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What's Next in TBI Research

Innovation, Collaboration, and Impact at Kessler Foundation

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The Big Picture: Kessler Foundation's Collaborative Approach to TBI

Nancy Chiaravalloti, PhD

Director of the Centers for Neuropsychology, Neuroscience, and Traumatic Brain Injury Research

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Traumatic Brain Injury Research at Kessler Foundation

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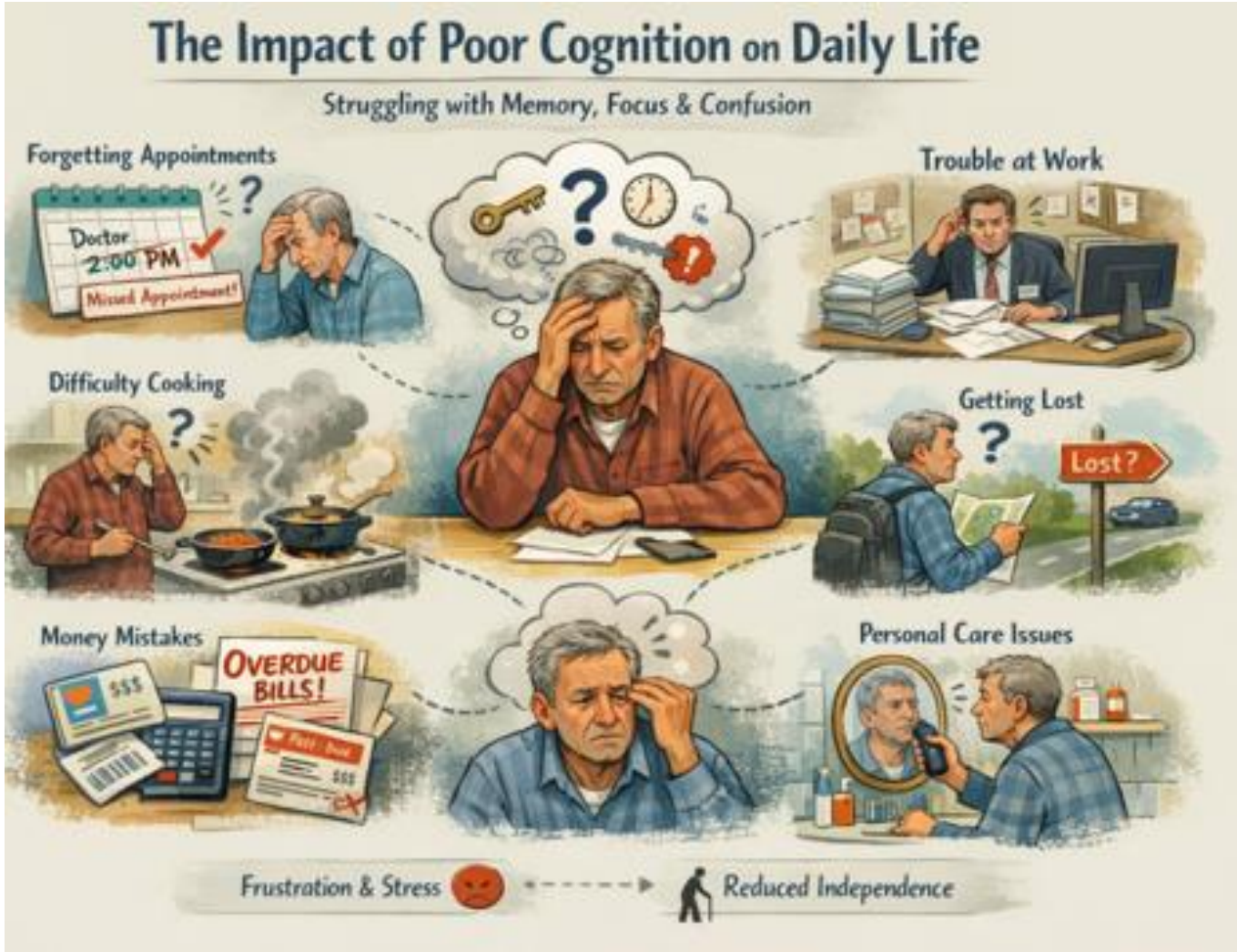
Neuroscience, Neuropsychology, and Traumatic Brain Injury

- Neuropsychology & Neuroscience interact to help understand TBI and post-TBI challenges
- TBI often leads to changes in behavior, including thinking abilities
- Neuropsychology – facilitates our understanding of behavior and thinking
  - Why are they changing?
- Neuroscience – links changes in brain function to those changes in behavior
  - Understanding changes in brain anatomy and function post TBI
    - How does that relate to changes in behavior and thinking



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Converting Thorough Research Into Impactful, Practical Results

- People have been studying TBI and its resulting challenges for years
  - Cognition
  - Emotional Functioning
  - Employment
  - Social Relatedness
  - Physical Functioning
- We continue efforts to increase our understanding of changes post TBI
- Additional emphasis
  - How to these changes impact daily life?
    - Self-Report
    - Informant Report
    - Everyday Life Assessment

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Partnering with People with TBI and their Families to Guide Research

Several Mechanisms to Facilitate Consumer Input

Community Advisory Board

Consumer Consultants

Dissemination

brainwaves

Center for Traumatic Brain Injury Research at Kessler Foundation
Northern New Jersey Traumatic Brain Injury System

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Studies from the
Center for Traumatic Brain Injury Research at Kessler Foundation

Northern New Jersey
Traumatic Brain Injury System
proudly presents

A Consumer Conference for Persons with Brain Injury

"Moving Forward: Overcoming Obstacles and Improving Quality of Life"

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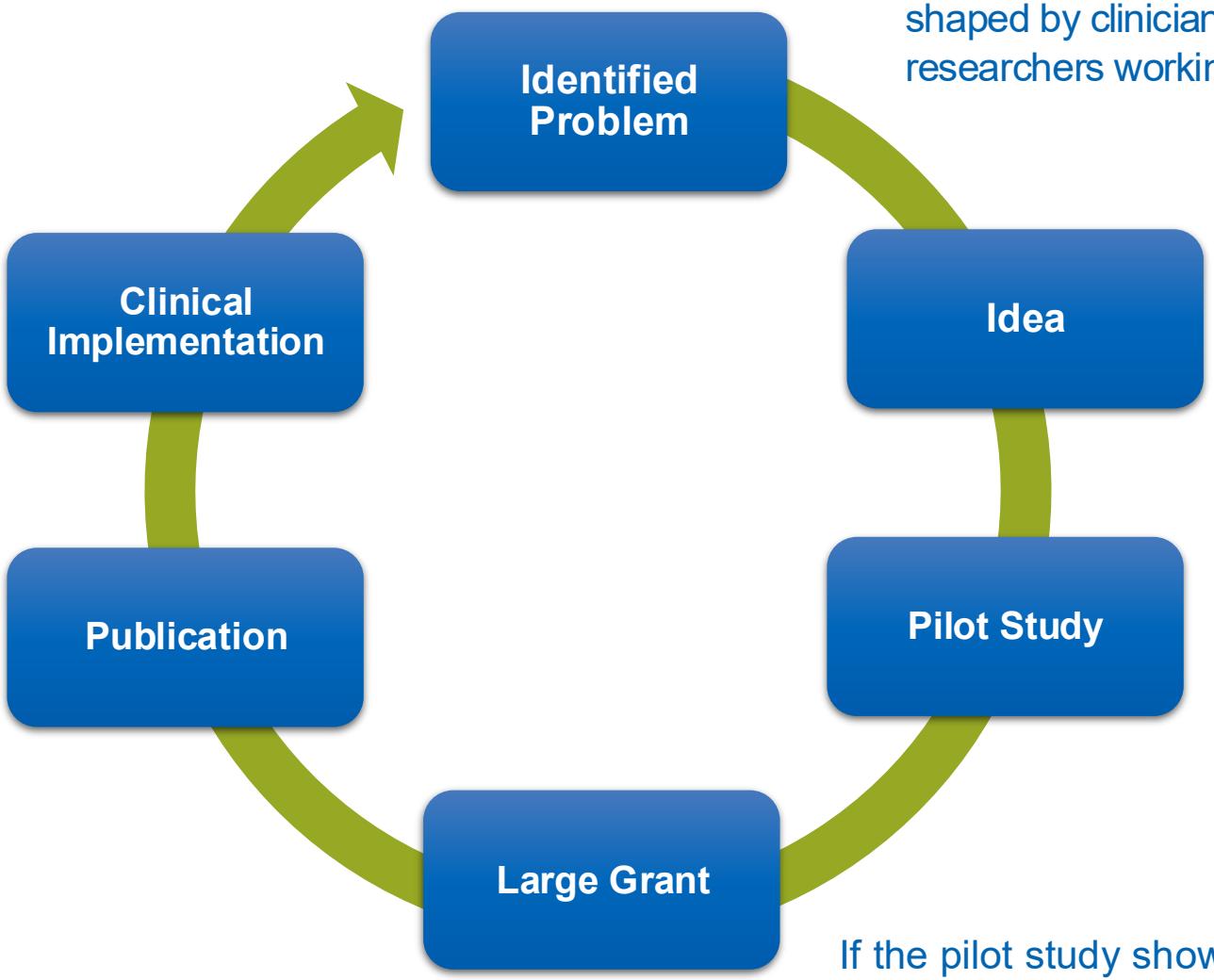
How Rehabilitation Research Moves from Theory to Practical Intervention

New treatments begin with an identified need, shaped by clinicians, patients, caregivers, and researchers working together.



The idea may be generated by an individual or a brainstorming group

The idea is first tested in a small group of participants

If the pilot study shows promise, a larger study is designed

The larger study will result in a publication to share the new treatment with other professionals

As clinicians learn of the new treatment they implement it with patients

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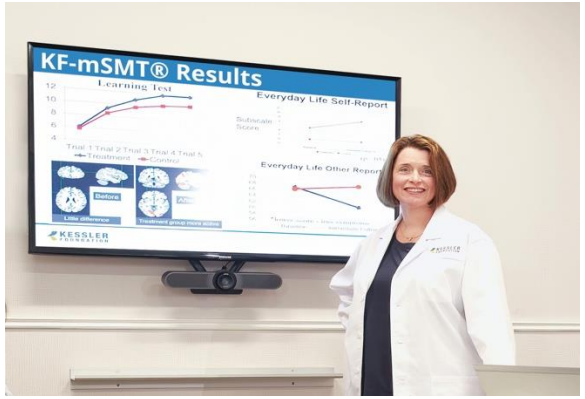

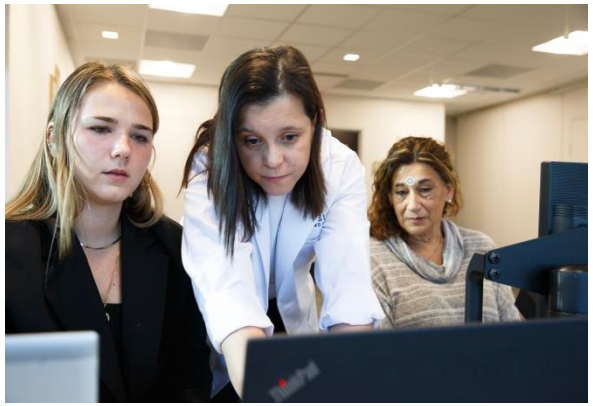

Today's Topics

- Cognition and Cognitive Rehabilitation
- Exercise and Cognition
- Eye Movements and Eye Tracking

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Cognition and Cognitive Rehabilitation

Nancy Chiaravalloti, PhD

Director of the Centers for Neuropsychology, Neuroscience, and Traumatic Brain Injury Research

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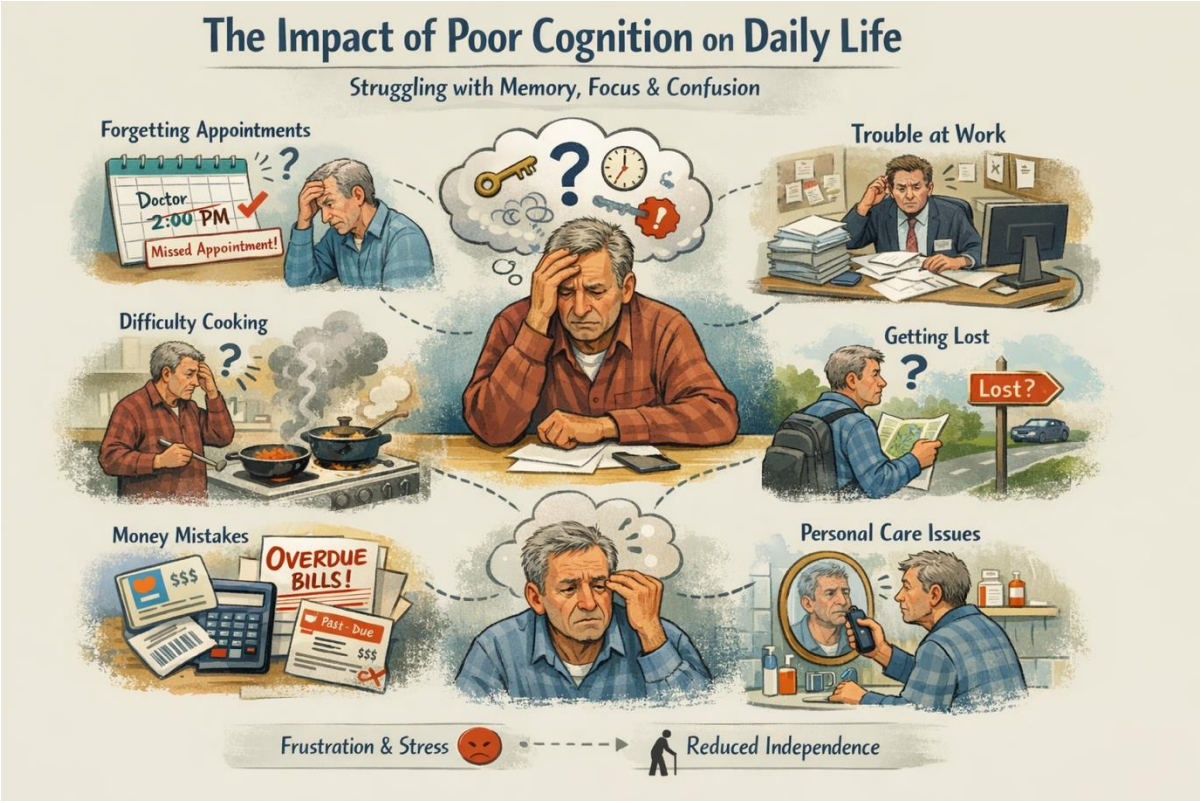
Why Study Cognition and Cognitive Rehabilitation?

- Our cognition makes us who we are.
  - Allow us to create and maintain relationships, engage in social interactions, pursue educational activities, work and enjoy a high quality of life.
- When cognition declines, engagement in these life activities may decline as well.
- Cognitive deficits impact daily life functioning and quality of life.
- We need to find ways to strengthen cognition into healthy old age and in the face of injury and illness.



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Our Cognition and Cognitive Rehabilitation Goals

- Understand the complexity of cognitive deficits and their interaction
- Develop and Evaluate Cognitive Rehabilitation Programs
  - Kessler Foundation modified Story Memory Technique (KF-mSMT®)
- Understand the Impact of Cognitive Rehabilitation on Everyday Life

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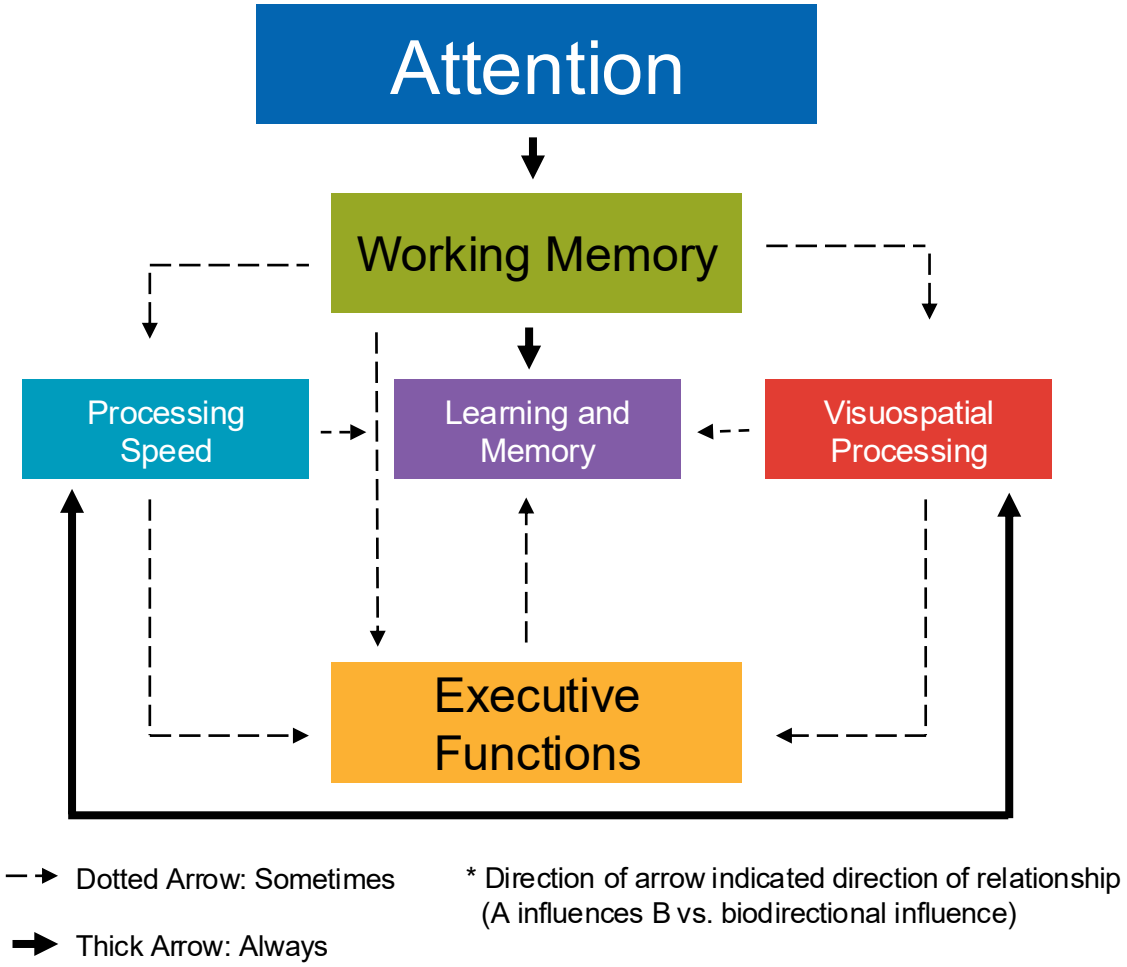
Understanding Cognitive Challenges After TBI



Attention

Processing Speed

Working Memory

Executive Functioning

Learning and Memory

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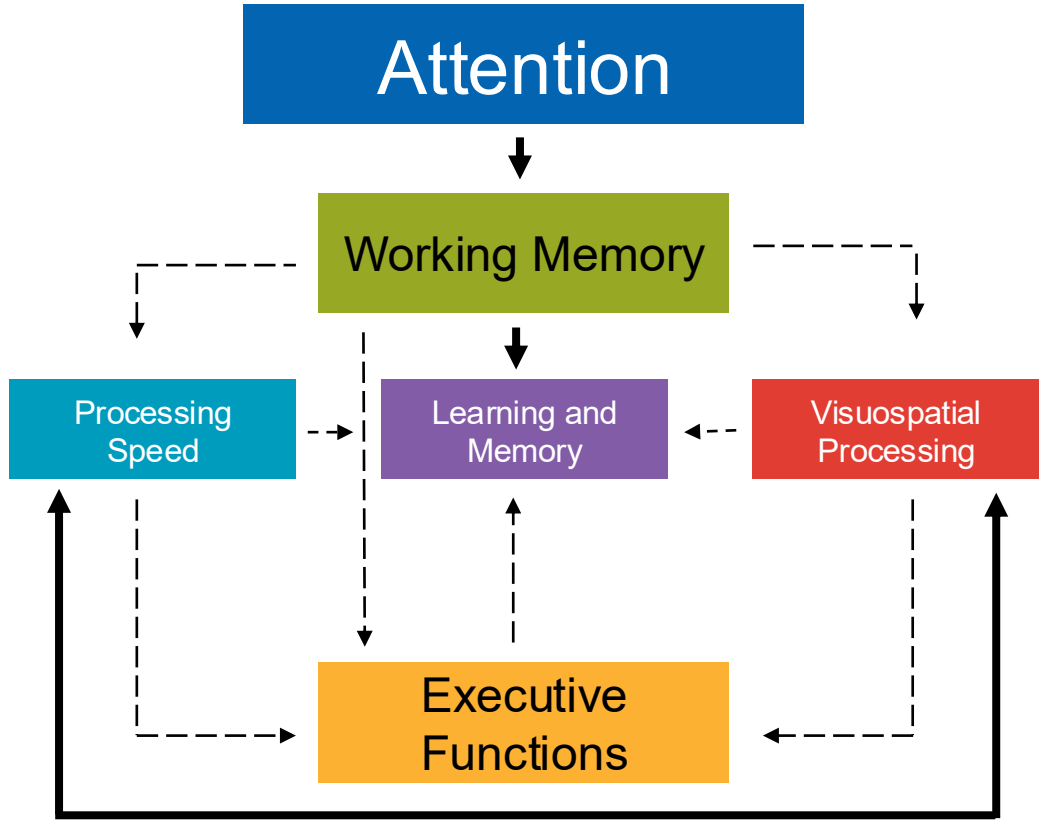
Understanding Cognitive Challenges After TBI



Attention

Processing Speed

Working Memory

Executive Functioning

Learning and Memory

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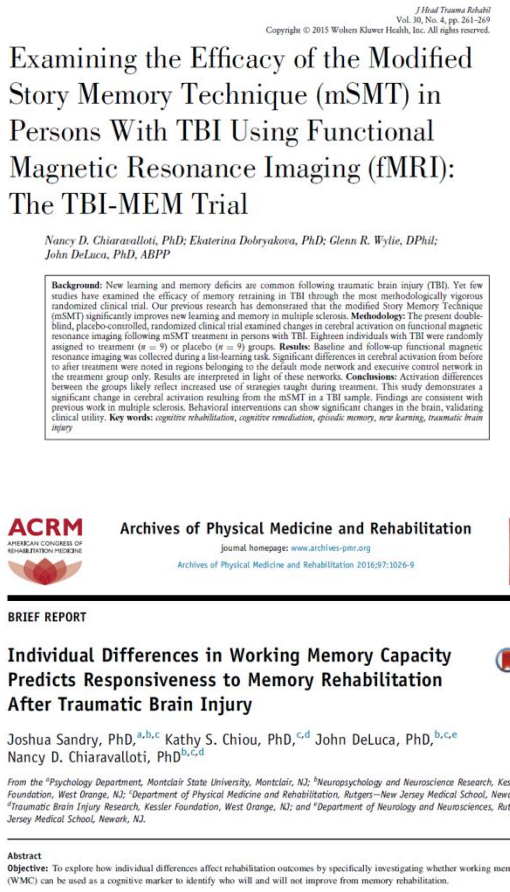
Goal 2: Develop and Evaluate Cognitive Rehabilitation Programs

Kessler Foundation modified Story Memory Technique (KF-mSMT®)

- Computer-mediated cognitive rehabilitation program
- Teaches use of context and imagery to strengthen memory in 10-16 sessions
- Several publications showing efficacy across 3 domains
  - Neuropsychological tests
  - Daily life functioning
  - Functional neuroimaging
- Many versions
  - Zoom and in-person
  - English, Spanish, Chinese, Italian, Portuguese, Greek
  - Pediatric Version
  - Group Administered Version
- The KF-PUPIL program is currently being developed as a supplement
  - Caregiver curriculum
  - Tabletop game designed to teach/practice strategies



J Head Trauma Rehabil
Vol. 30, No. 4, pp. 261–269

Examining the Efficacy of the Modified Story Memory Technique (mSMT) in Persons With TBI Using Functional Magnetic Resonance Imaging (fMRI): The TBI-MEM Trial

Nancy D. Chiaravalloti, PhD; Ekaterina Dobryakova, PhD; Glenn R. Wylie, DPhil; John DeLuca, PhD, ABPP

Background: New learning and memory deficits are common following traumatic brain injury (TBI). Yet few studies have examined the efficacy of memory retraining in TBI through the most methodologically vigorous randomized clinical trial. Our previous research has demonstrated that the modified Story Memory Technique (mSMT) significantly improves new learning and memory in multiple sclerosis. **Methodology:** The present double-blind, placebo-controlled, randomized clinical trial examined changes in cerebral activation on functional magnetic resonance imaging following mSMT treatment in persons with TBI. Eighteen individuals with TBI were randomly assigned to treatment ($n = 9$) or placebo ($n = 9$) groups. **Results:** Baseline and follow-up functional magnetic resonance imaging was collected during a list-learning task. Significant differences in cerebral activation from before to after treatment were noted in regions belonging to the default mode network and executive control network in the treatment group only. Results are interpreted in light of these networks. **Conclusions:** Activation differences between the groups likely reflect increased use of strategies taught during treatment. This study demonstrates a significant change in cerebral activation resulting from the mSMT in a TBI sample. Findings are consistent with previous work in multiple sclerosis. Behavioral interventions can show significant changes in the brain, validating clinical utility. **Key words:** *cognitive rehabilitation, cognitive remediation, episodic memory, new learning, traumatic brain injury*

ACRM AMERICAN CONGRESS OF REHABILITATION MEDICINE
Archives of Physical Medicine and Rehabilitation
journal homepage: www.archives-pmr.org
Archives of Physical Medicine and Rehabilitation 2016;97:1026-9

BRIEF REPORT

Individual Differences in Working Memory Capacity Predicts Responsiveness to Memory Rehabilitation After Traumatic Brain Injury

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From the [a]Psychology Department, Montclair State University, Montclair, NJ; [b]Neuropsychology and Neuroscience Research, Kessler Foundation, West Orange, NJ; [c]Department of Physical Medicine and Rehabilitation, Rutgers—New Jersey Medical School, Newark, NJ; [d]Traumatic Brain Injury Research, Kessler Foundation, West Orange, NJ; and [e]Department of Neurology and Neurosciences, Rutgers—New Jersey Medical School, Newark, NJ.

Abstract
Objective: To explore how individual differences affect rehabilitation outcomes by specifically investigating whether working memory cap (WMC) can be used as a cognitive marker to identify who will and will not improve from memory rehabilitation.

BRAIN INJURY
https://doi.org/10.1080/02699052.2023.2216024
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Taylor & Francis Group

The influence of information processing speed on benefit from learning and memory rehabilitation in TBI: a sub-analysis of the TBI-MEM trial

Nancy D. Chiaravalloti[a,b], Silvana Costa[a,b], Caroline Armknecht[a], Kristen Costanza[a], Aubree Alexander[a,b], and John DeLuca[a,b,c]

[a]Kessler Foundation, Center for Neuropsychology and Neuroscience Research, East Hanover, New Jersey, USA; [b]Rutgers –New Jersey Medical School, Department of Physical Medicine and Rehabilitation, Newark, New Jersey, USA; [c]Rutgers –New Jersey Medical School, Department of Neurology & Neurosciences, Newark, New Jersey, USA

ABSTRACT
Objective: This study examined the influence of processing speed (PS) on benefit from treatment with the Kessler Foundation modified Story Memory Technique® (KF-mSMT®), a cognitive rehabilitation intervention shown to improve new learning and memory in traumatic brain injury (TBI).
Setting: Non-profit research center
Participants: 62 participants with moderate-to-severe TBI were included, 31 assigned to the treatment group and 31 to the placebo-control group.
Design: Double-blind, placebo-controlled, randomized clinical trial. The present study represents a post-hoc analysis to examine the role of PS on treatment efficacy.
Main Measures: Baseline and follow-up neuropsychological assessment including the California Verbal Learning Test, Second Edition (CVLT-II), Memory Assessment Scales – Prose Memory (MAS-PM) and the Symbol Digit Modalities Test (SDMT).
Results: A treatment effect was not observed on the CVLT-II learning slope in the treatment group relative to the placebo group post-treatment, after co-varying for education, baseline CVLT slope and PS performance. However, performance on a measure of PS, the SDMT, was a significant predictor of post-treatment change following KF-mSMT® treatment. PS was not a significant predictor of benefit from treatment as documented by the MAS-PM immediate or delayed recall score, both of which showed a significant treatment effect.
Conclusion: Performance on measures of cognitive dysfunction aside from learning and memory impact the benefit from KF-mSMT® treatment. Implications for cognitive rehabilitation for individuals with TBI are discussed.

ARTICLE HISTORY
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Accepted 16 May 2023

KEYWORDS
Traumatic brain injury; episodic memory; processing speed; cognitive rehabilitation; KF-Msmt; learning

Clinical Research Article

An RCT to Treat Learning Impairment in Traumatic Brain Injury: The TBI-MEM Trial

Neurorehabilitation and Neural Repair
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Nancy D. Chiaravalloti, PhD[1,2], Joshua Sandry, PhD[1,2], Nancy B. Moore, MA[1], and John DeLuca, PhD[1,2]

Abstract
Objective. To examine the efficacy of the modified Story Memory Technique (mSMT) to improve learning (ie, acquisition) and memory in participants with TBI. The mSMT is a behavioral intervention that teaches context and imagery to facilitate learning within 10 sessions over 5 weeks. *Methods.* A total of 69 participants with moderate-severe Traumatic Brain Injury (TBI), 35 in the treatment group and 34 in the placebo control group, completed this double-blind, placebo-controlled randomized clinical trial. A baseline neuropsychological assessment was administered, including questionnaires assessing everyday memory. Repeat assessments were conducted immediately posttreatment and 6 months following treatment. Participants in the treatment group were randomly assigned to a booster session or a non–booster session group after completion of treatment with the mSMT to examine the efficacy of monthly booster sessions in facilitating the treatment effect over time. *Results.* The treatment group demonstrated significant improvement on a prose memory task relative to the placebo group posttreatment ($\eta^2 = 0.064$ medium effect). Similar results were noted on objective measures of everyday memory, specifically prospective memory (Cohen's $w = 0.43$, medium effect), and family report of disinhibition in daily life ($\eta^2 = 0.046$, medium effect). *Conclusion.* The mSMT is effective for improving learning and memory in TBI. *Classification of evidence.* Based on widely accepted classification systems for treatment study design, this study provides class I evidence that the mSMT behavioral intervention improves both objective memory and everyday memory in persons with TBI over 5 weeks. Thus, this study extends the evidence for efficacy of the treatment protocol to a sample of persons with TBI.

Keywords
traumatic brain injury, new learning, memory, cognitive rehabilitation

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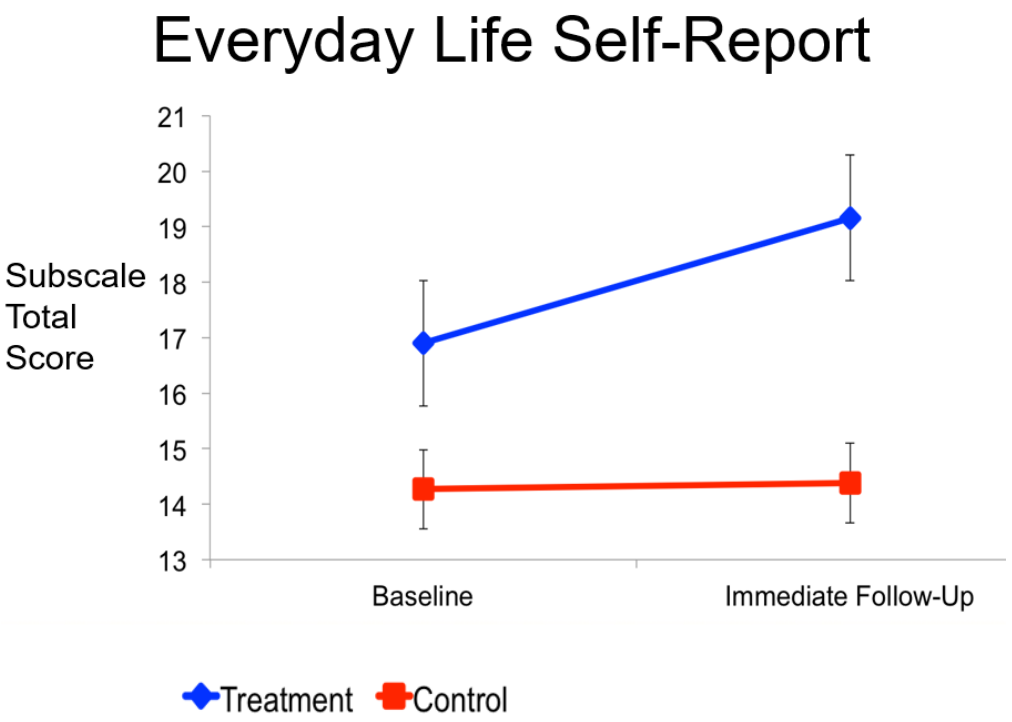
Goal 4: Understand the Impact of Cognitive Rehabilitation on Everyday Life

In MS samples, the KF-mSMT® shows benefit in cognition in daily life



- Neuroscientists focus on standardized neuropsychological tests and neuroimaging to measure outcome
- Patients, clinicians, and insurance companies are interested in the impact on everyday life.

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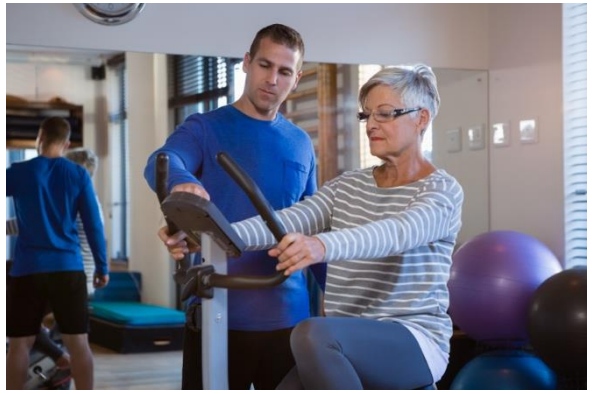
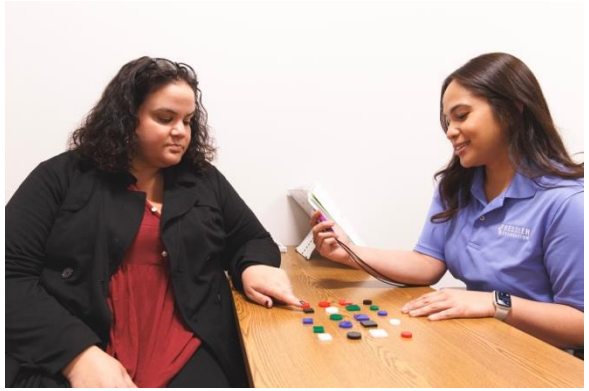
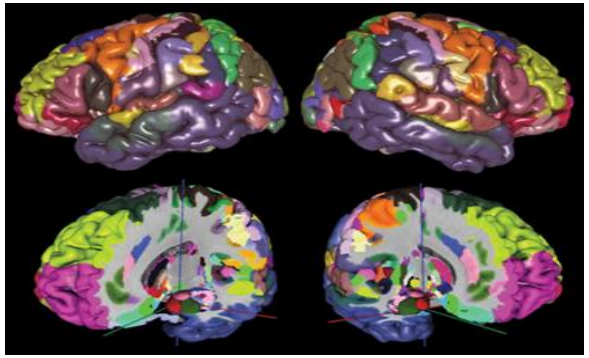
Goal 4: Understand the Impact of Cognitive Rehabilitation on Everyday Life







Is Cognitive Rehab Impacting Everyday Life?

- We do not see this impact on everyday life in traumatic brain injury
- The innovative value of cross-disciplinary collaboration

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Exercise Neurorehabilitation Research at Kessler Foundation

Brian M. Sandroff, PhD

Assistant Director
Center for Neuropsychology and Neuroscience Research

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PART I: HISTORY OF EXERCISE AND COGNITION

Fitness and Cognition in Older Adults

- **Late 1960s:**
  - *A healthy mind in a healthy body*

- **1970s**
  - Research demonstrating that trained individuals may have physiologically “younger” nervous systems than inactive individuals

- **Late 1990s – early 2000s**
  - Engaging in more physical activity and exercise training can improve cognition in sedentary older adults

  - Publications in major medical journals!

Saturday Night Live

- Weekend Update, 2000:
  - Exercise improves cognition in older adults!

- There are some exceptions to the rule…

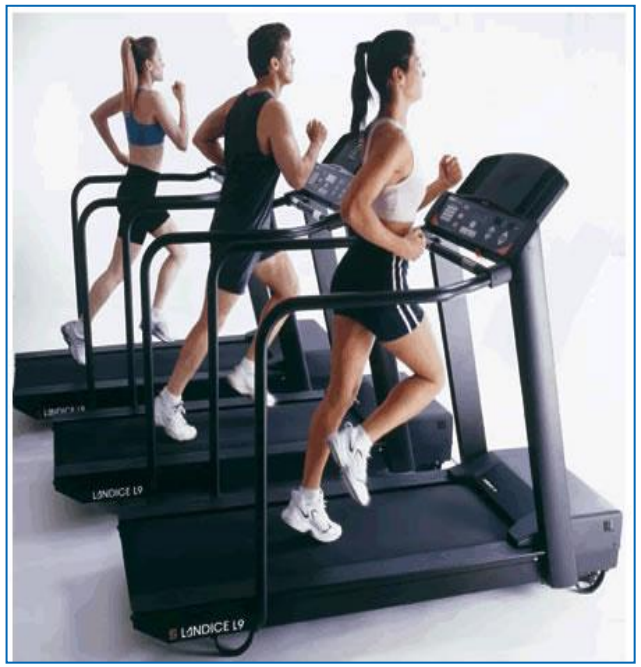
Present Day…

- **Systematic reviews and meta-analyses → exercise training associated with:**
  - Improved executive function *(Colcombe & Kramer, 2003; Chen et al., 2020)*
  - Improved general cognitive function *(Northey et al., 2019; Zheng et al., 20*
  - Improved learning and memory *(Zheng et al., 2016; Biazus-Sehn et al., 2020*
  - Improved processing speed *(Smith et al., 2010)*
  - Improved gray matter volume *(Wilckens et al., 2021; Feter et al., 2018)*
  - Improved patterns of brain activation *(Yu et al., 2021)*
  - Improved brain connectivity *(Haeger et al., 2019)*
- Healthy older adults, MCI, AD *(Heyn et al., 2004; Kelly et al., 2014)*
- Aerobic, resistance, combined effects *(Northey et al., 2019)*
- Dose-response effects *(Gomes-Osman et al., 2018; Sanders et al., 2019)*

PART II: EXERCISE AND COGNITION IN NEUROLOGICAL DISORDERS

Step 1: Exercise Training and Cognition in MS

- 2 early RCTs of exercise training on cognition in MS[1,2]:
  - No significant intervention effects on cognition
  - Not in-line with literature from the general population on exercise and cognitive function[3]
  - **Methodological concerns:**
    - Unsupervised, low intensity exercise
    - Non-targeted MS samples
    - Exercise stimulus issues



[1] Oken et al., 2004; [2] Romberg et al., 2005; [3] Stillman et al., 2016

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Kessler Foundation Exercise Research

What is most likely to work?	Does it actually work?	Can it work in the real world?	Overall Goal
• Develop exercise **prescriptions** for future interventions to improve cognition and brain • **Stage 0 Research**	• Test and optimize exercise interventions in **tightly controlled laboratory settings** • **Stage I-II Research**	• Test and optimize exercise interventions in **home/community settings** • **Stage III-V Research**	• Provide comprehensive evidence for developing **exercise-specific guidelines for treating cognitive impairment and improving brain health**

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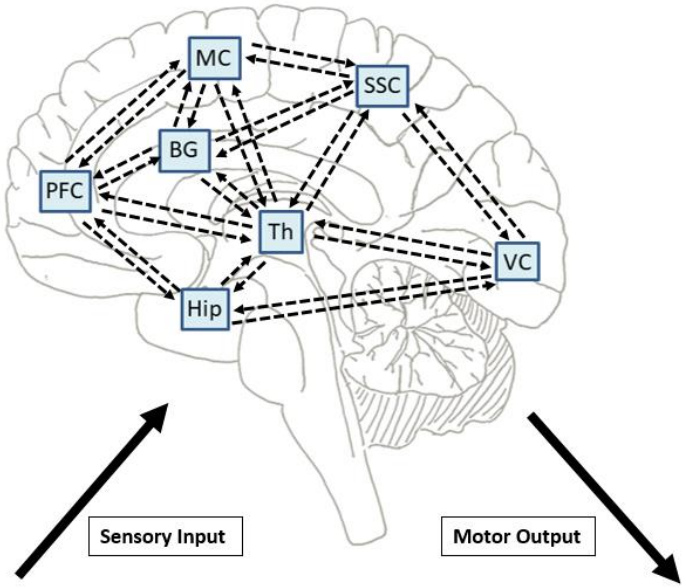
What Is Most Likely to Work? – Evidence

What is most likely to work? → **Does it actually work?** → **Can it work in the real world?** → **Overall Goal**

- **Systematic research informing an optimal exercise prescription in MS[1]**
  - Cross-sectional studies of fitness and cognition[2-4]
  - Cross-sectional and longitudinal studies of physical activity and cognition[5-7]
  - Acute exercise studies on cognitive outcomes[8,9]
  - Acute exercise studies on neuroimaging outcomes[10]



[1] Sandroff et al., 2018; [2] Sandroff & Motl, 2012; [3] Sandroff et al., 2015, NNR; [4] Sandroff et al., 2017, MSSE; [5] Sandroff et al., 2013; [6] Sandroff et al., 2014; [7] Sandroff & Motl, 2020; [8] Sandroff et al., 2015, JCEN; [9] Sandroff et al., 2016, P&B; [10] Sandroff et al., 2026, *in press*

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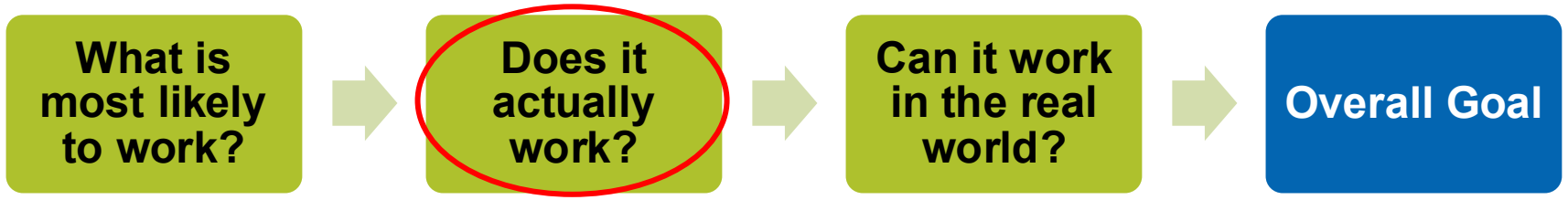
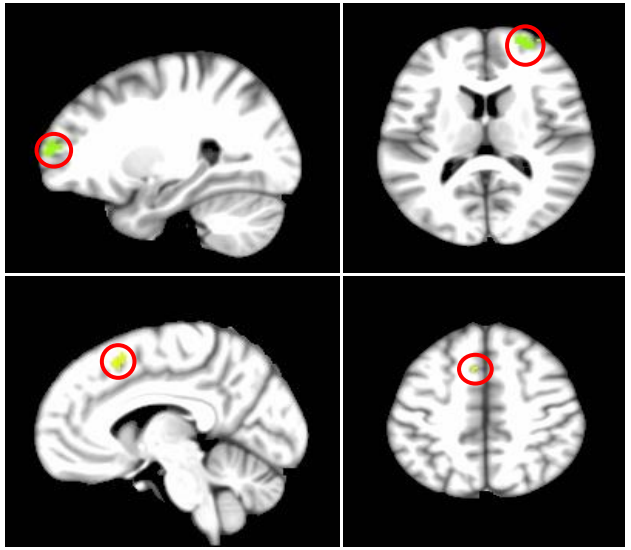
Does It Actually Work? – Evidence



Early-stage laboratory-based trials of exercise training on cognition and brain:

- Aerobic walking exercise training improves cognitive processing speed and MRI outcomes vs. waitlist control[1-3]
- Aerobic walking exercise training improves cognitive processing speed, learning and memory, and MRI outcomes vs. active control[4,5]
- Aerobic walking exercise training improves thalamic connectivity vs. active control condition in processing speed impaired persons with MS[6,7]



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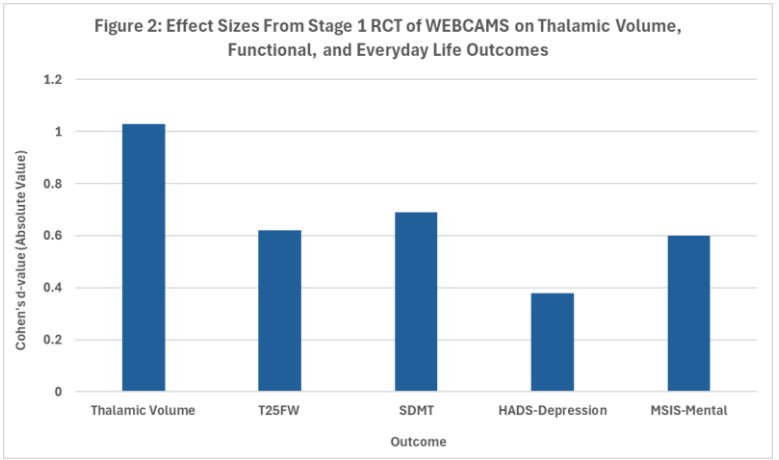
[1] Sandroff et al., 2016; [2] Sandroff et al., 2017; [3] Sandroff et al., 2018, MSJ ETC; [4] Sandroff et al., 2018, BMJ Open; [5] Sandroff et al., 2021; [6] Sandroff et al., 2019, CCT; [7] Sandroff et al., 2025

Can It Work in the Real World? – Evidence

What is most likely to work? → **Does it actually work?** → **Can it work in the real world?** → **Overall Goal**

Trials of remotely delivered and supported exercise on cognition and brain:

- 16-weeks of remote aerobic walking exercise training improves cognitive processing speed vs. active control in processing speed impaired persons with MS[1]
- 48-weeks of remote aerobic walking exercise training in processing speed impaired persons with MS[2]:
  - Preserves thalamic volume
  - Slows brain aging
  - Improves cognitive processing speed
  - Improves everyday life outcomes



[1] Sandroff et al., 2023, MSARD; [2] Sandroff et al., 2026, J Neurol

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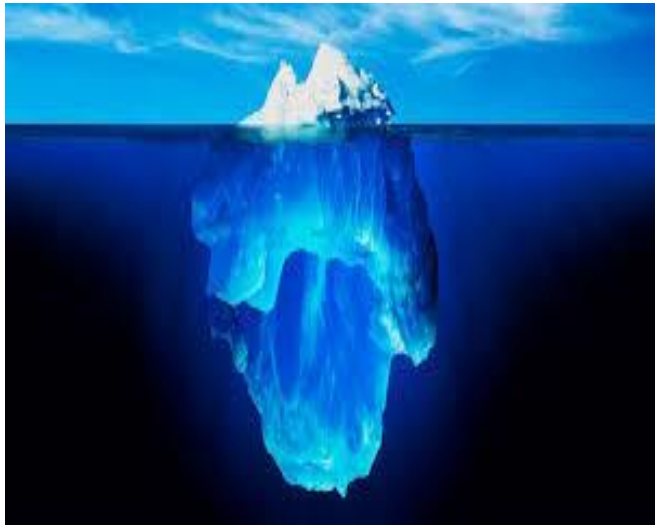
What Next?

What is most likely to work? → **Does it actually work?** → **Can it work in the real world?** → **Overall Goal**

- Large-scale, fully-remote efficacy trials of aerobic walking exercise training to treat MS-related cognitive impairment[1]
- Large-scale hybrid effectiveness-implementation research for delivery through comprehensive MS care settings[1]
- Long-term aerobic walking exercise training as a disease-modifying behavior and/or neuroprotective behavior in MS[2,3]
- Extension of the research in persons with brain injury[4,5]



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[1] Sandroff & Motl, 2025; [2] Motl & Sandroff, 2021; [3] Sandroff et al., 2022; [4] Sandroff et al., 2024; [5] Boukrina et al., 2025

Traumatic Brain Injury

Recent exercise research in TBI at Kessler Foundation:

- Cross-sectional research[1]:
  - Aerobic fitness, cognitive processing speed, and working memory
- Acute exercise research[2]:
  - Cycling + varying degrees of virtual reality on cognitive processing speed, inhibitory control
- Ongoing NIDILRR-funded RCT[3]:
  - Combined cognitive rehab + aerobic exercise vs. cognitive rehab + active control on learning/memory and hippocampal MRI outcomes
- Upcoming, fully-remote study on aerobic walking exercise for improving multiple cognitive outcomes in TBI:
  - Projected start date = May 2026

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[1] Wender et al., 2024; [2] Wender et al., 2022; [3] Sandroff et al., 2023, *Contemp Clin Trials*

Our Systematic Research Approach is Collaborative!

**N=144 different collaborators; N=19 mentees*

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Using Eye Tracker Technologies to Study Traumatic Brain Injury

Silvana L. Costa, PhD

Senior Research Scientist
Center for Neuropsychology and Neuroscience Research

Director
Neuropsychology of Eye Movements Lab

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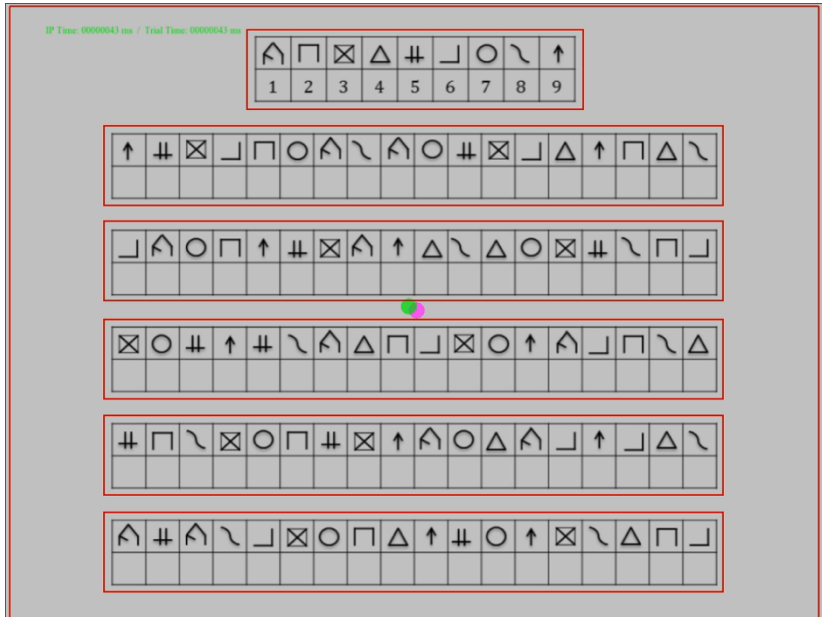
Using Eye Tracker to Study Cognitive Abilities



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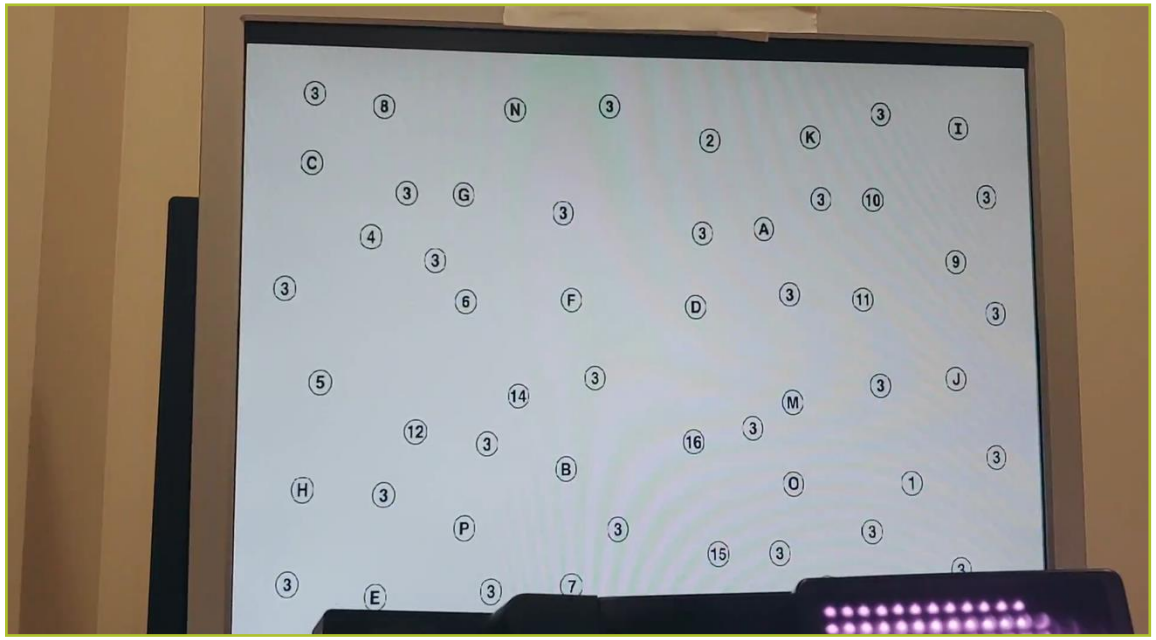
Using Eye Tracker as a Human Computer Interface



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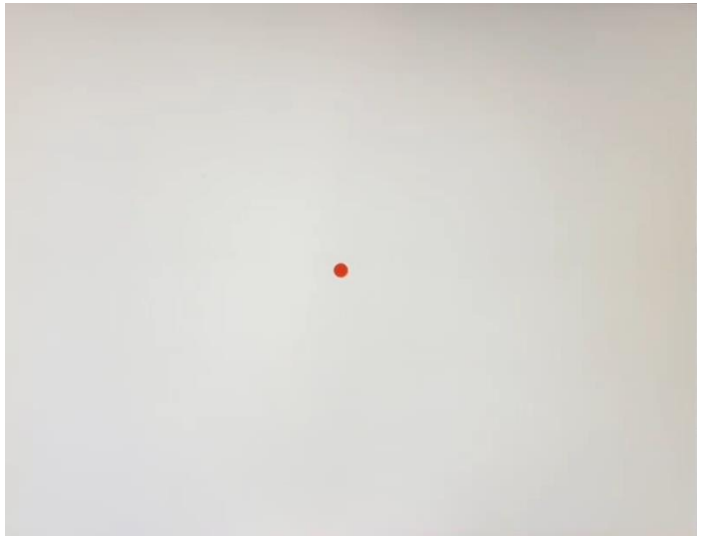
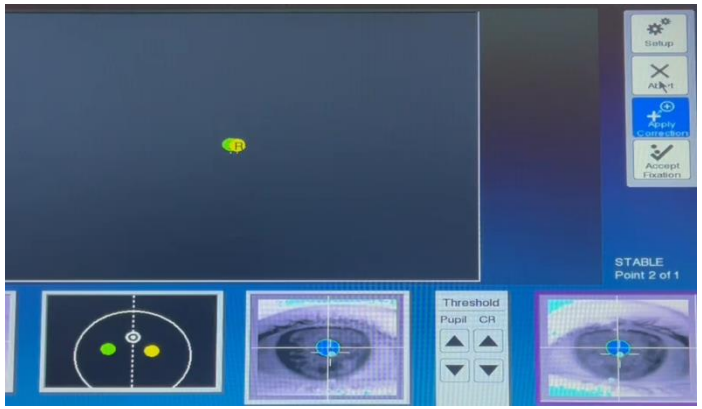
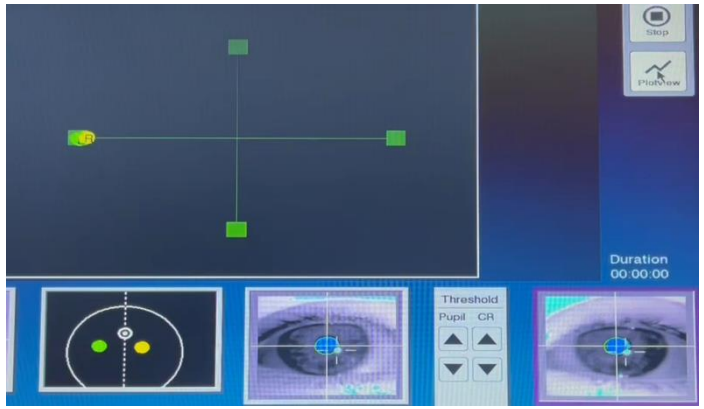
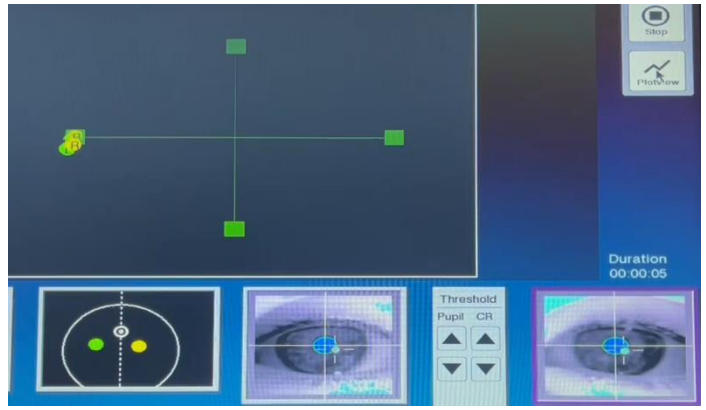
Chasing TBI With the Eyes









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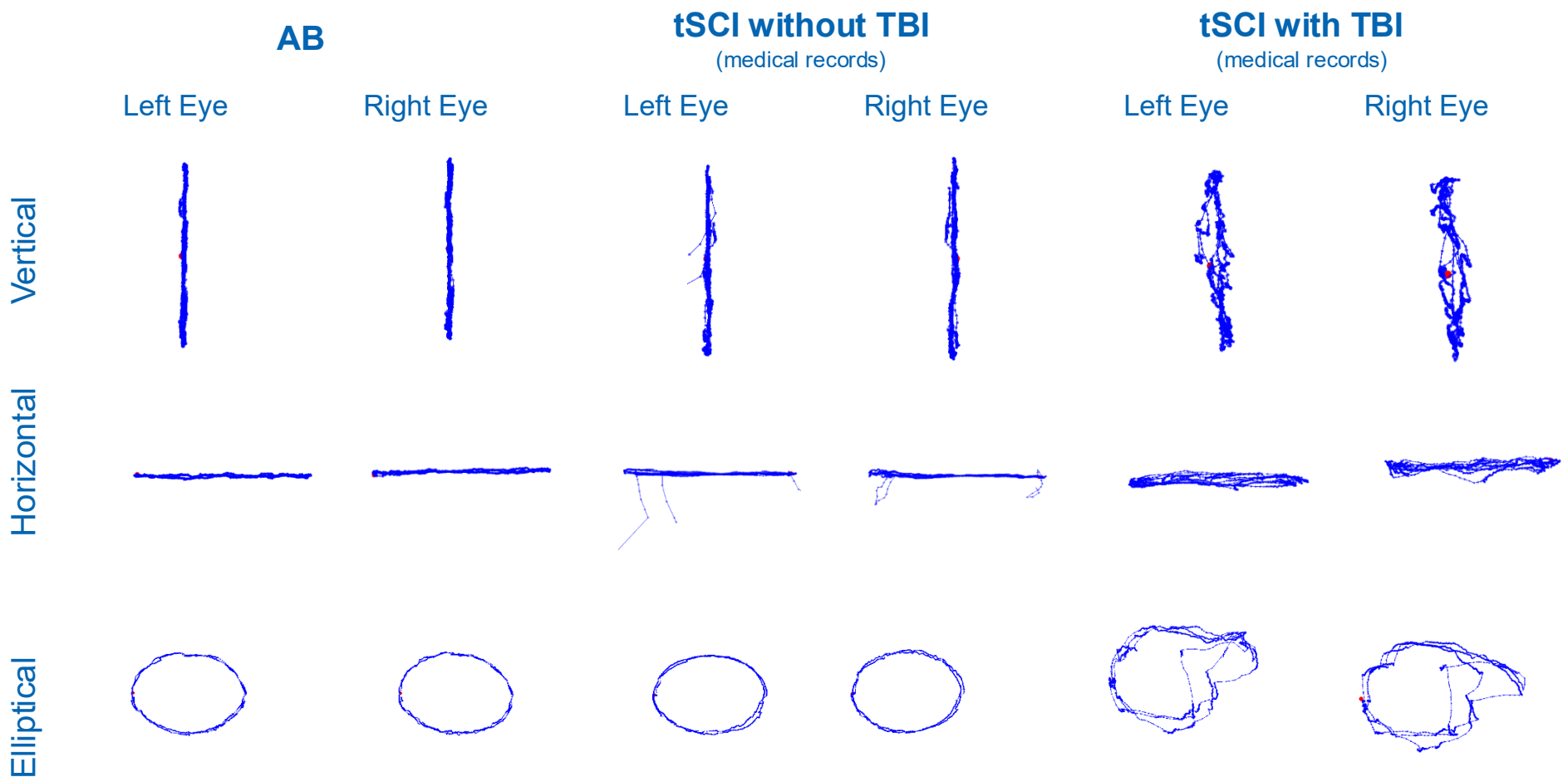
Using new technologies to study TBI



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Traumatic Brain Injury Events and Resources

Thinking Outside the Box for TBI Care

Spring Brainstorm: A Free Virtual Speaker Event for Individuals with Brain Injury, Family Members, and Friends

Thursday, April 2, 2026 | 12 PM – 1 PM ET | Via Zoom

The Northern New Jersey Traumatic Brain Injury System and Kessler Foundation are excited to invite you to our seasonal virtual speaker series.

Join us for a conversation with Mandi Dickey, NP, and her powerful perspective on traumatic brain injury as both a clinician and survivor. Her journey blends 20+ years of clinical expertise with lived experience to reshape how we understand concussion and brain injury recovery. You won't want to miss this inspiring conversation.

Community Resources

Living Well After Traumatic Brain Injury

In our TBI community resource hub, you'll discover clear, research-based information regarding traumatic brain injury. This includes resources on recovery, daily living, employment opportunities, newsletters, and practical support for individuals with TBI and their families. Our team consistently shares updates from ongoing rehabilitation research, connecting scientific advancements with practical advice for clinicians, individuals, and caregivers.

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real life science

Thank You!

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