Hope or Hype?
The Use and Misuse of Neuroscience in Education

Nadine Gaab, PhD
Associate Professor of Pediatrics
Harvard Medical School
Boston Children's Hospital
Developmental Medicine Center
Laboratories of Cognitive Neuroscience

Children's Hospital Boston
Harvard Medical School
HARVARD GRADUATE SCHOOL OF EDUCATION

www.gaablab.com
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Overview

- What is the role of neuroscience in education?
- Learning differences, neuroscience and education
- Predicting treatment response and outcomes using neuroscience
- Neuromyths
- Brain trainings
- Public Policy meets Neuroscience
- Summary

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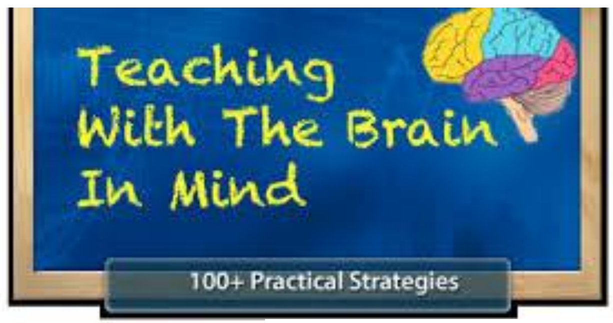
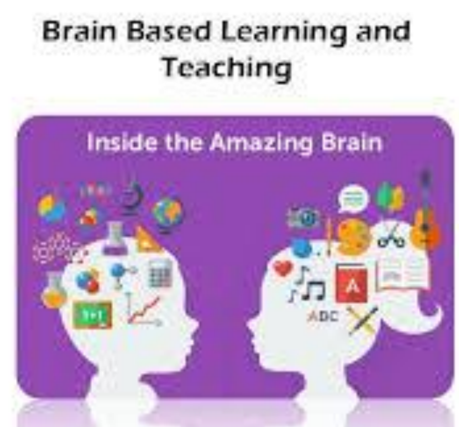
A quick guide
on brain-based
learning


BRAIN-BASED
LEARNING


Brain-based Learning


Teaching
With The Brain
In Mind
100+ Practical Strategies

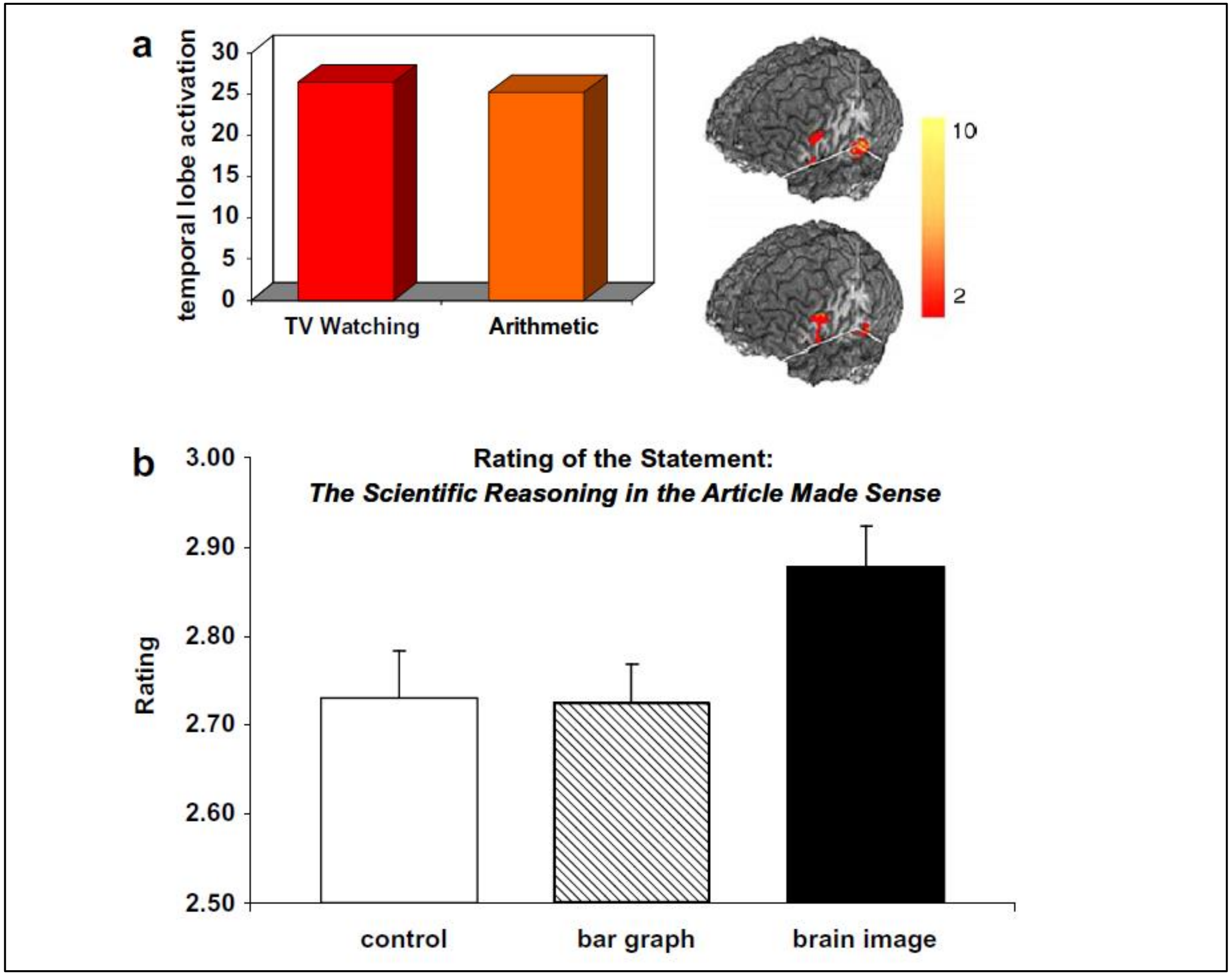

BRAIN BASED LEARNING
MEANS KEEPING THE BRAIN ENGAGED


Brain Based Learning and
Teaching
Inside the Amazing Brain

Is there any learning without the brain?

Seeing is believing: The effect of brain images on judgments of scientific reasoning ☆,☆☆

David P. McCabe [a,*], Alan D. Castel [b]



What is the role of Neuroscience in Education?


BACK TO SCHOOL

Neuroscience and Education

"Education is about enhancing learning, and neuroscience is about understanding the mental processes involved in learning. This common ground suggests a future in which educational practice can be transformed by science, just as medical practice was transformed by science about a century ago." (p. v)

Report by the Royal Society, U.K. (2011)

Defining the role of Neuroscience in Education

- Neuroscience offers education an alternative perspective on learning, learning differences, and its underlying etiologies.

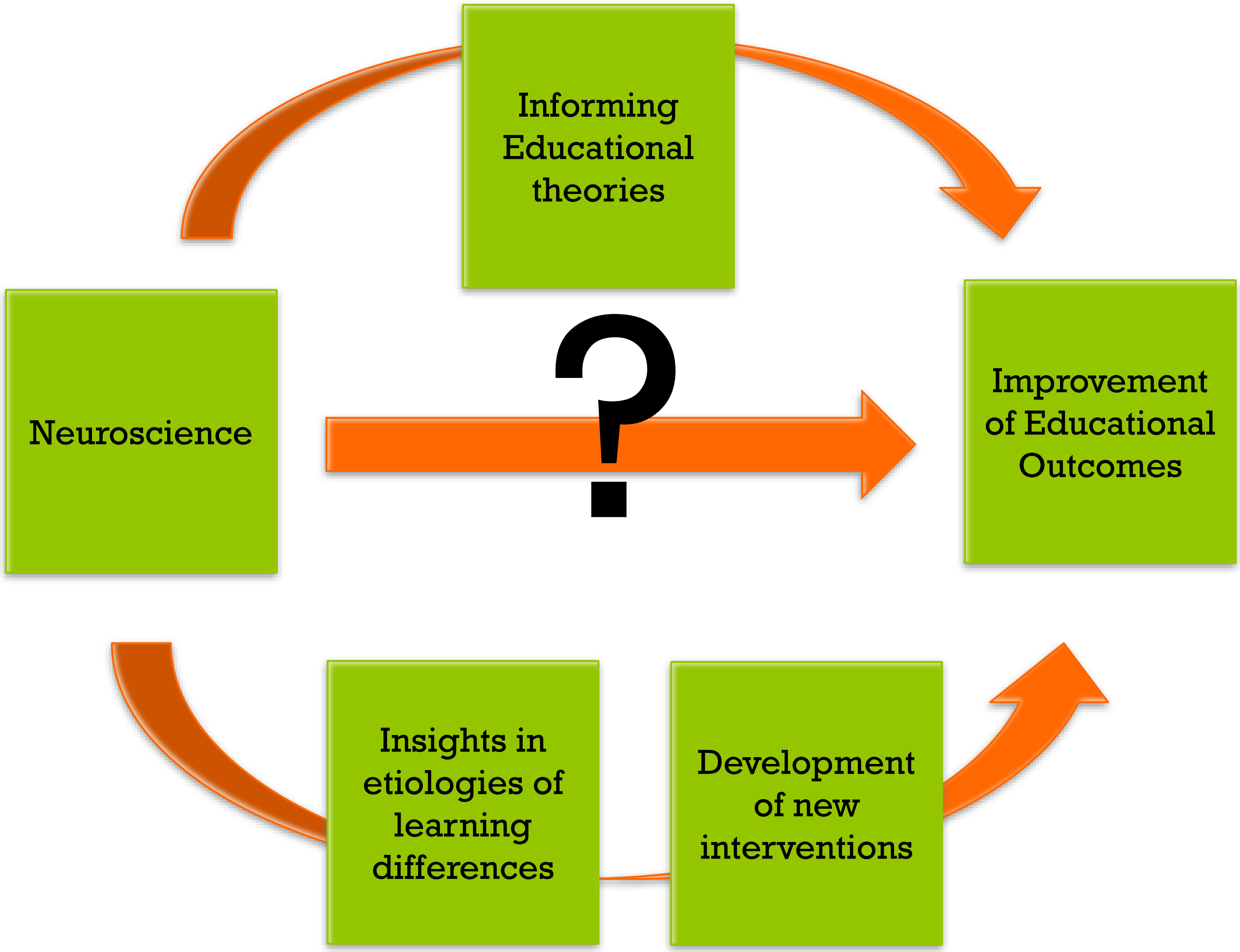
- Neuroscience can deliver a biological level of description to better understand how students learn and to integrate learning into a bigger picture.

- It can further determine which neural correlates are typical/atypical and which compensatory mechanism are successful or unsuccessful.

- The acquired knowledge must be transformed by pedagogical principles into curricula, teaching principles, interventions, etc.

(*Howard-Jones et al., 2016; Gabrieli, 2016*)

The indirect route.



Illuminating the black box

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Learning differences, neuroscience and education

- Educational Neuroscience is especially relevant for children with learning differences who struggle with educational progress, emotions and social interactions (e.g. children with LBLD, ADHD, autism, dyscalculia, NVLD).

→ 1 out of 8 students in the US receive special education (National Center for Education Services; U.S. Department of Education, Office of Special Education Programs, 2014)

- Understanding the underlying etiology of their struggles and individual brain differences is one major goal of Educational Neuroscience. This includes perceptual, cognitive, affective, and social development.

(*Gabrieli, 2016*)

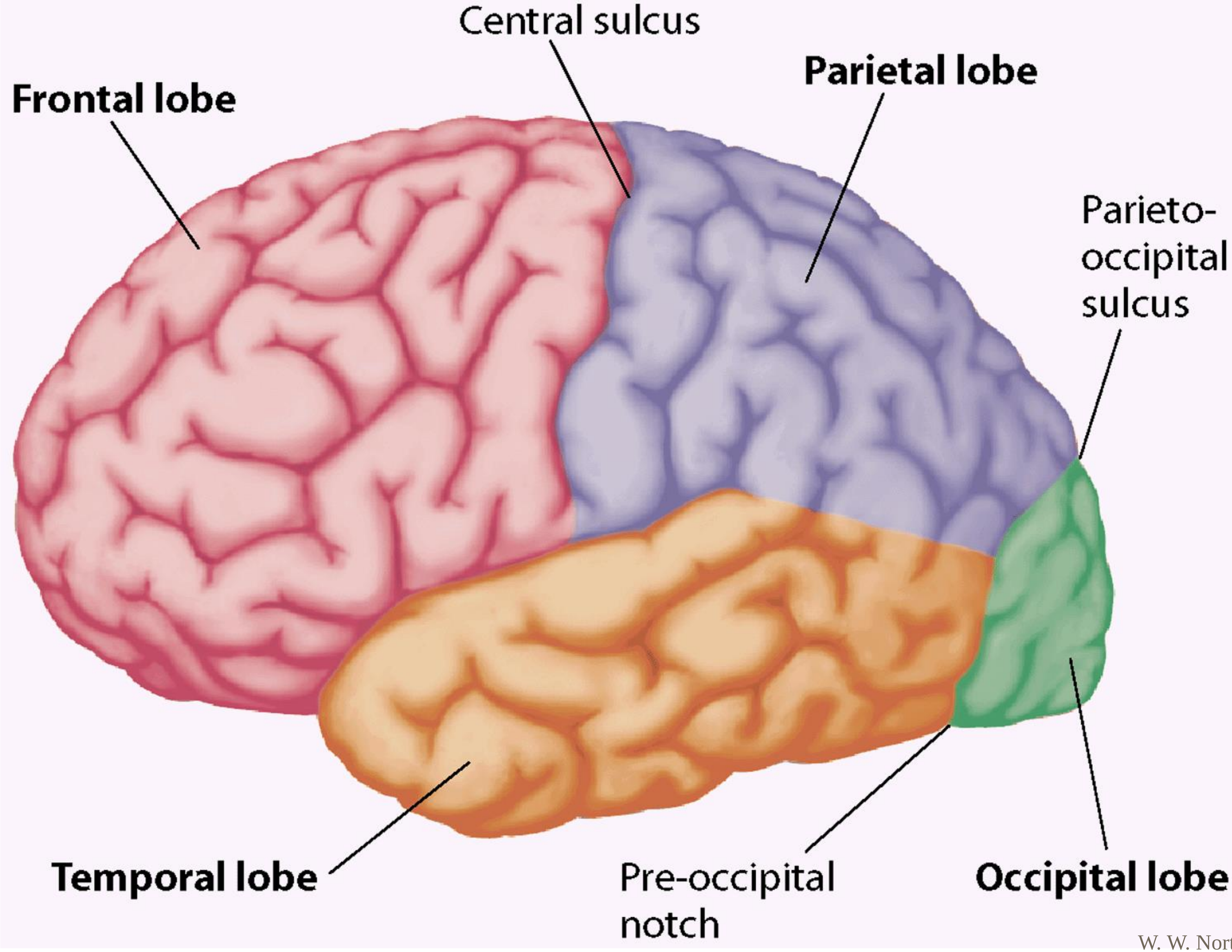
"The immediate research goal has not been the development of novel teaching methods, but rather a deepening understanding of how brain differences relate to learning differences".

(*Gabrieli, 2016; p. X*)

The idea that teachers do not need 'explanations' is like suggesting a washing machine can be fixed without knowing how it works (*Dehaene, 2009*)

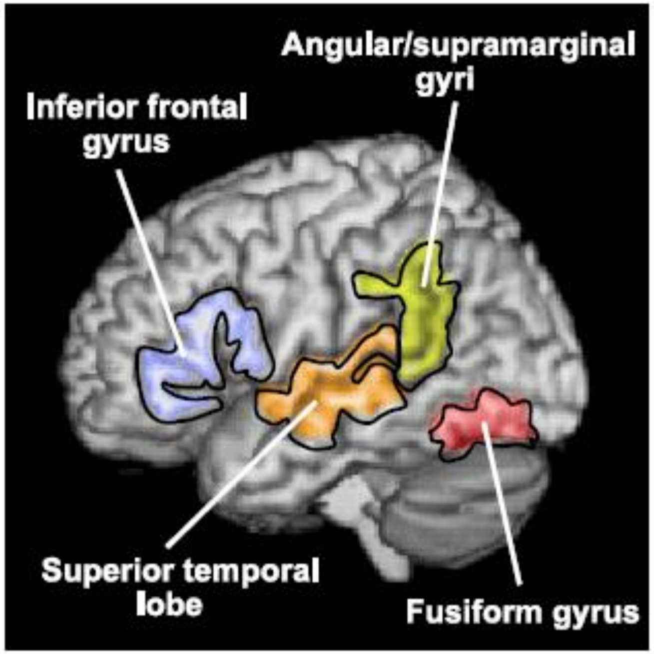
A few examples…

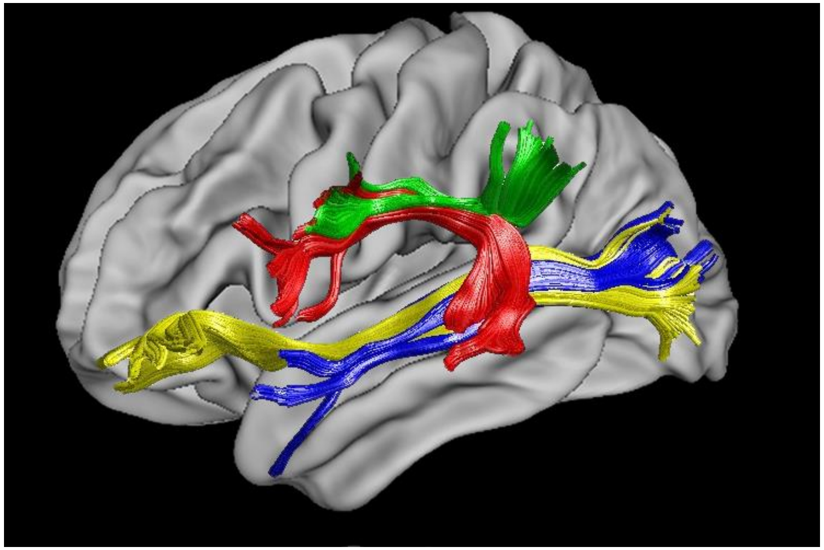
- A less optimal brain to learn to read
- Dyslexia and IQ
- Compensatory mechanisms
- Individualized Instructions and Predictions


Central sulcus
Frontal lobe
Parietal lobe
Parieto-
occipital
sulcus
Temporal lobe
Pre-occipital
notch
Occipital lobe

W. W. Norton

The typical reading network with its key components





Genetics

- Studies of families with DD suggest that DD is strongly heritable, occurring in up to 68% of identical twins and up to 50% of individuals who have a first degree relative with DD [Finucci *et al.,* 1984; Volger *et al.,* 1985; Grigorenko, 2008).

- Several genes (e.g.; ROBO1, DCDC2, DYX1C1, KIAA0319) have been reported to be candidates for dyslexia susceptibility and it has been suggested that the majority of these genes plays a role in early brain development. [e.g.; Galaburda *et al*., 2006; Hannula-Jouppi *et al*., 2005; Meng *et al.,* 2005; Paracchini *et al*., 2006; Skiba *et al*., 2011].

- A tentative pathway between a genetic effect, developmental brain changes and perceptual/cognitive deficits in DD has been proposed based on studies in animal and humans (Galaburda et al., 2006).

Variant function in any number of genes involved in cortical development

↓

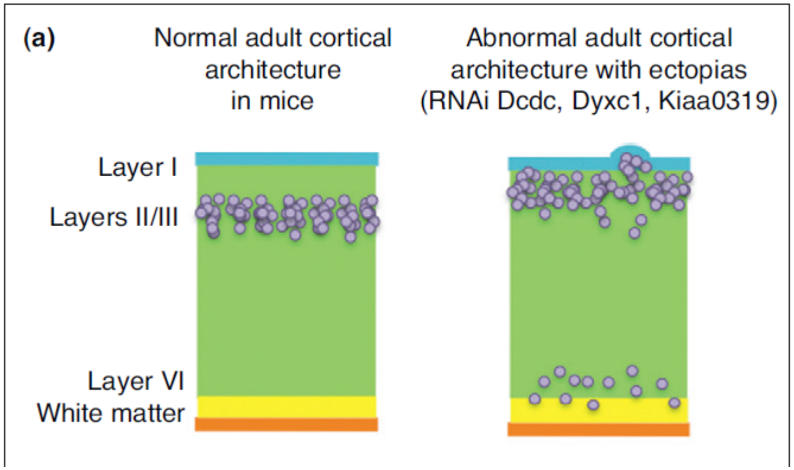
Subtle cortical malformation involving neuronal migration and/or axonal growth

↓

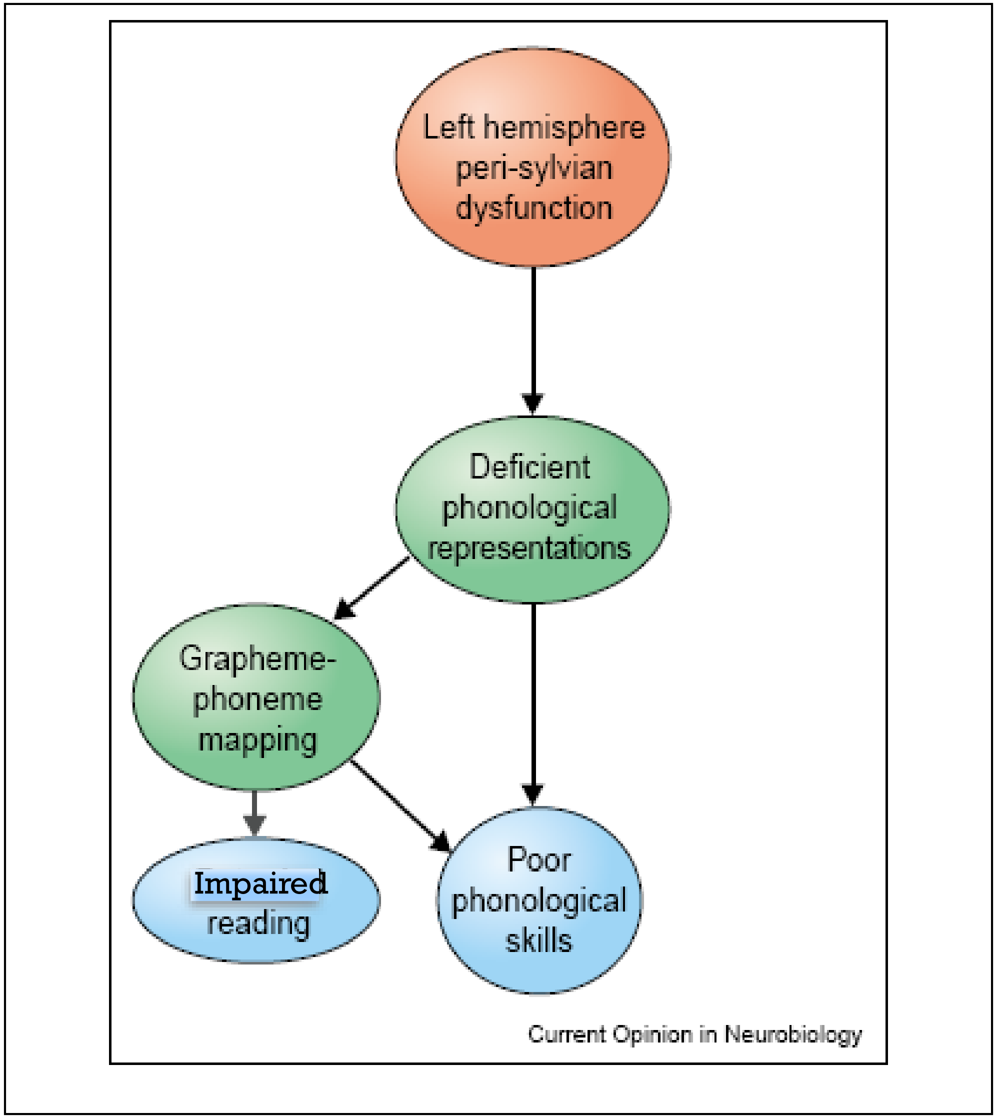
Atypical cortico-cortical circuits

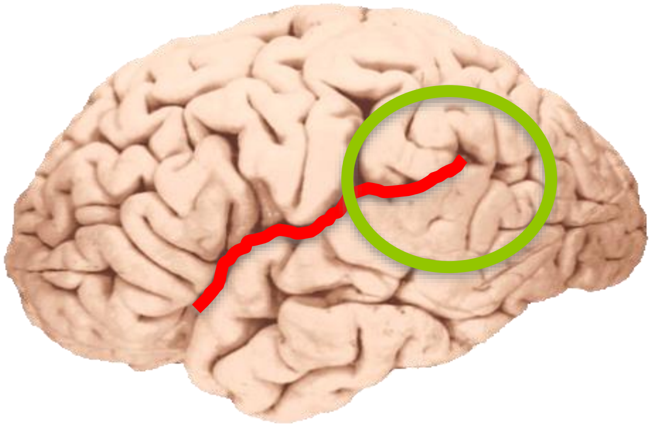
↓

Atypical sensorimotor, perceptual and cognitive processes critical for learning (to read)

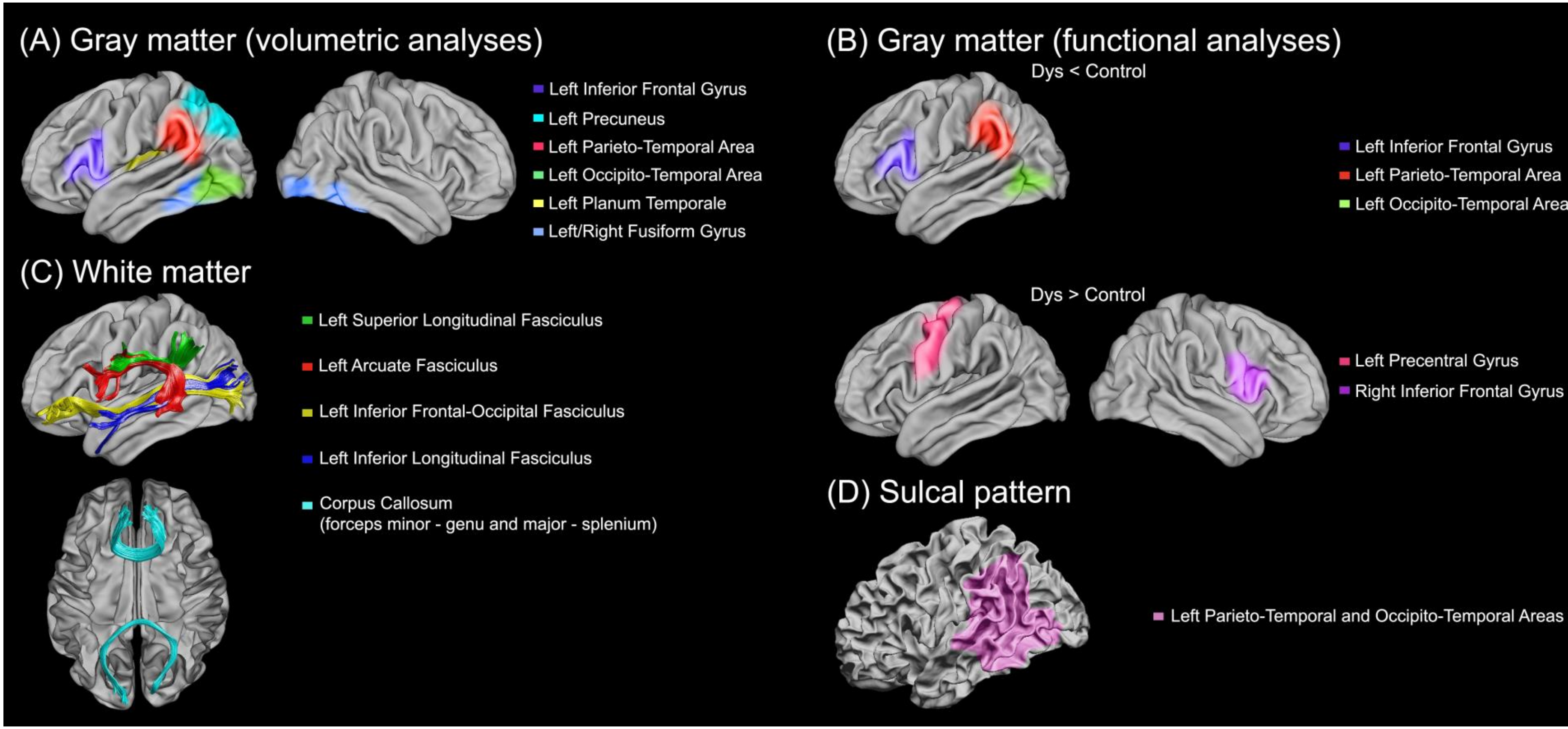


Giraud & Ramus, 2013





[after Ramus, 2003]



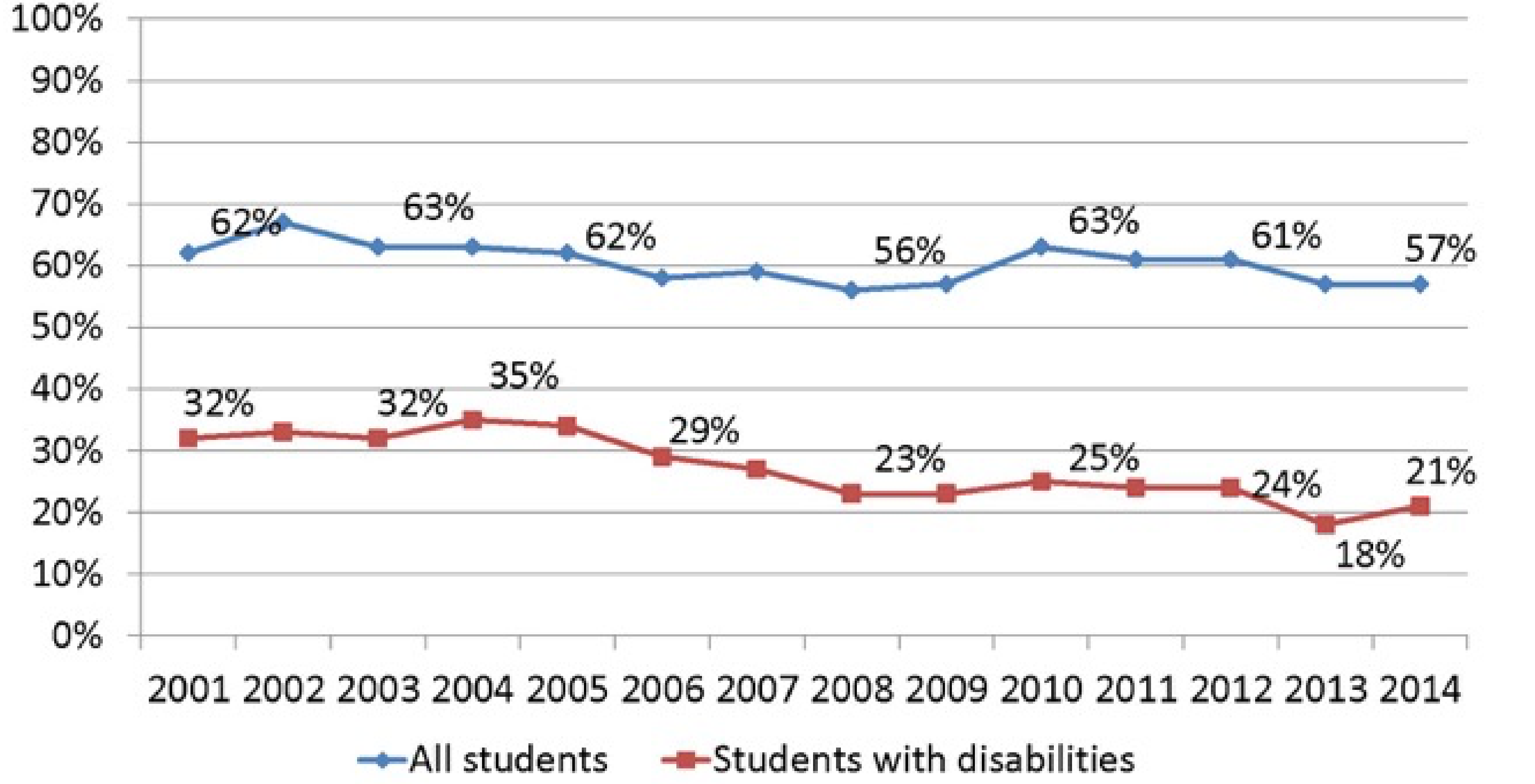
Ozernov-Palchik et al; 2016

Percentage of below average readers in 1st grade who were below average readers in 9th grade. (de Jong & van der Leij, 2003; Juel, 1988; Landerlamp & Wimmer, 2008; Lundberg, 1994)

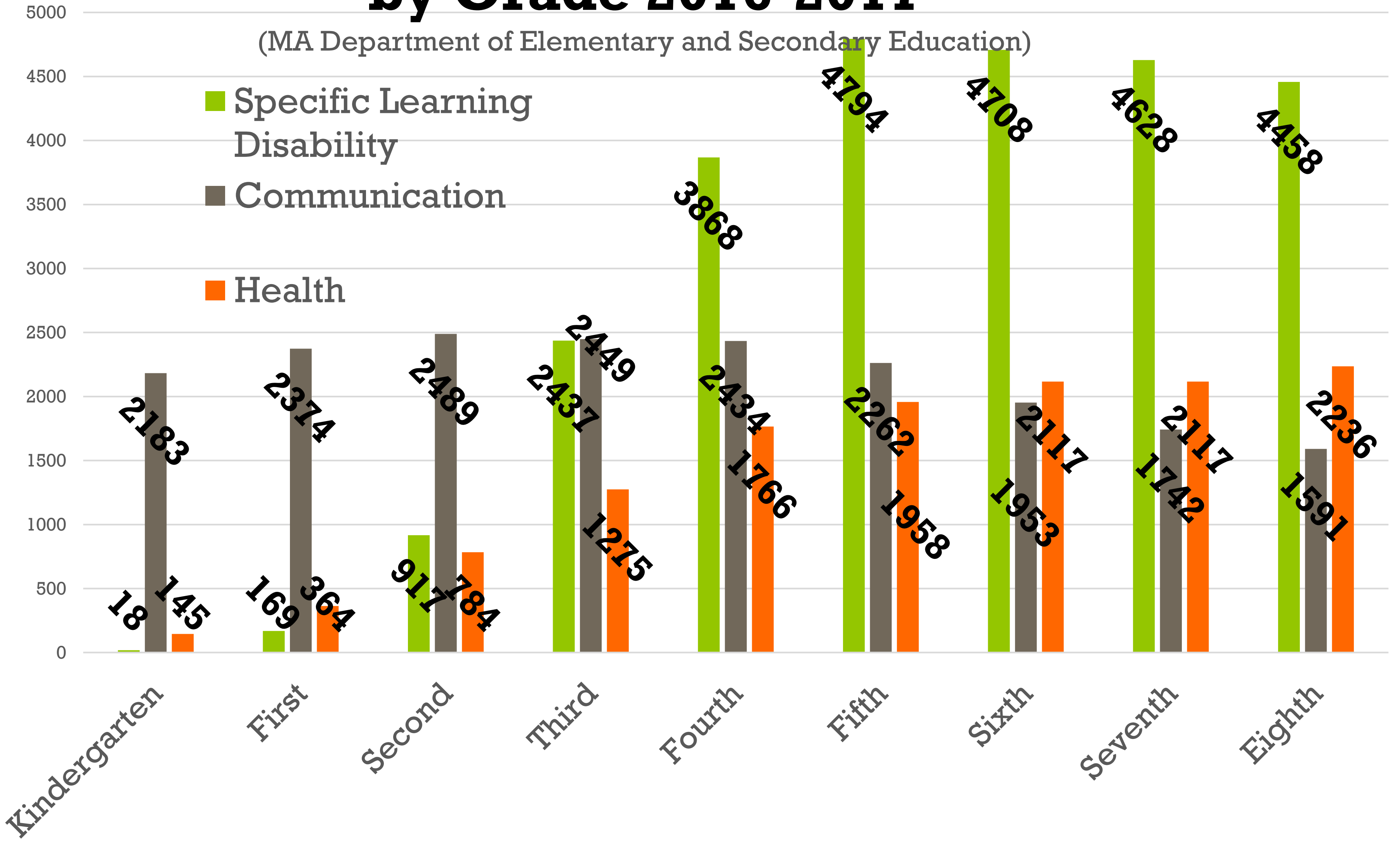
[*Slide: Melissa Orkin*]

MCAS 3rd Grade Reading Proficiency Trends 2001 – 2014

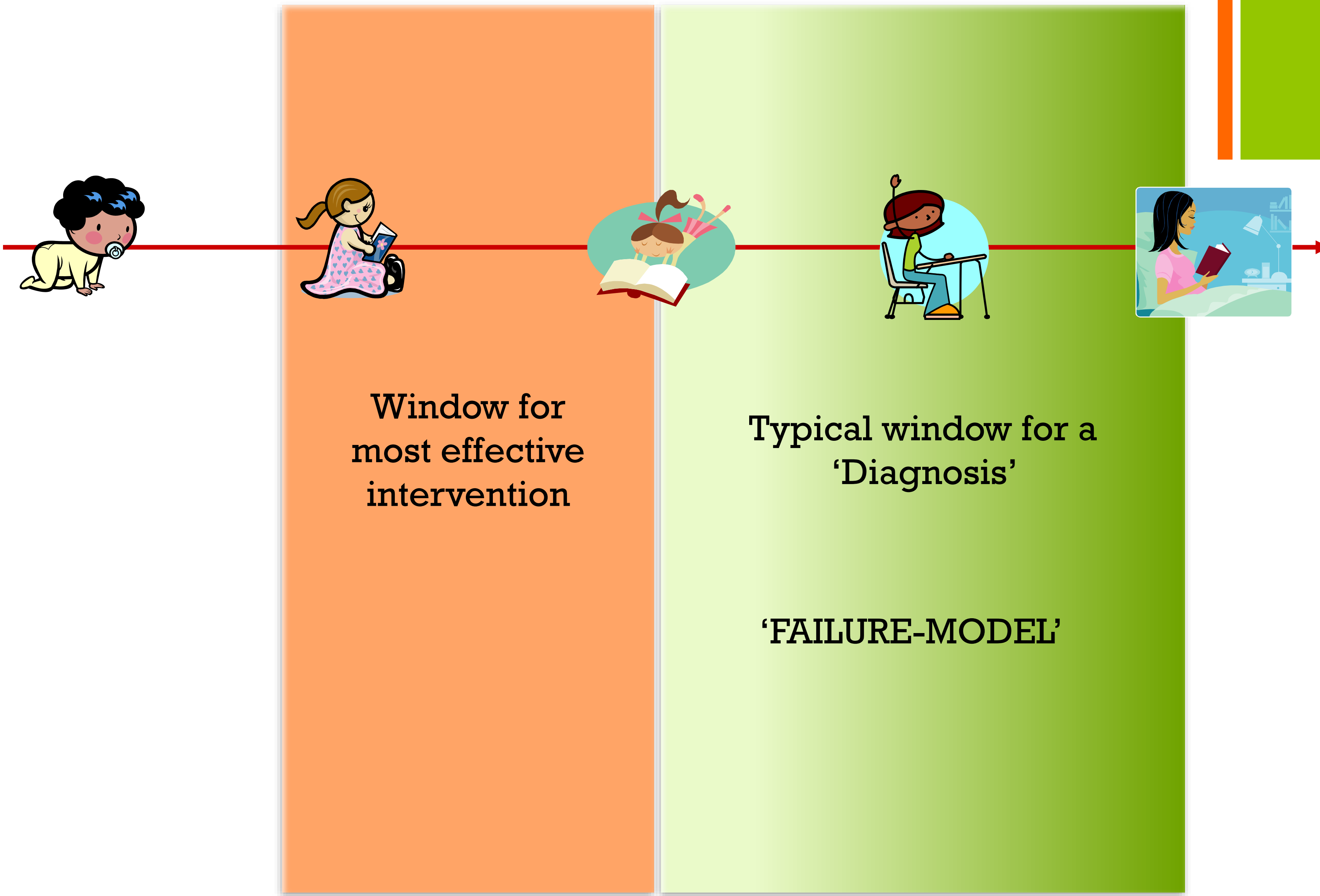
(Percent proficient or above)



Students with "High Incidence" Disability by Grade 2016-2017

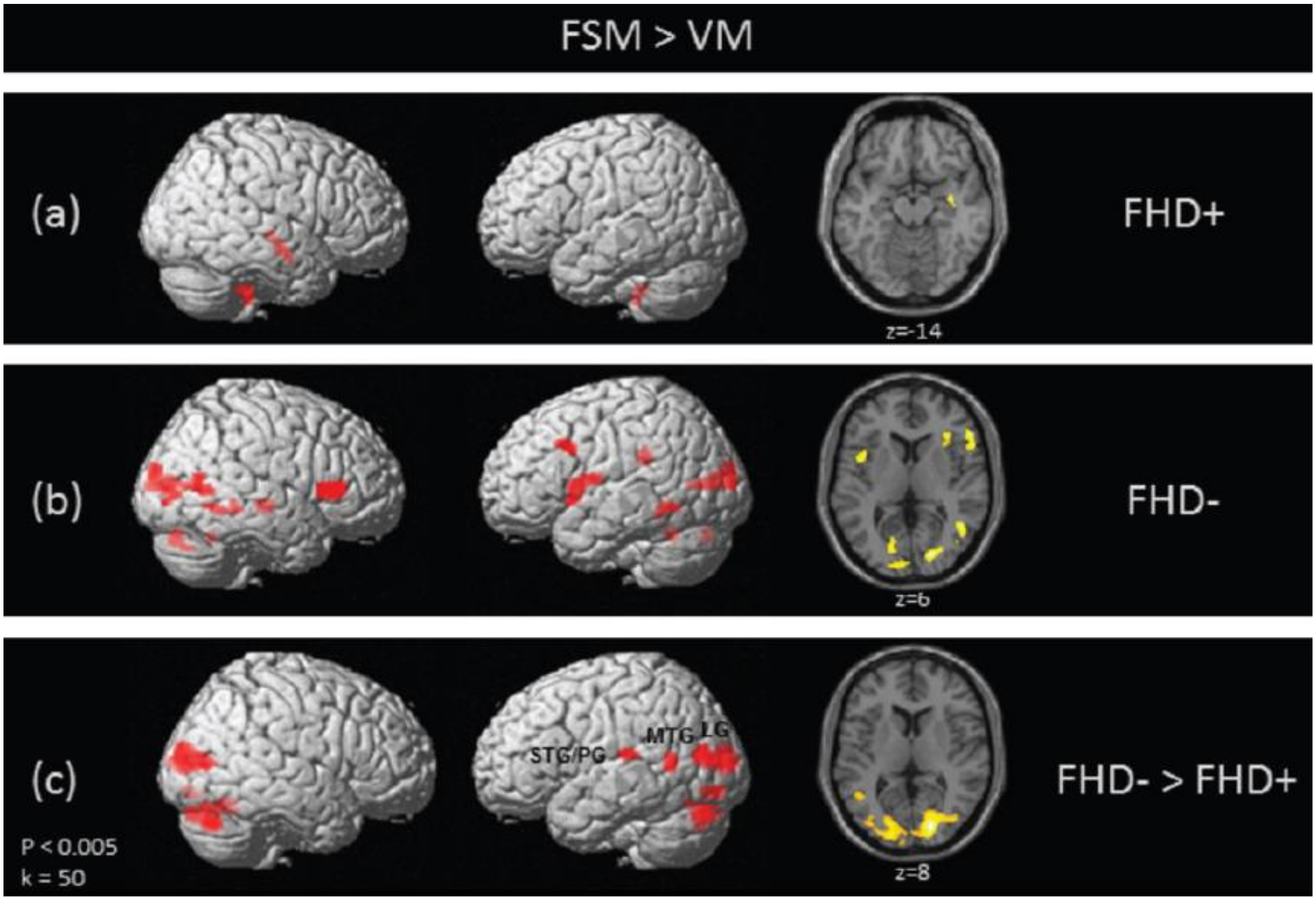


The dyslexia paradox



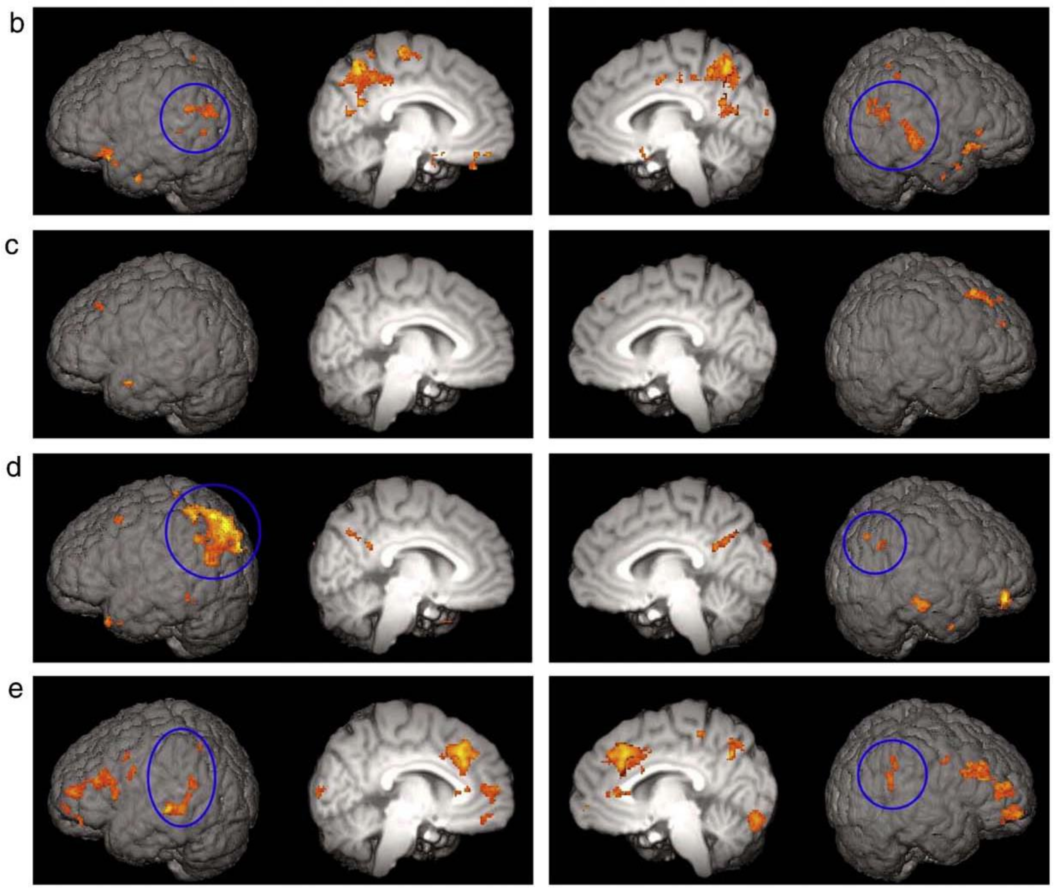
Functional characteristics of developmental dyslexia in left-hemispheric posterior brain regions predate reading onset

Nora Maria Raschle[a,b], Jennifer Zuk[a], and Nadine Gaab[a,b,c,1]



[*Raschle et al., PNAS 2012*]

Brain changes in response to three months of reading instruction in typical developing children and children at-risk for dyslexia.



Typical children at the start of kindergarten

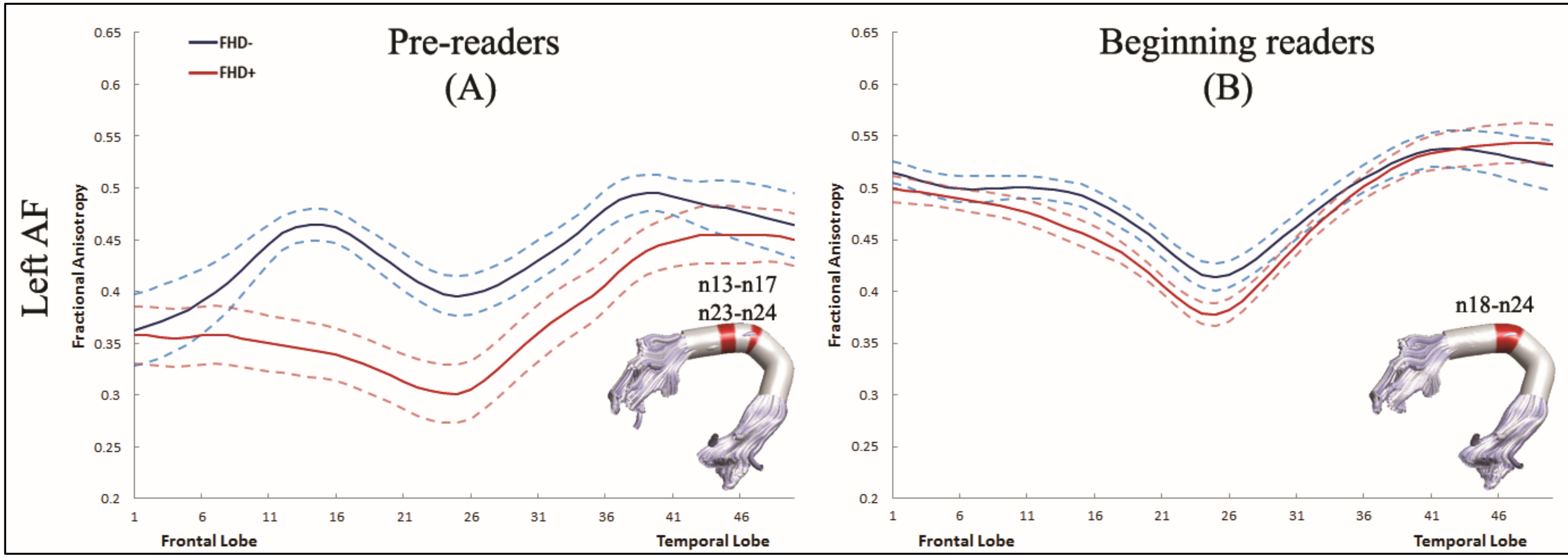
At-risk children at the start of kindergarten

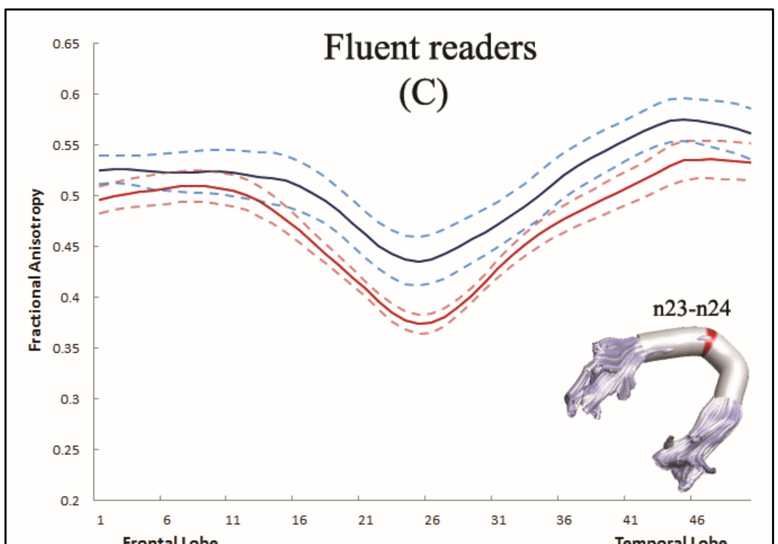
Typical children after three month of kindergarten

At-risk children after three month of kindergarten

(*Yamada et al., 2012*)

Cross-sectional results (n = 78): Arcuate Faciculus





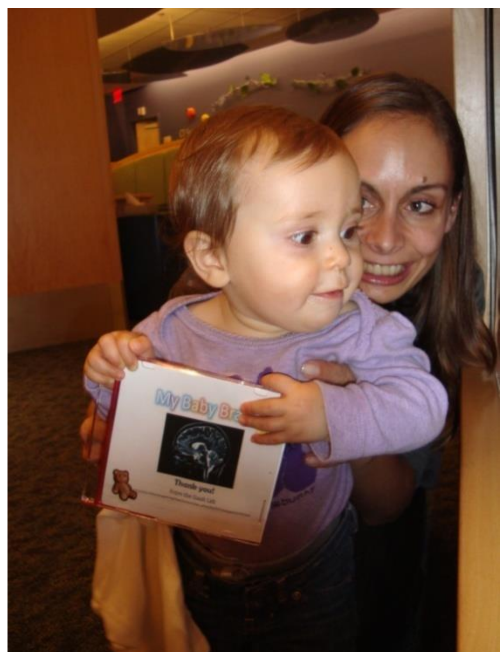
[*Wang et al., 2016*]

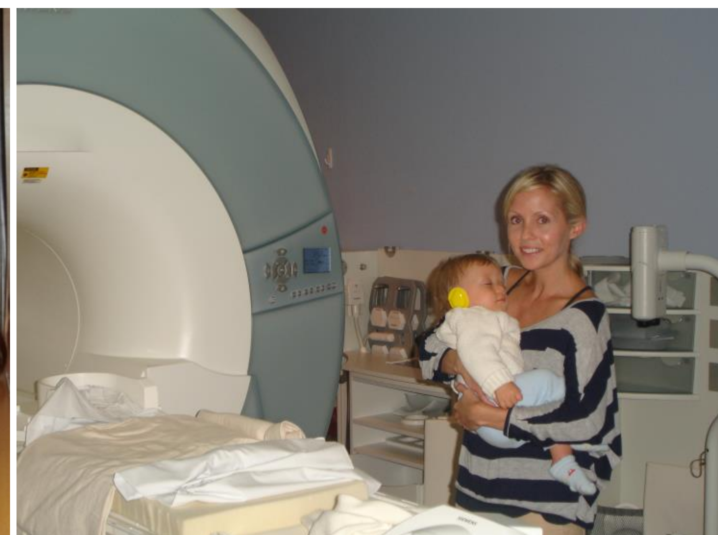
Investigating 4-12 months old infants with and without a family history of dyslexia

To date:
N=60 (32 FHD-/28 FHD+)
<u>Protocol:</u>
T1 MPRAGE
Resting state (e.g. auditory networks)
DTI
FMRI (passive speech)

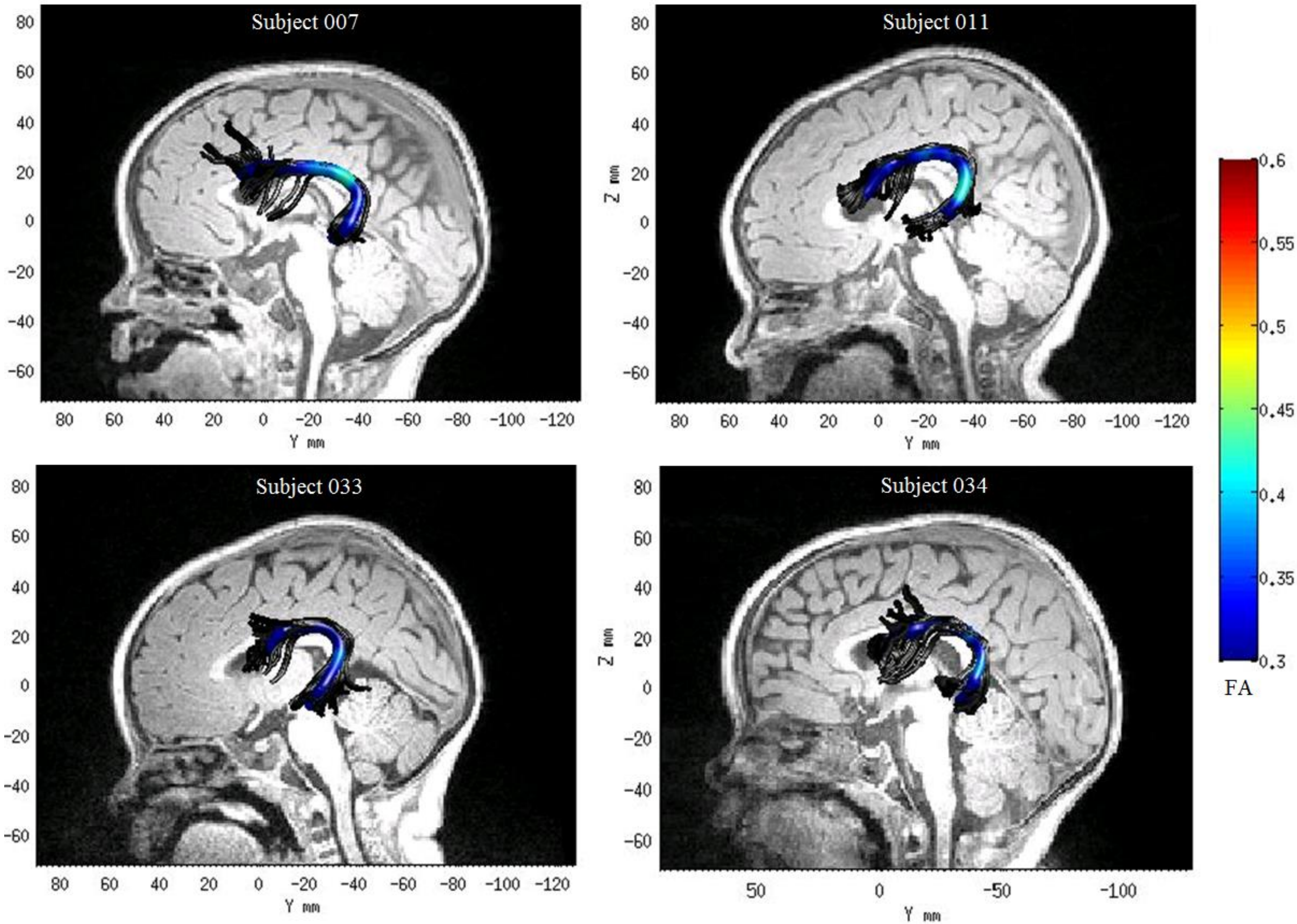
[*Methods: Raschle et al., 2012*]


SIEMENS
Trio
A Tim System





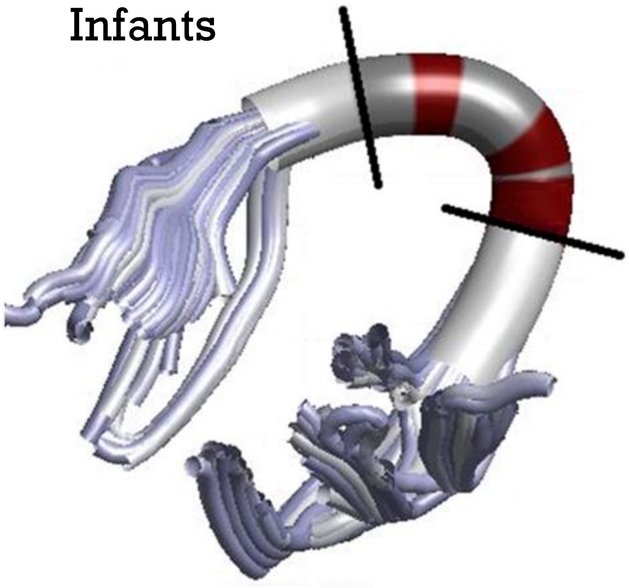
AFQ

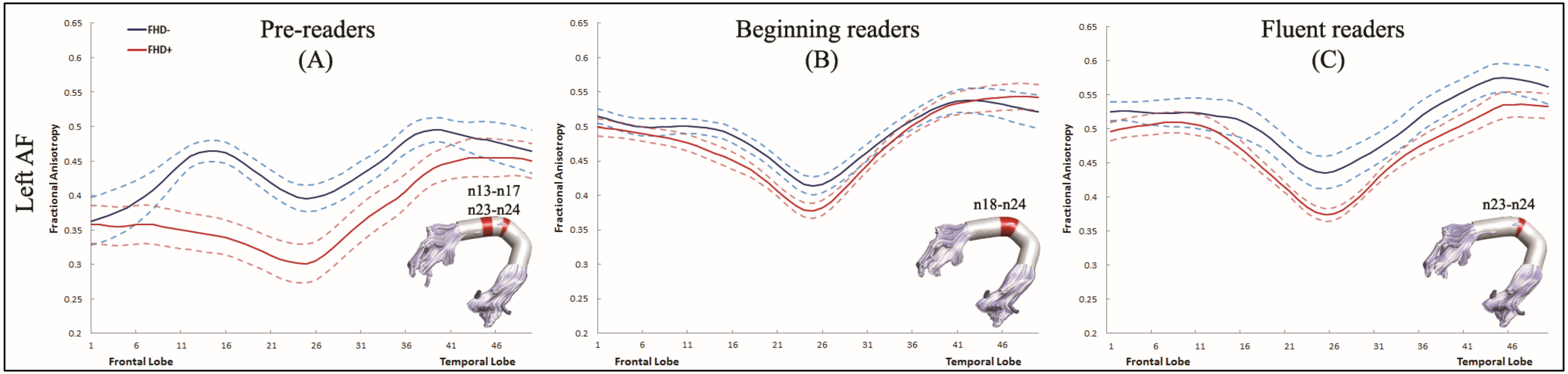


Subject 007
Subject 011
Subject 033
Subject 034
Y mm
Z mm
80
60
40
20
0
-20
-40
-60
-80
-100
-120
50
-50
0.6
0.55
0.5
0.45
0.4
0.35
0.3
FA

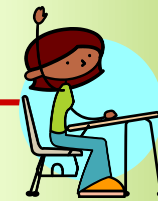
Atypical development of AF from infancy to late elementary school

Infants





Solving the Dyslexia paradox



Early screening for dyslexia risk and accurate identification of students with dyslexia supports evidence-based early intervention (ideally within general education)

'SUPPORT-MODEL'

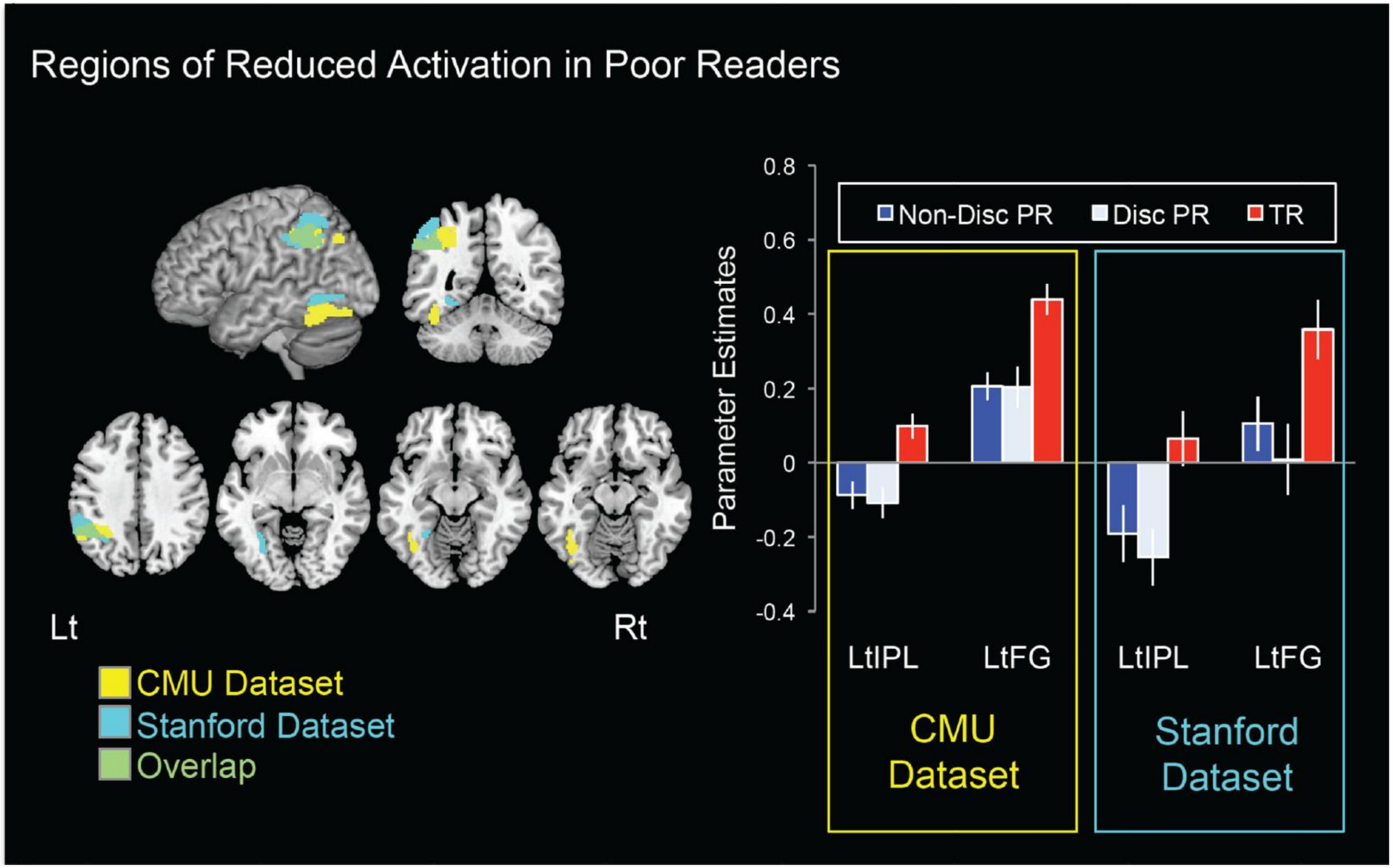
Lower rates of dyslexia diagnosis and improved reading outcomes in children wit dylexia

Understanding the complex etiology of specific learning disabilities and their co-occurrences will be essential to underpin the training of teachers, school psychologists, and clinicians, so that they can reliably recognize and optimize the learning contexts for individual learners

→ personalized education (Butterworth & Kovas, 2013)

The 'discrepancy' criterion...

- For decades struggling readers with high IQ were diagnosed with dyslexia while children with low IQ were not.

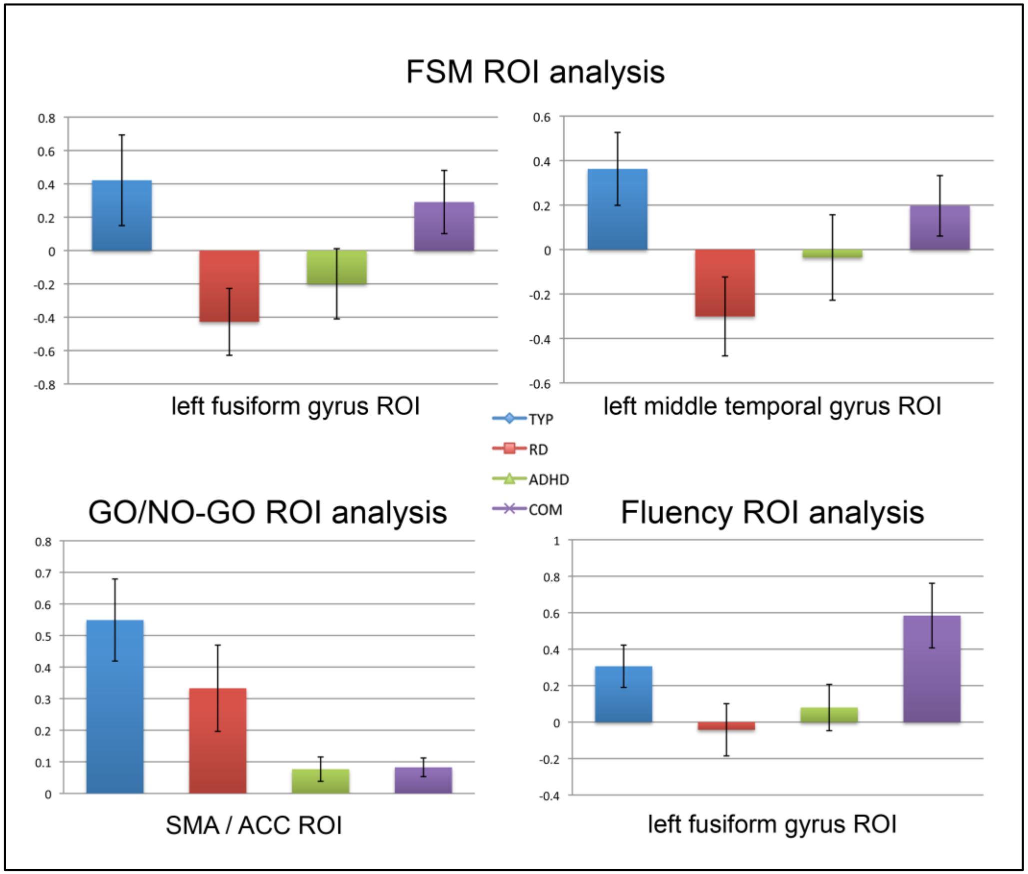


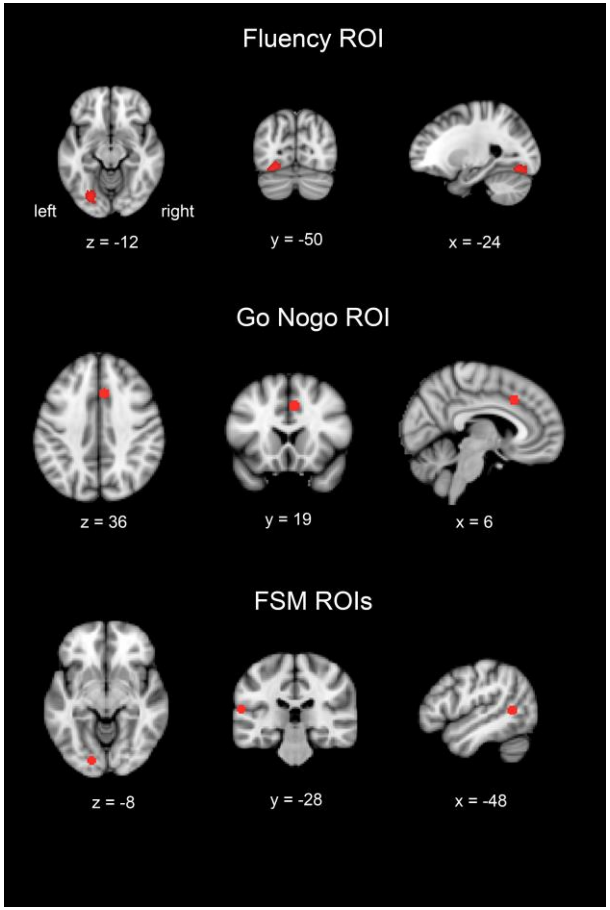
[*Tanaka et al., 2011*]

The comorbid brain

- ADHD and DD co-occur very frequently; 25%-40% of children with ADHD also meet diagnostic criteria for DD (e.g., Faraone *et al*. 1998) and vice versa (e.g., Dykman *et al.* 1991).
- The causal pathways leading to comorbidity between ADHD and DD are not fully understood. In order to identify the most effective treatment for comorbid DD/ADHD, it is critical to understand its neuropsychological/neurocognitive profile.
- Many studies have identified structural and functional brain correlates of DD or ADHD (e.g., Maisog *et al*. 2008 ; Seidman *et al.* 2005), to date little is known about the structural/functional brain correlates of children with comorbid DD/ADHD.

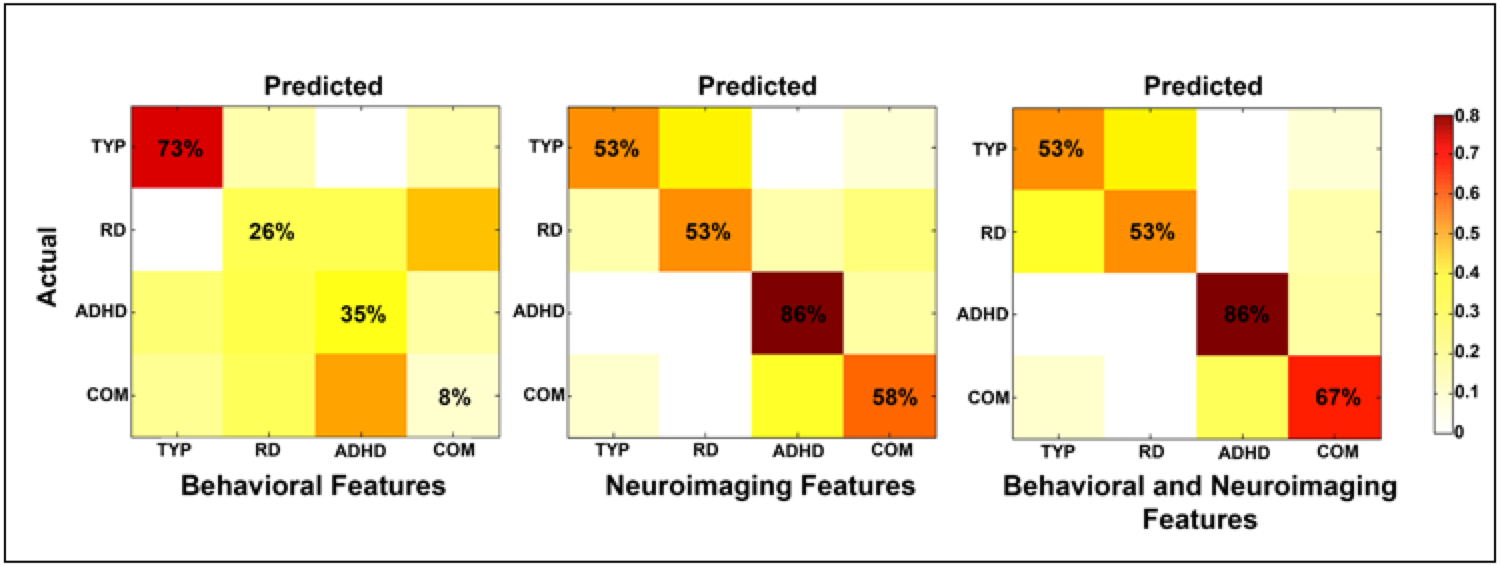
The comorbid brain
DD + ADHD = ?





Langer *et al.*, under review

What predicts a diagnosis best?



This figure illustrates how accurately the feature sets predict the actual group membership. The behavioral features demonstrate highest prediction accuracy for TYP children. The neuroimaging and combined features sets demonstrate highest accuracies for the ADHD and COM groups.

[Langer et al., in prep]

Compensatory mechanisms, resiliency and protective factors

- Some children do ‘compensate’ and some don’t
- What is the brain basis of compensation or resilience?

→ Typical development?

→ Alternative pathway(s)?

Who does compensate and how?

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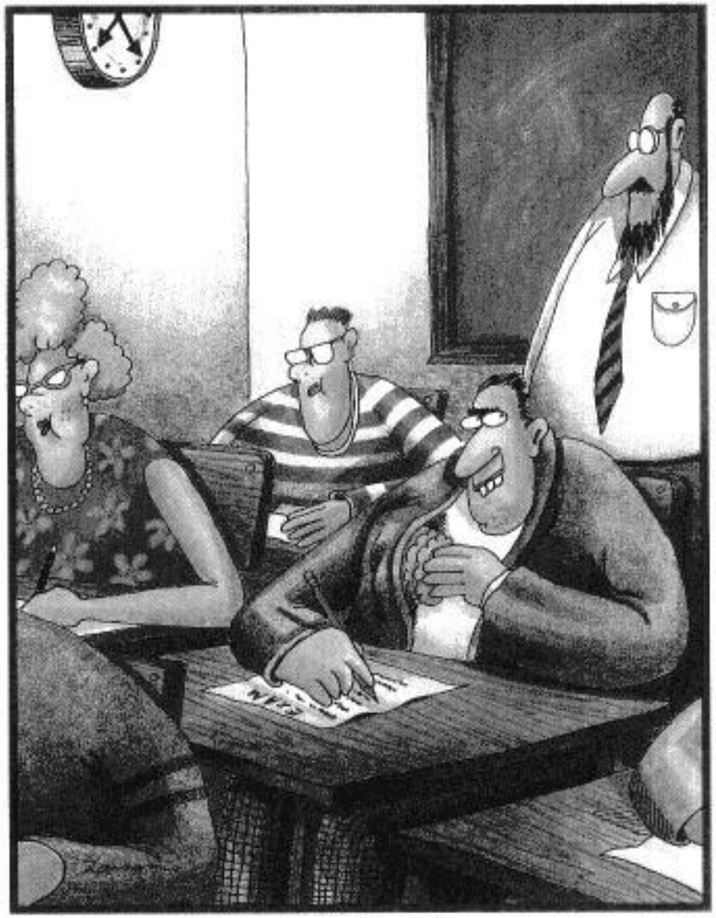
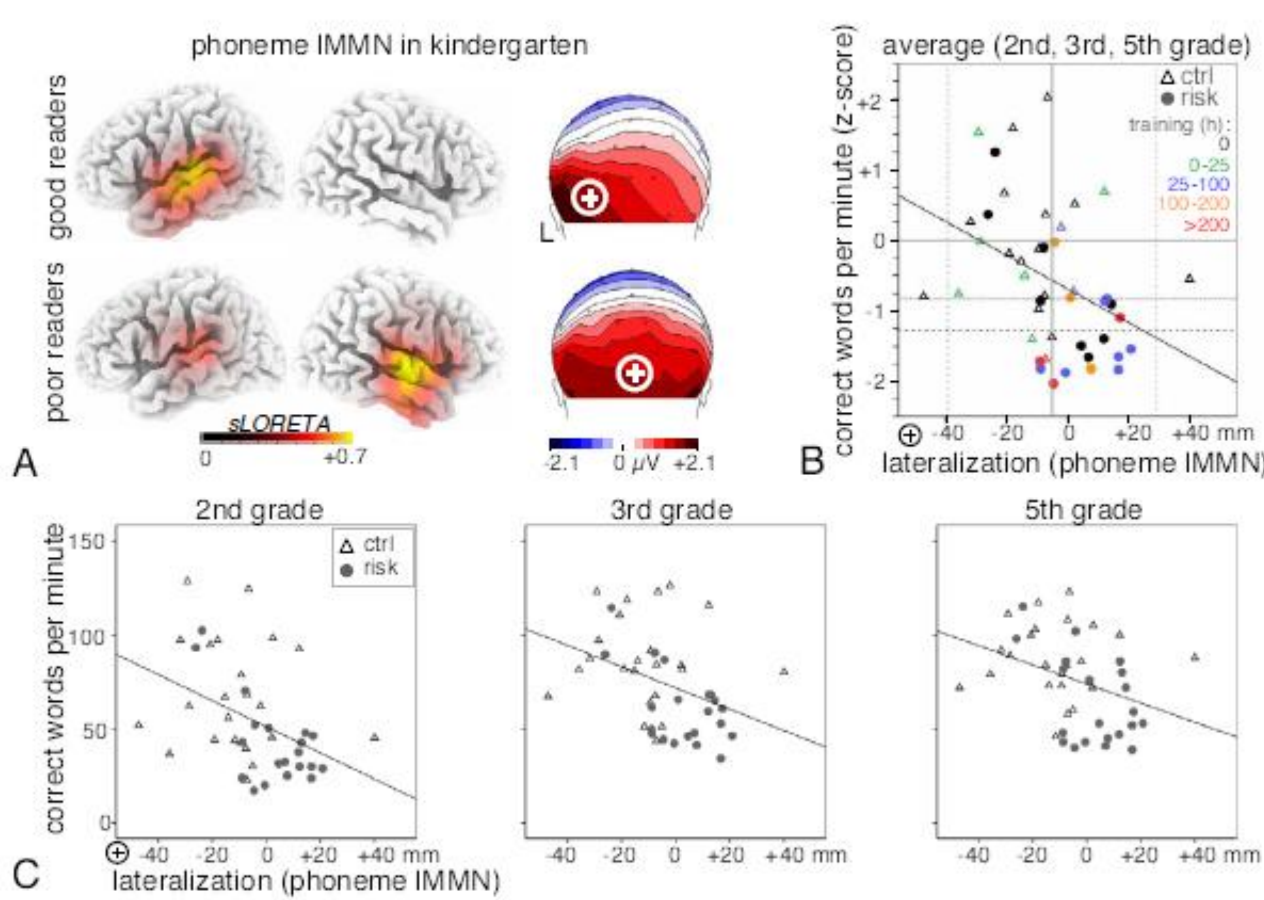
Predicting outcome and who will benefit from interventions



Midway through the exam, Allen pulls out a bigger brain.

Brain measures in kindergarten not only improved prediction of reading ability in grade 2 over behavioral measures alone, but only brain measures significantly predicted reading success in grade 5 (Maurer et al., 2009). (**T*he brain measure was better than any behavioral measure used in that study*).**

342 BIOL PSYCHIATRY 2009;66:341–348 U. Maurer *et al.*

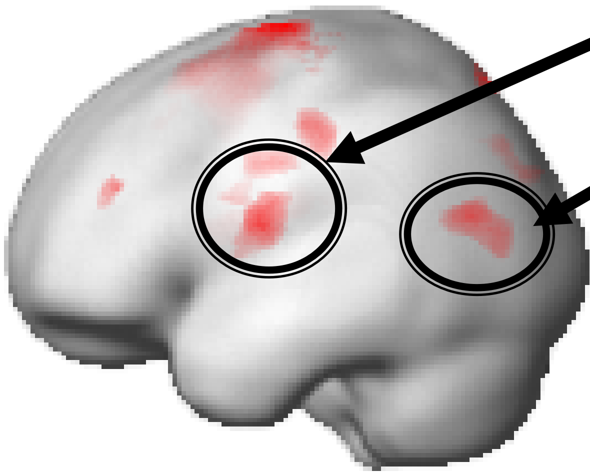


Neural deficits in children with dyslexia ameliorated by behavioral remediation: Evidence from functional MRI

Elise Temple[†‡], Gayle K. Deutsch[§], Russell A. Poldrack[¶], Steven L. Miller[||], Paula Tallal[||††], Michael M. Merzenich[||‡‡], and John D. E. Gabrieli[†§]

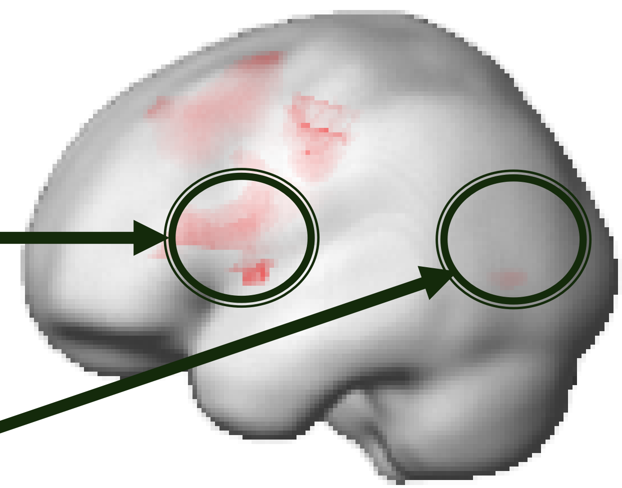
n= 45
8 weeks intervention

Control



Frontal AND Temporo-parietal

Dyslexia



Frontal but NOT Temporo-parietal

Example:

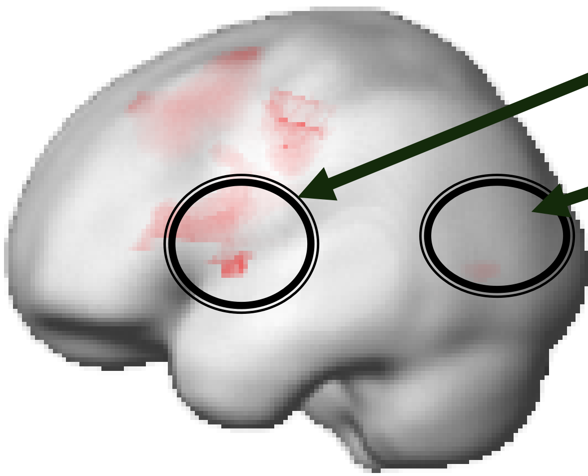
B D = Rhyme

B K = Do Not Rhyme

[Temple et al. (2003) PNAS, 100]

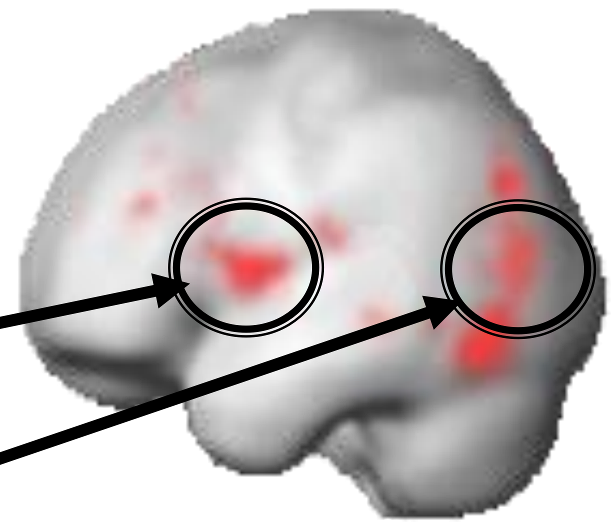
Neural effect of intervention

Pre-Intervention



Frontal but NOT Temporo-parietal

Post-Intervention



Increased activity in Frontal AND Temporo-parietal

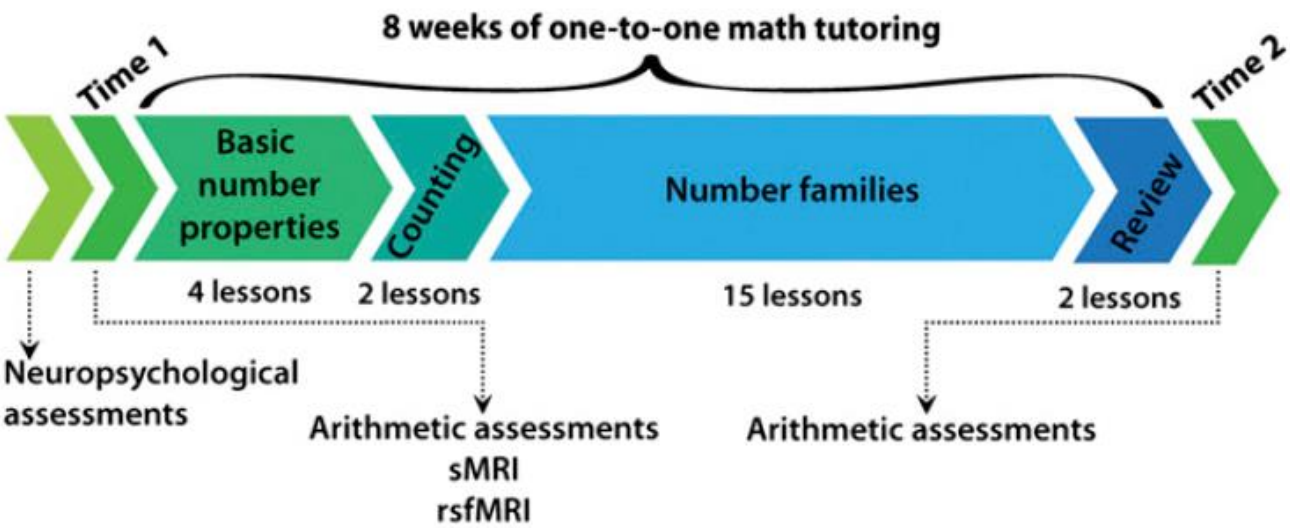
After training, metabolic brain activity in dyslexics more closely resembles that of typical readers.

[Temple et al. (2003) PNAS, 100]

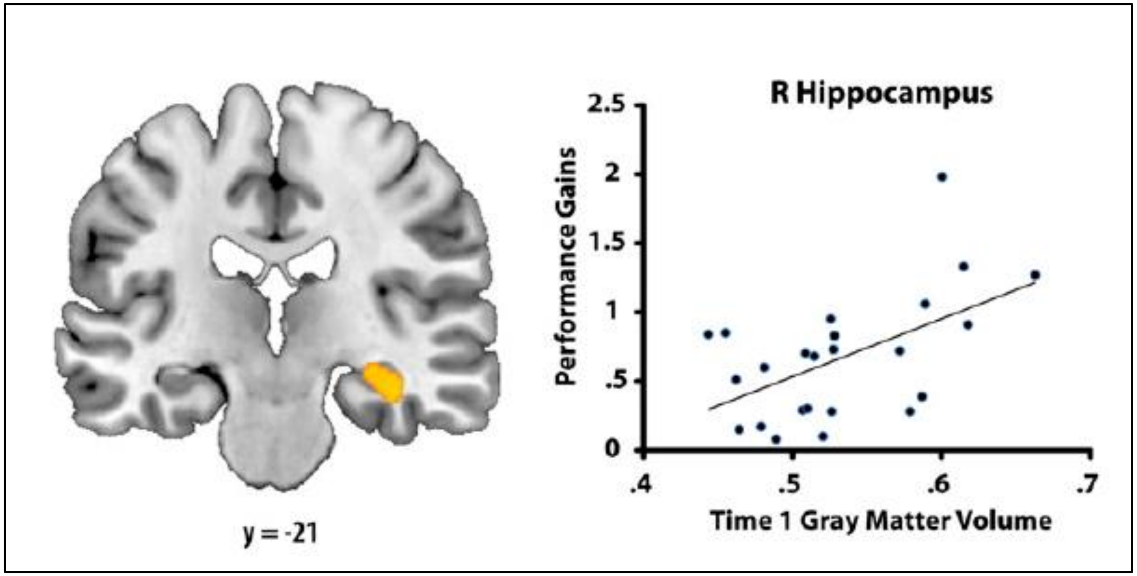
Neural predictors of individual differences in response to math tutoring in primary-grade school children

Kaustubh Supekar[a,1,2], Anna G. Swigart[a,1], Caitlin Tenison[a], Dietsje D. Jolles[a], Miriam Rosenberg-Lee[a], Lynn Fuchs[b], and Vinod Menon[a,c,d,e,2]

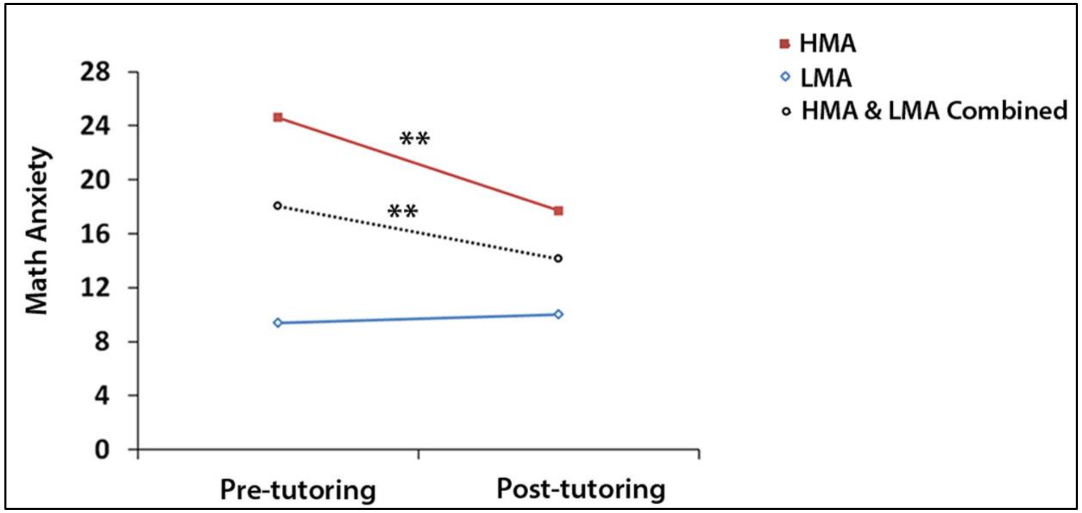
- Can behavioral or brain measures predict individual differences in arithmetic performance improvements with tutoring?

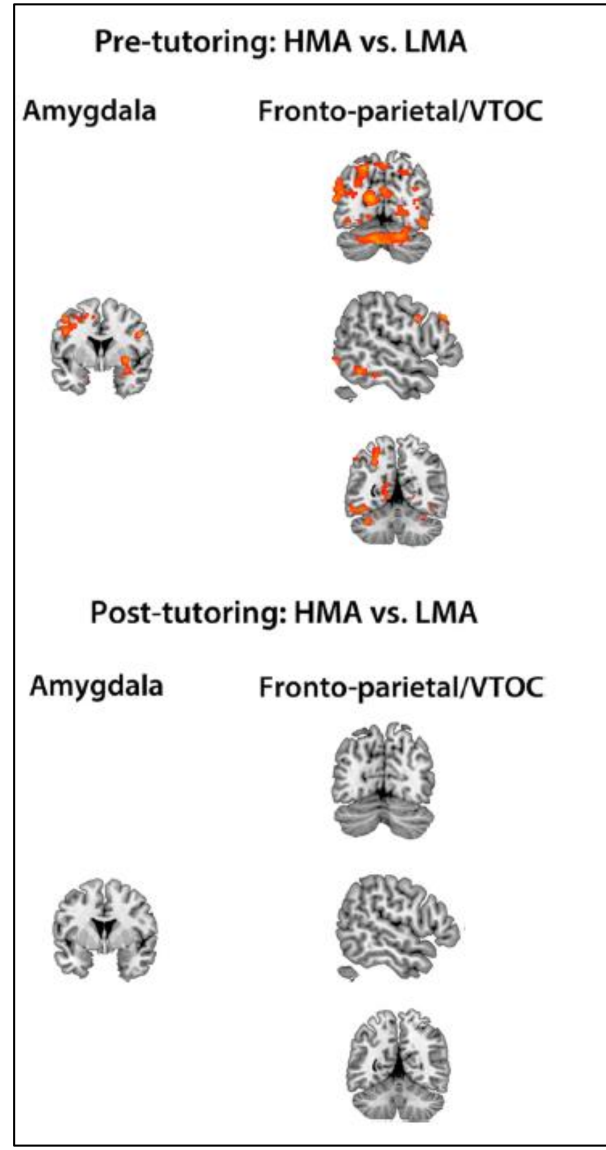


- A significant shift in arithmetic problem-solving strategies from counting to fact retrieval was observed with tutoring.
- Speed and accuracy of arithmetic problem solving increased with tutoring, with some children improving significantly more than others.
- No behavioral measures, including intelligence quotient, working memory, or mathematical abilities, predicted performance improvements.
- In contrast, pre-tutoring hippocampal volume (associated with learning and memory) predicted performance improvements.



[*Supekar et al., 2013*]





- Math anxiety during early childhood has adverse long-term consequences for academic and professional success

- Intensive 8 week one-to-one cognitive tutoring not only reduces math anxiety but also remarkably remediates aberrant functional responses and connectivity in emotion-related circuits anchored in the amygdala.

[*Supekar et al., 2015*]

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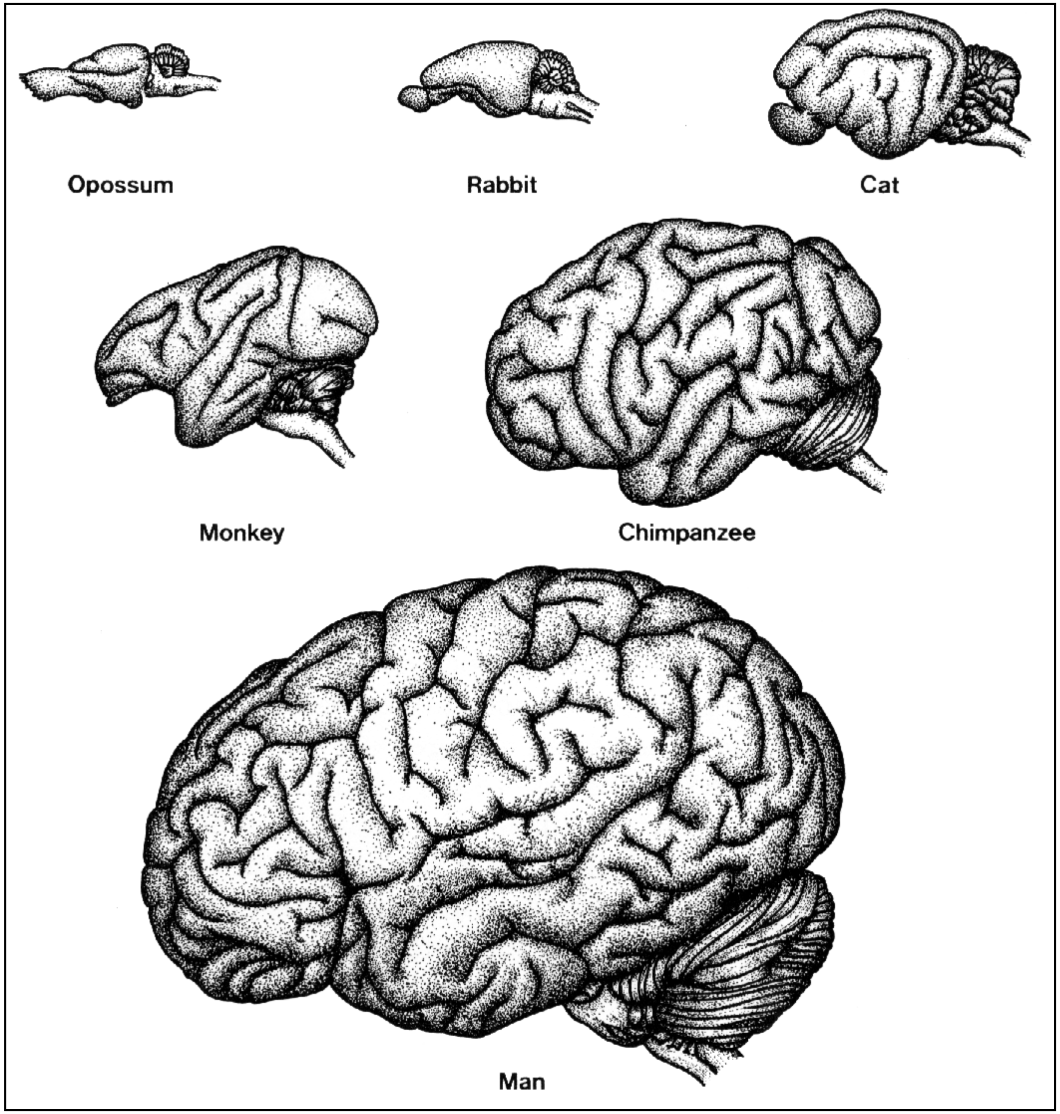
Brain Size: Is bigger better?



What is a neuromyth?

NEUROMYTH: "Misconception generated by a misunderstanding, a misreading or a misquoting of facts scientifically established (by brain research) to make a case for use of brain research in education and other contexts" *[Organization for Economic Co-operation, and Development, 2002]*

Neuromyth

Table 1 | **Prevalence of neuromyths amongst practising teachers in five different international contexts**

Myth*	Percentage of teachers who "agree" (rather than "disagree" or "don't know")				
	United Kingdom ($n = 137$)	The Netherlands ($n = 105$)	Turkey ($n = 278$)	Greece ($n = 174$)	China ($n = 238$)
We mostly only use 10% of our brain	48	46	50	43	59
Individuals learn better when they receive information in their preferred learning style (for example, visual, auditory or kinaesthetic)	93	96	97	96	97
Short bouts of co-ordination exercises can improve integration of left and right hemispheric brain function	88	82	72	60	84
Differences in hemispheric dominance (left brain or right brain) can help to explain individual differences amongst learners	91	86	79	74	71
Children are less attentive after sugary drinks and snacks	57	55	44	46	62
Drinking less than 6 to 8 glasses of water a day can cause the brain to shrink	29	16	25	11	5
Learning problems associated with developmental differences in brain function cannot be remediated by education	16	19	22	33	50

*The table shows some of the most popular myths reported in four different studies from the United Kingdom[1], The Netherlands[1], Turkey[4], Greece[2] and China[7]. In all studies, teachers were asked to indicate their levels of agreement with statements reflecting several popular myths, shown as "agree", "don't know" or "disagree". The table shows the percentages of teachers within each sample who responded with "agree".

[*Howard-Jones et al., 2014*]

More Neuromyths:

- **Myth A:** The first language must be spoken well, before the second language is learnt
- **Myth B:** The brain is only plastic for certain kinds of information during specific "critical periods", with the first three years of a child being decisive for later development and success in life.
- **Myth C**: There is a visual, auditive and a haptic type of learning.
- **Myth D:** Some children learn better with the left, some learn better with the right hemisphere.
- **Myth E:** Sugar reduces attention.
- ….

How can we stop the spread of neuromyths?

The most effective tool preventing the spread of neuromyth is educating teachers…
→ critical consumers of ‘brain-based’ programs and products.

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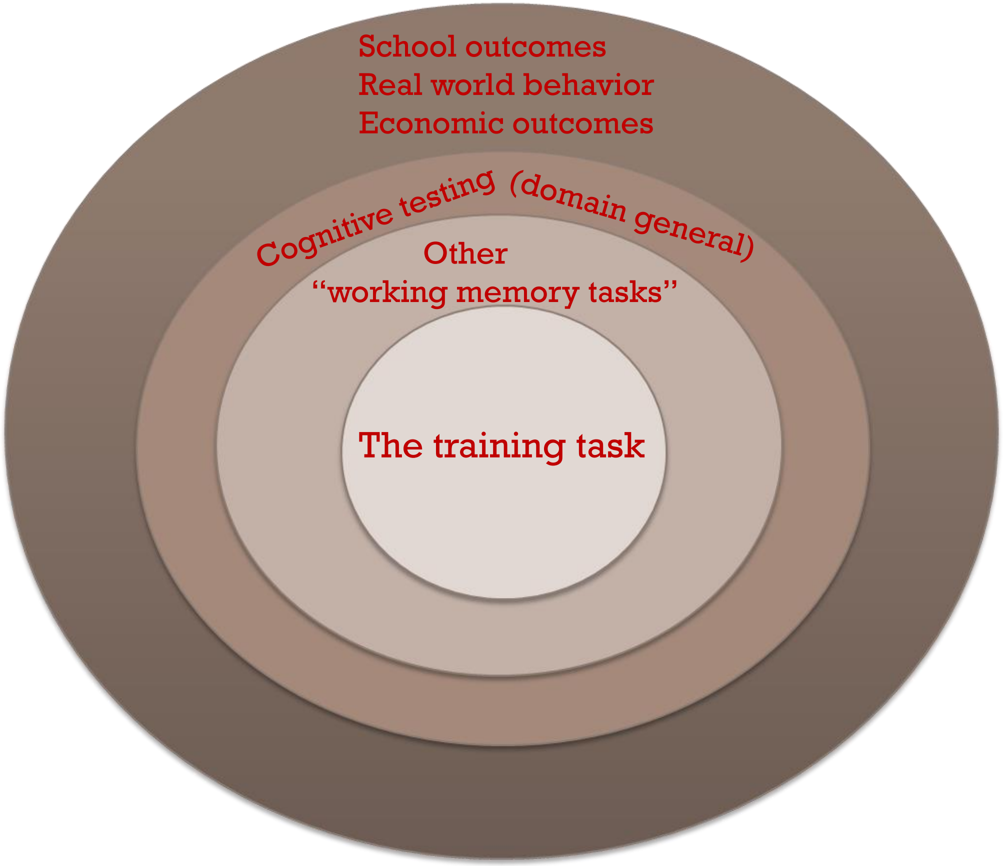
Brain Training

- Want to raise intelligence levels, think faster, boost your memory, and stretch your attention?

- Various brain training tools were developed to enhance many cognitive skills.
  - Lumosity: www.lumosity.com
  - Cogmed: www.cogmed.com
  - MindSparke: www.mindsparke.com
  - Tools of the mind: www.toolsofthemind.org
  - Elevate: www.elevateapp.com
  - brainHQ: www.brainhq.com
  - Fit brains: www.fitbrains.com
  - Brain Metrix: www.brainmetrix.com

Far versus near transfer effects….

Transfer

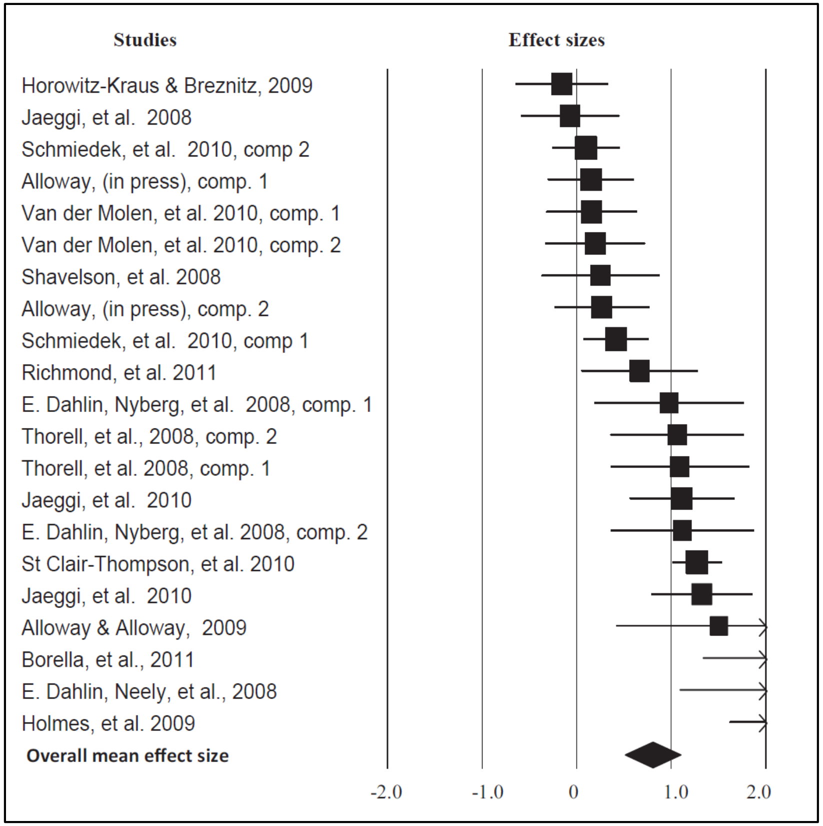


Several concerns when evaluating a training….

- The tendency for researchers to define change to abilities using single tasks
- Inconsistent use of valid tasks
- Questionable control groups
- Subjective measurement of change
- Placebo effects

[Shipstead et al., 2012]

- Some programs produced reliable gains in working memory skills
- Near-transfer effects were not maintained
- No evidence of the generalization of working memory to other skills



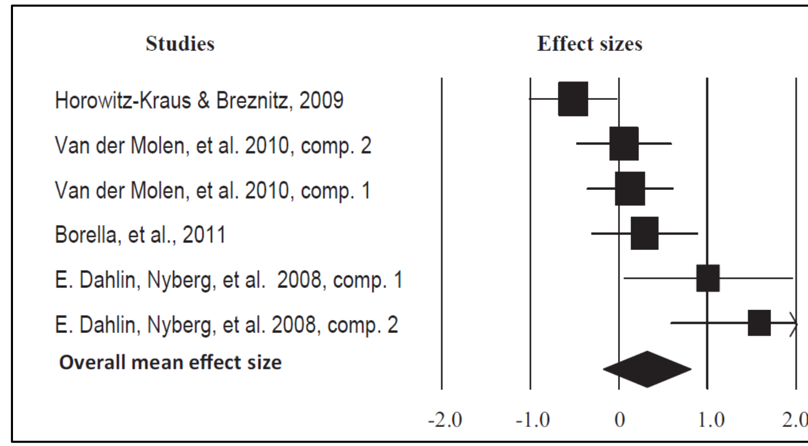


Table 4

Total Number of Participants, Number of Effect Sizes, Time Between Posttest and Follow-Up, and Effect Size With 95% CI Between Pretest and Follow-Up

	Pretest–follow-up group difference				
Variable	Total *N* E (C)	Number of effect sizes (*k*)	Time between posttest and follow-up (months)	Effect size (*d*)	95% CI
Nonverbal ability	138 (120)	6	7.8	−0.06	−0.31, 0.17
Attention	102 (94)	4	5.0	0.09	−0.19, 0.37
Decoding	91 (84)	3	3.7	0.13	−0.17, 0.42
Arithmetic	108 (76)	3	3.33	0.18	−0.11, 0.47

Note. *N* = number of participants; E = experimental training group; C = control group; CI = confidence interval.

Putting brain training to the test

Adrian M. Owen[1], Adam Hampshire[1], Jessica A. Grahn[1], Robert Stenton[2], Said Dajani[2], Alistair S. Burns[3], Robert J. Howard[2] & Clive G. Ballard[2]

A large scale (11,430 participants) test of a six-week online training

Baseline
Measurement on
- reasoning
- verbal short-term memory (VSTM)
- spatial working memory (SWM)
- paired-associates learning (PAL)

→

Training
Three groups trained on
1. Tasks emphasized reasoning, planning and problem-solving abilities
2. Task of VSTM, attention, visuospatial processing and mathematics
3. obscure questions from six different categories (control)

→

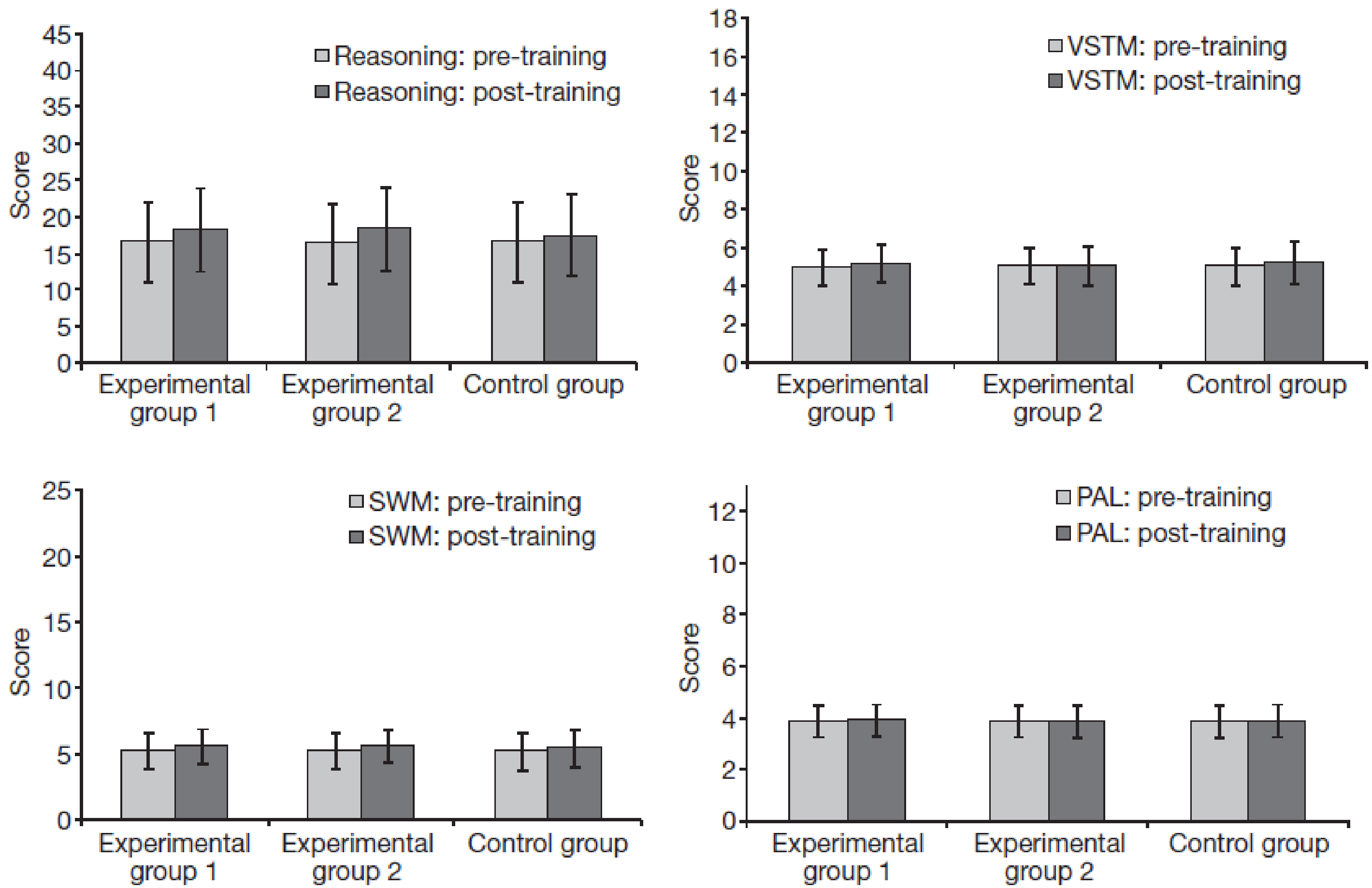
Retest using the same tests

[*Owen et al., 2010*]

Putting brain training to the test

nature

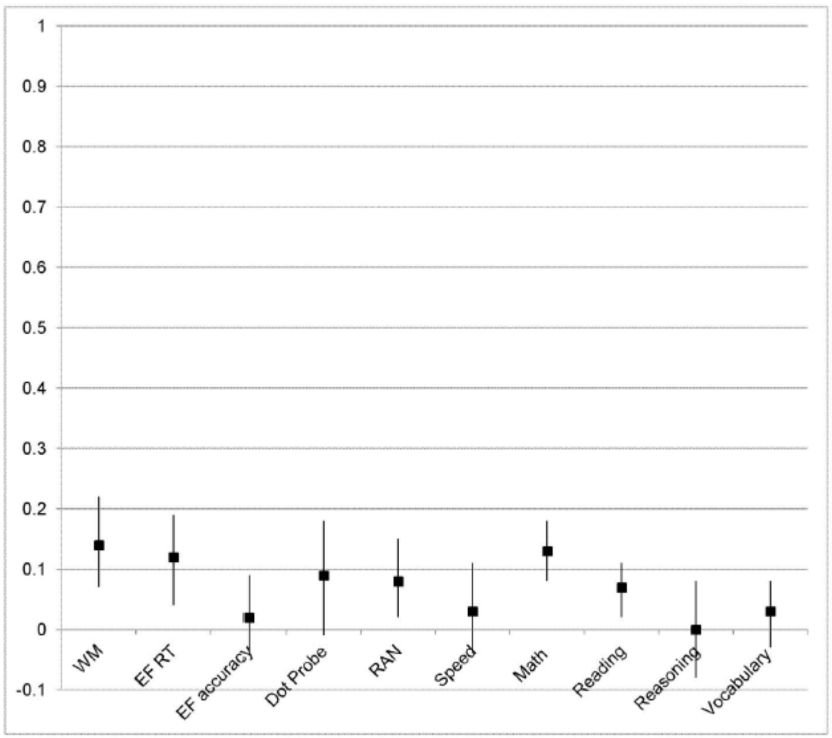
Results: little transfer effects to untrained tasks, even when those tasks were cognitively closely related (group2)

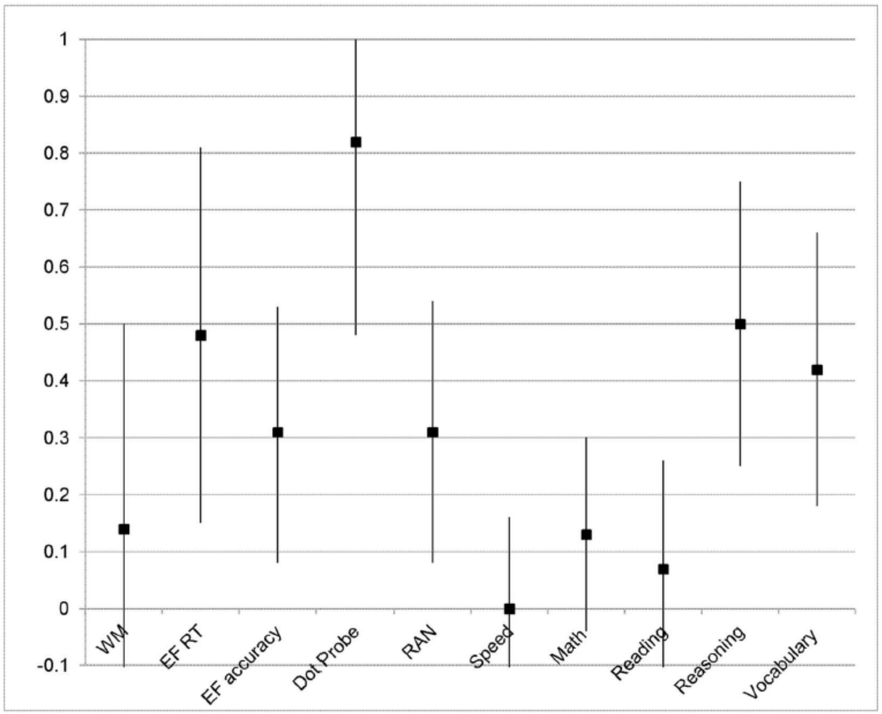


Closing the Achievement Gap through Modification of Neurocognitive and Neuroendocrine Function: Results from a Cluster Randomized Controlled Trial of an Innovative Approach to the Education of Children in Kindergarten

Clancy Blair*, C. Cybele Raver

- A large RCT of Tools of the Mind in Boston





WM = working memory; EF = executive functions, RT = reaction time; RAN = rapid automatic naming

Effect size: all schools

Effect size: high poverty schools

Brain Training

On-going debates on the effect of these brain training tools

- Lumosity claims:
  - Fixes (almost) everything
  - Staves of aging
- CogMed claims:
  - Improves ADHD symptoms
  - Improves 'attention' and 'focus'
- MindSparke claims:
  - Makes you smarter
- etc……

Brain Training - Lumosity

Improvement of Visual Attention and Working Memory through a Web-based Cognitive Training Program

Michael Scanlon
Lumos Labs, Inc.

David Drescher
Lumos Labs, Inc.

Kunal Sarkar
Lumos Labs, Inc.

Context: Prior work has revealed that cognitive ability is adaptive and can be improved with cognitive behavioral training methods; however, use of these methods is limited outside of the lab.

Objective: To investigate the efficacy of *Lumosity*, a web-based cognitive training program developed by Lumos Labs to improve attention and memory in healthy adults.

Design, Settings, and Participants: Randomized, controlled experiment consisted of assessment, training intervention, and post-training assessment. Volunteer participants (n=23, mean age=54) were recruited from various locations across the US. Training and testing were conducted on each participant's personal computer to simulate conditions of actual use. Both groups used computers on a regular basis. Results and compliance data were captured automatically via the online program.

Intervention: Online cognitive training for twenty minutes once daily for five weeks. Trained participants completed an average of 29.2 sessions, and control participants received no training. Training sessions consisted of five distinct exercises.

lumosity

GET STARTED NOW | LOG IN

Our scientists research the efficacy of Lumosity

We conducted a randomized study on Lumosity, using crossword puzzles as an active control.

What we did

Our scientists had 4,715 participants complete the study. Half trained with Lumosity, while the rest did online crossword puzzles to control for placebo effects.

What we found

After 10 weeks, the Lumosity group improved more than the crosswords group on an aggregate assessment of cognition.

Next questions

These results are promising, but we need to do more research to determine the connection between improved assessment scores and everyday tasks in participants' lives. That's our next focus.

Brain Training - Cogmed

- Cogmed: www.cogmed.com (Computerized Training)
- Working memory training

Brain Training

Training program (by group characteristic)	Authors	Control group	Near			Far						
				WMC								
			STM	BS	CS	Gf	Ach.	Attn.	ADHD Obj.	ADHD Subj.	*n*	Age in years *M* (*SD*)
Children with ADHD and/or low WMC												
Cogmed (ADHD)	Beck et al. (2010)	No contact								?	51	11.75 (32.59)
Cogmed (ADHD)	Gibson et al. (2011)	None							—	✓	37	12.59 (1.21)
Cogmed (ADHD)	Holmes et al. (2010)	None	✓	✓	✓	—	—				25	9.75 (.92)
Cogmed (ADHD)	Klingberg et al. (2002)	Nonadaptive task	✓			✓		✓	?		14	11.20 (2.55)
Cogmed (ADHD)	Klingberg et al. (2005)	Nonadaptive task	✓			✓		✓		?	44	9.80 (1.30)
Cogmed (ADHD)	Mezzacappa & Buchner (2010)	None	✓	✓						✓	8	8.75 (.89)
Cogmed (cochlear implants)	Kronenberger et al. (2011)	None	✓	?							9	10.20 (2.2)
Cogmed (low WMC)	Holmes et al. (2009)	Nonadaptive task	?		✓	—	—				42	8–11[c]
Cogmed (special education)	K. I. E. Dahlin (2011)	Klingberg et al. (2005)	✓	✓		—	?	—			57	10.71 (1.09)
JungleMemory (learning disability)	Alloway (in press)	Learning support			✓		✓				15	13.00 (.78)
OddYellow (borderline IQ)	Van der Molen et al. (2010)	Response time task	?	—	—	—	—	—			93	15.21 (.69)
Typically developing children												
Cogmed	Bergman Nutley et al. (2011)	Nonadaptive task	?		✓	—					101	4.30 (.25)
Cogmed	Shavelson et al. (2008)[b]	Nonadaptive task	✓		—	—					37	13.50 (.70)
Cogmed	Thorell et al. (2009)	Computer games	✓			—		?			62	4.70 (.43)
n-back	Jaeggi et al. (2011)	Knowledge training				?		DNR			62	9.03 (1.49)
Running span[a]	Zhao et al. (2011)	Computer games				✓					33	9.76 (.61)

Note. ✓ = significant transfer remained; ? = mixed transfer; dash = transfer regressed; STM = short-term memory; WMC = working memory capacity; BS = backward span; CS = complex span; Gf = general fluid intelligence; Ach. = achievement.
[a] Training task did not adapt to performance.

Shipstead, Redick & Engle, 2012)

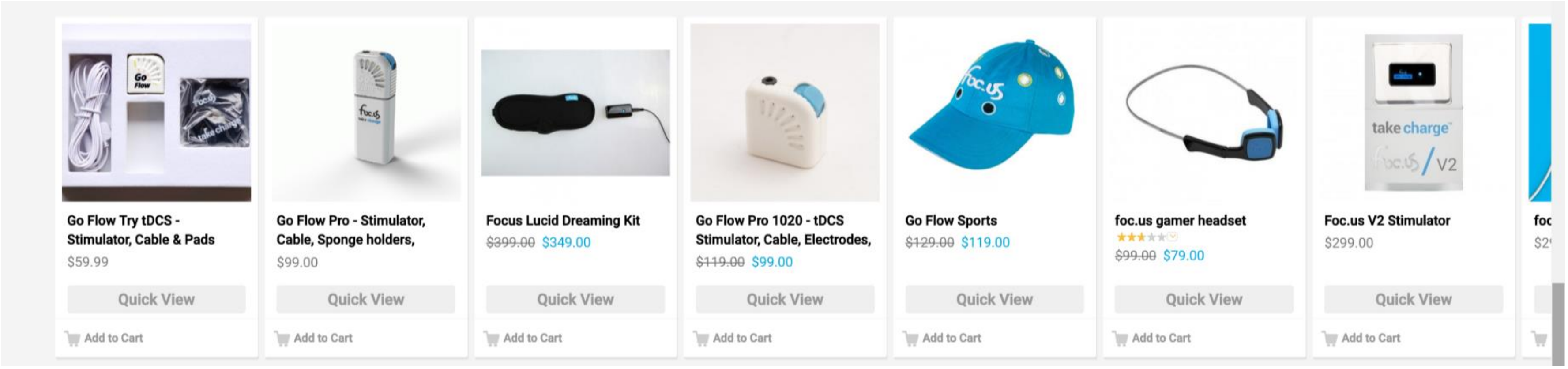
Brain Training

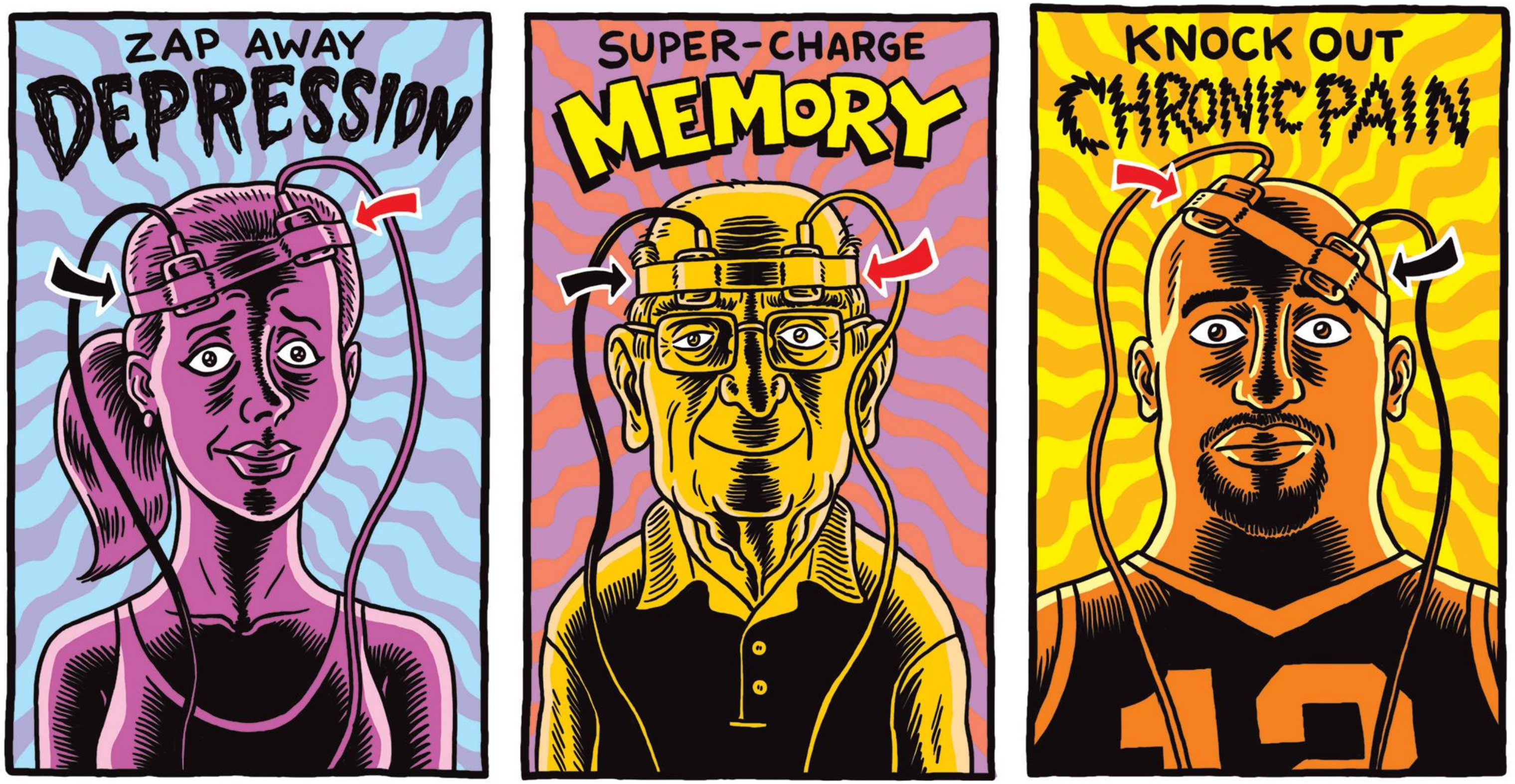
The Promise and Perils

- Brain plasticity ≠ Brain training
- Cognitive changes vs. brain changes
- Some training programs do work for certain people
- However, a lot of existing tools are not fully tested and the effects of these tools are exaggerated since companies want to make profits.
- Should the Food and Drug Administration (FDA) do the quality control of these training tools since they charge people huge amount of money?
- Overall, a dearth of research on brain training tools provides weak evidence that these tools have a lasting effect.

Navigating the Brain training maze

- **Scientific Credentials**: Are there scientists behind the designed training? Does the company have an active, credible scientific advisory board? Are there published, peer-reviewed scientific papers in high impact journals on the training's efficacy? Are claims justified? Is this the best training?
- **Target group:** For whom is the training designed? What are the targeted benefits? Does it work for everyone?
- **Operation Training**: What type of training is required to run the training and who will provide the necessary training?
- **Costs:** Which costs are involved? One-time fees, up-front fees, ongoing fees, hardware fees, software fees, training/staff fees
- **Evaluation and Interpretation**: Who will evaluate the program? Who will interpret the results? What are the implications of certain results (ethics)?





Pictures:
Ward Sutton

Overview

- What is the role of neuroscience in education?
- Learning differences, neuroscience and education
- Predicting treatment response and outcomes using neuroscience
- Neuromyths
- Brain trainings
- Public Policy meets Neuroscience
- Summary

ASK YOUR STATE LEGISLATORS TO ACTIVELY SUPPORT 2017 MA DYSLEXIA SCREENING LEGISLATION

H.330 - H.2872 - S.313 - S.294

1. **THE SCIENTIFIC DEFINITION OF DYSLEXIA;** *Accepted by the National Institute of Health (NIH)*

2. **EARLY SCREENING STARTING NO LATER THAN AGE 5;**

   Including the key indicators predicting students at risk for dyslexia

   A. Phonemic Awareness (PA)

   B. Rapid Automatized Naming (RAN)

   C. Letter Sound Knowledge (LSK)

   Leading to Evidence-based Reading Instruction Specific to Dyslexia

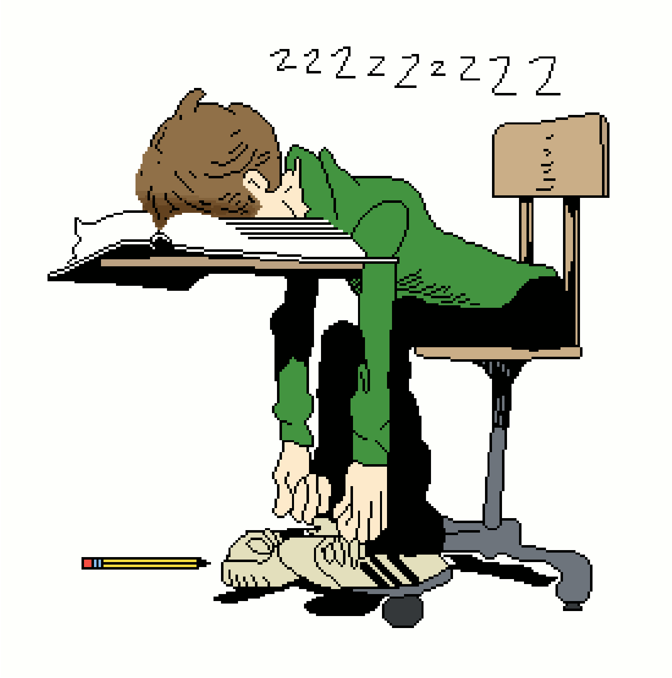
3. **A Task Force or Committee of Dyslexia Statewide Guidance;** *Collaboration including Neuroscience, Speech and Language, Developmental Pediatrics, and other Dyslexia Specialists along with Educators, Policy makers and Parents to improve awareness and evidenced based practices through out the Commonwealth.*

4. **Board Dyslexia Endorsement;** *Regulations specifying subject matter knowledge, skills, and competencies required for endorsement; coursework and field experience for licensed general and special education teachers to acquire the competencies necessary to use the scientifically based reading research and evidenced based practices to instructing and remediating students with dyslexia.*

www.decodingdyslexiama.org

Sleep policies

- Policy changes and subsequent interventions in response to neuroscientific research on sleep regulation processes.



Overview

- What is the role of neuroscience in education?
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- Summary

Summary

- Educational neuroscience as a "collaborative attempt to build methodological and theoretical bridges between cognitive neuroscience, cognitive psychology, and educational practice without imposing a knowledge hierarchy" *[Howard-Jones et al., 2016; p.625].*

- This can only be done through fostering of mutual respect for the diverse fields on both sides, common terminology , the creation of a learning environment for all parties involved and clear, frequent and bi-directional communication between neuroscientists, educators and parents.

www.gaablab.com
www.babymri.org

Hope or Hype?
The Use and Misuse of Neuroscience in Education

Nadine Gaab, PhD
Associate Professor of Pediatrics
Harvard Medical School
Boston Children's Hospital
Developmental Medicine Center
Laboratories of Cognitive Neuroscience

Children's Hospital Boston

Harvard Medical School

HARVARD
GRADUATE SCHOOL OF EDUCATION

www.gaablab.com
www.babymri.org

Does anyone in your family have dyslexia? Do you have a 2-8 months old infant?

The Gaablab is looking for infants for the first longitudinal infant dyslexia study using MRI in the world.

Why participate? The goal is to better understand underlying etiological mechanisms of dyslexia and to investigate early behavioral and brain markers.
Where? Boston/Waltham Children's Hospital; Developmental Medicine Center
When? At your convenience, weekdays or weekends.
How to participate? Contact the Gaab lab at (857) 218-4629 or email gaablab@childrens.harvard.edu.
More Information: This investigation is conducted at Boston Children's Hospital. Visit our website www.gaablab.com or contact the Gaab lab at (857) 218-4629.