THE BIG 3

3 COMMON NEUROCOGNITIVE DYSFUNCTIONS ASSOCIATED WITH TBI

Assessment to Intervention

Dr. Peter Thompson

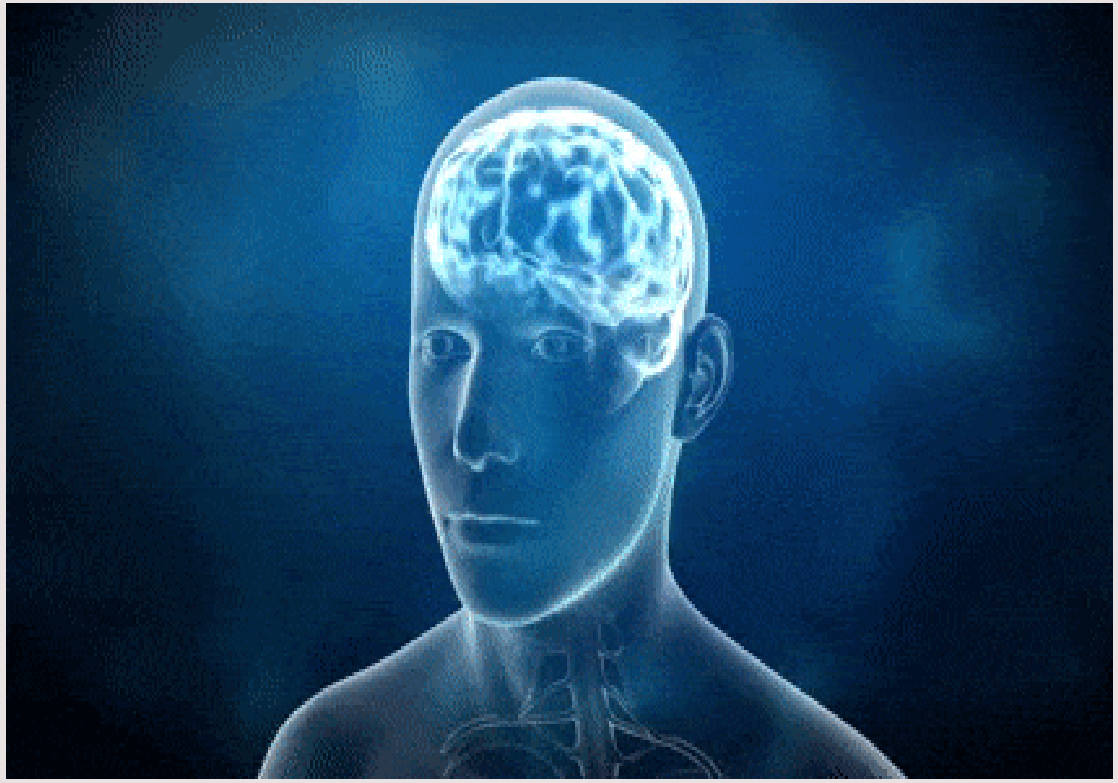


Image: Formanager on Pinterest

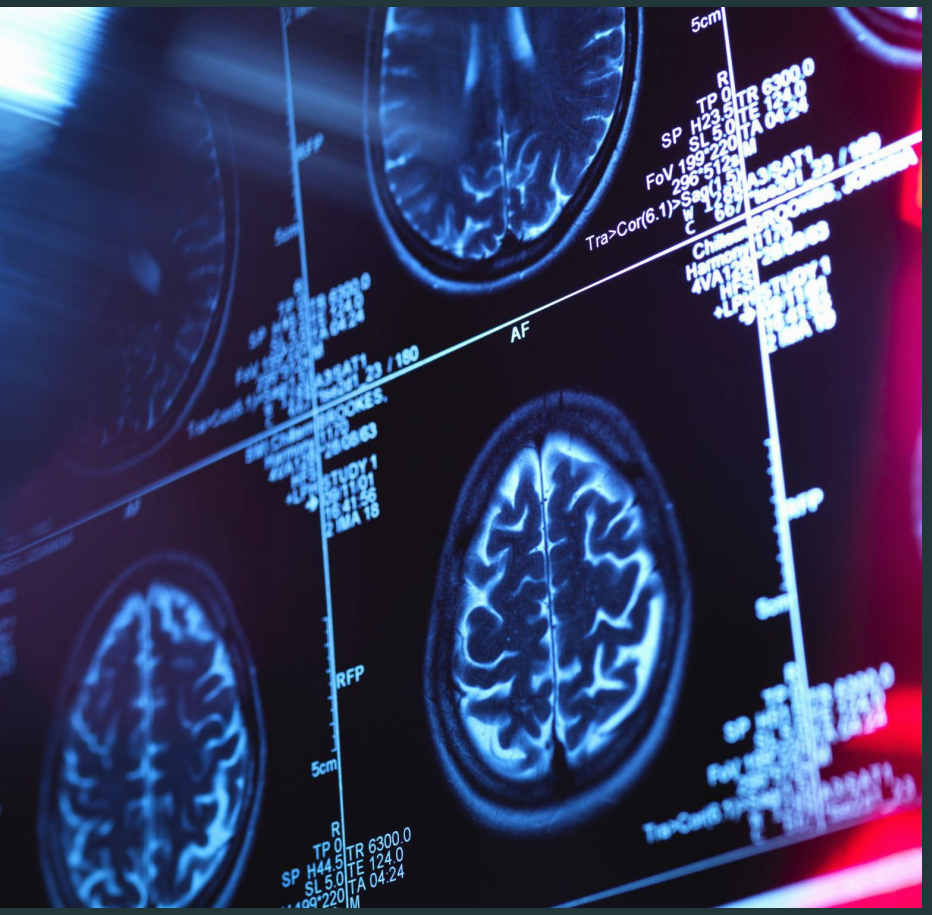


Image CDC

Agenda and Outcomes

1. What are the 3 most common neurocognitive deficits associated with mild-moderate TBI? (*Not* physical symptoms)

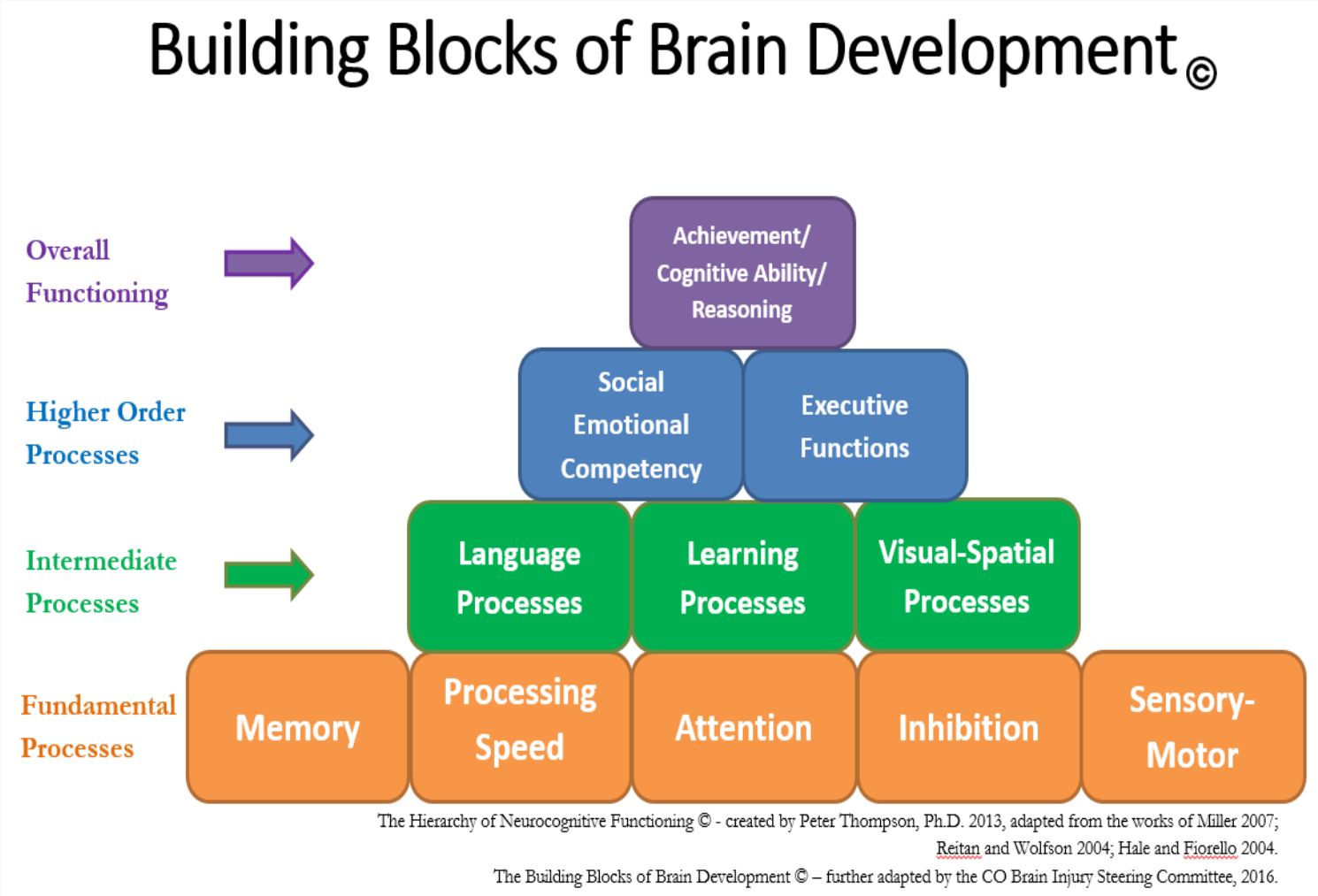
2. Introduce an efficient assessment framework to assure a comprehensive evaluation for the Big 3?

3. What are some targeted and broad interventions/supports we can employ?

WHAT ARE THE 3 NEUROCOGNITIVE FUNCTIONS THAT ARE SENSITIVE TO DISRUPTION?

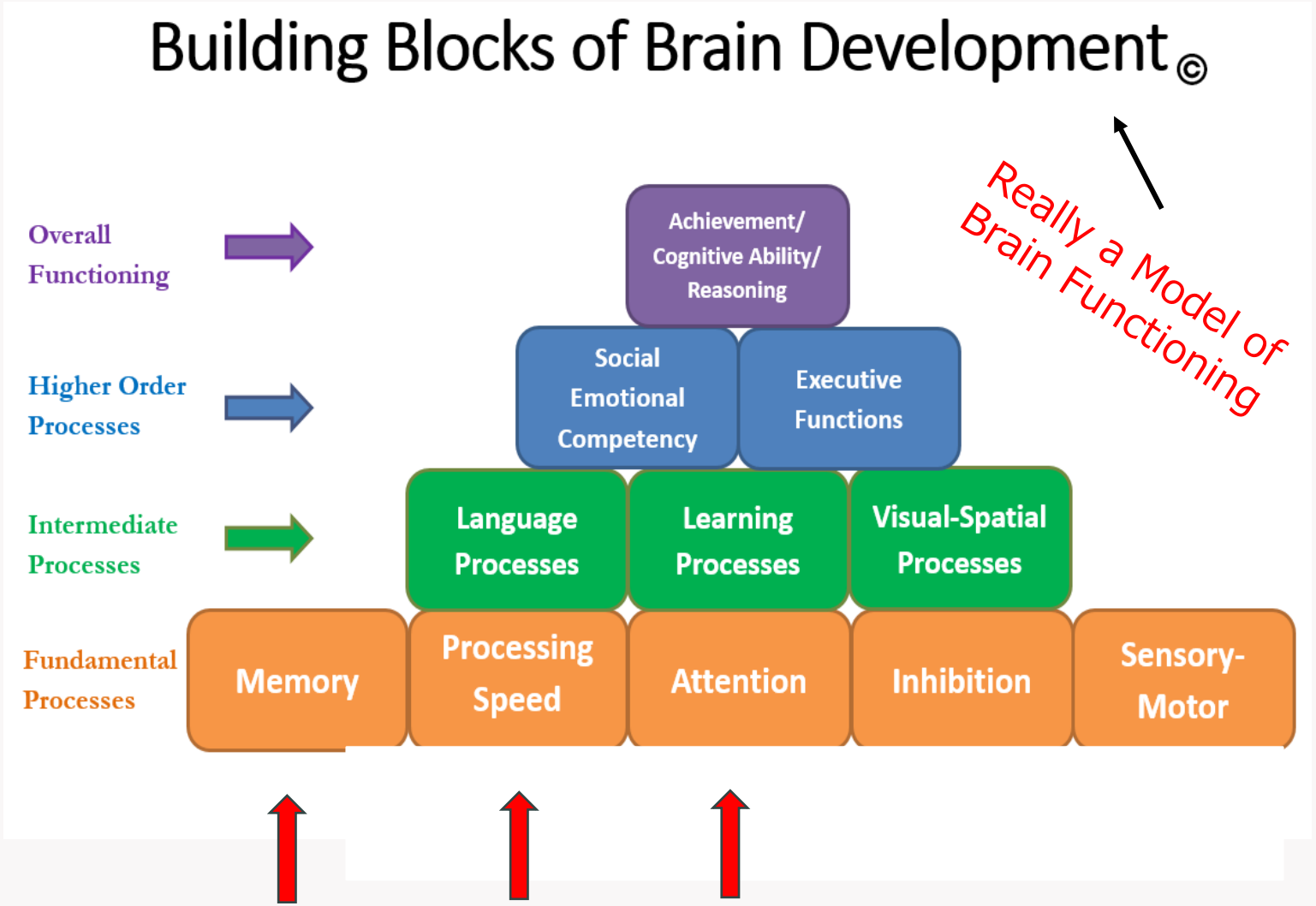
A MODEL OF BRAIN FUNCTIONING

BRAIN MUST WORK AS AN INTEGRATED UNIT



Source: CDE 2016

3 Dysfunctions Commonly Seen in MTBI and Moderate TBI Are At the *Fundamental* Level



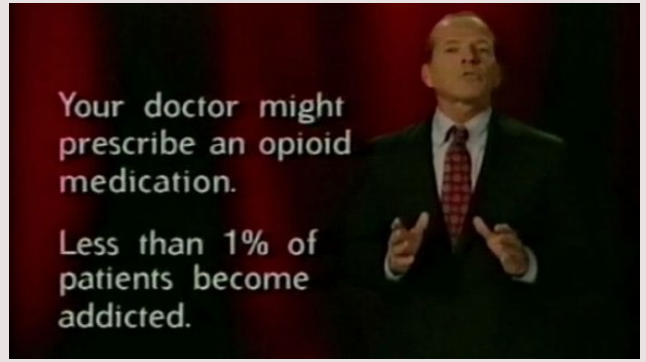
Source: CDE 2016

Evidence and Research

Fake Science, AI, Vested Interest, BIAS

WARNING! CAUTION ADVISED!!!!!

Study: Waffles and Hair Loss



Source / Citation

RUTGERS–NEW BRUNSWICK
Center of Alcohol and Substance Use Studies
Graduate School of Applied and Professional Psychology

Evidence and Research

Journal Articles

(Note: Everything is debatable!)

Carlson, A. O., et al. (2023). **Profiles of Cognitive Functioning at 6 Months After Traumatic Brain Injury in Patients at Level I Trauma Centers.** *JAMA Network Open / PMC10751593*

Robertson-Benta CR, Pabbathi Reddy S, Stephenson DD, et al. **Cognition and post-concussive symptom status after pediatric mild traumatic brain injury.** Child Neuropsychol. 2024 Feb;30(2):203-220.

Chan A, Ouyang J, Nguyen K, Jones A, Basso S, Karasik R. **Traumatic brain injuries: a neuropsychological review.** Front Behav Neurosci. 2024 Oct 8

Lennon MJ, Brooker H, Creese B, et al. **Lifetime Traumatic Brain Injury and Cognitive Domain Deficits in Late Life**: Neurotrauma. 2023 Jul;40(13-14):1423-1435.

Evidence and Research

Note: This is just a fraction of the supportive research studies. Decades of support, although there are a few contraindicated studies.

Tsai YC, Liu CJ, Huang HC, Lin JH, et al. **A Meta-analysis of Dynamic Prevalence of Cognitive Deficits in the Acute, Subacute, and Chronic Phases After Traumatic Brain Injury**. J Neurosci Nurs. 2021 Apr 1;53(2)

Mavroudis, I.; Ciobica, A. et al. **Cognitive Impairment Following Mild Traumatic Brain Injury (mTBI): A Review.** Medicina 2024, 60, 380

Bai, L., Bai, G., Wang, S., et al. (2020). **Strategic White Matter Injury Associated with Long-Term Information Processing speed Deficits in Mild Traumatic Brain** injury. *Human Brain Mapping*,

Wilson L, Horton L, et al. **Understanding the relationship between cognitive performance and function in daily life after traumatic brain injury** Journal of Neurology, Neurosurgery & Psychiatry

Evidence and Research: *Clinical Practice*

- Approximately 1000 TBI cases observed during my tenure as brain injury team leader for DCSD
- ImPACT Program—Real baseline cognitive data vs. post mTBI cognitive performance
- ImPACT primary cognitive functions: Memory, Attn, and Processing Speed.
- The majority of observed diagnosed concussion cases had co-occurring PS deficits (rare that it would not be observed)

Collins, Lacee K, Sione A. et al. (2023) **Cognitive Deficits Following Concussion: A Systematic Review.** *Journal of Orthopaedic Experience & Innovation*

What Happens

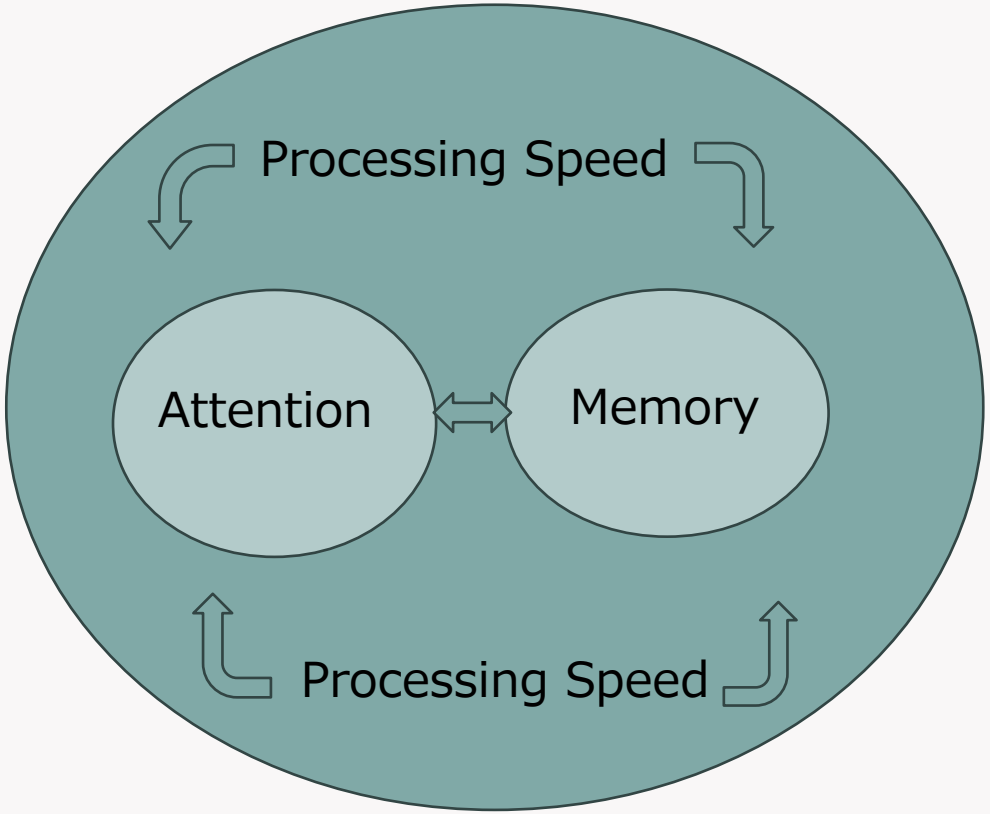
Not all TBIs are the same!

This is an example of **a typical** neuron firing properly.

mTBI interferes with the very tight tolerances necessary for proper neuronal functioning (**K+ floods the extracellular space as Ca+ and Na+ flood the intracellular space—ENERGY Crisis**)

Processing Speed

(Conceptualized as a General Function, *Not* Specific)



All **processes have some overlap and interdependency**

Not localized, but diffused by nature in the brain

All **processes are influenced by processing speed (General Process) because all processes work by neuronal signaling**

Processing Speed: Why?

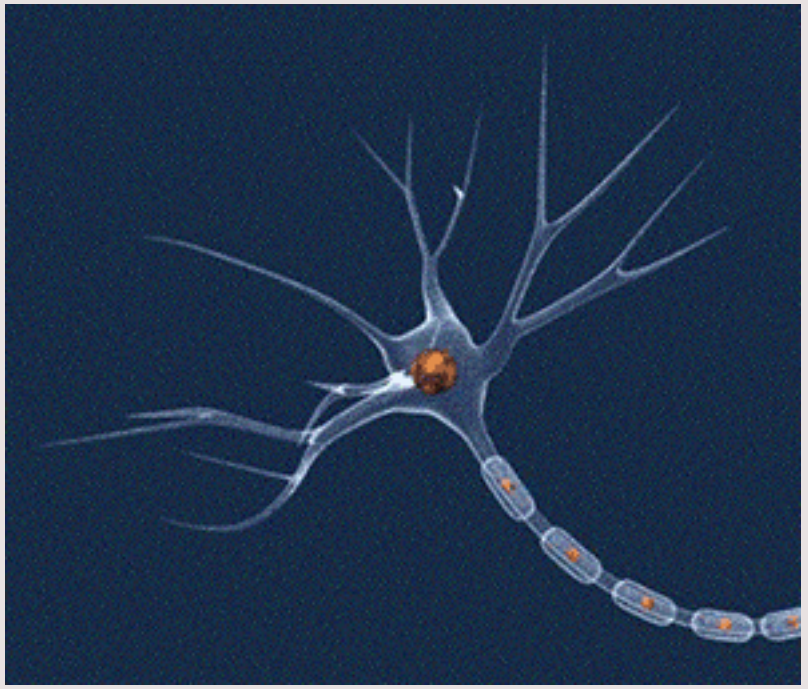
- **TBI disrupts the nerve cell connections (neural net) in the brain, slowing down the speed at which information is processed and communicated.**
- **Slowed processing speed makes *ALL* functions (attention, memory, behaviors, cognition) less efficient—because the intra-cerebral cortex communication system is altered.**
- **PS dysfunction causes cognitive inefficiency, which in turn increases cognitive fatigue, in a negative cycle.**

Images: Northwell 2025
Carrier Mngt 2025

Why?
Processing Speed

The brain's nerves (neurons) provide for a neural net to control everything we do- physiology, biology, emotions, thoughts, behavior, etc.

The neural net becomes damaged—
Diffused Axonal Injury (DAI)



1. Damage to myelin
2. Disruption to key neurochemicals (Ca+, K+, Na+; Sodium-K Pump)
3. Damage to internal neuronal structures (mitochondria)
4. Damaged neurons present a "roadblock," and signals must circumvent the area— inefficient, more time

WHY? ATTENTION DISRUPTION

Several areas, but *primarily*:

Prefrontal Cortex (PFC)

Parietal Lobe

Structural Damage and **Neurochemical** Dysfunction

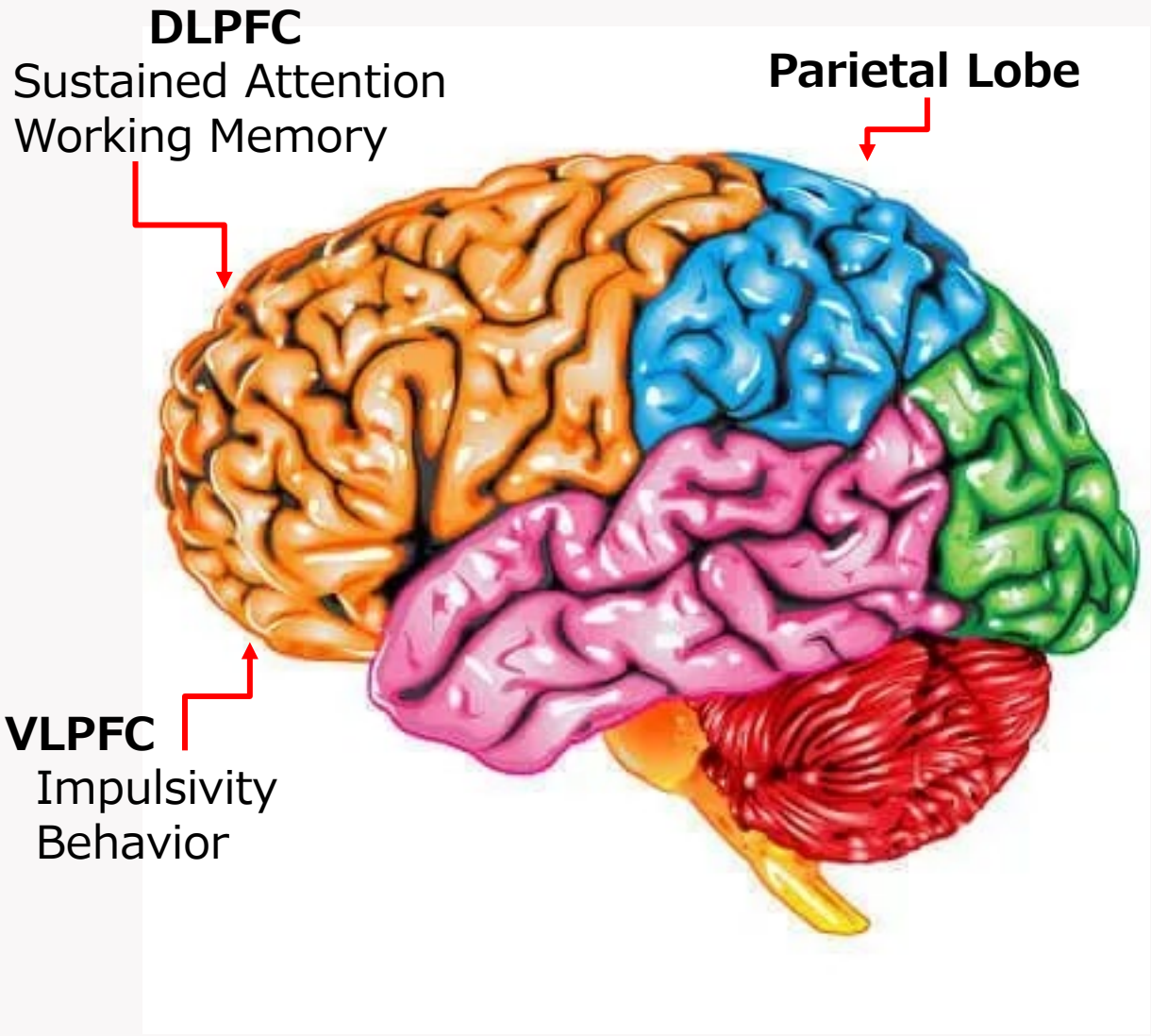


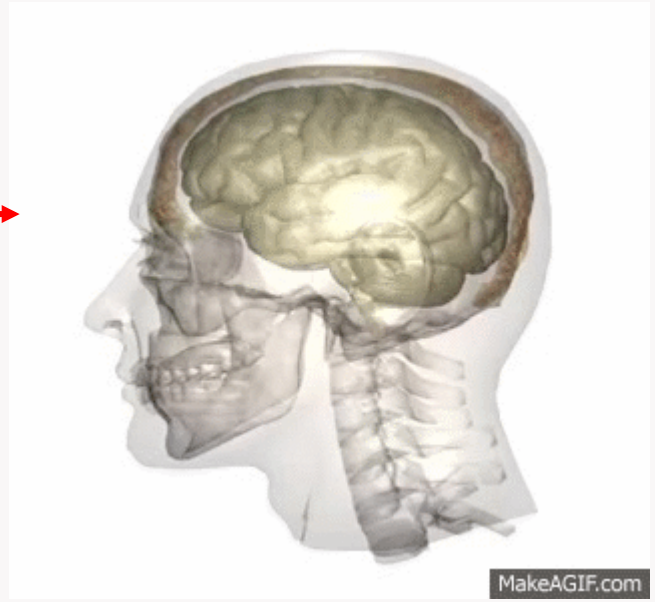
Image BIAA 2025

ATTENTION DISRUPTION

Coup contrecoup

Notice the frontal impact causes structural ***and*** neurochemical disruption

Prone to Structural Neuronal Damage



WHY? MEMORY

SO MANY TYPES!

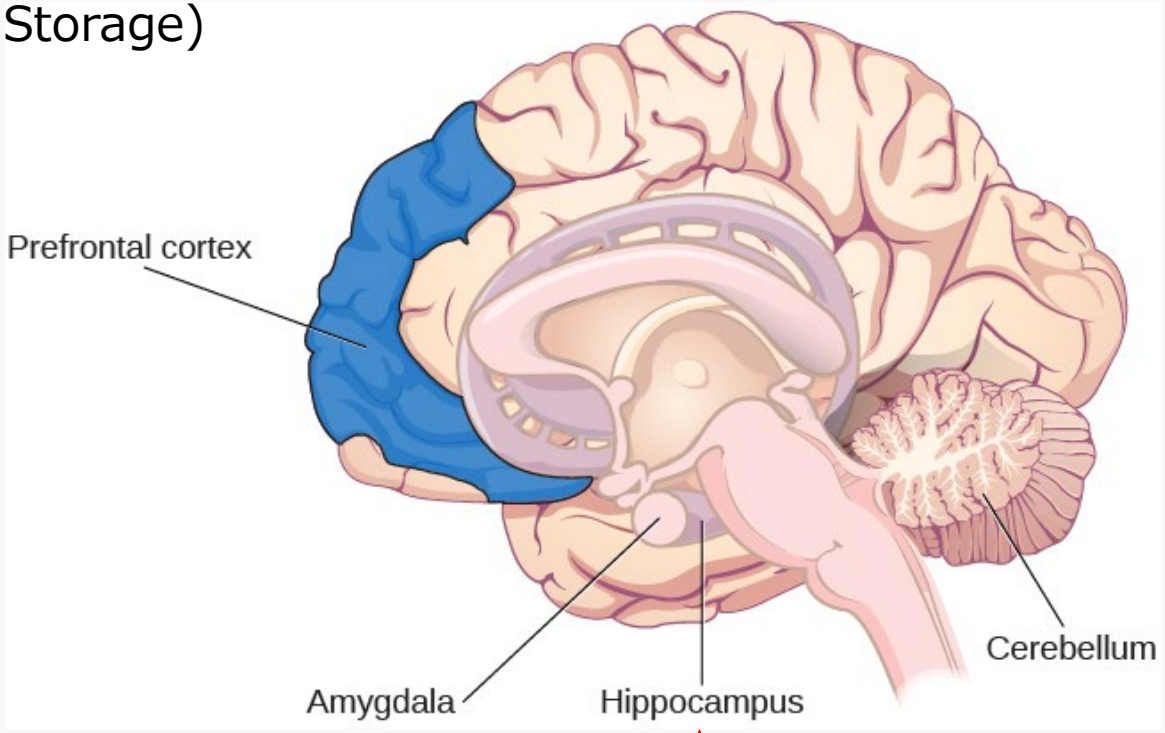
Working Memory

Verbal Memory

Visual Memory

Short-term Memory

Note: Need Attention for Memory (Doorway to Storage)



Primary Memory *Creation* Brain Mechanism—sensitive to damage and anoxic events

Evaluation

What is an efficient assessment model to ensure a comprehensive evaluation?

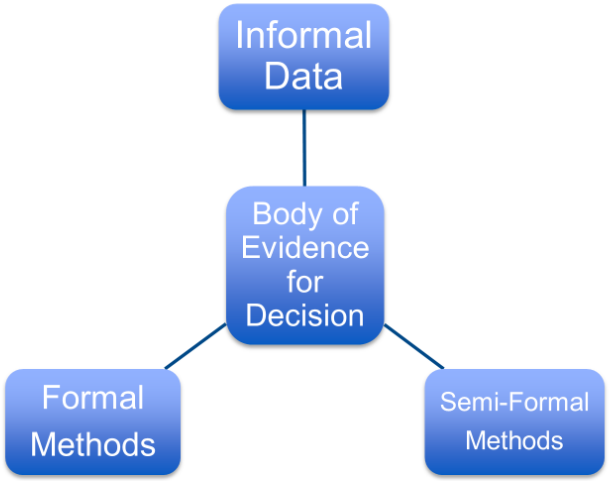
3-Factor Method (Triad Data Collection)

Key Points

- All legs of the triad will ensure a comprehensive and complete evaluation
- Emphasizes "convergence" of data
- Can collect all streams of information simultaneously

Review: 3-Factor Model

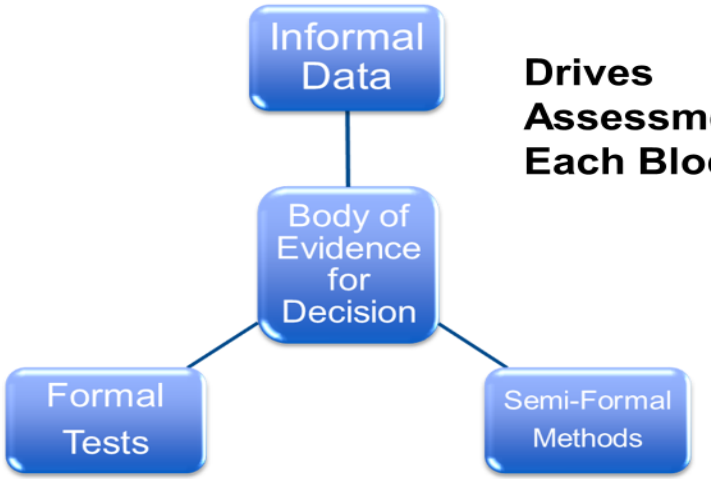
Gathering Comprehensive Information to Use for Interventions



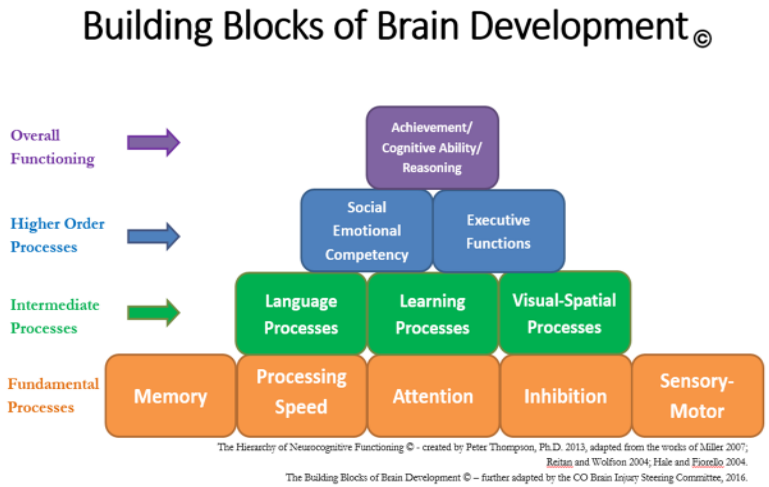
Thompson, P. and Sousa, K. (2013 / 2020)

The 3-Factor Model: “How vs. What”

All Blocks Examined with the 3-Factor Model



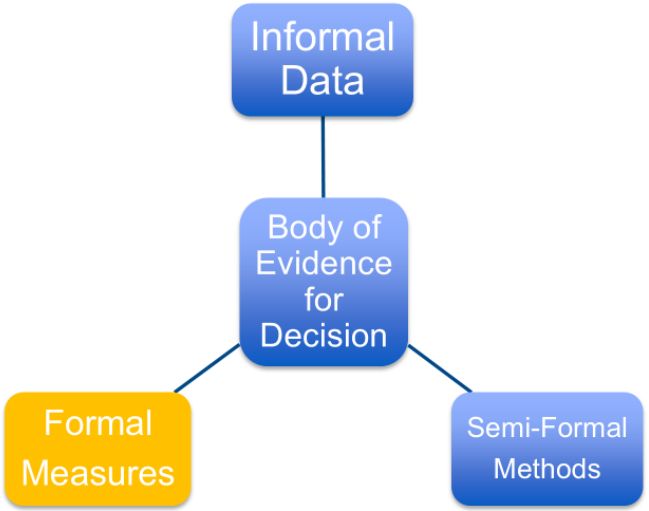
Drives Assessment of Each Block



How

What

First Factor: Formal Measures



I. Formal Methods 3-Factor Model Explained

- Typically, normed referenced assessments
- Standardized scores
- Strict standardized administration
- Restricted use with training and license
- Indicates what is “normal” performance
- Expensive and time consuming
- Impacted by confounding factors

Formal Measures: Processing Speed, Attention, Memory (No Endorsement-But Favorite Suggestions)

- Select at least ONE from each area
- Subtests are very quick to administer
- 4-6 minutes typical

Processing Speed

- DAS-2 NU Rapid Naming / SIP
- WISC-V PS Domain
- CAS-2 Planning Domain (Planned Connections)

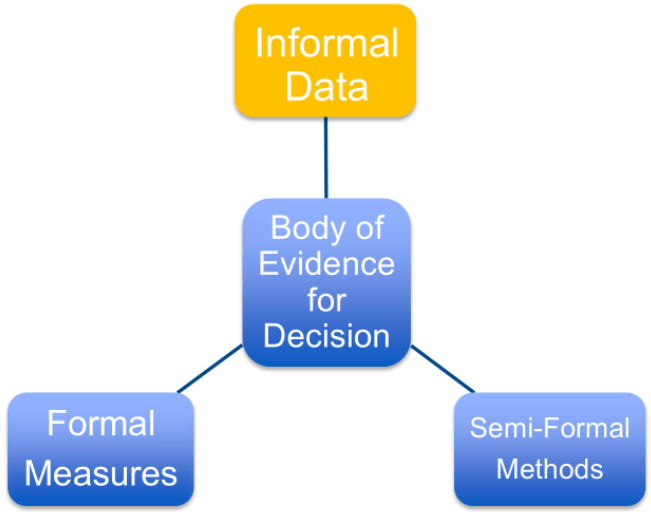
Attention

- CAS-2 Attention Domain (EA, ND)
- IVA-QS (Computerized Quick Screen 8 minutes)
- NEPSY-2 Attention Subtests

Memory

- DAS-2 NU / WISC: Digits Fwd / Bkwds
- DAS-2 Recall of Seq Order (verbal Mem)

Second Factor: Informal Methods (Data)



II. Informal Methods
3-Factor Model Explained

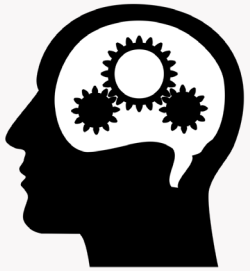
- Just as vital as formal measures
- Critical *qualitative* information- Especially behavioral data (authentic or environmental data)
- Not typically restricted, employed by most school staff
- Should confirm and support formal data
- Inexpensive
- Impacted by bias

Second Factor: *Informal Methods* (Data)

Processing Speed, Attention, Memory

For All 3 Cognitive Functions

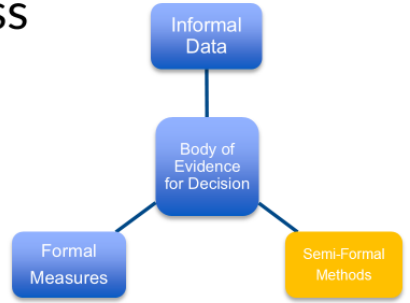
- **Parental / Teacher Interviews**—Pre-functioning questions, specific questions regarding PS, Attention, Memory.
- **Health History** and nature of the brain injury incident
- ***Observation(s)*** of a person in an authentic environment (not just an office) **Work-sample** analysis (Key)
- ***Brain Check Survey** (Pat Sample-CSU) Structured Interview (Cut Score)



Third Factor: *Semi-Formal* Methods

III. Semi-Formal Methods
3-Factor Model Explained

The critical bridge between formal and informal
Hybrid-combines aspects of both qualitative and quantitative methods
Not restricted, employed by most school staff
Provides robust 360 view via multi-perspectives
Allows for multiple voices in the process
Inexpensive
Still impacted by bias, but moderates it



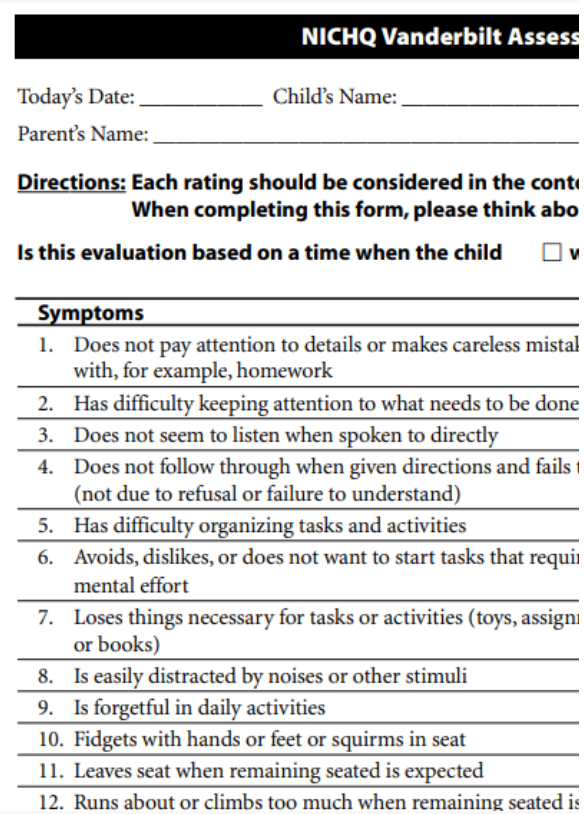
Third Factor: *Semi-Formal* Methods

Suggestions

- Vanderbilt Scales-Free
- NEF-Brain Injury Manual
- Self-made forms (1-5 ratings suggested)

- Ratings scales (flexible administration, non-standardized scores not norm-referenced)
- Symptom checklists
- Structured / standardized interviews
- Structured / standardized observations
- Can be self-created scales, interviews
- Disclosure

Examples: Semi-Formal Methods



NICHQ Vanderbilt Assess

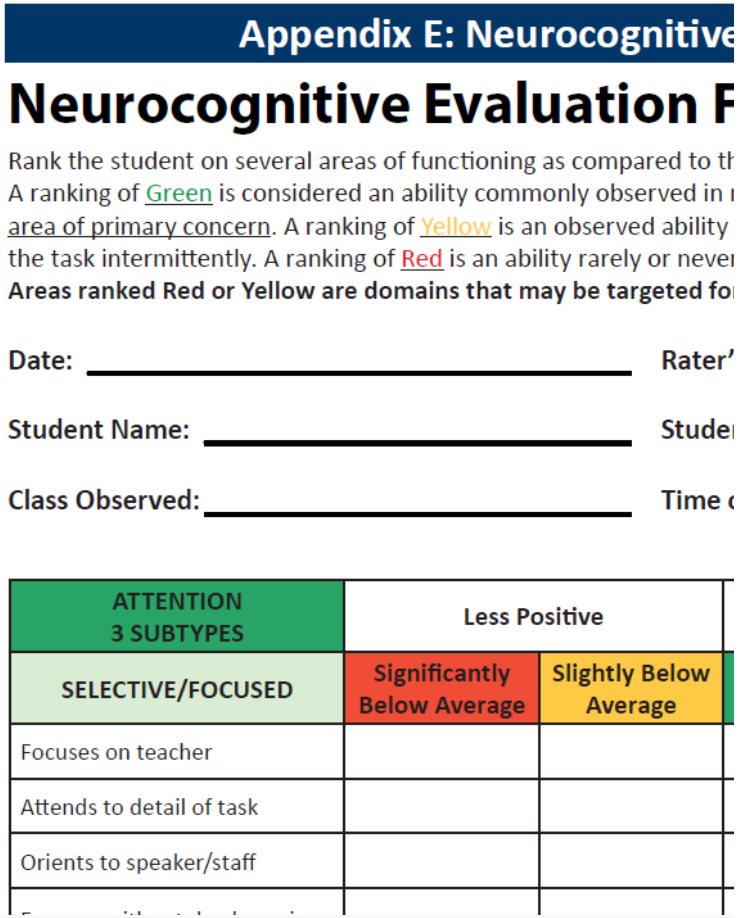
Today's Date: _____ Child's Name: _____

Parent's Name: _____

Directions: **Each rating should be considered in the cont**
When completing this form, please think abo

Is this evaluation based on a time when the child ☐ **v**

Symptoms	
1.	Does not pay attention to details or makes careless mistal with, for example, homework
2.	Has difficulty keeping attention to what needs to be done
3.	Does not seem to listen when spoken to directly
4.	Does not follow through when given directions and fails t (not due to refusal or failure to understand)
5.	Has difficulty organizing tasks and activities
6.	Avoids, dislikes, or does not want to start tasks that requi mental effort
7.	Loses things necessary for tasks or activities (toys, assign or books)
8.	Is easily distracted by noises or other stimuli
9.	Is forgetful in daily activities
10.	Fidgets with hands or feet or squirms in seat
11.	Leaves seat when remaining seated is expected
12.	Runs about or climbs too much when remaining seated is



Appendix E: Neurocognitive

Neurocognitive Evaluation F

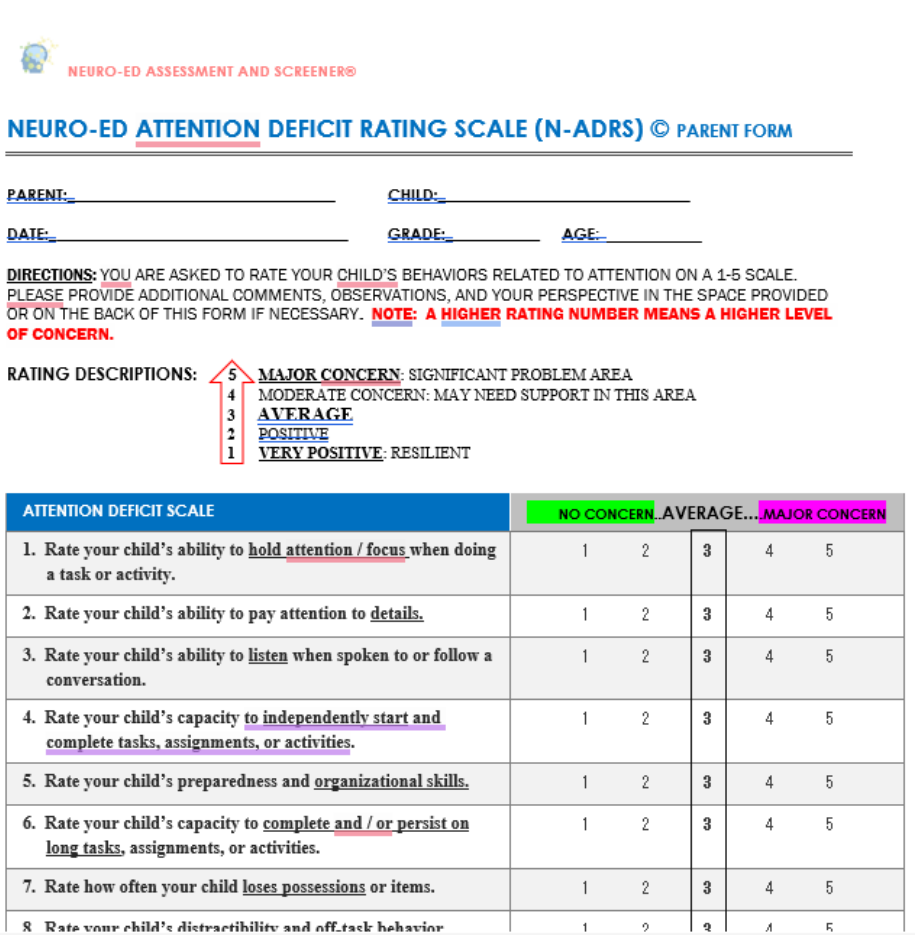
Rank the student on several areas of functioning as compared to th
A ranking of Green is considered an ability commonly observed in
area of primary concern. A ranking of Yellow is an observed ability
the task intermittently. A ranking of Red is an ability rarely or neve
Areas ranked Red or Yellow are domains that may be targeted fo

Date: _____ **Rater'**

Student Name: _____ **Stude**

Class Observed: _____ **Time**

ATTENTION 3 SUBTYPES	Less Positive	
SELECTIVE/FOCUSED	Significantly Below Average	Slightly Below Average
Focuses on teacher		
Attends to detail of task		
Orients to speaker/staff		



NEURO-ED ASSESSMENT AND SCREENER®

NEURO-ED ATTENTION DEFICIT RATING SCALE (N-ADRS) © PARENT FORM

PARENT:_____ CHILD:_____

DATE:_____ GRADE:_____ AGE:_____

DIRECTIONS: YOU ARE ASKED TO RATE YOUR CHILD'S BEHAVIORS RELATED TO ATTENTION ON A 1-5 SCALE. PLEASE PROVIDE ADDITIONAL COMMENTS, OBSERVATIONS, AND YOUR PERSPECTIVE IN THE SPACE PROVIDED OR ON THE BACK OF THIS FORM IF NECESSARY. **NOTE: A HIGHER RATING NUMBER MEANS A HIGHER LEVEL OF CONCERN.**

RATING DESCRIPTIONS:
5 MAJOR CONCERN: SIGNIFICANT PROBLEM AREA
4 MODERATE CONCERN: MAY NEED SUPPORT IN THIS AREA
3 AVERAGE
2 POSITIVE
1 VERY POSITIVE: RESILIENT

ATTENTION DEFICIT SCALE	NO CONCERN..AVERAGE....MAJOR CONCERN				
1. Rate your child's ability to hold attention / focus when doing a task or activity.	1	2	3	4	5
2. Rate your child's ability to pay attention to details.	1	2	3	4	5
3. Rate your child's ability to listen when spoken to or follow a conversation.	1	2	3	4	5
4. Rate your child's capacity to independently start and complete tasks, assignments, or activities.	1	2	3	4	5
5. Rate your child's preparedness and organizational skills.	1	2	3	4	5
6. Rate your child's capacity to complete and / or persist on long tasks, assignments, or activities.	1	2	3	4	5
7. Rate how often your child loses possessions or items.	1	2	3	4	5
8. Rate your child's distractibility and off-task behavior	1	2	3	4	5

PRACTICAL INTERVENTIONS

(NON-MEDICAL AND DISCLOSURE)

Remediate vs. Compensation Strategies

Variable Research for Effectiveness

Domain Specific Gains (near v. far)

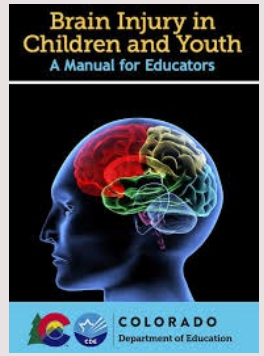
Financial Incentive Concerns

If it works...

Targeted

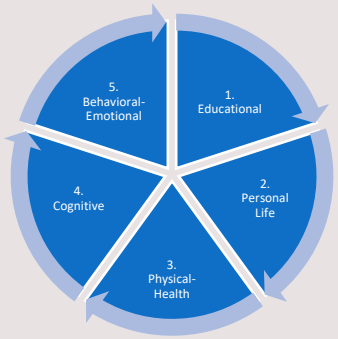
Primary Resource: Brain Injury Manual for Educators (CDE)

Computer and AI Interventions / Supports



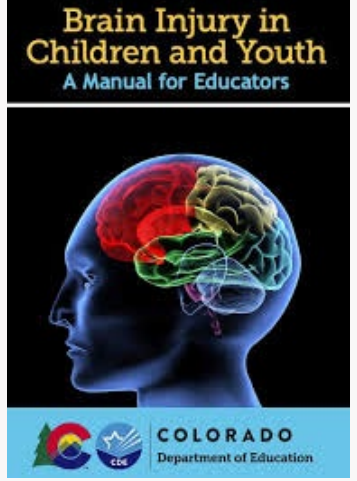
Broad-Based Intervention / Supports

Intervention Wheel



TARGETED INTERVENTIONS FOR:

PROCESSING SPEED
ATTENTION
MEMORY



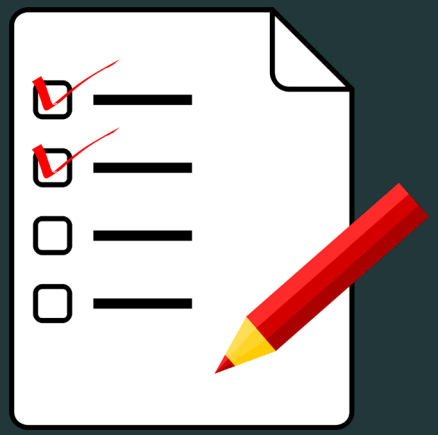
Download FREE Copy

https://ed.cde.state.co.us/cokidswithbraininjury

- Interventions for ***Attention***—Page 24-25
- Interventions for ***Processing Speed***—Page 28-29
- Interventions for ***Memory***– Page 30-31

TARGETED / SPECIFIC

MY TOP INTERVENTIONS AND SUPPORTS FOR EACH DOMAIN (*RESEARCH SUPPORTED*)



Attention

Consistent Physical Exercise (Medical Consult)
Self-Monitoring Skills / Timers (5-5 rule)
Cognitive Behavioral Therapy (Self-Talk Strats)
Prime the Pump

Processing Speed

Cognitive Training (Repetition-Domain Specific)
Reduce Task Demands (Reduce Multitasking)
Self-Monitoring for Fatigue (Speed vs. Fatigue)

Memory

Spaced Retrieval Techniques
Use Electronic Devices (Reminders, Planners)
Constant Repetition and Review (aloud)

<u>Supplemental:</u>

- Cogmed Computer Training (Some Caution)
- Metacognitive Strategies- helpful except for PS
- Must Keep Active, Enriching Environment and Stay Positive (Attitude Helps)

BROAD BASED

THE INTERVENTION WHEEL

Research: Multifaceted Interventions Effective

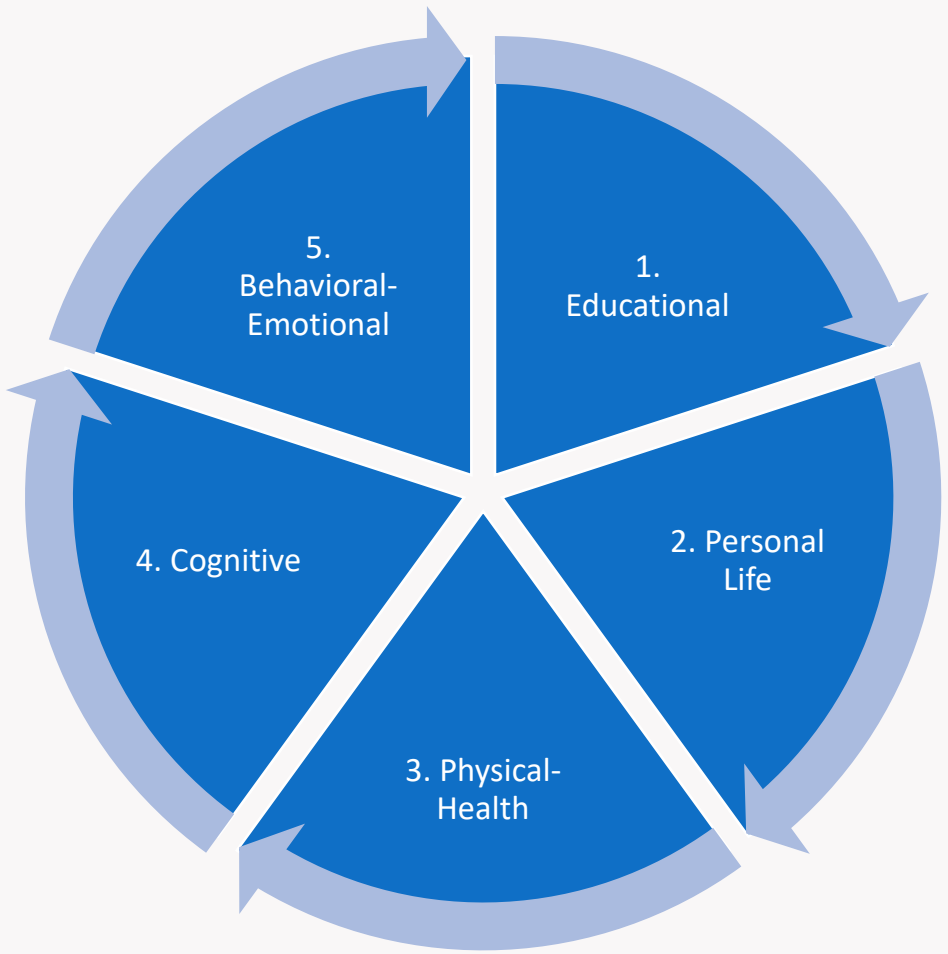
General well-being

Lifestyle Change

Needs Commitment

Needs Support from all Stakeholders

Holistic Approach



BROAD BASED

THE INTERVENTION WHEEL

Needs Family / Extended Supports!

Provides Foundation for Interventions to Work

Positive Attitude From All Stakeholders

Good Brain Hygiene

Education	• Education on TBI –Person and Family • Describe Supports / Intervention-Provide “Why” • Set Meaningful Goals Together / Environments
Personal Life Changes	• Set New Healthy Routines • Commit to a Healthy Lifestyle / Enriching Environment • New Limits and Increases
Physical Health	• Easy Exercise Routine (make it fun and doable) • Go outside 1x per day—sunshine benefits (dopamine) • Eat Healthy / Supplements (Key)
Cognitive (Thinking)	• Cognitive Restructuring / Therapy -CBT • Cognitive Engagement-Brain Games / Learning • Positive Self Talk / Self-Awareness
Behavioral / Emotional	• Use Planners/Organizational Skills • Actively Seek Help--Self-Advocacy • Skill Building by High Repetition and Role Play

DEEPER DIVE SUPPLEMENTAL

CONSULT WITH **MEDICAL** AND OTHER SPECIALISTS

SOME RESEARCH EVIDENCE

SIDE EFFECTS

INFLAMMATION-PRIME CONCERN

Methylphenidate

- **Attention, Processing Speed, Fatigue**
- **Frontiers in Science Neurotrauma (Meta Review)**

Nutrition

- **Food As Medicine (Dr. Siegel)**
- **Hydration is Critical**
- **Limit Ulta-Process Foods / Sugar**

Supplements

- **Magnesium—Modulates Excitotoxicity**
- **Creatine Helps Maintain ATP (energy, headaches)**
- **Omega-3—Most Studied, Helps with Inflammation**

Sleep

- **Often Overlooked**
- **Critical for Brain Health**
- **Exercise Can Help. Be Wary of Sleep Supplements**

THANKS!

Q&A

Citations and Resources

Rees JLC, Saunders R, et al. (2025). **Methylphenidate for the cognitive and neurobehavioural sequelae of traumatic brain injury in adults: a systematic review and meta-analysis**. Frontiers in Neurology, 16:1546080.

Conti, F., McCue, J. J., DiTuro, P., Galpin, A. J., & Wood, T. R. (2024**). Mitigating Traumatic Brain Injury: A Narrative Review of Supplementation and Dietary Protocols**. *Nutrients*, *16*(15), 2430.

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Grant, A., et al. (2024). **Speed of processing training to improve cognition in moderate to severe TBI: A double-blind, placebo-controlled, randomized clinical trial.** *Frontiers in Neurology.*

Citations and Resources

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Cicerone KD, Goldin Y. et al. **Evidence-Based Cognitive Rehabilitation: Systematic Review of the Literature From 2009 Through 2014**. Arch Phys Med Rehabil. 2019.

Peterson, B., Frias, J., & Tourgeman, I. (2021**). Examining Cogmed's Impact on the Cognitive Improvement of Individuals with Traumatic Brain Injury.** *Archives of Physical Medicine and Rehabilitation*, *102*(10).

Fetta J, Starkweather A, Gill JM**. Computer-Based Cognitive Rehabilitation Interventions for Traumatic Brain Injury:** A Critical Review of the Literature. J Neurosci Nurs. 2017 Aug;49(4)