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Prior to completing the Piedmont Project Workshop, I defined sustainability rather narrowly with a singular focus on environmental considerations. This definition led me to propose implementation of sustainability concepts in my course content primarily through a reduction in paper handouts and an emphasis on electronic course content delivery. I teach a graduate-level scientific foundations course during the summer semester with 70 students in the Doctor of Physical Therapy program at Emory University. Students in the program have a long-held expectation of receiving paper handouts of lecture notes. This expectation has resulted in substantial paper usage and significant costs incurred by the program. To raise awareness regarding this aspect of sustainability and to begin to modify behaviors, students were required to complete an electronic survey through the Blackboard Learning Management System to 'opt-in' to receiving handouts prior to the start of the course. In the first year, this step has reduced the number of handouts required per class session by over 50%. The goal is to be paper-free in 2016. As the course organizer, I have also made formatting changes to slide handouts and composition of the student versions of handouts to eliminate superfluous to further decrease handout volume. It is estimated these changes will reduce paper use in the course by 25% alone. Each of these enhancements to the course will reduce environmental impacts and promote graduate student awareness of sustainability as a potential entry point for further action.

After completing the Piedmont Project Workshop, I came to the realization that sustainability concepts in my classroom can and need to address more than the environmental aspects of sustainability. In conjunction with the paper saving measures previously described, the course syllabus has been revised to facilitate student engagement and responsibility in an effort to cultivate sustainable life-long learners in the health care field. The course will now have a course session devoted to introducing the core concepts of sustainability in a broader context and identifying commonalities with contemporary physical therapy practice (July 2<sup>nd</sup> in the syllabus below). The primary goal of this session is to emphasize the importance of fostering sustainable positive change in each patient that results in more complete and longer-lasting therapeutic improvement. A secondary goal is to challenge the students to generate creative ideas that further incorporate sustainable practices into rehabilitation. It is expected this novel course content will improve student understanding of sustainability and, critically, create a framework to think about how to leverage the concepts discussed into innovative therapeutic approaches that improve the efficacy of physical therapy. Overall, incorporating sustainability into my course has already led to changes in students' perceptions of environmental considerations and also offers new tools to support creative problem solving in the context of patient care.

**DPT-805 Principles of Motor Learning**  
**Emory University Doctor of Physical Therapy Program**  
**Summer 2016**

**Textbook:** Shumway-Cook A and Woollacott M, (2012) **Motor Control – Translating Research into Clinical Practice**. 4<sup>th</sup> edition Lipincott Williams & Wilkins, Philadelphia, PA.

**You can purchase the entire textbook or individual chapters online. Please go to: [store.vitalsource.com](http://store.vitalsource.com) and create an account. Then search for the above textbook title in the search engine. You may purchase the entire book (recommended), or the following chapters that are required for class: chapters 1-5.**

In addition, there will be articles that are required reading for most class sessions. Citations are provided below and you will be responsible for acquiring the assigned articles.

**Also recommended:** Schmidt RA and Lee TD (2014) **Motor Learning and Performance – From Principles to Application**. 5<sup>th</sup> edition Human Kinetics, Champaign, IL. [Website](#)

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Course Objectives: Students will:

- 1) gain an understanding of the basic principles of motor skill learning and their application to physical therapy intervention including:
  - a) the theoretical framework of historical motor control models and contemporary models
  - b) variables of practice that influence motor learning
  - c) the role and types of feedback that influence motor learning
  - d) measures of performance as a means to assess motor learning
  - e) skill retention and transfer
  - f) task analysis of functional goals
- 2) gain an understanding of the role of the physical therapist in a teaching/learning paradigm that include:
  - a) learning and understanding patient motivation
  - b) how to actively engage the patient in the therapeutic process
  - c) clearly and concisely communicating/guiding the patient through the physical therapy intervention program
  - d) diagnosing a learning situation
  - e) designing a learning experience
- 3) gain an understanding of the neurobiological underpinnings of both normal and abnormal motor control and learning:
  - a) contributions of the spinal cord, brainstem, cerebellum, basal ganglia, and motor cortex
  - b) contributions of the sensory/perceptual system
  - c) develop a framework to link motor control impairments with physical therapy interventions
- 4) gain exposure to state-of-the-art research in motor control and learning as well as in related fields of study:
  - a) skill adaptation (e.g. split-belt treadmill walking)
  - b) advanced neuroimaging and neurostimulation techniques to evaluate brain anatomy and physiology
  - c) rehabilitation applications of novel technologies
  - d) influence of aerobic exercise on motor performance
  - e) contributions of sleep to motor performance and memory formation

**Course grades** will be determined in the following manner:

Attendance and Classroom Engagement – 10%

Individual Assignment – 15%

Midterm Exam – 20%

Group Project – 25%

Final Exam – 30%

Please note the following expectations for class:

1. Students are expected to attend each class and to be on time. Absences without excuses PRIOR to the class that is missed will result in a reduction of the Attendance and Classroom Engagement grade, as will chronic tardiness for class.
2. Class assignments are to be turned in prior to the stated submission deadline; assignments submitted after the deadline will result in a significant loss of points. If there are extenuating circumstances, advanced warning is required and will be evaluated on a per-case basis.
3. Students struggling with class material are encouraged to **proactively** work with the instructors or classmates to improve understanding of material.
4. The syllabus should be used as a guide to determine what material is relevant to this class and likely to be included on an exam. However, the syllabus is subject to change. Students will be notified as soon as possible of any changes in class material or the availability of guest lecturers.

## **Planned Lecture Schedule:**

### **May 12<sup>th</sup> and May 19<sup>th</sup>: Course Introduction and Theories of Motor Control - Borich**

Pre-class objectives: Students will:

- 1) be prepared to discuss the differences and relation between motor control and motor learning
- 2) know the relationship between motor learning and performance
- 3) discuss how a combination of factors related to the individual, the task and the environment affect motor control and learning
- 4) define types of motor and cognitive skills and provide examples of each type of skill
- 5) be able to discuss the history of motor control models and the evolution to contemporary models.

Class Objectives: Students will:

- 1) gain an understanding of motor learning and motor performance
- 2) gain knowledge of theoretical frameworks for motor control by comparing and contrasting the following theories of motor control: reflex, hierarchical, motor programming and systems models
- 3) compare and contrast neurofacilitation techniques to a task-oriented approach with respect to assumptions underlying normal and abnormal movement control, recovery of function and clinical practices related to assessment and treatment.

Readings: S-C&W Ch1, 3

Hallet M. Volitional control of movement: the physiology of free will. *Clin Neurophysiol.* 2007; 118(6): 1179-92.

### **May 21<sup>st</sup>: Theories of Motor Learning - Borich**

Pre-class objectives: Students will:

- 1) define motor learning in more detail and understand the similarities and differences between motor learning and performance
- 2) have an understanding of implicit vs. explicit control processes
- 3) knowledge of theoretical concepts of stages of motor learning and associated motor performance

Class Objectives: Students will:

- 1) understand how to measure or demonstrate motor learning
- 2) provide examples of implicit vs explicit forms of learning
- 3) compare and contrast the similarities and differences between motor control and motor learning
- 4) compare and contrast the following theories related to stages of motor learning: Fitts and Posner's three-stage theory, systems three-stage theory and Gentile's two-stage theory

Readings: S-C&W Ch2 (up to 'Practical Applications of Motor Learning Research' section)

Van Tilborg et al. How should we teach everyday skills in dementia? A controlled study comparing implicit and explicit training methods. *Clin Rehabil.* 2011; 25(7): 638-548.

Boyd et al., Providing explicit information disrupts implicit motor learning after basal ganglia stroke. *Learn Memory.* 2004; 11(4): 388-96.

### **May 22<sup>nd</sup>: Neural Plasticity and Motor Learning - Borich**

Readings: S-C&W Ch4

Jones T.A. and Kleim J.F. Principles of experience-dependent neural plasticity: implications for rehabilitation after brain damage. *J Speech Lang Hear R.* 2008; 51:S225-S239.

Nudo RJ et al. Neural substrates for the effects of rehabilitative training on motor recovery after ischemic infarct. *Science.* 1996;276(5269): 1791-1794.

### **May 26<sup>th</sup>: Neural Plasticity and Motor Learning - Borich**

Readings: S-C&W Ch4

Scholz J et al. Training induces changes in white-matter architecture. *Nat Neurosci.* 2009;12(11):1370-1371.

Lang C.E. et al. Observation of amounts of movement practice provided during stroke rehabilitation. *Arch Phys Med Rehab.* 2009;90:1692-1698.

### **May 28<sup>th</sup>: Practice Variables of Motor Learning - Borich**

Pre-class objectives: students will:

- 1) be able to explain variables of practice
- 2) be able to discuss the concept of individual differences and why peoples' abilities are important for the practitioner to understand

Class Objectives: students will:

- 1) gain an understanding of the impact of practice variables on the structure of practice and describe their effect on performance vs. learning
- 2) compare and contrast the different elements of practice including: massed vs. distributed, constant vs. variable, random vs blocked and whole vs. part practice.
- 3) be able to design a mock practice session based on individual characteristics, stages of learning and determined goals of learning.
- 4) be able to discuss terminology/concepts above in the context of contemporary research article(s)

Readings: S-C&W Ch2

Lin et al. Effect of Task Practice Order on Motor Skill Learning in Adults with Parkinson Disease: A Pilot Study. *Phys Ther.* 2007;87:1120-1131.

Porter and MaGill. Systematically Increasing Contextual Interference is Beneficial for Learning Sports Skills. *J of Sports Science.* 2010; 1277-1285.

**June 2<sup>nd</sup>: Variables of Feedback; Diagnosing a Learning Situation and Designing a Learning Experience, Intro to Individual Assignment and Group Project - Borich**

Pre-class Objectives: students will:

- 1) be able to explain variables of feedback that influence learning
- 2) be able to discuss the concept of individual differences and why peoples abilities are important for the practitioner to understand

Class Objectives: students will:

- 1) be able to define and provide examples of intrinsic vs extrinsic feedback
- 2) explain and provide examples of knowledge of performance vs knowledge of results
- 3) describe informational feedback and the role it plays in a therapist-patient relationship
- 4) discuss the frequency of feedback and its impact on learning situations
- 5) critically review research articles pertaining to learning vs. performance and how to evaluate performance
- 6) gain evidenced-based information regarding learning and measurement of performance
- 7) discuss a framework to diagnosis a learning situation and design a learning experience.

Readings: S-C&W Ch2;

Abdollahi F et al., Error augmentation enhancing arm recovery in individuals with chronic stroke: a randomized cross-over design. *Neurorehabil Neural Repair.* 2014; 28(2): 120-8.

**June 4<sup>th</sup>: Midterm Exam**

**June 9<sup>th</sup>: Clinical considerations using the principles of motor learning - Laura Zajac-Cox and Tami Philips**

Readings: S-C&W Ch5

Article(s): TBD

**June 11<sup>th</sup>: ICF Model Framework for Motor Control - Aimee Reiss**

Pre-class objectives: students will:

- 1) review components of the ICF model
- 2) understand a clinical decision making (CDM) framework approach to examination and intervention

Class objectives: students will:

- 1) use a CDM framework to diagnosis deficits in impairments, function and participation and then choose an appropriate intervention
- 2) use the ICF model to diagnosis deficits in impairments, function and participation and then choose an appropriate intervention
- 3) apply ICF framework to a video case study

Readings: Atkinson H and Nixon-Cave K. A Tool for Clinical Reasoning and Reflection Using the *International Classification of Functioning, Disability and Health* (ICF) Framework and Patient Management Model. *Phys Ther.* 2011;91(3):416-430.

**June 16<sup>th</sup>: Measuring Peripheral Nervous System Adaptations to Training - Dr. Manning Sabatier**

Readings: TBD

**June 22<sup>nd</sup>: Exercise Induced Plasticity in the Central Nervous System - Drs. Joe Nocera and Keith McGregor**

Readings: TBD

**June 23<sup>rd</sup>: Using Mixed Reality Approaches in Stroke to Promote Neuroplastic Change - Dr. Steve Wolf**

Readings: TBD

**June 25<sup>th</sup>: Task-Oriented Training and Neuroplasticity - Borich**

Class objectives: students will:

- 1) describe the essential components to task-oriented training (TOT)
- 2) discuss how TOT relates to principles of neuroplasticity
- 3) apply above principles to current research in stroke rehabilitation

Readings:

Timmermans et al. Effects of task-oriented robot training on arm function, activity, and quality of life in chronic stroke patients: a randomized controlled trial. *J. Neuroeng and Rehabil.* 2014; 11:45.

Winstein et al. Interdisciplinary Comprehensive Arm Rehabilitation Evaluation (ICARE): a randomized controlled trial protocol. *BMC Neurology.* 2013;13:5.

### **Individual Assignments Due**

#### **June 30<sup>th</sup>: Sleep on it: The Relationship Between Motor Learning and Sleep - Borich**

Readings:

Tononi G et al. Perchance to prune. During sleep, the brain weakens the connections among nerve cells, apparently conserving energy and, paradoxically, aiding memory. 2013;309(2):34-9.

Huber R. Arm immobilization causes cortical plastic changes and locally decreases sleep slow wave activity. *Nat Neurosci.* 2006;9(6):1169-1176

#### **July 2<sup>nd</sup>: Defining and Promoting Sustainable Learning During Rehabilitation - Borich**

Class objectives: Students will:

- 1) Define the three primary domains of sustainability (Social, Environmental and Economic)
- 2) Discuss how these principles can be applied in a rehabilitation environment
- 3) Identify current concepts in physical therapy that can be characterized as sustainable
- 4) Describe future opportunities to apply sustainable concepts to improve patient treatment outcomes

Readings:

Hopwood et al. Sustainable Development: Mapping Different Approaches. *Sust. Dev.* 2005;13:38-52

Ehde et al. Developing, testing, and sustaining rehabilitation interventions via participatory action research. *Arch Phys Med Rehabil.* 2013;94(1 Suppl):S30-42.

#### **July 7<sup>th</sup>: Group Presentations**

#### **July 9<sup>th</sup>: Group Presentations**

#### **July 14<sup>th</sup>: Regenerative rehabilitation: regenerating physical therapy through practice - Dr. Randy Trumbower**

Readings: TBD

#### **July 16<sup>th</sup>: Return group project grades and course content review**

#### **July 23<sup>th</sup>: Final Exam**