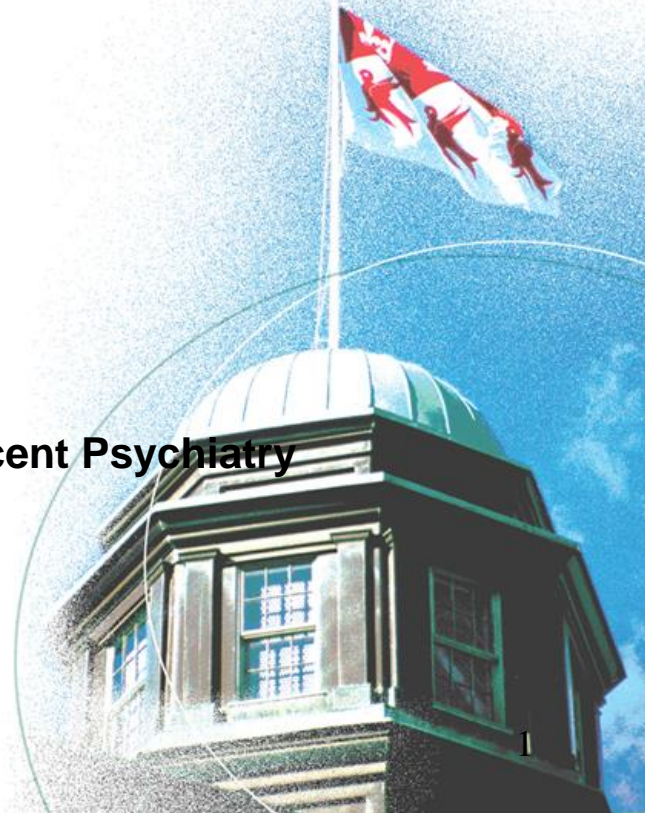
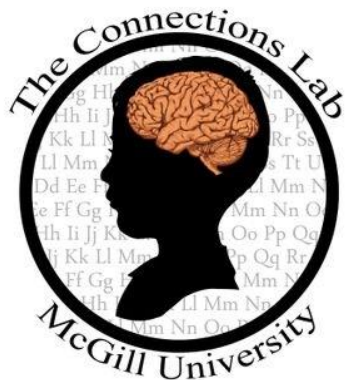


Brain Science in Education: Innovation, Implementation and Quackery

**Steven R. Shaw
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**Canadian Academy of Child and Adolescent Psychiatry
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Disclosure



The speaker has no financial interests in the content or arguments of this address

Overview

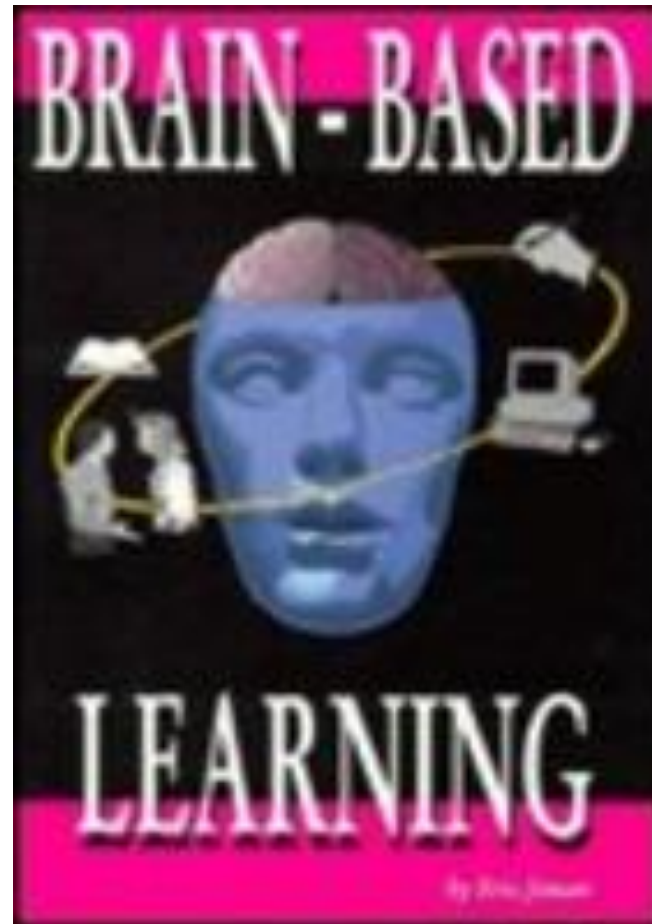


- I. Introduction
- II. Innovations in neurologically based education
- III. Challenges of implementation
- IV. Quackery (and I am naming names)
- V. Future practice and research

Bio sketch



- Steven R. Shaw is associate professor in the Department of Educational and Counselling Psychology at McGill University in Montreal.
- At McGill University he is director of the Resilience, Pediatric Psychology and Neurogenetic Connections Lab and co-director of the McGill Developmental Research Lab.
- Before entering academia, he had 17 years of experience as a school psychologist in school, university, hospital, medical school, and independent practice. From 1997 to 2004, he served as lead psychologist and associate professor of pediatrics at The Children's Hospital in Greenville, South Carolina and Medical University of South Carolina.
- His clinical and research interests include pediatric school psychology, improving education of children with rare genetic disorders and autism, and development of resilience skills in children at risk for academic failure. He has over 210 scholarly publications and presentations and has published four books. He is on the editorial board of six international scholarly journals and is editor of School Psychology Forum.





Brain-Based Learning



Brain-Based Learning Theory is based on the structure and function of the human brain. As long as the brain is not prohibited from fulfilling its normal processes, learning will occur.



Brain-Curricula Connections for ALL Children



- Advances in the neuroscience of learning and behaviour
- Brain changes more quickly than thought before: Implications for typical learners and instruction
- Brain matters for early intervention and identification of special need
- Brain matters for differential diagnosis of disability
- Brain matters for targeted interventions for struggling learners

The Three Axes Interpretation

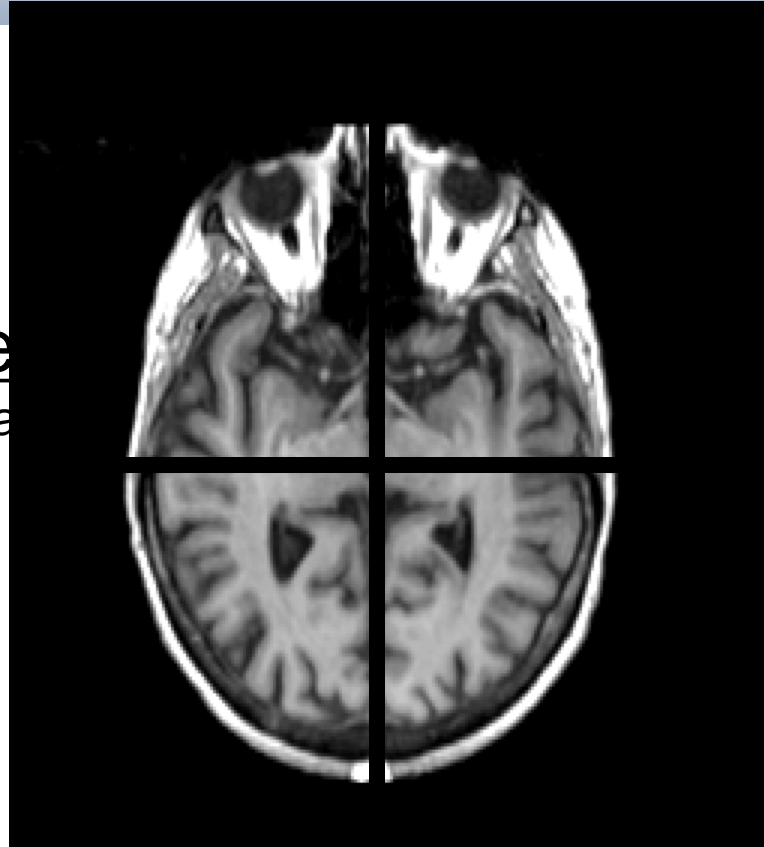


Anterior

- Executive Functions
- Motor Output

Left Hemisphere

- Routinized/Detailed/Local
- Convergent/Concordant
- Crystallized Abilities



Right Hemisphere

- Novel/Global/Coarse
- Divergent/Discordant
- Fluid Abilities

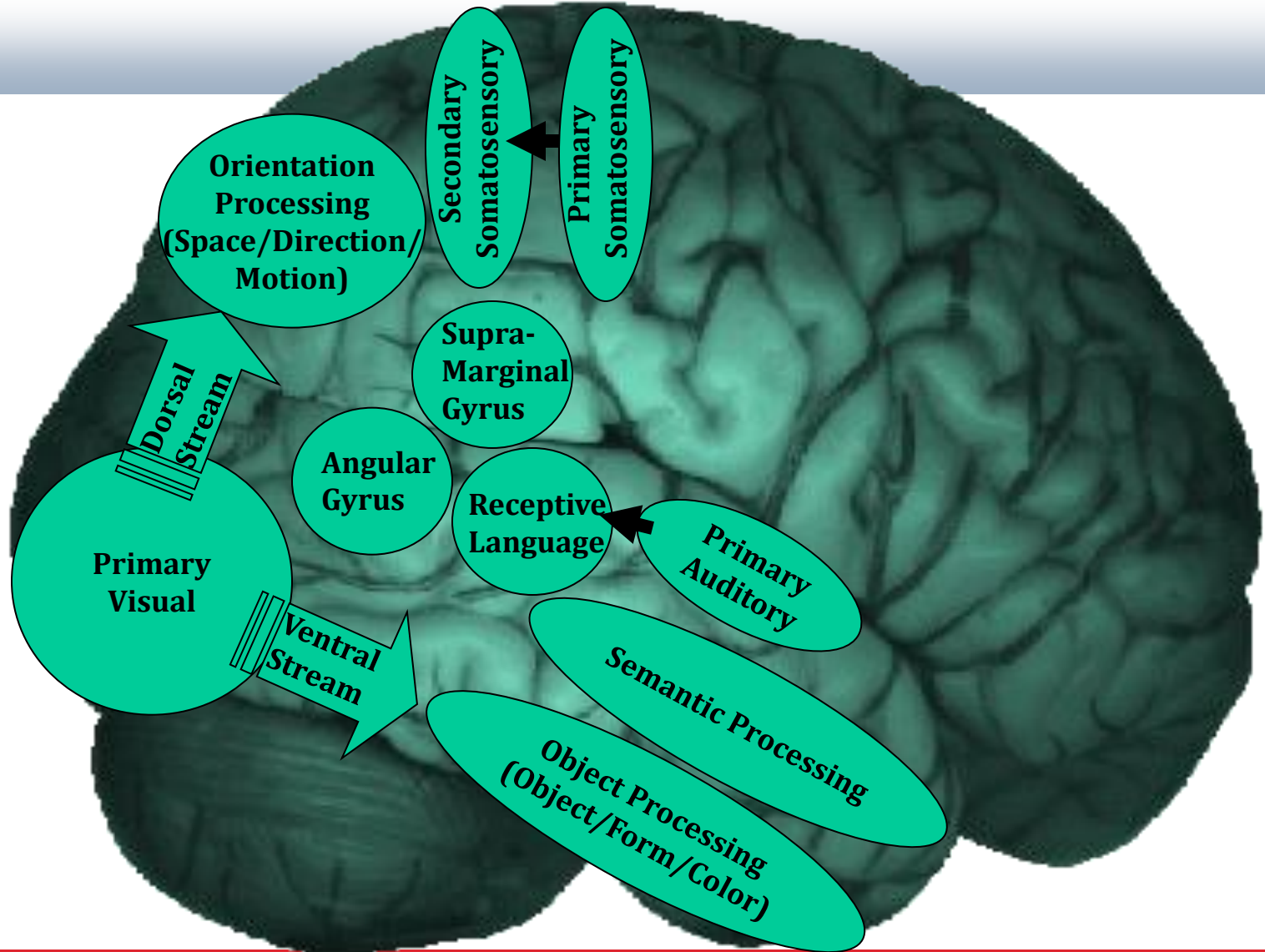
Posterior

- Sensory Input
- Comprehension



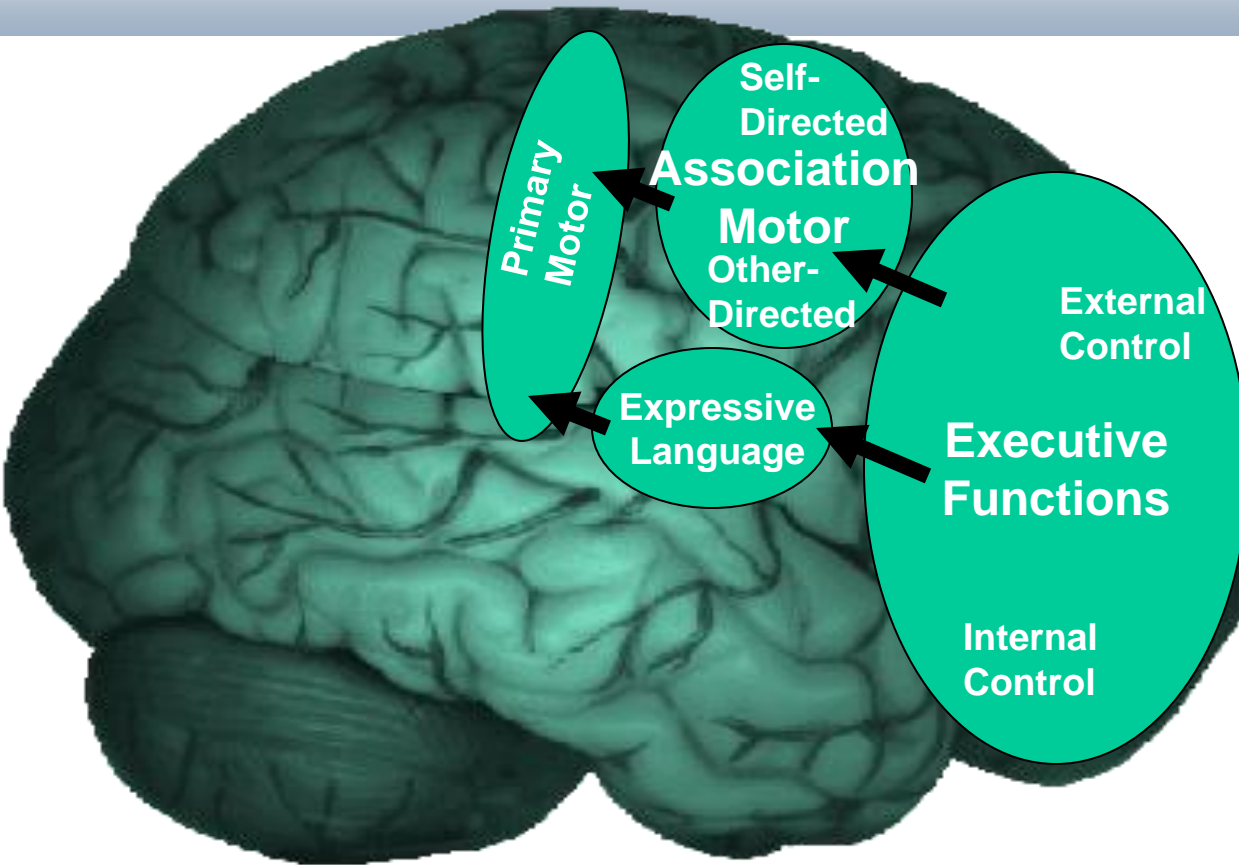
The Posterior-Anterior Axis

Unit for Receiving, Analyzing, and Storing Information



The Posterior-Anterior Axis

Unit for Programming, Regulating, and Verifying Activity



The Brain Manager



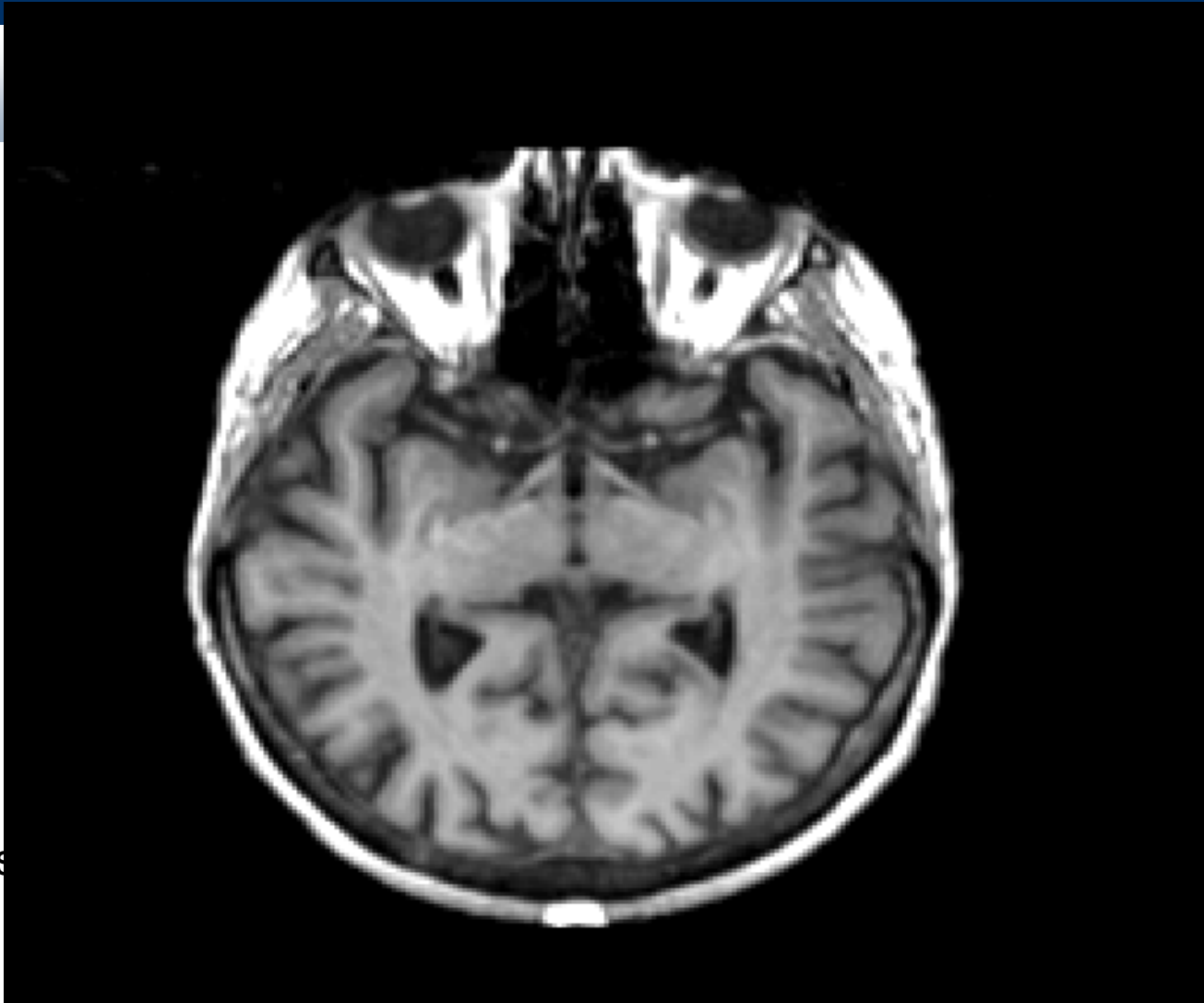
Left Hemisphere

Right Hemisphere

More
Grey
Matter

More
Primary
Cortex

More
Intramodal
Connections

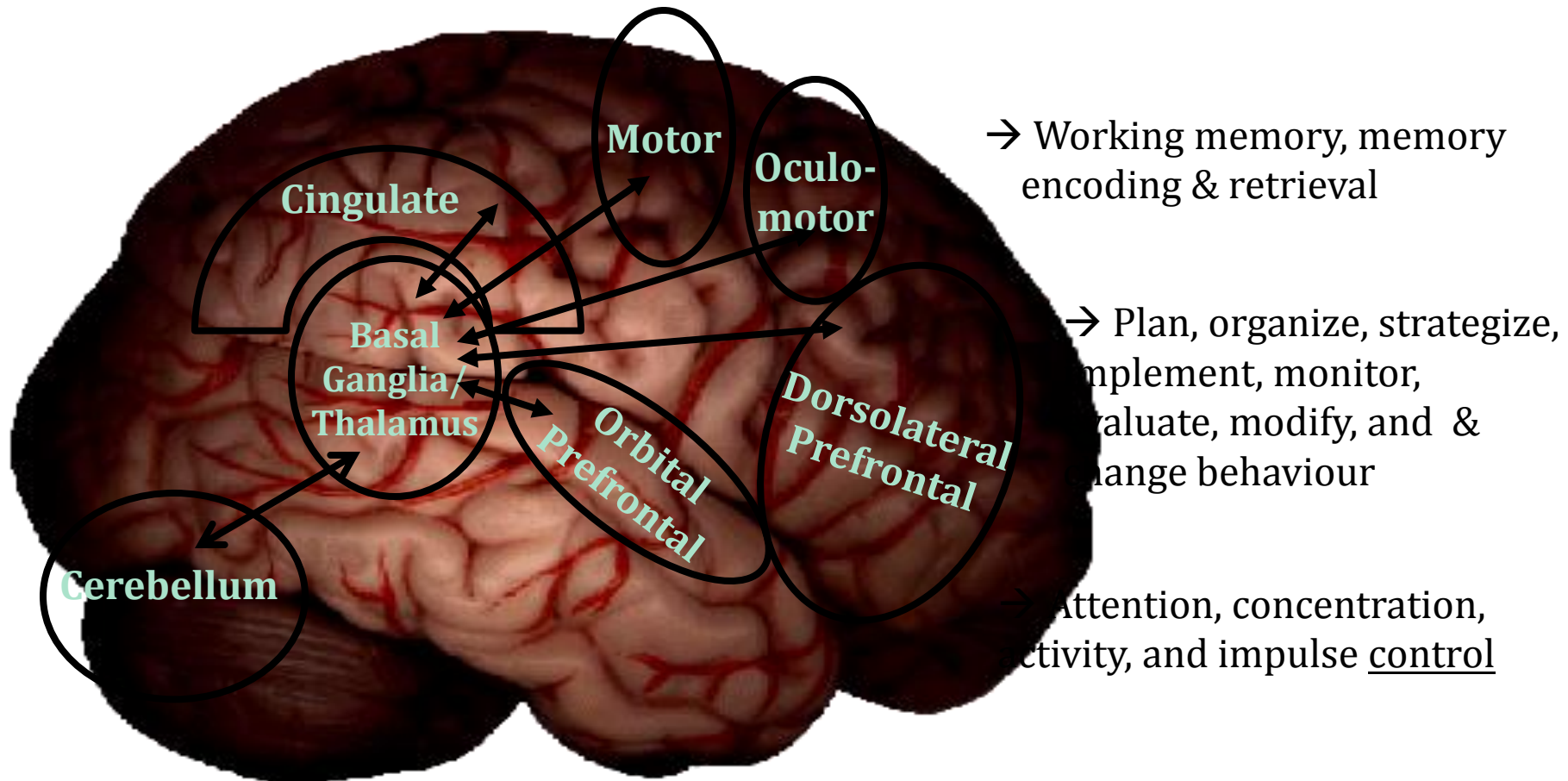


More
White
Matter

More
Association
Cortex

More
Intermodal
Connections

Cortical-Subcortical Circuits and the Third Axis

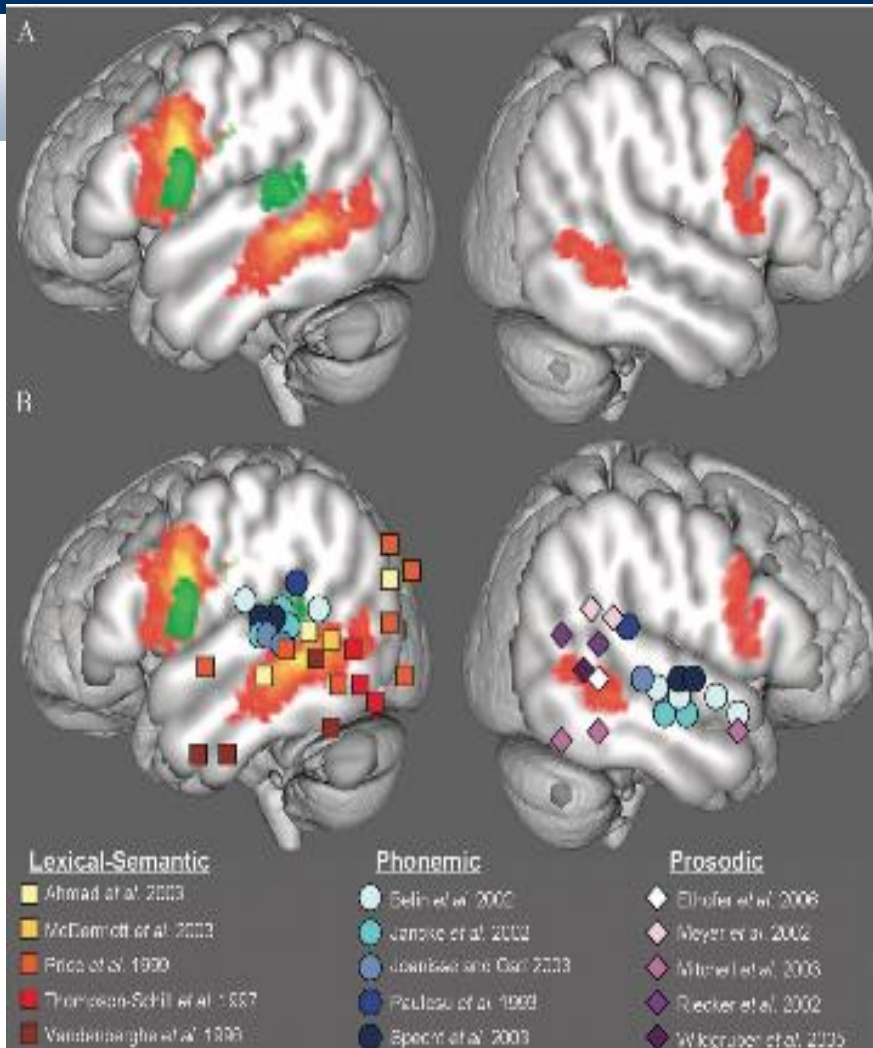


Language Brain Activation Patterns



Left

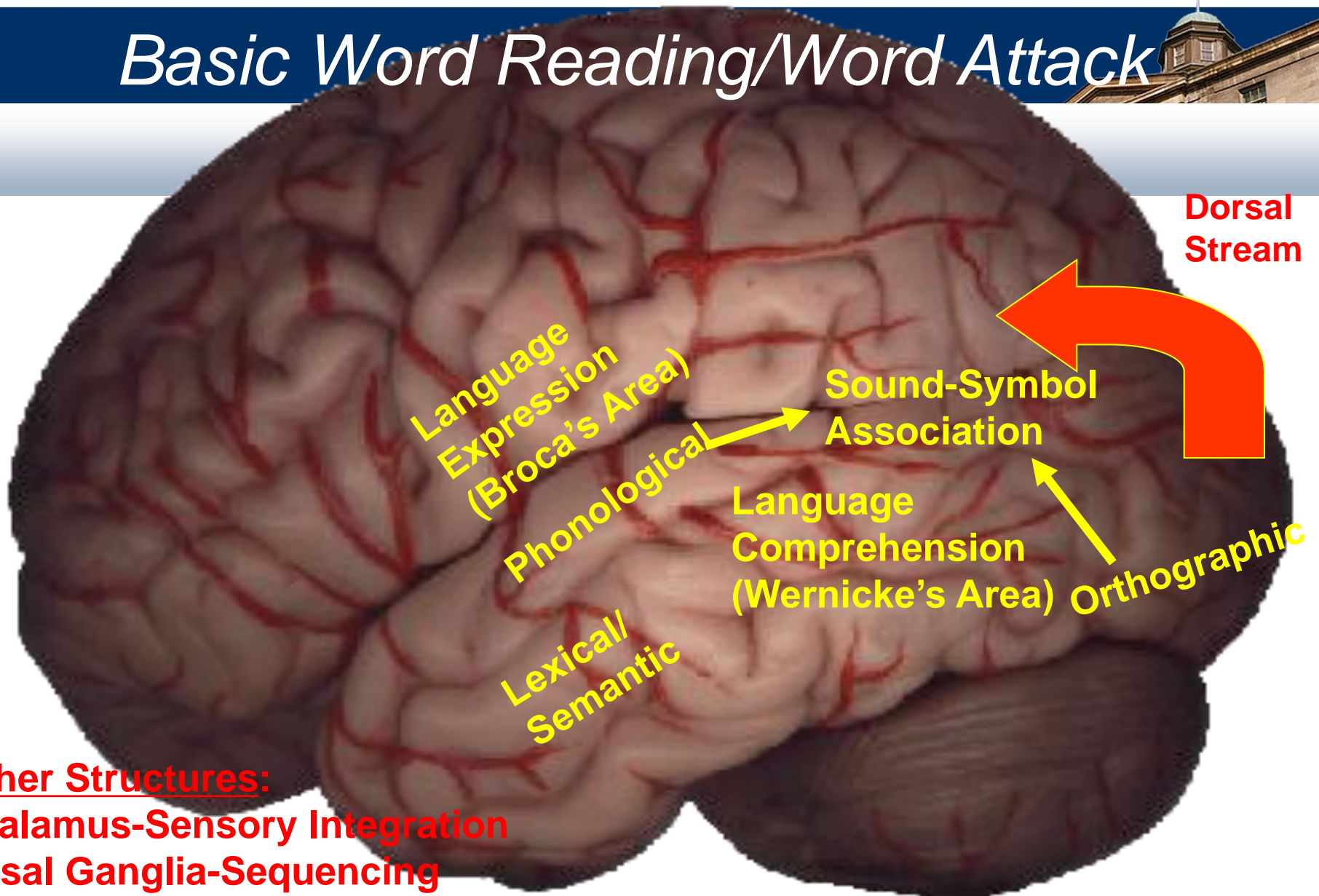
- Alphabetic principle
- Fluency
- Temporal
- Phonological Processing
- Explicit Language
- Speech (Articulation)
- Dysfunction in word reading & explicit comprehension common



Right

- Rate
- Pitch
- Spectral
- Complex Language
- Implicit Language
- Speech (Prosody)
- Difficulty with implicit comprehension common yet good word reading

Basic Word Reading/Word Attack



Other Structures:

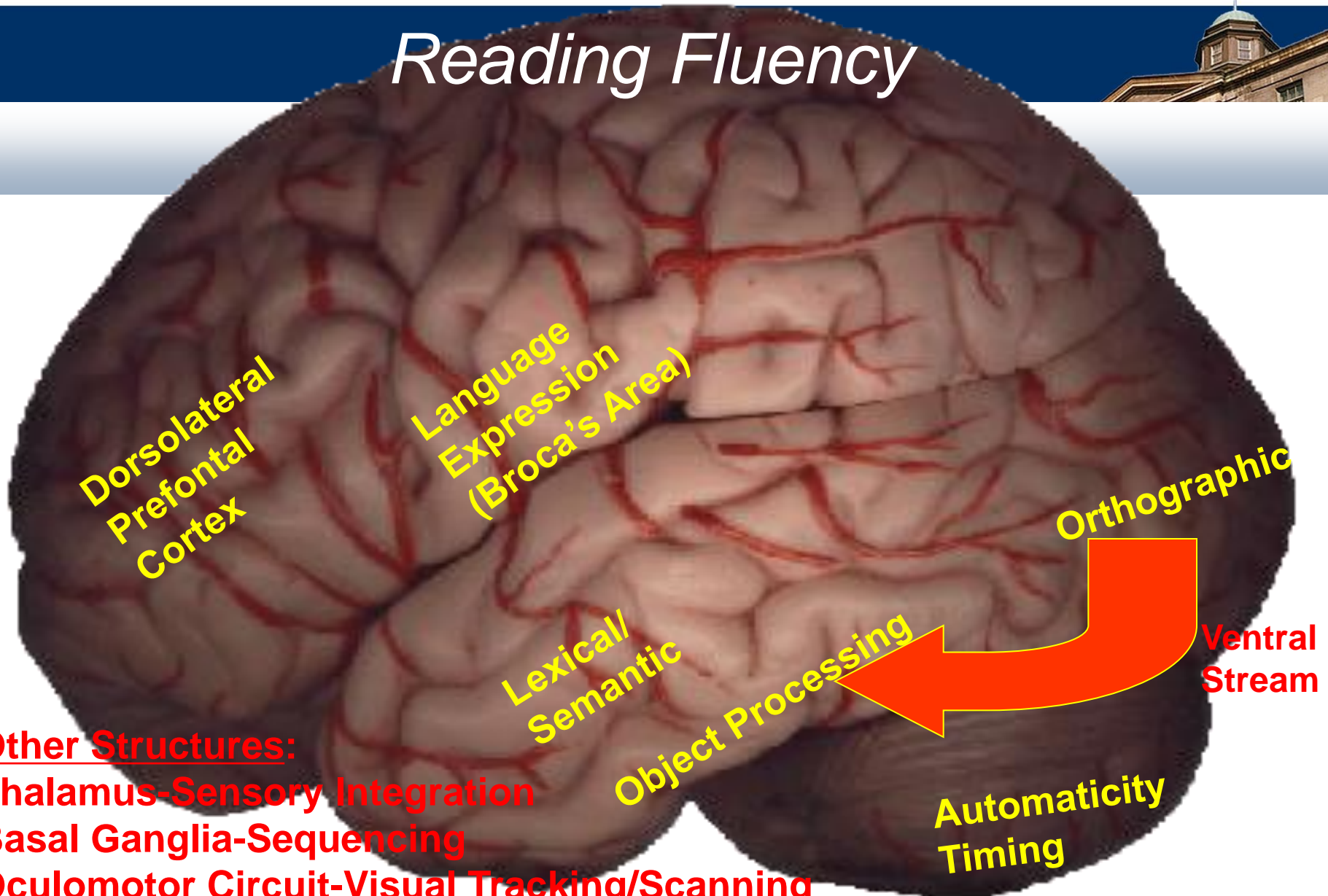
Thalamus-Sensory Integration

Basal Ganglia-Sequencing

Oculomotor Circuit-Visual Tracking/Scanning



Reading Fluency



Other Structures:

Thalamus-Sensory Integration

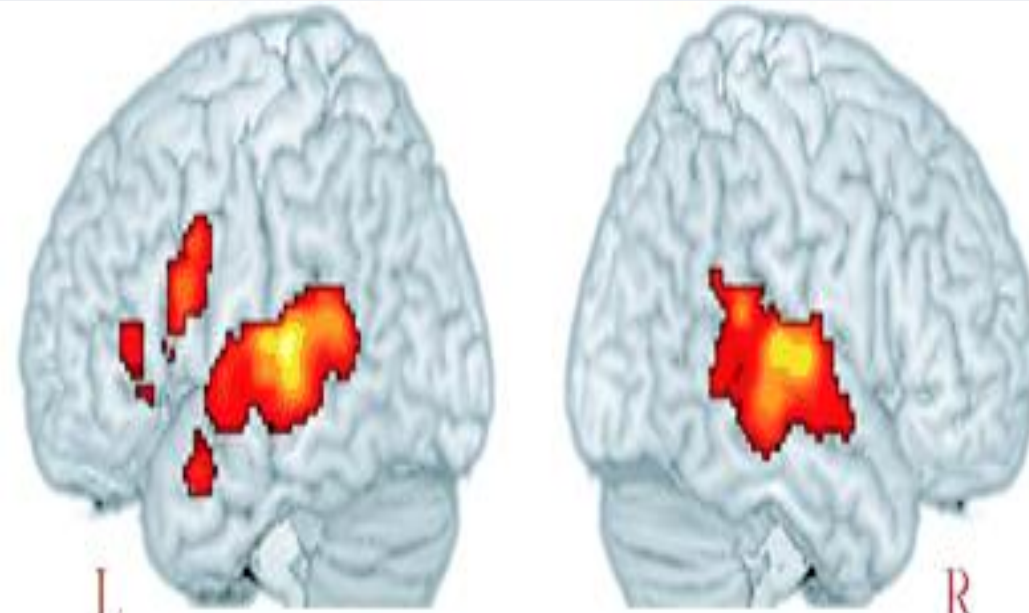
Basal Ganglia-Sequencing

Oculomotor Circuit-Visual Tracking/Scanning

Cingulate Circuit-Online Monitoring/Decision Speed



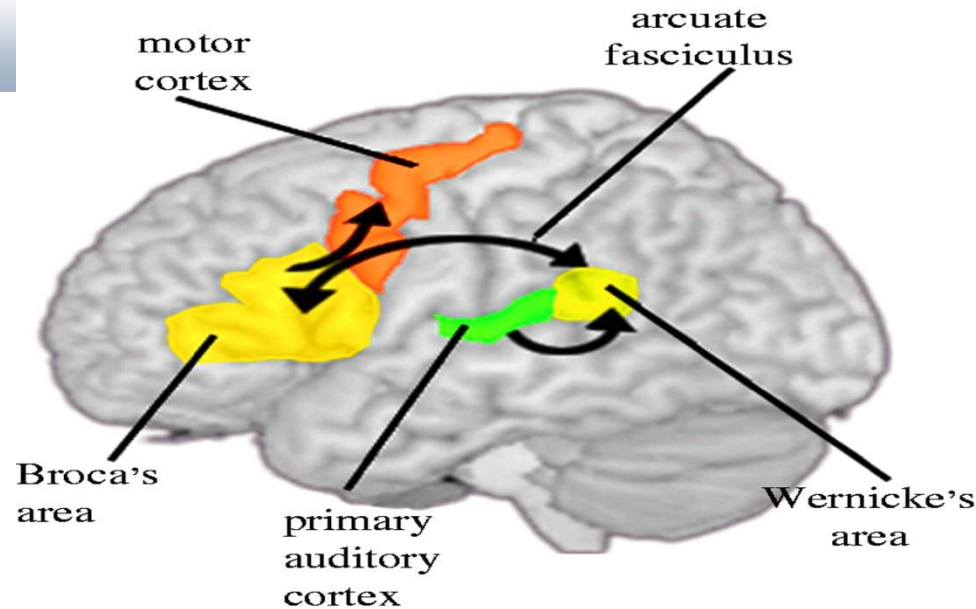
Temporal and Frontal Systems in Comprehension



- Bilateral temporal lobe activation for speech and phonological processing
- Superior temporal activity suggests accessing lexical representations
- Self-talk important for self management and understanding

Brain Area	Possible Effects of Left Hemisphere Damage?	Possible Effects of Right Hemisphere Damage?
Superior Temporal Lobe	Frequent requests for repetition, poor word reading, poor auditory and phonological processing	Poor perception of rate and pitch or prosody, difficulty with complex sentence processing
Lateral/Medial Temporal Lobe	Can't remember facts and words due to difficulty with long-term memory, poor categorization	Limited understanding of context, metaphor, multiple word meanings, and humor

Broca's Area and Grammar



Broca's area involved in more than speech production:

- Linguistic processing (de Vries, Barth, Maiworm, Knecht, Zwitserlood, & Flöel, 2010; Forkstam et al., 2006)
- Rule-based knowledge (Flöel et al., 2009)
- Detecting violations in syntax (Udden et al., 2008; de Vries, Barth, Maiworm, Knecht, Zwitserlood, & Flöel, 2010)
- Implicit learning of artificial grammar (de Vries, Barth, Maiworm, Knecht, Zwitserlood, & Flöel, 2010)

Science and brain-based learning

Exploratory big toy

We know that learning takes place in the brain

We know there are typical pathways for basic academic skill development

That is what we know



Fundamental issues



Knowing the links between localization and function is fine, but:

- Causal or correlational?
- Faulty syllogism
- Conflating neuroplasticity and learning
- Development
- Aptitude X Treatment
- Applications and implementation
- The “so what” question

Implementation



Does the specific intervention affect the specific brain function?

Remediate weakness or build strength or accommodate?

How does instruction get differentiated?

Value added?

Neurology and Education



- Eaton Arrowsmith
- Brain Gym
- Brain-based learning
- Cogmed
- Many other programs

The working memory example

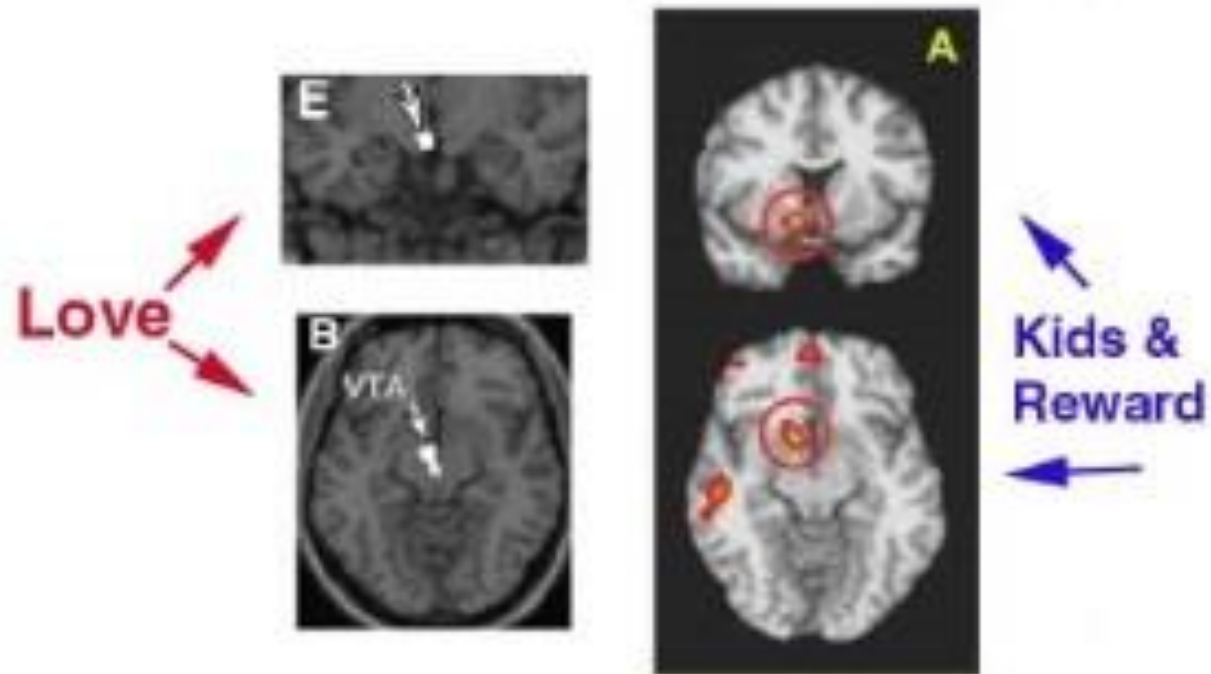


WM is a major influence on academic skills

Many efforts to training it that are evidence based—e.g.,
Cogmed and Luminosity

- --significant task-specific improvement
- --no generalization

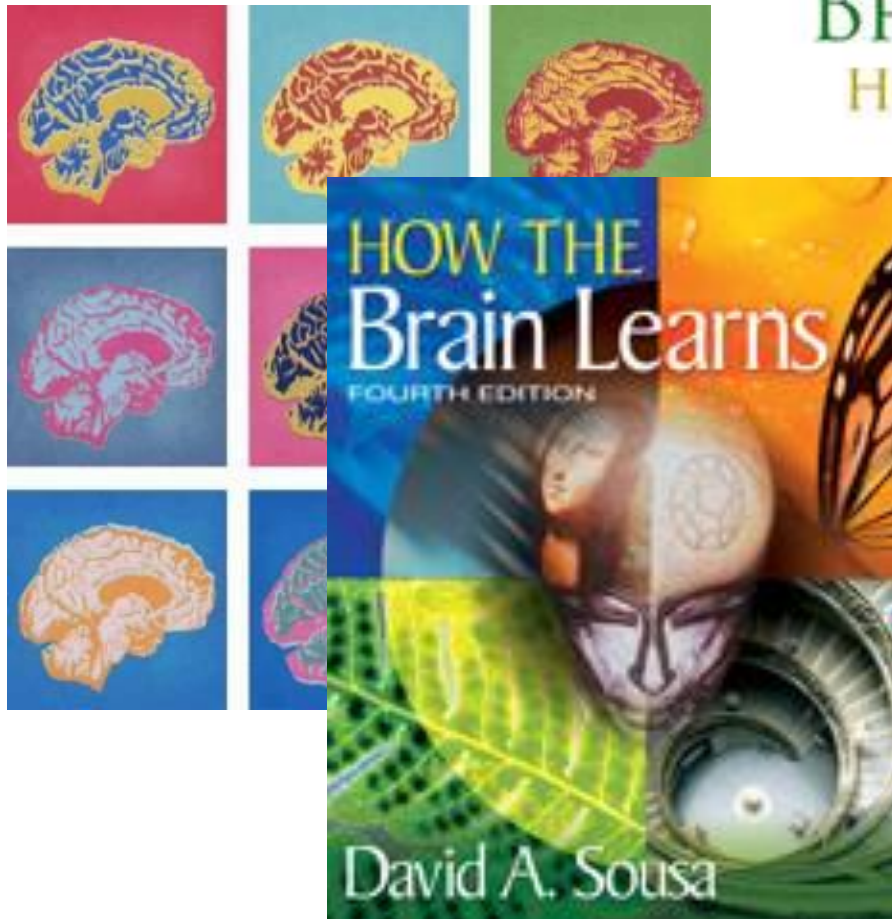
Conclusion: not a good investment of
therapeutic resources





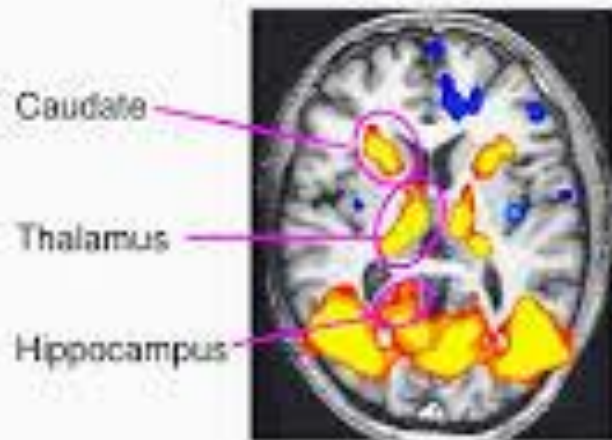
BRAIN SCHOOL

HOWARD EATON, ED.M.

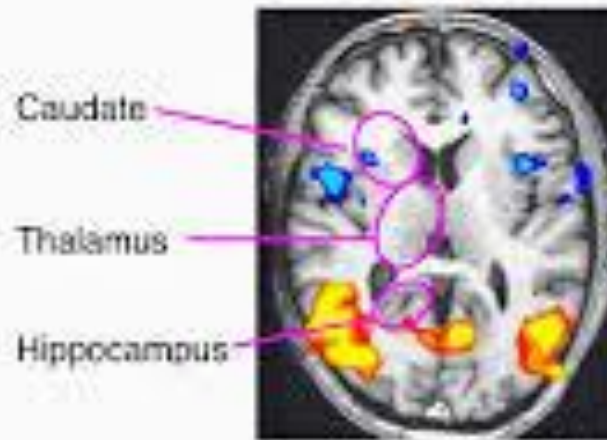


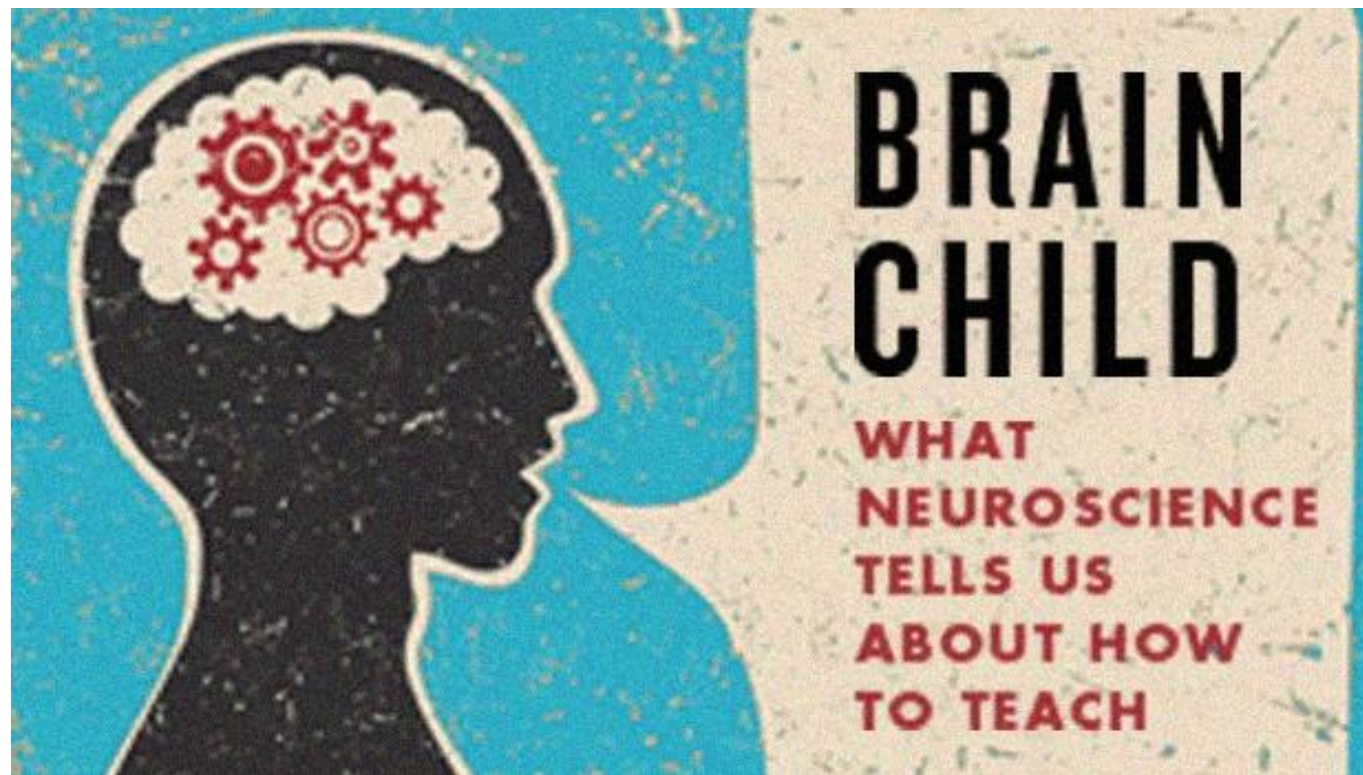


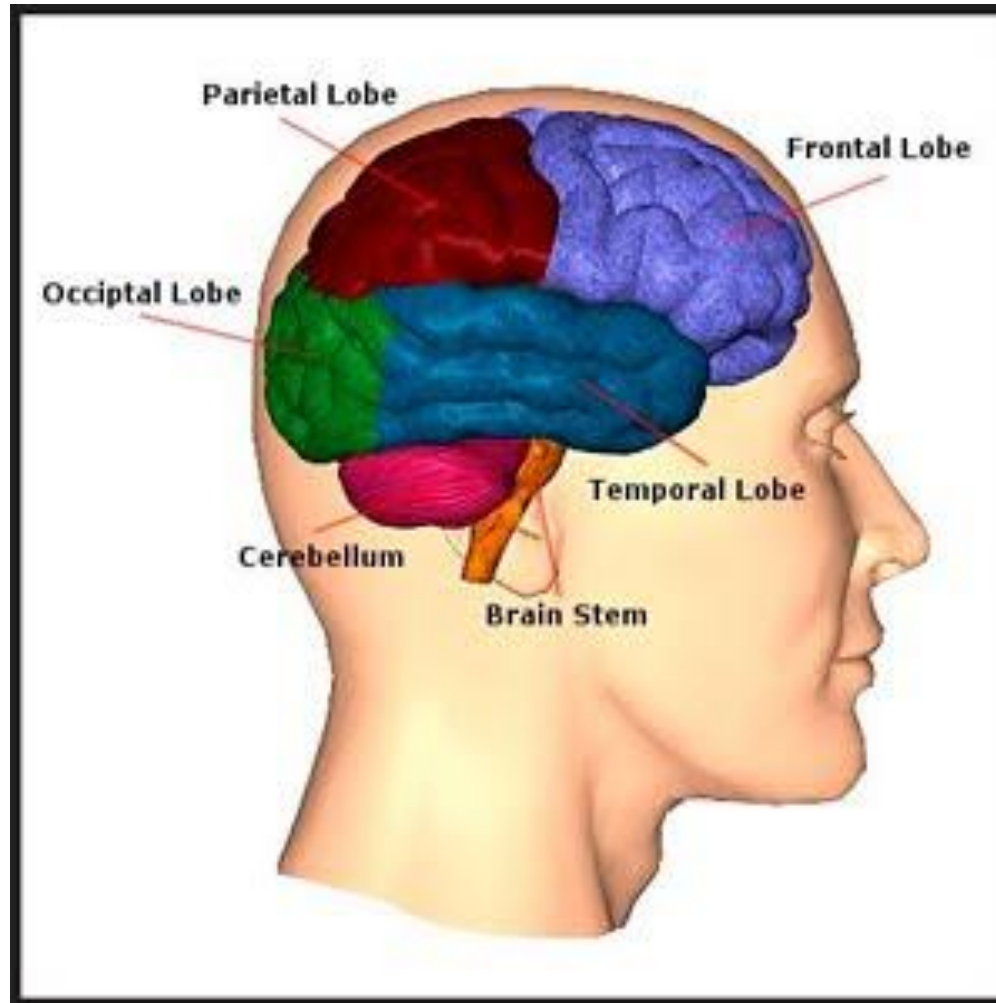
Interactive play



Passive exposure







Previous failed efforts



- Learning styles
- Multiple intelligences
- Left brain/right brain
- Neuromotor patterning
- Multisensory education
- Sensory integration therapy

Evidence-based practices



- The latest requirement
- The ability to cherry pick bad science
- One step above making stuff up
- Link to recent article from my lab:
https://www.mcgill.ca/connections/connections/files/connections/cq_43_1.pdf

Evidence-based practices



- Few studies are replicated
- Individual differences
- Evidence of Aptitude X Treatment
- Implementation
 - Who, when, why, where, and how
 - Context
- Evidence-based practices as proof-of-concept, not a carte blanche to implement

4th Law of Thermodynamics



“The amount of energy
necessary to refute bullshit is
an order of magnitude bigger
than to produce it.”

Retractions



49 fMRI and learning refereed and published papers have been retracted by journals due to misleading analysis or fraud—
retractions rarely get attention

2 during the last week of August

Source: retractionwatch.com

Discarded studies



Scanning cadavers and fish and made up constructs seem to have positive results in blind studies

Uncorrected statistics, poor procedures, and nearly all results are not replicated

Not retracted, but severely flawed

Adding to error



The seductive allure of neuroscience explanations by Weisberg, Keil, Goodstein Rawson, and Gray.

Seeing is believing: The effect of brain images on judgments of scientific reasoning by McCabe and Castel

- Brain images and neurobabble generally make folks believe anything

basic research v. clinical practice



- Neuroscience has extraordinary potential for informing education, psychology, and psychiatry
- Imaging is now basic science
- There is zero evidence that this information currently has utility for education or instruction
- Efforts to make premature application are well-meaning folks who are simply ahead of the science or snake-oil salesman with a profit motive

Future studies



- Need to develop a theory of learning/brain links
- Need to develop validated pathway specific instruction
- Need to integrate basic science and implementation science

Steve's view



My view is that genetics studies are more likely to lead to improved educational techniques and mental health in medicine than imaging. But...

There is a common refrains:

- Brain science = pretty pictures
- Genetics = Nazis

Conclusions



There is potential for brain science to contribute to education, but it is a long way off

Current efforts are well-meaning speculation or outright quackery

Basic science is very exciting and we need to look for implementation opportunities

For more information



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