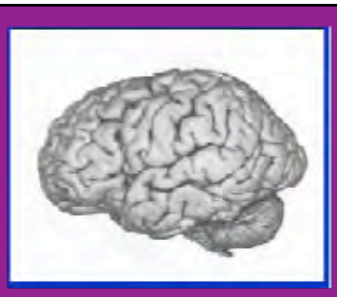
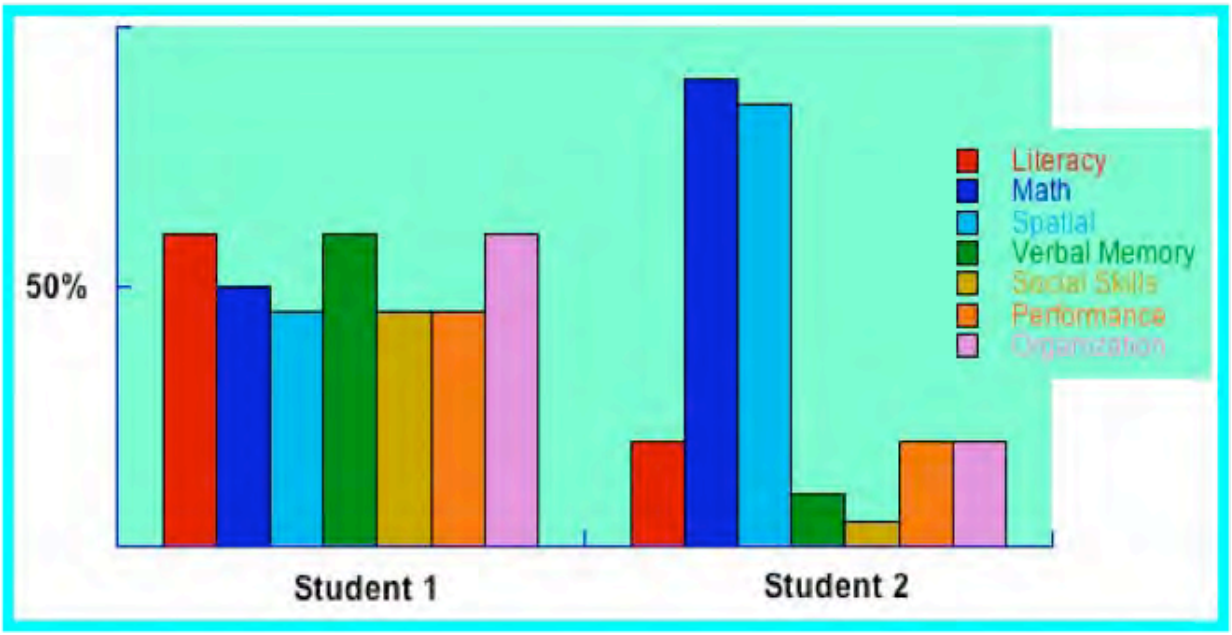


Building Better Brains for Reading

Steve Wilkins The Carroll School
swilkins@carrollschool.org

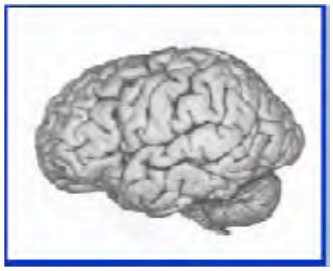
Profiles of Cerebrodiversity



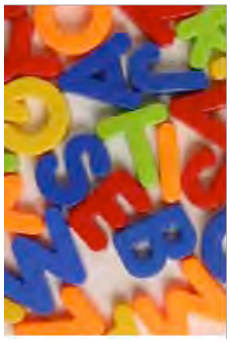
WISC –IV SCORES SCHOOL WIDE -

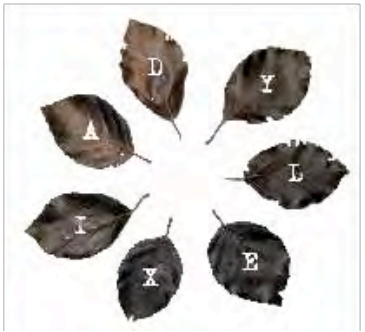
Number of Students in each category corrected 5/25/09

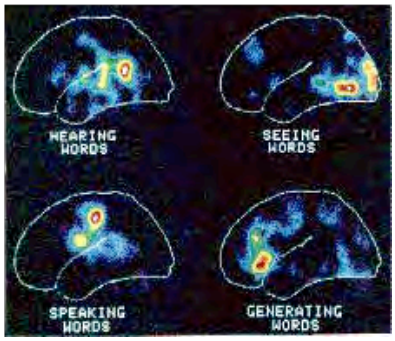
	Verbal Compr	Percept Reason	Working Memory	Processing Speed
80 or <	0	6	27	35
90 or <	9	20	52	58
100 or <	54	45	86	78
Total	**63**	**71**	**165 (70%)**	**171 (70%)**
120 or >	45	38	4	3
110 or >	47	62	15	18
No score	37	47	45	40



The Science of Reading

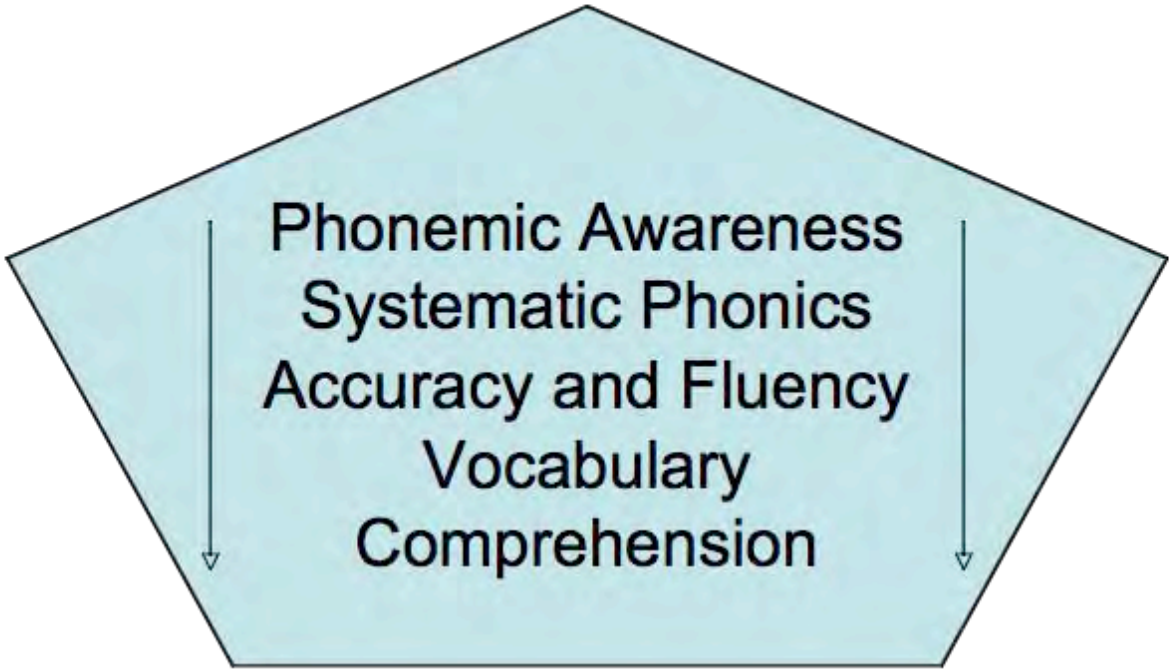






National Reading Panel, 2000

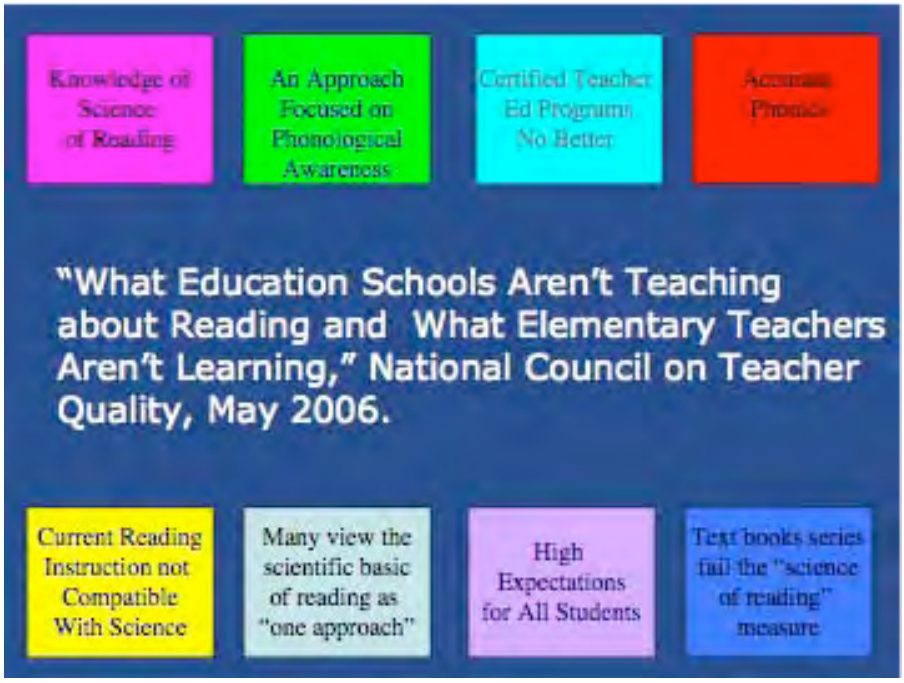
(examined 100,000 research studies on reading)



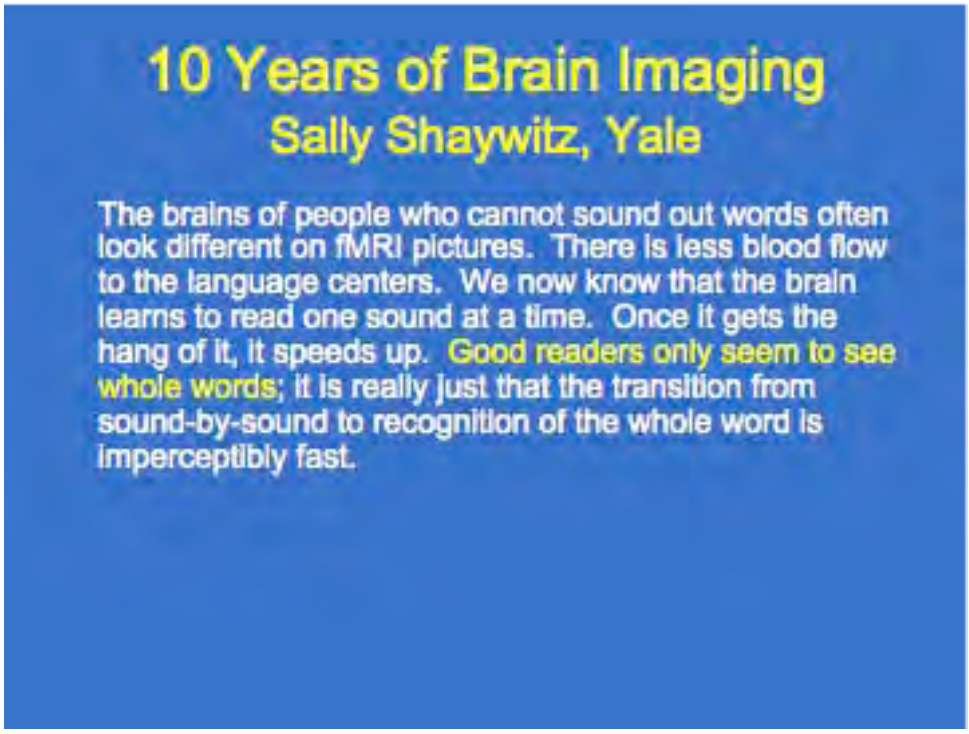
National Reading Panel, 2000

✓ difficulties learning to read were caused by inadequate phonemic awareness

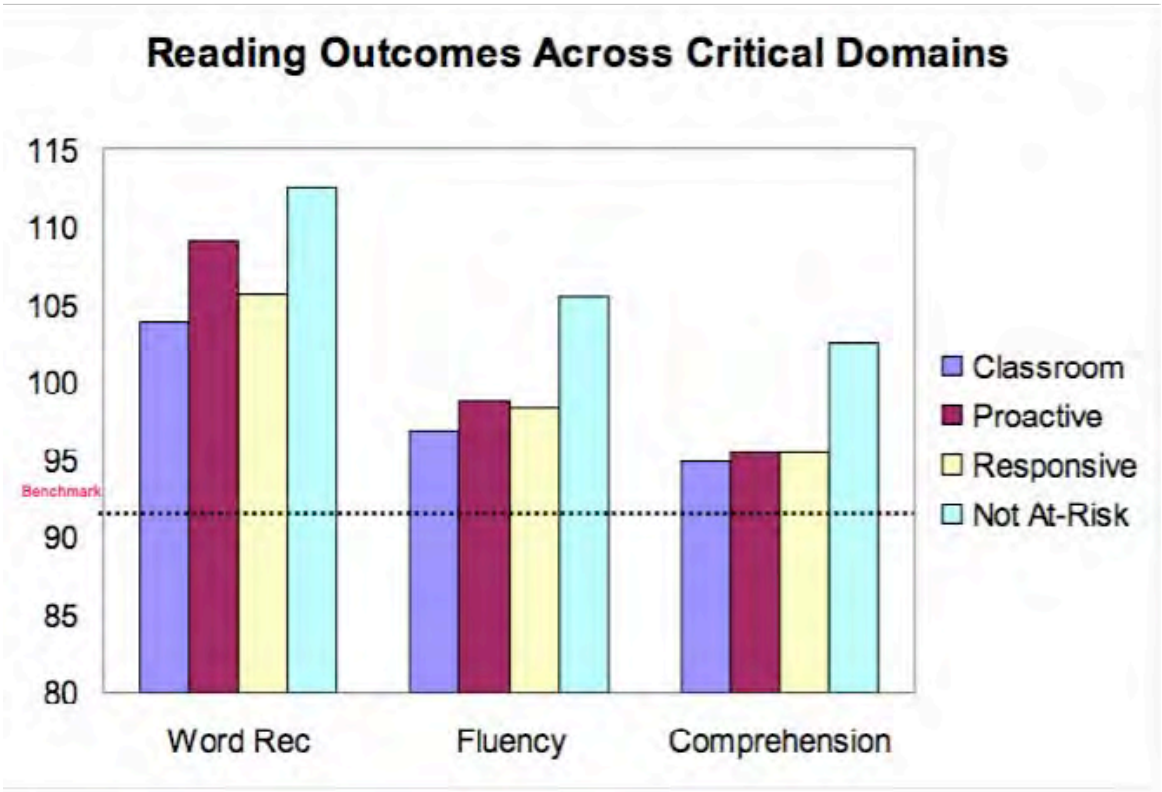
✓ systematic and explicit instruction in phonemic awareness directly caused improvements in children's reading and spelling skills

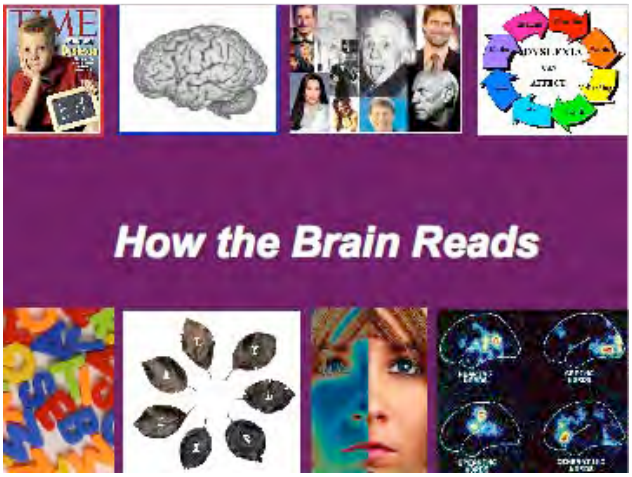

Knowledge of Science of Reading
An Approach Focused on Phonological Awareness
Certified Teacher Ed Programs No Better
Accurate Phonics
"What Education Schools Aren't Teaching about Reading and What Elementary Teachers Aren't Learning," National Council on Teacher Quality, May 2006.
Current Reading Instruction not Compatible With Science
Many view the scientific basic of reading as "one approach"
High Expectations for All Students
Text books series fail the "science of reading" measure

It is Phonology.
It is Phonology.
It is Phonology.

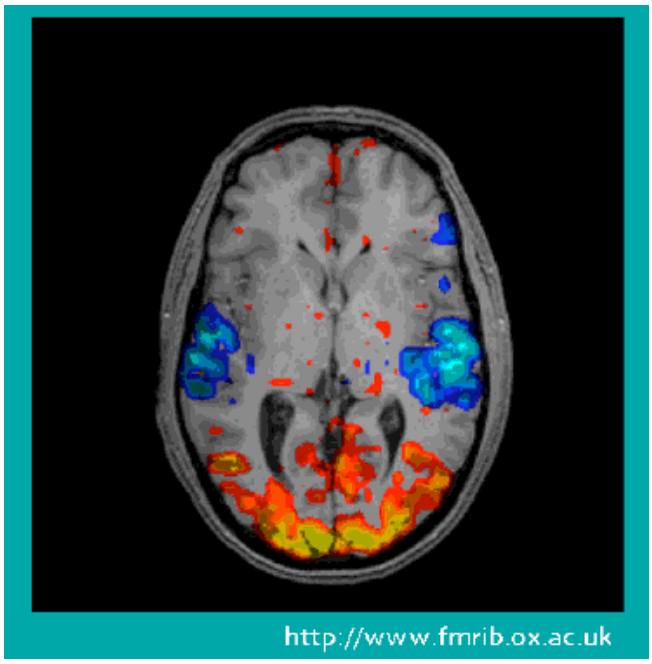

10 Years of Brain Imaging
Sally Shaywitz, Yale
The brains of people who cannot sound out words often look different on fMRI pictures. There is less blood flow to the language centers. We now know that the brain learns to read one sound at a time. Once it gets the hang of it, it speeds up. Good readers only seem to see whole words; it is really just that the transition from sound-by-sound to recognition of the whole word is imperceptibly fast.

Barbara Foorman, FCRR



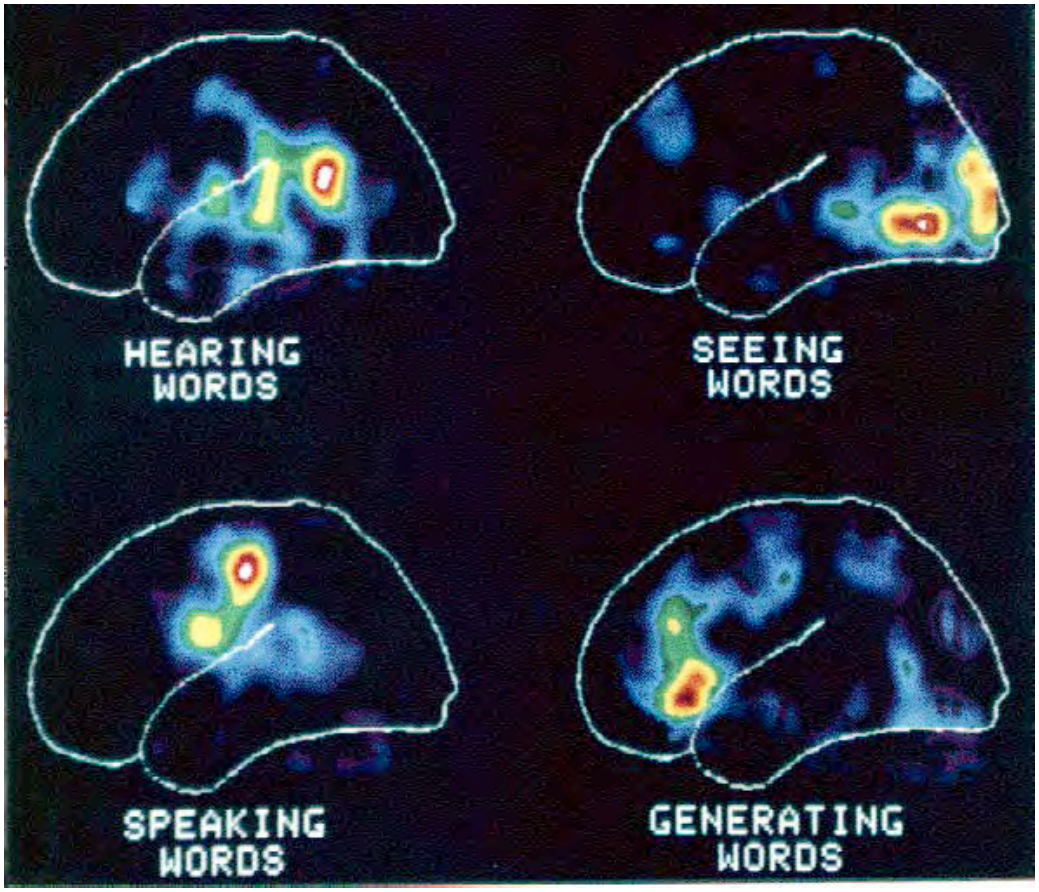

How the Brain Reads

Nadine Gaab

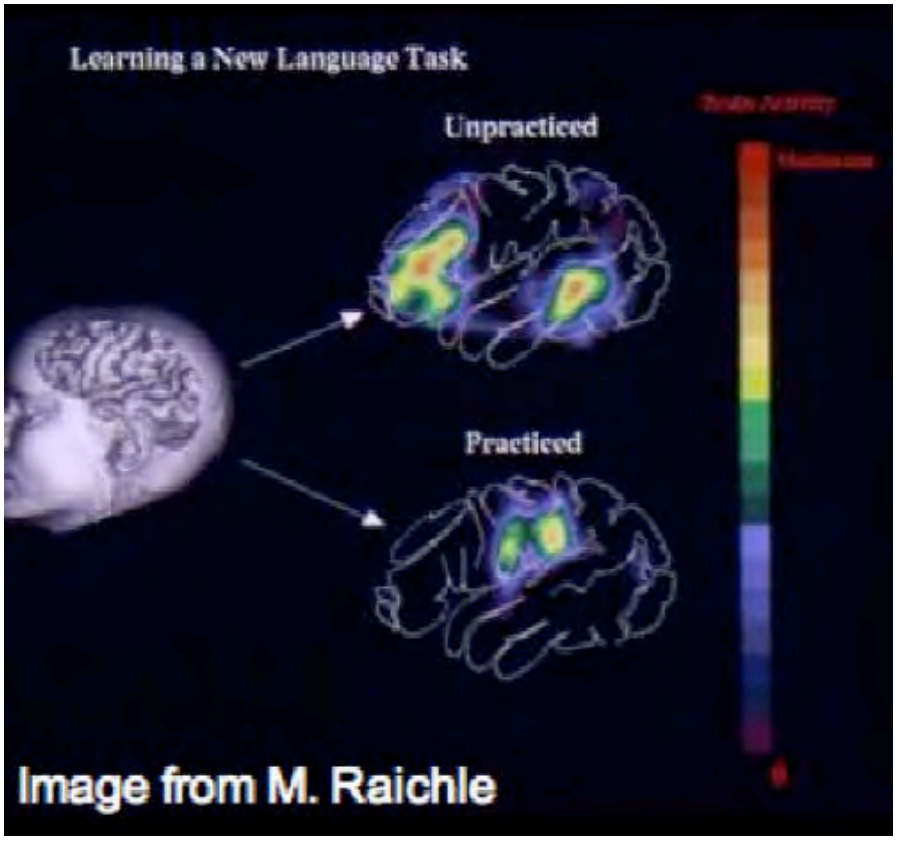


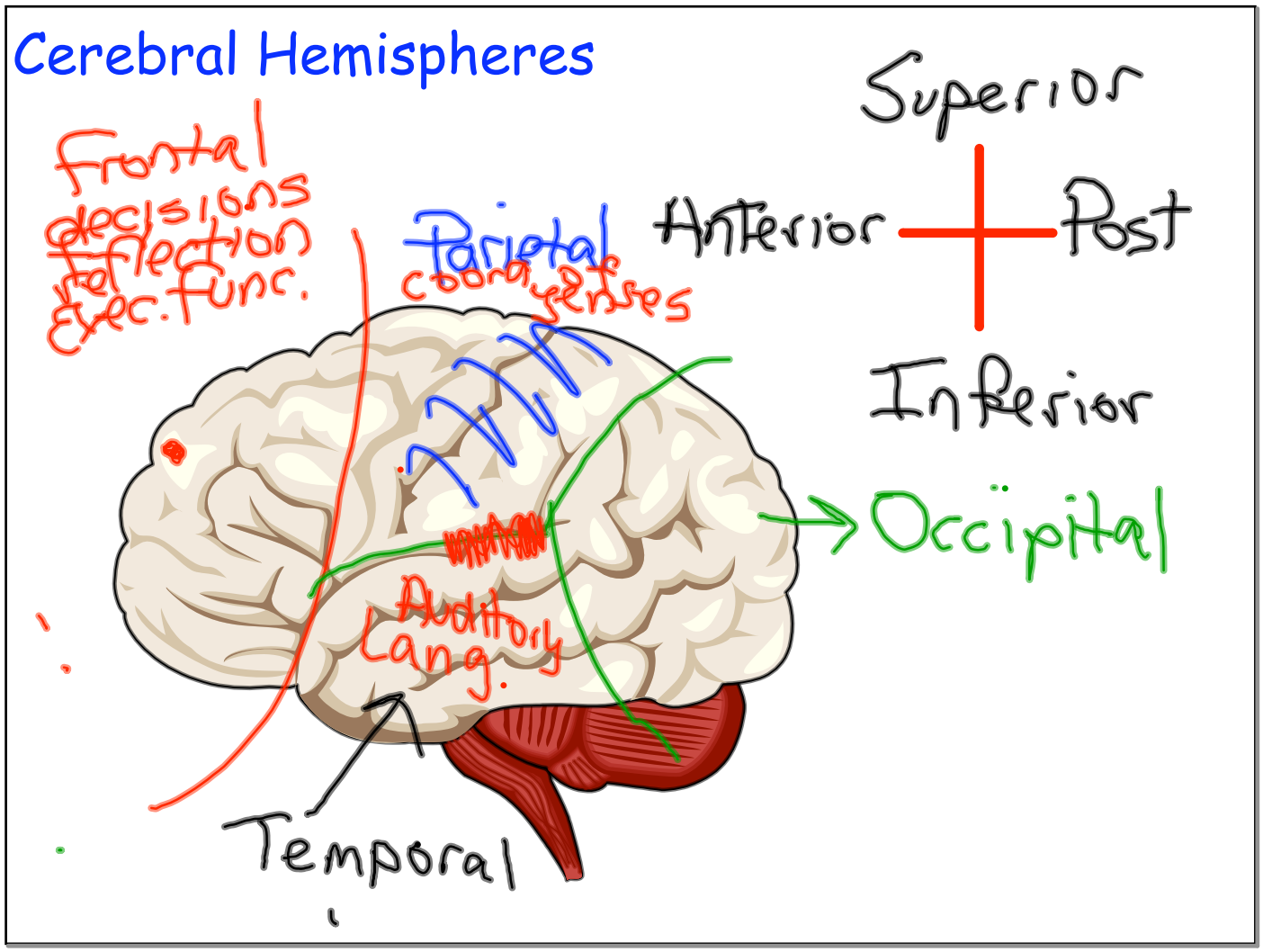
Red
Orange
Yellow
Green
Blue

Hot


HEARING WORDS
SEEING WORDS
SPEAKING WORDS
GENERATING WORDS

BEAM

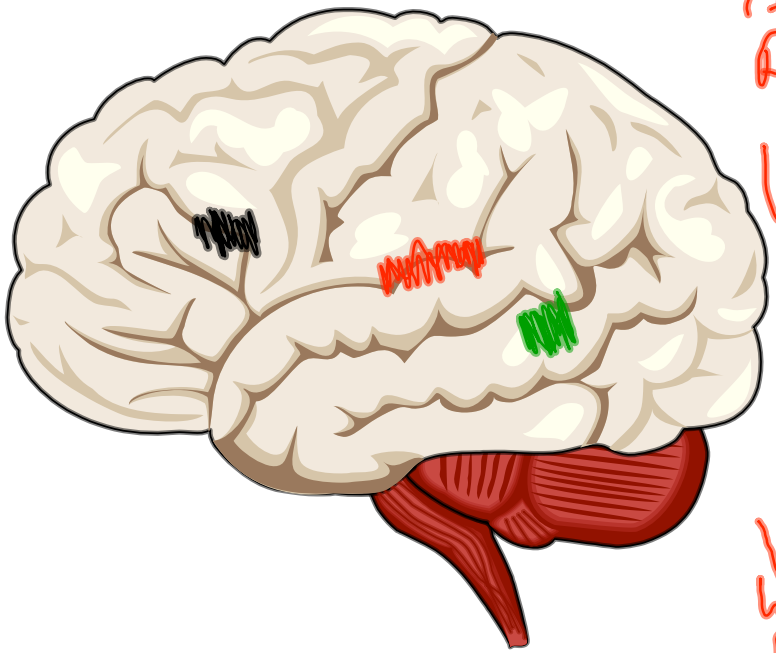

Learning a New Language Task
Unpracticed
Practiced
Image from M. Raichle


Cerebral Hemispheres
Frontal
decisions
reflection
Exec. Func.
Parietal
coord. senses
Superior
Anterior
Post
Inferior
Occipital
Auditory
Lang.
Temporal

Language Centers

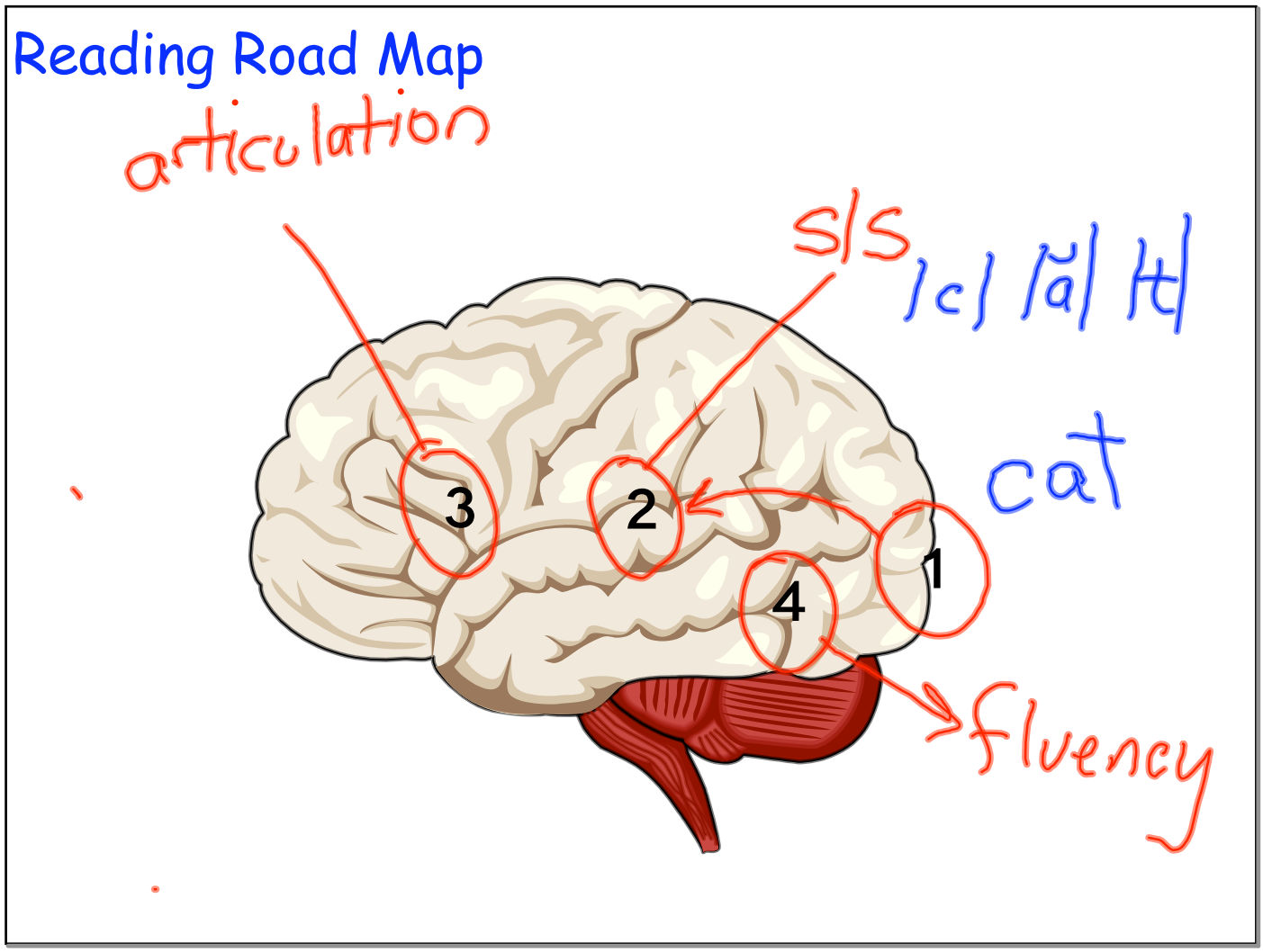
Broca's

tpt → Convergence Zone
Tempo-Parietal
Dorsal Ridge of
Temporal L.
Angular
Gyrus
Wernicke's

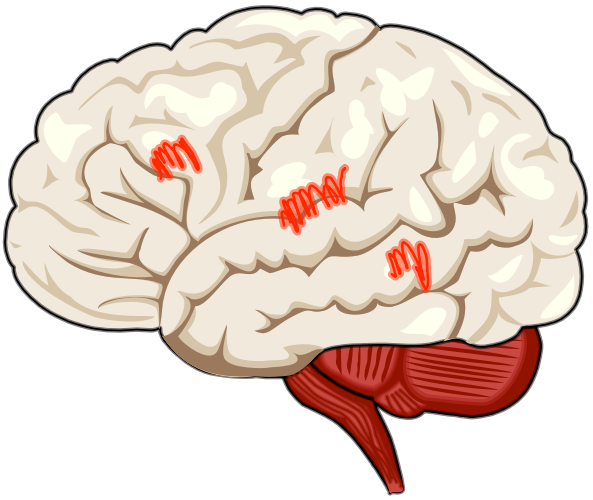


Occipito-
Temporal
Visual
Word
Form

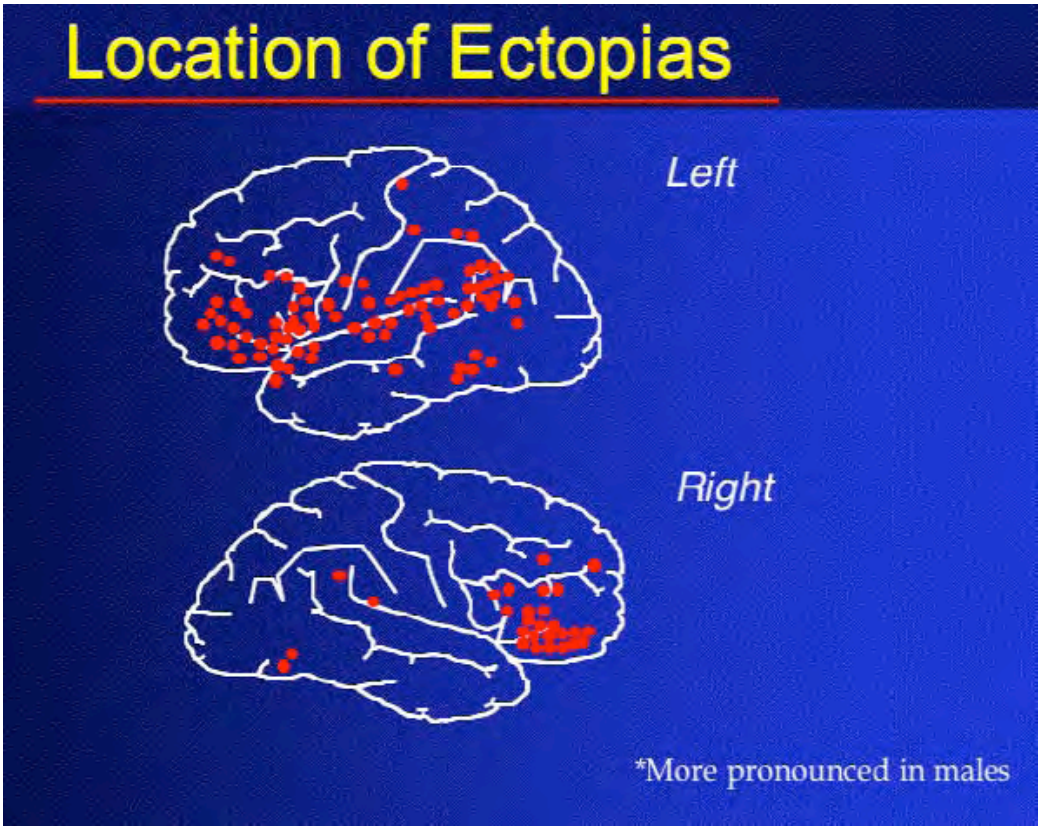
Reading Road Map



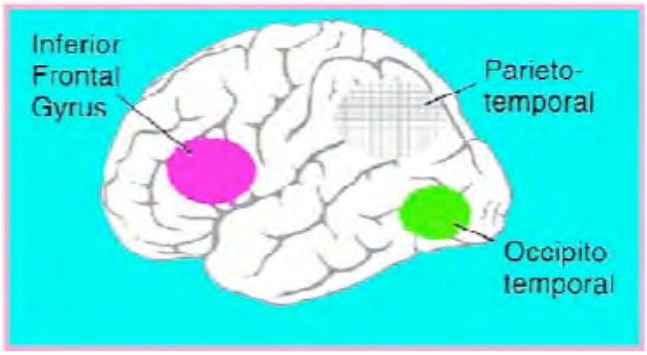
Dyslexia Findings



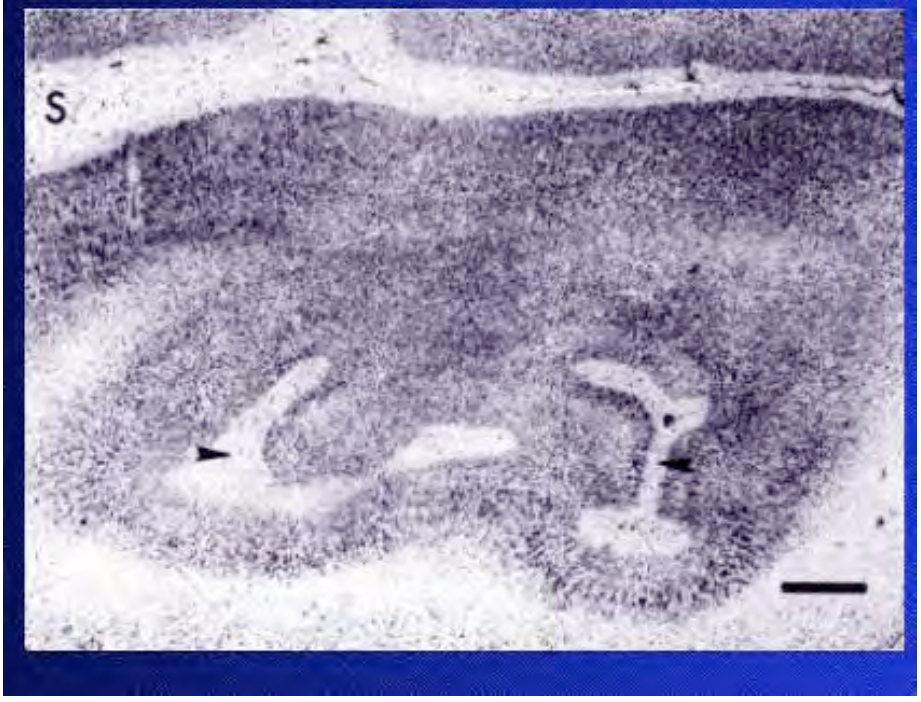
1. Symmetry
2. Ectopias
3. Rt Hemisphere
4. Interhemispheric Connectivity


Location of Ectopias
Left
Right
*More pronounced in males

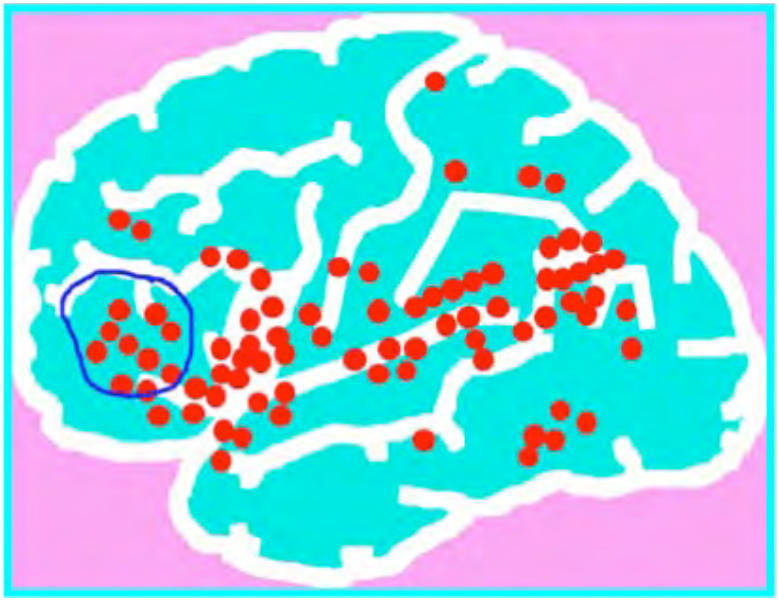
Ectopias in Language Areas

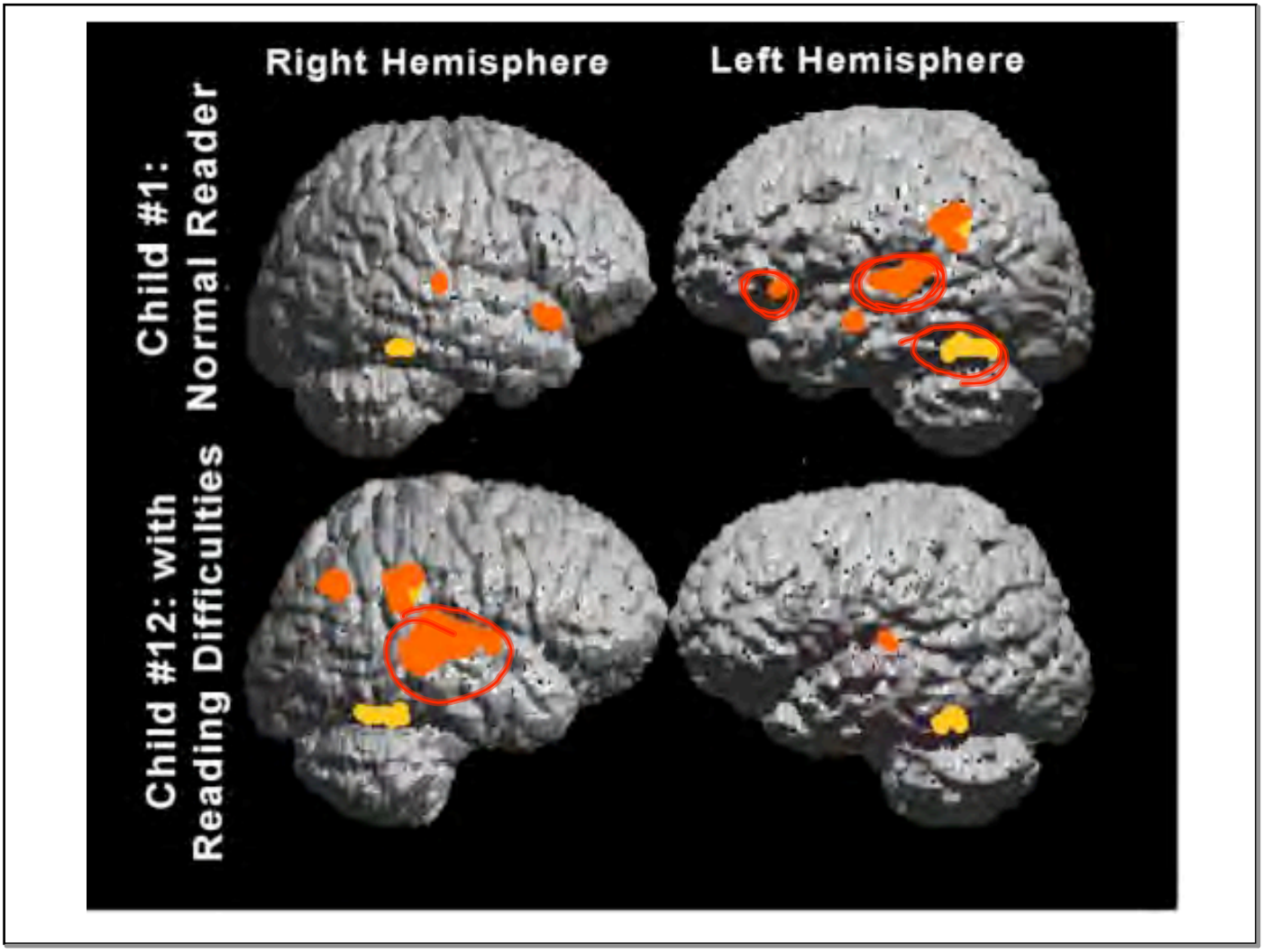


Micropolygyria



Ectopias in Working Memory Areas

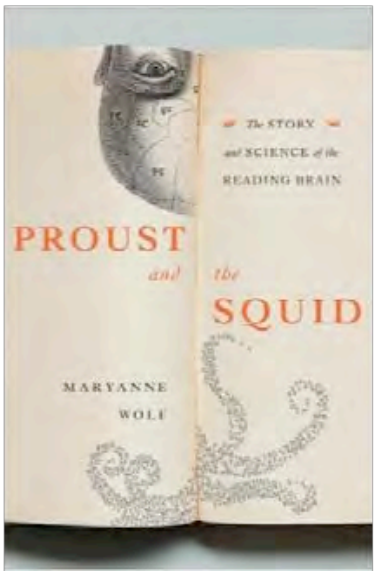



Right Hemisphere
Left Hemisphere
Child #1: Normal Reader
Child #12: with Reading Difficulties

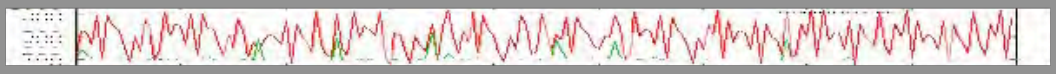
Credit to Maryanne Wolf "Proust and the Squid"

"The timeline is the result of cumulative research in the United States, Israel, and Finland. It is hardly finished. At best, it is thought-provoking; at worst, it is misleading.

"The timeline helps us understand the unwanted principle: multiple structures, multiple deficits, and multiple subtypes.



0 to 100 milliseconds "Attention to Letters"

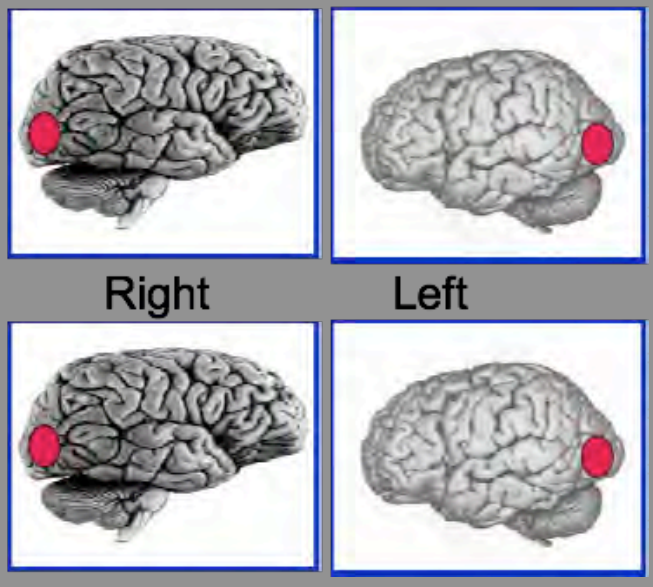


Activation in the Typical Brain

- Bilateral Posterior Occipital

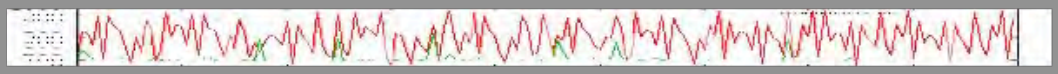
Activation in the Dyslexic Brain

- Similar



At 50 to 150 milliseconds

"Recognizing a Letter & Changing the Visual Cortex"



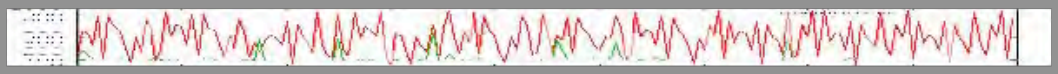
Activation in the Typical Brain

- Focal Left Anterior Occipital

Activation in the Dyslexic Brain

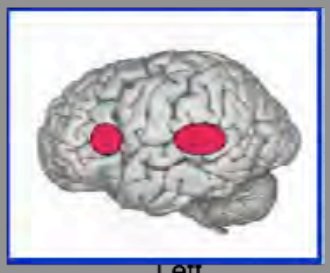
- Left Anterior and Right Anterior Occipital

At 100 to 200 milliseconds
"Connecting Symbols to Sound"



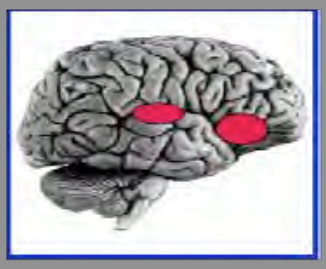
Activation in the
Typical Brain
Left Dorsal
Temporal-Parietal and
Left Inferior Frontal Gyrus

Right



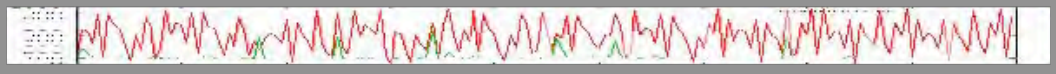
Left

Activation in the
Dyslexic Brain
Left & Right Dorsal
Temporal-Parietal, Minor
Left IFG and Significant Right IFG



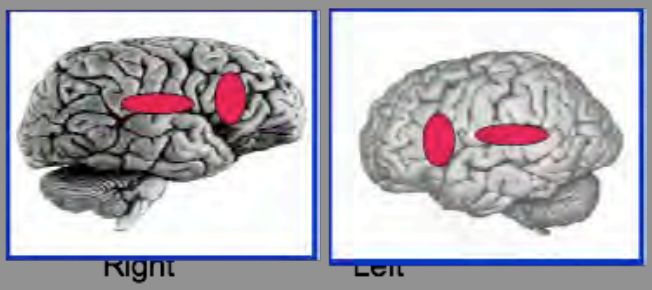
At 200 to 500 milliseconds

"All We Know About a Word- Semantic Processing"



Activation in the Typical Brain

Bilateral Dorsal Temporal-Parietal & Frontal



Right Left

Activation in the Dyslexic Brain

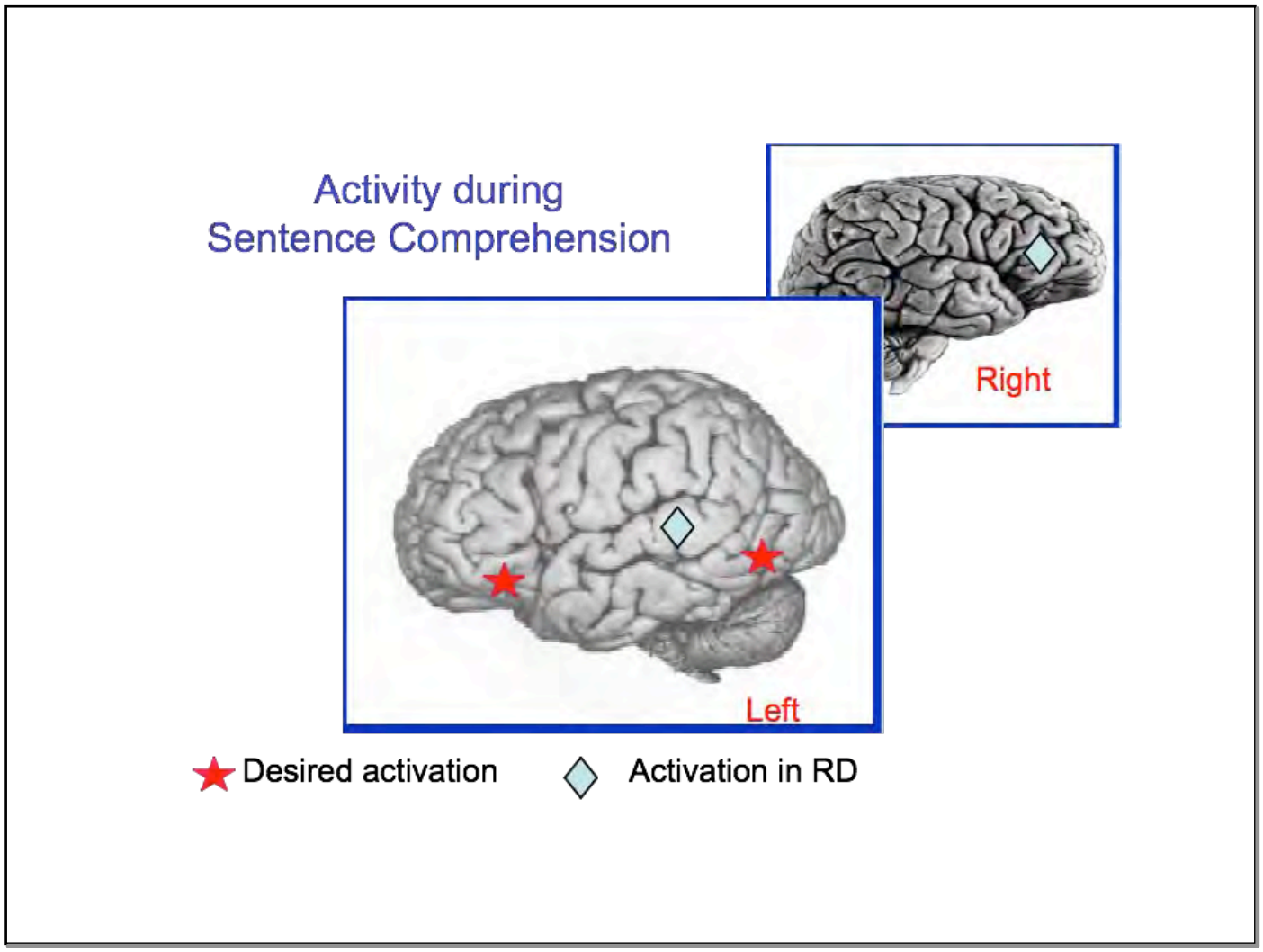
Much More Pronounced Right Dorsal Temporal-Parietal & Right IFG

fMRI of Sentence Comprehension in Children with Dyslexia
Rimrodt, Clements-Stephens, Pugh, Cutting, et al. (JHU, Yale- 2008)

Initial Foundations for Understanding Neurobiology of Correlates of High Level Processes of Reading Comprehension

Comparing Activation Patterns among 9-14 yr olds performing Word Recognition versus Sentence Comprehension Tasks

Controls	Higher Order Thinking (Left Inferior Frontal Activity) Visual Word Form Area (Left Occipital-Temporal)
Reading Disabled	Linguistic Processing Areas (Left Superior Temporal-Frontal Gyrus) Overactivity in (Right Superior Frontal Gyrus)


Activity during
Sentence Comprehension
Right
Left
Desired activation
Activation in RD

Neural deficits in children with dyslexia ameliorated by behavioral remediation: Evidence from functional MRI

Temple, Deutsch, et al. (Tallal, Merzenich, Gabrieli), 2003

The study examined whether **behavioral remediation** ameliorates dys**functional neural** mechanisms **in children with dyslexia**.

*f*MRI performed on 20 children with dyslexia (ages 8-12)

*f*MRI before and after phonological processing remediation

- **Behaviorally**
  - training improved oral language and reading performance
- Physiologically
  - increases occurred in left tempo-parietal cortex and left inferior frontal gyrus, bringing brain activation in these regions closer to that seen in normal-reading children
  - children with dyslexia showed a correlation between the magnitude of increased activation in left tempo-parietal cortex and improvement in oral language performance

Implications:

These results suggest that a partial remediation of language-processing deficits, resulting in improved reading, ameliorates disrupted function in brain regions associated with phonological processing and produces additional compensatory activation in other brain regions.

Restructuring Language Centers in Dyslexics' Brains

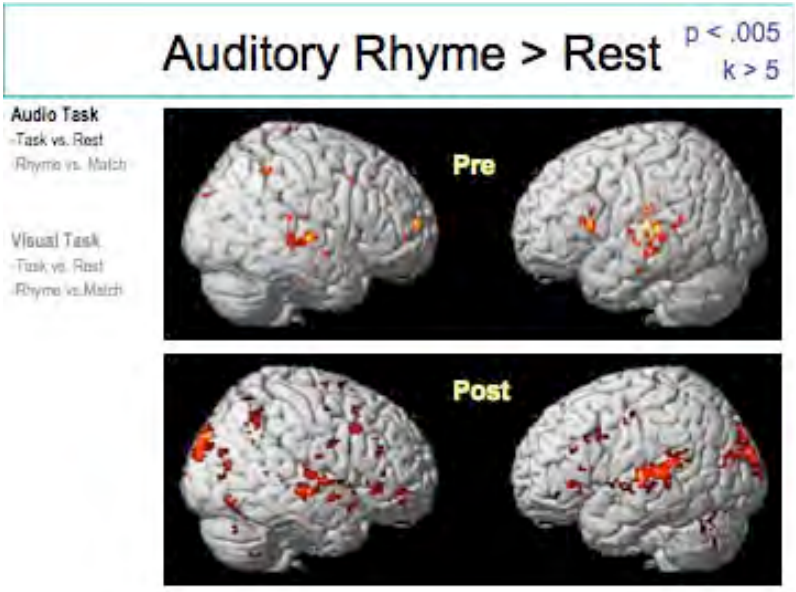
Neuroimaging allows us to observe changes in the neural structure of the language centers in the brains of dyslexic children.

Reid Lyon and Jack Fletcher

Figure 1–Neural systems supporting reading may not be fixed, but develop if challenged. Shown is an image of a 10-year-old with severe reading disabilities before and after 60 hours of intensive instruction, during which the child rose into the average range in word-reading ability. The "before" image captures a brain exhibiting the standard activity pattern of children with reading disabilities. The "after" image shows increased activity in the left hemisphere, a pattern common to nonimpaired readers.

CARROLL SCHOOL OG/RAVE-O STUDY

Maryanne Wolf, Tufts University

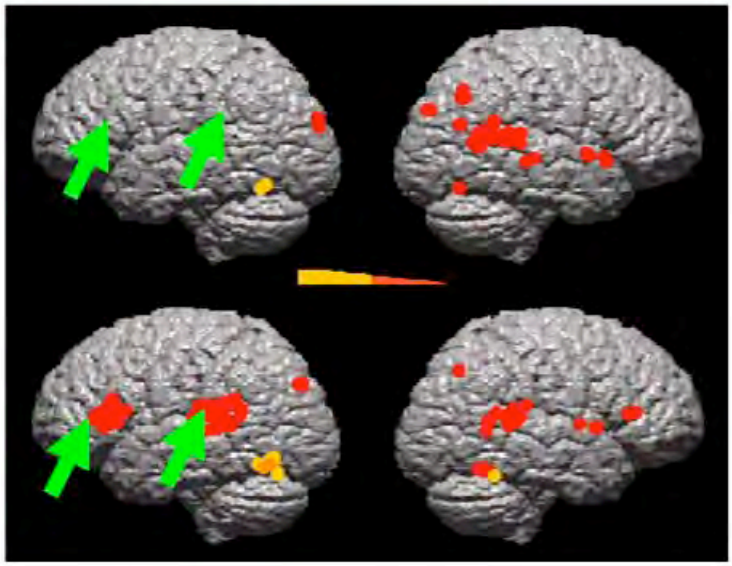


John Gabrieli Speaks on Neuroplasticity in Dyslexia

http://news-service.stanford.edu/news/2003/february26/dyslexia-video-226.html

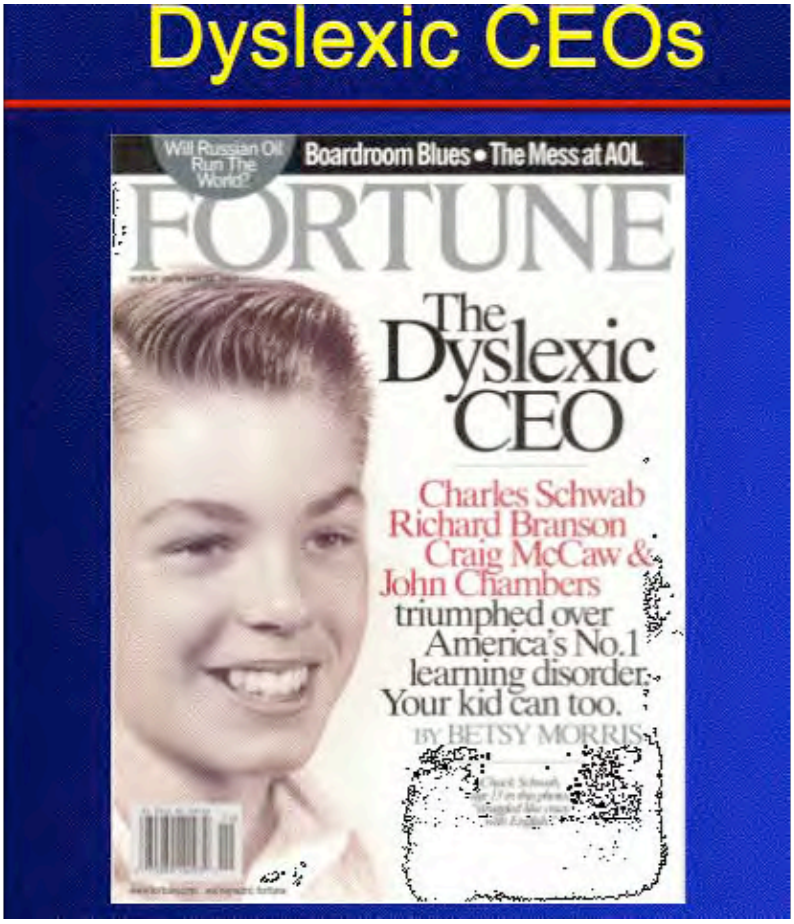
At Risk Reader

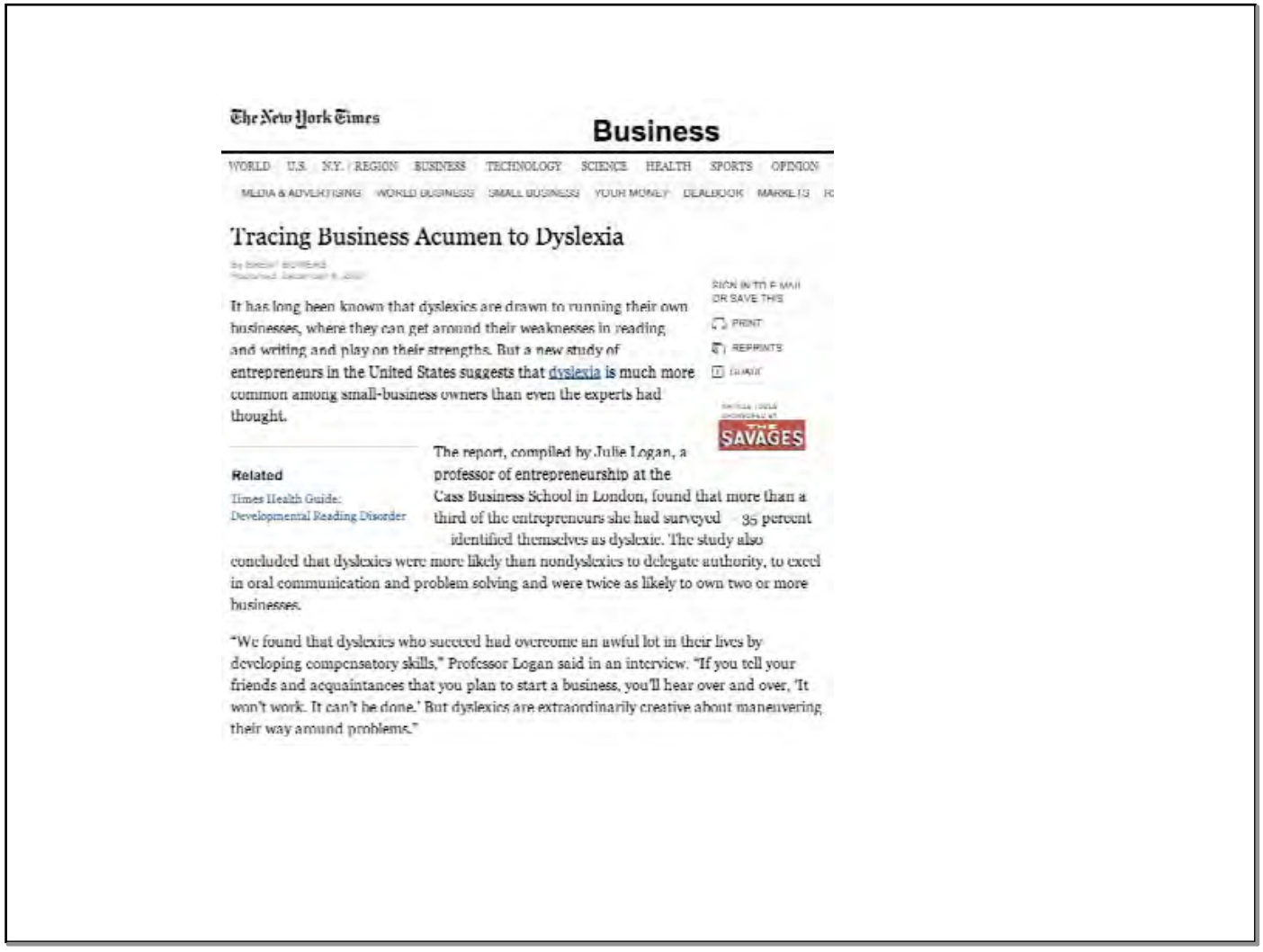
A Model of Neuroplasticity



Simos et al., 2006

Dyslexic CEOs





The New York Times

Business

Tracing Business Acumen to Dyslexia

It has long been known that dyslexics are drawn to running their own businesses, where they can get around their weaknesses in reading and writing and play on their strengths. But a new study of entrepreneurs in the United States suggests that dyslexia is much more common among small-business owners than even the experts had thought.

Related

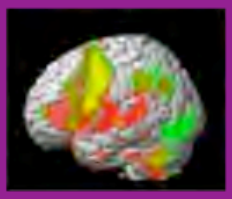
Times Health Guide: Developmental Reading Disorder

The report, compiled by Julie Logan, a professor of entrepreneurship at the Cass Business School in London, found that more than a third of the entrepreneurs she had surveyed — 35 percent — identified themselves as dyslexic. The study also concluded that dyslexics were more likely than nondyslexics to delegate authority, to excel in oral communication and problem solving and were twice as likely to own two or more businesses.

"We found that dyslexics who succeed had overcome an awful lot in their lives by developing compensatory skills," Professor Logan said in an interview. "If you tell your friends and acquaintances that you plan to start a business, you'll hear over and over, 'It won't work. It can't be done.' But dyslexics are extraordinarily creative about maneuvering their way around problems."

u

Here's the biggest idea….



- Gather DNA from well-diagnosed dyslexics
- Develop an understanding of the subtypes within dyslexia
- Prescribe an intervention accordingly
- Take *f*MRI (or better) images of the change in activation patterns
- A new diagnostic-prescriptive cycle emerges