Virtual Evaluation of Speech Recognition in Noise with Live Listen Feature on the iPhone

Kortney Bush, B.S. and Linda Thibodeau, Ph.D.

The University of Texas at Dallas

School of Behavioral and Brain Sciences

Introduction

Persons with atypical hearing often have trouble listening in background noise, which leads to social isolation and may explain why hearing loss is a negative predictor for employment.[1,2] The greater the degree of hearing loss and intensity of the background noise, the more difficulty the person will have communicating with others.

Possible solutions:

1. Remote Microphone Technology
2. Smartphone features (i.e., Live Listen on the iPhone)

As a result of COVID-19, global connectivity and access to services from a distance is more important than ever. Previous work has shown no significant differences exist between face-to-face audiological evaluation and remote audiological evaluation.[3,4] However, little is known about remote aural rehabilitation, specifically the use of remote microphones and smartphone features, such as Live Listen, to improve communication.

iPhone Feature – Live Listen

- Built-in feature
- Utilizes Apple airPods
- Picks up the target signal obtained by the microphone on the iPhone and routing it directly to the airPods
- AirPods attenuate the surrounding background noise
- Increases the signal-to-noise ratio.

Purpose

1. Provide a foundation for future research in virtual access to aural rehabilitation services
2. Facilitate ongoing collaboration with the engineering department regarding development of smartphone applications for persons with hearing loss

Figure 1. Setup

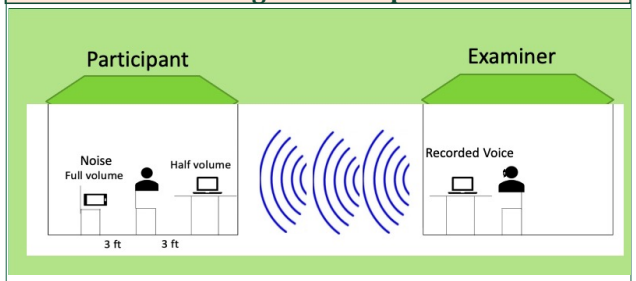

Figure 1. Setup for virtual evaluation for the examiner and participant.

Materials and Methods

Equipment

The protocols in this study were developed to collect data remotely using:

- Amazon 7 generation Fire Tablet (provided by mail)
- Personal Apple Macbook Laptop
- Personal Apple iPhone
- Personal Apple airPods
- Webex Virtual Platform

Setup

As shown in Figure 1, the participants were instructed to:

- Set their personal Macbook laptop at half volume, three feet in front of them.
- Set the Amazon Fire Tablet at full volume, three feet behind them with speaker facing the participant.
- Set the iPhone on the mousepad of the Macbook laptop in between the laptop speakers with the microphone facing forward.

Task

Participants underwent two listening conditions with HINT sentences presented in front while noise[5] played from behind:

1. Utilizing the Live Listen feature with airPods and,
2. Utilizing the computer speakers and no wireless technology.

Two recorded HINT sentence lists[6] were presented per condition by the researcher in the remote location.

Participants

- n=10
- Normal hearing
- Age range: 21-25 years

Instructions and Scoring

- Participants were given instructions:
  - How to set up Live Listen
  - How to set up the testing area
  - Repeat the sentences or guess if they were unsure
- Responses were scored by the number of words correct by the examiner in real time
- Total percent of words correct per two sentence lists was calculated

Additional Instructions and Conditioning

- All participants were presented one HINT sentence list for practice
- If the task was too difficult or too easy, the participant was instructed to adjust the volume on their laptop higher or lower, respectively.

Results

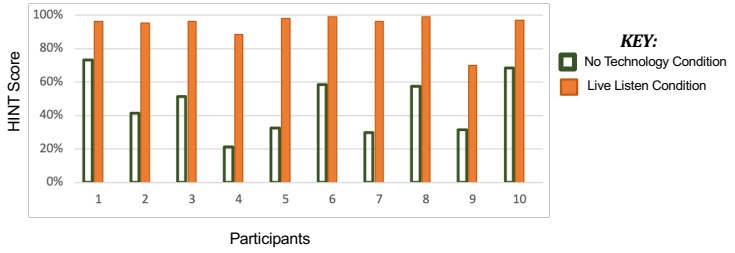

Figure 2. Performance on HINT Sentences for Live Listen Condition versus No Technology Condition

Speech recognition performance on HINT sentences for each condition is shown in *Figure 2*. The results of this pilot study showed a significant difference between the scores for the Live Listen ($M = 93.6\%$, $SD = .09$) and the No Technology ($M = 46.6\%$, $SD = .18$) conditions ($t(9) = 9.43$, $p < .001$).

- All participants scored better in the Live Listen condition.
- 9/10 participants preferred the Live Listen condition over the No Technology condition.
- 9/10 participants reported that they were unaware of the iPhone Live Listen feature.

CONCLUSION

Due to COVID-19, the demand for virtual access to hearing health care is more important than ever. The results of this study show a potential methodology for delivering aural rehabilitation services remotely, specifically, speech performance in noise when using remote microphones.

These findings provide a foundation for future research in remote access to aural rehabilitation services and facilitated ongoing collaboration with the engineering department at the University of Texas at Dallas regarding development of smartphone applications for persons with hearing loss. More research is needed to establish if this is an effective method of evaluating speech recognition in noise virtually.

Limitations

Limitations included the small sample size, the required mailing of the fire tablet, internet connectivity and lack of control of ambient noise.

ACKNOWLEDGEMENTS

This work was funded by the University of Texas at Dallas Master's Research Fellowship Summer Program 2020.

REFERENCES

[1]National Research Council (US) Committee on Disability Determination for Individuals with Hearing Impairments (2004) Hearing loss: determining eligibility for social security benefits. *National Academies Press*, Impact of Hearing Loss on Daily Life and the Workplace, 6.

[2]World Health Organization (2017). Global costs of unaddressed hearing loss and cost-effectiveness of interventions. *A WHO Report 2017*

[3]Swanepoel, D.W., Koekemoer, D., & Clark, J. (2010). Intercontinental hearing assessment – a study in tele-audiology. *Journal of Telemedicine and Telecare*, 16(5), 248-52.

[4]Swanepoel, D. & Clark, J. (2019). Hearing healthcare in remote or resource-constrained environments. *Journal of Laryngology and Otology*, 133(1), 11-17.

[5]Thibodeau, L. (2020). Classroom *Noise File*. Hearing Health Lab. Retrieved from https://www.utdallas.edu/hhlab/resources-and-publications/clinical-tools/

[6]Nilsson, M., Soli, S. D., & Sullivan, J. A. (1994). Development of the Hearing in Noise Test for the measurement of speech reception thresholds in quiet and in noise. The Journal of the Acoustical Society of America, 95(2), 1085-1099. https://doi.org/10.1121/1.408469