Impacting Patient Outcomes Through Strategic Motor Learning Interventions Case-Based Approaches for PT & OT

Jordyn Rice OTR/L

Objectives

- Define motor learning & basic motor learning principles.
- Compare & contrast different motor learning strategies to improve function.
- Integrate motor learning into everyday clinical intervention for improved function.

Definitions

- **Motor Control:** The study of the nature and control of movement, focusing on understanding movement already acquired.
- **Motor Performance:** Refers to the performance of a skill, but not for the long term.
- **Motor Learning:** The study and understanding of the acquisition and/or modification of movement or skill for long term.
- **Recovery of Function:** Referred to as the reacquisition of movement skills after injury.

Neuroplasticity

Differential experience can change the structure and function of various brain regions:
- Tissue adjacent to damaged area can take over; residual neural tissue can compensate
- Extensive overlapping of muscle representation of motor tissue
  
  This organization may be the foundation for plasticity in the motor cortex

Nudo et al. 2001
The brain changes both anatomically and physiologically with resultant changes in:
- Growth of new connections
- Membrane excitability
- Unmasking of pre-existing connections

"The basis for relearning lost behavior in the damaged brain"
"Use it and improve it"

Adult brains need to attend to stimuli and be actively part of the activity for change to occur.
Specific reinforcement schedules and feedback are beneficial.


Activity is introduced in Challenging Environments
- Changes in Neural Signals
- Reorganization & New Neural Connections
- Changes in Function

(Tarduno, 2015)
Motor Learning

Key principals

Motor Learning

Individual Learning
Task
Environment

Effective Motor Outcomes

Consider Dynamic Systems

Pre Test

video
Dynamic Systems Theory

- Include picture of dynamic systems

Sensation

Observational Guidelines

- What are the difficulties that you see and or survivor reports?
- Look at how long it takes to locate the object and the trajectory
- How long does it take to pick up the object?
- Is there any slipping or dropping on the way to a good grip?

Observational Guidelines

- What can you tell about the amount of time it takes to stabilize the amount of force used to grip the object?
- Are they able to sustain grip?
- What hand surfaces are used for gripping?
- Do they contact the object well?
- Are they constantly using vision to monitor what is happening? (Doyle, 2015)
Alteration in control of pinch grip
Changes in ability to sustain and adapt appropriate force without vision
Difficulties with object manipulation
Difficulties combining component parts of movement such as transport and grasp

Difficulties with restraint of moving objects
Impairments with adjustments to sensory conflict conditions (rough surface)
Decreased spontaneous use contributing to learned non-use

Non specific sensory stimulation (rubbing, brushing, estim, vibration and weight bearing)
Compensatory approaches, incorporated into ADL training, safety education
Sensory retraining (incorporating re-education principals)
Motor approaches (NDT, constraint induced)
Discrimination activities

Education
- General info on stroke, self management, planned follow/reinforcement, active engagement of pt/caregiver

Compensation
- Reliance on other senses, frequent positional changes, avoiding high pressure tasks, increased awareness of danger, avoidance of repetitive motions and friction, good skin care
- No existing research evidence which tests effects

Remediation
- Active sensory training- cortical reorganization based on neuroplasticity, motor relearning principals
  - Mirror therapy, graded sensory re-training
- Passive sensory training- cortical re-organization in response to sensory input
  - Sensory bombardment, E Stim

(Doyle, 2015)
Evidence

- E Stim
  - Detection of LT, vibration, proprioception (Moderate)
- Graded Sensory Re-education
  - Composite sensory discrimination, stereognosis, kinesthesia, graphesthesia (Moderate)
- Thermal Stimulation
  - Rate of recovery of sensation (Moderate)

(Doyle, 2015)

Evidence

- Visual Motor Imagery
  - Light touch (Moderate)
- Mirror Therapy
  - Allydonia (Moderate)
  - Surface sensitivity, LT, temp (Strong)

Awareness Training

- Metacognitive-strategy training (Haskins, 2012)
  - Internalize awareness and control over behavior
**Awareness Training**

- Can be done in the context of another assessment or activity
- Goal: improve awareness so patient can use cognitively based problem solving strategies to compensate
  - Cognitively based problem solving strategies improve task performance and can be generalized

**Strategy Training: Guided Discovery**

- Self-Selected Goals
- Self-Evaluation
- Global Skills Training

Guided Discovery
Generalization and Transfer

(Skidmore, 2015)

**Global Strategy Training**

- Goal
- Meta-Cognitive Process
- Plan
- Check
- Do

**Guided Discovery**

- Low Discovery Learning
- Mid: Guided Discovery
- High: Explicit Instruction

(Skidmore, 2015)
Motor Practice
Interventions and EBP

Practice/Repetitions

- Research supports increased repetition for learning
  - Motor
  - Mental
  - Visual

Types of Practice

- Blocked vs. Random
- Distributed vs. Massed
- Part vs. Whole

Random vs. Blocked Practice

- Blocked: Practicing one task repeatedly, then moving on to the next task.
  
  TTTTTTTTPPPSSSSSSSSSSSS

- Random: Practicing tasks in random order.

  TPSTSPPTSSTPPPSSSTPP
**Distribution versus Massed**

- **Distributed Practice**: Rest time between trials is equal to or greater than practice time  
  10 seconds practice to 10 second or > rest time

- **Massed Practice**: Rest time between trials is less than practice time  
  10 seconds practice to 5 second rest

**Repetitions**

- Repetition alone, without usefulness or meaning in terms of function, is not enough to produce increased motor cortical representations
- Inform patients how the activity will help to achieve the goal
  
  (Bayona et al, 2005)

**Types of Training**

- Task-oriented training interventions
  - Constraint Induced Movement Therapy
  - Repetitive Task Practice
- Augmentative task-oriented training with cognitive strategies
  - Mental Practice
  - Mirror Therapy
  - Action Observation
- Strengthening and Exercise
  
  (Nilsen, 2015)

**Evidence Based Practice**
**CIMT vs. mCIMT**

<table>
<thead>
<tr>
<th>CIMT</th>
<th>mCIMT</th>
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<tbody>
<tr>
<td>1. Daily 6 hours/day 7 days/week training</td>
<td>1. 30 min to 3 hrs/day- 2-5 days/week</td>
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<tr>
<td>2. 90 % waking hours restrained</td>
<td>2. Less restrained-- &lt;6 hours/day</td>
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<tr>
<td>3. Two week intensive</td>
<td>3. two-10 weeks (distributed over time)</td>
</tr>
<tr>
<td>4. Intensive repetitive practice</td>
<td>4. Less intensive training over time</td>
</tr>
<tr>
<td>5. ADL’s, repetitive, shaping</td>
<td>5. ADL’s, repetitive, shaping</td>
</tr>
</tbody>
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**Evidence**

- UE function: 19/19 reported and findings in favor of CIMT & mCIMT
- ADL: 6/7 reported favor CIMT and mCIMT
- Evidence that gains are retrained over time (2 mos- 2 years)
- Feasible evidence group tx and home environment
- More compliance with mCIMT

**Repetitive Task Practice**

- Performance of goal-directed tasks that emphasize high intensity repetition of functional movement
  - Tasks varied
  - Dosages varied
    - 1hr/4-5x/wk/4wks
    - 30 min/5x/wk/3 wks

**Evidence**

- 18 Level I studies (3 systematic reviews) 6 Level II studies
  - 17/24 included outcomes related to UE function
  - 9/24 included outcomes related to mobility
  - 6/24 included outcomes related to ADL

- UE function: 13/17 found favor of RTP
- Mobility: 7/9 reported in favor of RTP
- ADL: 4/6 reported favor of RTP
- Evidence gains are retained over time
- Feasible in group & home environment
Mental Practice

- Cognitive rehearsal of physical skills in the absence of overt movements
  - Combined with task practice facilitated by audio or visual guidance
  - Tasks imagined varied
  - Dosages varied
    - 8-60 minutes / 2-5wk / 2-10 wks

Hypothesis about Mental Practice

- Motor improves due to the learner
  - Thinking about what can be tried
  - Predicting consequences based on practice
  - Integrating the sequence of the task
  - Activating mirror neurons

Evidence

- 9 Level I (2 systematic review)
- 7/9 included outcomes related to UE function
- 7/9 included outcomes related to ADL
  - 3/7 (2 systematic reviews) reported favor of MP
  - 3/7 (1 systematic reviews) reported favor of MP
  - Evidence that gains retained over time (f/u 1-3 mos)
  - Feasible in home environment

Demonstration

Mental Practice
**Mirror Therapy**

- Unimanual or bimanual training methods
  used AROM, functional movement with objects
- Dosages varied
  - 10-60 mins/ 2-7 days wk/ 2-6 wks

**Evidence**

- 3 Level I studies (1 systematic review)
- 3/3 included outcomes related to UE function
- 2/3 included outcomes related to ADL
  - UE function: 2/3 reported favor of MT
  - Evidence that gains are retained over time
  - ADL ½ reported findings in favor of MT
  - Feasible in group and home environment (6 mos f/u)

**Action Observation**

- Individual watches another perform an activity with the intention to imitate task performance
- Watching pre-recorded videotape- followed by task practice
- Tasks viewed and practiced varied
- Dosages varied 15-90 mins/ 2x-5x wk/ 18 days- 4 wks

**Evidence**

- 2 Level I studies
- 2/2 included outcomes related to UE function
- ½ included outcomes related to ADL
  - UE function: 2/2 reported favor of AO
  - ADL ½ reported findings in favor of AO
  - Evidence that gains are retained over time
**Strengthening/ Exercise**

- Resistance training
- Cardiorespiratory exercises
- Mixed training
- Tai Chi
- Yoga
- Dosages varied: 45 mins- 1hr/2x-6x wk/ 4-12 wks

**Evidence**

- 15 Level I studies (5 systematic reviews)
- 1 Level II study
- 6/16 included outcomes related to UE function
- 11/16 included outcomes related to mobility
- 13/16 included outcomes related to ADL
  - UE function: 5/6 reported favor of ST/Ex
  - Mobility: 8/11 reported favor of ST/Ex
  - ADL: 11/13 reported favor of ST/Ex
  - Evidence that gains are retained over time
  - Feasible in group and home environment

**Bridging the Gap: Task Oriented Training**

- 1. Functional Goals
- 2. Individualized
- 3. Active
- 4. High-Repetition
- 5. Task Object
- 6. Grading
- 7. Feedback
- 8. Activity Log

**Bridging Gap: Augmenting Task-Oriented Training (MP)**

- Provides practice opportunities with minimal motor recovery
- Combined with high intensity task-oriented training for additional practice
- Concurrent use of MP
  - Integration of mental rehearsal within physical practice, rate repetitions of MP
  - Self-Practice of MP
  - Independent use of MP outside of formal therapy
  - Develops autonomy
Considerations of MP

- Considerations: evaluate capacity to engage in imagery
- Introduce training and decide what should be imagined & perspective

Bridging Gap: Augmenting Task-Oriented Training (Mirror Therapy)

- Mirror placed in mid-sagittal plane between unaffected (in front of mirror) and affected (behind mirror)
- Make sure jewelry removed
- Decide on using the unimanual or bimanual training method

Considerations of Mirror Therapy

- Should be participant focused
  - AROM
  - Functional tasks with object (grasp-transport-release)
  - If bimanual make sure to use same object in same locations
  - Dosage (1) 30 min or (2) 15 min per day/ 5 days/wk/ 4 weeks

Bridging Gap: Augmenting Task-Oriented Training (AO)

- Video footage of live models completing specific task
Considerations of Action Observation

- Tasks should be participant focused
  - Functional tasks with objects
  - Dosage: suggest equal amounts of AO and actual task practice

Considerations for Strengthening and Exercise

- Consider mind-body exercise programs within clinic or recommended at discharge
- Dosage UE: 1h/2-3wk/4wks or Mind-body exercise: 1h wk/2x wk/8-12 wks

Bridging the Gap: Strengthening and Exercise

- Many consider an occupation
- Can be used to supplement task-oriented training interventions

Summary

- Practice is necessary for learning motor skills
- Retention improves with practice and challenging tasks
- Adjuncts to “traditional therapy”
  - Mental practice
  - Visual observation
  - Mirror therapy
- Knowing the goal and components is critical
- Implement evidence based into your practice
- Keep the tasks functional
