Cognitive Functioning in Individuals with Spinal Cord Injury (SCI)

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Disclosures

Dr. Chiaravalloti has no disclosures to report.

Outline

- Defining Cognition
  - Cognitive domains
- SCI and Cognitive Functioning
- Potential causes/ sources of Cognitive Deficits in SCI

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Cognition

- "the mental action or process of acquiring knowledge and understanding through thought, experience, and the senses."
  - conscious and unconscious
  - Concrete and abstract
  - Intuitive and conceptual

Cognition

- Includes the concepts of
  - Knowledge
  - Attention
  - Memory
  - Judgment and evaluation
  - Reasoning and "computation”
  - Problem solving and decision making
  - Comprehension and language production

Cognition

- Cognitive processes use existing knowledge and generate new knowledge
- Ongoing changing *process.*
- *We rely on cognition EVERY day.*
- Central to who we are and what we do with our lives.

Impact of Cognition on Daily Life

- Cognitive deficits lead to:
  - Depression, anxiety
  - Decreased participation
  - Increased unemployment
  - Decreased quality of life

So What?

- Age of onset and career productivity
  - Career development may slow or stop
- Physical and cognitive impairments lead to early retirement
- Biggest Obstacles to maintaining employment
  - information processing deficits
  - memory deficits

What does this mean?

- MUST identify cognitive deficits when they present and treat them effectively

- First step: Reliably identify the deficits experienced

Cognitive Domains

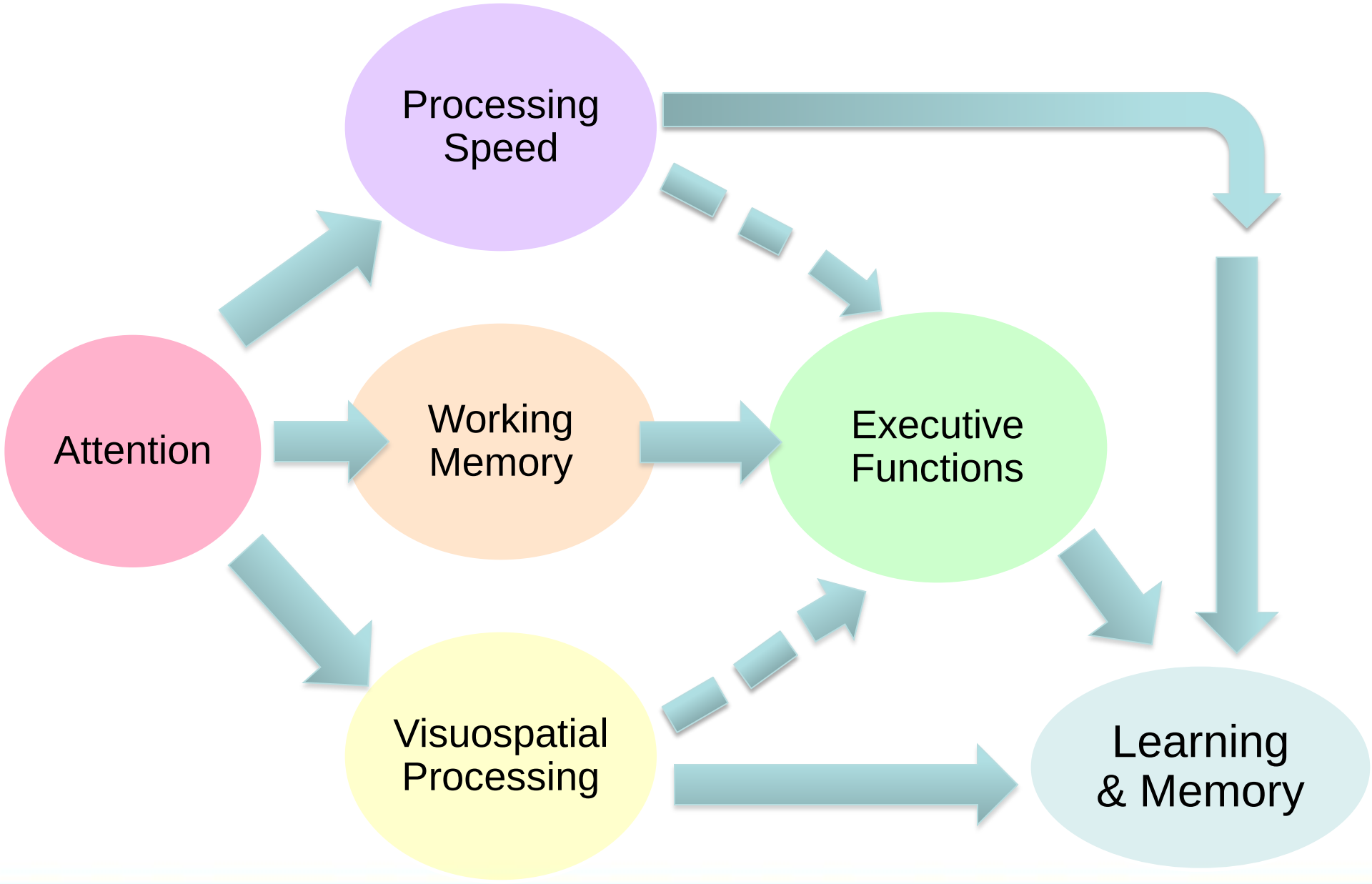
- Attention
- Working Memory
- Processing Speed
- Visuospatial processing
- Long Term Memory
- Executive Functioning

Intelligence - not a cognitive domain, culmination of cognitive abilities

Breaking Down the Domains

- Attention
  - Simple
  - Sustained
  - Divided
- Working Memory
  - Maintenance
  - Manipulation

- Long Term Memory
  - Verbal and Non-verbal
  - Episodic, procedural
  - Retrospective, Prospective
  - Encoding, Consolidation, Retrieval
- Executive Functioning
  - Fluency
  - Mental flexibility
  - Disinhibition
  - Problem Solving
  - Abstract Reasoning


Processing Speed
Attention
Working Memory
Executive Functions
Visuospatial Processing
Learning & Memory

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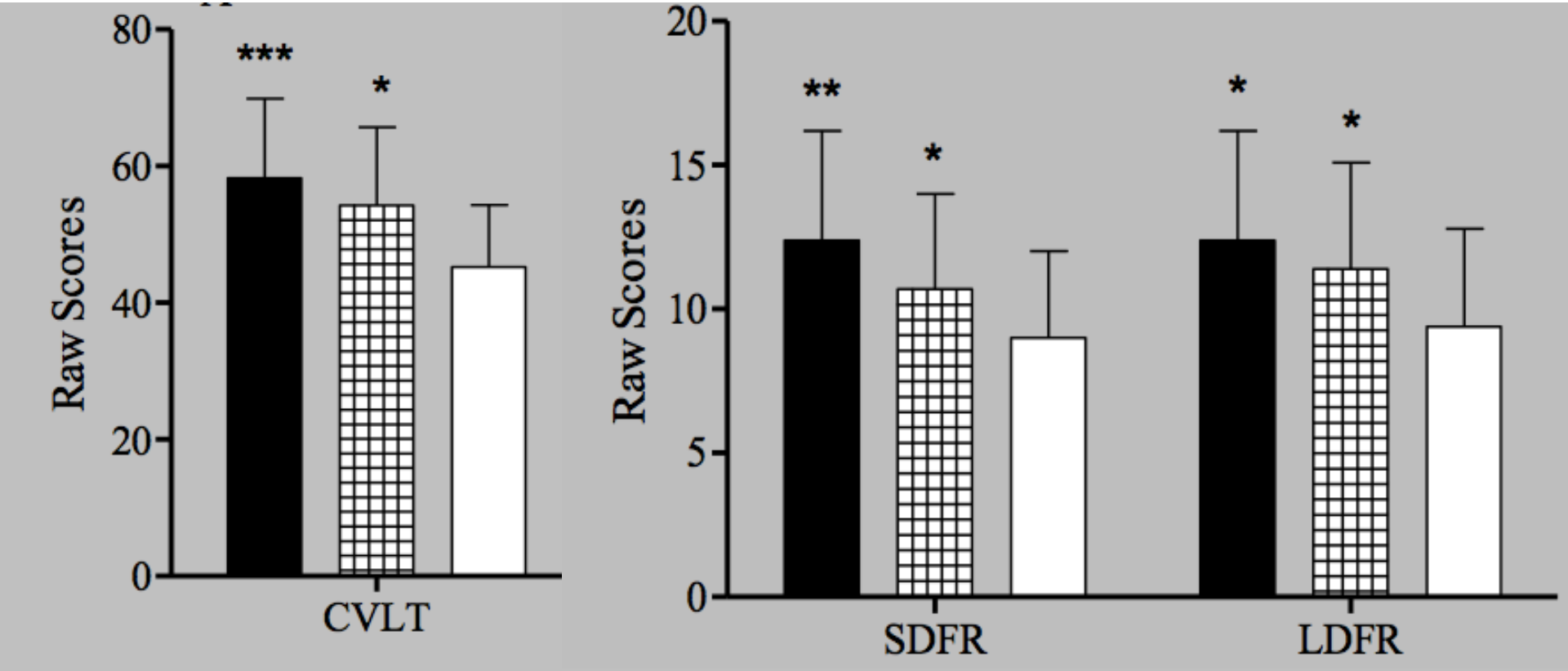
Sample Characteristics

	Tetraplegia N=18 C3-C8	High Para N=5 T1-T5	Low Para N=14 T7-T12	Older Controls N=14	Age Matched Controls N=18
Age	38±8	39±6	34±6	60±3	36±8
Duration of Injury	14.2±8.9	13.6±5.1	8.4±4.5	n/a	n/a
Education	14.1±2.8	13.8±1.5	13.3±2.2	16.3±2.5	15.9±2.0

Our Data (unpublished)



*** $p<0.001$ vs. SCI; ** $p<0.01$ vs. SCI; * $p<0.05$ vs. SCI

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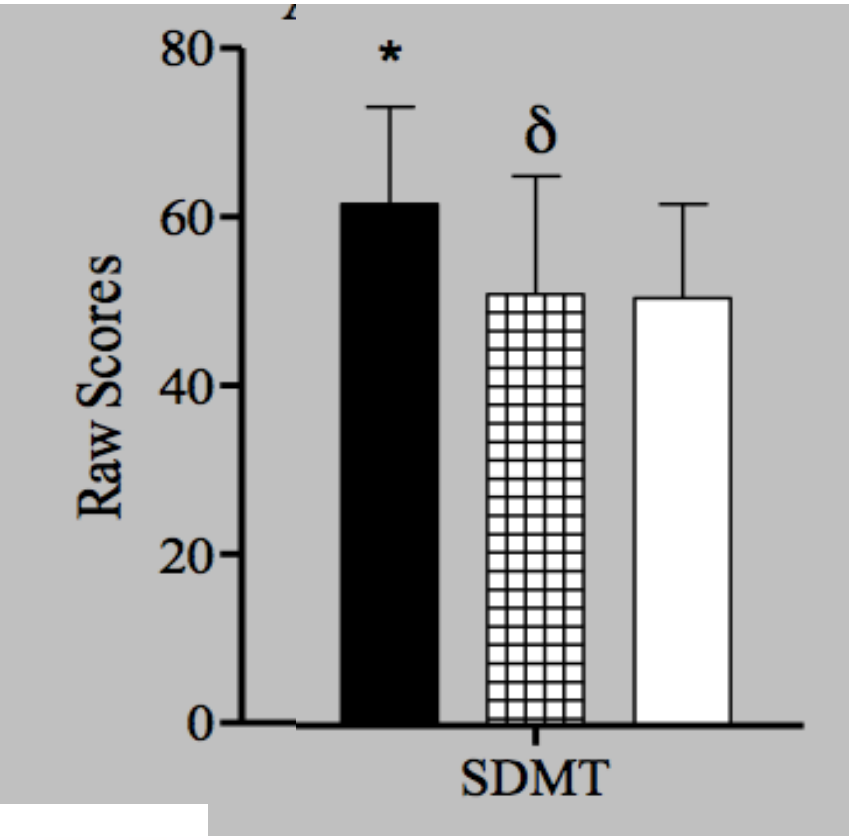

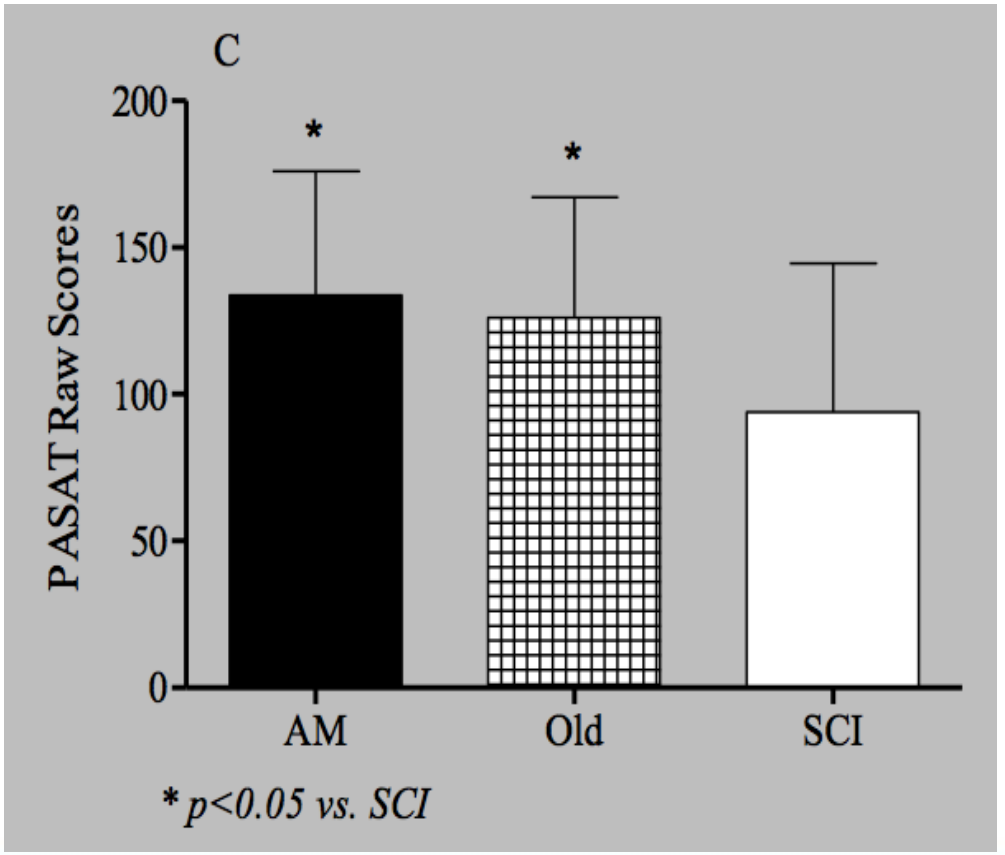

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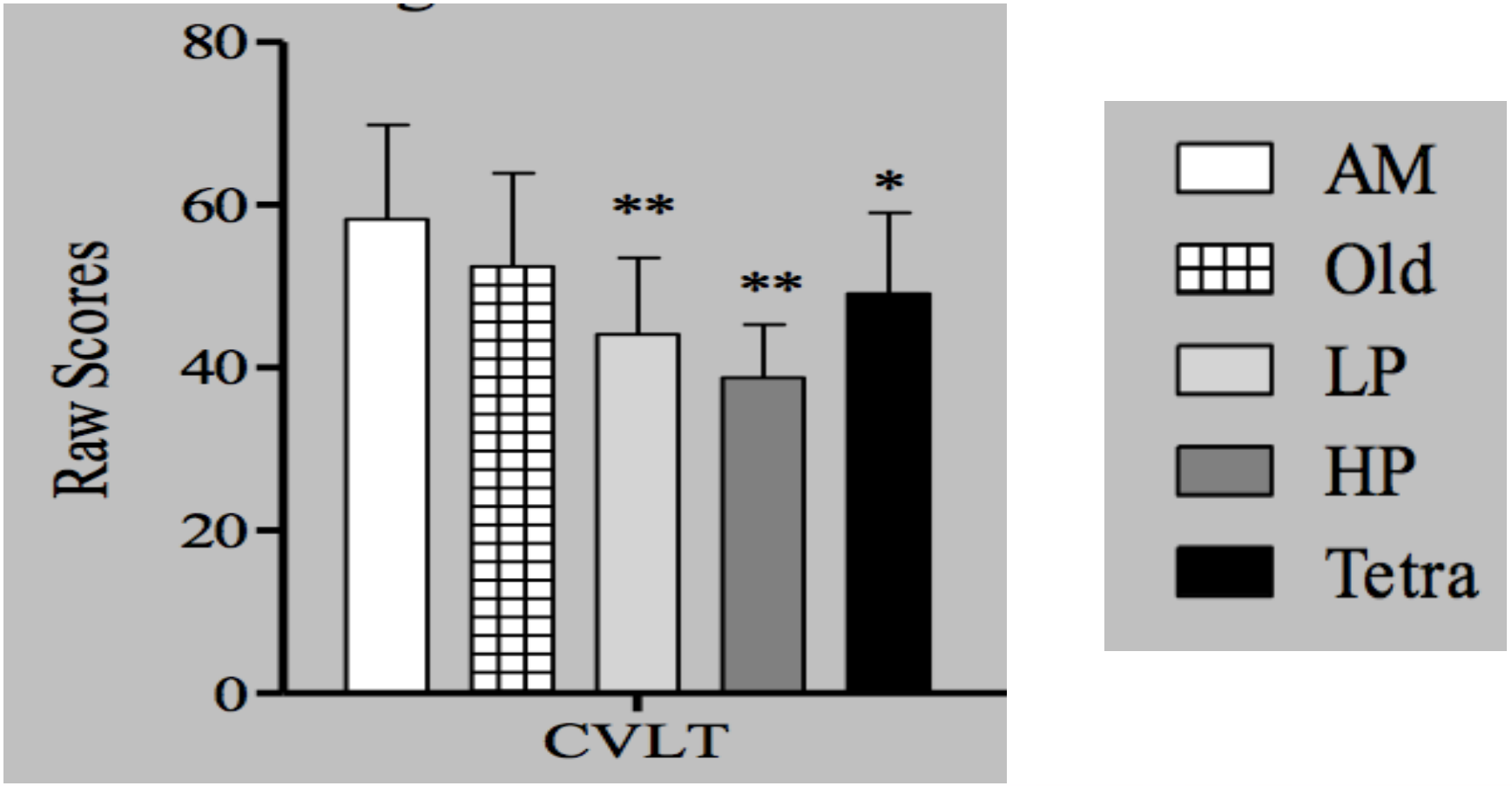

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** $p<0.01$ vs. AM; * $p<0.05$ vs. AM

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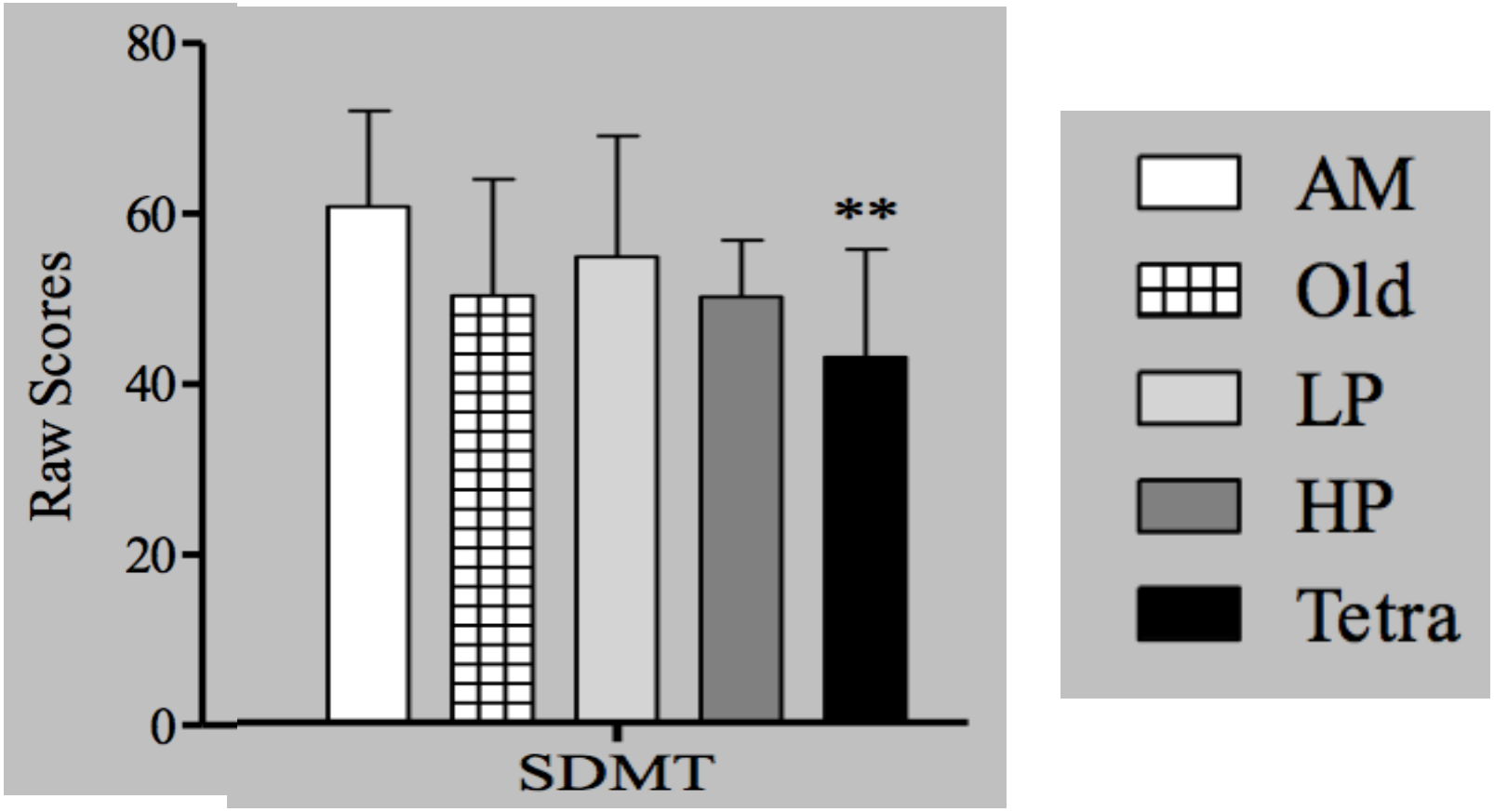

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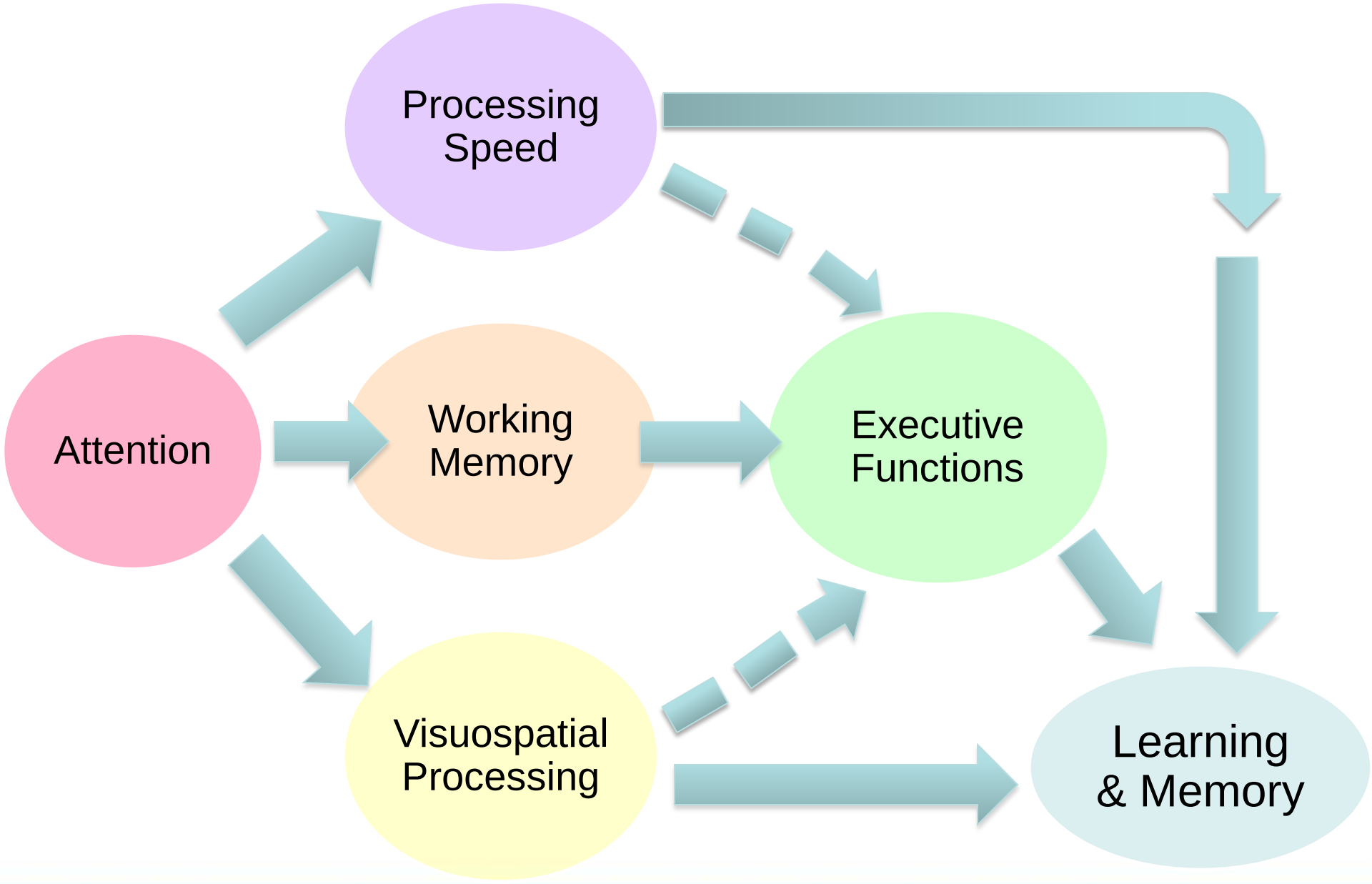
** $p<0.01$ vs. AM; * $p<0.05$ vs. AM

Thinking about treatment

- EXACTLY what is the deficit?
  - Off to a good start
  - Learning, immediate recall, long term recall
  - Processing speed
- Are there other deficits?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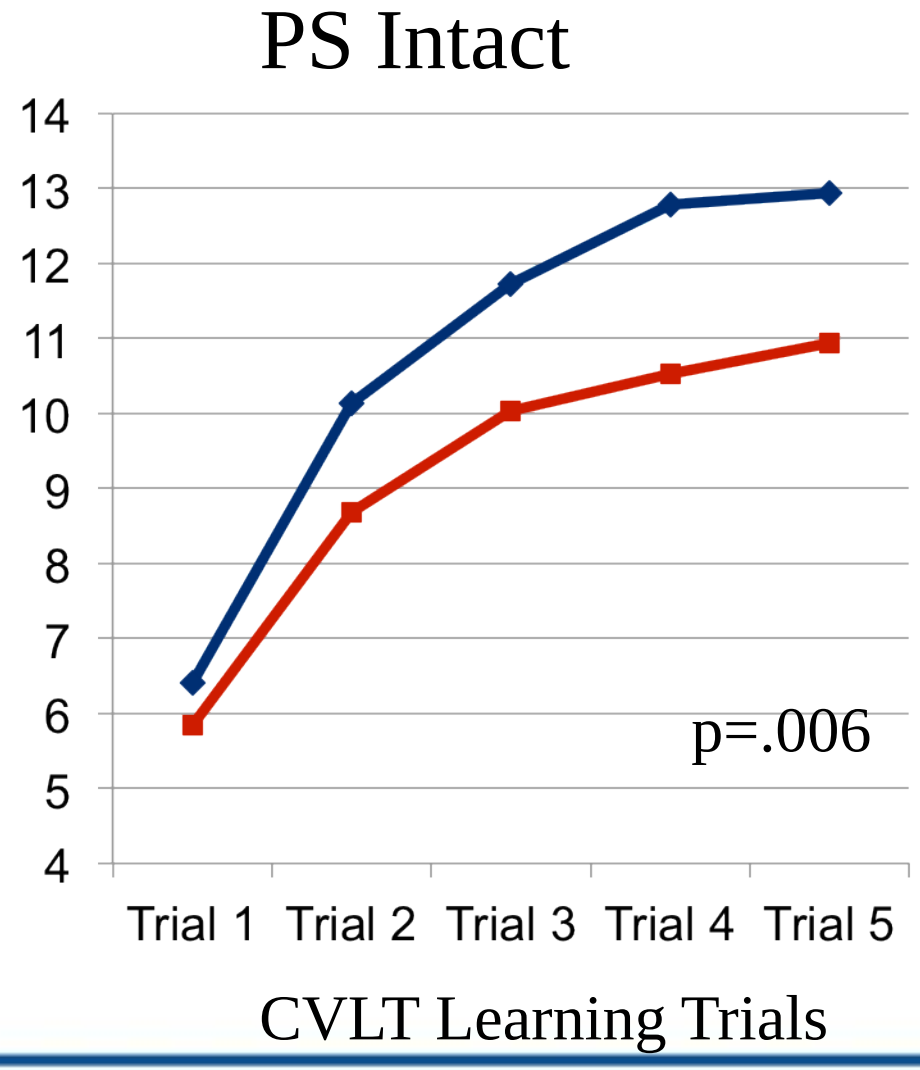
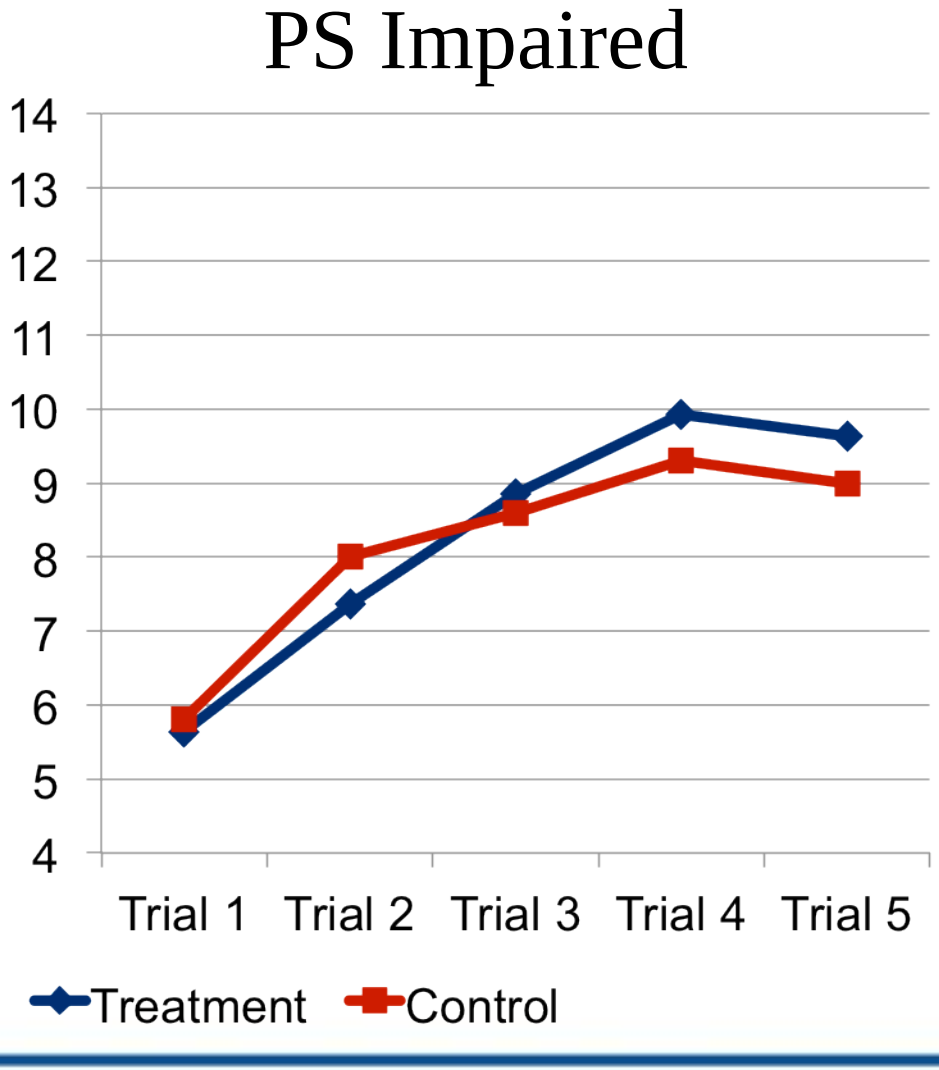
How does Processing Speed affect memory?

- When information is coming in fast
  - Cannot process all of it
  - Certainly cannot process it correctly
- All working memory tasks requiring one to process information within a circumscribed period of time
  - Tasks may not be timed, but there is a decay of information (decay occurs over *time*)
- What does this mean?
  - Poor PS → poor learning and memory

Impact of PS on treatment efficacy





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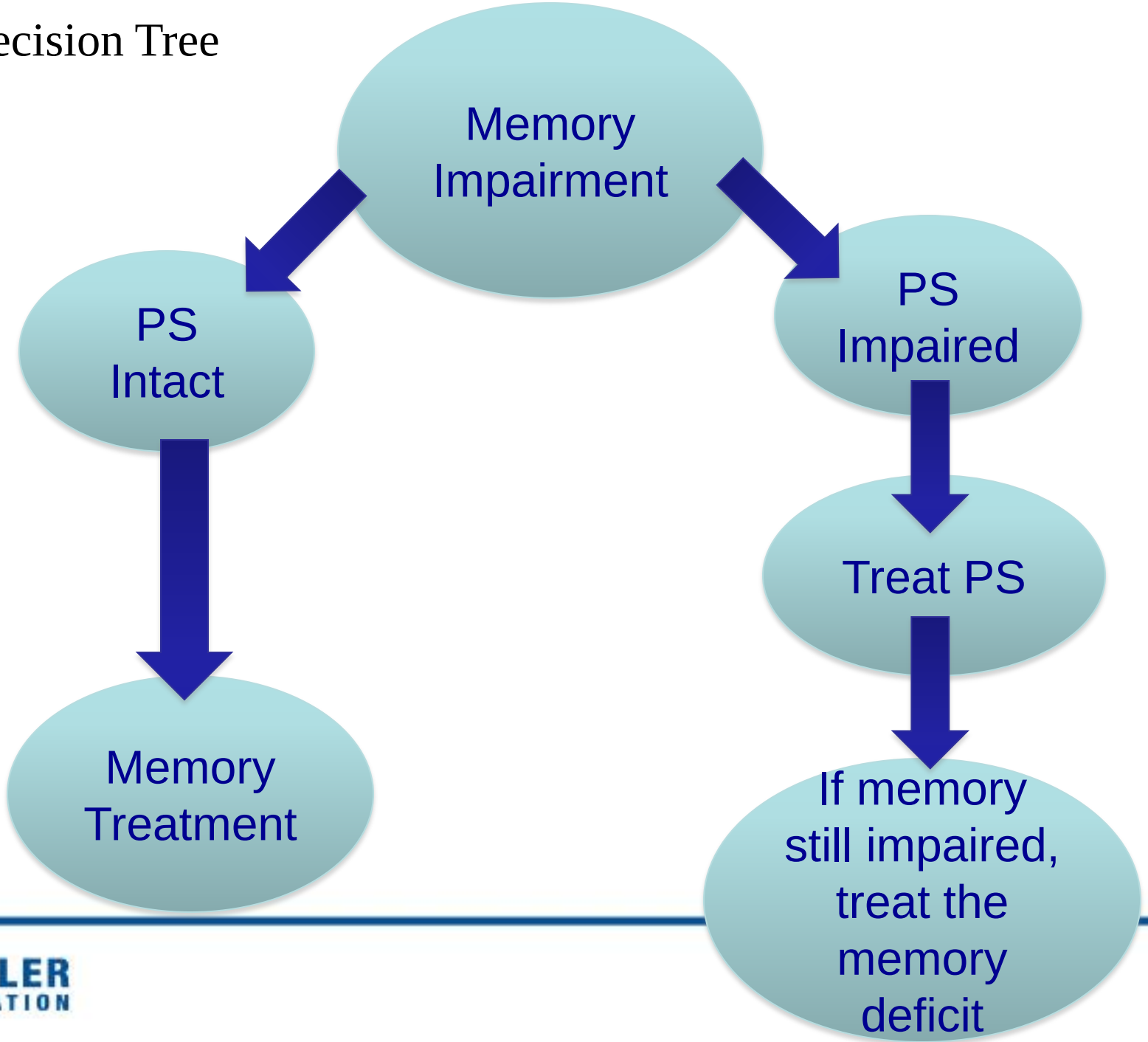
* No significant group difference pre-treatment

Model Decision Tree



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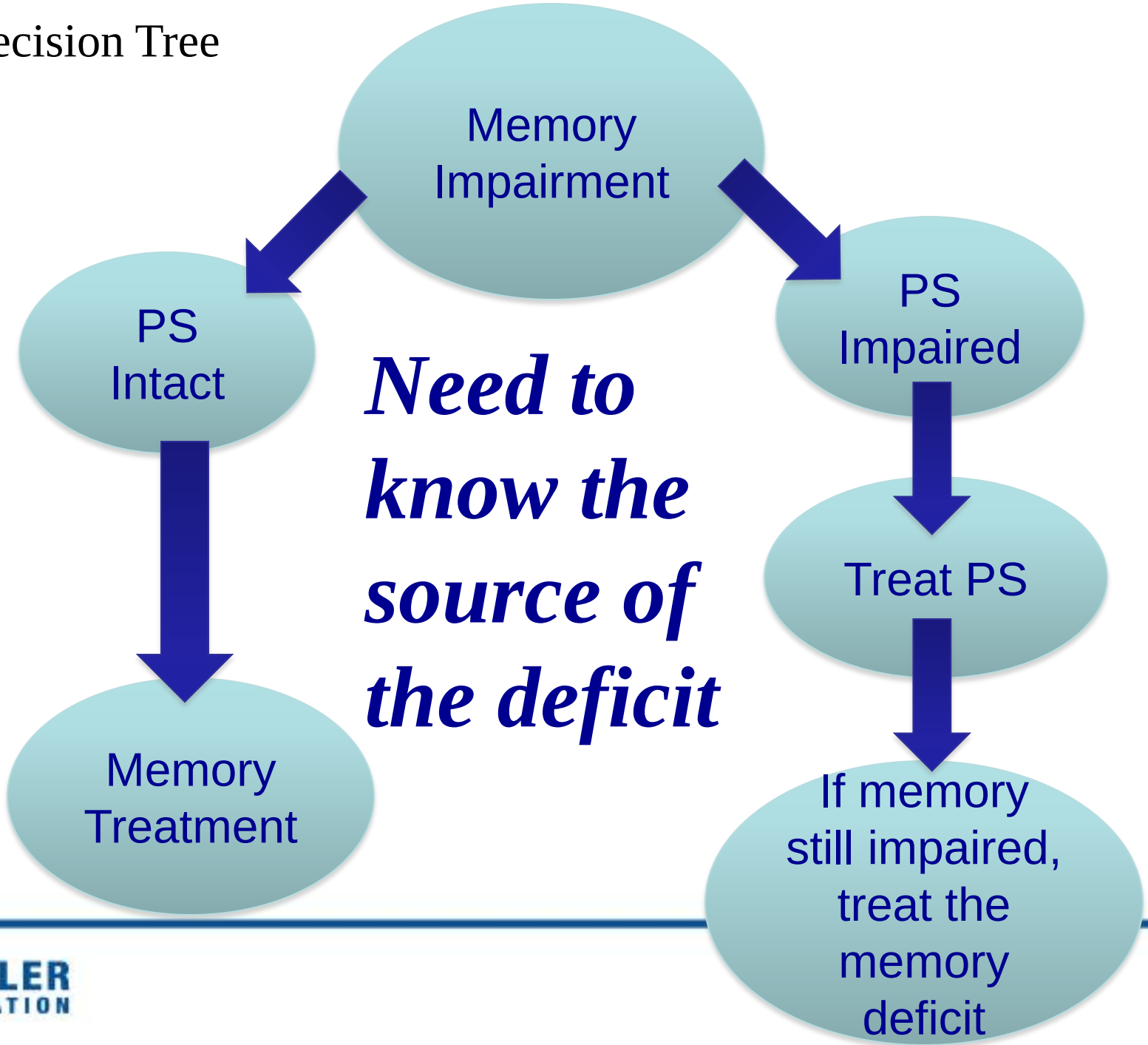

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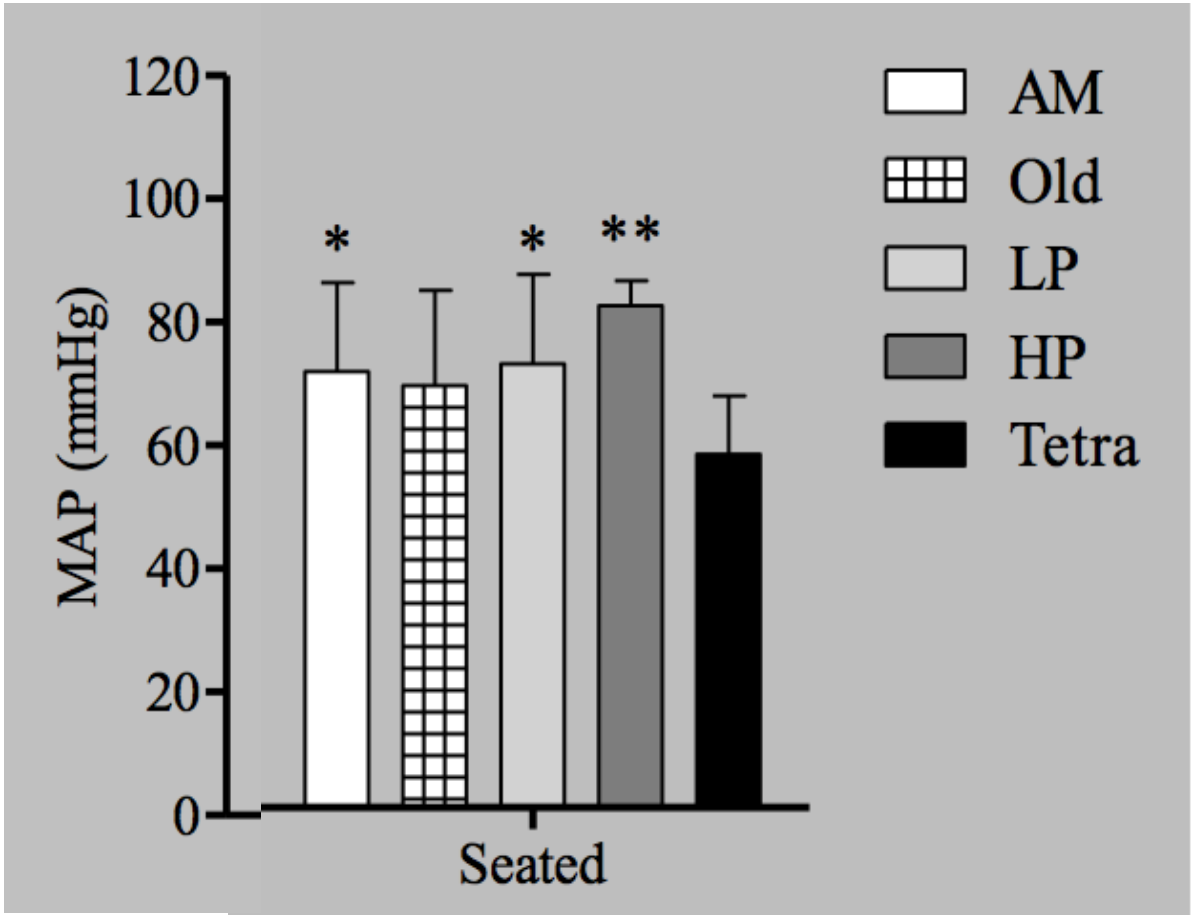
Potential Causes of Cognitive Deficits in SCI Population

- Cerebrovascular Insufficiency
- Concomitant TBI
  - Dual Diagnosis
  - TBI may be mild
- Both

Methods for Determining Cause

- Cerebrovascular Testing during cognitive performance
- Imaging
  - Brain
  - DTI, fMRI
- Observing trajectory of change

MAP Data (unpublished)



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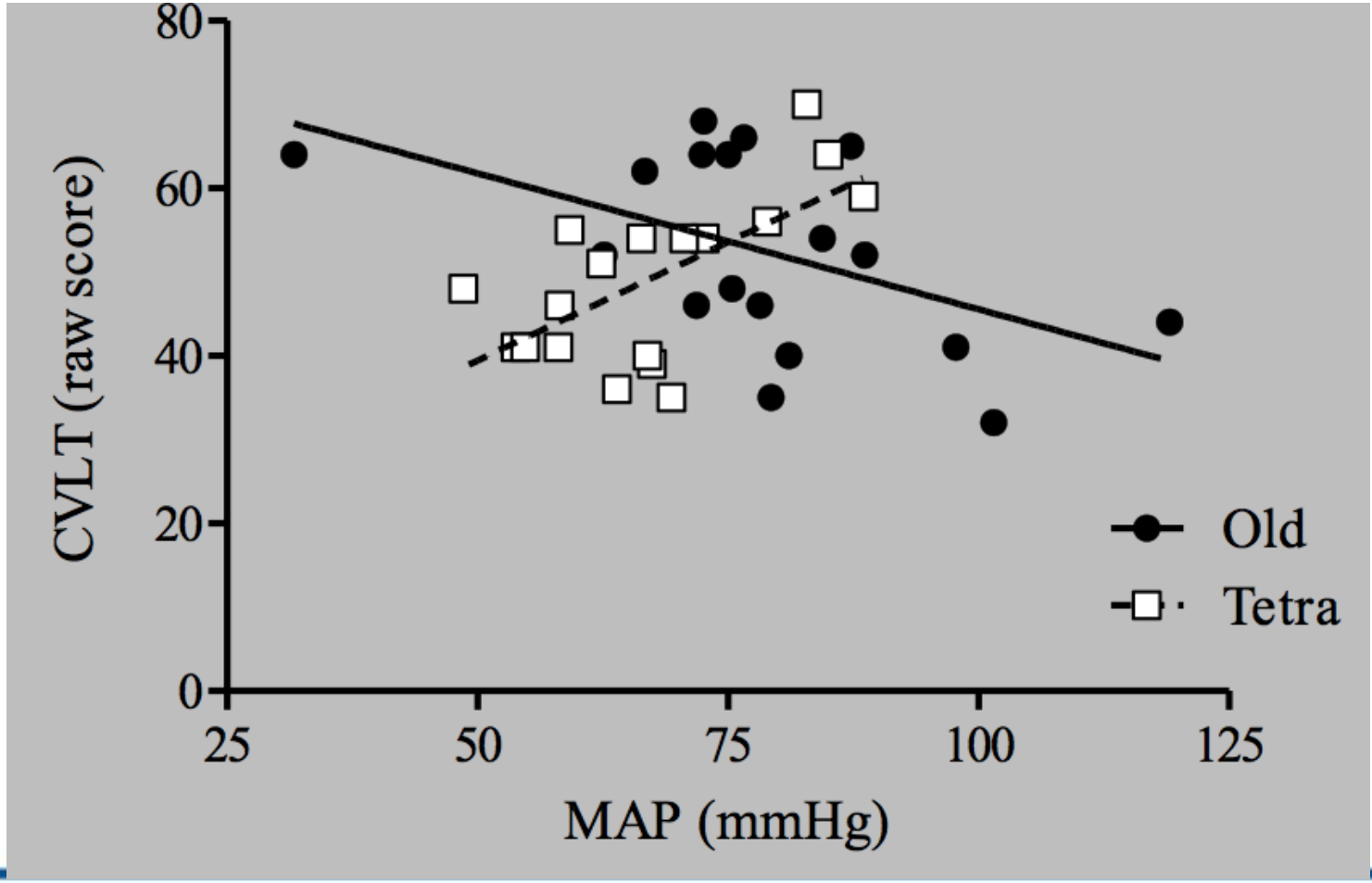
** p<0.05 vs. Tetra; ** p<0.01 vs. Tetra*

MAP and Memory Data (unpublished)



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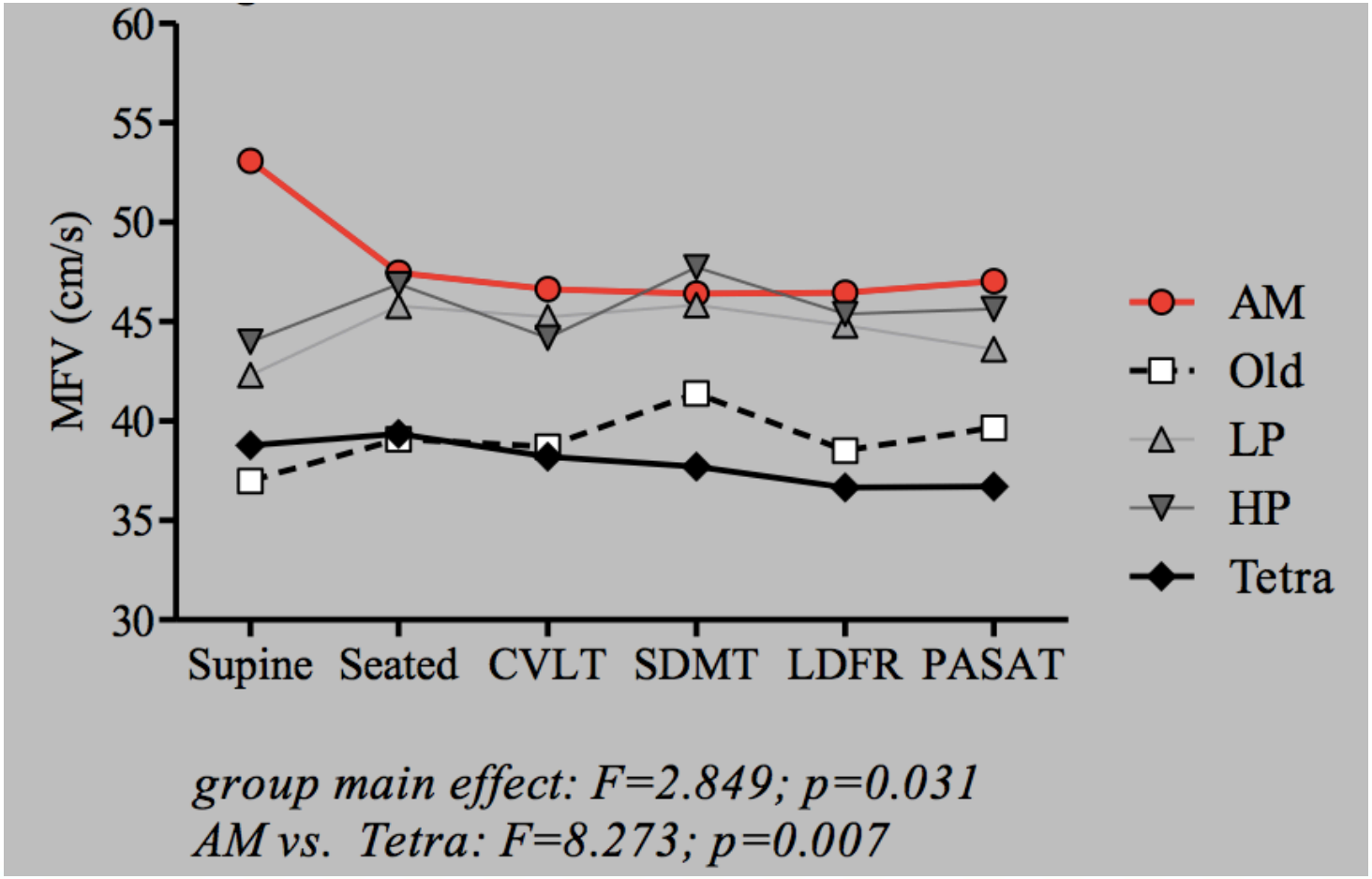
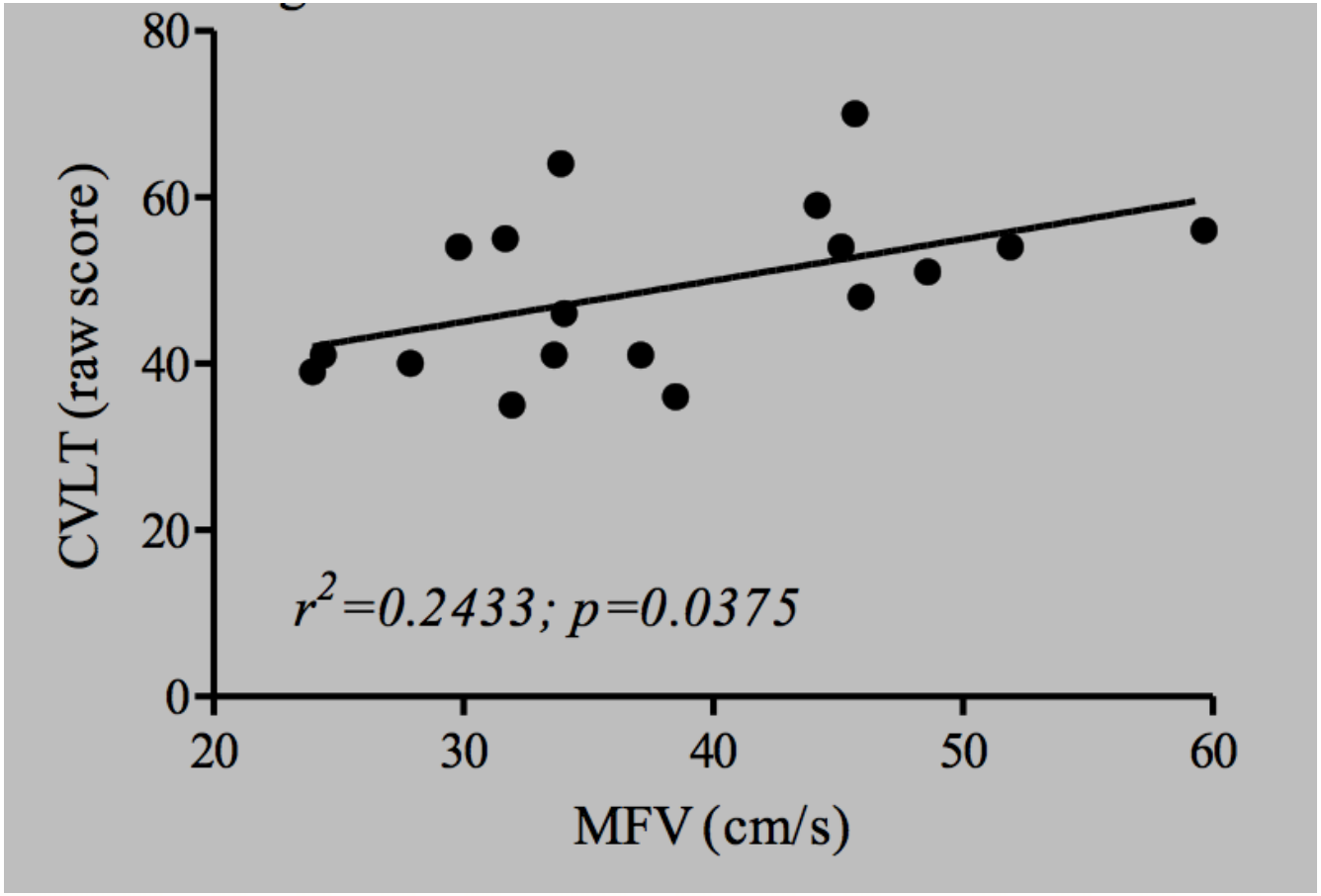
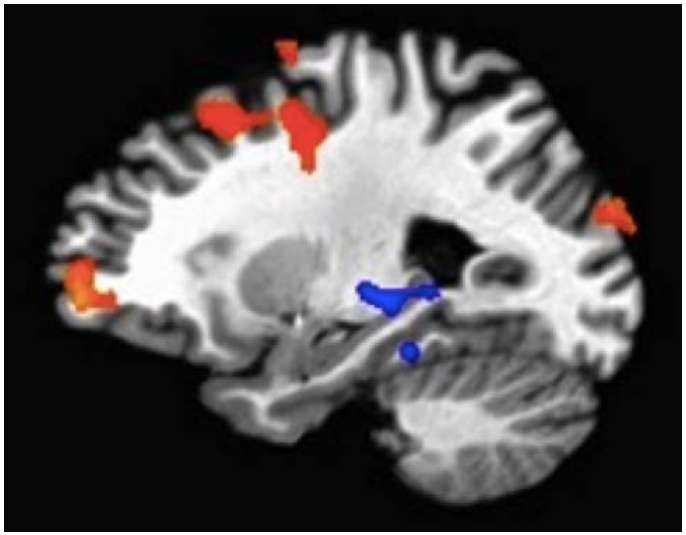
MFV Data (unpublished)



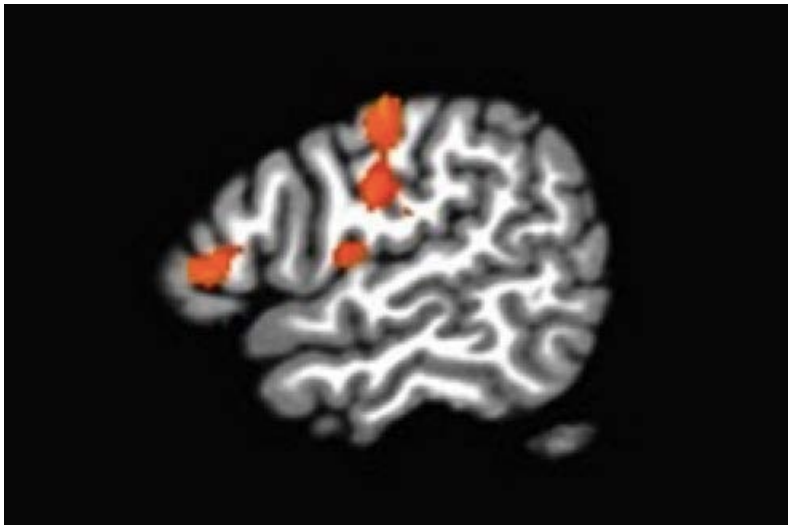
MFV and Memory Data (unpublished)



fMRI Data (unpublished) subset (n=29)



Increased activation in frontal and parietal areas in LP compared to AM (red), Less activation (blue) in memory areas



More activation in frontal and motor regions than AM controls during PS task, performance required more cerebral resources in Tetra

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** fMRI findings corroborate behavioral findings

What does this mean? Informing Treatment

- Data indicate a contribution of cerebrovascular insufficiency
  - Treat low BP and observe cognition
    - Ongoing with Mitodrine
    - Observing immediate and long term effects
- Also observing fMRI abnormalities
  - Early CR
    - Launching cognitive rehab trial in SCI
  - Treat for mild TBI early

Collaborators

Jill Wecht, PhD
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