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| **Client:** | Macy Griffis | **File:** 24-023 |
| **Dept:** | Speech, Language, and Hearing Sciences | **Faculty:**  **Student:** |
| **Date:** | 3/19/24 | **Initial Meeting:**  **Follow-up:** |
| **Consultant and Attendees:** Sumeeth Guda, Macy Griffis, Dr. Chong Gu, Dr. Georgia Malandraki | | |
| **Statement of Problem:** To identify neuromuscular amplitude and timing characteristics of typical swallows and compare to rehabilitative swallowing maneuvers in idiopathic Parkinson's disease patients. | | |
| **Goal of this Project:** M.S Thesis | | |
| **Background:** The client’s research is about studying swallowing techniques among people with Parkinsons disease. Primarily, the two most common techniques for swallowing and dysphagia rehabilitation are the Mendelsohn maneuver and effortful swallow techniques. One of the major issues in patients affected with diseases that affect the head and neck is that they have difficulty swallowing. What the client is trying to determine is which exercises and maneuvers are most effective to rehabbing the swallowing among patients with Parkinson’s disease.  The client will collect data from a group of patients with idiopathic Parkinson’s disease and dysphagia (n=15). The patients will wear a sEMG (surface electromyography) sensor system developed by the I-EaT lab (i-Phagia system) to collect submental muscle activity. Participants will perform two trials each of the following five tasks:   1. Typical swallow, 5ml thin liquid 2. Typical swallow - 5cc pudding 3. Swallows using a swallow maneuver (Mendelson maneuver) 4. Swallows using maximum effort (effortful swallow) 5. Maximum isometric tongue press.   Submental muscle activity will be measured during these five tasks.  The experimental factors include the patient population (idiopathic Parkinson’s), as well as the labeling of the swallowing tasks (effortful swallow, Mendelsohn maneuver, tongue resistance, and typical swallow 1 and 2) Surface EMG will be used to quantify muscle activity in the study. The client will measure three outcome variables of each trial in the study: normalized mean sEMG amplitude, time to peak, and burst duration.   * The normalized mean sEMG amplitude is measured in % of maximum effort and indicates the level of muscle contraction and force. * Time to peak is the duration from the onset of contraction to the time of peak amplitude (measured in seconds). This indicates how quickly a muscle reaches its maximal activation from the onset of the muscle activity. * The burst duration is the total duration of the muscle contraction during an event (measured in seconds) detected on the EMG device. | | |
| **Progress of project at this time:** Presently Collecting Data | | |
| **Relevant information presented at meeting:** During the meeting itself, the client and her advisor informed the attendees that presently there were some steps which differed from their description in the application. Currently, they have (n=9) patients participating in the experiment. Additionally, they will only evaluate Mendelsohn and effortful swallowing techniques in the experiment.  For each trial, the client will collect the baseline swallowing technique sensor data in a randomized order with respect to the liquids in a subsequent order ((water, water), (pudding, pudding)) before repeating the experiment with the trial techniques, also in a randomized order ((Mendelsohn, Mendelsohn), (effortful swallow, effortful swallow)). They will then average the 3 signals (Time to peak, burst duration, amplitude) from each ordering and input the averages into an excel file. As discussed in the meeting, Dr.Gu recommended not to average out the values first, as this could cause order effects within the data. Since the 3 signals (Time-to-peak, burst duration, and amplitude) are being measured, the client wants all 3 signals to be analyzed independently, not jointly.  Overall, the design appears to be a complete randomized block design, and for the comparisons of the 4 activities, it was suggested to use 2-way additive ANOVA with participants as blocks and with 4 treatment levels; the complete data have 4 readings in each cell, left and right, repeated twice. The 3 responses are to be analyzed separately, and transformations might be needed for the responses.  The student did indicate that possible order effect and left-right discrepancy could be explored via the residuals. The sides, ordering, and participant ID could be incorporated in residual analysis using different colors and plotting symbols. If any patterns appear in the residual plots, then refined modeling techniques and/or data handling might be implemented, otherwise the analytical results using individual observations should be the same as the results using averaged data. For summaries on individual activities, the variability could be larger as the inter-participant variability cannot be canceled out without the blocking structure. The client did not have a preference for the software for the analysis, so R will likely be used if only for its graphical flexibility. | | |
| **Recommendations for Design and/or Analysis:** For a baseline experimental design this is a textbook example of a random complete block design. Overall, within the meeting the design has a good solid foundation. The only addition to the design as suggested was that instead of getting 2 replicates per exercise type, take 4 instead and have the sensor’s attached to both the right side and left side of the neck. This is to ensure that there won’t be any drift present within the sensor system, averaging over both the right and left sizes of the neck should be the same. Specifically, to analyze the left and right sizes, verify if the residual patterns in the left and right side are approximately the same. Ideally, they should be the same, but if there exists significant difference between the right and left sides, then both sides need to be tested independently using pairwise comparison methods. | | |
| **Who will carry out these actions?**  **Client:**   * Send Consultant collected data. * Update design to include both the right side and left side of the neck. * Get familiar with R and SAS for data analysis.   **Consultant:**   * Analyze the collected data to find any patterns within the Left-Right test. Verify the RCBD assumptions for the data. * Fit a glm model into the data, investigate the residuals of the model. Investigate if ordering matters. With respect to the swallowing tasks. Investigate the residuals of the right and left sides and verify that they are the same, otherwise report any anomalies. Complete the regression analysis in R. * Provide the client with the sample code in R. Meet with the client to demonstrate the code and results. * Get the data from the client, play a bit, then sit with the client side-by-side going over the phases using one of the three responses. | | |
| **Status:** Follow-up is necessary, potentially have a weekly meeting time to touch basis about the project. | | |

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