

# A Multi-Disciplinary Treatment Program for Patients With Post-Concussive Syndrome

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# Neuroplasticity in the Human Brain:

## My Research & Publications



# Objectives

- The story of a teenager with post-concussive syndrome
- Five reasons some patients have persistent post-concussive symptoms for months to years
- Five key components of a multi-disciplinary “concussion recovery program”





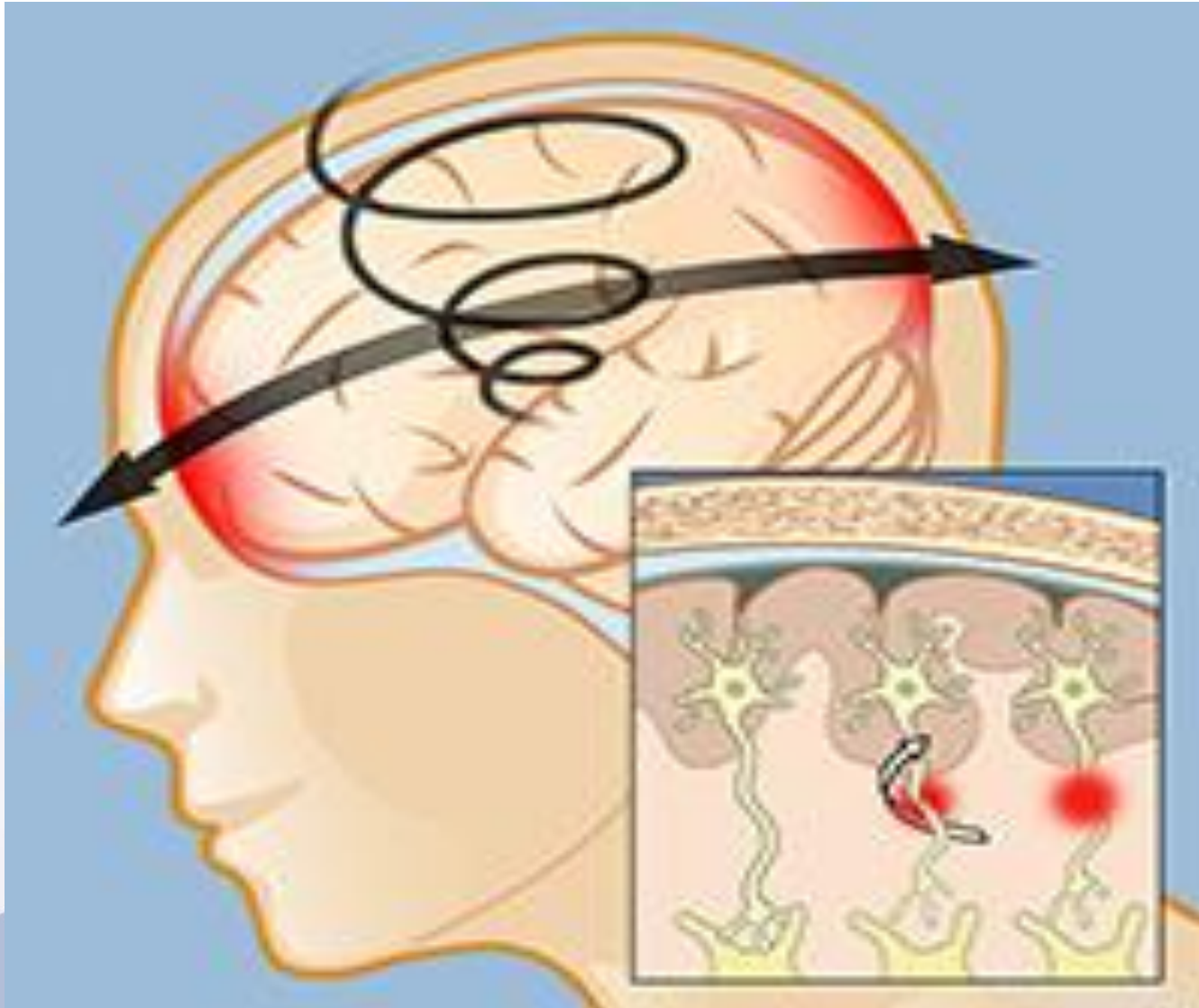


# Michelle's Story

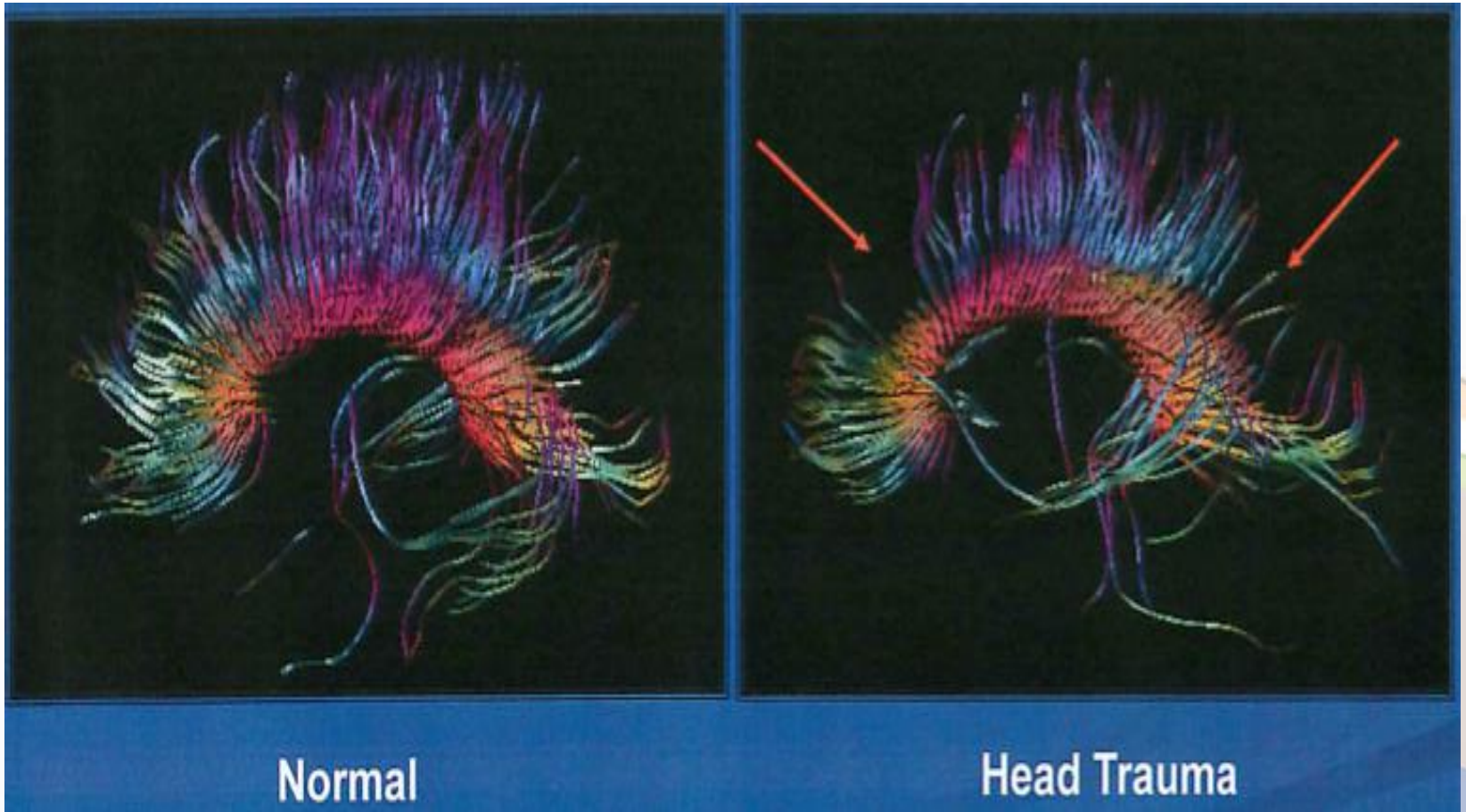
- Sensitive to sounds, lights, and people
- Constant headaches, almost daily
- Felt dizzy and was sensitive to moving her head
- Difficulty performing simple tasks, even crossing the street
- Unable to go to school
- Stopped many of her extra-curricular activities such as music
- Depressed, hopeless
- For one year, had seen dozens of specialists and received frequent tests, eye movement therapy, massage, acupuncture, and tried different medication
- Nothing had worked; she and her family were frustrated
  - WHAT HAPPENED TO HER BRAIN?
  - WHY WAS SHE NOT GETTING BETTER ONE YEAR LATER?



## TBI Causes Micro-tears in Axons

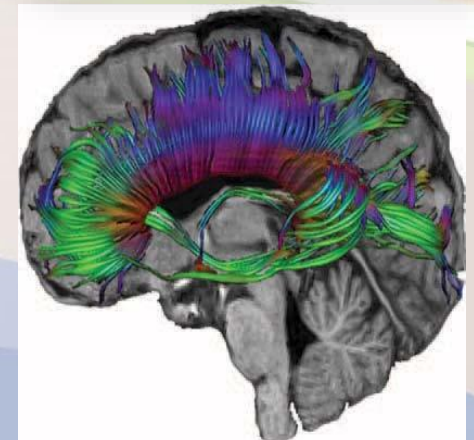
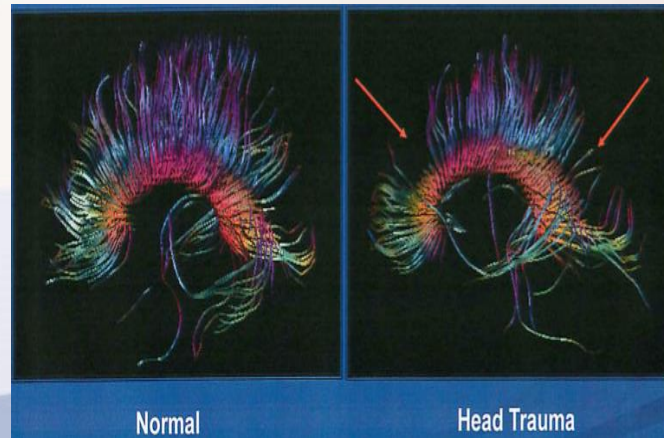
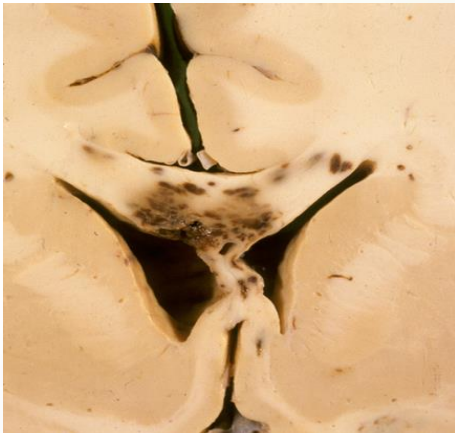
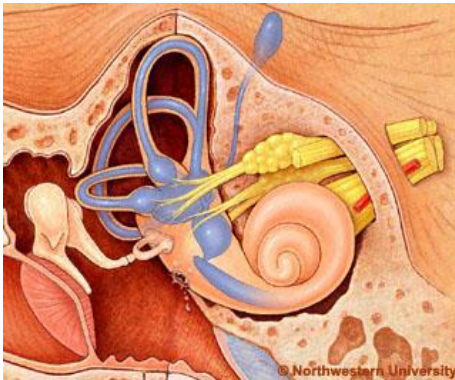


# Torn Neuronal Connections: Diffuse Axonal Injury

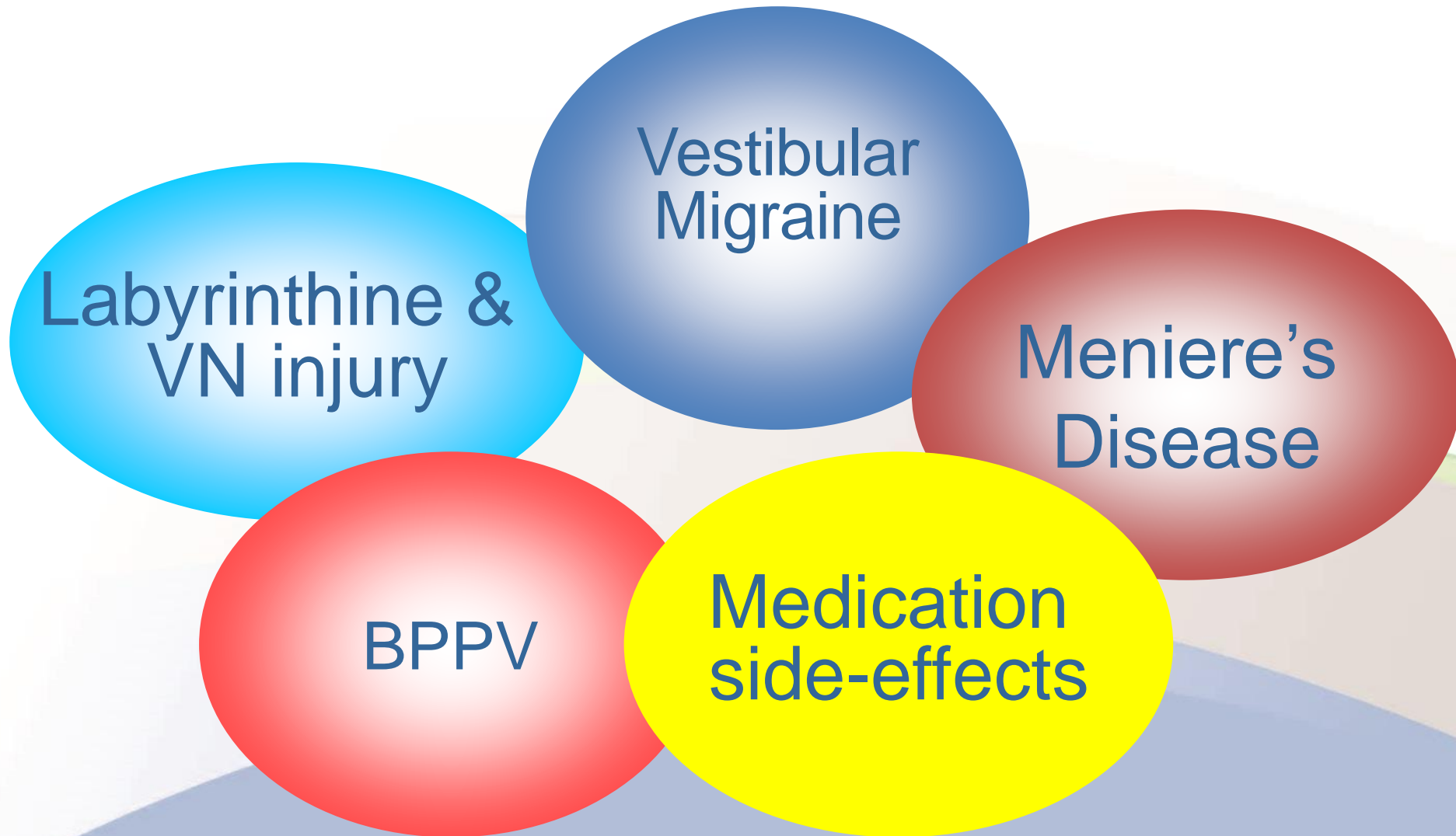




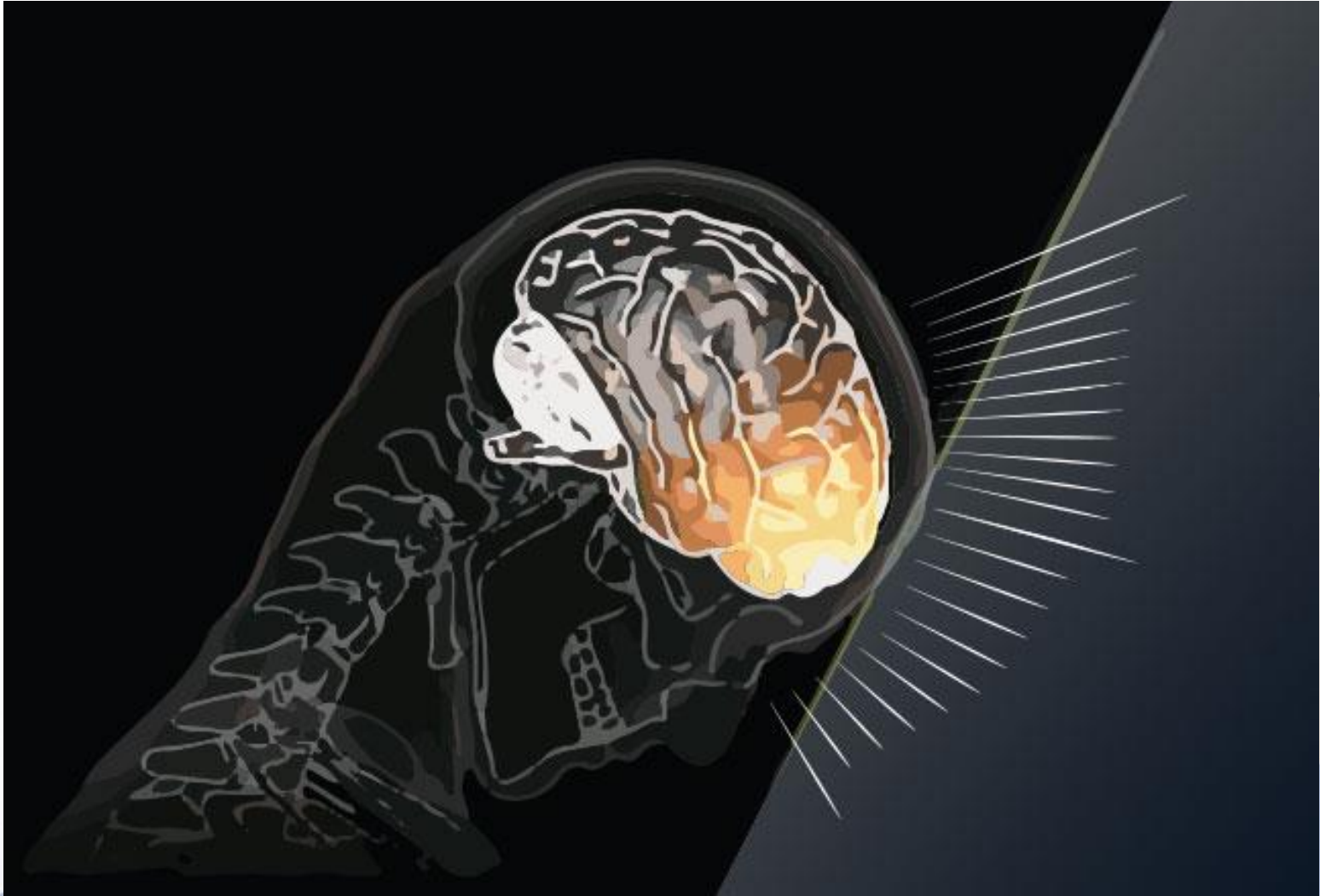
# Trauma to Brain, Inner Ear. and Spinal Cord



# Common Causes of Post-Concussive Dizziness



# Symptoms Depend on Location and Angle of Trauma



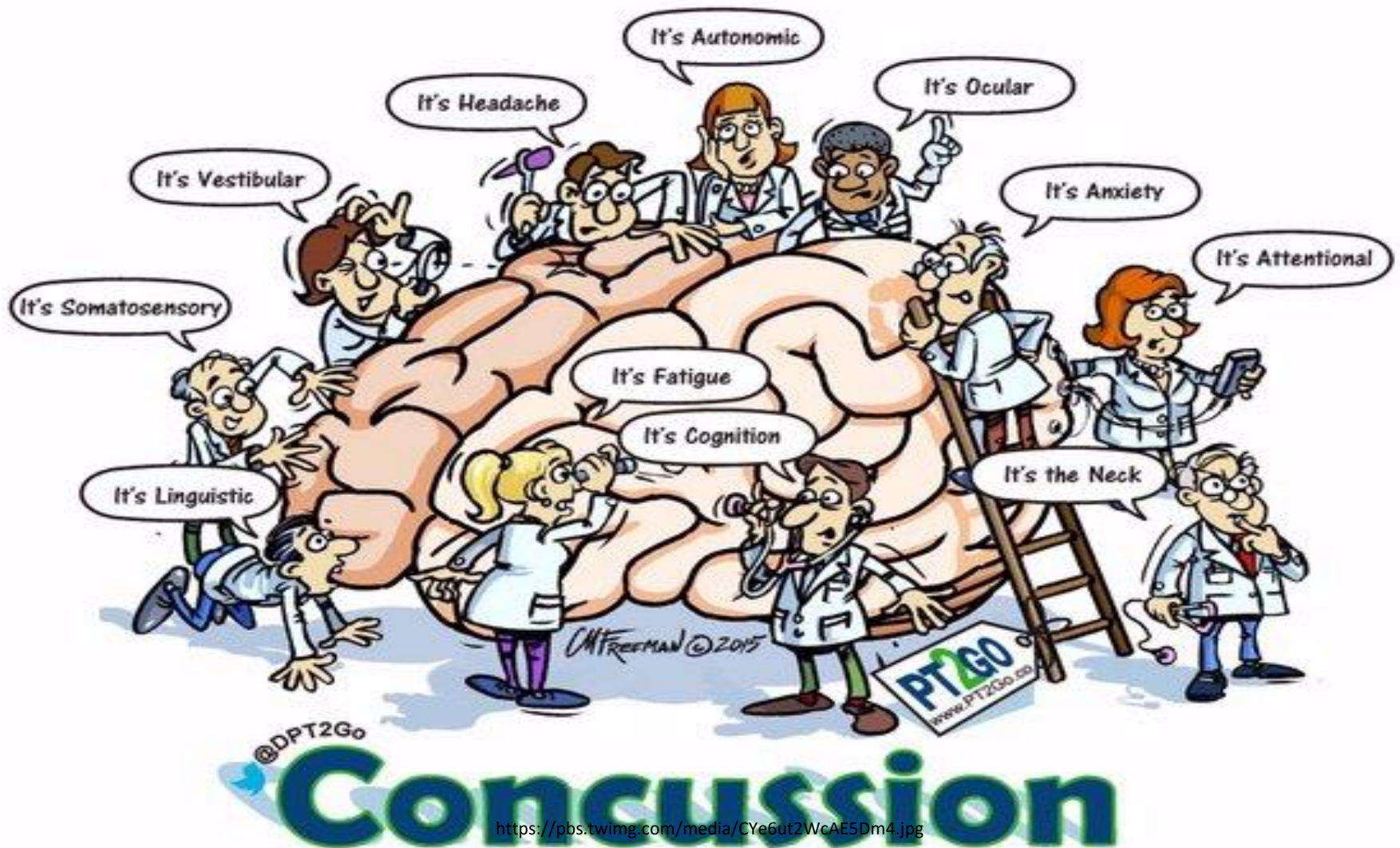
<http://img.medscapestatic.com/pi/features/slideshow-slide/pediatric-concussion//updated/fig1.jpg?resize=645:439>



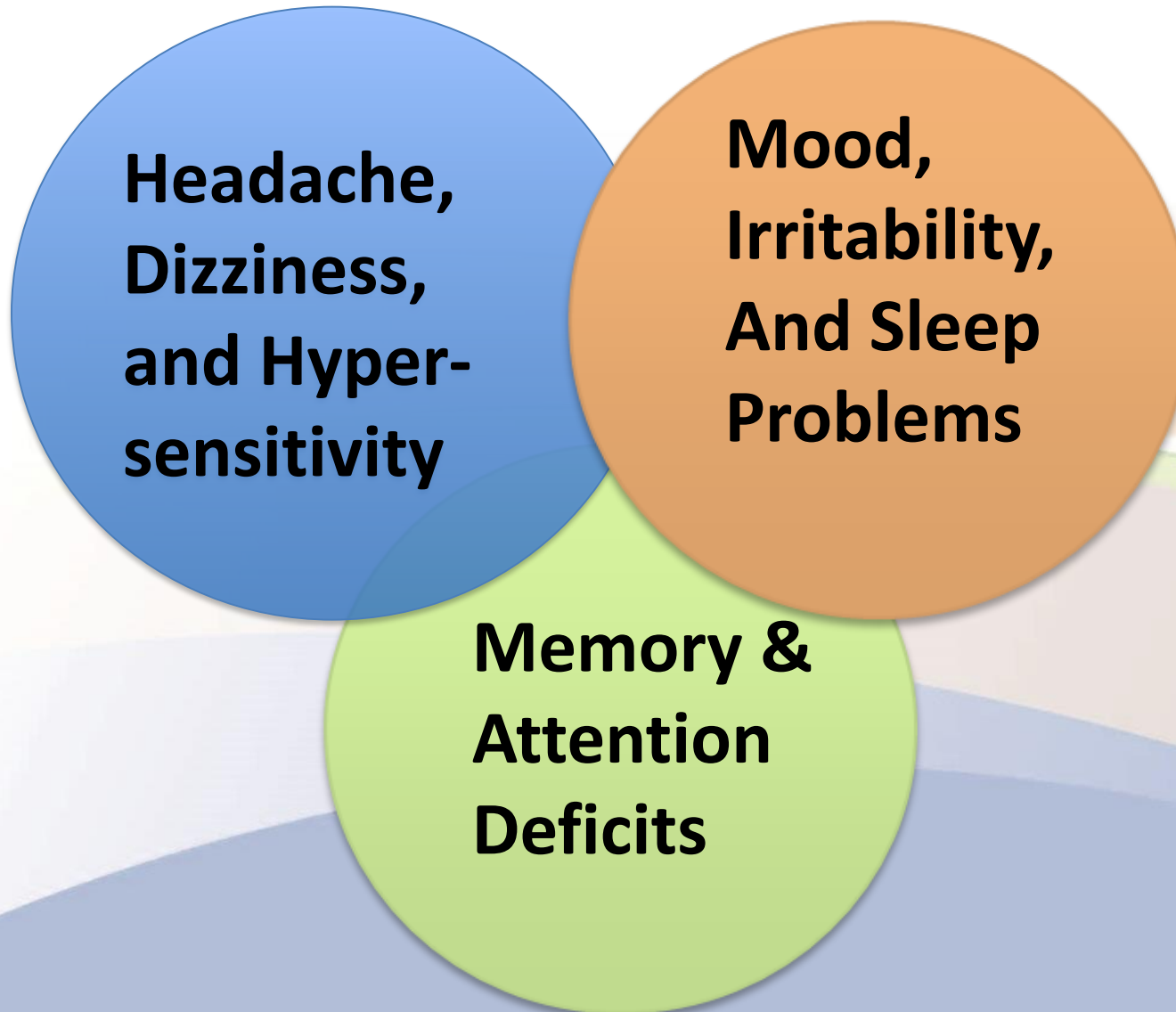
# Objectives

- The story of a teenager with post-concussive syndrome
- Five reasons some patients have persistent post-concussive symptoms for months to years
- Five key components of an effective “concussion recovery program”

# 1. Multiple expert opinions, multiple therapies



## 2. Many Symptoms, Each Worsening Other





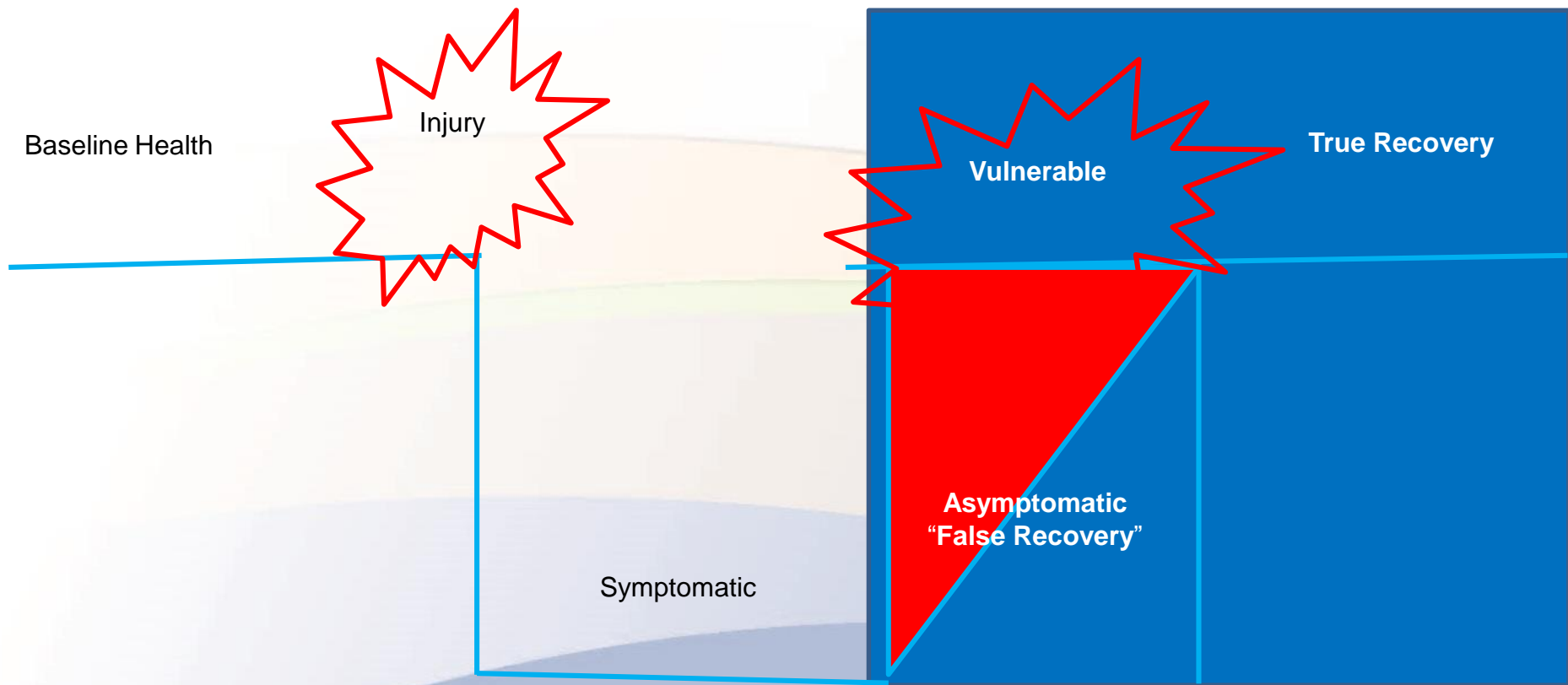
### 3. Fragmented Care, in Different Facilities



## 4. No universally accepted outcome measure for monitoring patients



## 5. False Recovery, Return to Study or Work Too Soon





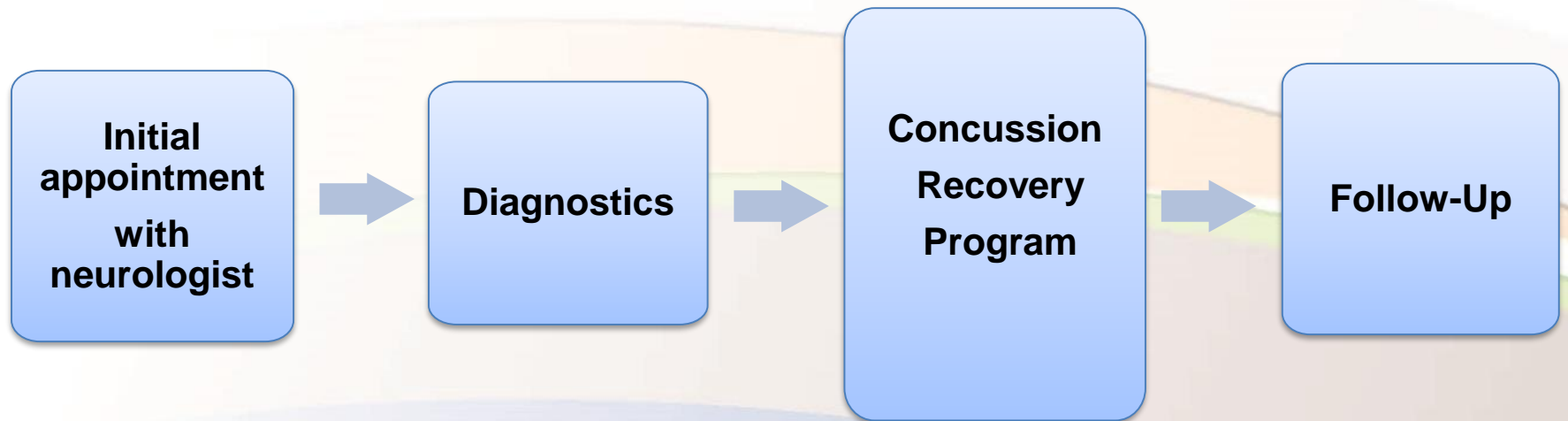
# Objectives

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# Key Components of NeuroGrow Concussion Recovery Program

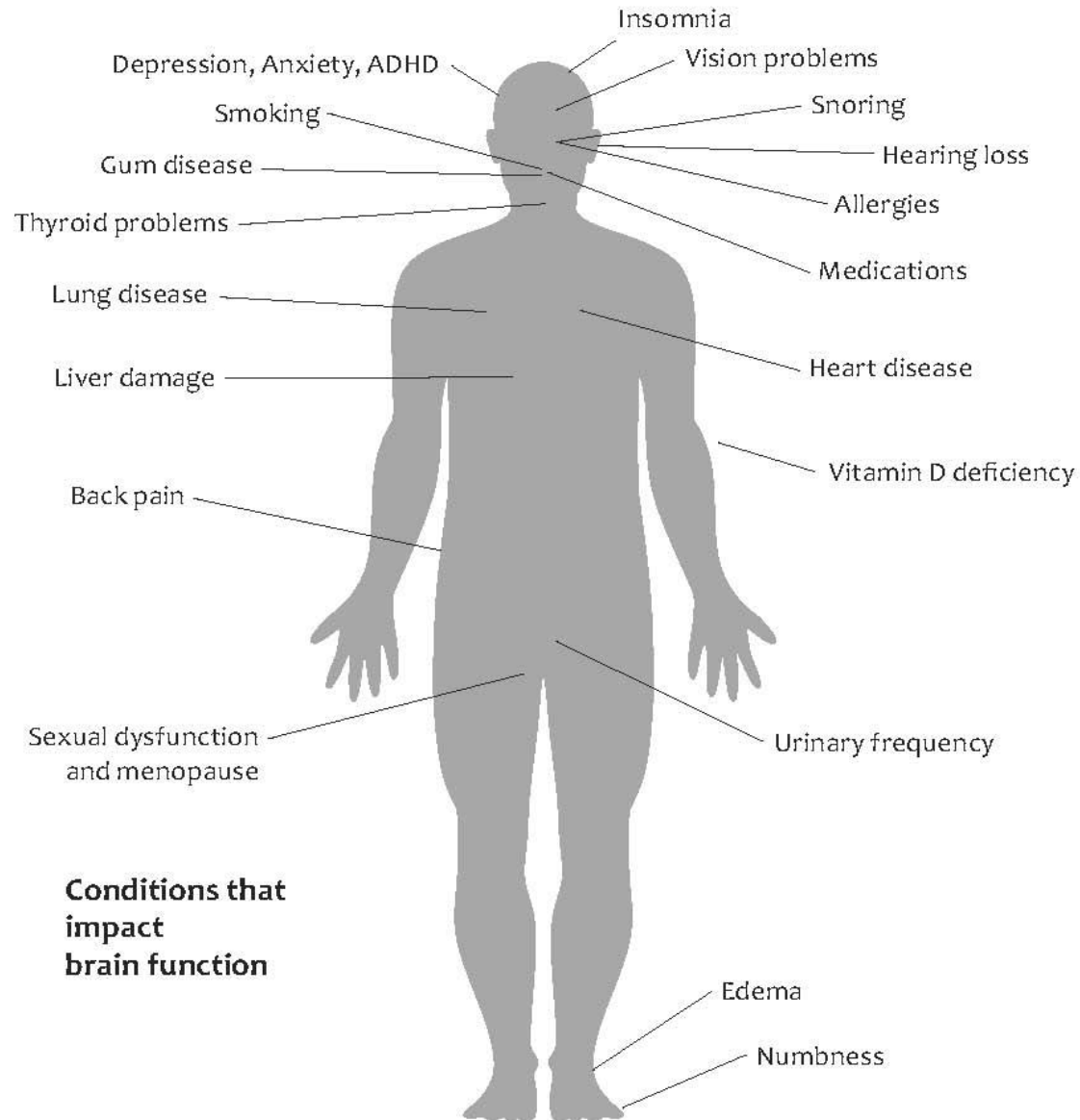
- 1) Making an accurate diagnosis, with emphasis on understanding patient's pre-existing conditions
- 2) One person in charge of all of patient's symptoms
- 3) Becoming patient's advocate (addressing and obtaining support from family, school, and employer)
- 4) Multi-disciplinary approach (e.g. vestibular exercises, stress reduction, exercise, meditation, and brain training)
- 5) Objective measurements for monitoring progress, until full recovery is achieved

# Concussion Recovery Program: Overview



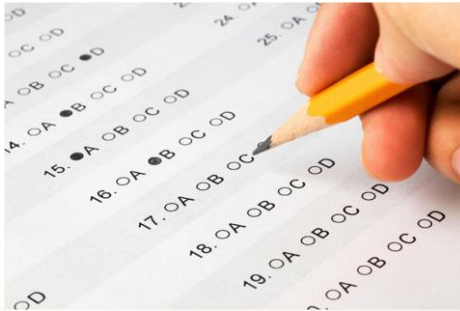


# Concussion Recovery Program: Initial Comprehensive Assessment

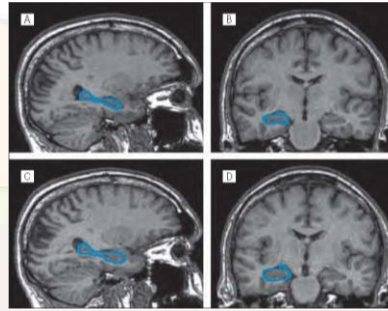


# Concussion Recovery Program: Comprehensive Diagnostic Tests

## Neuro-cognitive Evaluation



## Brain MRI



## Cardiopulmonary Testing



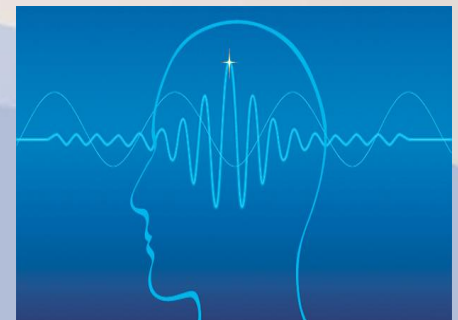
## Blood Test



## Sleep Assessment

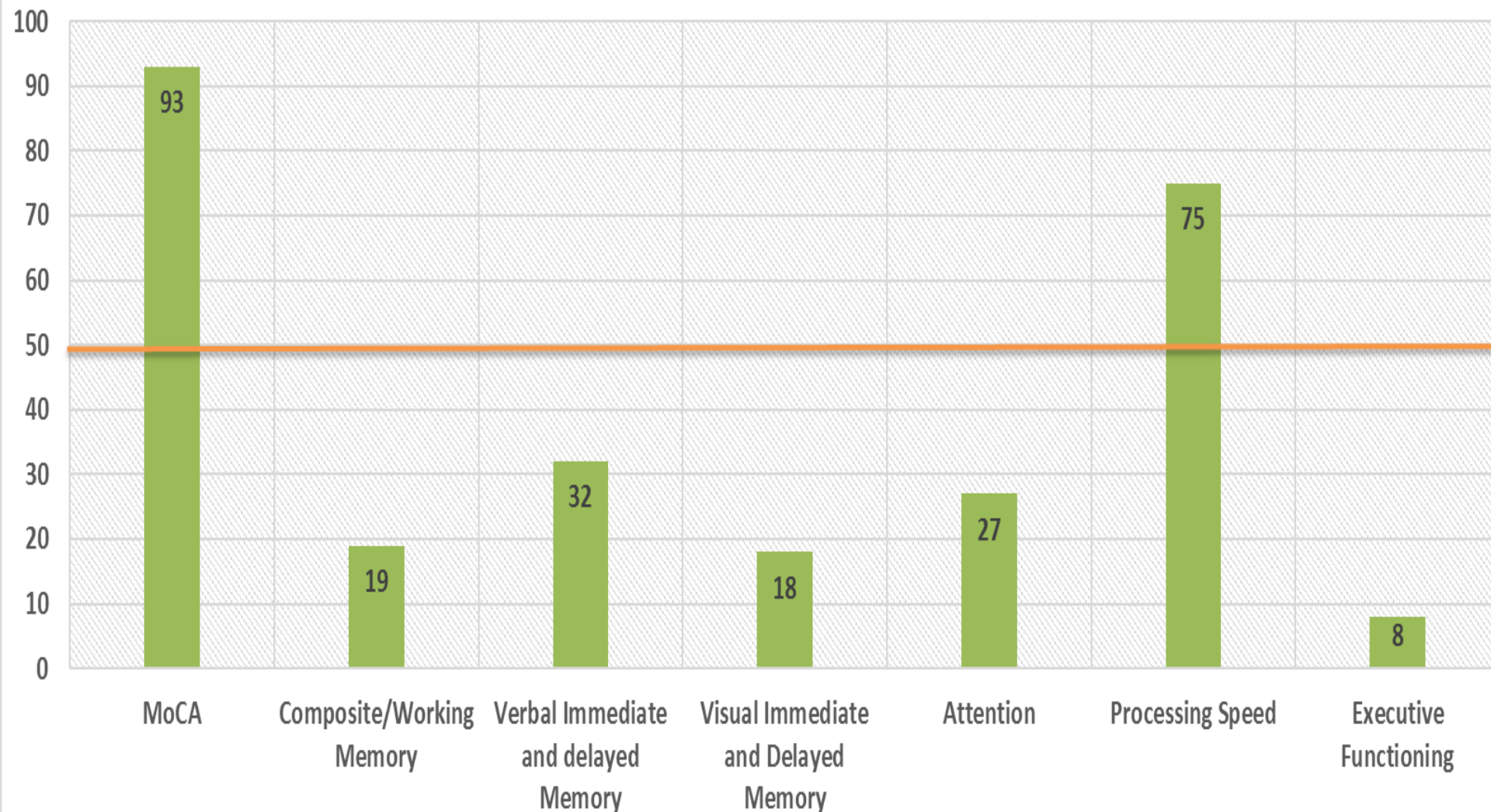


## Brain Mapping qEEG



# Concussion Recovery Program: Complete Cognitive Evaluation

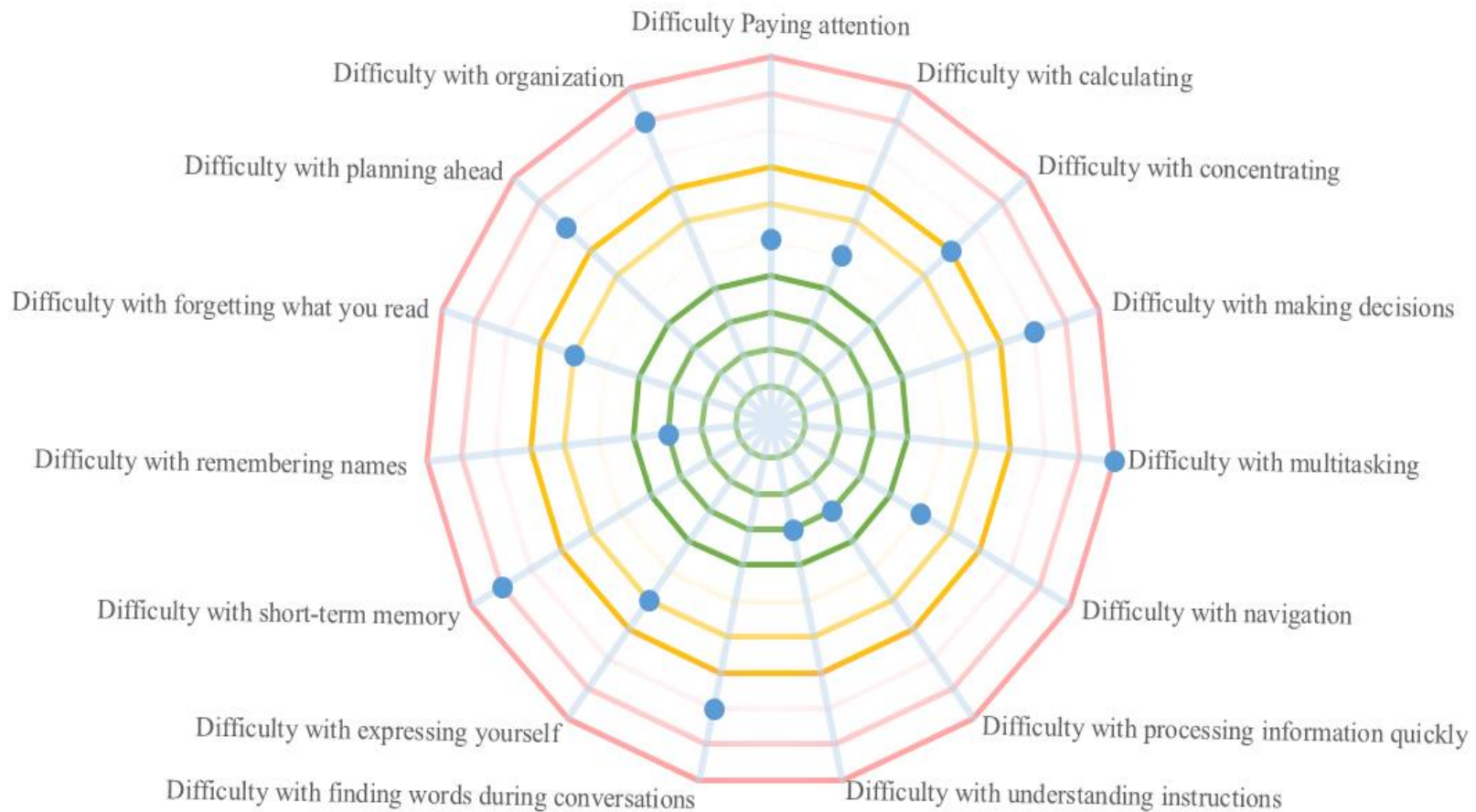
Results Summary





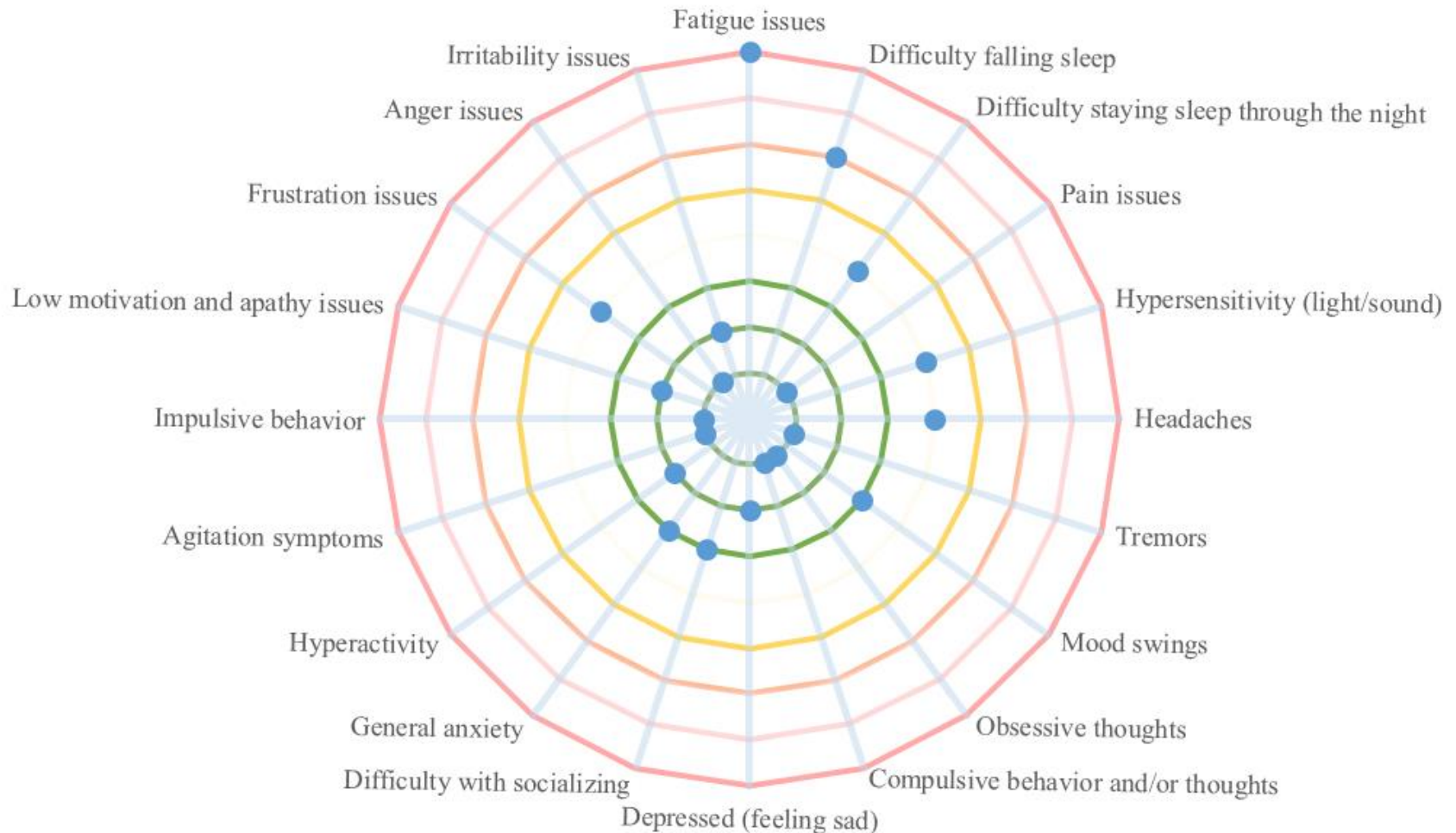
# Concussion Recovery Program: Cognitive Symptoms

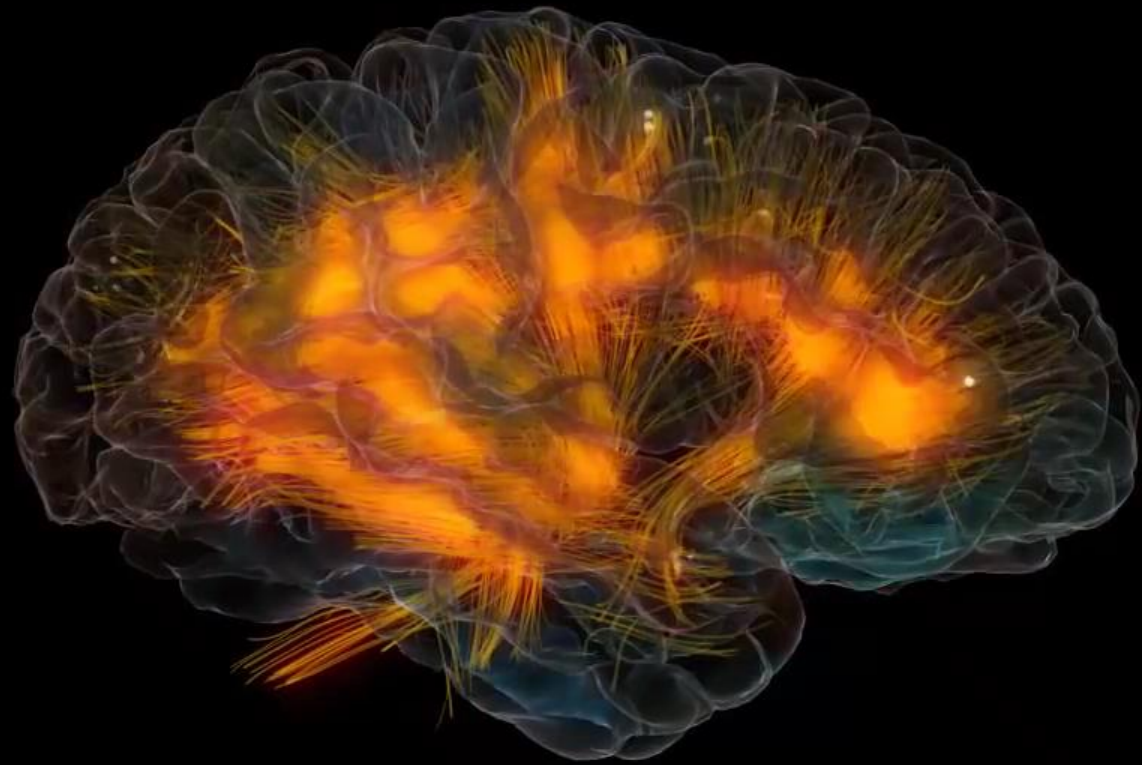
## Neuro-Cognitive Symptoms



# Concussion Recovery Program: Behavioral Symptoms

## Neuro-Behavioral Symptoms

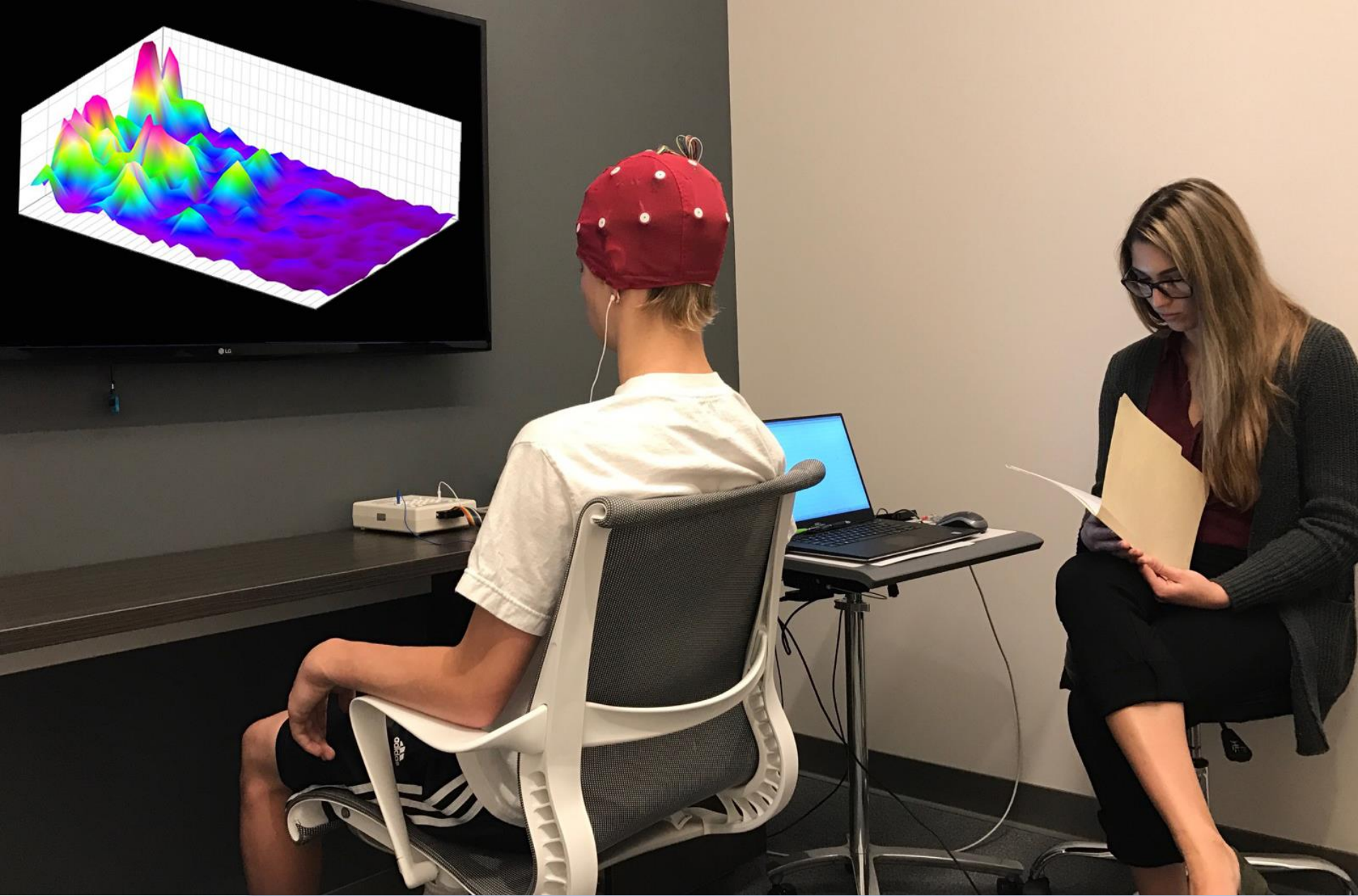




EEG powered by BCILAB | SIFT

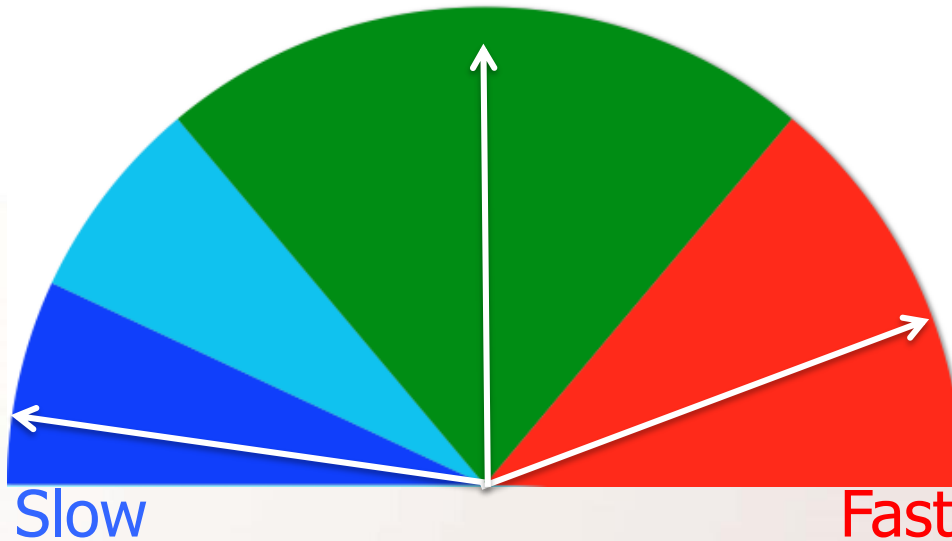
From <http://neuroscape.ucsf.edu/technology/#glass-brain>





# Brain Waves: Too Slow vs Too Fast

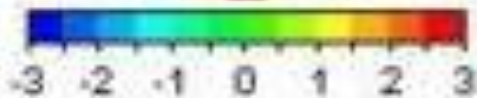
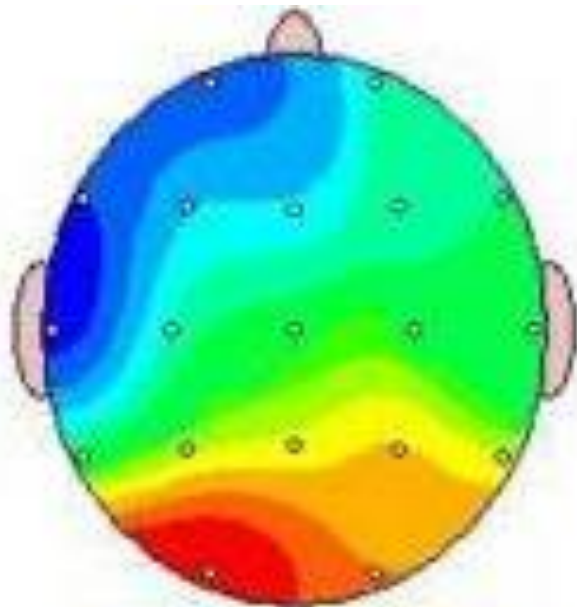
- Depression
- Low Motivation
- Fatigue
- Poor attention
- Memory loss



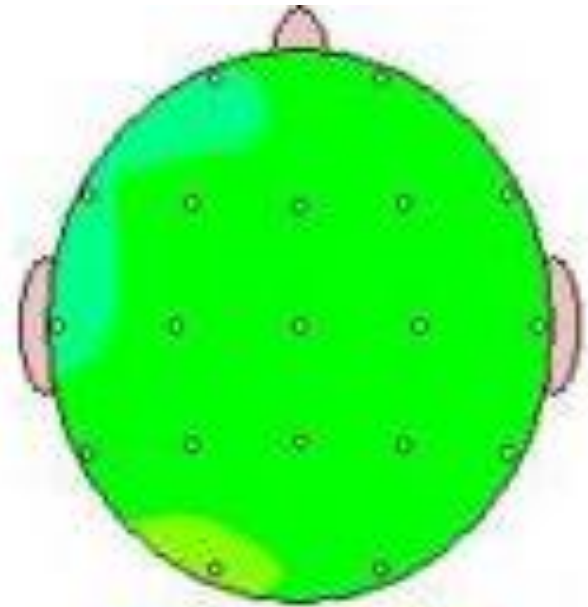
- Calm
- Focus
- Optimal sleep

- Insomnia
- Anxiety
- Stress
- Obsessive Thoughts
- Distractibility

# Abnormal vs. Normal Brainwave Activity

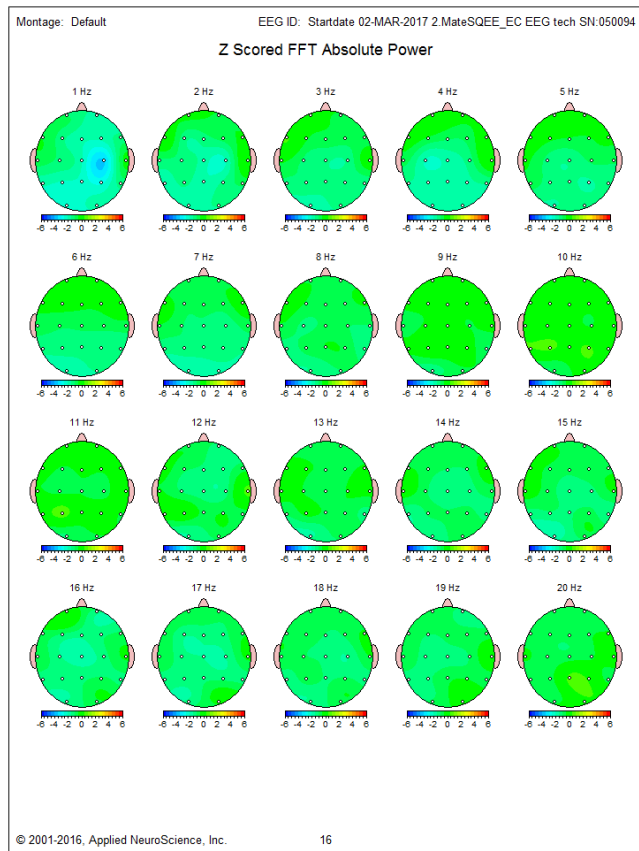


ABNORMAL ELECTRICAL ACTIVITY  
RED=EXCESSIVE BLUE=DIMINISHED



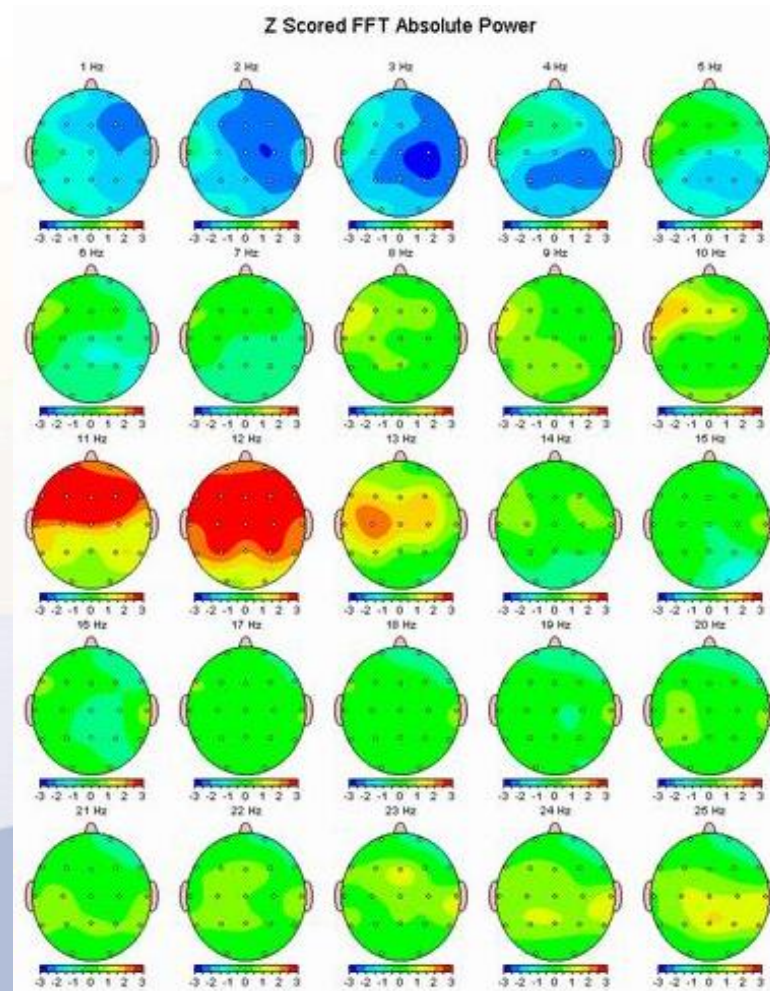
GREEN=NORMAL ELECTRICAL ACTIVITY

# Normal Brain Map

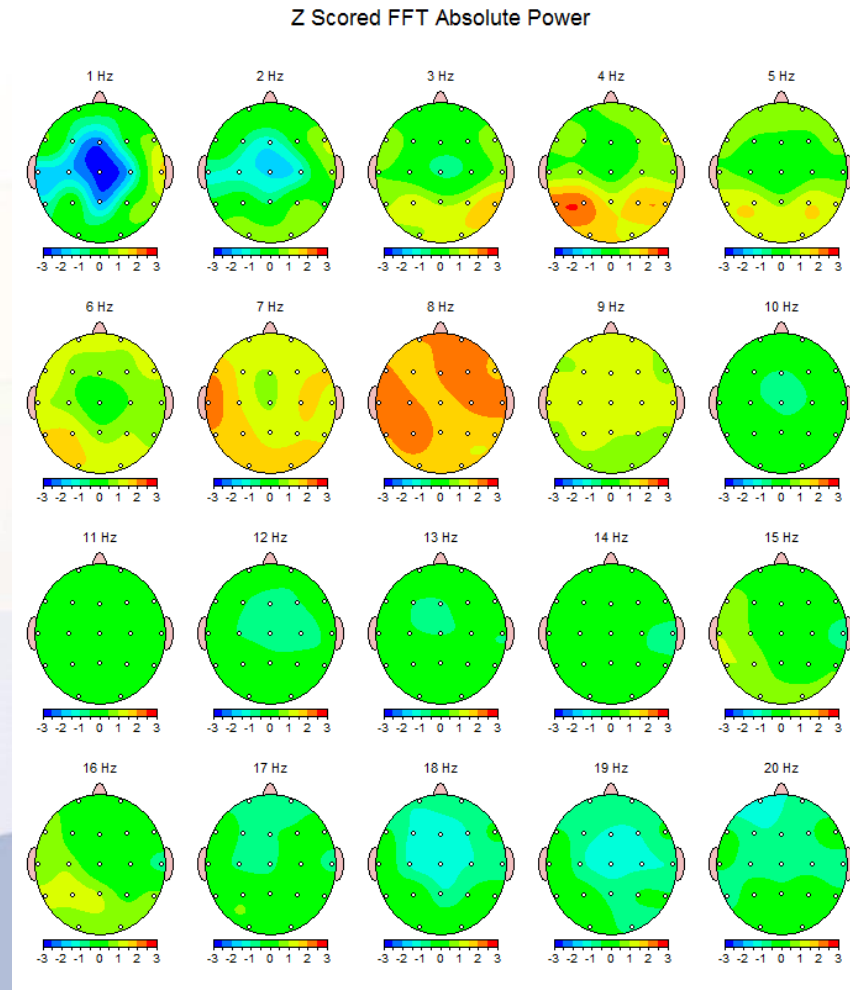




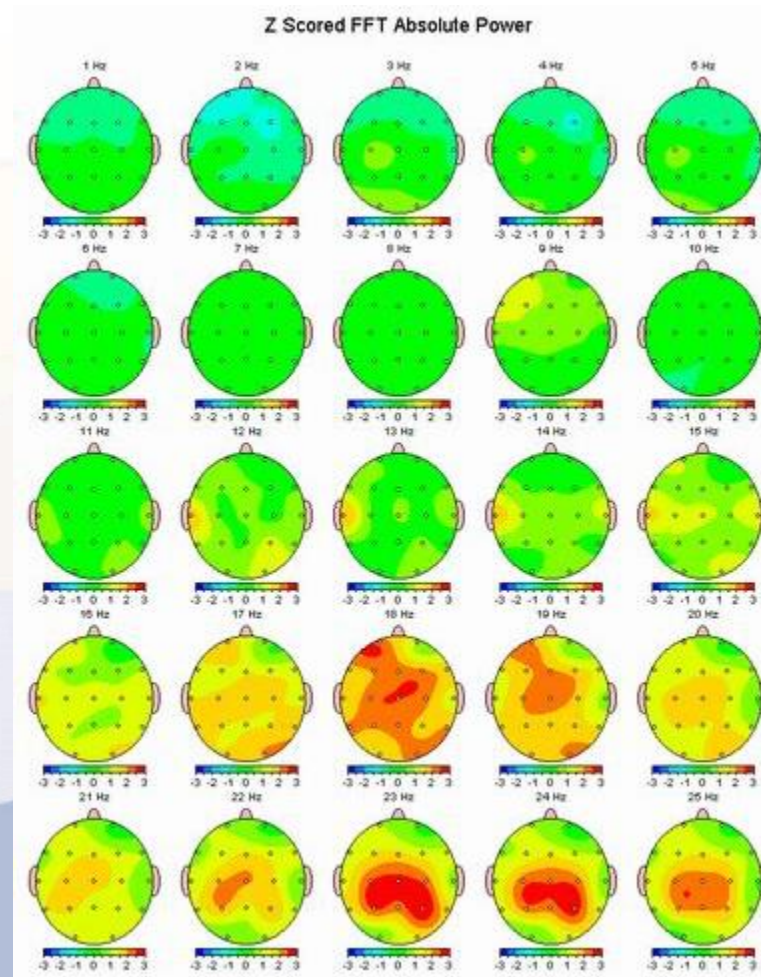
# Brain Map #1: Mainly sleep and anxiety issues



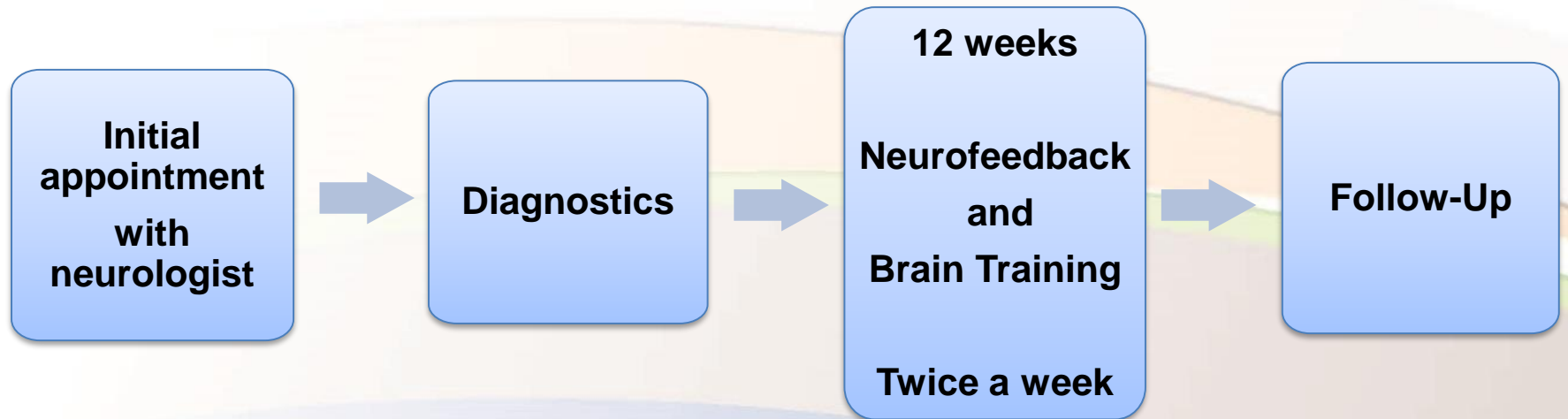
# Brain Map #2: Mainly memory and attention issues



# Brain Map #3: Mainly irritability, and depression issues



# Concussion Recovery Program: Overview





# Concussion Recovery Program: Twice Weekly Treatments, 12 Weeks

# Neurofeedback



## Cognitive Skills Training



## Brain Coaching & Meditation



## Nutrition Counseling



## Exercise Training



## Weekly Monitoring



# Neurofeedback:

## Based on Operant Conditioning Learning

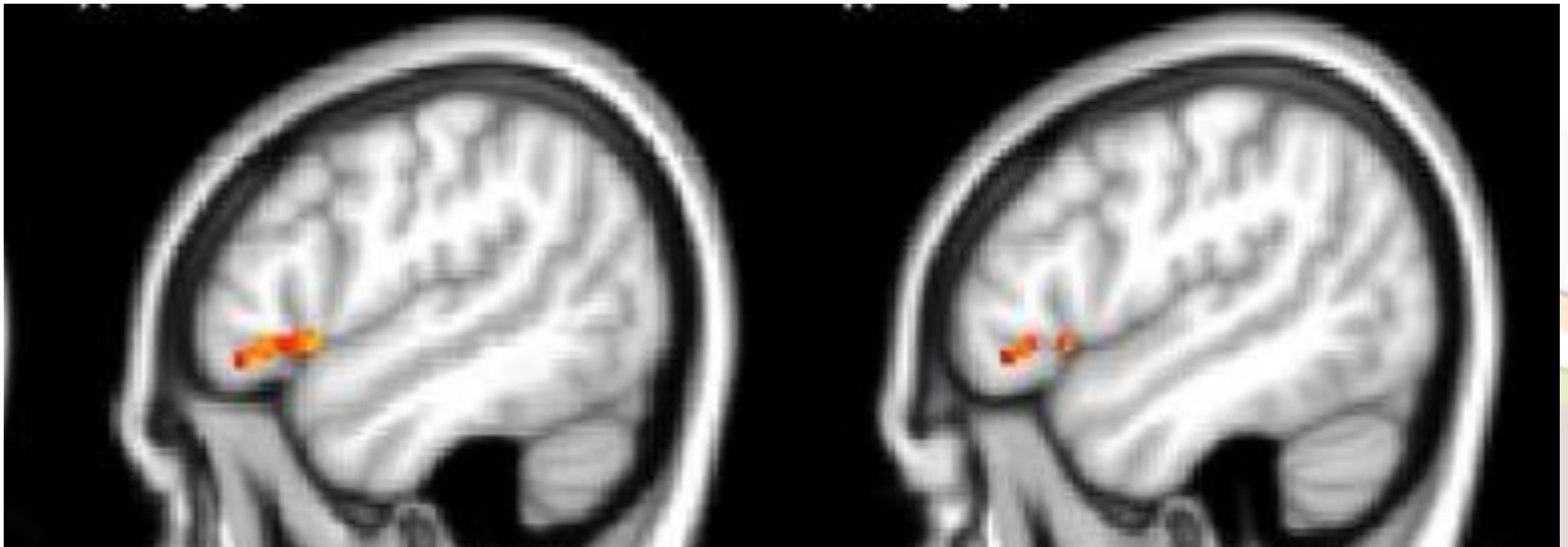
### Rewarding the Brain When It Improves



## **Combined Neurofeedback and Heart Rate Variability Training for Individuals with Symptoms of Anxiety and Depression: A Retrospective Study**

*Elyse K. White<sup>1\*</sup>, Kayleah M. Groeneveld<sup>1</sup>, Rachel K. Tittle<sup>1</sup>, Nicholas A. Bolhuis<sup>1</sup>, Rachel E. Martin<sup>1</sup>, Timothy G. Royer<sup>2</sup>, and Majid Fotuhi<sup>1,3</sup>*

# Neurofeedback Improves Cognitive Function and Increases Volume of Cortex



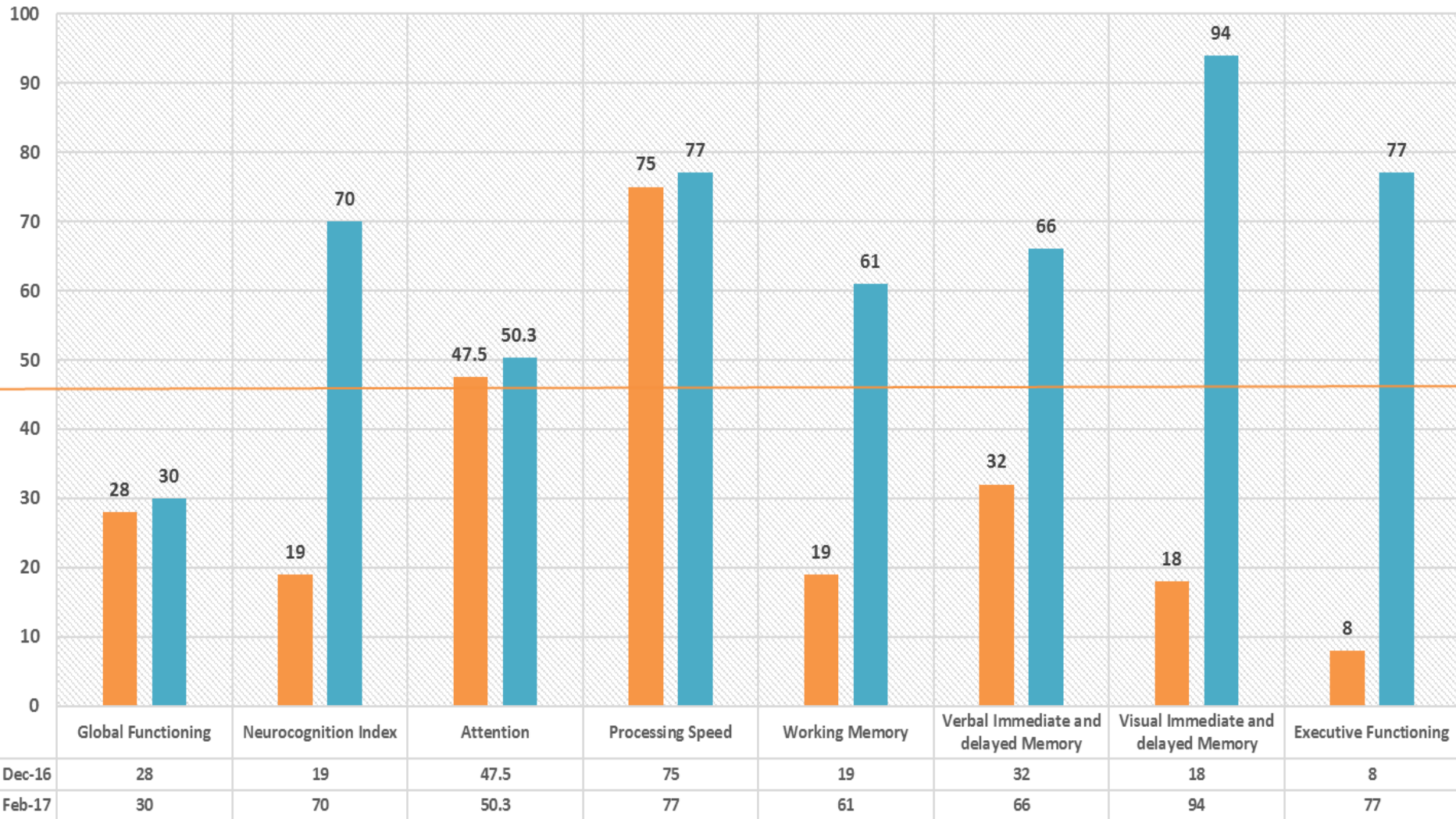


# Objectives

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- Five reasons some patients have persistent post-concussive symptoms for months to years
- Five key components of a multi-disciplinary “concussion recovery program”
  - Michelle’s story

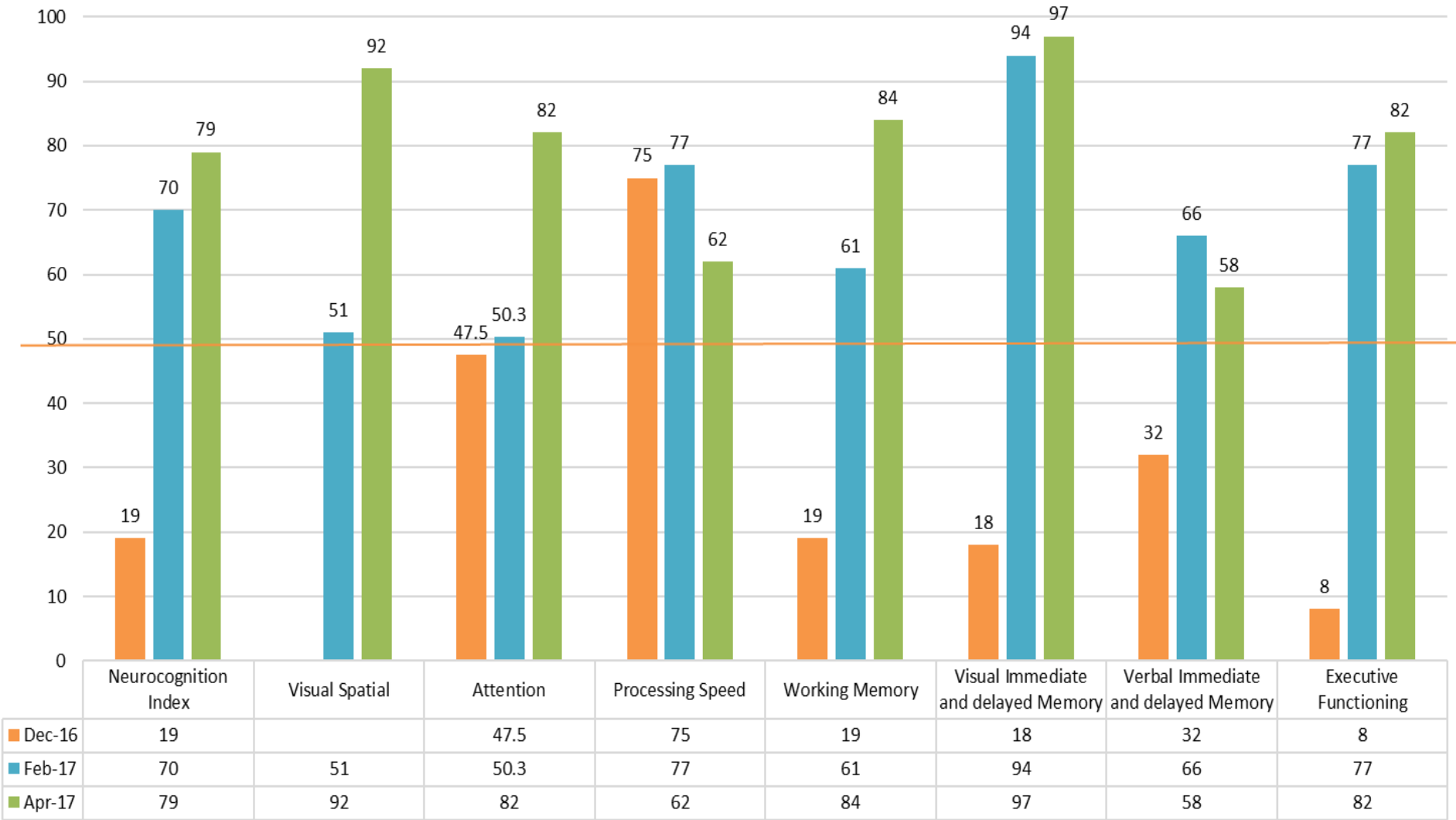
# Michelle's Cognitive Improvements: Mid-program results (6 weeks)

## Comaparative Results Summary



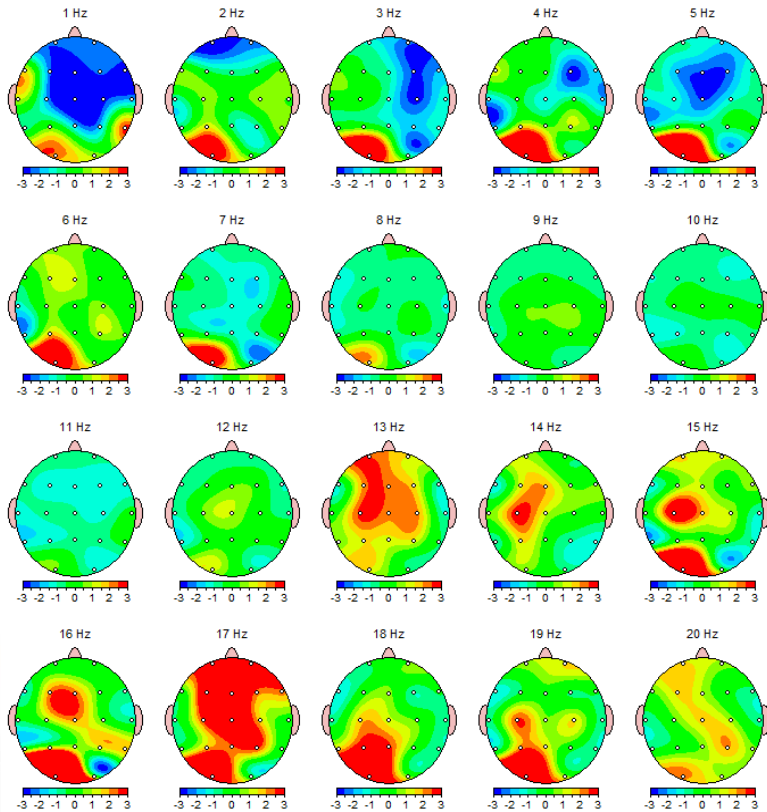
# Michelle's Cognitive Improvements: Final results (12 weeks)

Comparative Results Summary

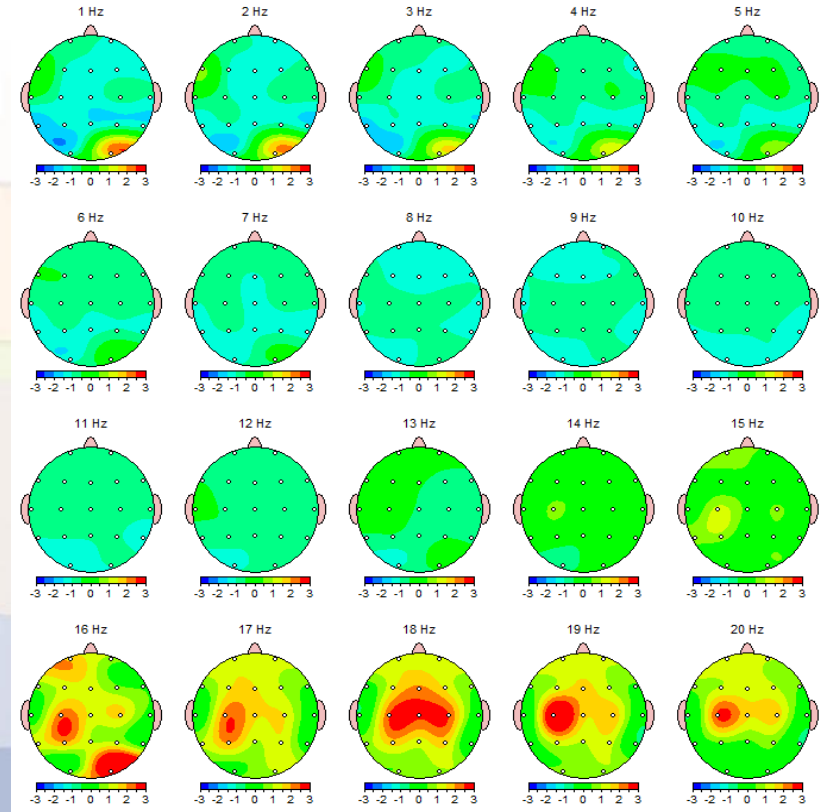


# Improvement in Brain Maps

Z Scored FFT Absolute Power



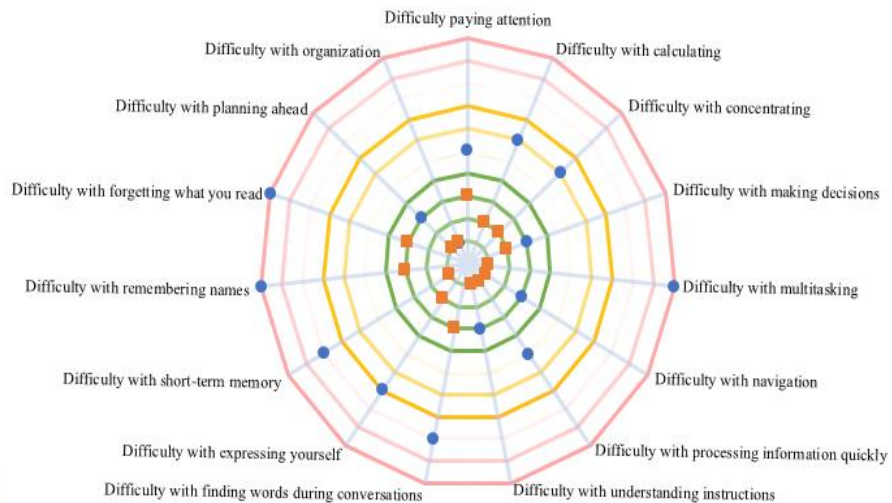
Z Scored FFT Absolute Power



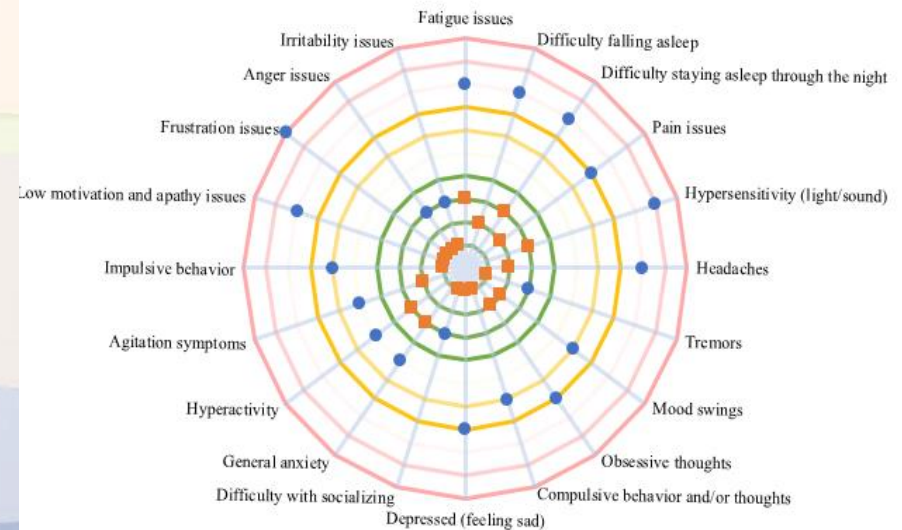


# Improvement in Cognitive and Behavioral Symptoms

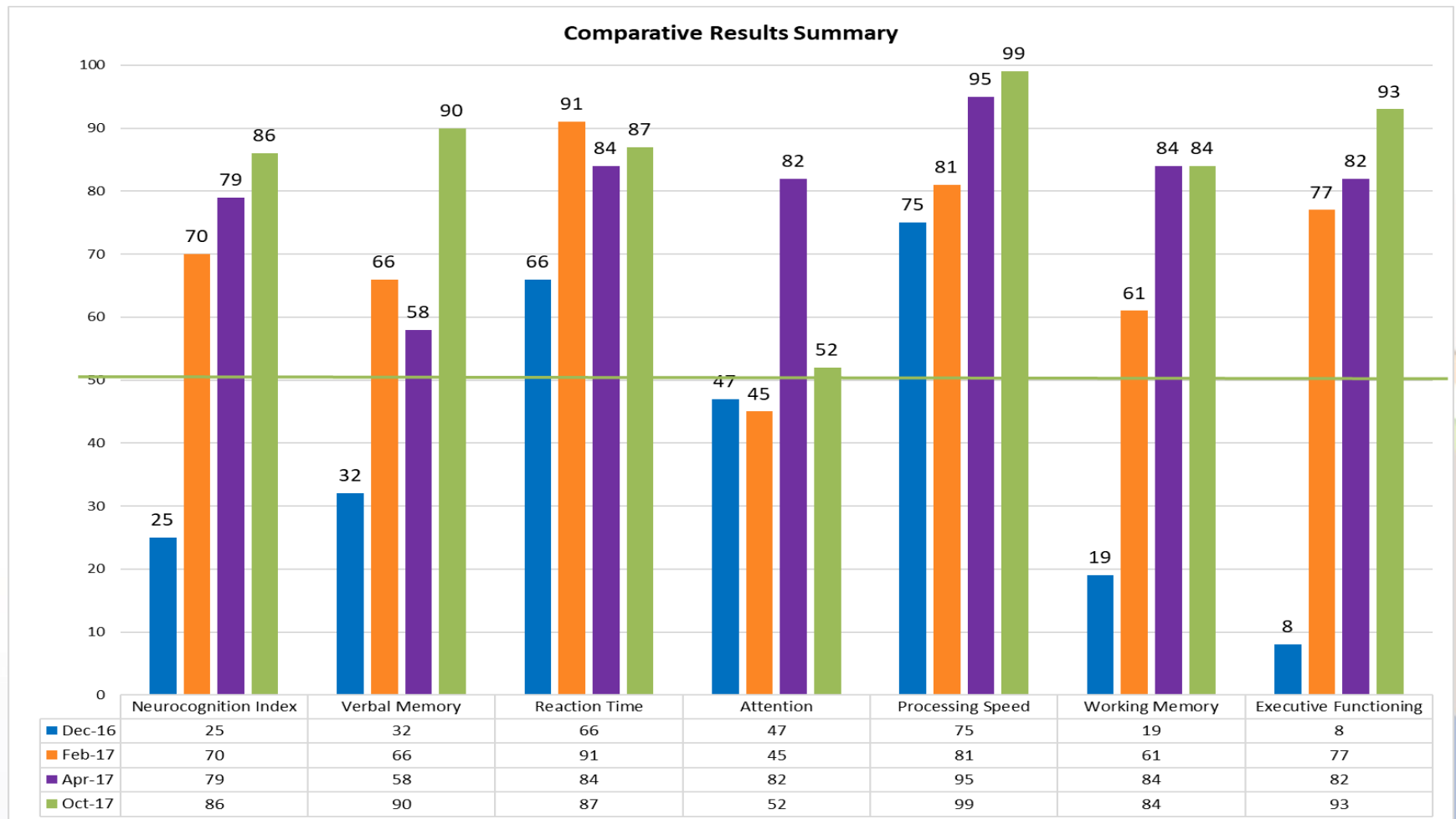
Neurocognitive Symptoms



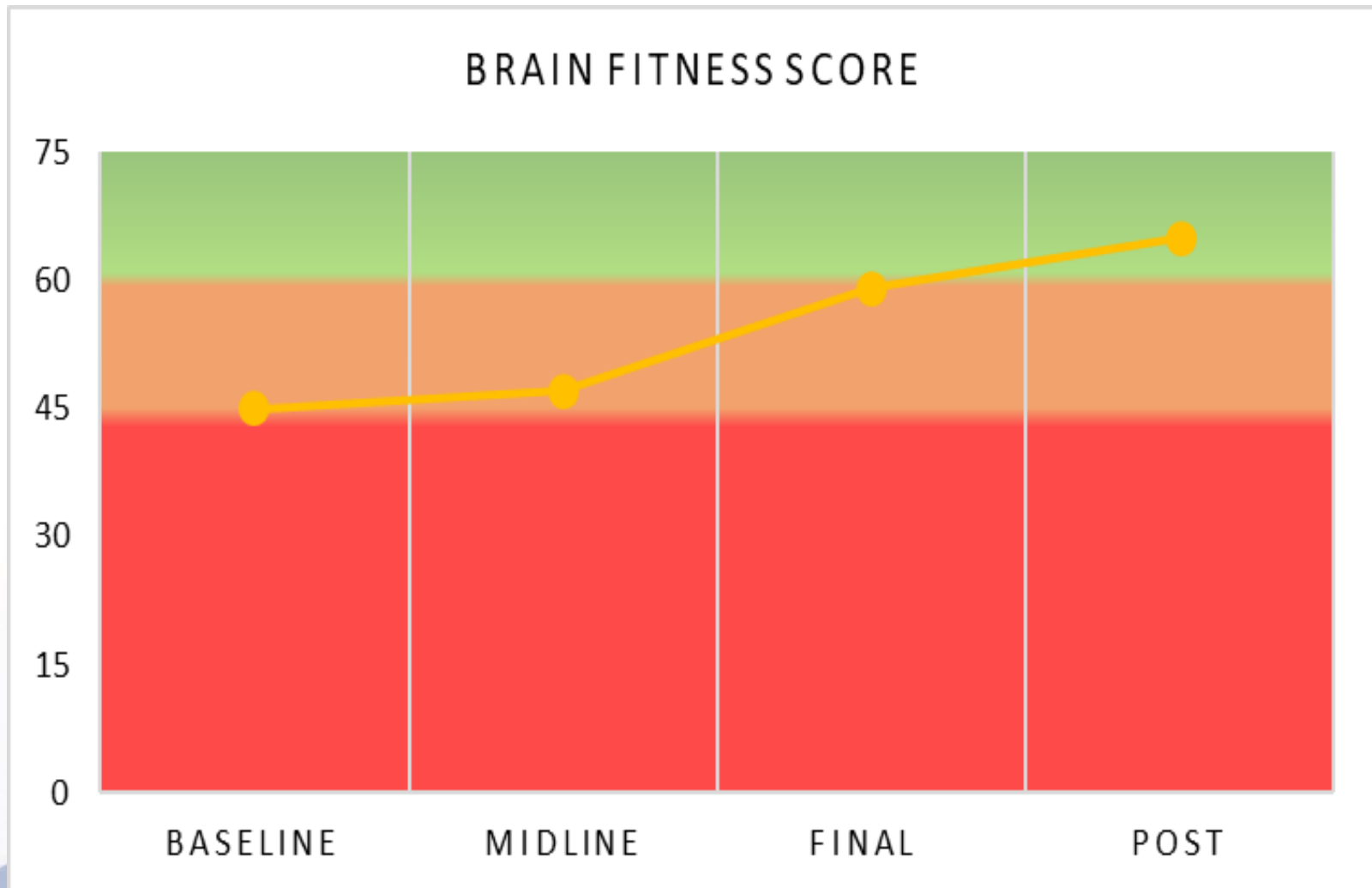
Neurobehavioral Symptoms



# Michelle's Cognitive Improvements: Six Months After Finishing our Program

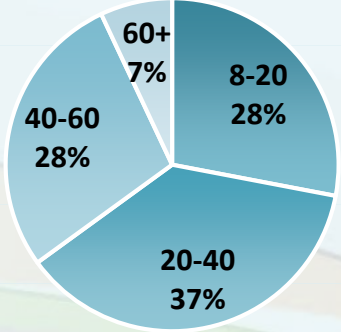
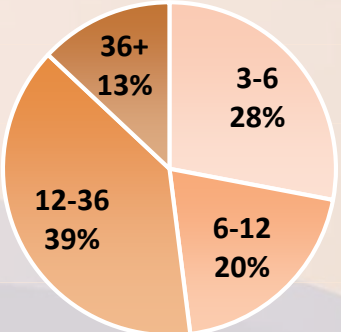


# Michelle's Improvements in Lifestyle Choices Better Diet, Exercise, and Attitude

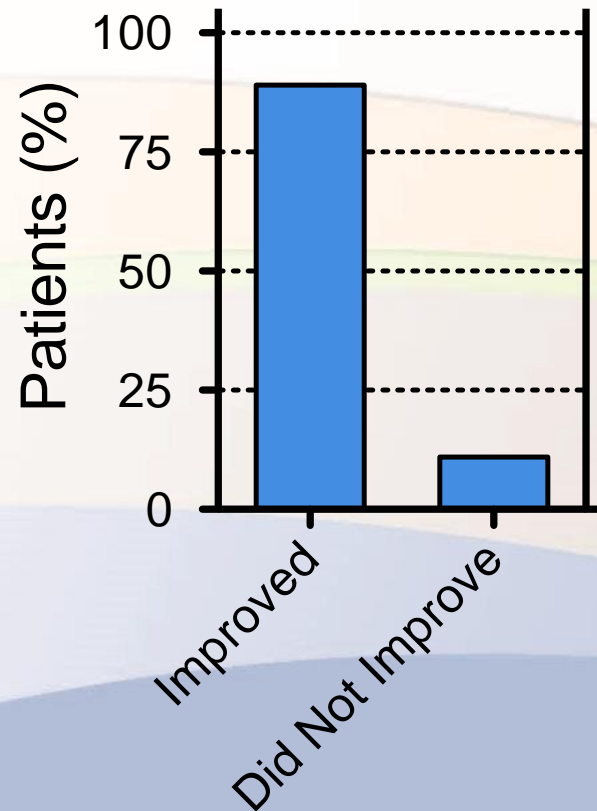




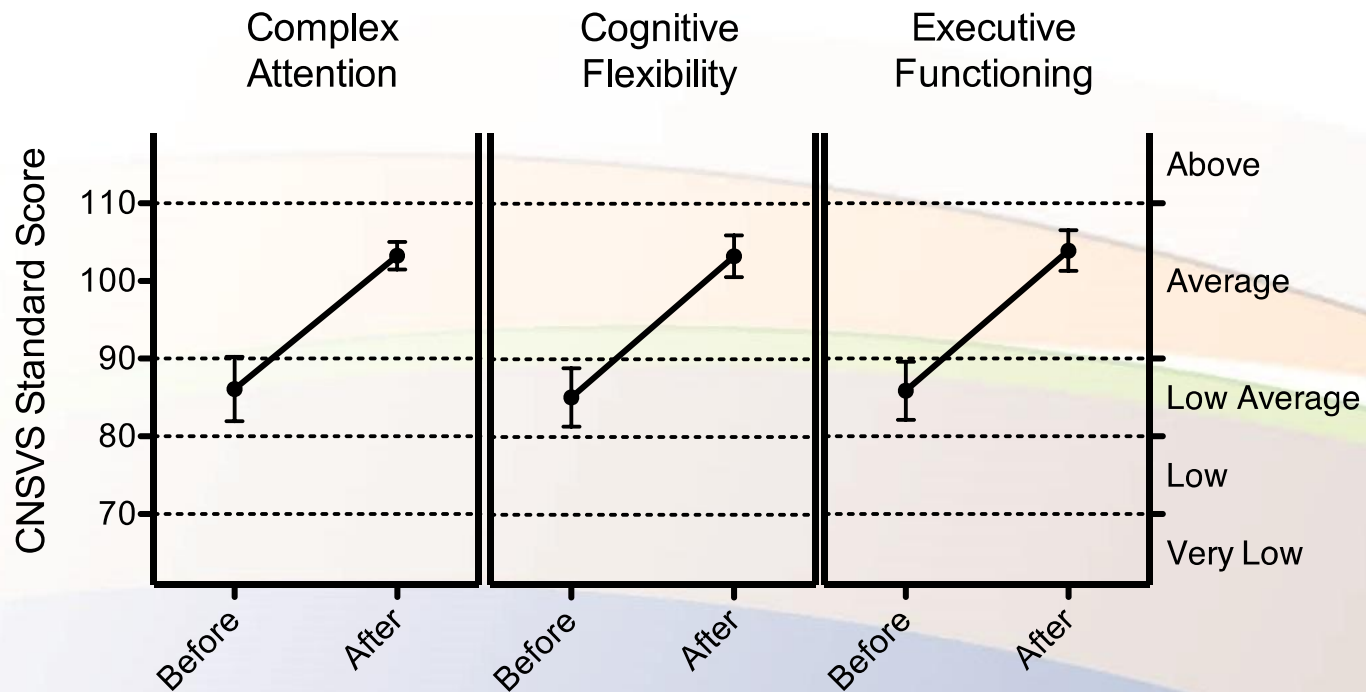


<b>Total Patients</b>	<b>46</b>	<b>Average # of Sessions</b>	
Males	35%	Brain Coaching	20
Females	65%	Neurofeedback	23
<b>Average Age</b>	<b>32 years</b>	 <p>A pie chart illustrating the age distribution of patients. The chart is divided into four segments: 8-20 (28%), 20-40 (37%), 40-60 (28%), and 60+ (7%).</p>	
Age 8-20	28%		
Age 20-40	37%		
Age 40-60	28%		
60 or older	7%		
<b>Average Time Since Concussion</b>	<b>22 months</b>	 <p>A pie chart illustrating the time since concussion for patients. The chart is divided into four segments: 3-6 months (28%), 6-12 months (20%), 12-36 months (39%), and 36+ months (13%).</p>	
3-6 months	28%		
6-12 months	20%		
12-36 months	39%		
36 months or more	13%		

# 89% of Patients Had Statistically Significant Improvements in Their Neurocognition Index

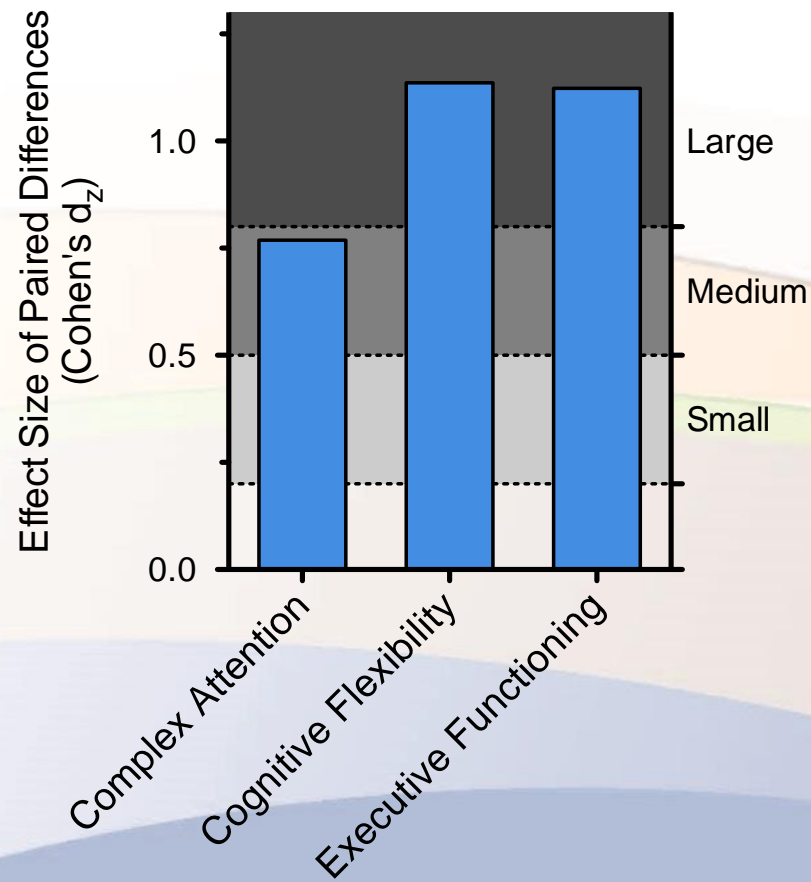


# Significant Improvement in Common TBI-Related Cognitive Domains



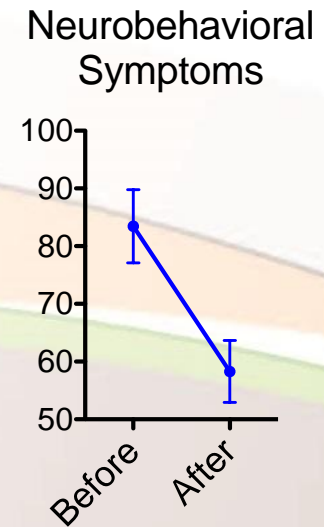
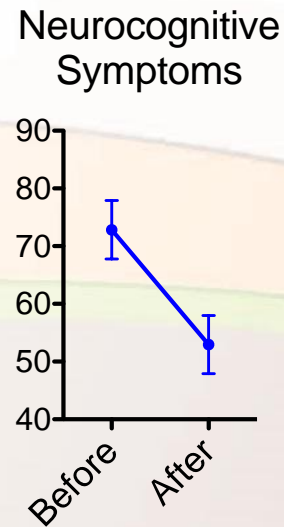
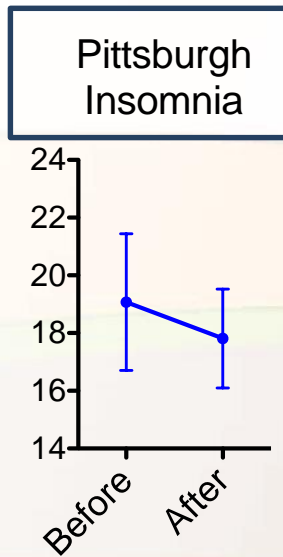
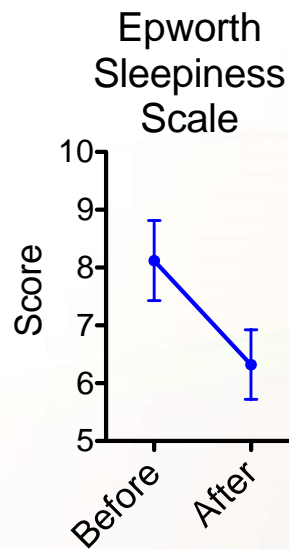
All before-to-after mean of differences changes are significant.  
Error bars represent SEM.

# Pre-Post Change Effect Sizes





# Significant Reduction in Sleep, Cognitive, and Behavioral Symptoms



# Summary

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# Thank You

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