Evidence Based Applications of Motor Learning to Everyday Patient/Client Care

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Description: The goal of patient/client care is optimal functional competence; that is, the ability of patients/clients to perform daily activities in a variety of environments, under different conditions, with a minimal cost of physical and cognitive demand. This often requires patients/clients to change their motor behavior. Motor learning is a set of processes through which changes in motor behavior can be promoted, retained, and generalized. Several of these processes may be disrupted following a pathology. Physical therapists can promote motor learning by manipulating task conditions, providing external feedback and physical assistance, and structuring the manner and schedules of practice. To provide the most effective learning conditions therapists must always consider the cognitive and physical resources of patients, the complexity of the tasks to be learned, and the amount of practice that is possible. The purpose of this session is to illustrate how physical therapists can use judicious delivery of external feedback, and structure practice conditions to optimally engage clients with different neurologic pathologies in the processes that underlie the learning of functional motor tasks.

Objectives: Upon completion of this course, you will be able to:
1) Describe the major components of motor learning, and how these components may be disrupted in clients with various types of neurologic pathologies,
2) Compare and contrast how the delivery of external feedback and structuring of practice conditions can be manipulated to optimally engage clients in the processes underlying motor learning,
3) Provide judicious external feedback and create and modify practice conditions to optimally engage clients in the processes underlying motor learning.

I. The Goal of Clients: Functional Competence

A. Definition:
“The ability of patients to perform daily activities in a variety of environments, under different conditions, with a minimal cost of physical and cognitive demand”
(Majsak, in press)

B. How do clients get there?
1. Utilization of available resources (previously referred to as “compensation”)
2. Recovery of damaged systems
3. Neuroplasticity (Kleim and Jones, 2010)

II. Changes in motor behavior involve some manner of motor learning:

A. Definition of motor learning:
“A set of processes associated with practice or experience leading to relatively permanent changes in the capability for responding.”
(Schmidt, 1988)

B. What do we know about predicting the motor learning capacity of clients?
1. Actually, very little…
   - Clients: CVA, PD, TBI, CP
   - Tasks:
   - Practice conditions:
C. How do we assess learning… clinically?
   1. Observation vs. Probing
      - Explicit and Implicit learning
   2. Motor performance vs. Capacity for responding
   3. Acquisition/Habit formation vs. Retention and Generalization of motor skills

III. A Contemporary Model of Motor learning (Majsak, in press):

![Diagram of Motor Learning Model]

Three Major Components of Motor Learning

A. Perception of Self and Environment
   1. Personal Constraints: Contributing subsystems
      - Biomechanical
      - Neuromuscular
      - Psychological
      * Dynamic Systems Model (Thelan and Ulrich, 1991)
   2. External Constraints: Spatial and Temporal
      - Taxonomy of Tasks (Gentile, 1987)
   3. Perception/Action Coupling (Gibson, 1966)
      - How do I “fit” (spatial/temporal) in my world?
      - Affordances (Gibson, 1977)

B. Developing a Motor Plan: What Needs to be Planned?
   1. The relationship and possibilities between the intrinsic constraints of the client and the external constraints of the real world
   2. The Rules for successful task performance - “Finding the 10s” (Majsak, in press)
3. Appropriate diversity of movement patterns within a “coordination mode” of task performance (Latash et al., 2002; Newell et al., 1991)

4. The processes for motor planning: Perception, action, and assessment:
   - Picking-up information
   - Creating or using previously learned movement strategies to accomplish tasks
   - Selecting appropriate movement patterns to carry out movement strategies
   - Analyzing results of actions
   - Assessing the plan and the execution of the motor plan
   - Making appropriate corrections to the plan or execution if he task was not successful
   - Reassessing task performance
   - Refining and diversifying movement strategies and patterns to attain functional competency

5. Motor planning is not entirely “cognitively mediated”
   - Biomechanical constraints
   - Emergence of a “self-organized” plan
   - Perception-Action Coupling

6. What is the capacity of clients to plan?
   - Clients: CVA, PD, TBI, CP
   - Tasks:

7. What can therapists do to promote the motor planning of clients?
   - Clarify the goal
   - Discuss possible movement strategies and patterns
   - Help the client assess task performance
   - Share observations
   - Probe
   - Model/physically assist the client in appreciating the possibilities
   - Provide the client the plan
     - Why?
     - When?
     - How?

C. Performing, Information Processing, and Practicing: What needs to be practiced and learned?
1. The processes that lead to motor learning, not merely motor output
2. Different classes of actions (functional tasks) that contain Rules for performance (the “10s”)
3. Task performance utilizing three contributing levels of neuromotor organization
   - Cognitive “direction” - Subcortical “automaticity” - Spinal level motor “regulation”
4. Movement diversity within “coordination modes” of task performance
5. The same processes as motor planning (perception, action, and assessment):
   - Picking-up information
   - Creating or using previously learned movement strategies to accomplish tasks
   - Selecting appropriate movement patterns to carry out movement strategies
   - Analyzing results of actions
   - Assessing the plan and the execution of the motor plan
   - Making appropriate corrections to the plan or execution if he task was not successful
   - Reassessing task performance
   - Refining and diversifying movement strategies and patterns to attain functional competency

6. What is the capacity of clients to learn?
7. What can therapists do to promote the learning of clients?
   - Structure and manipulate tasks
     - Embedding desirable movement strategies and patterns into functional tasks
   - Provide external feedback and physical assistance with a frequency and timing that
     optimally engages clients in the processes underlying motor learning
     - Boundary conditions
     - Augmented information
       - Knowledge of Performance
       - Knowledge of Results
       - Transitional Information
     - Timing:
   - Frequency:

   - Structure the manner and schedule of practice that optimally engages clients in the processes
     underlying motor learning
   - Intensity:
     - Massed vs. Distributed:
     - Specificity of Practice
   - Part vs. Adapted:
     - Self-guided vs. Physically guided:
   - Random vs. Blocked:

8. The three dimensional, non-linear, optimal engagement workspace (Majsak, in press)
Task Complexity

Intrinsic Processing Capacity of Clients

High Capacity or Later Learner

‘optimal engagement workspace’

Low Capacity or Early Learner

Opportunity for Practice (# of Trials)

High Level of Assistance Needed
- High Frequency/Concurrent AI?
- Physical assistance?
- Blocked Practice?

Much Less Assistance Needed
- Intermittent AI?
- Less Physical Assistance?
- Random Practice?

Side Tilt

GOAL

Distance

Pitch

High Capacity or Later Learner

Limited Extensive Complex

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V. Summary and Concluding Comments

A. We must do all we can to try to understand the ability of clients to: perceive their intrinsic constraints and the constraints of tasks and environments; to motor plan; and to perform, process information, and practice.

B. The main principle for motor learning is to optimally engage the client in the processes underlying motor learning.

C. The key to promoting motor learning is to appropriately manipulate the structure of tasks, the delivery of external information, and practice structure to optimally engaging clients in the processes underlying motor learning... the key is the processes, not the techniques.

D. The ways in which therapists can optimally engage clients in the processes underlying motor learning will depend upon the learning skills of the client, the complexity of the tasks to be learned, and the opportunities for practice that are available.

References for Handout and Slides


