



The Science (and Poetry) of Reading

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THE MISSION

Literacy is a basic
human right.
In every “zip code”.
Everywhere.

Reading is our species' *Canary in the Mind*

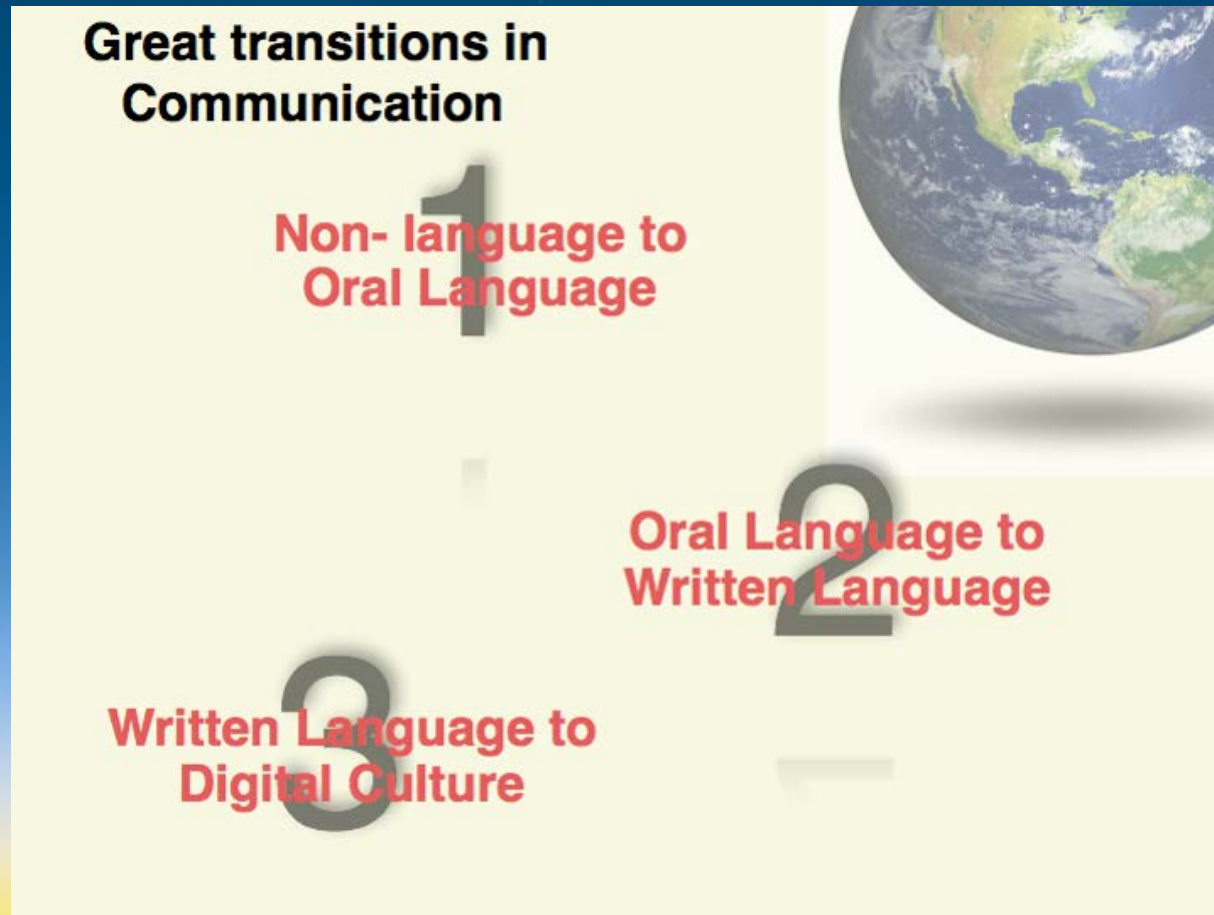
- Literacy changes the brain, which changes the individual, which changes society, which changes the future species
- This has all begun to change within a digital culture ---
with both promise and perils.

漢字

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The HINGE MOMENT: From Print Culture to Digital World



Gene



Classrooms

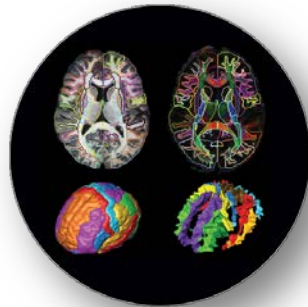


Cognitive Behaviors



**THE WORK:
Connecting
Neuroscience
Research with
Education**

Brain Areas



**Cell /
Neuron**



**Neural
Circuits**



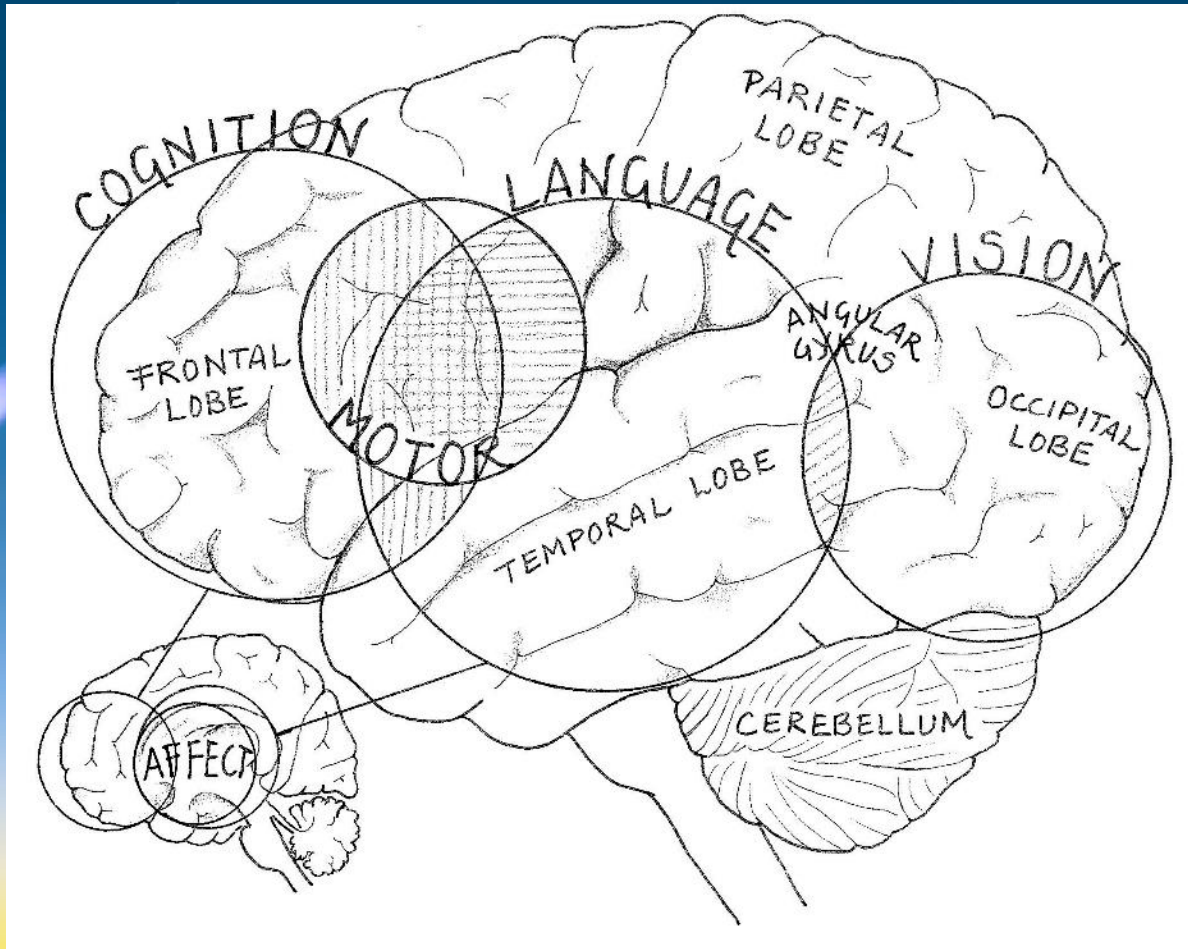
Why Neuroscience and Education?

“Parents and educators must have a better understanding of what reading changes in a child’s brain. I am convinced that increased knowledge of these circuits will greatly simplify the teacher’s task.”

Stanislas Dehaene



Let's Begin with the Reading Circuit

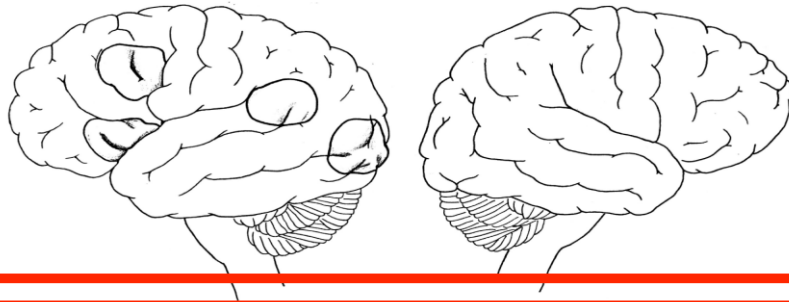


The human brain was never born to read.

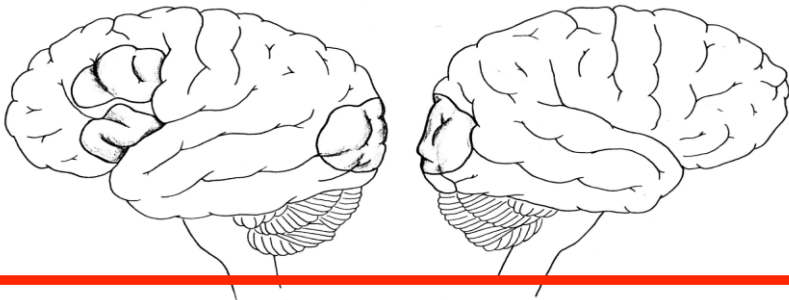
Each reader creates a new, *plastic* reading circuit from older cognitive and linguistic structures.

PLASTICITY allows Multiple Circuits

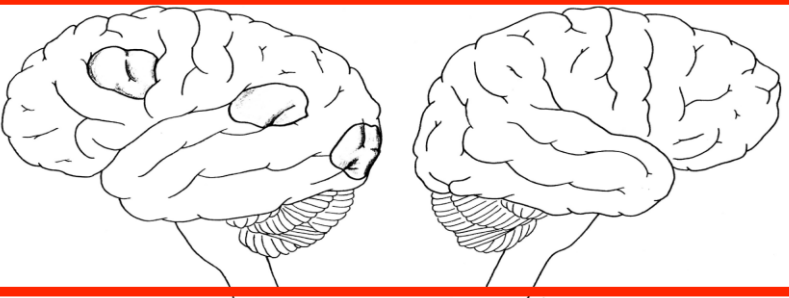
English



Chinese &
Kanji



Japanese
Kana



Brain can rearrange itself in multiple ways to read, depending on the writing system, education, and **medium.**

Principles of '*Plasticity Within Limits*' for Reading Brain

1

Ability to form
whole new
connected
circuits

2

Ability to
recycle and
repurpose
areas

3

Depends on
environment/
characteristics
(e.g., **writing
and medium**)



How Does the Brain Learn to Read?

Each new reader must
create a
new reading circuit
that connects older
linguistic, perceptual,
cognitive, and affective
networks.

Developing the Components of the Young Brain: Language, Cognition, and Emotions



Phonemes
Orthography
Semantics
Syntax
Morphology

Phonemes

**Phoneme
Awareness**

**Explicit
emphasis on
sounds'
representations**

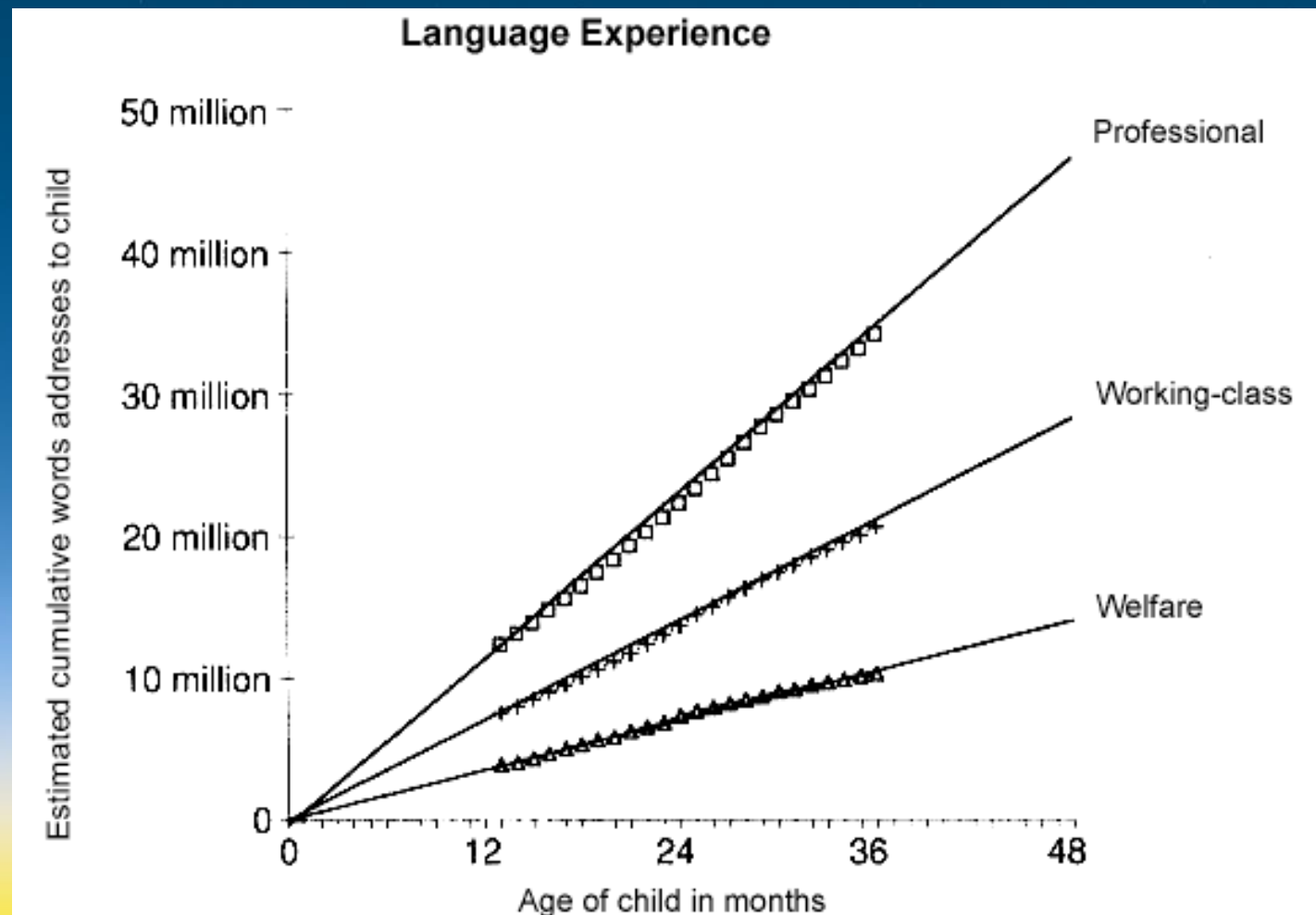


Semantic, Syntactic, and Phoneme Development

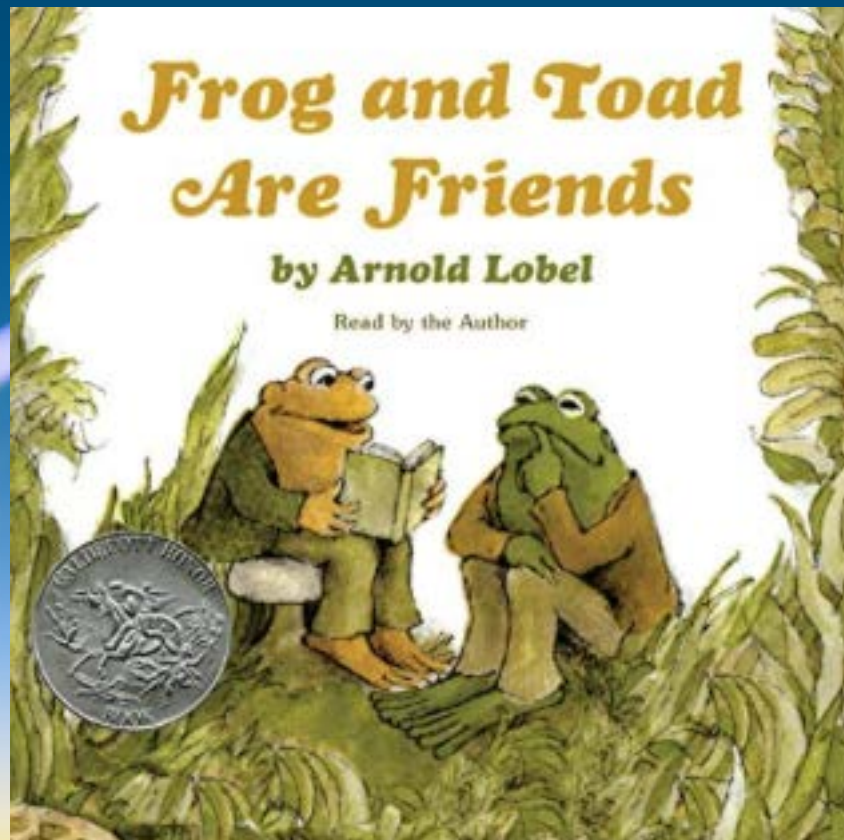


Language
Development
in Every Book
and Story

32 Million Word Gap



Developing Emotional and Social Development: The Origins of Empathy



Every story introduces the child to a new piece of information about how others think and feel, and a chance to try this on for themselves without fear.

Developing Cognitive Development and Background Knowledge

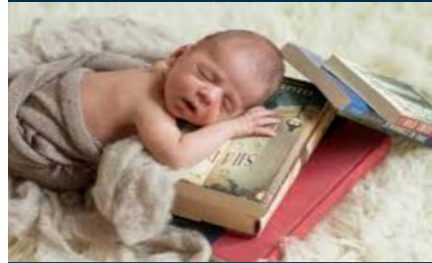


“The rich get richer and the poor poorer.”

...Matthew 4:23

(Stanovich for vocabulary)

Antidote: Books From Birth! AAP Literacy Recommendations



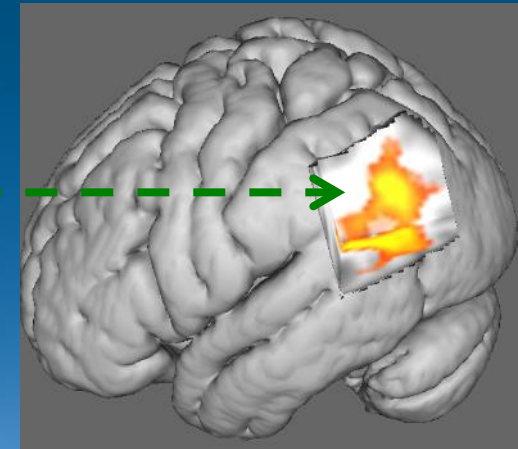
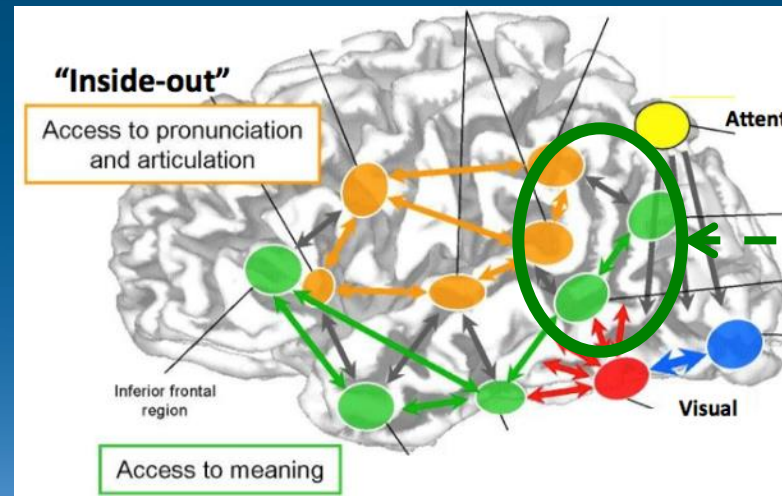
Shared reading...

“stimulates optimal patterns of brain development which, in turn, builds language, literacy, and social-emotional skills that last a lifetime.”

Examples: Reach Out and Read; Bring Me a Book

Effects of Parents Reading “Under the crook of an arm”

John Hutton et al, Cincinnati Hospital for Children

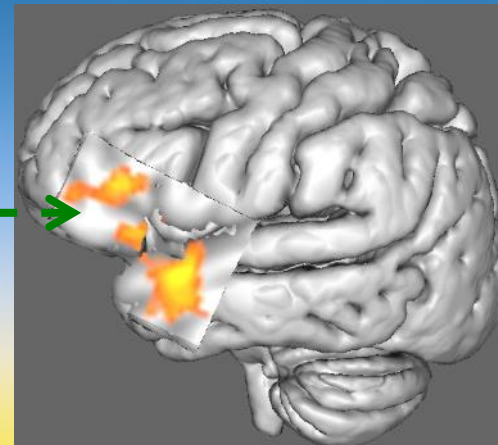
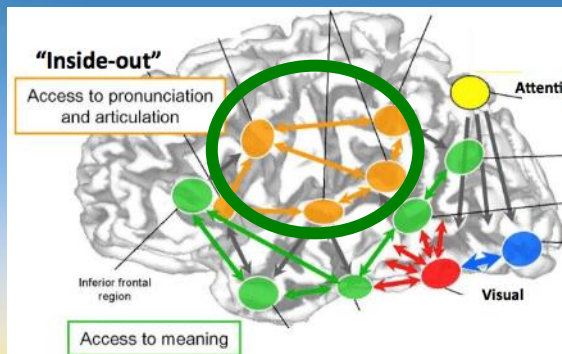


- **Semantic Processing**
(Understanding)
- **Visual Imagery**
- **Controlled for household income**

“Goldilocks” Effect in Mediums

Parent Book Reading > Audio Book > Animated Story

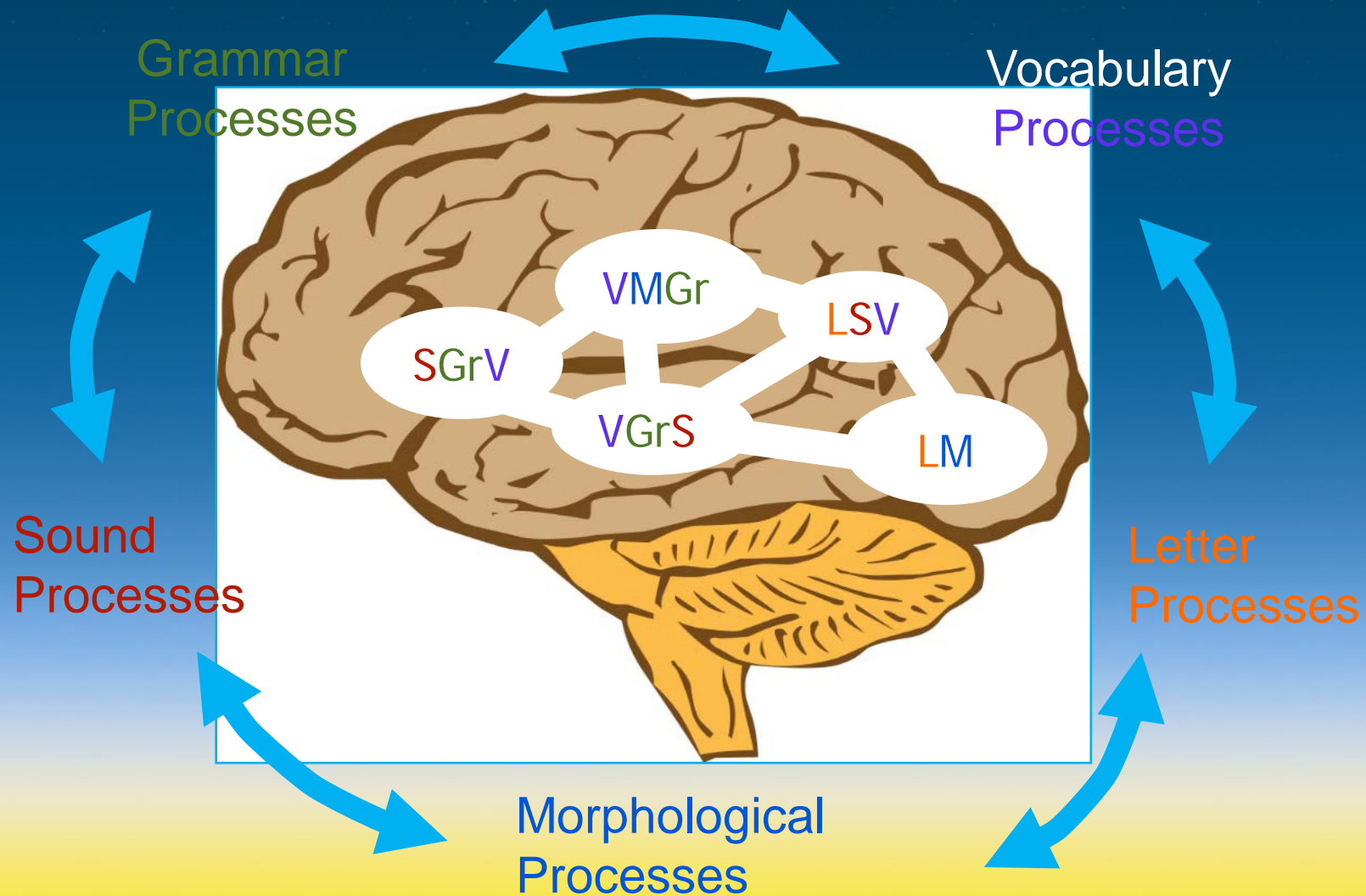
John Hutton



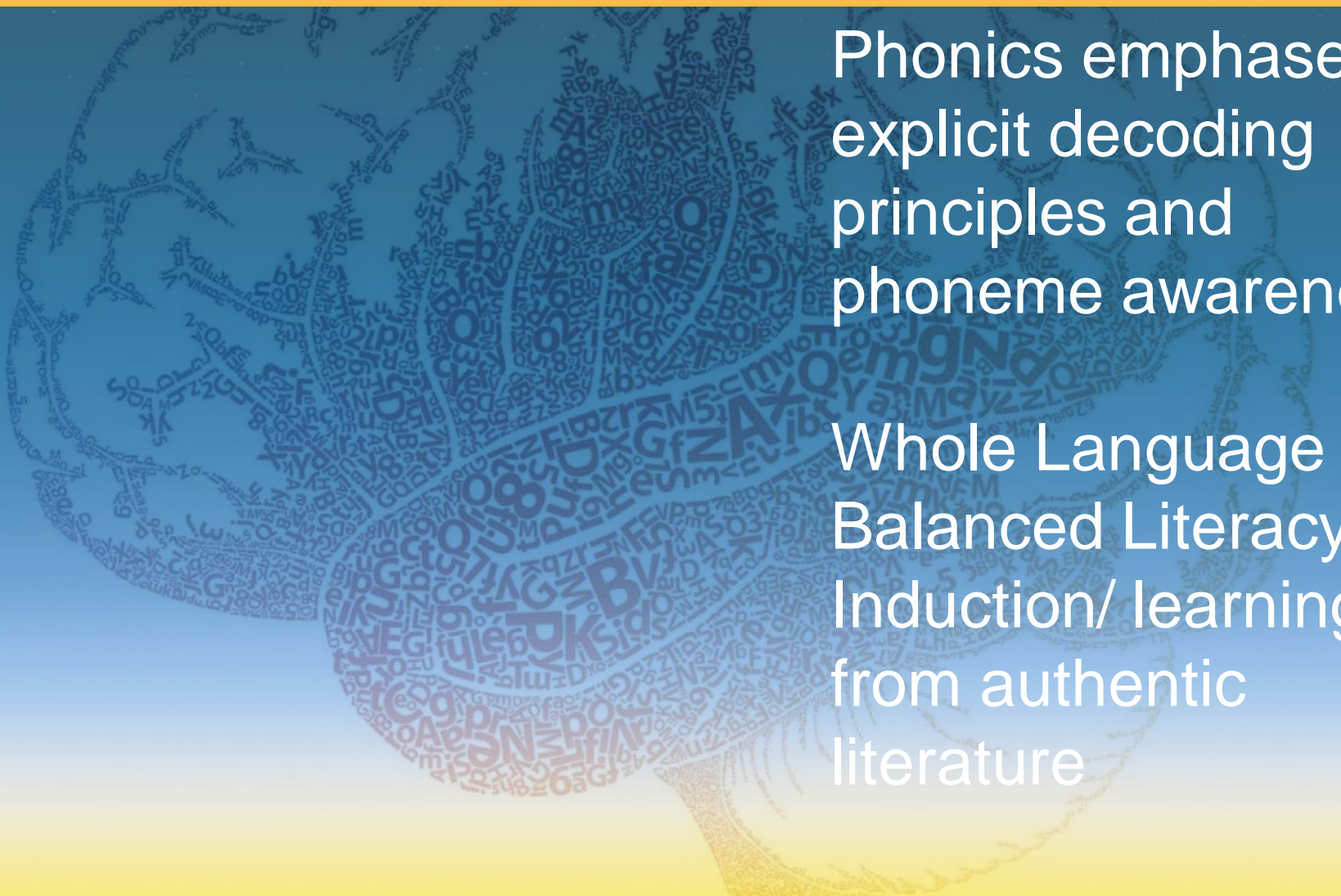
- Expressive language
- Complex language processing
- Social-emotional integration
- Working memory/attention

1. Adapted from S. Dehaene, “Reading the Brain,” 2010.
2. Hutton, et al. *In Submission*, 2016; presented at PAS 2016.

Translating the Pre- Reading Circuit into a Curriculum for Learning to Read



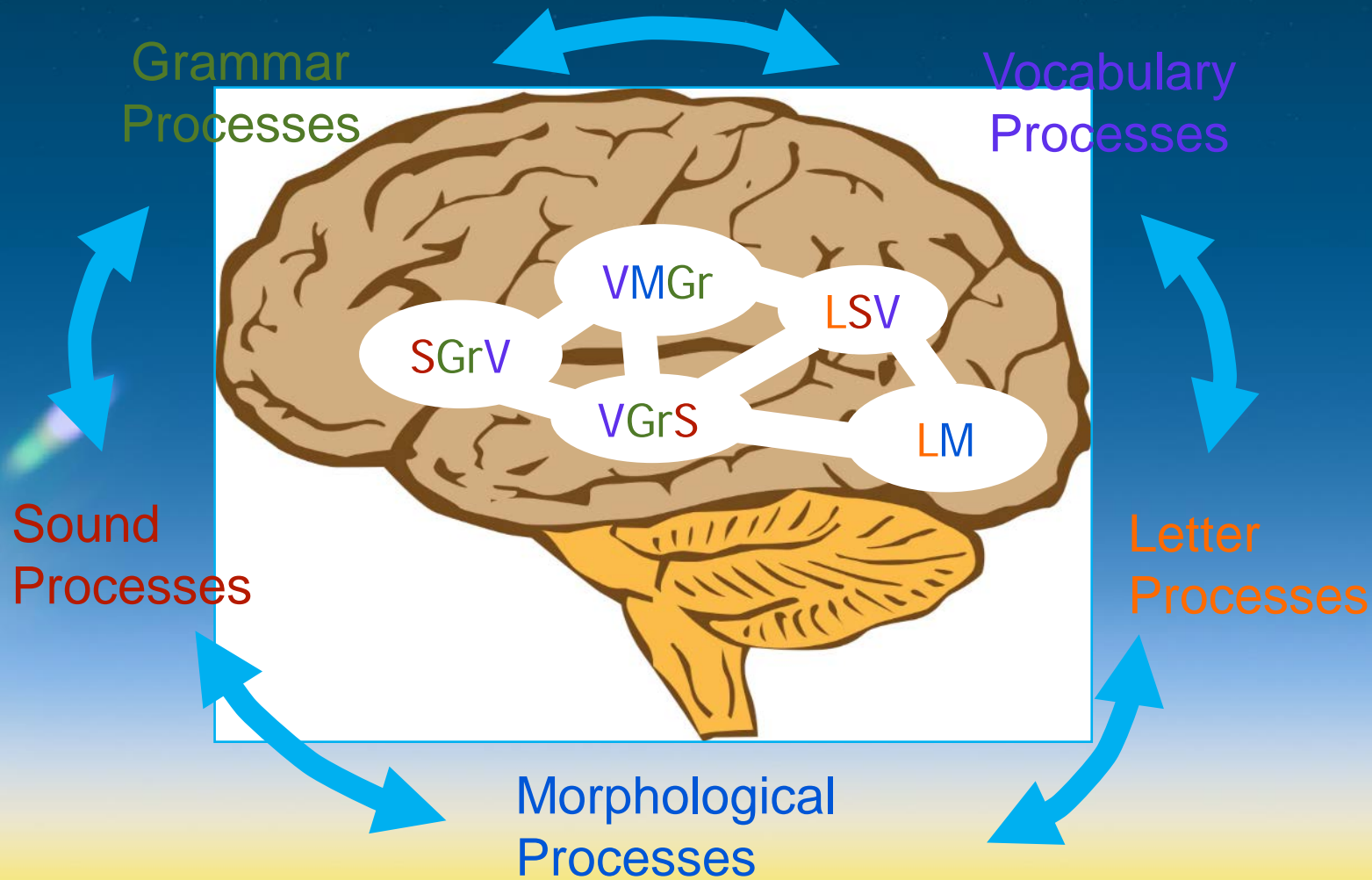
The Great Unnecessary Reading Debate



Phonics emphasizes:
explicit decoding
principles and
phoneme awareness

Whole Language and
Balanced Literacy:
Induction/ learning
from authentic
literature

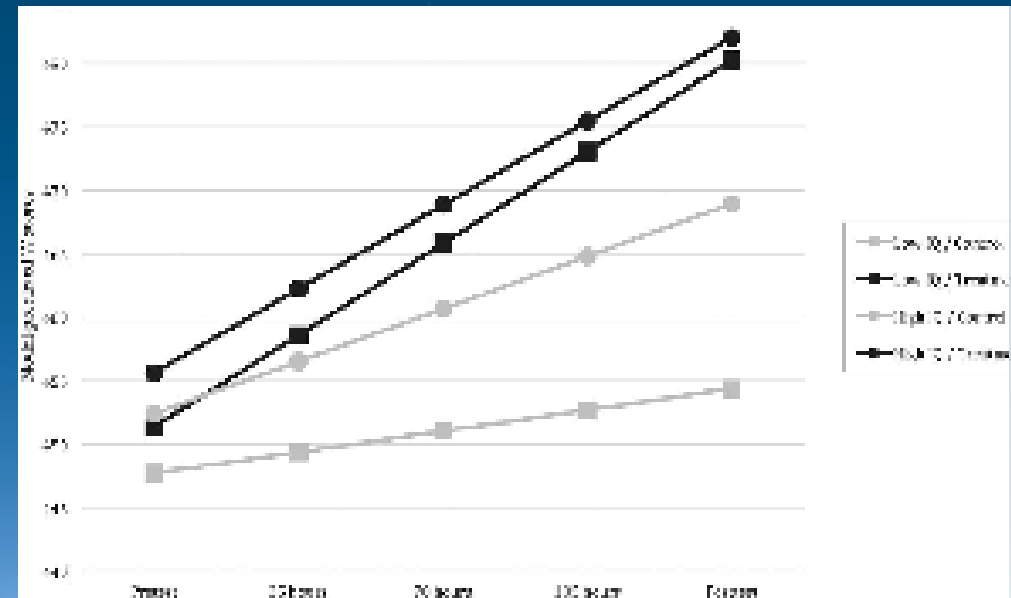
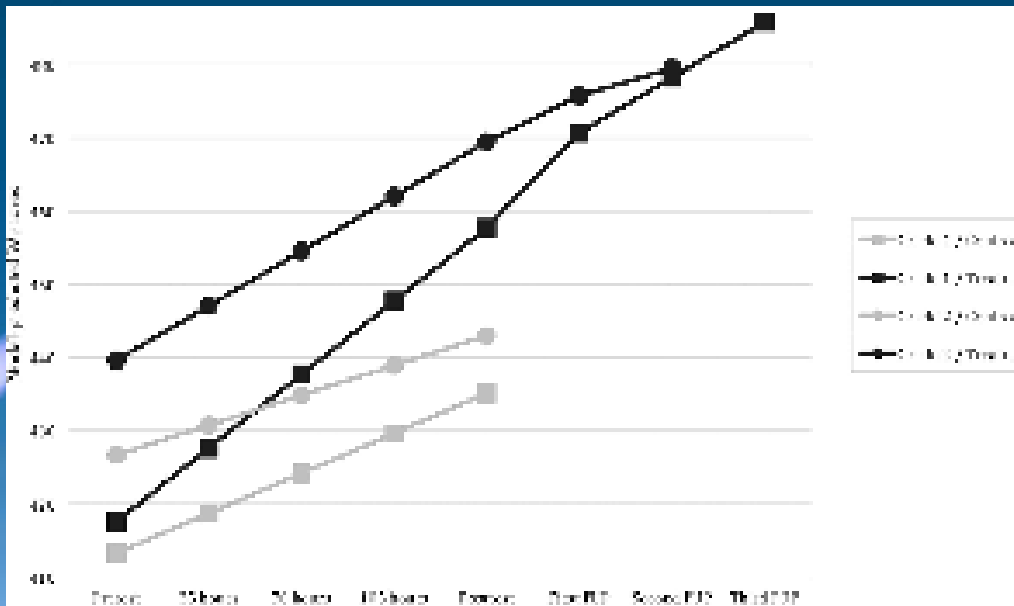
Insights from the Reading Brain: Explicit, Integrated, Systematic Instruction Across All Components



The more you know about a word...the faster you will read and comprehend words and stories

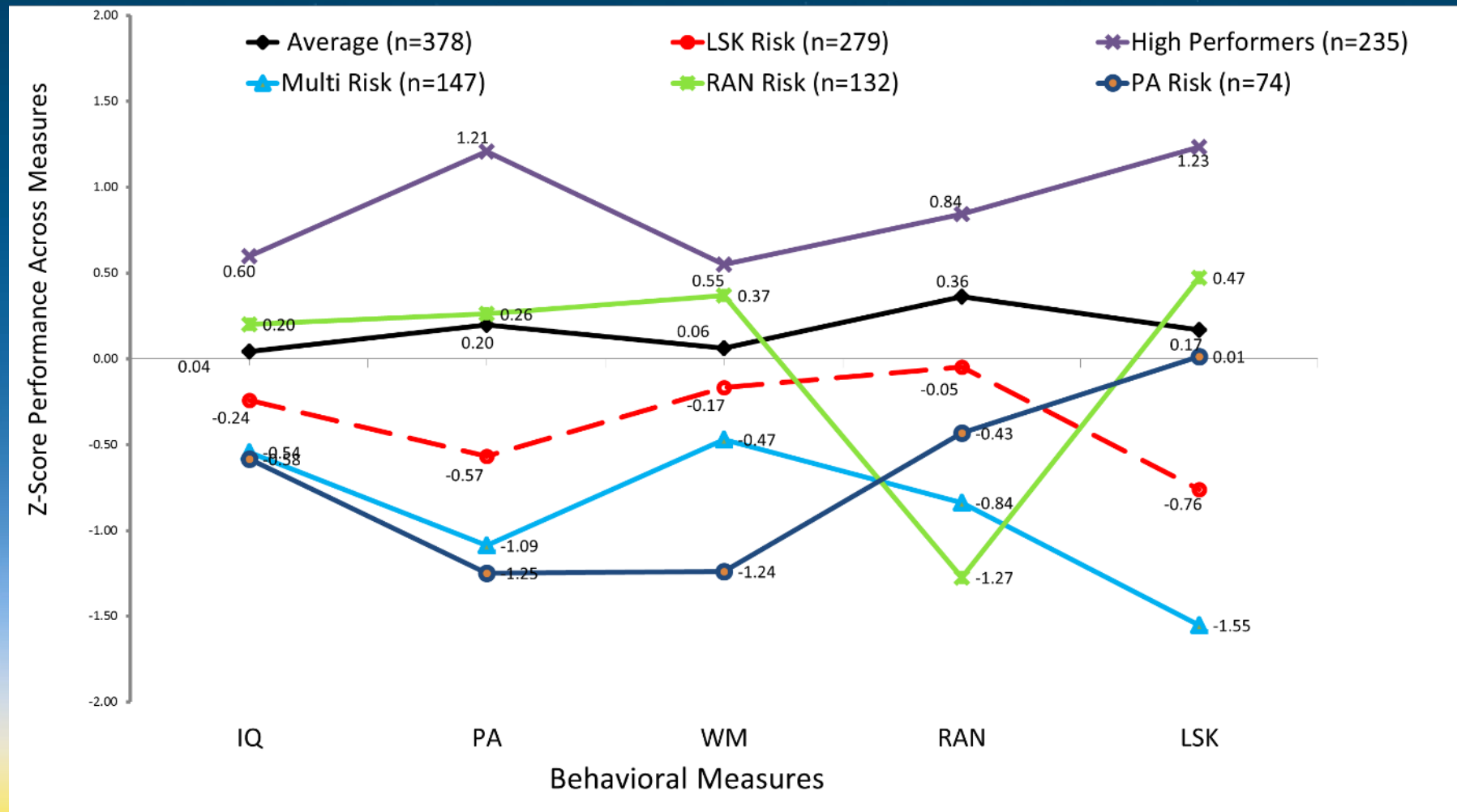
Multi-component Intervention

See Lovett, Wolf, Morris, JEP, 2018

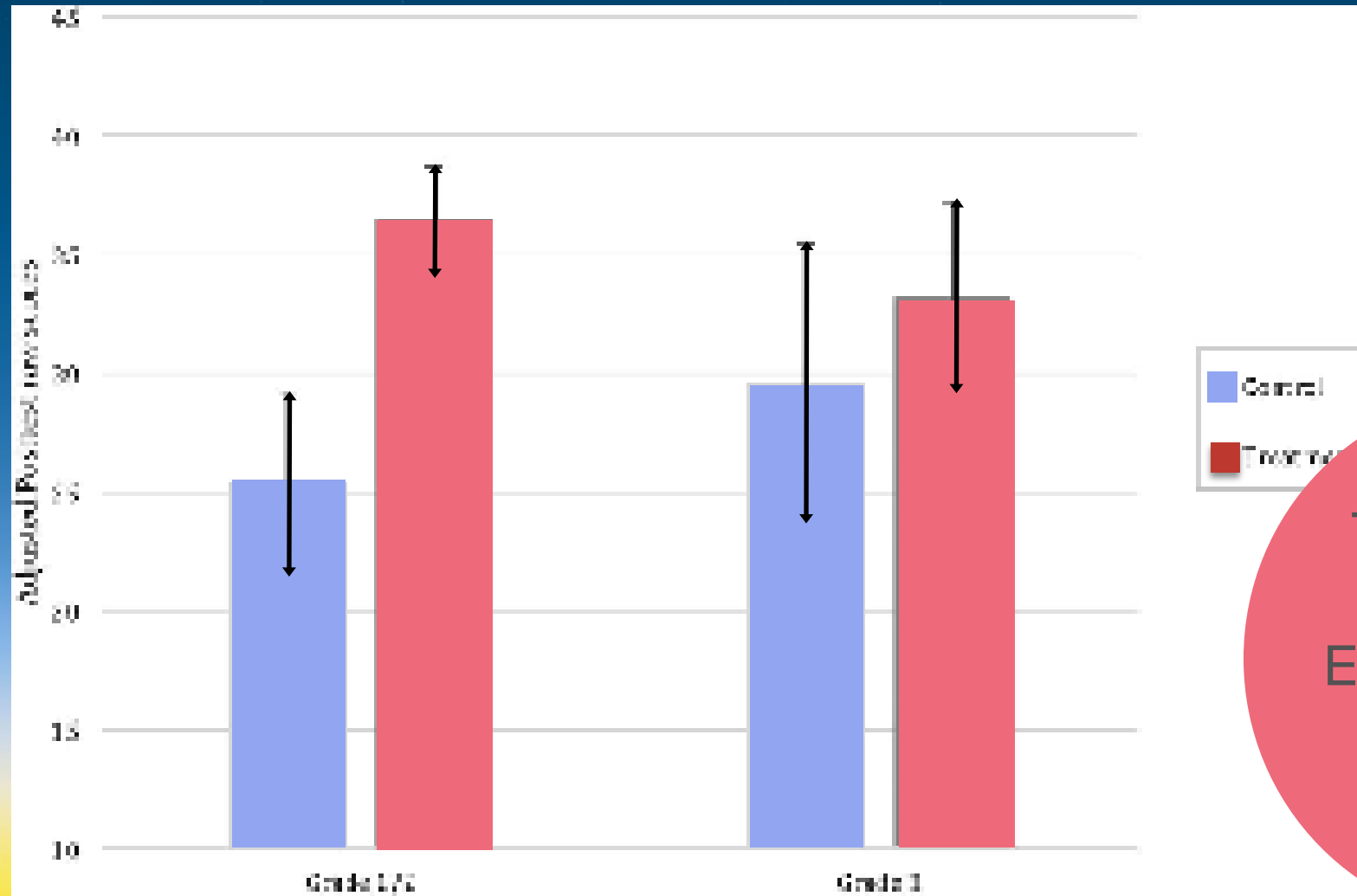


Effect Sizes
avg .99 over
14 measures

Six Distinct Profiles of Early Reading

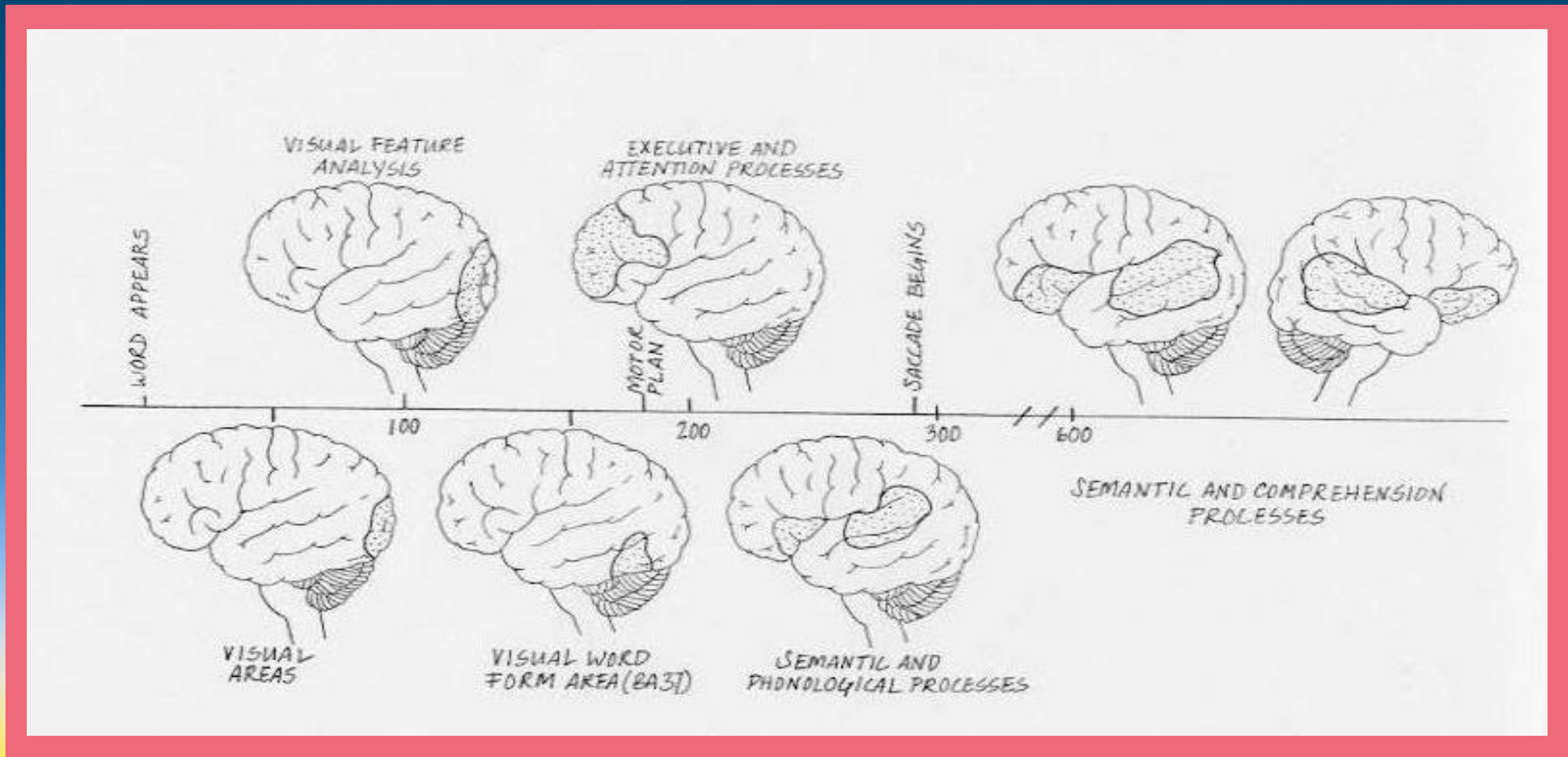


Early v. Later Intervention Effects



Test of Word
Reading
Efficiency sight
words
(raw scores)

How Does the Circuit Move from Basic Decoding to “Deep Reading” ?



Deep Reading

Background Knowledge

Perspective Taking/Empathy

Critical Analysis

Novel Thought

Inference,
Deduction/Induction,
Analogical Thinking

Imagery

Insight & Reflection

Going beyond the
wisdom of the
author.

Empathy and Perspective-Taking : Our Moral Laboratory

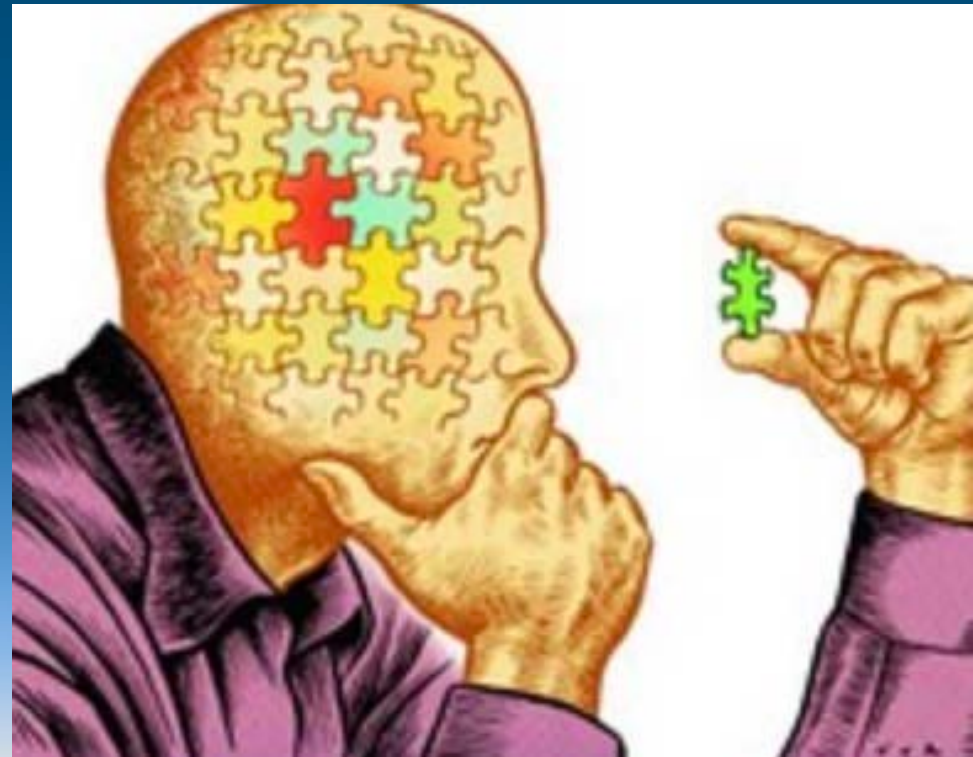
“Here is the Golden Key. It is the capacity to pass over to others and come back to ourselves. We all have the capacity, but we do not all discover it, come to use it, learn to pass over.”

John S. Dunne

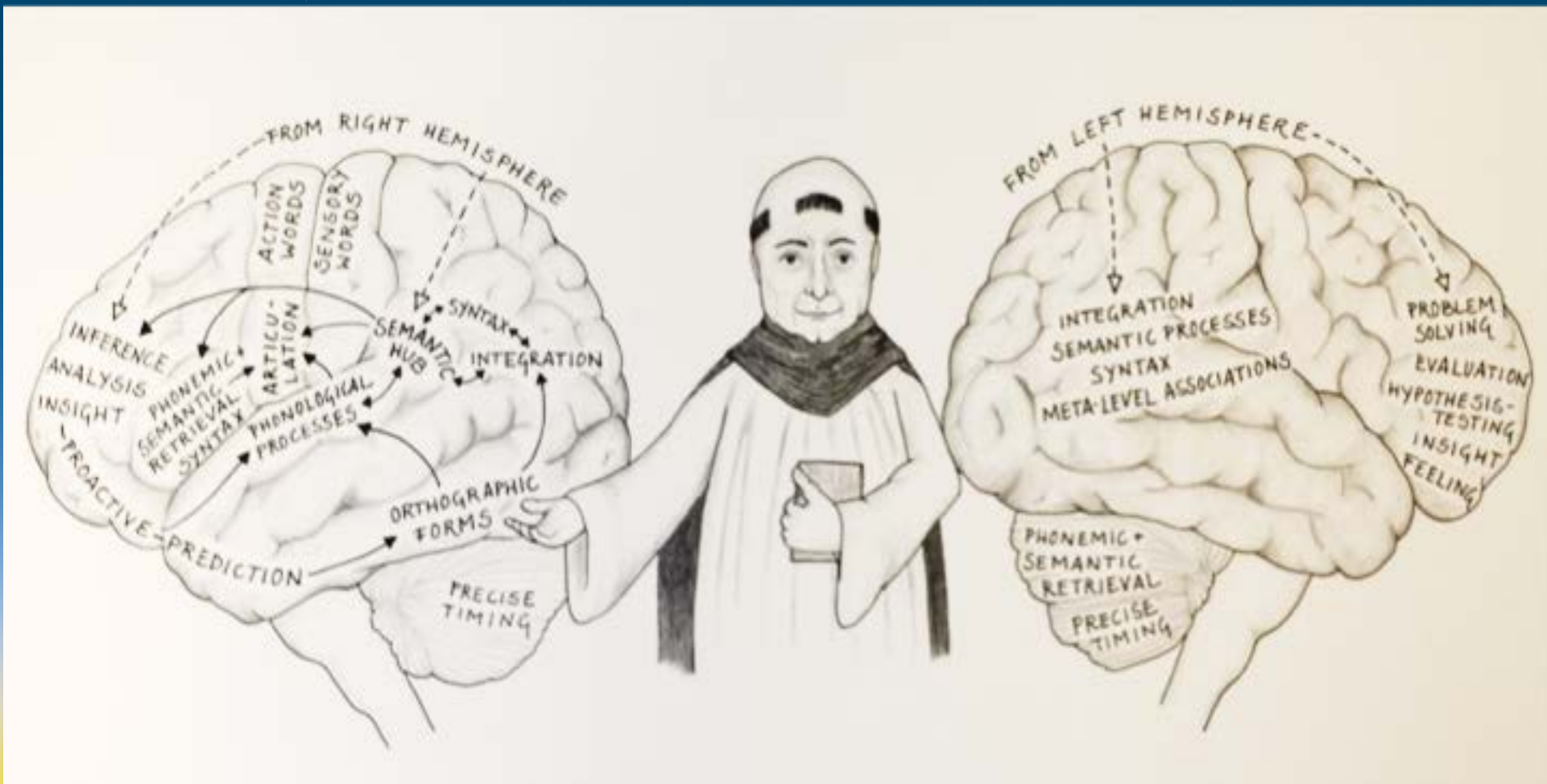


Critical Analysis

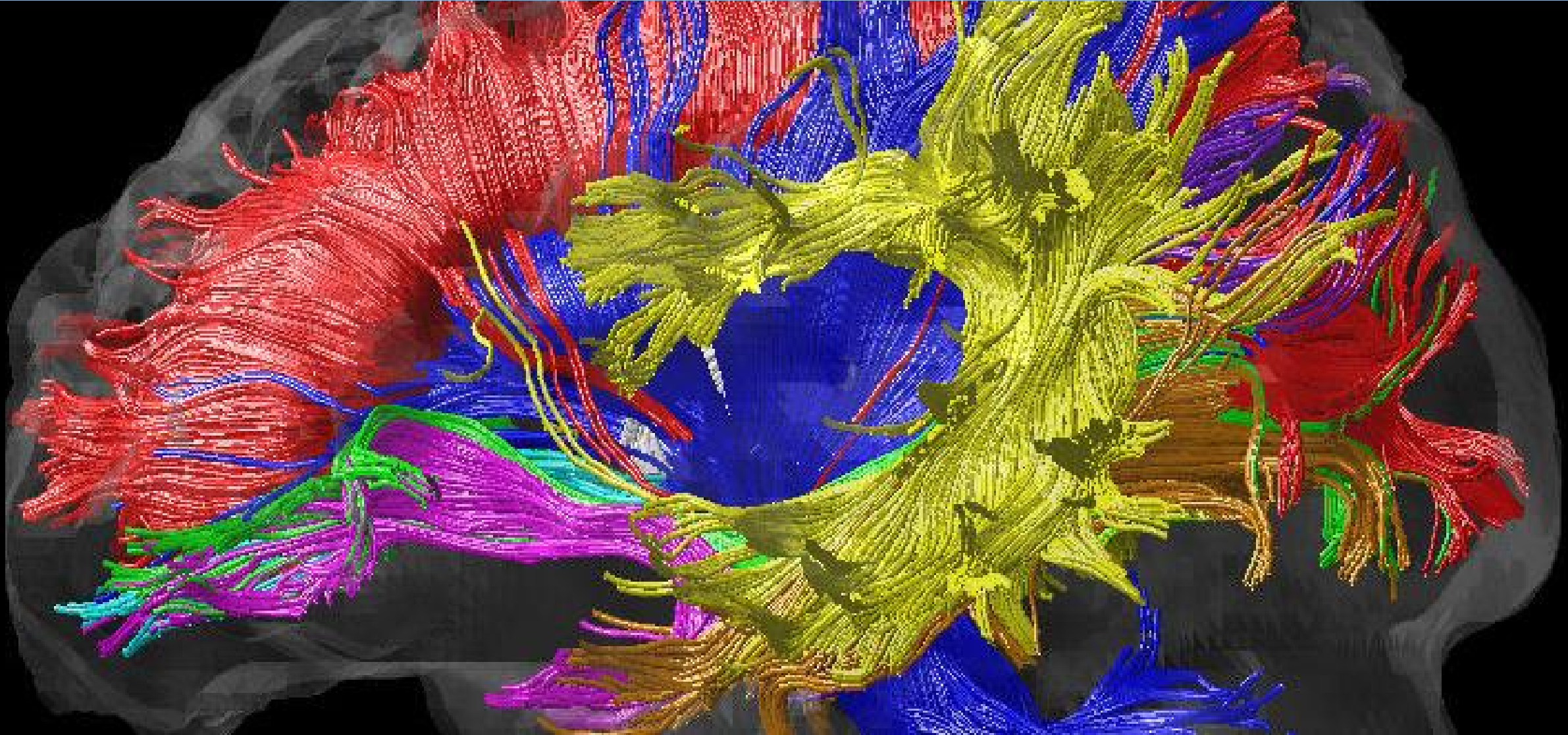
Connects what is read and
what is known
with inferences;
evaluates our hypotheses;
And discerns truth value.



Expert Reading Brain and Contemplative Function



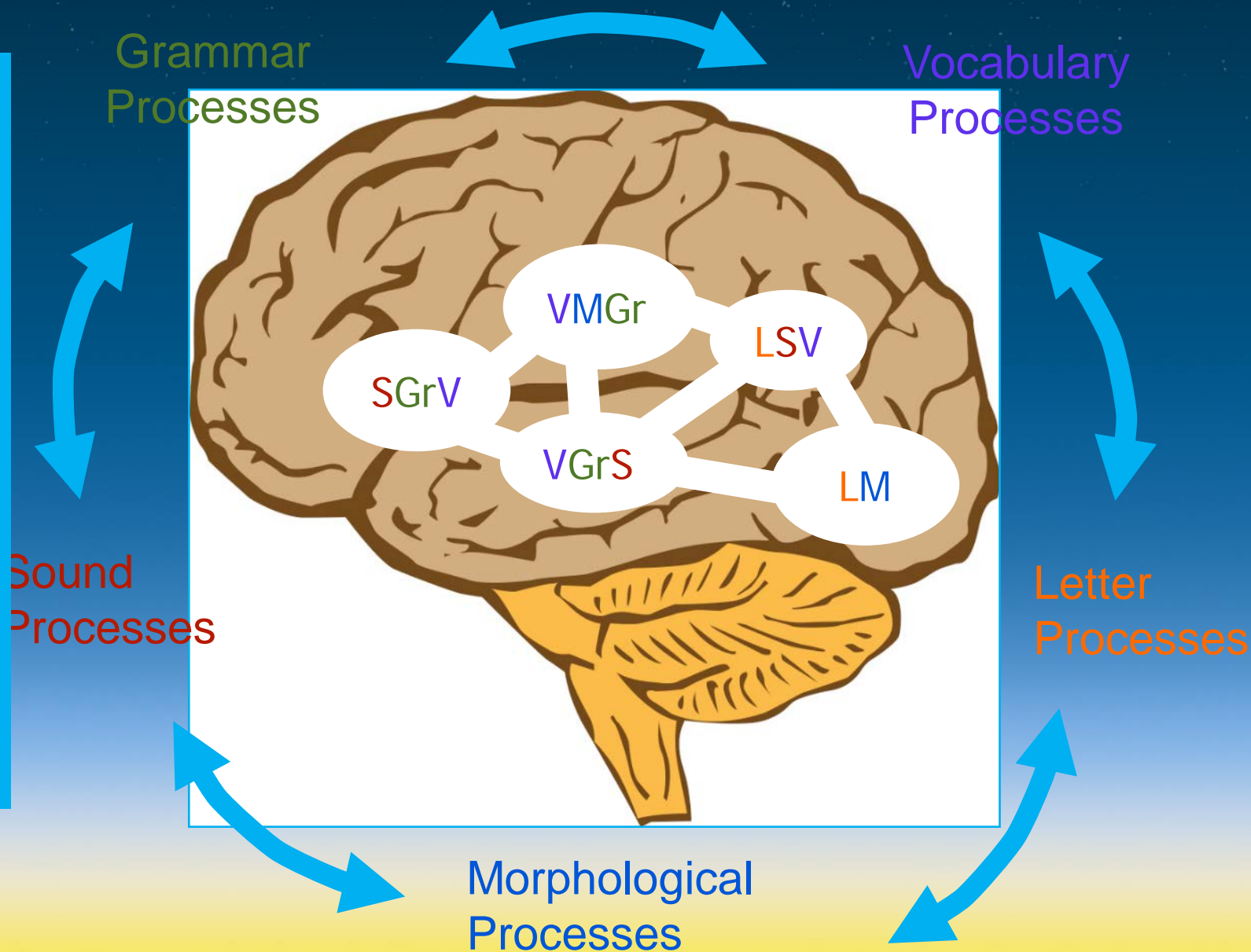
Understanding the Reading Brain Circuit in a Digital Medium in the Time of Covid



Advantages of Technology where there is Access and Equity: Engagement, Practice of Foundational Skills and Dissemination of Background Knowledge



Reading Brain:
Basis for
Curation and App
Development:
see Haskins
Global Literacy
Resource Library



The Reading Circuit Reflects the Medium



“Every medium has its costs and weaknesses... the cost (in the digital medium) seems to be to deep processing.”

-Patricia Greenfield, 2009

Evidence on What Digital Culture Diminishes from Infancy to Five: Early Language Development



Hirsh-Pasek et al. 2014
Zuckerman & Radesky, 2017

Evidence in Youth: Attention Changes

Continuous partial attention and multi-tasking and Distraction

Requires high levels of stimulation

Low-level threshold for boredom



Evidence in Young Adults: Comprehension Changes (E-Read Network)

Over 50 studies from
2000 to 2017

171,055 Participants

Print superior to
screen for
comprehension





“Skimming is the New Normal in Adults”

EVIDENCE

1

Skimming,
browsing,
keyword spotting;
F or Z pattern

2

Less
concentrated
reading;
more distractions

3

Decreased
attention and
memory

(Baron, 2014)

Implications for Reader and Society

less time to understand complexity,
perceive beauty, and feel empathy;
more susceptibility to false information
false fears, false hopes,
and demagoguery:
all threaten a **democratic society**





Stewards of the Next Generation

“It would be catastrophic to become a nation of technically competent people who have lost the ability to think critically, to examine themselves, and to respect the humanity and diversity of others.”

Martha Nussbaum

Applying “Best Knowledge” to the Future of Literacy

The Development of a Biliterate, Deep Reading Brain

