Gaming, Cognitive Rehabilitation and Harnessing Neuroplasticity

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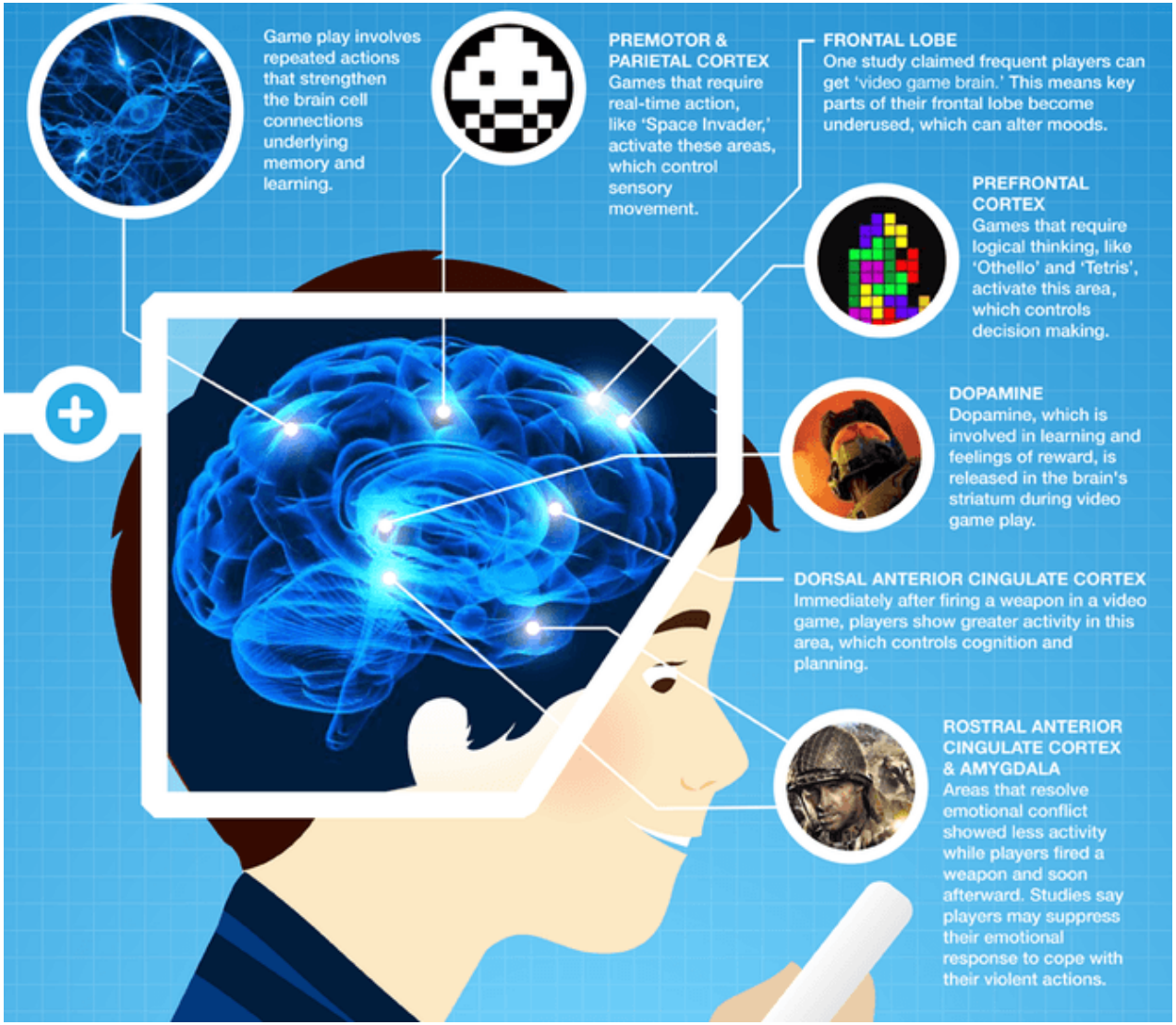
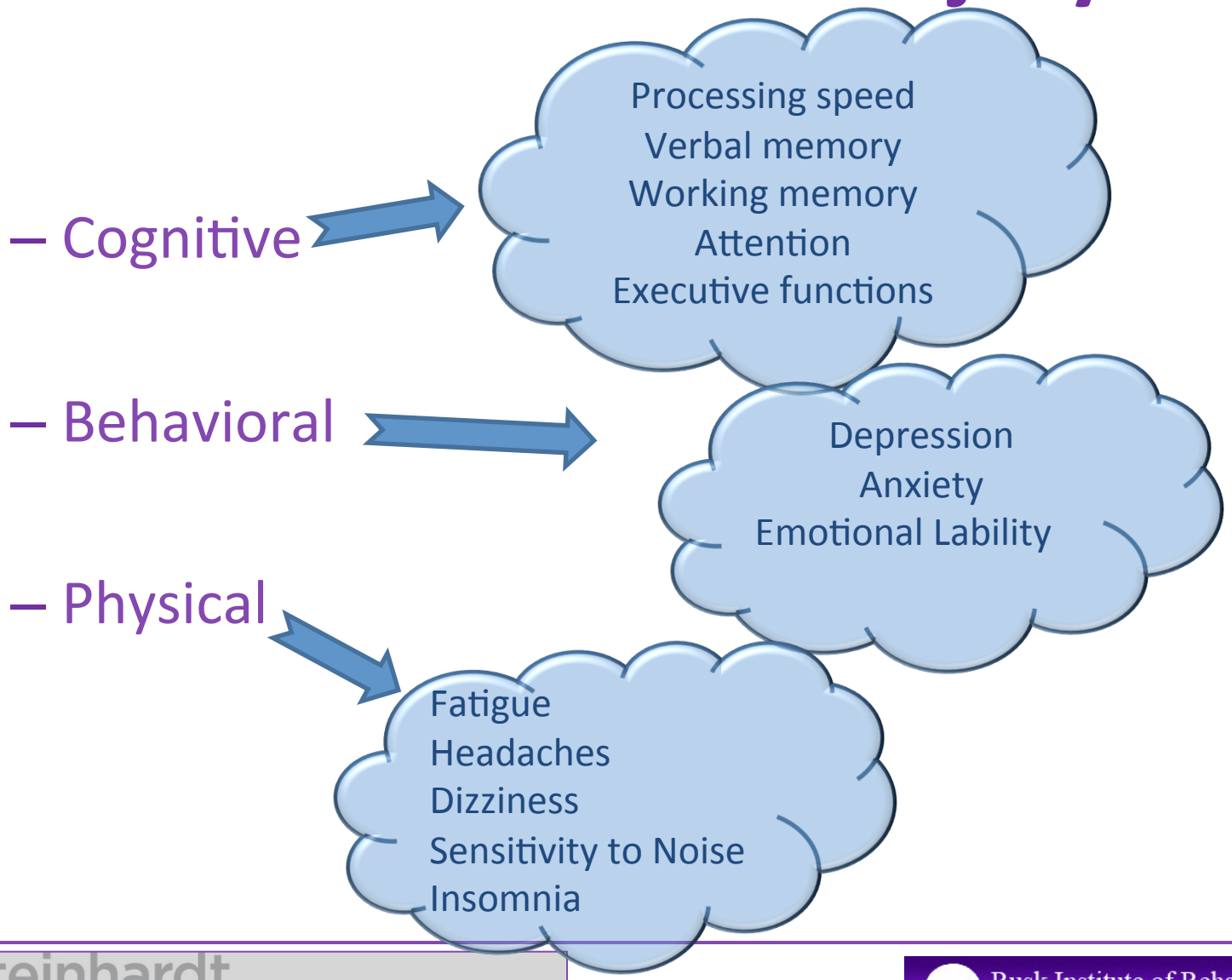
Brain Changes: Neuroplasticity



theconversation.com/playing-video-games-is-good-for-your-brain-heres-how-34034

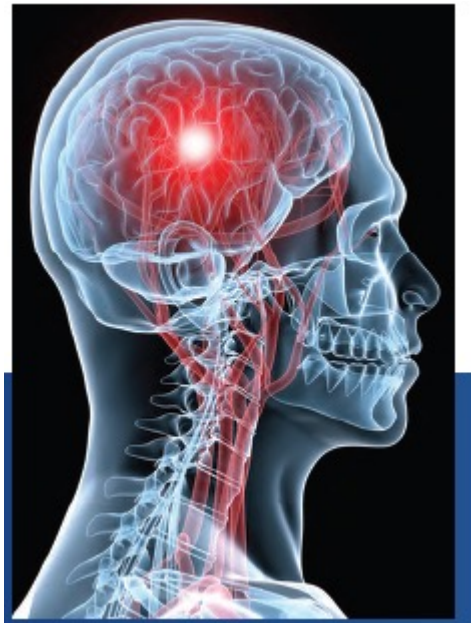
Traumatic Brain Injury

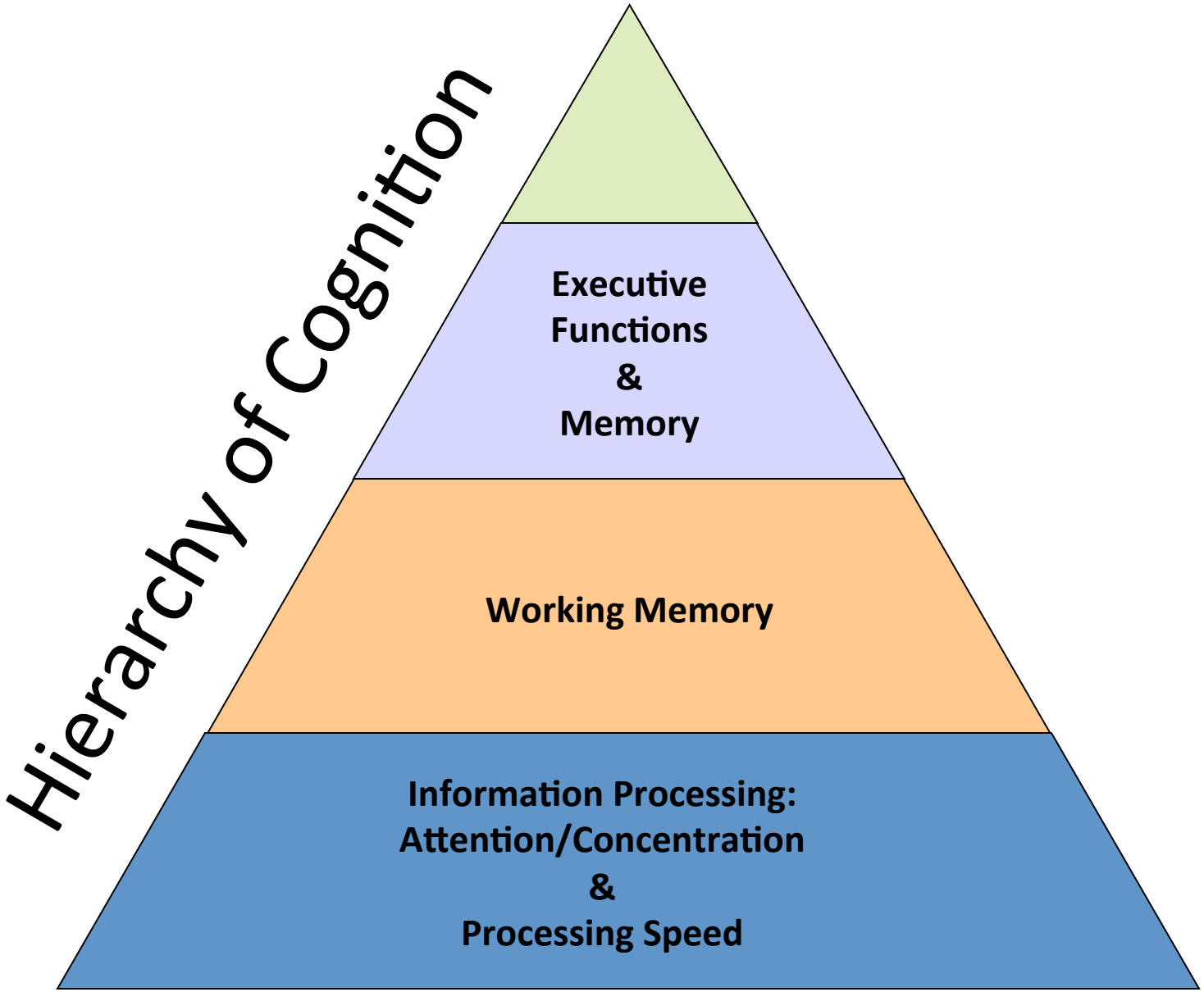


Processing Speed Deficits

Processing Speed (PS) is measured as decision time or the number of correct responses in the given time.

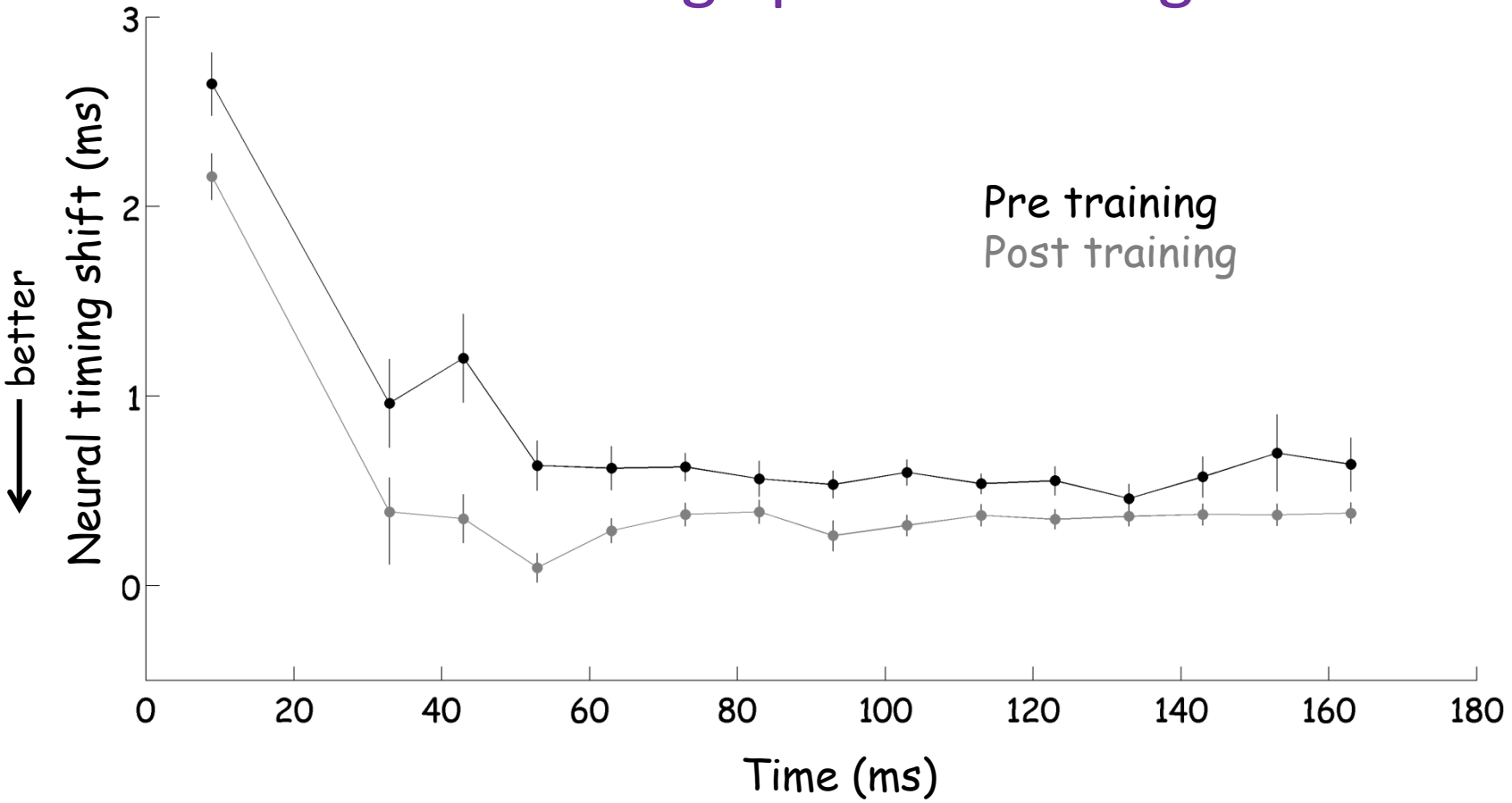
- Consistent Mild, Moderate and Severe TBI deficit.
- Verbal PS is more sensitive than Visual PS (Madigan et al., 2000)




Hierarchy of Cognition
Executive Functions & Memory
Working Memory
Information Processing: Attention/Concentration & Processing Speed

Auditory Processing Training . . .

. . . Is Processing Speed Training

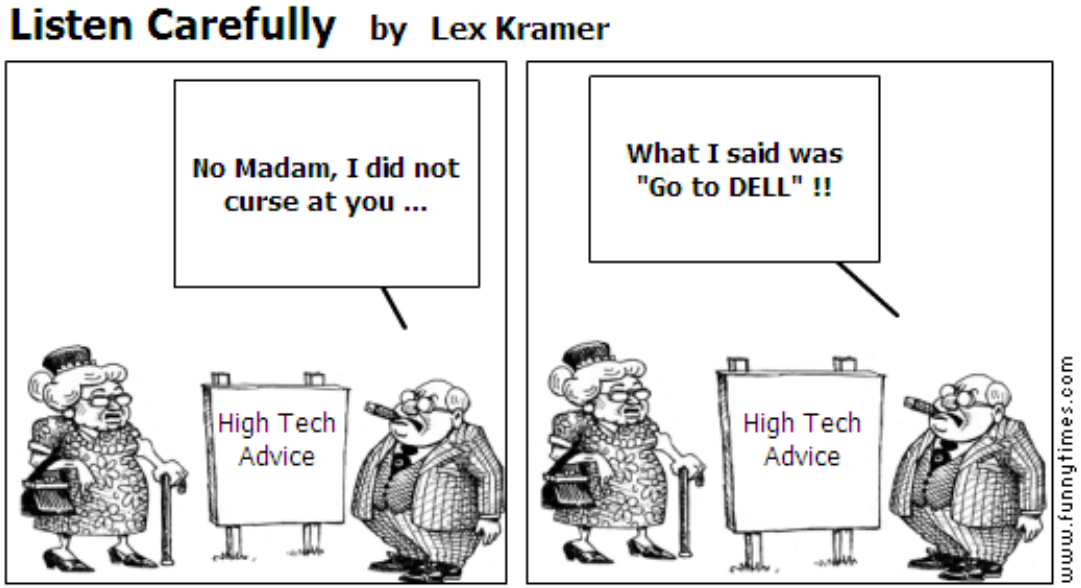


Courtesy of Nina Kraus, Ph.D.

Anderson…..Kraus *PNAS*, 2013

Research Questions

- Can we improve auditory processing speed, attention, & memory in adults with a brain injury with brain games?



Methods

	Experimental Group (N=12)	Control Group (N=12)
	Mean (SD)	Mean (SD)
Age (Years)	43.13 (13.35)	43.50 (13.98)
Education (Years)	15.91 (2.27)	16.33 (1.72)
Gender (% Male)	75% (n=9)	33% (n=4)
TBI Severity	Mild/ Moderate: n=4 Severe: n=8	Mild/ Moderate: n=6 Severe: n=6
Time Since Injury (Months)	75 (60)	80 (81)

Voelbel et al., in preparation

Pre- & Post-Neurocognitive Assessment

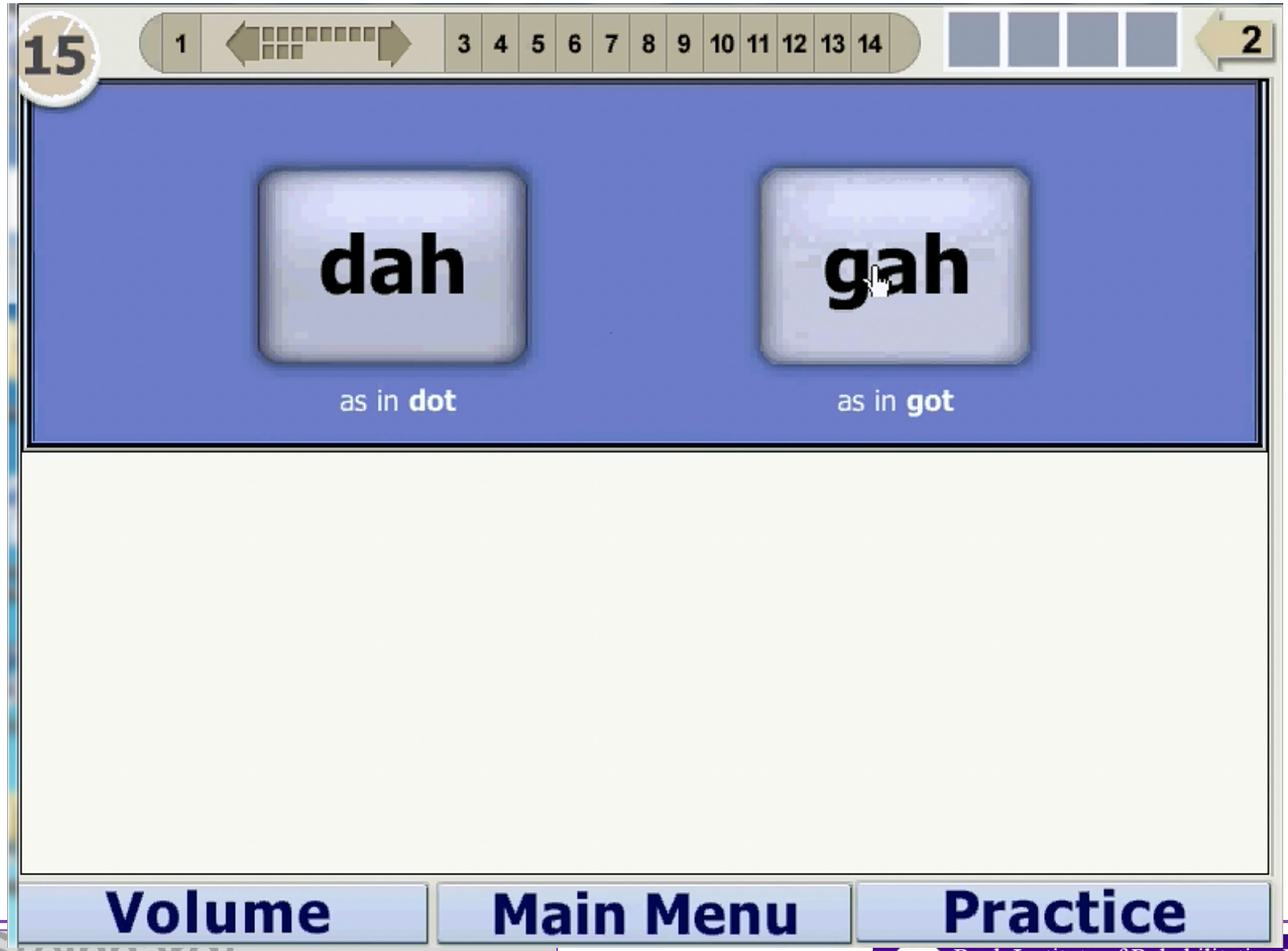
- **Processing Speed**
  - Paced Auditory Serial Addition Test (3” & 2”)
  - Digit-Symbol Coding
  - Trail Making Test (A & B)
  - CNS-VS PS Index
- **Executive Function**
  - Wisconsin Card Sorting Test – Perseverative Errors
- **Verbal Memory**
  - CNS Immediate and Delayed Recognition
- **Attention & Working Memory**
  - WCJ-III Understanding Directions
  - CNS-VS Shifting Attention
  - CNS-VS 2-Back task
  - CNS-VS WM Index

Intervention

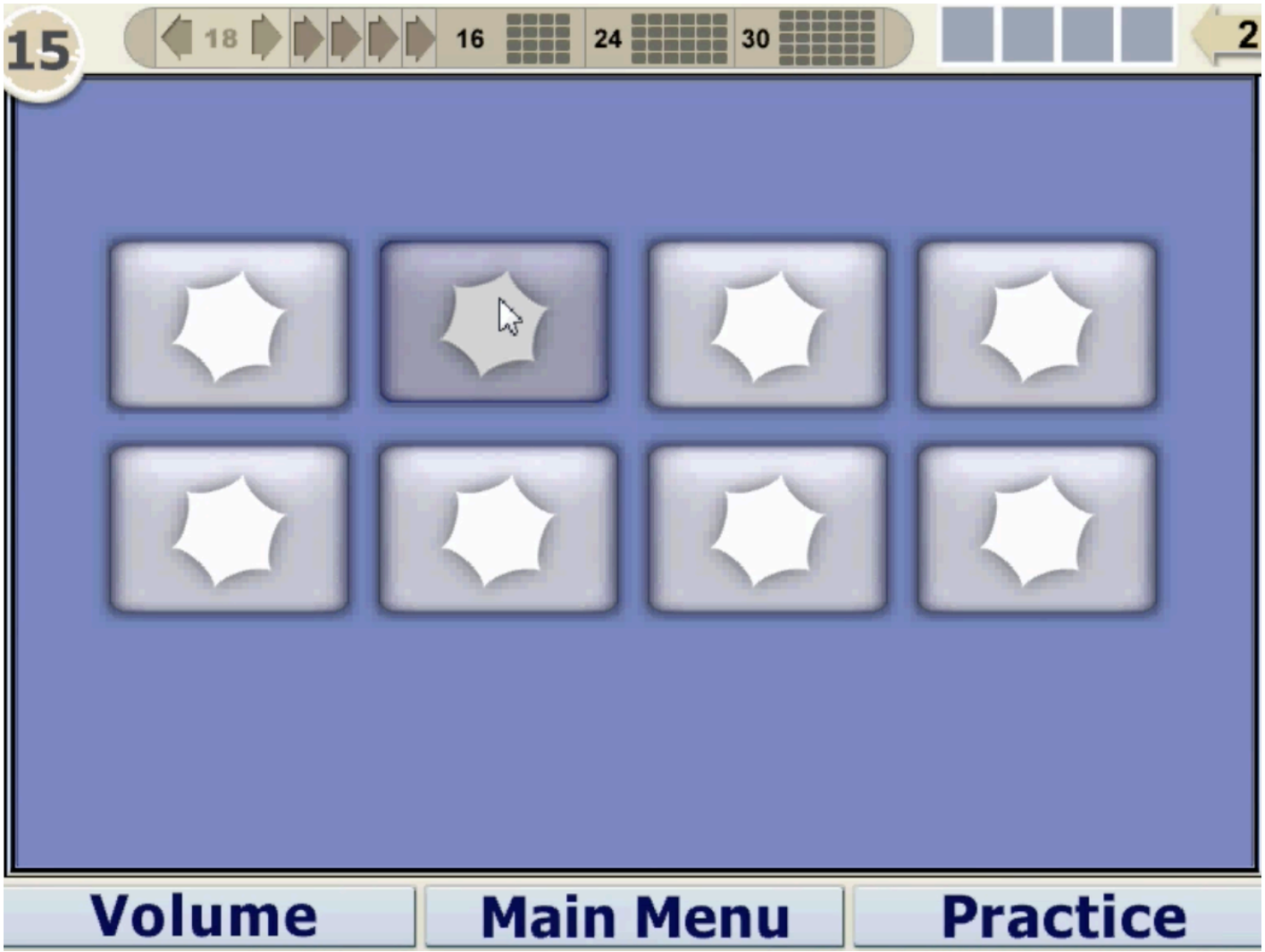
- Brain Fitness Program (Posit Science)
  - 40 hours of training
  - 6 modules
    - Time order judgment of pairs of frequency-modulated Sweeps
    - Discrimination of confusable syllables
    - Recognition of sequences of confusable syllables
    - Matching pairs of confusable syllables
    - Reconstruction of sequences of verbal instructions
    - Identification of details in a verbally presented story

High or Low

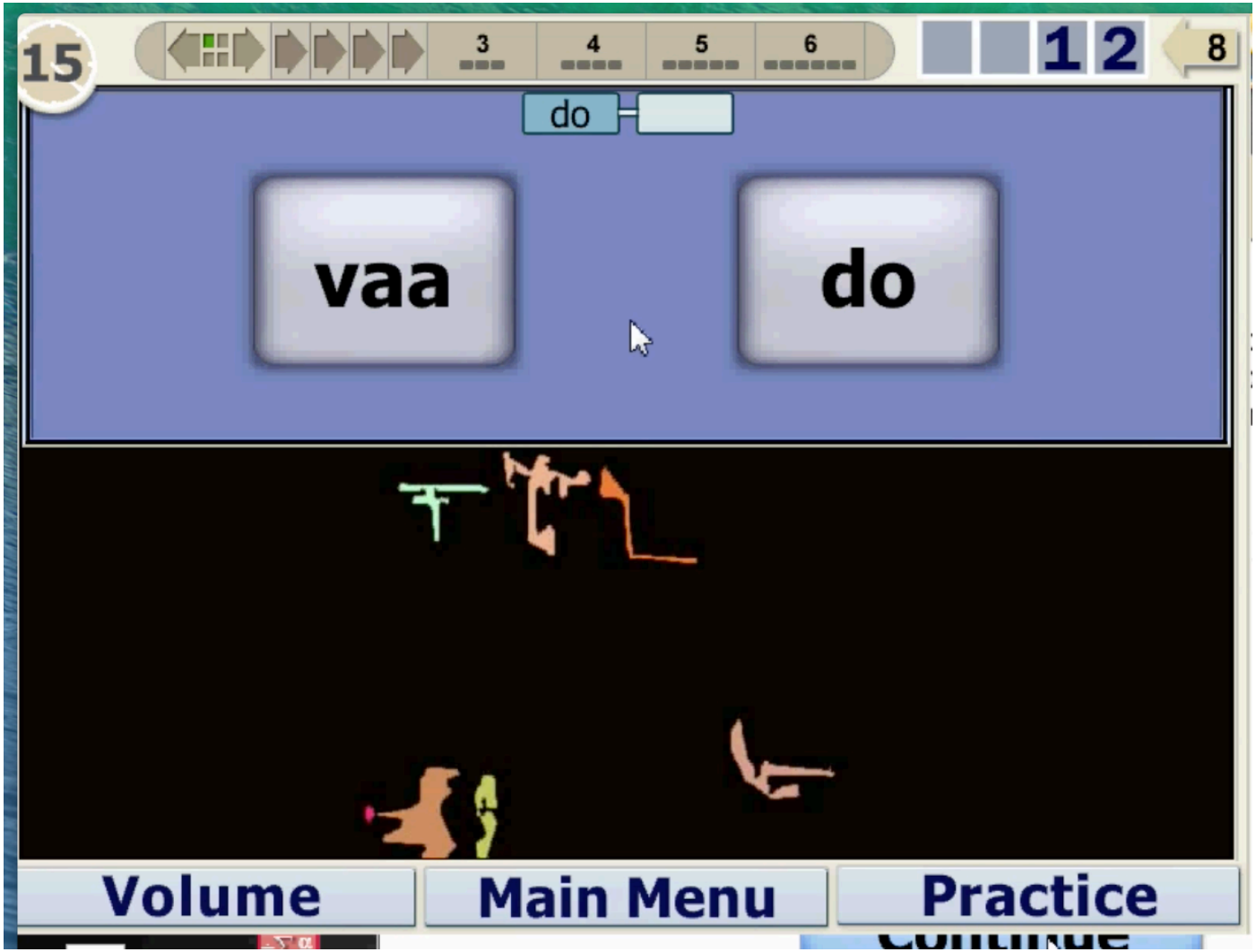
Tell Us Apart



Match It



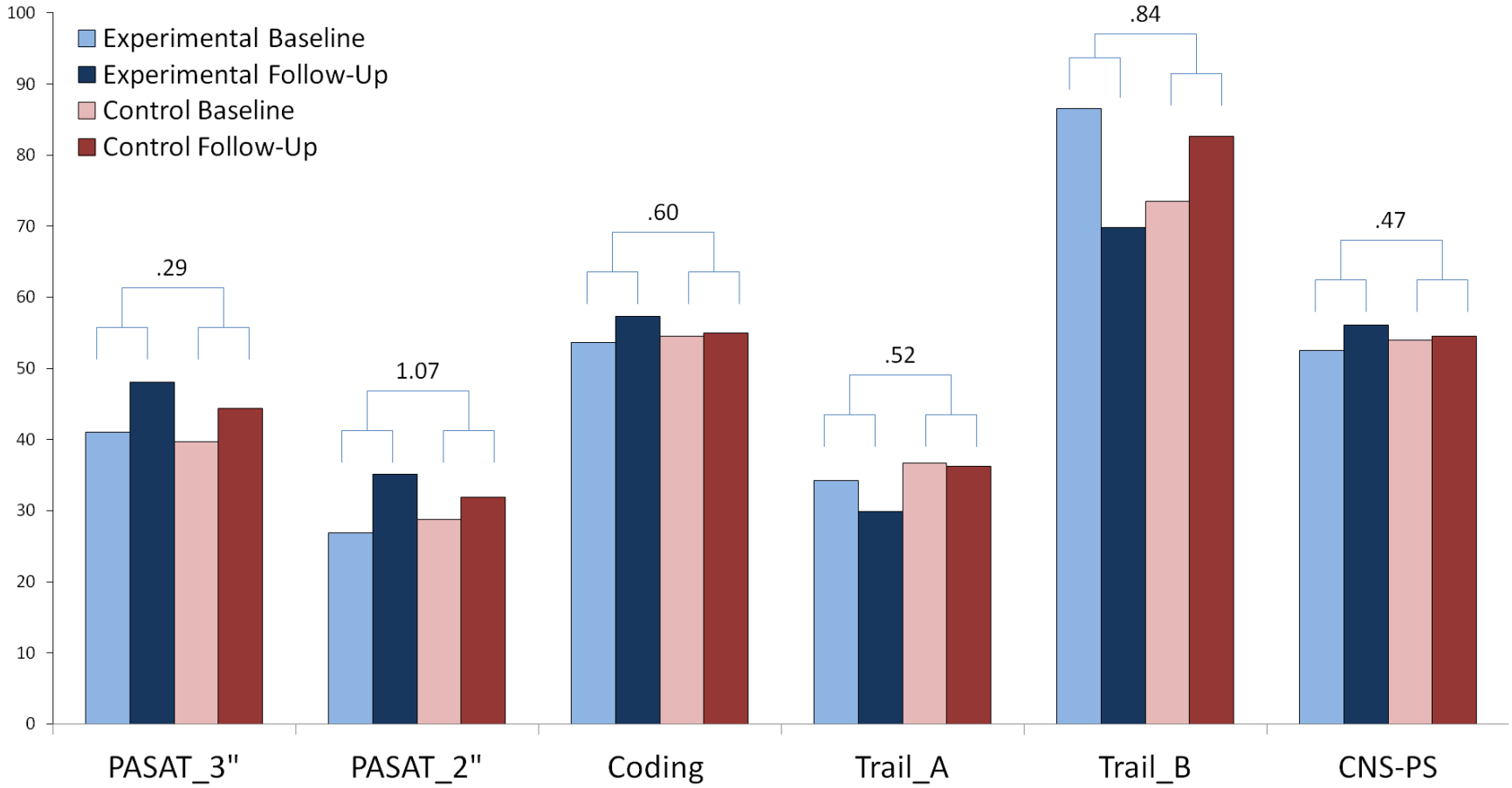
Sound Replay



Listen and Do

Story Teller

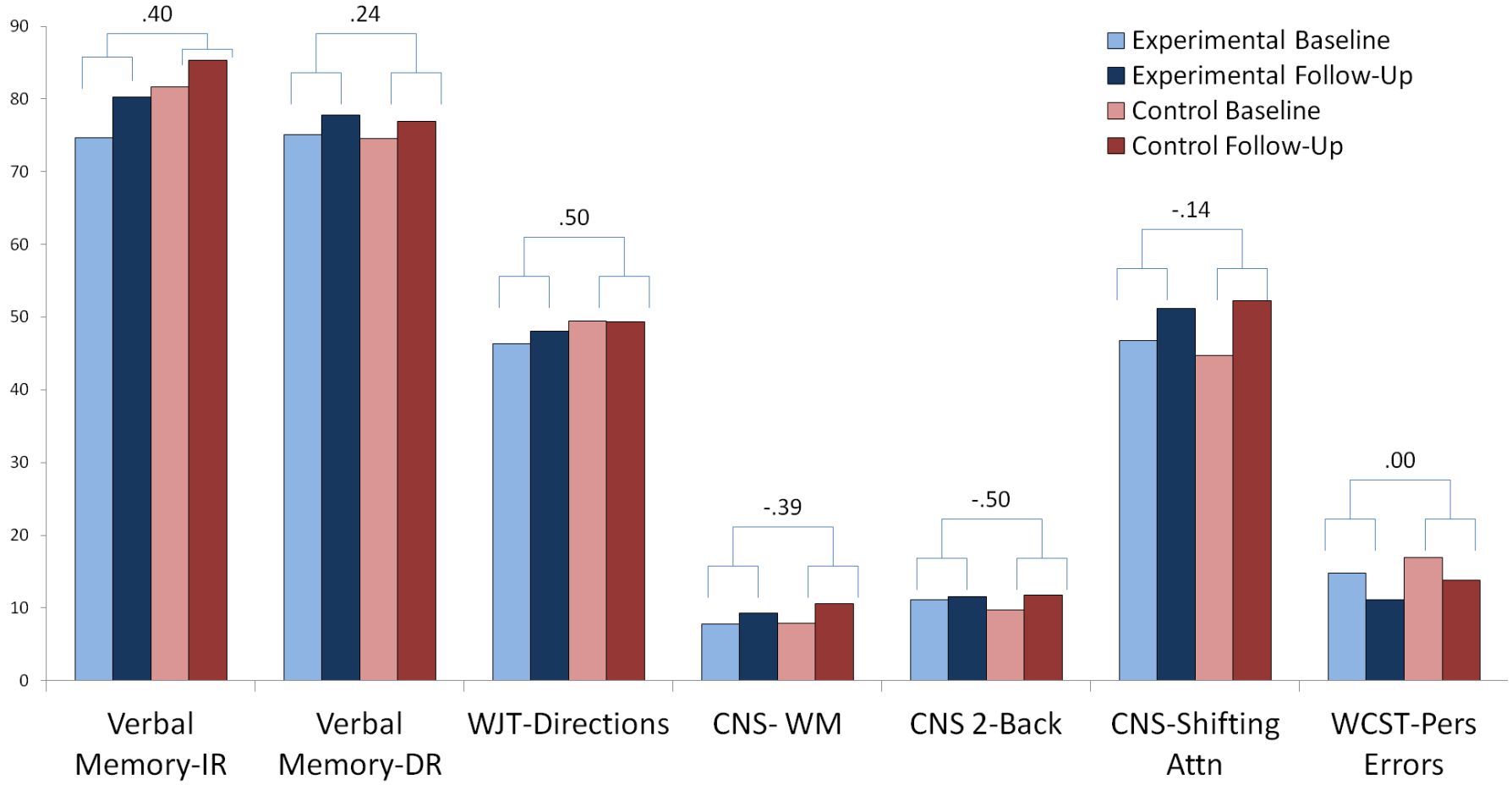
Results: Processing Speed



Effect Size: Small = .10; Medium = .30; Large = .50

Voelbel et al., in preparation

Results



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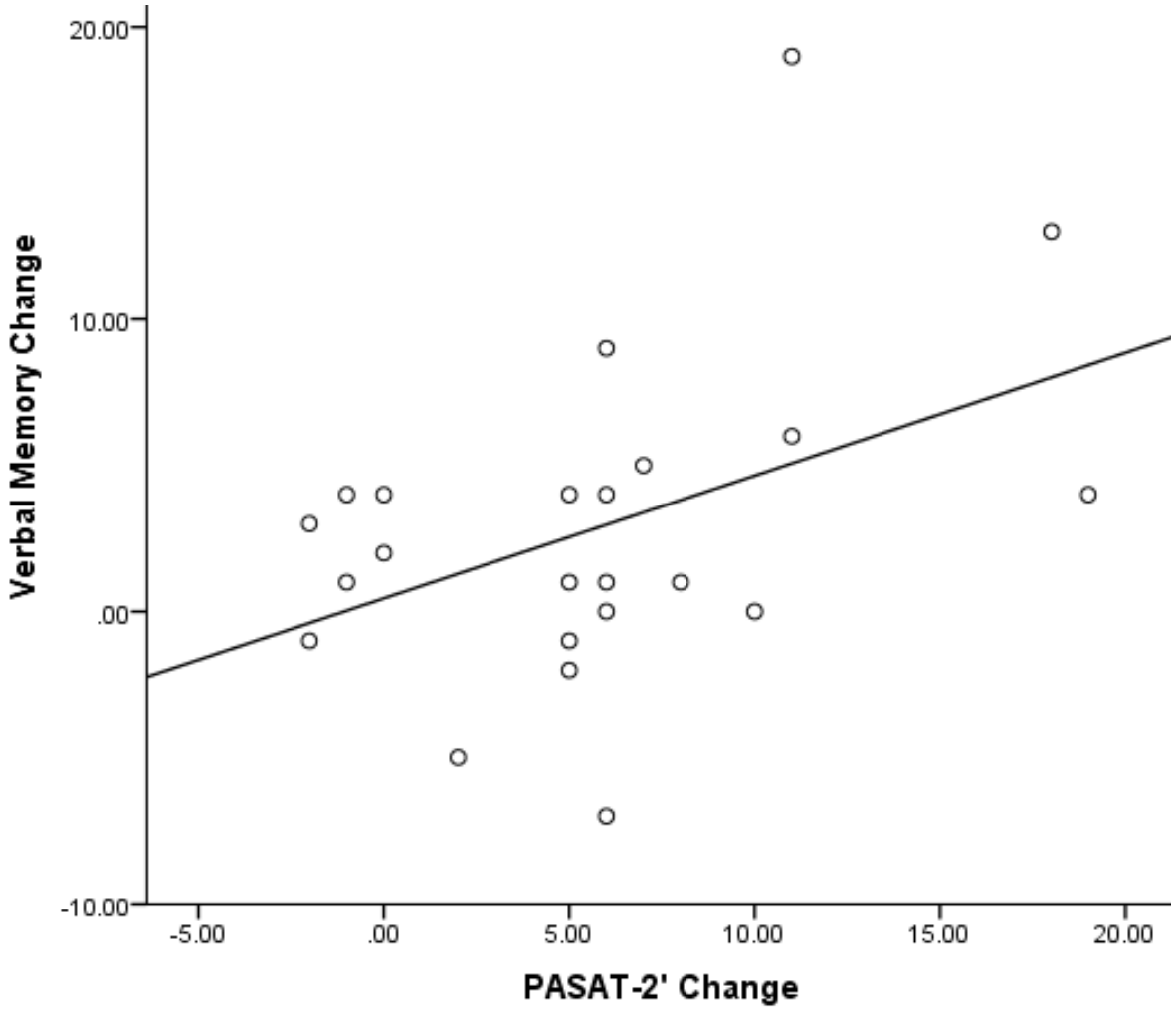
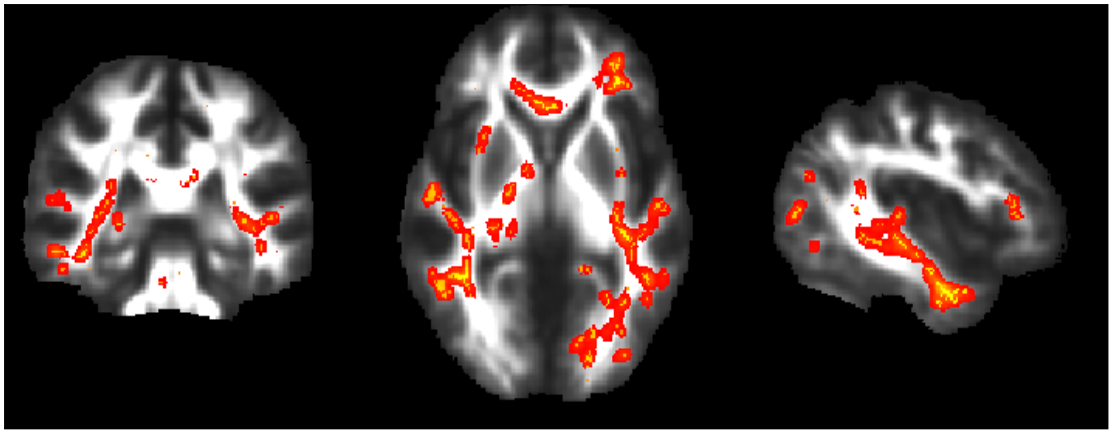
Processing Speed and Memory



r = .43

DTI Results

- **8 adults** (6 men)
- Changes in FA, MD, AD, and RD values were ID using Tract Based Spatial Statistics (TBSS).
- **Reduced AD, RD, & MD** were found in the genu, splenium, and superior longitudinal fasciculus.



Cognitive Remediation intervention resulted in reduced AD, RD, and MD (p. <.05, uncorrected).

Conclusions

- Auditory processing training increases cognitive verbal processing speed in adults with TBI.
- Remediation increases verbal memory and following verbal directions.
- Improvement in verbal processing speed is associated with verbal memory.

Conclusion

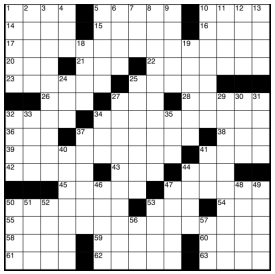
- Cognitive enrichment vs Targeted cognitive remediation programs.

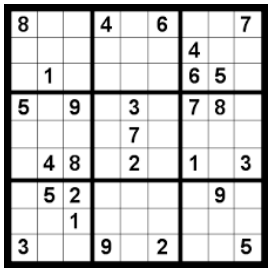
OPEN ACCESS Freely available online

PLOS ONE

A Randomized Controlled Trial of Cognitive Training Using a Visual Speed of Processing Intervention in Middle Aged and Older Adults

Fredric D. Wolinsky[1]*, Mark W. Vander Weg[2], M. Bryant Howren[2], Michael P. Jones[3], Megan M. Dotson[4]





8			4		6			7
						4		
	1					6	5	
5		9		3		7	8	
				7				
	4	8		2		1		3
	5	2					9	
		1						
3			9		2			5

Key Ingredients

- Targeted Training
- Multiple Training Trials
- Adaptability
- Motivating/engagement
- Bottom-up/Top-Down approaches

Restore, Improve, Repair

- Neuroplasticity induced cognitive training:
  - Restore or Improve cognition
  - Repair or Strengthen neural pathways
- BUT . . .
  - We need to show that it translates to ecological functional repair to improve patients everyday activities.

Thank you for your attention.