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| **Client:** | Macy Griffis | **File:** 24-023 |
| **Dept:** | Speech, Language, and Hearing Sciences | **Faculty:**  **Student:** |
| **Date:** | 9/18/24 | **Initial Meeting:**  **Follow-up:** |
| **Consultant and Attendees:** Macy Griffis, Sumeeth Guda, Dr. Bruce Craig, 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:** Master’s Thesis | | |
| **Background:** The client’s research is about studying swallowing techniques among people with Parkinson’s disease. The two most common rehabilitation techniques for swallowing and dysphagia are the Mendelsohn maneuver and effortful swallow. 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 has collected data from a group of patients with idiopathic Parkinson’s disease and dysphagia (n=15). The patients wore a sEMG (surface electromyography) sensor system developed by the I-EaT lab (i-Phagia system) to collect submental (i.e., below the chin) muscle activity. Participantsperformed two trials each of the following four 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)   The experimental factors include the patient population (idiopathic Parkinson’s), as well as the labeling of the swallowing tasks (effortful swallow, Mendelsohn maneuver, and typical swallow 1 and 2) Surface EMG will be used to quantify muscle activity in the study. The client will consider three outcome variables of each trial in the study that summarize the sEMG signals: 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.   Previously the client and consultant worked together to validate the randomized complete block design assumptions and to show the right and left sides for the sensors performed approximately the same. A follow up meeting was determined because the client needed help answering the following research question:   * How to compare neuromuscular amplitude and timing components of rehabilitative swallowing maneuvers (effortful swallow, Mendelsohn maneuver) with typical swallows (5mL thin liquid and 5cc pudding) in patients with idiopathic PD. | | |
| **Progress of project at this time:** Analysis (All data has been collected) | | |
| **Relevant information presented at meeting:**  The meeting started off with Macy explaining to Dr. Craig about the project itself. She is taking the 3 outcome variables (Burst Duration, Amplitude, Time to Peak) from 15 patients through two trials with the four techniques (5ml liquid, 5cc pudding, Effortful Swallow, Mendelsohn Maneuver). The typical swallowing techniques (5ml liquid, 5cc pudding) were measured first before the rehab swallowing techniques (Effortful Swallow, Mendelsohn).  As Macy explained, her project has two aims. The first aim is to gather the descriptive statistics for the three response variables for the four techniques. And to validate that the right-side measurements are the same as the left-side measurements. The second aim is to compare the two swallowing maneuvers (Effortful Swallow, Mendelsohn) against the typical swallowing techniques (5ml liquid, 5cc pudding) and to validate that there is difference between the means of each typical swallowing technique against the rehab techniques.  The client has two concerns for the Fall semester. The first one is regarding the work she and the consultant have worked on so far. While the consultant created a statistical report containing all the ANOVA and graphic visuals to show that the left and right-side data performed the same. Ultimately the consultant did not generate any summary statistics to quantitatively show that the sides were different. The second concern was that they did not know any statistical techniques to compare the swallows against each other, and hence needed help to compare the swallows together for the 3 responses.  Dr. Malandraki brought up three important points for the project. The first was a timeline component, in that the project needs to be finished by early December 2024, since Macy will be going on clinical rotations in Spring 2025 and hence won’t have a lot of time to finish the project. The second major point she brought up was that with respect to the analysis they are ultimately looking at the means of the responses (BD, AM, TTP) for the typical swallowing techniques (5ml liquid, 5 cc pudding, pudding \* liquid) against the means of the responses for the maneuver techniques (Mendelson, Effortful Swallow). It was noted that before the interaction term of the pudding \* liquid term is considered it is important to test the liquid and pudding separately against the maneuvers to see if there is any difference. Lastly, Dr. Malandraki wanted each of the sides to be tested separately to account for the case that left and right perform differently for the study. | | |
| **Recommendations for Analysis:**  The plan this semester is to finish and conclude this project by December 2024. To do this, the following recommendations were suggested by Dr. Craig:  Aim 1   * Macy needs to get quantitative values to show that the left and right sides are approximately the same. It was recommended that the consultant provide a numerical summary for the mean and standard deviations of the left and right sides. As well as conduct a test of equivalence to formally test the difference between the sides. This would be done through using confidence intervals for the difference between the left and right sides and seeing how big the gap is between the two.   Aim 2   * The first stage of aim 2 is to compare the mean of the typical swallows (mean\_5ml, mean\_pudding) for each response (BD, AM, TTP) for each side (L, R), against each of the respective maneuver swallows (mean\_effortful\_swallow, mean\_mendhelson). Implement a pairwise testing approach to evaluate the significant difference. Sumeeth should teach Macy how to do this testing for at least one of the pairwise tests, as her advisor wanted Macy to learn the statistics behind her project as well as wanted her to have a deeper understanding of the methodologies. * Fit the model: Response ~ Subject + Task + Subject\*Task + Side + Side\*Task + Side\*Subject + Error.   + Assess if side\*subject is needed to describe the correlation and see if side\*task is significant. If it is significant, compare the tasks within each side, if they are not then only consider the main effects. * Check to see if the mean\_5ml has the same behavior as the mean\_pudding. If this is the case, then repeat the procedure with the interaction average: mean\_5ml\*pudding and see if the results are similar. | | |
| **Who will carry out these actions?**  Client:   * Provide consultant with a cleaned and properly formatted dataset for analysis. * Get more familiar with R programming and pairwise testing.   Consultant:   * Deliver to client the summary statistics and confidence interval results to answer aim 1. * Using one of the responses and sides as a toy example, develop the pairwise testing on the mean to show that the typical swallow average is different than the maneuver average. * Teach client the methodologies behind the analysis. | | |
| **Status:** Follow up meeting needed | | |

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