REHABILITATION AND NEUROPLASTICITY

A practical approach

Elissa Held Bradford, PT, PhD, NCS, MSCS
NMSS 2018 Regional MS Summit
Objective

Apply neuroplasticity principles to design a rehabilitation patient-centered evidence-based plan of care that maximizes restorative potential and neuroplasticity in MS.
Neurons that fire together wire together
AUDIENCE POLL

Years of clinical experience
Professional background
Number of individuals living with MS seen/year
Ways you promote neuroplasticity in your practice
Outline

- Neuroplasticity principles in rehab
- Decision-making for application of principles
- Clinical examples
- Monday morning ...

- THANK YOU... Randy Karmin PT, DPT, NCS, CBIS & Alicia Flach, PT, DPT, NCS
NEUROPLASTICITY PRINCIPLES IN REHABILITATION
Neuroplasticity in motor training and motor learning

- Learning a skill
  - Initially uses numerous regions of the brain
  - Increased cognitive demand/attention (cognitive stage)
  - As skill of task or movement increases (associative to automatic stages) decreased areas of brain are activated
  - Refined and efficient ‘algorithm’ or activation
Brain Training
Principles of experience-dependent neural plasticity: implications for rehabilitation after brain damage.
An evidence-based approach to promote neuroplasticity in MS
Self-Management and Task-Oriented Approach to Rehabilitation Training (START)

**Social Cognitive Theory**
- Self-Management
  - goal setting
  - action planning
  - self-monitoring
  - self-efficacy
  - applying strategies to break the symptoms cycle

**Neuroscience & Motor Learning**
- Task-Oriented Functional Training
  - meaningful task practice
  - high repetition
  - challenging-progression
  - problem solving
  - self-evaluation

Summary of Fig. 2 Richardson et al. 2015 Phys Ther
How do I promote neuroplasticity in my practice? Optimizing Movement Programs (OMP)

- Relevant, Engaging, Meaningful
- Task-specific (job, hobbies, daily activities)
- (Mod to) High intensity
- High repetitions
- Instructions, Feedback
- Environment (sensory)
- Attention (focused vs. divided; stage of motor learning)
- Errorless vs. Error-based
- Performance vs Learning
Introducing the concept of Neuroplasticity & Motor Learning, ensuring Physical Assistance and providing Feedback to optimize the learning process. The intensity of tasks is dynamic, varying based on the degree of skill acquisition and the stage of motor learning. This approach ensures a personalized learning experience, aligning with the principles of neuroplasticity and motor skill development.
Can I apply this in MS? YES

Clinical implications of neuroplasticity – the role of rehabilitation in multiple sclerosis

*Peter Flachenecker*

Neurological Rehabilitation Center, Quellenhof, Bad Wildbad, Baden-Württemberg, Germany

*Correspondence: peter.flachenecker@sana.de*
<table>
<thead>
<tr>
<th>Across Disability Levels</th>
<th>EDSS 0-3.5</th>
<th>EDSS 4-5.5</th>
<th>EDSS 6.0-7.5</th>
<th>EDSS 8.0-9.5</th>
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<tbody>
<tr>
<td>Little disability</td>
<td>EDSS 4-5.5</td>
<td>Mild disability</td>
<td>Moderate disability</td>
<td>Severe disability</td>
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<tr>
<td>Neuroprotection &amp; Restorative Neuroplasticity</td>
<td>Compensatory Neuroplasticity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Address pertinent and specific underlying impairments</td>
<td>Address pertinent and specific underlying impairments</td>
<td>Address pertinent and specific underlying impairments, with energy conservation methods</td>
<td>Implement energy conservation methods</td>
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<tr>
<td>Adapted from PTNow.org - Clinical summaries</td>
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PT DECISION MAKING IN ASSESSMENT AND INTERVENTION PLANNING IN MS

Dose (FITT)
- Frequency
- Intensity
- Timing
- Type

Held Bradford et al. 2017 Disability and Rehab
PWMS
DECISION
MAKING
AND
ACTIONS

Held Bradford et al. 2017 Disability and Rehab
Dose - FITT

- Active ingredient
- Mechanism of action
- Half-life

Operational definitions from Basso M., Lang C. JNPT 2016

https://exerciseismedicine.org/assets/page_documents/EIM%20Prescription20pad%20%20up.pdf
Dose

Principles: Timing, Age, Use It or Lose It, Use It & Improve It --- Building Reserve

- Neuroprotective effect of exercise & physical activity in MS  
  Giesser B. Ther Adv Neurol Disord 2015

- Cognitive reserve hypothesis  
  Sumoski. Front Neuro 2015

The Power of Prevention & Early Intervention

Principle: Transference ---Prime the Movement System

Principle: Transference, not Interference --- It Adds Up

Use Mirror Neurons Acharya et al. 2012

- Mental practice
- Observational practice
- Mirror training
Principles: Intensity, Repetition, Specificity, Salience
Principles: Intensity, Repetition, Specificity, Salience - Assisted
Principle: Intensity – Trial & Error/ Active Learner Assisted

Error Augmentation
Principles: Intensity - Weighting
### 15-Category RPE

#### Light Intensity

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Ratio RPE</th>
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<tbody>
<tr>
<td>6</td>
<td>No exertion at all</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>Extremely light</td>
<td>0.5</td>
</tr>
<tr>
<td>8</td>
<td>Very light</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>Light</td>
<td>3</td>
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</table>

#### Moderate Intensity

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<th>Category</th>
<th>Description</th>
<th>Ratio RPE</th>
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<tbody>
<tr>
<td>12</td>
<td>Somewhat hard</td>
<td>4</td>
</tr>
<tr>
<td>13</td>
<td>Strong (heavy)</td>
<td>5</td>
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#### Vigorous Intensity

<table>
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<th>Category</th>
<th>Description</th>
<th>Ratio RPE</th>
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</thead>
<tbody>
<tr>
<td>14</td>
<td>Hard (heavy)</td>
<td>6</td>
</tr>
<tr>
<td>15</td>
<td>Very hard</td>
<td>7</td>
</tr>
<tr>
<td>16</td>
<td>Very, very strong (almost max)</td>
<td>10</td>
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**Start with light to moderate, 11-13, especially if deconditioning and fatigue present, then increase challenge as tolerated, max 15-17 (Motl et al. 2010)**

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Principles: Intensity, Repetition, Specificity, Salience - Environment
Principle: Intensity---
Attention
Focused Attention –
Cognitive stage

Divided Attention- Dual Task
Associated-Automatic stage
Principles: Intensity, Repetition, Specificity---
Instructions, Feedback

- Less is more
- External focus
- Stage of Learning
Principles: Repetition, Intensity, Specificity, Salience – Can learn & apply from CIMT & LSVT BIG to MS?

- Meaningful massed task specific practice
- 5 days per week x 4 weeks
- Shaping for progression of intensity of task practice
- Modeling
- Transfer package for home engagement

Mark et al. Constraint Induced Movement Therapy for the Lower Extremities in Multiple Sclerosis: Case Series with 4-Year Follow up. Archives of Physical Medicine and Rehab 2013
But do we really know as much as we think we know?

Professional resources

- **Consortium of MS Centers** – [www.mscare.org](http://www.mscare.org)
  - Offers MS specialist certification to AHPs (MSCS)
  - MS peer reviewed journal - IJMSC
  - PT & SPT – 5 day fellowship through IOMSRT [www.iomsrt.mscare.org](http://www.iomsrt.mscare.org)
- euRIMS – [www.eurims.org](http://www.eurims.org)
- ANPT – [www.neuropt.org](http://www.neuropt.org)
  - Degenerative disease SIG - [http://www.neuropt.org/special-interest-groups/degenerative-diseases](http://www.neuropt.org/special-interest-groups/degenerative-diseases)
  - Neuro list serve (yahoo group)
- National Multiple Sclerosis Society – [www.nmss.org](http://www.nmss.org)
WHAT 3 THINGS CAN YOU APPLY TO CLINICAL PRACTICE ON MONDAY?
THE TAKE AWAY
In summary...

- Remember ‘Neurons that fire together wire together’
- Know the BIG 10 of neuroplasticity
- Think dose – FITT
- Fill your toolbox of resources
- Practice metacognition
THANK YOU

Questions?
elissa.heldbradford@health.slu.edu