

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Connecting the Parts

Phonemes
(Individual Sounds)

Environmental sounds and sounds we hear when someone reads to us

Frontal Lobe

Motor Cortex

Somatosensory Cortex

Parietal Lobe

Occipital Lobe

Temporal Lobe

Cerebellum

Graphemes
(Letters)

Meanings

Dehaene, S. (2017). *How the Brain Learns to Read*.
https://www.youtube.com/watch?v=25GI3-kiLdo.6.08

Slide 35

Science of Reading

…Has Come a LONG Way in 30 Years

Brain Research Methods Not Available Until Recently

"Empowering teachers with… appropriate knowledge… will change classroom practice."

Dehaene, S. (2017). *How the Brain Learns to Read*.
https://www.youtube.com/watch?v=25GI3-kiLdo. 1:08, 2:01.

Slide 36

Beliefs vs. Facts

Beliefs $\Longrightarrow$ Facts

"A look at the basic science suggests specific ways to promote reading success... **What they require is changing the culture of education from one based on beliefs to one based on facts.**"

Seidenberg, M. (2017). *Language at the Speed of Sight. How We Read, Why So Many Can't and What Can Be Done About It.* Basic Books, p. 9

Slide 37

The Great Divide

"There is a profound disconnection between the science of reading and educational practice. Very little of what we've learned about reading as scientists has had any impact on what happens in schools…"

Seidenberg, M. (2017). *Language at the Speed of Sight. How We Read, Why So Many Can't and What Can Be Done About It.* Basic Books, p 9

Science   Classroom Practices

Some students are hanging on by a thread.

Slide 38

Gulf Between Science & Practice

Reading Science

Reading Instruction

"The gulf between science and education has been harmful. A look at the science reveals that the methods commonly used to teach children are inconsistent with basic facts about human cognition and development and so make learning to read more difficult than it should be."

Seidenberg, M. (2017). *Language at the Speed of Sight. How We Read, Why So Many Can't and What Can Be Done About It.* Basic Books, p 9
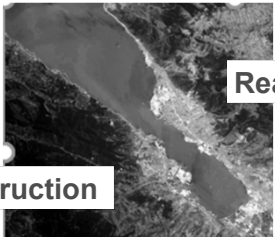
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Questions?

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