TMS Module: Bioinstrumentation 2021

Module Overview: This three-week module provides a comprehensive introduction to transcranial magnetic stimulation (TMS). Week 1 lecture topics include: overview of brain stimulation, how TMS works, examples and applications of TMS within both research and clinical practice, and safety considerations. Additionally, to deepen student understanding of one specific way in which TMS could be incorporated into their human movement neuroscience research, this module will go into depth on one TMS technique in particular: cortical silent period (cSP). Week 1 will include background on cSP, examples of studies which have used this technique, and a 30-minute video demonstration detailing experimental set-up, acquisition, and analysis of cSP data.

The Week 2 lab permits students to run their own mini-TMS study (virtual this year due to COVID). This includes screening and preparing the volunteer participant, measuring muscle activity and force, finding the motor hotspot and resting motor threshold, and administering TMS pulses to obtain cSPs. Students will be divided into small groups to complete the Week 2 lab. Each group will be assigned a paper to read before the lab. During the lab, they will walk through the steps to set up and collect data for an experiment aiming to replicate the findings in their assigned paper.

The Week 3 data analysis component involves analyzing the electromyography (EMG) data collected on Week 2 using MATLAB. Students will follow instructions for data analysis within MATLAB and then write a short report introducing cSPs, detailing the methods used, and comparing their obtained results to those established in the literature.

Student Learning Objectives:

- Describe how TMS differs from other brain stimulation approaches (e.g., transcranial direct current stimulation and deep brain stimulation).
- Understand the basic physics of how TMS works.
- Understand what TMS is and isn't -- list pros and cons of TMS compared to other neuropsychological research tools.
- Develop basic understanding of common TMS experimental paradigms: single pulse, paired pulse, repetitive TMS, and theta burst TMS. If applicable, develop a working knowledge of how TMS could be applied to the student's own research interests.
- Explain cortical silent period (cSP), including the types of research questions that can be answered using this technique and factors that may affect silent periods.

- Detail the risks and misconceptions associated with TMS, including eligibility criteria for TMS research participants.
- Demonstrate competence in applying TMS to the motor system and understand each of the required steps (i.e., screen and brief the participant, measure EMG and force, find the first dorsal interosseous motor hotspot, identify the resting motor threshold, and successfully elicit cSPs).
- Use MATLAB to quantitatively analyze cSPs in the EMG data collected during the lab.
- Write a research report that answers a scientific question based on the TMS data collected (i.e., be able to describe background information on cSPs, the research question, methods, and results, and discuss whether the results fit with the published literature).

2021 Schedule:

1. Week 1, Thursday Feb. 25th: Attend Zoom lecture. This lecture will include watching a TMS demonstration video.
    a. *Before class*: Read Rossi et al. 2020 and Hupfeld et al., 2020.
2. Week 2, Thurs. March 4th: TMS Data Collection (Zoom)
    a. *Before class*: Read only the paper assigned to your group.
    b. *Before class*: Be prepared to talk through setting up a participant for TMS and testing your group's research question with only some guidance.
3. Week 3, Thurs. March 11th: TMS Data Analysis (Virtual Office Hours)
    a. *Before class*: understand the cSP analysis methods used in the paper assigned to your group, as well as the expected results.
    b. *Not required:* call into the Zoom meeting only if you need help running the analyses or have questions. Or, email Dr. Seidler (rachaelseidler@ufl.edu) or Kathleen Hupfeld (khupfeld@ufl.edu) to schedule an alternate time to receive help with your data analysis or report.