

Field Study News

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A powerful noise-fighting duo: Roger™ and Phonak directionality

The use of a remote microphone is an effective solution for improving access to a talker in noise. However, it has always been implemented at the cost of directional processing for the hearing aid inputs. Phonak has for the first time implemented directional microphone settings within the Roger+Mic program of the pediatric portfolio, Phonak Sky V. The Phonak Audiology Research Center (PARC) worked in collaboration with Jace Wolfe, Ph.D. to evaluate the benefit of this feature for speech understanding of peers in quiet and noise. The results indicate that the use of an adaptively-activated fixed beamformer in the Roger+Mic program improves near field speech in noise performance by 26%, preserves hearing from all directions and maintains the strong Roger benefit for understanding speech from a distance, either in the classroom, home or outdoors using a remote microphone.

Introduction

Remote microphones are extremely effective at improving understanding in background noise (Wolfe, J., Morais, M., Schafer, E., Mills, E., Müller, et al., 2013, Thibodeau, L., 2010). When a speaker wears a Roger microphone or places one in close proximity, speech perception for the listener has been found to exceed even the performance of normal hearing listeners (Thibodeau, L., 2014). In the classroom environment, remote microphones provide an excellent solution for maintaining consistent and high quality access to the teacher's voice, regardless of proximity, classroom acoustics, and even, to a large degree, background noise level. However an internal study has revealed that students with hearing loss continue to struggle to understand peers who are not using a Roger microphone (Feilner, 2016). That same study, investigating students in classrooms around the world, also identified that interactive lessons and group work comprise more than a third of a typical student day. This finding highlights the need for hearing performance in this condition and for technology designed for listening in these situations. Additionally it was found that students often sit side-by-side with peers, so the maintenance of lateral signals is required for optimal hearing performance. As a result of these findings, Phonak has engineered an additional A/D converter in Sky V and Naida V devices to allow for an automatically activated fixed beamformer in the Roger+Mic program. Activation is dependent on two factors: noise level and 'Speech in Noise' detection by the classifier. Once activated, the beamformer

maintains a fixed polar pattern (figure 1) with maximum gain reduction to the back to ensure that lateral inputs, like neighboring students sitting side by side in class and in the lunch room, remain audible at all times. This study was designed to evaluate whether access to peer talkers in classroom conditions is improved with this innovation over the traditional Roger+Mic program employing an omnidirectional hearing aid microphone.

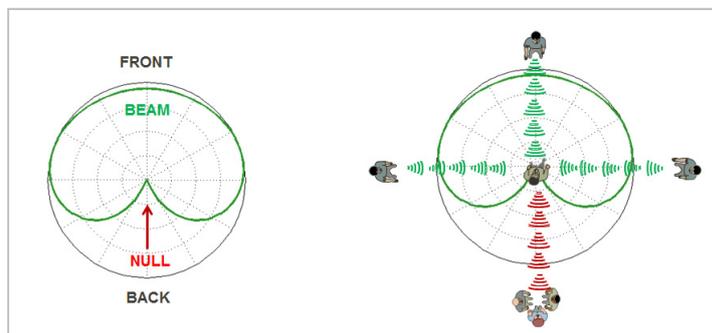


Figure 1 shows the fixed polar pattern on the left and illustrates on the right the maximum gain reduction to the back, while lateral inputs are audible.

Methodology

15 subjects between the ages of 7-17 years were included in this study. All exhibited mild to moderately-severe sensorineural hearing loss bilaterally and were full time hearing aid users. For this project, subjects were fitted with Sky V90 P hearing aids and Roger 18 design-integrated receivers, bilaterally. The DSL v5 Pediatric prescription was applied to set gain and output.

Subjects were tested in a carpeted classroom environment, measuring 4.7 by 6.8 meters (15'5" by 22'4" feet). Subjects were seated in the middle of a 7 speaker array, with each speaker placed at a distance of 1.4 meters (4.5 feet) away from the listener. Three listening configurations were tested in a randomized order and speech recognition was measured using AzBio sentences in the Roger+Mic_{omni} mode and Roger+Mic_{directional} mode for each listening scene.

Speech recognition was measured for a talker at 45 degrees (teacher) with noise coming from behind and from the sides (Figure 2). The speaker at 45 degrees represented the teacher and a Roger microphone was hung 15 cm (6") below the center cone of this speaker. Uncorrelated classroom noise was presented from speakers located at 90, 135, 180, 225 and 270 degrees. The speech was presented at 70 dB with a 0 dB signal-to-noise ratio (SNR). This scene was designed to assess speech understanding of the teacher in the presence of classroom noise to ensure that Roger+Mic_{directional} technology maintains the previously documented benefit of Roger.

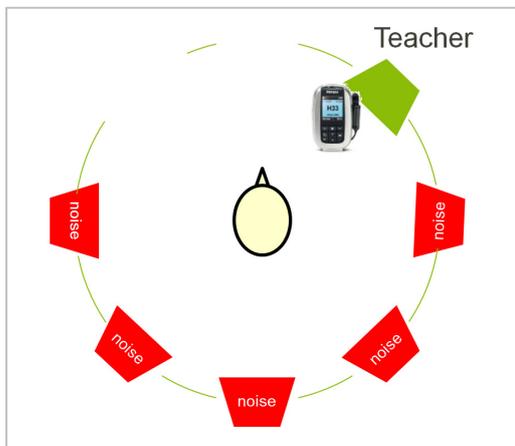


Figure 2. Condition representing a teacher speaking into an inspiro transmitter in presence of background noise in classroom environment.

The second condition was designed to test performance in small group discussion (Figure 3). A speaker at 315 degrees represented a "peer talker" in the near field. Speech from the peer was presented at 65 dB. The classroom noise was presented from 90, 135, 180, 225 and 270 degrees and yielded an SNR of 0 dB.

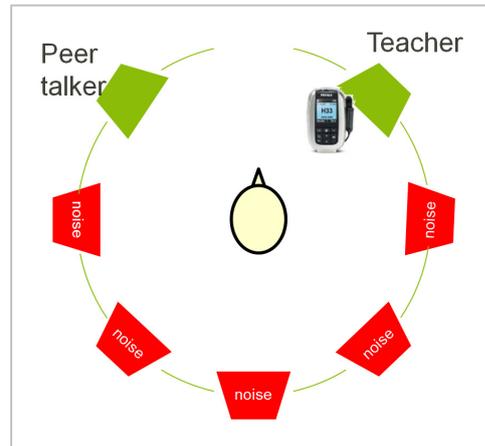


Figure 3. Condition representing a peer talker in the near field in the presence of background noise in classroom environment

Finally, in the third scene, speech was presented from a speaker at 225 degrees in quiet. This scene was designed to test understanding of a "peer" speaking from behind in the absence of background noise (Figure 4). This condition was designed to verify that even in the Roger+Mic_{directional} mode, the microphone reverted to an omni-directional pattern when background noise was not present, maintaining access to sounds arriving from all angles.

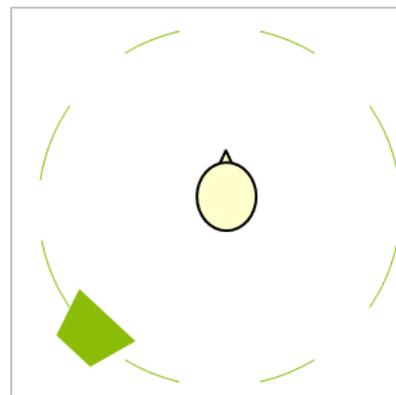


Figure 4. The third condition was designed to evaluate the audibility of a classmate speaking from behind in a quiet classroom.

Results

Average speech recognition scores for all subjects can be seen in figure 5. A repeated measures ANOVA revealed a significant main effect for microphone mode. Post hoc analysis confirmed a significant difference ($p=.003$) in the second listening condition between the Roger+Mic_{omni} and Roger+Mic_{directional} programs for the "peer talker" in noise. Average speech recognition when the fixed directional beamformer was activated in the Roger program was 26% better compared to performance with the Roger+Mic program using only omnidirectional.

No difference was seen between Roger+Mic_{omni} mode and Roger+Mic_{directional} mode for the speech coming from the "teacher". These results confirm that the benefit of Roger microphones will not be negatively impacted by the activation of a directional microphone in the Roger+Mic hearing aid program. Additionally, no difference was seen between the two hearing aid programs when a "peer" was speaking from behind in a quiet classroom. This confirms that the hearing aid microphone adapts, as intended, in quiet to an omnidirectional pattern, preventing undesirable loss of hearing when the speaker of interest is coming from behind the listener.

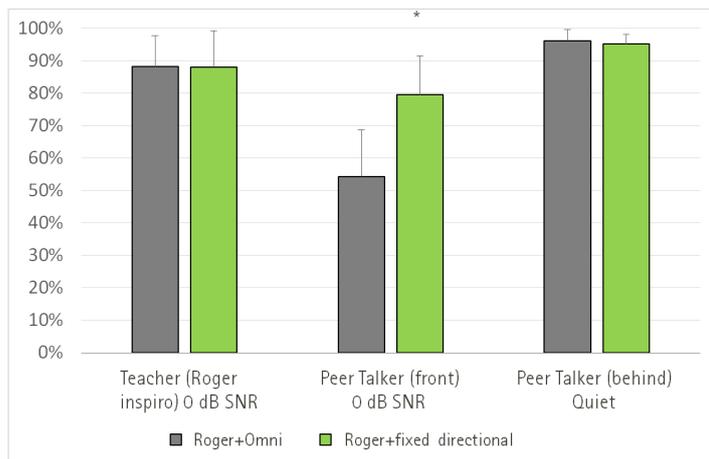


Figure 5. The average speech recognition scores for the Roger+Mic_{omni} mode and Roger+Mic_{directional} modes in each of the three conditions.

Conclusion

The results of this investigation demonstrate the near-field benefit of adaptively activating a hearing aid directional microphone in combination with a Roger remote microphone. In noise, the Roger+Mic_{directional} allows listeners to hear both a primary speaker and environmental input without compromise. This feature is especially relevant in dynamic classroom situations requiring students to follow teacher instruction and discuss or collaborate with peers. For children who might only have access to a Roger+Mic program, this innovation offers not only improved hearing in noise with Roger, but also the additional advantage of adaptive activation of the directional microphone when Roger is not in use. As the adaptive activation of the fixed beamformer is based on noise level and the presence of speech, the chance of any undesirable suppression of important signals from behind is minimized in the absence of background noise. This new Phonak innovation offers listeners the best of both worlds for the first time – the established benefit of far-field hearing performance with Roger, now with the near-field hearing performance of a directional microphone.

References

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Authors and Investigators



Christine Jones joined Phonak in 2001. She currently serves as the Director of the Phonak Audiology Research Center (PARC) where she manages a program of internal and external clinical research. Prior to this role, Christine was responsible for Phonak US Pediatrics and ran pediatric clinical research in PARC. Christine received her Master's degree in Audiology from Vanderbilt University and her Doctorate of Audiology from Central Michigan University.



Lori Rakita is a research audiologist at the PARC. Since joining Phonak she has managed a significant program of research including extensive technical assessments to participant testing to improve the application, evidence basis and clinical support of Phonak products. . Lori received her Bachelor of Science degree in Psychology from the University of Wisconsin-Madison and her Doctorate of Audiology from Washington University in St. Louis.