Understanding Information Processing and Memory after Traumatic Brain Injury (TBI)

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MSHA 2026

Objectives

Participants will:

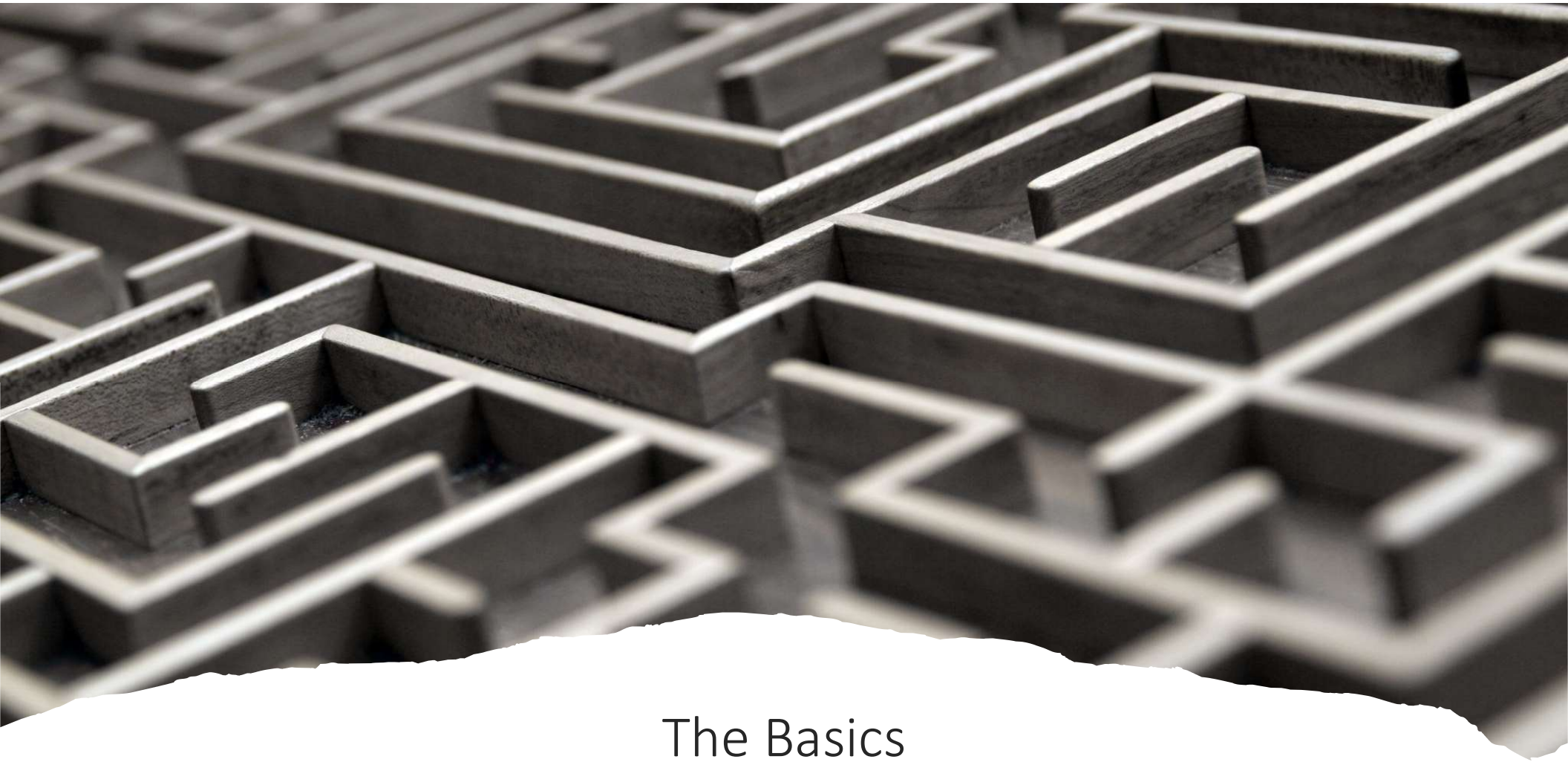
- Recognize key characteristics of information processing deficits across a spectrum of recovery following TBI.
- Recognize key characteristics of memory deficits specific to individuals with TBI.
- List therapy ideas (e.g. goal creation, therapy tasks) that have immediate application to their clinical practice treating individuals with TBI.

Overview

The Basics: TBI and Cognitive-Communicative Rehabilitation

Information Processing

Memory



The Basics

TBI and Cognitive-Communicative Rehabilitation

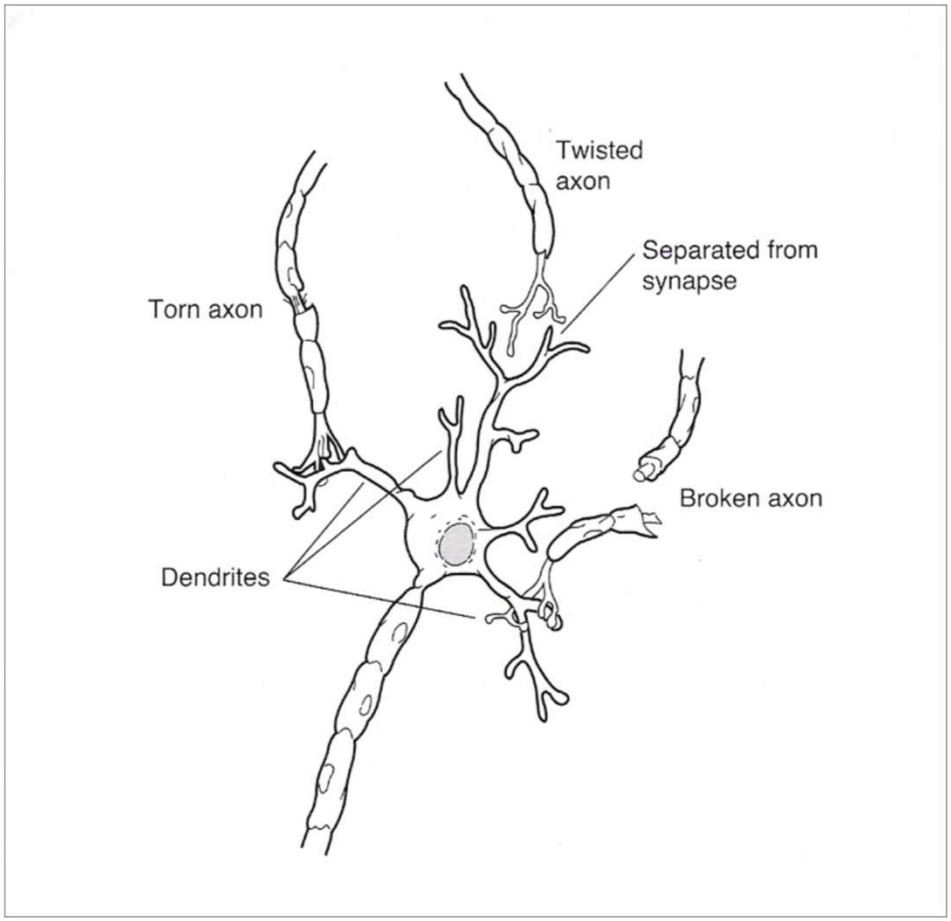
Defining Terms

- Traumatic Brain Injury (TBI): An acquired, neurogenic, cognitive-communicative disorder caused by a blow to the head that results in damage to the cortical or subcortical structures, leading to some degree of cognitive, physical, or behavioral/emotional impairment

Primary Damage of TBI

Diffuse axonal injury

- Acceleration, deceleration, and rotational forces
- Tearing, twisting, and shearing of axons from their myelin sheath at a microscopic level, to the point of breaking or cell death



Recovery

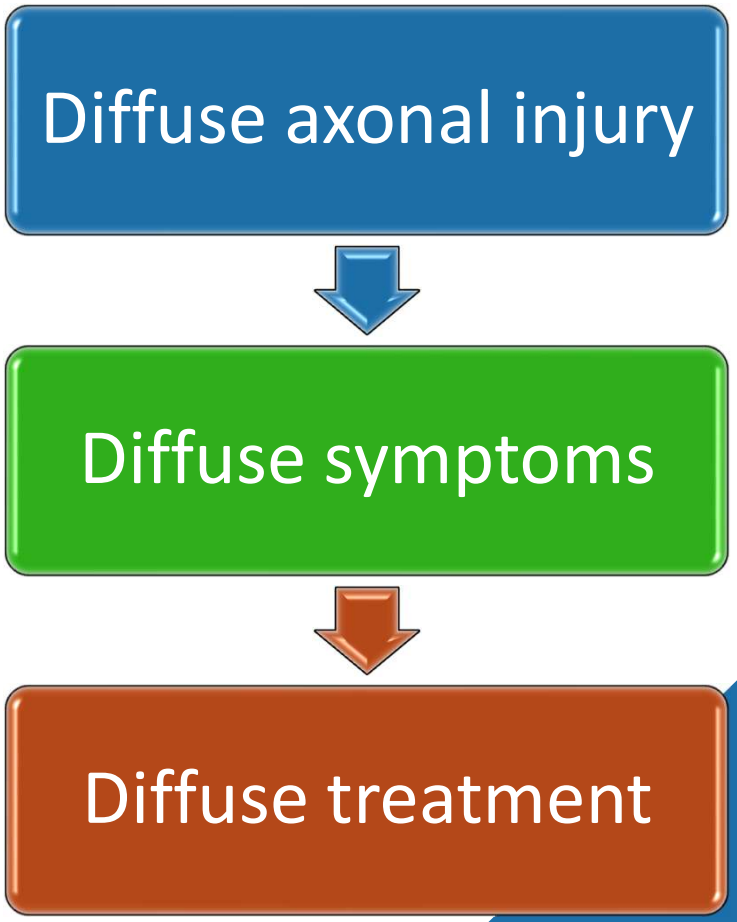
- Many comorbid diagnoses
- Symptoms of TBI are extremely variable, both within a person and across the population
  - Physical
  - Behavioral/emotional
  - Cognitive-communicative

Recovery

- Cognitive, behavioral, and academic deficits related to the brain injury become increasingly evident as environmental demands increase

- Individuals with TBI do not all follow the same trajectory of recovery
  - Uneven, inconsistent, and unpredictable recoveries
  - Regression, improvements, and plateaus in recovery are all *typical and expected* in TBI rehabilitation

Big Point #1


Diffuse axonal injury
Diffuse symptoms
Diffuse treatment

Cognitive-Communicative Rehabilitation

- Addresses cognitive skills which are:
  - Necessary for appropriate communication and behavior in all functional contexts
  - Foundational to learning
  - Influential on the creation and maintenance of social relationships
- Treats cognition as the foundational element to successful communication in all contexts

Big Point #2

TBI is NOT inherently linguistically focused; rather, it is inherently <u>cognitively</u> focused.

Cognitive-Communicative Rehabilitation

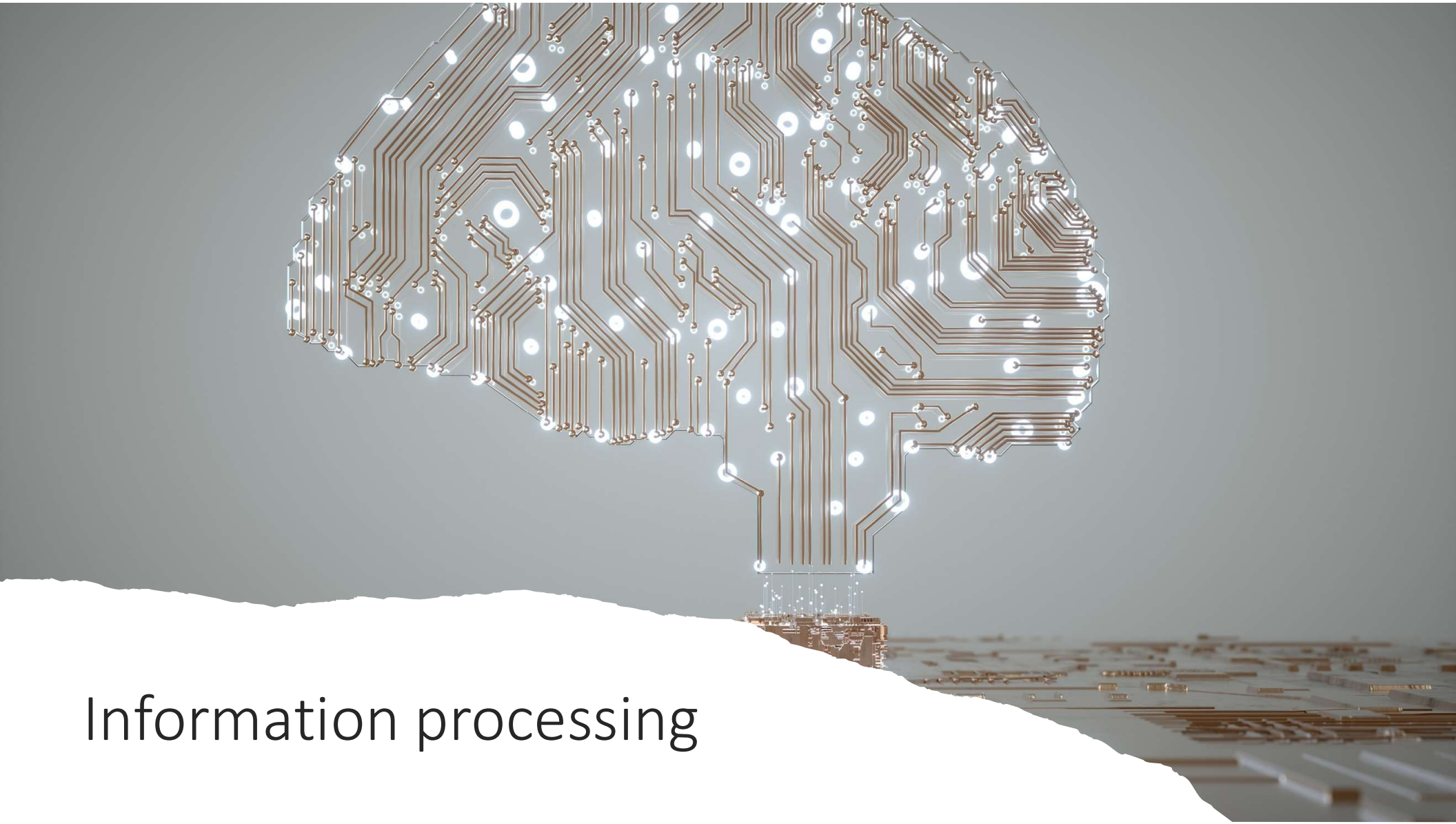
- Areas of cognition affected by TBI:
  - Attention
  - Executive Functioning
  - Information Processing
  - Memory

Big Point #3

Goal: Improve function

"Regardless of the specific approach or area of intervention, cognitive rehabilitation services should be directed at achieving changes that improve each person's function in areas that are relevant to their everyday lives."

(Cicerone et al., 2000)



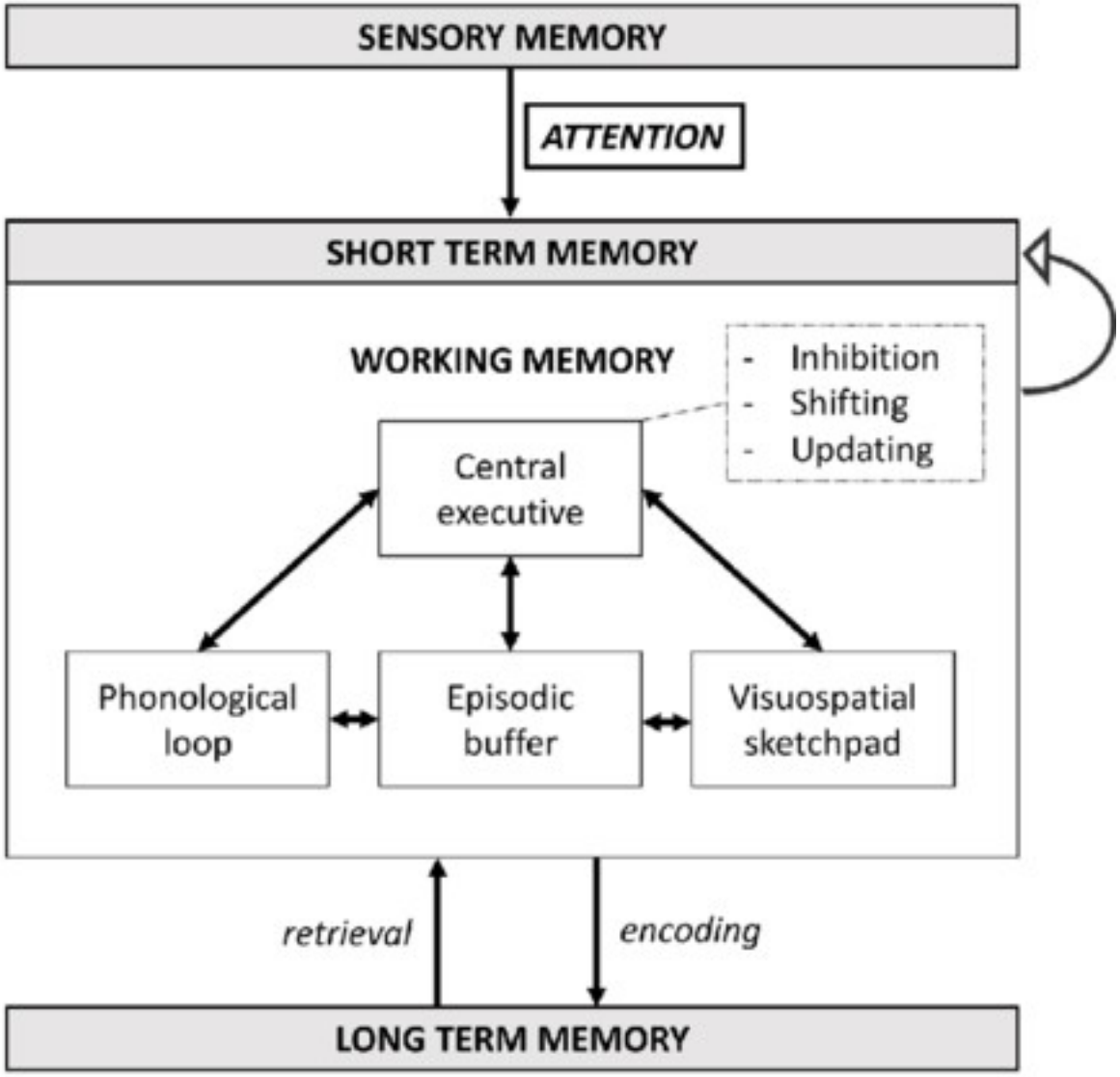
Information processing

Information Processing

Definitions:

- The process by which information is perceived, understood, organized, stored, retrieved, and disseminated
- The process by which information is understood and responses are formed

Theory



Baddeley, A. (1992). Working memory. *Science*, *255*(5044), 556-559.

Theory

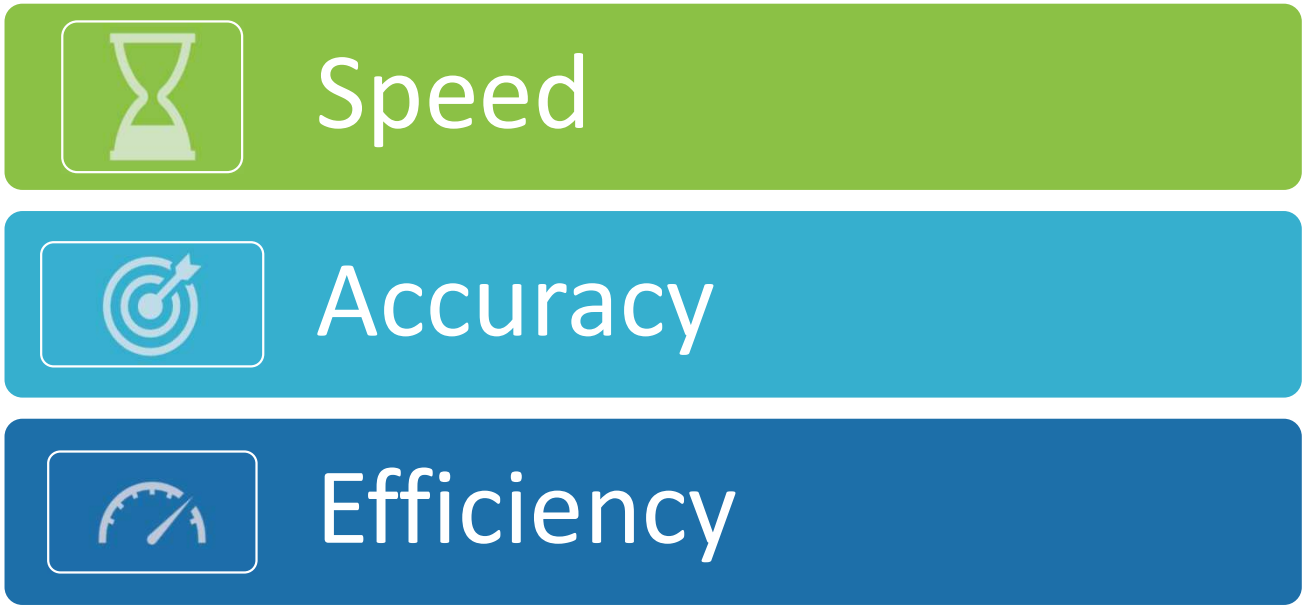
Sensory information/Attention

Big Point #4

Information processing deficits after TBI are intrinsically related to and reliant on the perceptual, cognitive, and linguistic functions of the brain

Information Processing

- Quantified by:



Information Processing after TBI

Slower Speed

- Typically slower than what it was prior to their brain injury and slower than their peers

- Slower, more effortful processing can result in:
  - Missing portions of what was said at the beginning, middle, or end
  - Slower reaction times or missed opportunities to respond
  - Greater memory decay

Information Processing after TBI

Decreased Accuracy

- Inaccurate perceptions or misunderstandings
  - Confusion
  - Struggle to following directions
  - Difficulty interpreting nonverbal communication (e.g. social cues)

Poor Efficiency

- High effort yielding low productivity
- Decreased efficiency:
  - Disorganized thought formulation
  - Struggles with word retrieval
  - Rambling, unconcise narratives

Information Processing after TBI

Working memory

Needed for “holding”

- Retaining, storing, and retrieving information

Impaired working memory impacts information processing by

- Limiting the available facts (incoming or stored)
- Decreasing the ability to integrate information into a cohesive / comprehensive thought

Attention

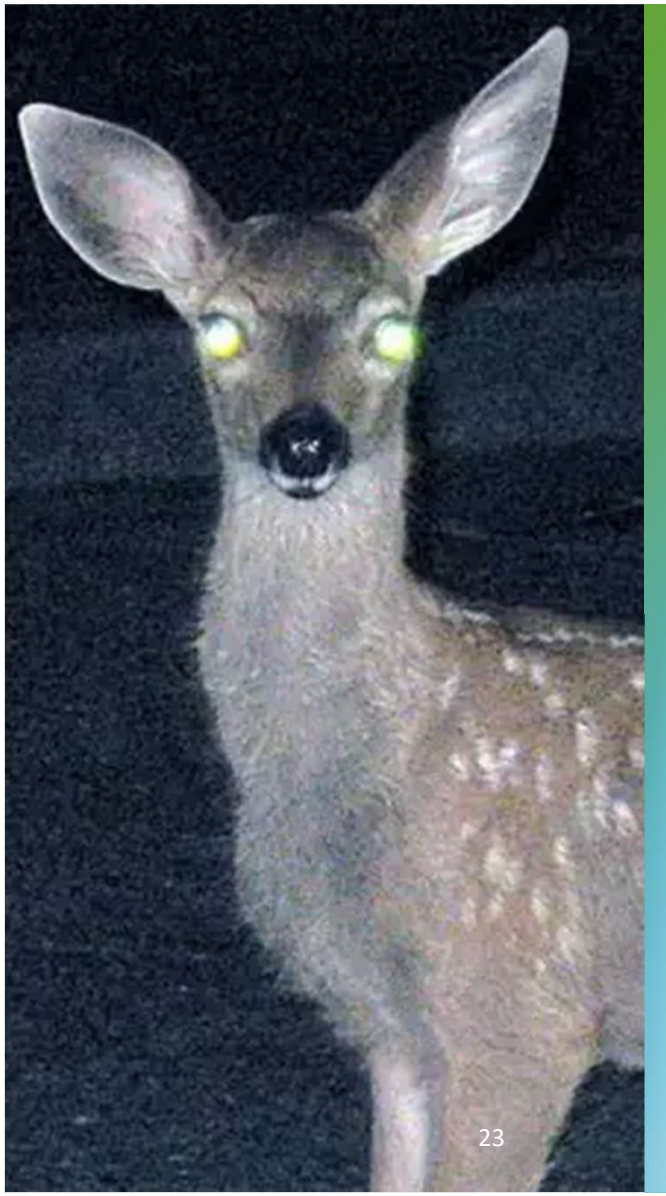
Needed for “gate-keeping”

- Attend to all incoming sensory information
- Alternate between different tasks or staying focused on a train of thought
- Inhibition: decipher and tune out distractions

Impaired attention impacts information processing by causing **flooding**

Flooding

- Definition: the moment or moments where the information processing system and the sensory system become overwhelmed to the point of nonfunctioning
- High level flooding
  - Operates on conscious thought
  - The brain can't keep up with its thoughts or with incoming information
- Low level flooding
  - Operates on senses and feelings
  - Sensory overload: the senses become overwhelmed modulating feelings and sensations



Context-Specific Presentation of Deficits

Home

- Following the plot of a TV show
- Problem-solving when an electronic device stops working
- Responding to the questions of others
- Grasping political issues

School

- Anything that requires thinking
- Studying and understanding concepts
- Participating in class discussions or group projects
- Navigating hallways or buildings between classes
- Following teacher's instruction

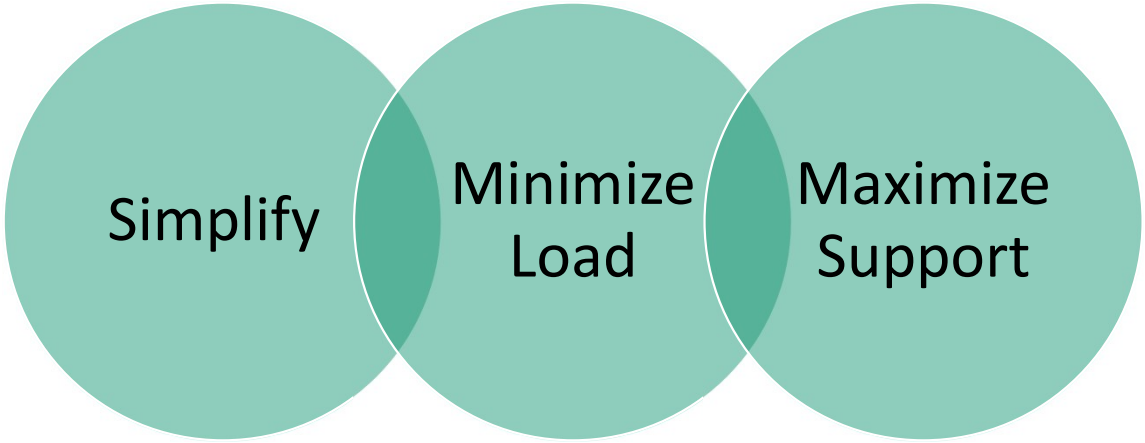
Context-Specific Presentation of Deficits

Work

- Determining next steps
- Following directions or protocols
- Understanding messages and relaying to others
- Understanding and discussing complaints
- Developing specific, pertinent responses to questions
- Driving

Treatment for Information Processing Deficits

- The therapist should:
  - Use short and clear directives
  - Break down tasks
  - Focus on accuracy first, speed later



Compensatory strategies

- Self-monitor and take breaks when needed
  - Help them recognize they need a break and to self-advocate
    - "Read the client" and discuss what you see
    - Ask: "How is your brain feeling?;" "What can we do to give your brain a little break?"
    - Give them the words to self-advocate: "I'm feeling overwhelmed with all this. Can I take a minute before listening to/ trying to do ___?"
    - Evoke a response in a controlled context

Compensatory strategies

- Teach them to:
  - Ask others to slow down or repeat
  - Verify
  - Summarize: main idea and key points
  - Take notes
    - Be brief and paraphrase
    - Organize
    - Review once it's written down
    - Recognize signal words or phrases
- Eliminate distractions, visual and auditory: i.e. clear the room!

Big Point #5

Strategies

>

Activities

Activities: Listening or Reading

High level processing

Content questions of facts or details

Structured increases in difficulty

- Gradual increases in length of information
- Increased speed of presentation
- Imposition of time constraints

Discussion questions

- What is the author's point of view? What is your opinion?
- Summarize what you've read/heard with X-amount of detail
- Form a conclusion based on the facts present
- What did you read/hear that was fact? that was opinion?

Following directions

- Follow a recipe
- Navigate to a location

Activities: Listening or Reading

Low level processing

Yes/no questions

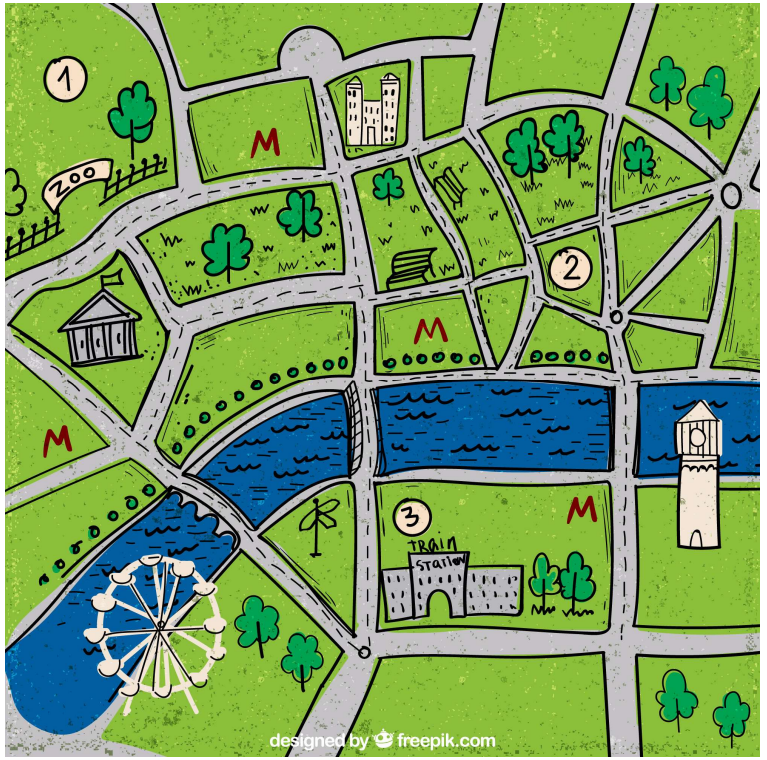
- Immediately relevant wants/needs
- Pain level
- Ability

Following Directions

- One-step body commands
  - Hold this
  - Point your finger
  - “Show me how to…”

Activities: Integration tasks

- Introducing new information into existing knowledge
- Maze task: navigate from point A to B, then provide a list of roadblocks or challenges that would require a change in route



Activities: Integration tasks

- Modifying opinions or plans: discuss a scenario then contribute additional context that could alter their view or change plans

Example: Johnny broke his mom's favorite cup after he'd been told not to touch it. What should the consequence be?

- Additional context: Johnny wanted to do something really nice for his mom and make her some tea, but then slipped and dropped the cup
- How does the context change your opinion of what should be done?

Activities: Reasoning tasks

- Yes/no questions
  - Do dull scissors cut well?
  - Are towels scratchy?
  - Is it safe to climb on the counter to reach the top shelf?

- Explanation tasks: for example, learn the rules to a new game then explain them to a friend

Memory

WebDonuts.com

Memory

Definition: The mental faculty or process of encoding, storing, and retrieving information

Encode — Initial learning, and transformation of sensory information into the memory store

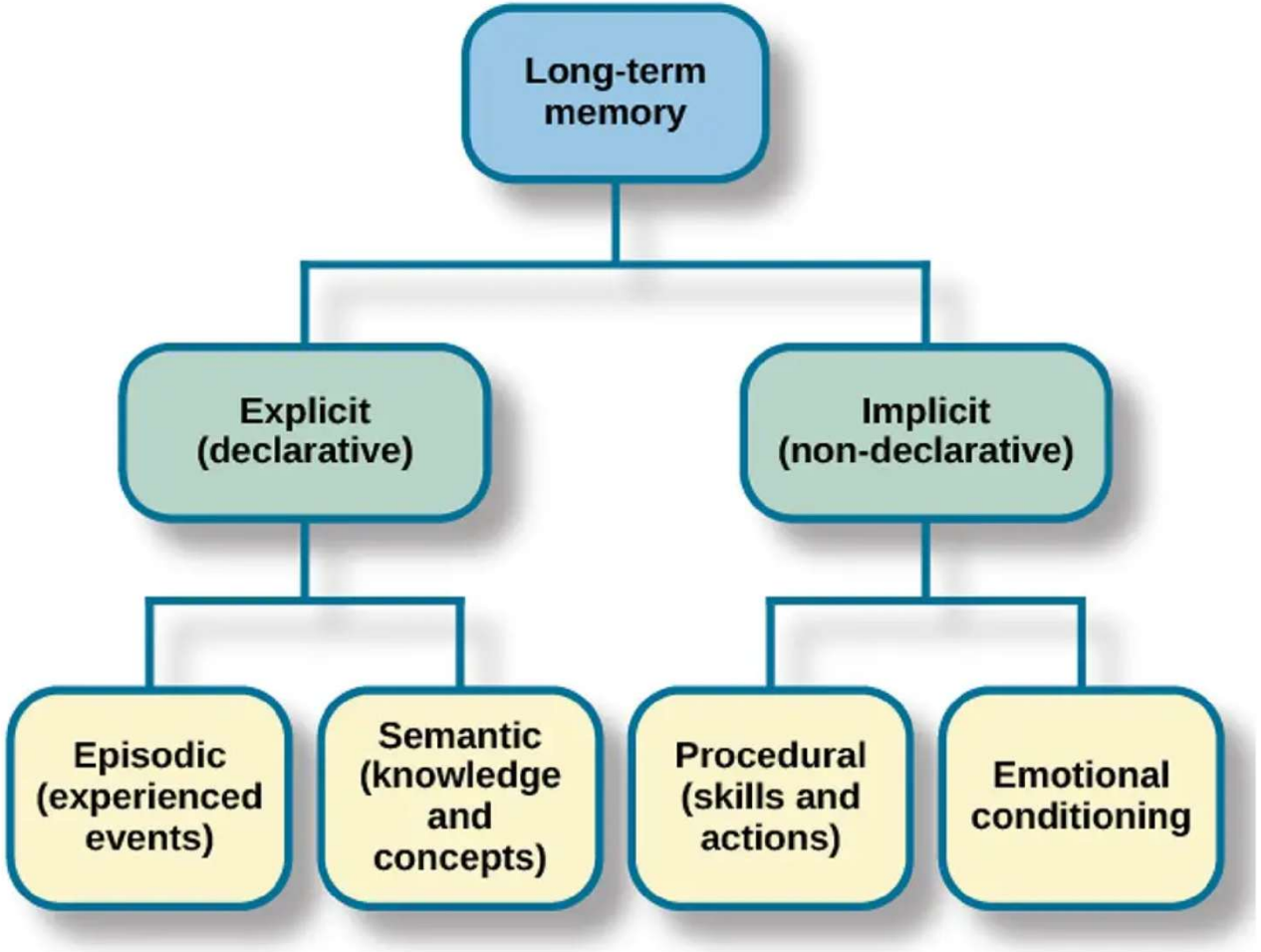
Store — Retaining that information in short or long-term memory

Retrieve — Pulling the information out of storage for recall and use

Memory

- Main components:
  - Long-term
  - Short-term
  - Working memory

- Long-term memory:



Long-term Memory

- The event of a TBI becomes a “time marker”
  - Retrograde memories: the long-term memories stored before the brain injury
  - Anterograde memories: the long-term memories stored after the brain injury

Short-term Memory

- Transient store: can hold approximately 7 pieces of information, +/- 2, for a few minutes
- Working memory: work area of STM in which information is processed and manipulated
  - Duration / decay
  - Capacity
  - Focus
- Relies on the perceptual, cognitive, and linguistic functions of the brain

Theory

Sensory information

Memory after TBI

Difficulties Encoding

- Breakdowns in the different stores/buffers of working memory
  - Deficits might be modality specific: auditory vs. written vs. visual
- Difficulty with creating new memories, or new learning

Difficulty Storing

- Shorter duration for the holding of information
- Faster decay of held information
- Decreased capacity and focus for the amount or complexity of information presented

Memory after TBI

Difficulty Retrieving

- Trouble locating information because it was stored in a disorganized way
- Not recognizing the information when it is located
- Word-finding and vocabulary deficits in conversation

Memory after TBI

Attention Deficits

- Disinhibited and overrun with irrelevant stimuli
- Easily distracted; unable to absorb information

Information Processing Deficits

- Too slow = memory decay or missing facts
- Flooding = prevents absorption or retention of new information

Executive Functioning Deficits

- Poor prioritization: not recognizing what's important to remember
- Strategy use: no initiation of memory strategies, or applying chosen strategies ineffectively/inconsistently

Memory after TBI

- Impairments in memory, discussed in terms of *timing*
  - **Prospective memory:** memory for future tasks/events
    - "I've got to do *this.*"
  - **Delayed memory:** memory for something learned
    - How long can information be held before it is forgotten?
    - "What did I do/learn?"
- Impaired **functional memory:** what is needed for ongoing, practical, and every-day functioning in normal living contexts

Context-Specific Presentation of Deficits

Home

- Retain and recall information from games or movies to talk about with friends
- Remember what you were doing and/or why you were doing it

School

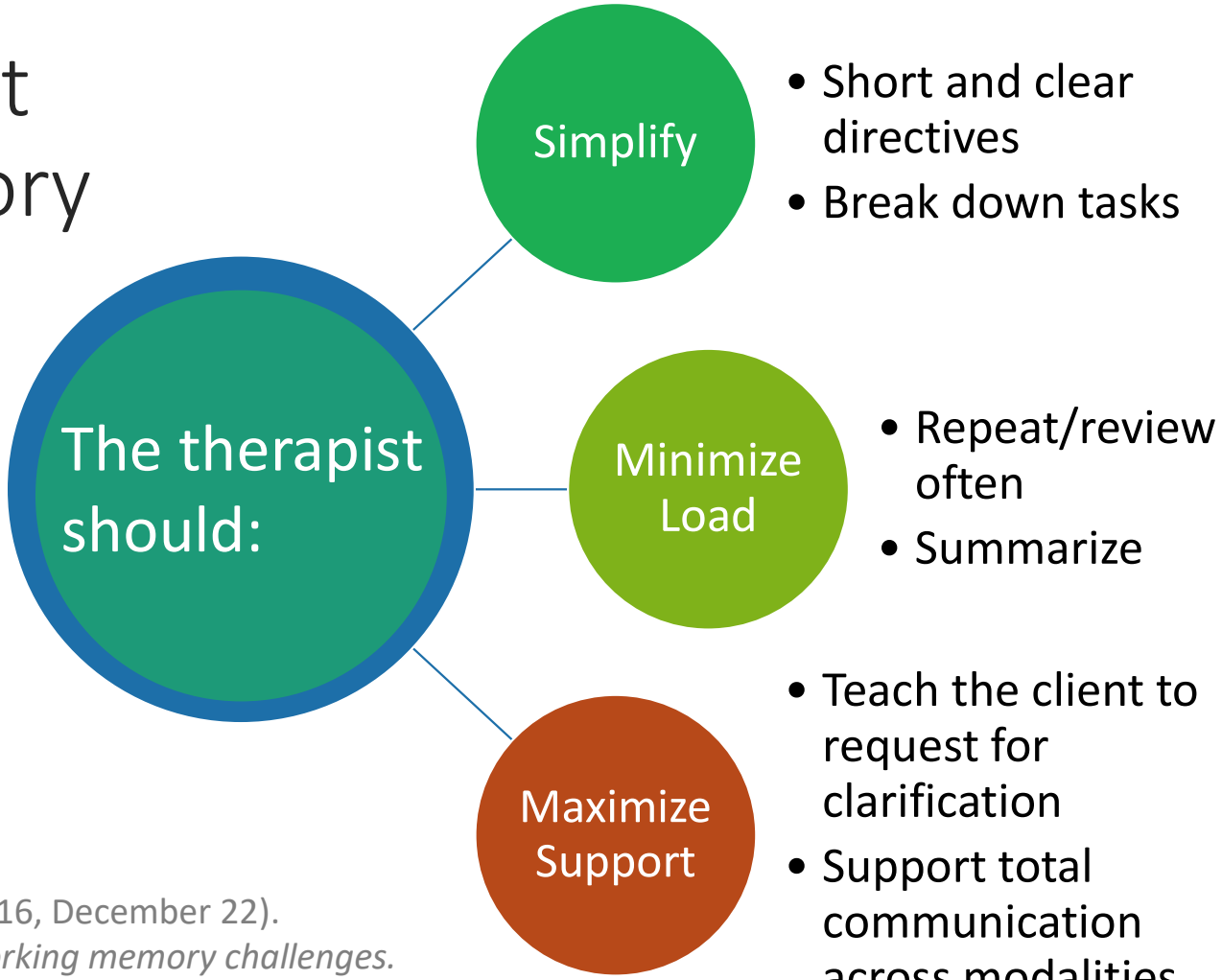
- Recall from verbal lectures and written textbooks
- Retrieve learned information for quizzes and exams
- Explain homework requirements or participate in class discussion

Context-Specific Presentation of Deficits

Work

- Remember to respond to calls, emails, and notifications
- Retain new information from meetings, correspondence, and questions
- Recall for protocols or safety procedures
- Retrieve knowledge relevant to problem-solving, addressing complaints, and resolving conflict

Treatment for Memory Deficits



Adapted from Pawan, A. (2016, December 22). *Supporting students with working memory challenges.* [Video]. YouTube. https://youtu.be/GLVo3woBkFQ

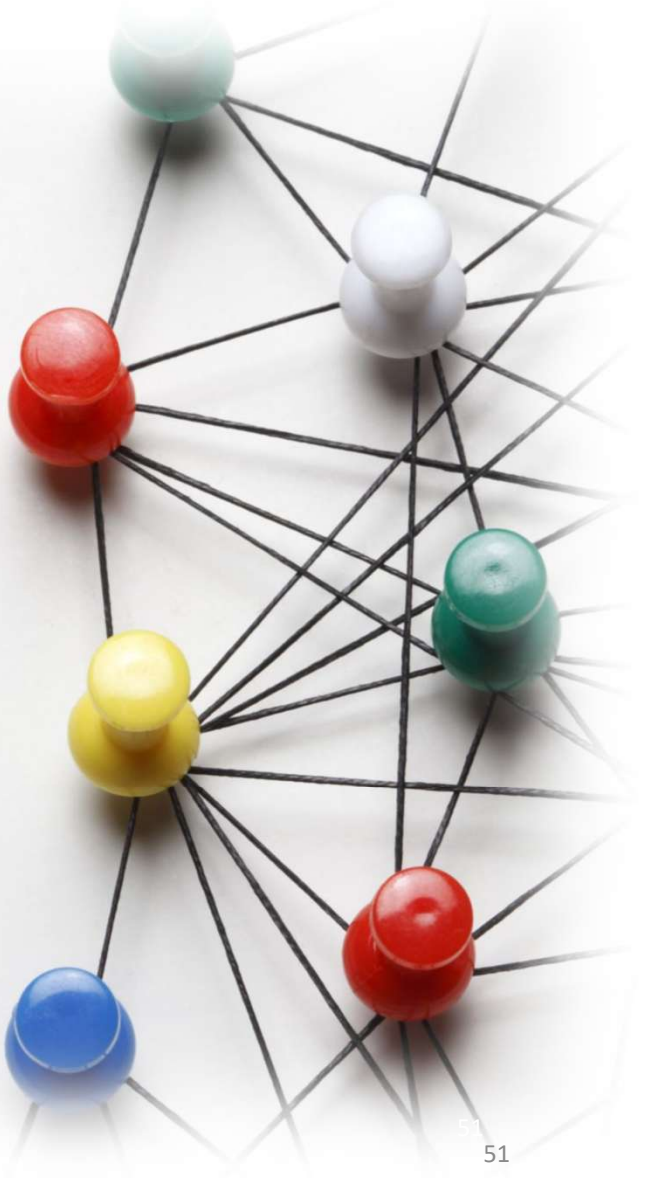
Compensatory strategies

- Internal strategies
  - Memory strategies which can be accomplished mentally and independently from external supports (e.g. repetition and rehearsal)
- External strategies
  - Use of external supports or cues

Compensatory strategies

Key points for strategy use

- Try out multiple strategies
- Teach them how to use the strategy!
- Aim for consistent use: Review > practice > apply



Treatment for Memory Deficits

- Specific techniques
  - Errorless learning
    - Discourage guessing and provide immediate prompts or cue to ensure accurate responses
    - Trial and error requires relatively preserved executive functioning (e.g. analytic skills) as well as memory (e.g. new learning from mistakes)
  - Spaced Retrieval
    - Rehearse information at increasing spaced intervals of time (usually doubled: 15 seconds, 30 seconds, 1 minute, 2 minutes, 4 minutes, etc.)

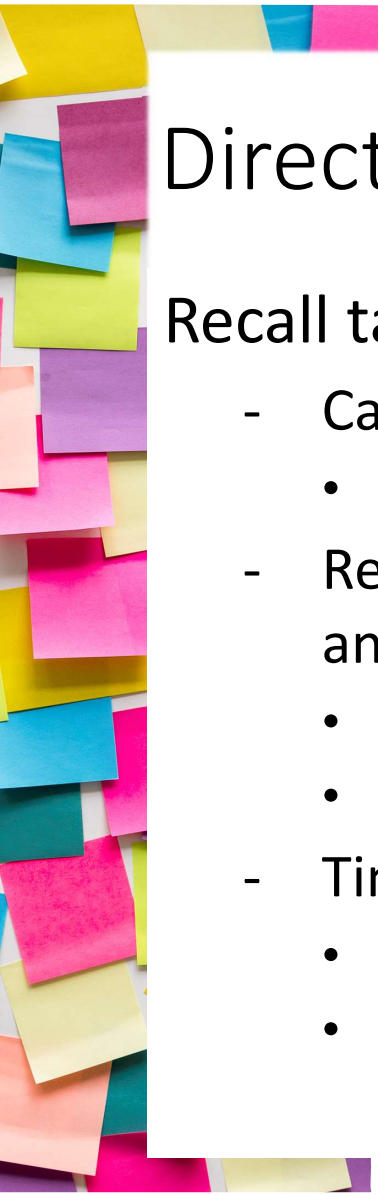
Direct Treatment Activities

- Draw from functional context
  - School / work / home
  - Personal interests: hobbies, sports, heroes, current events
  - Daily schedules: therapies, appointments, errands, conversations

- Use games and apps to model strategies, draw attention to strengths/deficits, and take productive breaks

Direct Treatment Activities

- Listening exercises (see slides 30-31)
  - Great resource for listening exercises: Randall's Listening Lab, https://www.esl-lab.com/



Direct Treatment Activities

Recall tasks

- Carry out an action in the future (prospective memory)
  - Find out the premiere date of a new tv series, and tell me next week
- Review what was learned or discussed throughout your session and at the end (new memory)
  - What are your goals are in speech
  - What are we doing, or what did we do today
- Time and association cues (delayed memory)
  - When Jenny walks by the door, please let me know
  - What did we do last time we met

HOMEWORK

Come up with one treatment activity for information processing or memory using something you already have in your treatment office

- Consider the compensatory strategies that should be taught before and throughout
- Consider what other elements of cognition the task might depend on, or require of the client
- Consider functional contexts


Other Treatment Resources

Remember:

Consider underlying and interacting cognitive and/or neuropsychological functioning

Example 1: a client presenting with information processing deficits may actually lack the sustained attention necessary to process visual/verbal/written information

Example 2: a client struggling with goal-orientated behavior (i.e. executive functioning) may really be suffering from a memory impairment preventing the retention and/or access to important details necessary to act on those goals

Websites

- Honeycomb Speech Therapy https://honeycombspeechtherapy.com/?view=about_activity_studio
  - Highly functional, ADL-related tasks, with goal and documentation ideas
  - "Home Sweet Home" series https://honeycombspeechtherapy.com/product/home-sweet-home-series/
  - "Back to Work" series https://honeycombspeechtherapy.com/product/back-work-series/

Websites

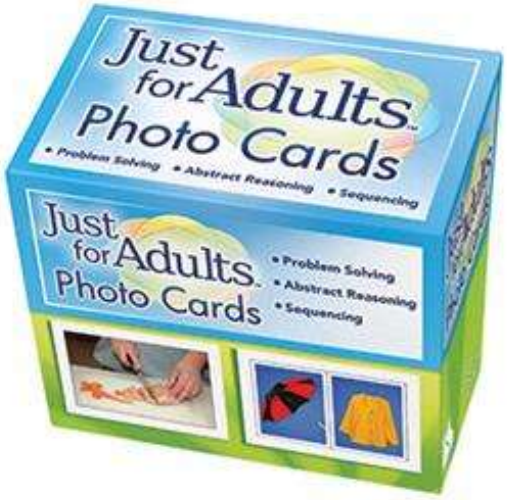
- Adult Speech Therapy: https://theadultspeechtherapyworkbook.com/
  - Great for goal-writing, also has practical cognitive rehab downloads

- The Center on Brain Injury Research and Training: https://cbirt.org/
  - School-based resources for SLPs with students with TBI
  - Goal bank: https://cbirt.org/sites/cbirt.org/files/resources/sample_iep_goals_for_students_with_tbi.pdf

Resources

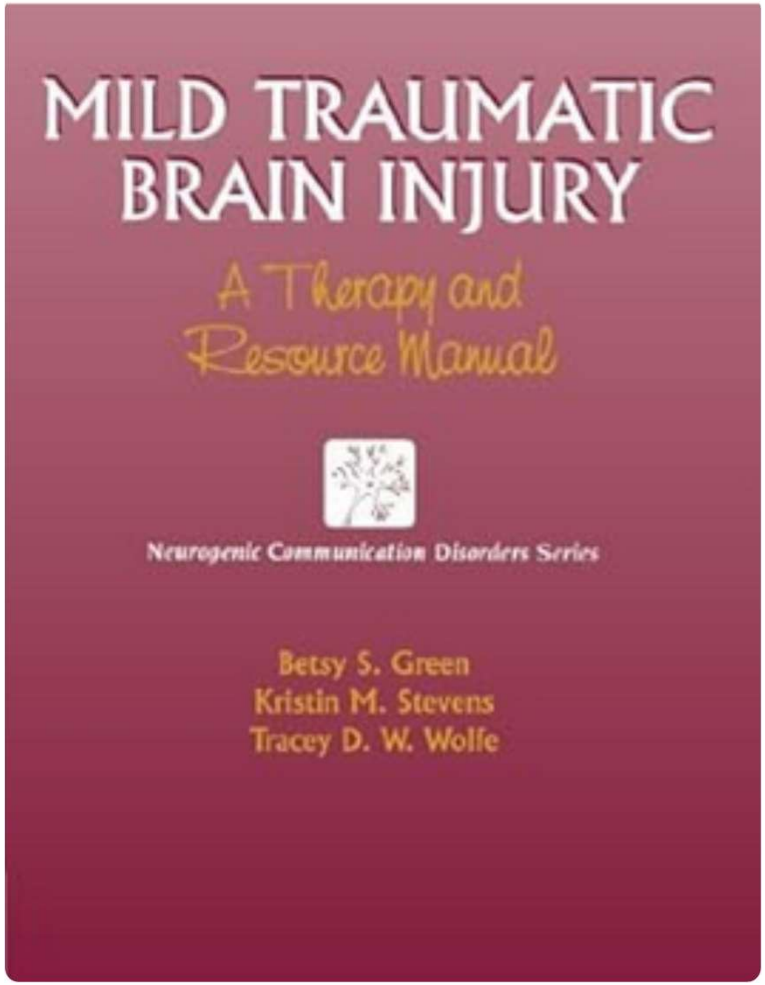
Card games: https://bicyclecards.com/how-to-play

- My favorites for memory and processing: Egyptian Rat Screw or 6 Card Golf



Just for Adults photo cards

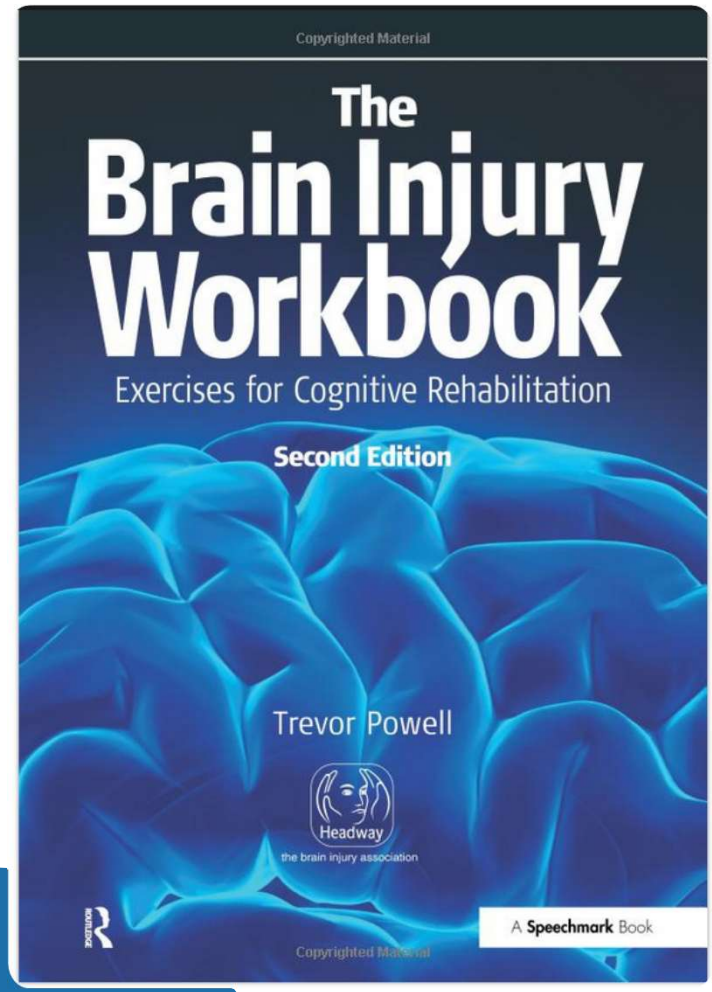
- Great visual stimuli that can be applied towards language or specifically for problem solving, abstract reasoning, and sequencing
- Linguisystems. (2010). *Just for adults photo cards.*



Resources: Workbooks

Mild Traumatic Brain Injury: A Therapy and Resource Manual

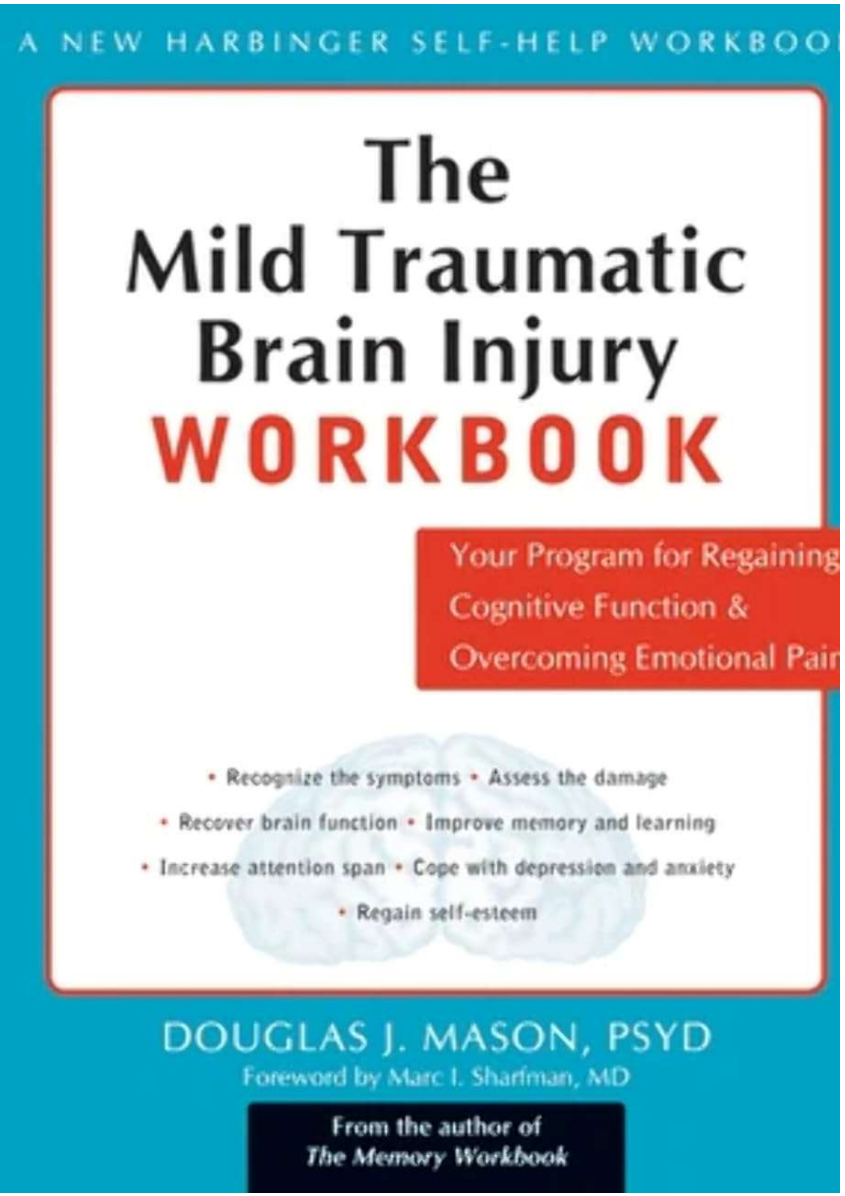
Green, B. S., Stevens, K. M., & Wolfe, T. D. (1997). Mild traumatic brain injury: A therapy and resource manual.



Resources: Workbooks

Brain Injury Workbook

Powell, T., Malia, K., & Evans, J. (2008). Brain Injury Workbook: Exercises for Cognitive Rehabilitation. *Journal of Occupational Psychology, Employment and Disability*, *10*(2), 131.

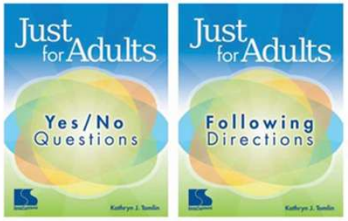


Resources: Workbooks

The Mild Traumatic Brain Injury Workbook

Mason, D. J. (2004). The mild traumatic brain injury workbook: your program for regaining cognitive function & overcoming emotional pain.

Resources: Workbooks

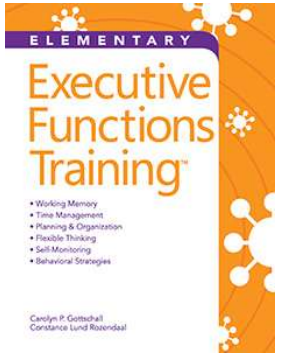


Just for Adults series

Tomlin, K. J. (2007). *Just for Adults*. East Moline, IL: LinguiSystems.

Executive Functions Training

- Working memory, planning, flexible thinking, self-monitoring, etc.
- Therapist, parent, and teacher strategies or approaches to treatment
- Gottschall, C. P., & Rozendaal, C. L. (2011). *Executive functions training: elementary*. LinguiSystems.



Resources: Workbooks

Workbook of Activities for Language and Cognition (WALC)

- Tomlin, K. J. (2002). Workbook of activities for language and cognition 1. *East Moline, IL: LinguiSystems*.
- Link to free section: https://therapistsforarmenia.org/wp-content/uploads/2021/03/WALC-10-Memory.pdf

Resources: Apps

- Can You Escape: game demo https://youtu.be/sSu3TzxZ1eM
- Tactus Therapy: https://tactustherapy.com/find/#
  - Can create patient profiles
  - Can narrow search down to specific cognitive skills to find apps/activities within app
- EPICC: https://apps.apple.com/us/app/epicc/id1596183691
  - Modules simulating real-life scenarios, targeting practical communication and cognition
  - No games

Resources: Apps

- Constant Therapy: https://constanttherapyhealth.com/constant-therapy/for-clinicians/
  - Can create patient profiles
  - Individual clients can log in to their account within the app and do home practice on activities
  - Specifically designed to be a speech, language, and cognition app for speech therapists

Resources: Apps

- CogniFit App: https://www.cognifit.com/online-memory-games-training
  - Brain games, individualized toward specific deficit areas
  - Easy to individualize and set up for specific clients within apps

Thank you!

Questions?