Brain Health and Recovery after Traumatic Brain Injury

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Definition of TBI

- BIAA definition:
  - *TBI is defined as an alteration in brain function, or other evidence of brain pathology, caused by an external force.*

- Mild, moderate, severe
  - The large majority of TBIs are mild (concussion)

- Severity of injury does not always predict the recovery...

*It’s not just the injury itself that determines recovery, it’s the brain that is injured - what can we do to help with that recovery?*
TBI is Very Common

- One million new cases of TBI in the United States every year
- 50,000 deaths every year
- 70,000-90,000 suffer long term disability from TBI
- The incidence of TBI is greater than that of multiple sclerosis, Parkinson’s disease, and Alzheimer’s disease combined.

TBI symptoms

- **Physical** - headaches, fatigue, sleep disturbance, dizziness, vertigo, balance, coordination, sensitivity to light or noise, reduced smell/taste

- **Emotional** - irritability, lability, anxiety, overwhelmed, depression

- **Cognitive** - slow, memory, concentration, reduced problem solving, multitasking, less efficient, decreased reaction time

- **Behavioral** - impulsivity, poor initiation, personality changes, anger/acting out
Biopsychosocial Factors in Recovery

- Successful recovery is based on multiple pre- and post-injury factors -

  - Pre-injury factors - age, physical and mental health, substance use, AHDH/learning disability, prior TBI or neurological condition, personality style, education/occupational level, lifestyle

  - Post-injury issues - pain, sleep disorder, other injury, support system, psychological distress/PTSD, environmental demands, motivation, availability of resources, family dynamics, lifestyle choices/habits, stress/coping, awareness of symptoms

  - Resilience and cognitive reserve
Some things cannot be changed...
Need to shift focus to what can be changed....
The Biology: Nervous System Overview

Triune Brain

http://www.slideshare.net/ericksonchelsea/intro-brain-algernon
Neuron

http://starklab.slu.edu/Physio/Neuron.jpg
Neuroplasticity: Ability of nervous system to respond to intrinsic or extrinsic stimuli by reorganizing its structure and function
Neuroplasticity

- Neuron: soma, axon, dendrites

- Communication between Neurons
  - Electrical axon potentials (AP’s) travel from soma down axon, stimulate /inhibit release of neurotransmitters
  - Neurotransmitters bind to dendrites of nearby neuron.
  - If sufficiently stimulated, nearby neuron fires AP

- Neuroplasticity: Neurons that Fire Together Wire to Together - Repetitive Firing strengthens signal
Neuroplasticity: Acupuncture
Theory

- In traditional Chinese medicine, illness caused by imbalance of qi which is a sort of life force energy or force, acupuncture corrects these imbalances.

- Western explanation involve possible improvement of blood flow, release of endorphins, stimulation of nerves.
Neuroplasticity: Transcranial Magnetic Stimulation (TMS)
Neuroplasticity: Neurofeedback

1. Sensors are placed on the scalp & ears to read the brain's electrical activity.
2. Brainwaves are displayed on the therapist's computer and goals are set.
3. When the brainwave activity meets the set goals, the client gets positive feedback (visual & auditory) to guide their success with the game.
Neuroplasticity: Art
Neuroplasticity: Yoga
Neuroplasticity: Meditation

1. Slagter http://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.0050138
2. Lazar et al https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1361002/
3. https://www.bing.com/images/search?view=detailV2&ccid=1AufQxLm&id=1BC240B6B3D1AE06F868B673488FE4DC1EA19662&thid=OIP.1AufQxLmMkydiADkhj_PIwHaFj&mediaurl=http%3a%2f%2fmedia.10news.com%2fphoto%2f2013%2f02%2f06%2fmarine_meditation_1360205456130_369193_ver1.0_320_240.jpg&expw=240&expw=320&q=marine+meditating&simid=608011949507350181&selectedIndex=0&ajaxhist=0
Neuroplasticity: Meditation

- Multitasking of cognitive tasks extremely fatiguing, challenging for TBI, PTSD patients

- Decreased PFC activity in subjects with mTBI with performance of auditory task\(^1\)

- Abnormal PFC activity in subjects with PTSD\(^2\)

Practice Habits to Maximize Neuroplasticity and Optimize Quality of Life:

Diet, Sleep, Exercise
Healthy heart = Healthy brain

- Heart healthy diet helps brain health and memory functions
  - Omega 3 fatty acids - fish, walnuts, flax seed
  - Berries - antioxidants, anthocyanins, flavanols
  - Leafy greens - folate/folic acid
  - Increase whole grains and limit saturated fats
  - Supplements
SLEEP - It does a body good!

Effects of Sleep Deprivation

- Stress & Anxiety
- Fatigue
- Daytime Drowsiness
- Health Risks
- Emotional Issues
- Hunger

- Physical Performance
- Muscle & Strength Gains
- Mental Performance
- Anabolic Hormones
- Recovery

Underdog Strength
underdogstrength.com
Exercise

- Most individuals do not get enough physical activity
- Regular physical activity can help maintain independence and quality of life
- Improves balance and reduces risk of falls
- Improves mood and reduces stress
- Protects against illness, improves cardiovascular fitness
- Improves sleep
- Stimulates cognitive functioning
- Decreases risk of dementia
Social and Leisure Activity
Social Capital - Relationships

- Social capital includes those closest to you, as well people you see regularly
- Impacts healthfulness, happiness, and longevity
- Less cognitive decline, less depression/anxiety
- More options for
  - Jobs - meaningful activities
  - Housing / living options
  - Transportation - better engagement in community
- Average individual = 150; Disabled individual = 30
- Need to help patients/families preserve and expand social capital
Neuroplasticity: Memory

Figure 1. Corticolimbic system

- Motivation and executive function
- Reward anticipation, decision making, empathy, emotion, and impulse control
- Processing of emotions

DLFPC: dorsolateral prefrontal cortex; ACC: anterior cingulate cortex; AMY: amygdala; HPC: hippocampus.

https://www.bing.com/images/search?view=detailV2&ccid=vOe0unwC&id=9A53B785BBED7D0215506DAB0A8987DF350238BA&thid=OIP.vOe0unwCJUmj5CTeBx_sCgHaHM&mediaurl=https%3a%2f%2fi.pinimg.com%2f736x%2f29%2fb%2f29fb9104631a69cf9ebdfae0f0fb297e--mental-health-articles-adderall.jpg&exph=715&expw=736&q=corticolimbic+system&simid=608051630686736283&selectedIndex=121&ajaxhist=0
Neuroplasticity
Neuroplasticity: *The Knowledge*

https://www.bing.com/images/search?view=detailV2&ccid=SFrvdxUH&tid=1F397792D6a0D0F9E3956F6BDC11C3C9B3CE35E4&thid=OIP.SFrvdxUHiFeAa1_UBLdAHaEZ&mediast https://cdn.images.express.co.uk%2fimg%2fdynamic%2f41%2f590x%2fcabby2-443856.jpg&exph=350&expw=590&q=london+taxi+driver&simid=608055831136898859&selectedIndex=2&ajaxhist=0

Neuroplasticity: Musical Training

Gaser, Schlaug  
http://www.jneurosci.org/content/23/27/9240, Adrian  

https://www.researchgate.net/publication/24180018_White_matter_plasticity_in_the_corticospinal_tract_of_musicians_A_diffusion_tensor_imaging_study
Music and Memory

- Music is used in acute rehab settings, as well as post acute and long term residential settings
- Activates most of your brain - auditory/motor/visual/frontal areas
- Multisensory
- Brain waves resonate with sound waves; we are wired to respond
- Emotional connections, retrieval of long term memories
- Your favorite music activates your hippocampus
- Neurotransmitters - makes you feel good
- Memory, attention, sequencing, motor/movement, imaging, abstract thinking
- Playing music is like a “full body workout” for your brain

(TEDEd April 14, 2016, How music affects your brain; check out the variety of talks on YouTube)
Factors Affecting Memory

- Fatigue
- Mood
- Motivation
- Relevance
- Knowledge
- Modality
- Emotion/meaning
Memory Interventions

- Treatment approaches include:
  - Teaching compensatory strategies
  - External memory aids
    - Notebooks, calendars, smartphone, sticky notes
  - Internal memory aids
    - Mnemonic devices, repetition, categorization, focusing on consequences, associations, chunking
  - Direct therapy drills
  - Medications/supplements
General Memory Strategies

FORECE

Focus - Organize - Rehearse - Chunk - Expend effort
Focus

- One thing at a time
- Quiet
- Distraction-free
- Concentrate
- Reason
Organize

- Use habits
- Make a list
- Familiar routines
- Locations
Rehearse

- Think about something new off and on every few minutes and hours
- Rehearse someone’s name silently to yourself during your conversation
- Visualize yourself doing the task
Group items together in a meaningful way
- grocery items
- Phone numbers
- Locations
Expend Effort

- Practice strategies
- Anticipate memory problems
- Write things down
- Acknowledge that memory takes effort
Everyone can enhance brain functioning

- Use it or lose it
  - Learn something new, do something different
- Provide enriched environments
  - Social activity, relationships, leisure/play
- Small changes can have big rewards
  - (diet, physical activity, sleep hygiene)
- Avoid alcohol, tobacco, inhalants, toxin exposure
  - Minimize medications where possible
- Find a sense of purpose… volunteer, work, school, church, hobbies