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:	Chung Chui Shan
Curriculum:	BSc (Sp&HearSc)
Year of Study:	3
Research Attachment Details:	
Institution:	The University of Hong Kong
HKU Supervisor:	Dr. Karen Chan
Research Topic:	Feasibility of face recognition technology in assisting swallowing rehabilitation
Attachment Period:	1/7/22-31/8/22

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

SECOND REPORT (due by August 30, 2023)
Leadership Development

- What was done to build leadership capability
- Action taken and experience gained to practice leadership
- Critical skills identified and developed for success in your future career
- Further experiences and development approaches that will best position you for your career

Overall Experience

- Reasons for undertaking the Laidlaw programme at the start
- What did you gain from the overall programme? The research experience, leadership training, networking and any other aspect you wish to comment on.
- Will the programme help you in the future and if so in what ways?
- Are there aspects of the programme that you think can be improved? And if so, how?
- Are you prepared to "give back" to the programme in the future by being an active alumnus?

Signature:_____ Date: 21/9/22

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:

Name: _____ Signature: _____ Date: _____

Purpose

The purpose of the project is to explore the technology which could be used to assist swallowing training for older adults. We investigated the feasibility of using visual feedback in training the oral motor functions of healthy older adults. Dysphagia is a growing concern in an aging society such as Hong Kong. Oral motor functions, such as lips closure and tongue mobility, are essential for swallowing. Swallowing muscles weaken and oral motor functions decline with age. Dysphasia could possibly lead to malnutrition, dehydration, aspiration pneumonia, and even death. To improve the swallowing functions of adults, it is important to develop relevant technology to assist swallowing training for them.

Hypothesis

We hypothesized that the technology would be feasible for assisting swallowing trainings in older adults, hence improving their swallowing functions.

Methodology

The project took place in Hong Kong from July 2022 and August 2022. The focused population was the healthy adults. 40 healthy adults were recruited to participate in the programme. The selection criteria of participants included not having self-reported speech problems or swallowing problems or impaired oromotor function; aged 18 or above; not having previous diagnosis of diseases in the head and neck or any dental deformities; not having previous diagnosis of neurological diseases (e.g. stroke, Parkinson's disease and multiple sclerosis), chronic respiratory diseases, heart disease or high blood pressure; not having difficulties in following the assessment procedures.

Procedures

Participants were invited to perform 4 oral-motor tasks and their performances were video-recorded. The four oral-motor tasks included kissing (lip protrusion, imagining kissing someone), smiling (lip retraction), jaw opening (opening the mouth), and cheek (using the tongue to push the left side and right side of the cheek from inside of the mouth). IPad Pro that captured at 300 frames per second was used to take the videos. The IPad Pro was placed in front of the participants in a stable position. The distance between the IPad and participants was adjusted accordingly to get the full view of their mouth and face. The 4 oral-motor tasks were performed three times by the participants after a practice trial. Standardized instructions and demonstrations were given for each task. Participants were trained to perform the tasks in three different levels, including using the maximum force (normal level), a relatively weaker force (mild impairment), and the minimum force (severe impairment) such that the tasks could barely be done. Participants practised with data collectors to ensure the validity of the data. Participants were allowed to take a rest upon request.

Data collection

Data was collected with an application employing the technology of true-depth cameras written by the technician in the Faculty of Education. The application was installed in the IPad Pro used for video-taking.

Statistical analysis

Repeated measures analysis of variance models were used to assess the feasibility of the face recognition technology in tracking and identifying different impairment levels. Performances of the oral motor tasks were measured using theoretically relevant parameters respectively. A normal P-value of .05 was regarded as being statistically significant.

Principle results
For jaw opening, the differences between different impairment levels of the following parameters were significant among all impairment level: mouth lower down left ($p<.001$), mouth lower down right ($p<.001$), mouth stretch left ($p<.001$), mouth stretch right ($p<.001$).
For lip protrusion (kissing), the differences between different impairment levels of the following parameters were significant: jaw open ($p<.05$), mouth funnel ($p<.05$), mouth pucker ($p<.001$).
For lip retraction (smiling), the differences between different impairment levels of the following parameters were significant: mouth smile right ($p<.001$), mouth smile left ($p<.001$), mouth lower down right ($p<.001$), mouth lower down left ($p<.001$), mouth upper up right ($p<.001$), mouth upper up left ($p<.001$), cheek squint right ($p<.001$), check swung left ($p<.001$).
For cheek, the differences of all parameters were not significant ($p>.05$) among all impairment levels.

Conclusion
To conclude, the findings indicate that it is feasible to automatically track and identify different performance levels. To further assess the feasibility of the face recognition technology in assisting swallowing rehabilitation, the face recognition technology could be applied to real patients with swallowing difficulties in future studies. The development of gamification of oral motor exercise could also be facilitated by the face tracking technology in future studies.

Difficulties encountered and resolution
After collecting the data, we found that the programme we used could not segmentate one of the movements we were investigating. This movement required participants to use their tongue to touch their left cheek and right cheek. At first, we asked the participants to do on the left side, then on the right side, which would be counted as one time of complete movement. The participants were asked to do it for five times and recorded as the same video. As the computer programme could not segmentate it, we decided to change the way to record this movement. We first asked the participants to use their tongue to touch their left cheek for five consecutive times, recording it as one video. Next, we asked the participants to use their tongue to touch their right cheek for five consecutive times, recording it as another video. In this way, we could analyse the data as we planned originally.

However, it brought inconvenience to our participants, especially during the pandemic. We did not realise the problem with the data until we tried to process the data after collecting it from all of the participants. We had to contact our participants and ask them to do this movement for us again. Not only did it bring inconvenience to our participants, but also slow down the progress of our project. If the project would be repeated, I would try it out once by myself first before asking the participants to do it for me. This would enable me to figure out the possible problems with data collection and data processing and solve the problems before carrying it out in a larger scale. Hence, the project would be done more efficiently.

Impacts of the study
In this project, we carried out the tasks on healthy adults. The impacts on the population with disabilities or disorders such as swallowing impairment are yet to be known. Still, healthy adults who participated in this project would gain more knowledge of oral motor exercise. Using the face tracking technology, it would be possible to make swallowing intervention and oral motor exercise more accessible to the general public. Swallowing rehabilitation conducted by speech therapists could be costly. Assisted by the technology, swallowing rehabilitation could be with higher cost efficiency and time efficiency.

Extensions for further study

Further studies could be carried out to investigate the results of the exercise on the population with certain disabilities or disorders. Moreover, the transferability of the exercise to the overall swallowing abilities remains unknown. It is suggested that follow-up swallowing assessments could be carried out to examine whether the participants have improvements in swallowing after completing the exercise. Furthermore, participants may lack the motivation to keep up with the swallowing on a regular basis. More biofeedback programmes could be designed to increase the motivation of them to do the exercise regularly.