THE UNIVERSITY OF HONG KONG

香 港 大 學

Laidlaw Undergraduate Research and Leadership Programme
Report Form

Please complete and return this form, together with a research attachment report, to the Horizons Office (laidlaw@hku.hk).
The report must be endorsed by your HKU supervisor.

Name: Lee Hoi Ling

Curriculum: BSc(Speech & Hearing Science)

Year of Study: Year 4

Research Attachment Details:

Institution: The University of Hong Kong

HKU Supervisor: Dr. Karen Chan

Research Topic: Development of technology-assisted swallowing training program for older adults

Attachment Period: 1/7/2022 – 26/8/2022

Report

Please provide two narrative reports of **1000 to 3,000 words or two videos of 3-5 minutes (with sub-titles)** describing the research activities undertaken during your Laidlaw Scholarship and your leadership development journey, which may include but need not be limited to the following:

FIRST REPORT (due by September 30, 2022)

Research

- Brief description summarizing the purpose of the project, hypothesis, methodology, procedures, principal results, and conclusions
- Difficulties encountered and how they were resolved
- Improvements that could be made if the project were to be repeated
- Impacts of the research beyond the classroom
- Suggestions and extensions for further study

Signature: _____ Date: 30/8/2022

Purpose of project

This project aims to develop a technology-assisted/online swallowing exercise program that can be used by participants at their living place so that they can practice more frequently and conveniently. During these two months of research, only data collection and processing targeting healthy adults were conducted due to time limitation. The two main aims of data collection are: 1) using digital imaging to measure the range of motion of the articulators and laryngeal excursion; 2) to assess the differences between clinical subjective judgement on oromotor functions and video analysis. Participants were required to do different oromotor motions in 3 levels, which they were trained to imitate adults with mild and severe oromotor impairment apart from normal level.

Hypothesis

It is hypothesized that digital imaging measurement can obtain significant and reliable results corresponding to oromotor impairments of different severities. Hence, it can act as a reliable assessment tool to determine patient's presence and level of severity of oromotor impairment. Digital imaging measurement might also be merged to future online swallowing exercise program for determining the difficulty of trainings applied to the patient.

Methodology

Participants

A total of 40 healthy adults were recruited openly from the community. This study was conducted from June to August 2022. The inclusion criteria were as follows: (1) aged 18 or above; (2) no cognitive deficit; (3) without showing any signs of previously undocumented dysphagia, neurogenic disorders, and other diseases with a possible influence on swallowing.

Data Collection

Data will be collected with an application that employed the technology of true-depth camera written by the technician of Faculty of Education, which was installed in an iPad Pro. Participants were first introduced with the aim and brief overview of the task. They were then asked to perform 4 different sets of oral motor movements (smiling, cheek, jaw opening and kissing) in 3 different levels (normal with largest energy, mild and severe with lowest energy). Each movement was required to be repeated for 5 times with 1 second break in between for reliable results. To ensure participants truly understand the task and to maintain a high validity of data, there was a practise trial for each movement of different levels.

The videos collected from the app will then generate numerous sets of data of different face movement parameters (e.g., eye blinking, mouth funnel, mouth pucker, eyebrow up/down, cheek puff, nose sneer and so on). Only relevant parameters will be chosen for each movement. The data

will be used as reference for determining the extent of motor movements that patients should be able to achieve with different levels of oromotor ability.

Principal results

Smile

Parameter	Wilks' Lambda F(2, 38)	Normal VS Mild	Mild VS Severe	Normal VS Severe
Mouth Smile Right	F=147.63; p<.001	F=102.483 ; p<.001	F= 187.823; p<.001	F= 294.266; p<.001
Mouth Smile Left	F=168.652; p<.001	F= 90.053; p<.001	F= 192.795; p<.001	F= 311.227; p<.001
Mouth Lower Down R	F= 147.741; p<.001	F= 89.717; p<.001	F= 174.549; p<.001	F= 288.061; p<.001
Mouth Lower Down L	F= 107.687; p<.001	F= 56.809; p<.001	F= 46.369; p<.001	F= 196.696; p<.001
Mouth Upper Up R	F= 94.562; p<.001	F=94.823 ; p<.001	F= 41.614; p<.001	F= 187.622; p<.001
Mouth Upper Up L	F= 91.722; p<.001	F= 93.663 ; p<.001	F= 42.735 ; p<.001	F= 183.962; p<.001
Cheek Squnit R	F= 110.438; p<.001	F= 106.948; p<.001	F=75.971 ; p<.001	F= 221.949; p<.001
Cheek Squnit L	F= 107.105; p<.001	F= 107.963 ; p<.001	F=71.810 ; p<.001	F=107.105 ; p<.001

Kissing

Parameter	Wilks' Lambda F(2, 33)	Normal VS Mild F(1, 34)	Mild VS Severe F(1, 34)	Normal VS Severe F(1, 34)
Mouth Smile Left	F= 3.608; p=.038	F= 6.398; p=.016	F=.778; p=.384	F= 7.332; p=.011
Nose Sneer Left	F= 17.311; p<.001	F= 31.696; p<.001	F= .591; p=.447	F= 26.598; p<.001
Jaw Open	F= 3.439; p=.044	F= 4.616; p=.039	F= 4.811; p=.035	F= 6.716; p=.014
Mouth Close	F= 3.449; p=.044	F= 1.348; p=.254	F= 5.115; p=.030	F= 5.407; p=.026
Mouth Funnel	F= 24.601; p<.001	F= 4.947; p=.033	F= 30.756; p<.001	F= 40.570; p<.001
Mouth Pucker	F= 47.536; p<.001	F= 17.934; p<.001	F= 73.532; p<.001	F= 90.332; p<.001
Mouth Shrug Lower	F= 9.282; p<.001	F= 16.078; p<.001	F= 2.754; p=.106	F= 16.816; p<.001
Cheek Puff	F= 7.373; p=.002	F= 3.415; p=.073	F= 12.473; p=.001	F= 10.798; p=.002
Nose Sneer Right	F= 17.145; p<.001	F= 28.542; p<.001	F= .934; p=.341	F= 28.790; p<.001
Mouth Smile Right	F= 4.072; p=.026	F= 7.386; p=.010	F= .724; p=.401	F= 8.165; p=.007
Mouth Shrug Upper	F= 7.864; p=.002	F= 15.884; p<.001	F=1.154; p=.290	F= 10.013; p=.003

Jaw

Parameter	Wilks' Lambda F(2, 38)	Normal VS Mild F(1,39)	Mild VS Severe	Normal VS Severe
Mouth Lower Down L	F= 126.287; p<.001	F= 76.812; p<.001	F= 137.050; p<.001	F= 258.543; p<.001
Mouth Stretch L	F= 119.842; p<.001	F= 116.685; p<.001	F= 56.298; p<.001	F= 245.788; p<.001
Jaw Forward	F= 46.849; p<.001	F= 1.251; p=.270	F= 94.584; p<.001	F= 40.840; p<.001
Jaw Open	F= 113.112; p<.001	F= 90.077; p<.001	F=112.549; p<.001	F= 231.117; p<.001
Mouth Funnel	F= 4.124; p=.024	F= 5.988; p=.019	F= .108; p=.744	F=7.771; p<.008
Mouth Stretch R	F= 117.639; p<.001	F= 123.448; p<.001	F= 51.495; p<.001	F= 240.812; p<.001
Mouth Lower Down R	F= 118.560; p<.001	F= 78.641; p<.001	F= 133.347; p<.001	F= 243.250; p<.001

Cheek (Right)

Parameter	Wilks' Lambda F(2,7)	Normal VS Mild	Mild VS Severe	Normal VS Severe
Cheek squint left	F=5.880; p=.032	F= 10.496; p=.012	F=3.821 ; p=.086	F=12.439 ; p=.008
Cheek squint right	F=3.535; p=.087	F=4.725; p=.061	F=2.764 ; p=.135	F=8.06 ; p=.022
Mouth pucker	F=15.027; p=.003	F=29.245 ; p=.001	F= 4.464; p=.068	F= 28.999; p=.001
Mouth press left	F=.693; p=.531	F=1.528; p=.25	F=.007 ; p=.937	F=1.498 ; p=.256
Mouth press right	F=.708; p=.525	F=1.552 ; p=.248	F=.007 ; p=.936	F=1.551 ; p=.248
Mouth shrug upper	F=.579; p=.585	F=.663; p=.439	F=.013; p=.912	F=1.313 ; p=.285
Mouth shrug lower	F=1.877; p=.223	F=2.072; p=.188	F=.136 ; p=.722	F=4.241 ; p=.073
Jaw forward	F=1.179; p=.362	F=2.263 ; p=.171	F=1.853 ; p=.210	F=2.471 ; p=.116

Cheek (Left)

Parameter	Wilks' Lambda F(2,7)	Normal VS Mild	Mild VS Severe	Normal VS Severe
Cheek squint left	F= 5.184; p=.042	F=.993, p=.348	F=8.595; p=.019	F=10.677; p=.011
Cheek squint right	F= 4.33; p=.06	F=.672, p=.436	F=9.886; p=.014	F=5.873; p=.042
Mouth pucker	F= 10.91; p=.009	F=10.86; p=.011	F=11.85; p=.009	F= 11.85; p=.009
Mouth press left	F= 1.281; p=.336	F= .909; p= .368	F= .268; p= .619	F= .002; p= .964
Mouth press right	F= 4.33; p=.06	F= .672; p= .436	F= 9.886; p= .014	F= 5.873; p= .042
Mouth shrug upper	F= 0.301; p=.749	F= .357; p= .567	F= .039; p= .848	F= .143; p= .715
Mouth shrug lower	F= 0.063; p=.939	F= .084; p= .779	F= .141; p= .717	F= .113; p= .746
Jaw forward	F= 4.33; p=.06	F= .672; p= .436	F= 9.886; p= .014	F= 5.873; p= .042

**Highlighted boxes are results that are significant*

All selected parameters of "smile" showed significant differences across different levels of severity. While most parameters of "kissing" and "jaw" also showed significant results across different levels. However, "cheek" has the least number of parameters (two) that showed significant results.

Conclusions

The results indicated that digital imaging is feasible in automatically tracking the performance of oromotor movements of different severity levels. Hence, it is also possible to provide instant feedback for participants in understanding their own performance.

The following is a summary of parameters that can be used for tracking participant's performance:

Smile	Kissing	Jaw	Cheek
1. Mouth smile R 2. Mouth smile L 3. Mouth lower down R 4. Mouth lower down L 5. Mouth upper up R 6. Mouth upper up L 7. Cheek squint R 8. Cheek squint L	1. Mouth smile R 2. Mouth smile L 3. Nose sneer R 4. Nose sneer L 5. Jaw open 6. Mouth close 7. Mouth funnel 8. Mouth pucker 9. Mouth shrug lower 10. Mouth shrug upper 11. Cheek puff	1. Mouth lower down R 2. Mouth lower down L 3. Mouth stretch L 4. Jaw forward 5. Jaw open 6. Mouth funnel 7. Mouth stretch R	1. Cheek squint L 2. Mouth pucker

Difficulties and how to resolve

The first difficulty was about participants recruitment, as it became harder due to the pandemic situation. As the data collection process requires participants to take off their mask, some people might have concern about it and refuse to conduct the video taking process.

Another barrier was regarded about the subjectivity of the extent of movements of each level. As different participants have their own perception regarding the degree of movements, especially in terms of mild and severe level. Hence, it might lead to some discrepancy between the participants' movement results. To prevent having a large discrepancy, demonstration was done for each movement before recording to ensure participants have a uniformed standard.

Moreover, the data of "cheek" movement was non-significant between the 3 levels during the first round of data collection. It is hypothesized to be due to its greater difficulty as participants have to move their tongue from their left to right cheek which requires more energy. The difference between the degree of movements among levels and rest time hence decreases. As a result, data of cheek movement had to be retaken. To minimize the results to be non-significant again, we have adjusted to separately record sticking tongue to cheek left and right respectively so that the difference between the movement and rest time is more obvious.

Improvements

As the difference between the oromotor movements of different severities might be too abstract for participants. Confusion might still exist when participants perform the actions and hence lowered the validity of results. Therefore, if the project were to be repeated, further task explanation and more practice trials will be done especially for mild and severe levels of impairment.

Impacts of research

The findings of this research can assist us in developing an assessment tool or even training tool for adults with oromotor disability. Not only is it more cost and time effective for clients with oromotor dysfunctions as they would not have to travel a long way to clinics for treatment, so they can receive trainings with higher frequency. This tool might also help discover elderly with suspected oromotor dysfunction, so that they can receive speech therapy at an earlier time.

Moreover, participants could also benefit from the project through gaining knowledge regarding the difference of levels of motor impairment. Participants might also learn more about the function and importance of different oromotor muscles and exercises in maintaining good swallowing functions. The simple yet effective exercises learnt in this project can be practiced in their daily life for maintaining their oromotor functions.

I have also gained a lot of fruitful experience through conducting this project. For example, how to provide a simple and understandable task instructions to the participants; explain the importance of oromotor exercise; different data processing skills using SPSS and so on. These skills are some hands-on skills that I could not learn from textbooks or lectures, but only from real-life experiences. They are definitely some useful skills that I can apply on my future clinical experience and research.

Suggestions and extensions

In the future, this study could be carried out in a larger scale through including greater variety of oromotor movements so that more swallowing-related muscles can also be trained to achieve a better outcome for swallowing. Participants with oromotor dysfunctions could also be invited to provide data to ensure the previously collected data are applicable to patients with actual impairments of different levels.

For the online training program, it is suggested to combine some interactive games such as dart throwing for instant biofeedback. Patient has to reach certain degree of movement in order to throw the dart to desired position. By combining the exercise with games, it is believed to enhance patient's motivation in doing training so that they can receive greater amount of trainings even when they could not meet their speech therapist often.

TO BE COMPLETED BY HKU SUPERVISOR

I have examined the research report and rate the student's performance as satisfactory / unsatisfactory (*Please circle whichever is applicable*)

Comments:

Jasmine, Lee Hoi Ling, has shown excellent performance throughout the project. She is a fast learner, responsible and took the lead in throughout the project period. The project is completed with success, Jasmine actively participated in project design, data collection, analysis and write-up. We are currently working towards publishing the project in international peer-reviewed journal.

I am confident that Jasmine will continue to excel in her academic studies and will be a successful researcher in the future.

Name: ___Karen Chan_____ Signature: _____ Date: ___20 Sept 2022