Phonak
Field Study News

Benefits in speech recognition in noise with wireless remote microphones in a simulated group setting for adults with hearing loss.

This study was designed to evaluate the potential benefits in speech recognition in noise for adults with hearing loss. Two different wireless remote microphones were compared to the use of a hearing aid or cochlear implant alone. When using the adaptive remote microphone technology in Roger™, participants experienced significant improvements in speech recognition in noise: up to 61% with the Roger Select™ and up to 45% with the Roger Pen™, versus the use of a hearing aid or cochlear implant alone in a simulated group setting.

Dr. Linda M. Thibodeau & Solange Anderson, MS / August 2019

Introduction

Individuals with hearing loss often report experiencing significant difficulties listening in noisy environments despite well-fit and sophisticated hearing aid- and cochlear implant technology. Although there have been advances in directionality and noise reduction, a common challenge for adults with hearing loss is a group situation in a noisy restaurant.

In such an environment, the impact of multiple speakers, background music, clanging dishes and cutlery can easily raise the noise levels to 75 dB A or higher. Such noise levels create poor or negative signal-to-noise ratios (SNRs) which make the dining experience less pleasurable.

Evidence demonstrates that improving the SNR through wireless microphone technology can have a significant impact on speech understanding in these difficult listening situations (Boothroyd, 2004, Hawkins, 1984, & Thibodeau, 2010, 2014).

Additionally, significant benefit has been observed with the use of directional microphone technology within remote microphones, as opposed to omnidirectional microphone technology (Lewis *et al.*, 2004).

When there are two persons dining together, a single microphone clipped onto the communication partner can significantly improve the SNR. However, when there are multiple speakers with individuals speaking at different times, this single microphone is not enough.

Roger wireless microphones can be linked together to create a MultiTalker Network giving access to multiple speakers, each wearing a microphone. De Ceulaer *et al.*, 2016 evaluated the benefits of a MultiTalker Network in a group setting with cochlear implant users. They found the use of multiple wireless microphones in different SNRs resulted in significant listening advantages over a single microphone.

While a network of multiple microphones has a positive impact on group communication in noise, this approach can introduce some unintended negative side effects. Such effects can include the additional cost for more microphones, handling potential objections from speakers to wearing a microphone, retrieving microphones back and the listener having no control over how the microphones are handled by speakers – this may make the situation uncomfortable and awkward.

A simple approach to handle such objections is to place a microphone in the center of the table to pick up multiple speakers and help improve speech recognition. For example, the Phonak Roger Select, designed for group conversations (Gigandet, Fulton, & Smith, 2018), microphone has three omnidirectional microphones arranged in a triangular configuration to create an adaptive directional microphone system. This microphone configuration utilizes MultiBeam Technology to automatically select the optimal beam to activate based upon the speaker with the highest SNR. Additionally, the listener can have control over MultiBeam microphone behavior by manually selecting one or more beams in order to focus on listening to one or more speakers.

The Roger Select, as a single wireless microphone can be used in small groups around a table and could potentially be a more feasible and economic approach to using a MultiTalker Network.

The main objective of this study was to compare the potential benefits in speech recognition in noise when using the Roger Pen or Roger Select as a single remote microphone compared to using no remote microphone in a group listening environment.

Methodology

Participants

Ten participants between the ages of 20 and 92 with bilateral sensorineural hearing loss took part in the study. Eight participants wore bilateral hearing aids (HA). The pure-tone audiogram of the better ear for the participants wearing hearing aids, can be seen in figure 1. Two participants had cochlear implants (CI) one was unilateral and the other was bilateral. All participants had more than two years of amplification experience and half of the group had more than five years of experience with remote microphone technology.

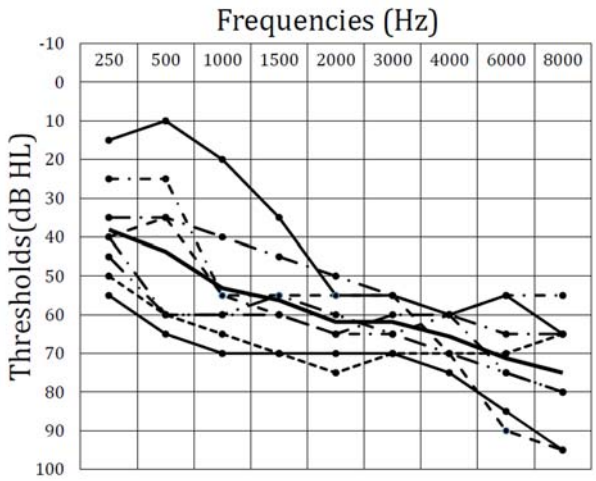

Figure 1. Pure tone audiogram of better ear for participants with hearing aids

Hearing technology

Six of the eight participants wearing bilateral HAs were fit with Phonak Naída V SP or UP with design-integrated Roger receivers. The remaining two participants used their own Phonak hearing aids with compatible design-integrated Roger receivers. All hearing aids were programmed and verified with real ear measures to NAL-NL1 targets (Byrne *et al.*, 2001). The two participants with cochlear implants used universal Roger X receivers attached via the euro adapter.

Two wireless remote microphones, Roger Select and Roger Pen, were used in different noise levels while speech recognition was measured in a simulated group setting.

Test set-up & procedures

Participants were asked to repeat HINT sentences (Nilsson, Soli, & Sullivan, 1994) in noise, and speech

recognition was measured as a percent correct score in three different listening conditions:

- HA or CI alone
- HA or CI + Roger Pen
- HA or CI + Roger Select

In each of these listening conditions, speech was presented randomly from one of the five speakers (figure 2). Speech was held at a constant 65 dB A measured at the location of the participant while restaurant noise levels were adjusted to create four signal-to-noise ratios of +5, 0, -5 and -10 dB to simulate a group dining experience.

For the listening situations where the remote microphones were used, a single Roger Select or Roger Pen was placed in the center of a table while participants listened via their wireless Roger receivers.

To evaluate the effect of individuals raising their voices in background noise, an additional speech recognition measurement was conducted. Speech was presented at 70 dB A at the highest noise level of 75 dB A and speech recognition was again measured in the three listening conditions.

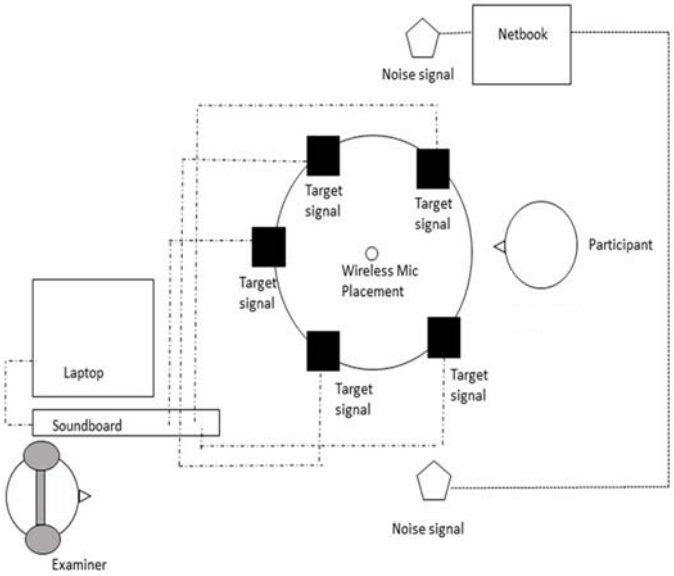

Figure 2. Test set-up – the target signal (speech) was randomly presented at a constant 65 dB A level while restaurant noise was presented at 90° and 270° and adjusted to different SNRs

Results

The effects on speech recognition in different listening conditions and between microphone technology and noise level are shown in Figure 3.

Following arcsine transformation, the data were analyzed using a two-way, repeated-measure ANOVA for the four noise levels and three listening conditions. There was a significant main effect for microphone technology (df = 2, p<.0001), noise level (df=3, p<.0001), and a significant interaction (df=6, p<.05) demonstrating the impact on speech recognition in the different listening situations in noise.

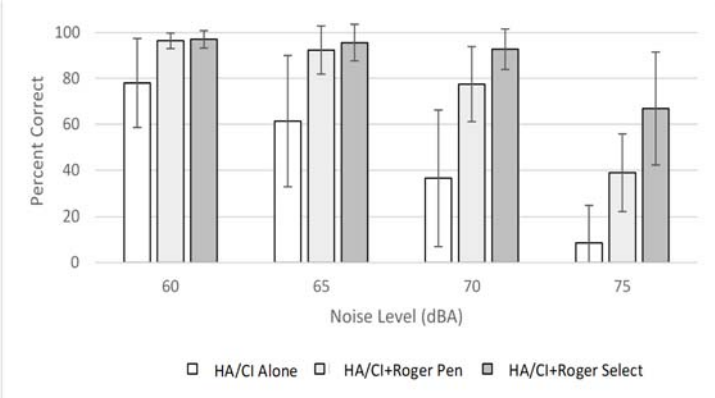

Figure 3. Mean HINT sentences scores across noise levels vs listening condition

Figure 4 shows the benefit in speech recognition from the two wireless remote microphone technologies comparing the listening situation with speech presented at 70 dB A (-5 dB SNR) vs speech presented at 65 dB A (-10 dB SNR) in 75 dB A noise. The results in the -5 dB SNR condition demonstrate participants performed an average of 61% better with the Roger Select and an average of 45% better with the Roger Pen than with HI or CI alone.

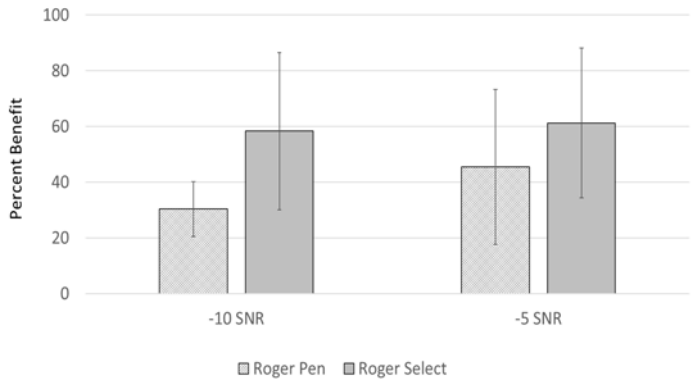

Figure 4. Average benefit in HINT sentence scores when using remote microphone technology at -5 and -10 dB SNR in 75 dB A noise. Benefit was determined by subtracting the score from the HA or CI alone from the score when the remote microphone was used.

Conclusion

Despite significant advancements in amplification technology, adults with hearing loss still encounter difficulties communicating in noise, especially where multiple speakers are present. The focus of this study was to evaluate the potential benefits in speech recognition in noise for two different types of remote microphone technologies - Roger Select and Roger Pen - compared to the use of a hearing aid or cochlear implant alone in a multi-talker situation.

When using the adaptive remote microphone technology in Roger, participants experienced an average improvement in speech recognition in noise of up to 61% with the Roger Select and up to 45% with the Roger Pen compared to the use of a hearing aid or cochlear implant alone. Therefore, these results demonstrate that the introduction of remote microphone solutions address the challenges which adults with hearing loss face in dynamic listening situations. These remote microphones are capable of significantly improving speech recognition in noise and minimizing the social barriers when there are multiple speakers present.

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