

Virginia E. Land, B.S. & Linda Thibodeau, Ph.D.
The University of Texas at Dallas

INTRODUCTION

It is well known that assistive technology can be of great benefit when trying to understand speech in noisy environments (Thibodeau, 2014). A commonly reported challenge for persons with hearing loss is dining in noisy restaurants. The Phonak wireless digital transmitter, known as the Roger Pen, has a sensitive microphone array system that is designed to improve the signal-to-noise ratio (SNR) in noisy environments. An accelerometer within the directional microphone determines the optimal response pattern depending on the position of the microphone in space. The Roger Pen may improve speech recognition in noisy restaurants when placed in the center of a group dining table.

RESEARCH QUESTIONS

Does sentence recognition in noise improve for participants with normal and impaired hearing who use a Roger Pen wireless system when the signal is coming from multiple locations in a simulated restaurant arrangement?

METHODS

- Subjects: 9 normal hearing (NH), ages 21 to 72 years
9 hearing impaired (HI), ages 22 to 55 years
- All HI had bilateral sensorineural hearing loss as shown in Figure 1
 - Pure-tone averages ranged from 26.6 to 76.6 dB HL
 - All were experienced hearing aid (HA) users

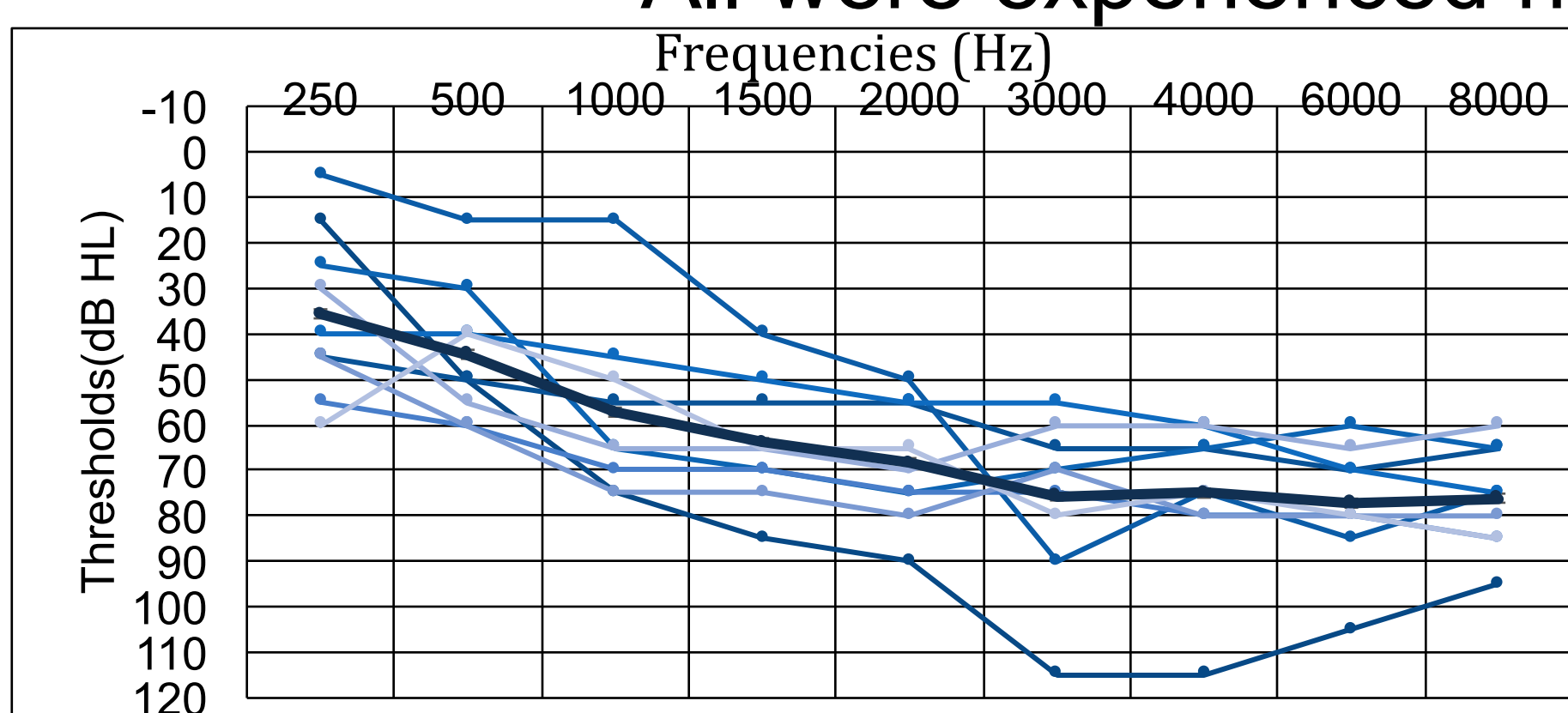


Figure 1. Hearing thresholds of the better ear for participants with hearing loss. The average is represented by the bold, black line.

Equipment:

- Phonak Wireless Digital System (see Figure 2)
- Naida v90 UP hearing aids with ML18i Roger receivers
- Roger Pen transmitter set in Omni-Directional Mode
- Five Fostex 6301 B3E speakers
- Two HDMX JAM wireless speakers
- Focusrite Scarlett 18i20 External Soundcard with Cubase LE AI Elements 8 software



Figure 2. Phonak Naida v90 UP hearing aid with integrated FM receiver and Phonak Roger Pen.

Hearing Aid Fitting:

- Bilateral Phonak Naida HAs programmed in Sound Flow and coupled with either comply tips or personal ear molds
- NAL-NL1 target outputs determined via Verifit Audioscan Hearing Instrument Fitting System
- Gain and maximum output verified with real-ear measures were within 3 dB of the targets for each participant with hearing loss or a flat 10-dB HL representation of normal hearing.
- Electroacoustic measures using the Verifit confirmed the HAs were within expectations for normal function based on ANSI S3.22 measurements

TESTING PROCEDURE

- Five speakers were situated at 300-, 330-, 0-, 30-, and 60-degrees azimuth to the participant as shown in Figure 3. HINT ten-sentence lists were presented randomly from one of the five speakers around the table at 60 dB SPL.
- Restaurant noise was played from two speakers at 80- and 160-degrees azimuth.
- To avoid ceiling/floor effects, SNR was increased or decreased so that performance was within a 50 to 80% range and then remained there for the testing of the technology conditions. SNR ranged from 0 to +5 dB for HI and -5 to 5 dB for NH.
- Participants repeated HINT sentences in two conditions: 1) HA only, and 2) HA+Roger Pen placed horizontally in the middle of the table facing away from the participant.

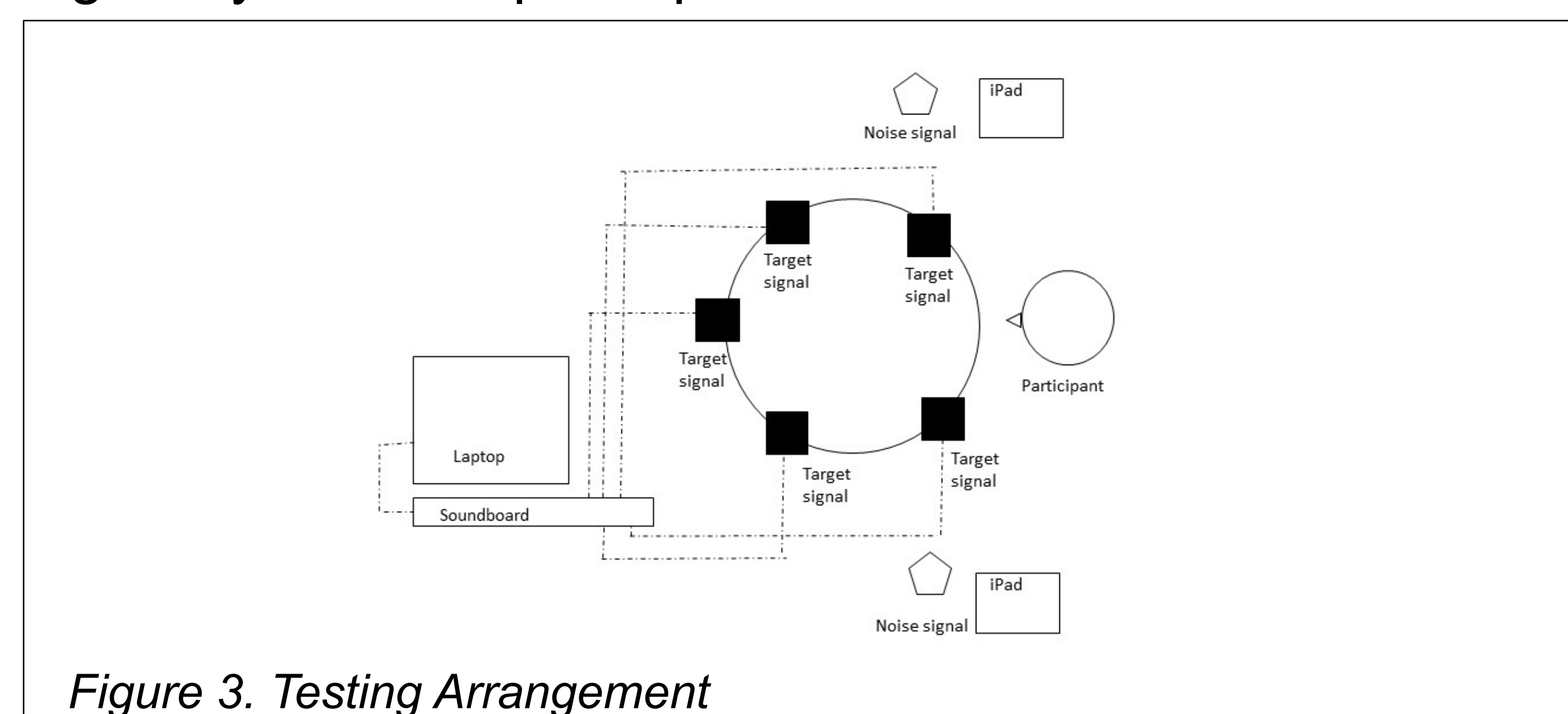


Figure 3. Testing Arrangement

RESULTS

Percent correct scores were determined for sentence recognition with HA only and with HA+Roger Pen as shown in Figure 4. Prior to statistical analysis, the scores were arc sin transformed to account for unequal variance in percent correct data (Sherbecoe & Studebaker, 2014). The benefit in speech recognition when using the Roger Pen was determined by subtracting the score obtained in HA-only condition from the score obtained in HA+Roger Pen condition. The average benefit was 18% (range 6 to 42%) and 14% (range -8 to 32%) for HI and NH, respectively. There was no significant difference between the benefit achieved by the two groups ($t(16)=0.75, p>0.05$).

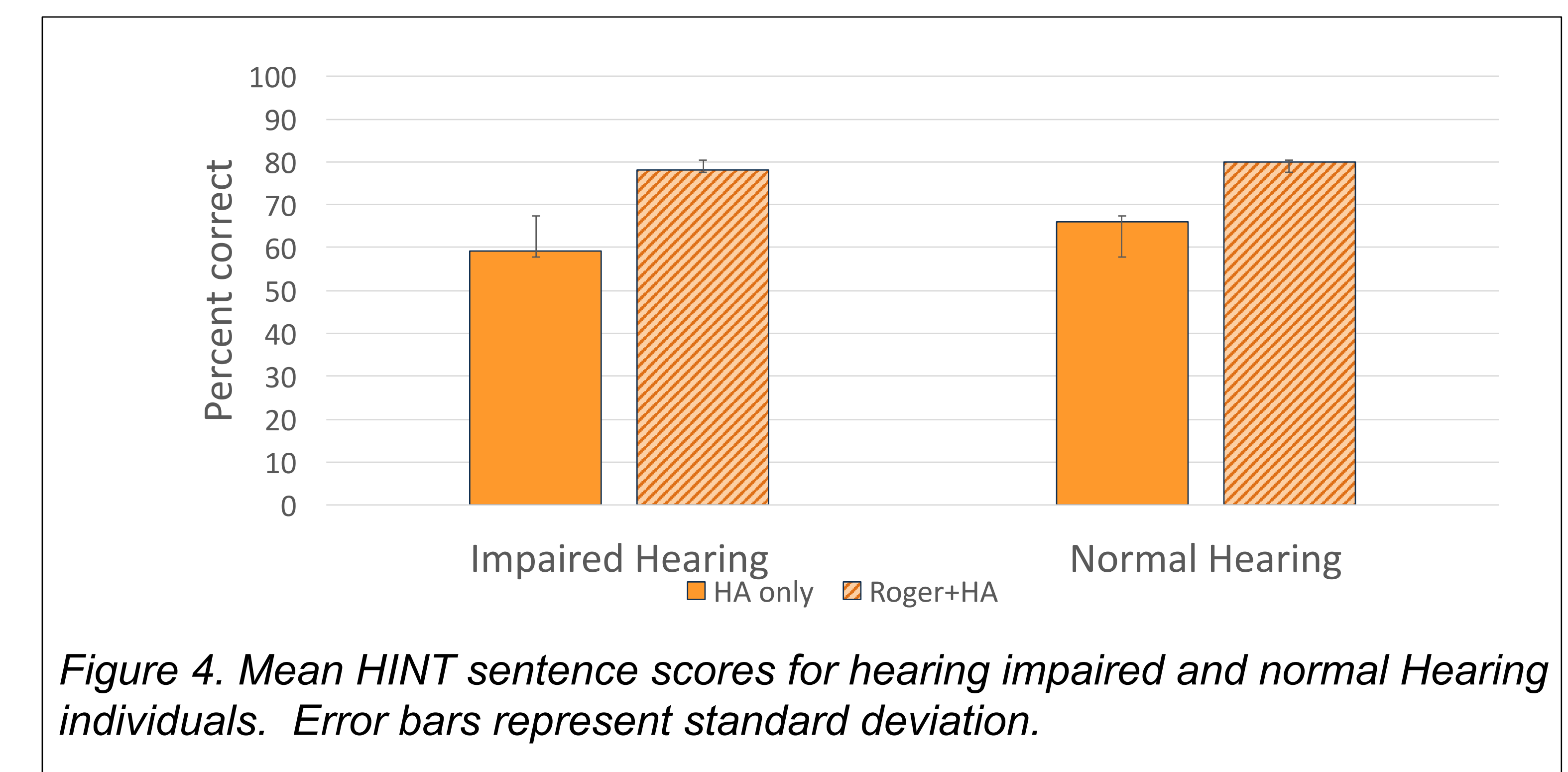


Figure 4. Mean HINT sentence scores for hearing impaired and normal hearing individuals. Error bars represent standard deviation.

SUMMARY

The use of a Roger Pen and Roger Receiver integrated with behind-the-ear hearing aids provided a 14 to 18% benefit in sentence recognition in noise for participants with normal and impaired hearing, respectively. This improvement is considered clinically significant. The use of the Roger wireless technology would reduce the challenges faced by persons with hearing loss in social settings when there are multiple speakers.

REFERENCES

- Sherbecoe, R. L., & Studebaker, G. A. (2004). Supplementary formulas and tables for calculating and interconverting speech recognition scores in transformed arcsine units. *International Journal of Audiology*, 43, 442-448.
- Thibodeau, Linda. (2014). Comparison of speech recognition with adaptive digital and FM remote microphone hearing assistance technology by listeners who use hearing aids. *American Journal of Audiology*, 23(2), 201-211.

ACKNOWLEDGEMENTS

Appreciation is expressed to Zachary Jernigan for assistance with programming and equipment setup.

