Hear Better, Anywhere: StarLink Edge Remote Microphone and Table Microphone

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Key takeaways:

- The addition of StarLink Edge Remote Microphone and StarLink Edge Table Microphone completes the accessory product family, offering two options for audio streaming in complex listening environments. This enhancement also provides greater flexibility in accessory selection for patients wearing Vitality AI and Aris AI hearing aids.
- Each of the streaming microphones provide an improved signal-to-noise (SNR) ratio benefit when tested in a laboratory environment.
- The StarLink Edge Table Microphone provides improved perceived speech understanding when used in Automatic Mode over Directional Mode when speakers are coming from a variety of directions in a laboratory environment.

Introduction

The innate variability of listening environments often poses significant challenges for individuals with hearing loss. While advances in hearing aid technology have made it easier to manage difficult listening situations, accessories can offer additional improvements in signal-to-noise ratio (SNR), providing critical support for those who continue to struggle. Audibel's StarLink Edge Remote Microphone and StarLink Edge Table Microphone offer an improved SNR over hearing aids alone when tested on participants in a laboratory setting. Furthermore, the StarLink Edge Table Microphone demonstrated enhanced perceived speech understanding when used in Automatic Mode, particularly in scenarios where speakers were positioned in multiple directions, compared to Directional Mode.

Remote Microphone

The StarLink Edge Remote Microphone *(Figure 1)* is a rechargeable accessory designed to enhance speech understanding in challenging listening environments, streaming a speaker's voice directly to the user's hearing aids.

Its adaptive design features three directional microphones that automatically adjust based on orientation—switching to directional mode when worn and omnidirectional mode when laid flat for group conversations. Additionally, the device doubles as a remote control, allowing users to adjust volume or switch hearing aid programs even when the microphone is turned off.

Figure 1: Image of the StarLink Edge Remote Microphone.

Table Microphone

The StarLink Edge Table Microphone *(Figure 2)* is a versatile, rechargeable accessory designed to enhance speech understanding in group settings. This accessory features eight built-in microphones, streaming audio directly to the user's hearing aids. When placed in Tabletop mode, the Table Microphone defaults to Automatic Mode, where five segments light up blue and dynamically follow the main speaker. In addition to Automatic Mode, the user can manually tap the segments to switch to Manual or Surround Mode. The user can select between one to eight segments to determine which microphones are active, depending on the listening environment and the signal of interest.

The Table Microphone can also be used as a remote microphone when worn by a conversation partner. The device comes with a lanyard which magnetically connects to the back of the accessory. Once in this vertical position, the directional microphones automatically point upwards towards the mouth of the conversation partner.

Figure 2: Image of StarLink Edge Table Microphone, set with all 8 microphone segments active.

Participants

Nineteen hearing-impaired participants (14 males, 5 females; mean age: 71 years [range: 60 to 83 years]) with primarily sensorineural hearing loss (see mean audiometric data in Figure 3) participated in two laboratory studies: one assessed the objective performance of both accessories, while the other evaluated the perceived benefit of the Automatic settings of the StarLink Edge Table Microphone.

All participants were fit with Aris AI 24 mRIC R hearing aids with audiometrically appropriate acoustic coupling and fitted with Audibel's proprietary e-STAT 2.0 fitting formula. For the laboratory testing, audio streaming settings were set to 'Best Fit' in Pro Fit and default streaming volume settings were used. Additionally, the hearing aid microphones were set to 'Mic Off' in the accessory streaming settings to ensure participants heard only the audio from the accessory, with no sound coming through the hearing aid microphone path.

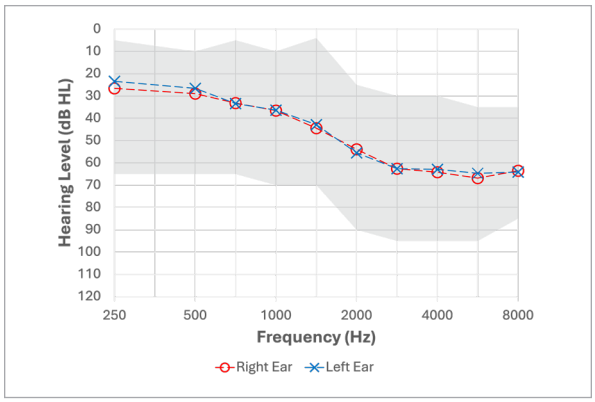

Figure 3: Mean and range of audiometric values for all participants.

Study 1 Procedures

In the first study, participants were tested using the Hearing In Noise Test (HINT) *(Nilsson et al. 1994)* to determine the signal-to-noise ratio (SNR) needed to correctly understand 50% of the sentences across three different counter-balanced conditions: Hearing Aids alone, Table Microphone (on the table 3 feet from the front speaker), and the Remote Microphone (clipped in a position to simulate being worn by the front speaker), see Figure 4. Uncorrelated speech-shaped noise played from the four corner speakers, at a summated level of 64 dBA. Twenty sentences (trials) were completed for each test condition, with the speech level increasing after an incorrect repetition and decreasing after a correct one.

The initial four trials in each condition were conducted using a 4 dB step size, after which the step size was reduced to 2 dB for the remaining trials. Results are reported as the SNR in dB needed for the participant to repeat 50% of the sentences correctly, with negative (lower) values indicating better results.

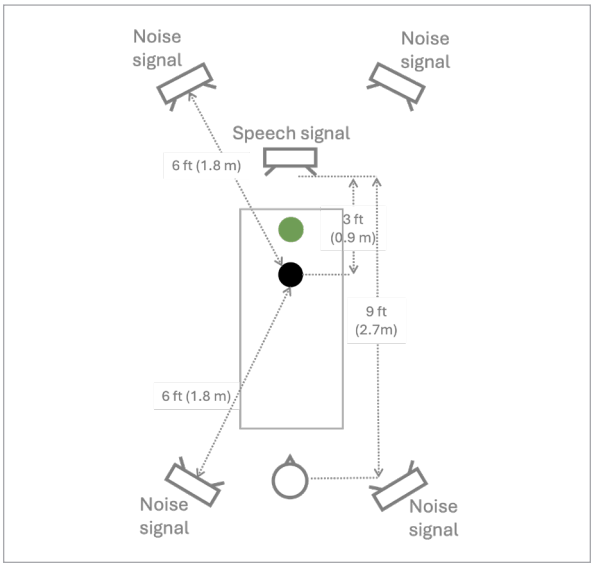

Figure 4: Room setup for study 1. Participant seated at one end of a long table, 9 feet away from the front (target) speaker placed at 0 degrees azimuth. The black circle represents the Table Microphone, positioned 3 feet away from the target speaker, and the green circle represents the Remote Microphone, positioned to simulate a neck-worn setup directly in front of the target speaker. The four noise speakers in the corners were each positioned 6 feet away from the Table Microphone.

Study 1 Results

Paired t-tests were used to analyze hearing aid performance against each accessory. On average, the results showed that both the StarLink Edge Remote Microphone and the StarLink Edge Table Microphone yielded an SNR benefit compared to hearing aids alone, when used for streaming:

- The Remote Microphone provided an average of 12.57 dB SNR over the hearing aids alone (T-Value = 16.08, p-value = < 0.001). *(Figure 5)*
- The Table Microphone provided an average of 6.82 dB SNR over the hearing aids alone (T-Value = 8.27, p-value = < 0.001). *(Figure 6)*

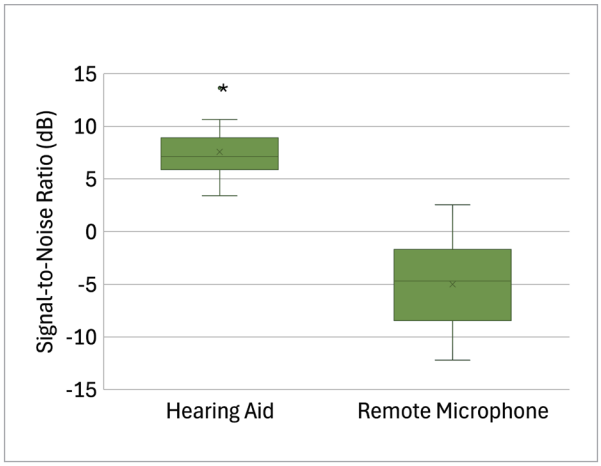

Figure 5: Boxplot of the HINT performance with hearing aids alone compared to streaming through the Remote Microphone. The "x" symbols represent the mean values. The asterisk represents an outlier in the data. Results are reported as SNR needed to repeat 50% of the sentences correctly, therefore the lower values indicate better performance.

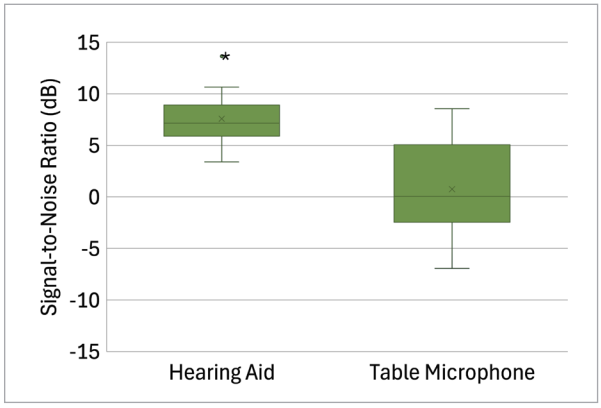

Figure 6: Boxplot of the HINT performance with hearing aids alone compared to streaming through the Table Microphone. The "x" symbols represent the mean values. The asterisk represents an outlier in the data. Results are reported as SNR needed to repeat 50% of the sentences correctly, therefore the lower values indicate better performance.

This test was designed to compare each of the streaming accessories to the hearing aid performance alone. A comparison between the Remote Microphone and Table Microphone performance was not conducted, due to the differences in test setup where the Remote Microphone was in a simulated worm position and the Table Microphone was seated in the middle of the speaker array.

While it is expected that test set-up resulted in performance differences between the devices, both accessories demonstrated improved SNR compared to hearing aids alone. This indicates that either accessory can provide benefit, and selection can be tailored to the specific needs of the patient.

Study 2 Procedures

In the second study, participants were asked to listen to simulated conversations of three talkers seated around a table. Connected Speech Test *(Cox et al., 1987)* sentences played randomly from each of the 3 Speech Signal speakers at a +3 dB SNR with the uncorrelated speech-shaped noise summated at 60 dBA from the Noise Signal speakers *(Figure 7)*, simulating listening to a dynamic conversation in a noisy environment. The Table Microphone was set to either Automatic or Directional to the front speaker.

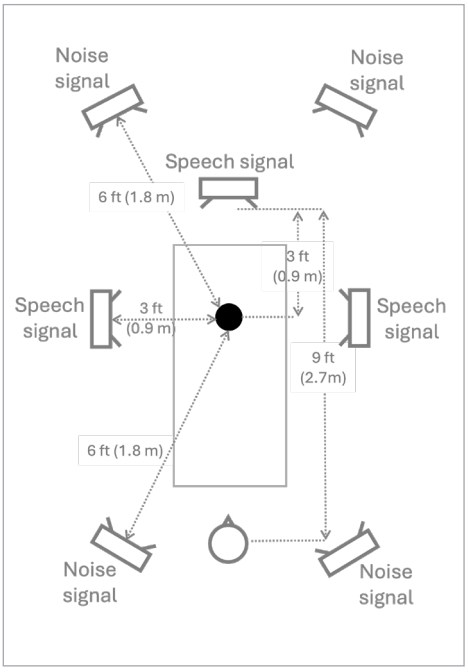

Figure 7: Room setup for study 2. Participant seated at one end of a long table, 9 feet away from the front speaker placed at 0 degrees azimuth. The black circle represents the Table Microphone, positioned 3 feet away from each of the target Speech Signal speakers. The four Noise Signal speakers in the corners were each positioned 6 feet away from the Table Microphone. A small, acoustically transparent barrier was placed between the Table Microphone and the participant to prevent the participant from seeing which microphone mode was being tested.

Participants listened to two passages per condition and listened to each Table Microphone setting twice. The participant provided a speech intelligibility rating using the 0-100 words understood scale after each condition. Each test pair rating for each condition was then averaged, to get one rating per condition.

Study 2 Results

A paired t-test was used to compare the speech intelligibility ratings between the two Table Microphone modes. Results *(Figure 8)* indicate a statistically significant improvement when using the automatic mode over the directional mode (t-statistic = -3.80, p-value = 0.001) in a simulated group environment. This suggests an improved ability to follow a conversation with multiple talkers by using the default mode of the Table Microphone. While the test was designed to simulate a group conversation, the directional mode may offer advantages in other use cases and should be considered accordingly.

The average perceived speech intelligibility improvement (Automatic Directional [mean]-Manual Directional [mean]) provided was 15.2 points on the 0-100 rating scale.

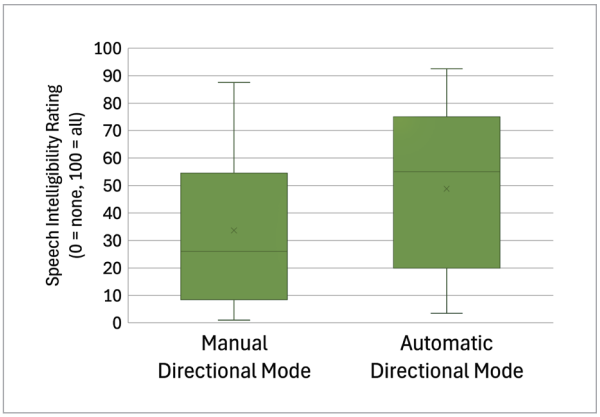

Figure 8: Box plot of the Speech Intelligibility Rating scores using Connected Speech Test sentences in the presence of background noise, comparing two of the Table Microphone modes. The "x" symbols represent the mean values.

The difference in the median score between the two groups (Automatic Directional [median]-Manual Directional [median]) was 26 points.

Conclusion

Providing patients with multiple options to enhance their speech understanding by improving the signal-to-noise ratio can facilitate easier communication in challenging situations. Laboratory testing from the first study demonstrates that both the StarLink Edge Remote Microphone and the StarLink Edge Table Microphone provide improved speech understanding in the presence of background noise compared to hearing aids alone. Although these devices were only tested in one position and setting, both devices offer multiple configuration options to help patients optimize their speech understanding in various challenging situations. Having the flexibility for patients to use either device as a worn device or as a tabletop device allows the patient to be in control of how and what they are hearing. Additionally, while all testing was done at the default Audio Streaming settings and with the hearing aid microphones muted, both the hearing care provider and the patient have control via Pro Fit or the My Audibel mobile application to make a variety of changes to the streaming settings. These adjustments include changing the microphone setting while streaming to on, reduced, or off, changing the frequency response, applying a streaming boost to the signal, and changing overall volume.

While the second study highlighted the accuracy of Automatic mode for understanding conversation with multiple speakers, the flexibility of having multiple modes allows the Table Microphone to provide benefit in a variety of environments. Directional mode may enhance one-on-one conversations, which can be done by either illuminating only the light closest to the speaker or by wearing the device with the lanyard.

Additionally, Manual mode enables the wearer to focus on specific speakers of interest in crowded environments, such as restaurants.

Together, these two StarLink Edge accessories complete this portfolio, empowering clinicians to deliver highly personalized solutions that address each patient's unique listening needs.

References

1. Cox, R.M., Alexander, G.C., and Gilmore, C.A. (1987). "Development of the connected speech test (CST). *Ear and Hearing*, 8 (supplement), 119S-126S.
2. Nilsson M, Soli SD, Sullivan, J.A. (1994, Feb). Development of the Hearing in Noise Test for the measurement of speech reception thresholds in quiet and in noise. *J Acoust Soc Am*, 95(2),1085–1099.

Author Biographies

Sarah Iverson, Au.D., CCC-A, is a Product Manager at Starkey, where she translates user needs into impactful product solutions. She currently supports the development of fitting software and mobile applications, ensuring they meet the evolving needs of hearing professionals and patients alike. Since joining Starkey in 2021 as a Research Audiologist, Dr. Iverson has applied her clinical expertise to guide data-driven decisions and competitive benchmarking, with a strong focus on audiological features that enhance patient outcomes. She earned her B.A. from the University of Minnesota and her Au.D. from Northwestern University.

Sian Halvorsen , Au.D., CCC-A, joined Starkey in 2023 as a Research Audiologist. She earned her B.S. at the University of North Texas and her Au.D. at the University of Arkansas for Medical Sciences. Her work at Starkey covers product and feature validation of hearing aids and accessories prior to market release, ensuring patient needs are met and clinically-relevant outcome measures are used.