



# Neuroplasticity: Setting the Stage for Effective Stroke Rehabilitation

Dave Anders, MS, CCC-SLP, CBIST  
Clinical Director

**On With Life Stroke Webinar Series**



Brain Injury Rehabilitation Specialists™



# Disclosures

- The presenter has no significant financial relationship with any commercial or proprietary entity that produces healthcare-related products and/or services relevant to the content of this presentation.



# [www.onwithlife.org/strokewebinar](http://www.onwithlife.org/strokewebinar)

**Jan. 17:** Treatment Options for Managing Depression, Anxiety, and Emotional Lability Following Stroke

*Lindsay Vaux Eldredge, MS, CBIS*

**Feb. 21:** Standing Tall: Preventing Falls Post Stroke

*Andrea Cherry, RN, EMT, CBIS, MANDT*

**Mar. 21:** Essentials for Post-Stroke Nutrition

*Lisa Tiedeman, RDN, LDN, CBIS*

**Apr. 18:** The Scoop on Language Group

*Sarah Becker, MA, CCC-SLP, CBIS, Amy Bishop, MT-BC, CBIS*

**May 16:** Peeling Back the Onion Layers: Cognitive Deficits Following Left Hemisphere Stroke

*Courtney Huber, MS, CCC-SLP, CBIS*

**Jun. 20:** Functional E-Stim in Stroke Recovery: Practical Applications and Creative Interventions

*Nicole Weidman, MHA, PTA, Sam Williams, OTR/L, CBIS,*

**Jul. 18:** Inpatient to Outpatient: Real life applications across the spectrum of rehab: A case management perspective

*Tammy Miller, COTA/L, MSL, CBIS, CCM, Carla Dippold, RN, BN, CRRN, CCM, CBIS*





# Healing Post-Stroke: The Science

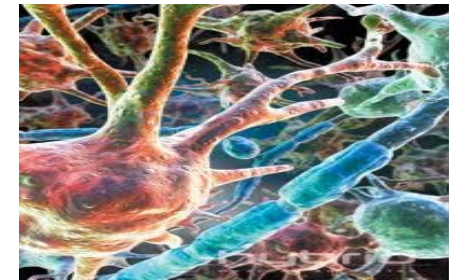
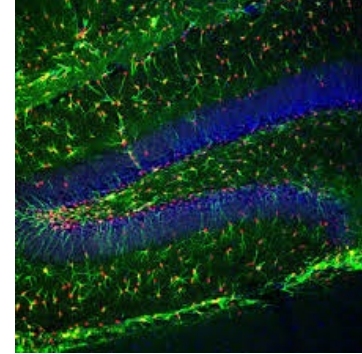
- **Diaschisis Resolution / Activation of Cell Repair**
  - Normalization of metabolic and blood flow changes following the acute injury
  - Not well understood in stroke.
- **Experience-Dependent Neuroplasticity**
  - Most simply put...is the underlying biological pathway to return of function following brain injury-related neuronal injury and death.





# Mechanisms of Neuroplasticity

- **Neurogenesis** – creation of new neurons
  - Currently believed to be in the hippocampus (subventricular zone and dentate gyrus), olfactory bulb, and cerebellum
  - Increases with exercise, decrease with stress / depression
- **Synaptogenesis** – creation of new synapses
  - Increase in contralesional axonal growth markers in the first week post-stroke
  - Perilesional growth markers continue for the first 3 -6 months post-stroke
- **Glioneogenesis** – creation of new glial cells
- **Angiogenesis** – creation of new blood vessels





# Return of Function: The Science

- To support these processes, the brain increases production of trophic (growth) factors.
  - Trophic factors enhance both the repair of injured structures and the creation of new neurological structures.
    - NGF (nerve growth factor)
    - BDNF (brain-derived neurotrophic factor)
    - GDNF (glial-derived neurotrophic factor)





# Return of Function: The Science

- It is believed that neuroplasticity peaks between 1 and 3 months post-onset
  - N=175

Days Between Onset and Admit	FOM % Change Admit to Discharge
0-60 days	102.37%
61-120 days	45.14%
121-180 days	40.47%
181-240 days	21.48%
241-300 days	23.95%
301+ days	21.13%

J Rehabil Med. 2007 May;39(5):345-52.

**Enriched environment and astrocytes in central nervous system regeneration.**

Nilsson M<sup>1</sup>, Pekny M.





# 3 Levels of Neuroplasticity



## 1. Chemical

- Have you ever learned something and forgotten it?
  - Long-Term Potentiation (LTP)
  - Long-Term Depression (LTD)

## 2. Structural

- London cab drivers & hippocampal volume

## 3. Functional

- Readers of braille (both structural and functional)



# 10 Principles of Neuroplasticity

1. Use it or lose it
2. Use it and improve it
3. Specificity
4. Repetition matters
5. Intensity matters
6. Timing matters
7. **Salience matters**
8. Age matters
9. Transference
10. Interference



 NO ACCESS | Journal of Speech, Language, and Hearing Research | Supplement Article | 1 Feb 2008

**Principles of Experience-Dependent Neural Plasticity: Implications for Rehabilitation After Brain Damage**

Jeffrey A. Kleim  and Theresa A. Jones

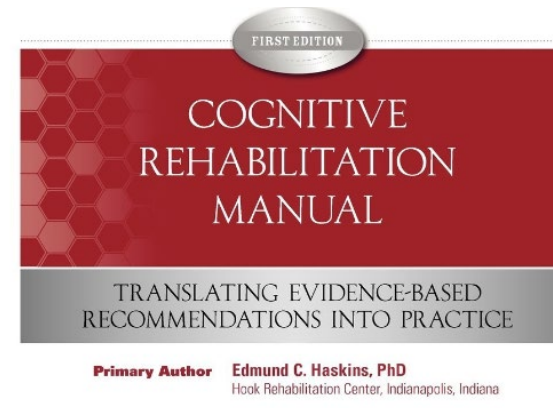
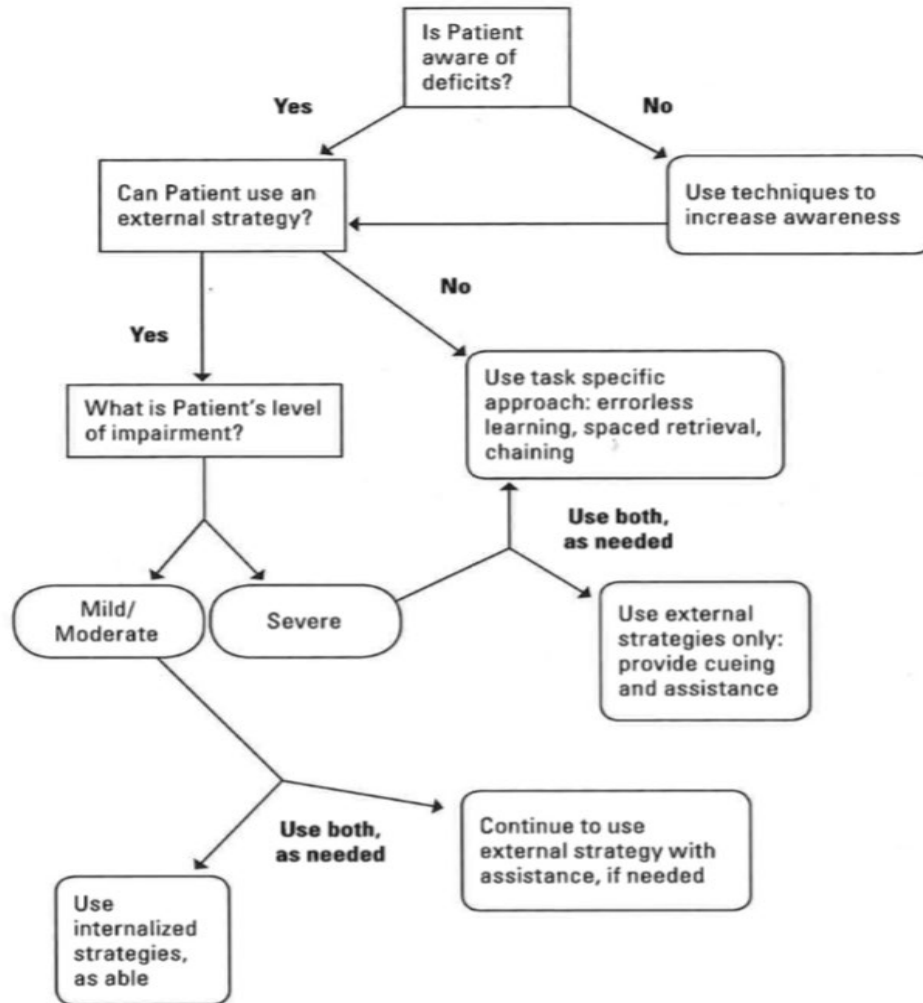
CONFIDENTIAL

**On**<sup>WITH</sup>  
**Life**

Brain Injury Rehabilitation Specialists™



# Saliency: The Awareness Challenge





# Salience: The Awareness Challenge

- Whom are we talking about here?
  - Damage to the right hemisphere or parietal regions (domain specific unawareness)
  - Damage to the frontal systems (anosognosia)
- What were pre-morbid personality traits and coping mechanisms?
- Is the PS emotionally prepared to acknowledge their challenges?
- Do you have a therapeutic alliance? You're gonna need one!



# Salience: The Awareness Challenge

- What do we usually do? Why doesn't it work?
  - Cue
  - Cue
  - Cue
  - Cue
  - Cue
  - Cue
  - Cue
  - Cue





# Treating Deficit Awareness

- What does the evidence tell us we need to do?
  - The best way to help a person served recognize their challenges is by pointing out discrepancies between self-perception and reality.
    1. Select key tasks and environments in which awareness behaviors are most important within everyday activities and roles
    2. Provide clear feedback and structured opportunities to help PS evaluate their performance, discover errors, and compensate for challenges.
    3. Use habit formation, when necessary, through repetition and procedural or implicit learning.
    4. Providing education and environmental supports.

Neuropsychol Rehabil. 2006 Aug;16(4):474-500.

**A review of awareness interventions in brain injury rehabilitation.**

Fleming JM<sup>1</sup>, Owensworth T.

CONFIDENTIAL



Brain Injury Rehabilitation Specialists™



# Awareness...Practice Standard

- **Predict-Perform Procedure:**
  - Therapist introduces a task. This can be purely paper and pencil, real, or simulated...along the gamut of task complexity.
  - Person served is asked to:
    1. Set a goal
    2. Predict their performance
    3. Anticipate and pre-plan for any possible challenges (e.g. “Are you going to need reminders or physical help with any aspect of this task?”).
    4. Choose a strategy to circumvent these challenges.
    5. Assess the amount of assistance he/she will need to successfully complete the task.
  - Following the above, the PS completes the task
  - Complete structured self-evaluation
  - Collaboration and comparison of perceived performance and reality
  - Record experiences, including tips or strategies to be more successful next time



# Specificity & Interference

- **Errorless Learning**
  - Survivor is involved in goal setting as much as possible
  - Develop routine...with task analysis and structured support at each step.
  - Supports function to elicit a correct response or task completion each trial.
  - No guessing by survivor...no quizzing by caregiver.
  - Fade supports over time.







# Use It or Lose It...A Cautionary Tale.

- FIM goes up...but at what cost?



CONFIDENTIAL

**On**<sup>WITH</sup>  
**Life**

Brain Injury Rehabilitation Specialists™



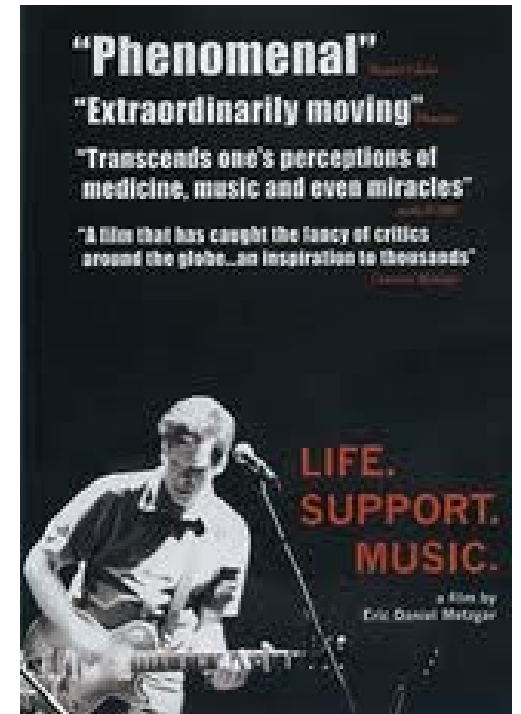
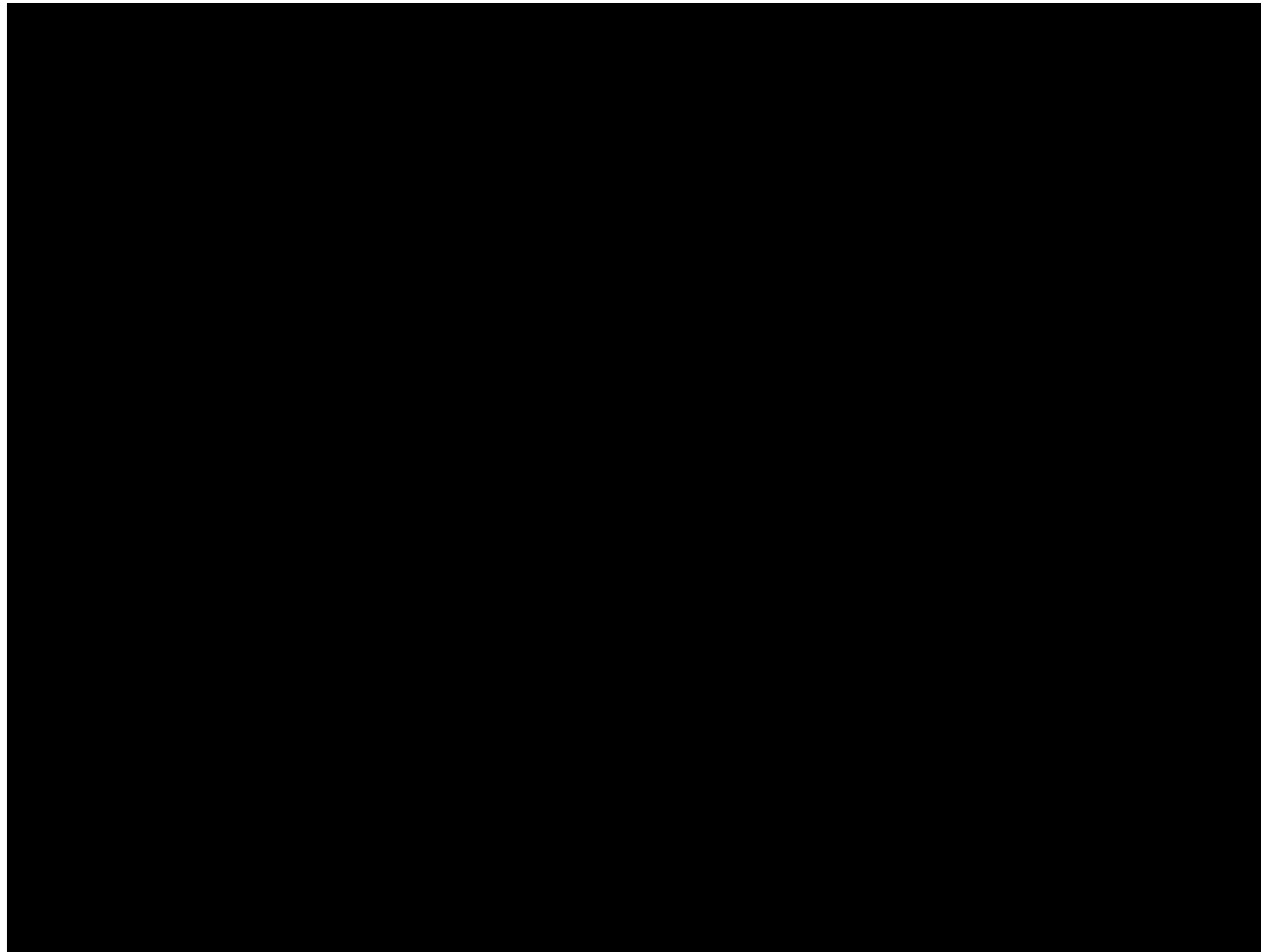
# Use It and Improve It: CIMT & CIAT

- **CIMT consists of three components:**
  - Massing of repetitive, structured, practice-intensive therapy in use of the more-affected arm
  - **restraint of the less-affected arm**
    - Restraint of unaffected arm for 90% of waking hours
    - 2 to 3 week period, 6 to 7 hours per day of intense therapy on consecutive weekdays
    - Repetitive training of more affected UE
    - Behavioral agreement
    - Treatment diary
  - transfer program, which includes monitoring arm use in life situations and problem solving to overcome perceived barriers to using the extremity
- **CIAT – similar philosophy**





# Salience + Repetition



CONFIDENTIAL



Brain Injury Rehabilitation Specialists™



# Technology and Neuroplasticity

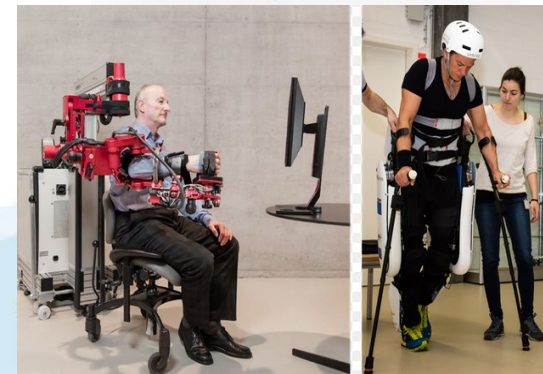
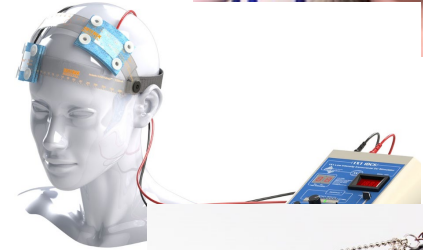
## Two Basic Types of Technology:

### 1. Non-invasive Brain Stimulation (NIBS)

- Repetitive Transcranial Magnetic Stimulation (rTMS)
  - Theta Burst Stimulation (TBS)
- Transcranial Direct Current Stimulation (TDCS)

### 2. Assistive Technology

- Passive assistance (i.e. Saebo)
- Active / Interactive Assistance (i.e. Exoskeleton)

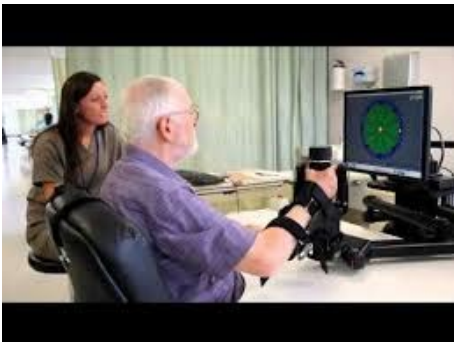




# Where Tech Might Be Helpful...

- **Conventional Therapy:**

- Repetitions / Intensity
  - **UE = 32 reps**
  - **LE = 350 reps**
- Many goals / activities
- Proximal to Distal



- **Robotic Assist:**

- Repetitions / Intensity
  - **UE = 400 reps**
  - **LE = 500-1000 reps**
- Fewer activities, but more of them
- Distal to Proximal



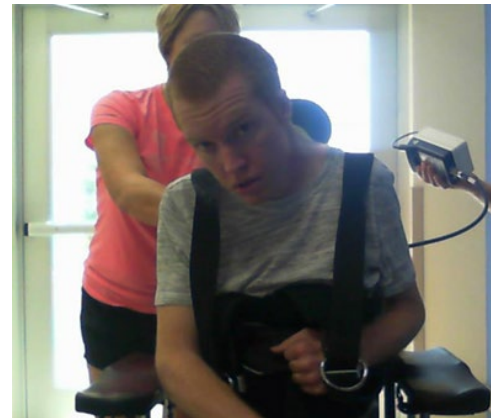
CONFIDENTIAL



Brain Injury Rehabilitation Specialists™



# Technology and Neuroplasticity



CONFIDENTIAL



Brain Injury Rehabilitation Specialists™



# The “Value” of Low Tech...



CONFIDENTIAL



Brain Injury Rehabilitation Specialists™



# Questions?

- Dave Anders, MS, CCC-SLP, CBIST
  - 515 965-1339 Ext. 126
  - [Dave.anders@onwithlife.org](mailto:Dave.anders@onwithlife.org)

