The Reading Brain
What Every Educator Needs to Know
Participants Will:

- **Examine** the reading process within the brain
- **Discover** the role of the phonology, orthography, and meaning in the reading brain.
- **Categorize and apply** the practices involved in the 4 Processing Systems for reading.
- **Debunk** reading myths using neuroscience
If a child is surrounded by spoken language, will they learn to talk?

If a child is surrounded by books, will they learn to read?

YES

NO
The brain is not wired to read naturally. We need to train it to learn to read. That makes us... neurosurgeons!
Reading is not a natural task, and children are not biologically prepared to it by evolution (unlike spoken language acquisition). Thus, teachers must be aware that many of the reading steps that they take for granted, because they are expert readers and have a fully automated and non-conscious reading system, are not at all obvious for young children. Massive changes are needed, at the phonological and at the visual level, before children master the skill of reading.

- Dehaene, 2011
Students learn to read from speech to print.
The Reading Brain

Access to Phonology (Pronunciation and Articulation)

https://www.youtube.com/watch?v=GzvMyzici6U
The Reading Brain: Sounds and Meaning

Access to Phonology (Pronunciation and Articulation)

Visual Word Form Area

Access to Meaning

https://www.youtube.com/watch?v=GzvMyzici6U
Students are not born with the capacity for reading. We have to train the brain to read.

Teaching reading is rocket science!

Reflection and introspection are insufficient. We need to KNOW the brain.

Fads have misled us. Student failure is unnecessary!
My goal is to bring these two together. Create all the theories and mathematics that will -

The Brain Puzzle – Stanislaus Dahaene https://www.youtube.com/watch?v=wlYZBi_07vk
Reading and Neuroscience

What is Neuro-recycling?

Education CHANGES the brain.

Teachers need to know how the brain works in children to teach reading effectively.

Learning to speak is natural, learning to read is not.
... because the brain is not evolved for reading, I am arguing that reading evolved for the brain.

- Stanislaus, Dehaene, 2016

If you want to change the system, you have to know how it works.

- Stanislaus, Dehaene, 2012
The Reading Brain Sounds and Meaning

Access to Phonology (Pronunciation and Articulation)

Visual Word Form Area

Access to Meaning

https://www.youtube.com/watch?v=GzvMyzici6U
• We when read, we recognize the letters, combining them into graphemes.
• We connect these to **speech sounds to decode the word**.
• We connect to **meaning processors** to recognize the words.
• The areas for **speech sounds** and **meaning** already exist for spoken language.
• We use the **same parts of the brain for spoken language and written language** when it comes to speech and meaning.

- Stanislaus Dahaene, 2012
Reading is about creating an interface between the visual and spoken language system.

This causes changes in the brain after children have learned to read. If you can read, you brain has been dramatically changed.

- Stanislaus Dahaene, 2012

Hmm... teachers are like neurosurgeons. They change the brain!
The Reading Brain

- Frontal lobe
- Parietal lobe
- Angular Gyrus
- Occipital lobe

- Broca’s Area
- Wernicke’s Area
- Temporal lobe
- Brain’s Letterbox
- Arcuate Fasciculus
The Reading Brain: Sounds and Meaning

Access to Phonology (Pronunciation and Articulation)

Access to Meaning

Arcuate Fasciculus

Visual Word Form Area

Frontal lobe

Temporal lobe

Parietal lobe

Occipital lobe

cerebellum

https://www.youtube.com/watch?v=GzvMyzici6U
The 4 Part Processor

Meaning

Context

Orthographic

Phonological

Phonics

Speech Sound System:
- Language Input
- Language Output

Sentence structures, text structure, background knowledge

Vocabulary, meanings of words

Memory for Letters:
- Reading Input
- Writing Output

Seidenburg and McClelland, 1989
Adams, 1990
Once students learn letter–sounds correspondences, they can self-teach for fluency.
The motor sequence in handwriting matters when teaching letters.

Handwriting and multisensory visual-motor instruction helps with letter recognition.

Letter reversals are common as the brain learns to distinguish letters.

Visual Memory is critical for learning letters.
Sight word vocabulary is NOT based on visual memory / visual skills!

- Dr. David Kilpatrick, Plain Talk About Learning Conference 2018
Phonology maps to the orthographic patterns in words.

Phonology is CRITICAL for word retrieval and accessing meaning.

We store and retrieve words via orthography, phonology, and meaning.

Visual Memory is does NOT play a role in word recognition.
Seidenburg and McClelland, 1989
Adams, 1990

Speech Sound System:
- Language Input
- Language Output

Vocabulary, meanings of words
Sentence structures, text structure, background knowledge

Memory for Letters:
- Reading Input
- Writing Output

Fluency

Phonological

Context

Meaning

Orthographic

Phonics
When we read, do we process written language:

A. Word by Word
B. Letter by Letter
The current thinking is that, during reading of a single word, millions of hierarchically organized neurons, each tuned to a specific local property (a letter, a bigram, or a morpheme), collectively contribute to visual recognition. This massively parallel architecture explains the speed and robustness of visual word recognition. Most importantly, for educators and teachers, it creates an illusion of whole-word reading. Because reading is so fast and takes about the same time for short and long words, some have assumed that the overall whole-word shape is being used for recognition, and that we should therefore teach whole-word reading rather than by letter-to sound decoding. This inference is wrong, however.

- Dehaene, 2011
Angular Gyrus
What about read alouds?

They are critical for building word recognition and language comprehension skills!
A large set of regions of the left hemisphere is identically activated when we read a sentence and when we listen to it.

(Devauchelle, Oppenheim, Rizzi, Dehaene, & Pallier, 2009)
• Read – Alouds for young children by a parent / caregiver affect the brain in ways that will impact later reading development.

• Technology led to underdevelopment in these critical brain regions.

(Hutton et al, 2019)
Some children come to school with too little language to support comprehension.

Washing our kids in words through READ ALOUDS and oral language gives them a background in language, background knowledge, and more access to meaning.
Learning to Read is NATURAL

We read and should memorize whole words.

The brain can teach itself to read.

The only way to learn to comprehend text is to read text.
What did you learn today?

1. Parts of the Brain involved in Reading

2. The 4 Part Processor

3. How to really teach sight words, according to how the brain reads.

4. The Role of Phonology in Reading

5. The importance of Read Alouds
Questions?

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