



Enhancing Conversation in Extreme Noise for Unilateral AB Cochlear Implant Recipients

Bimodal StereoZoom Feature

Unilateral cochlear implant benefit can be enhanced by adding a hearing aid to the contralateral ear, termed bimodal hearing. The ability to access low-frequency hearing through a hearing aid can help speech understanding in noise, improve music and voice pitch perception, and provide better sound quality overall for unilateral implant recipients.¹⁻⁵

Bimodal listeners with one AB cochlear implant now can take advantage of Binaural VoiceStream Technology™. With the introduction of the Phonak Naída™ Link hearing aid, bimodal listeners with one AB implant have the opportunity to take advantage of Binaural VoiceStream Technology, which makes it easier to communicate in many everyday listening situations. Binaural VoiceStream Technology is a proprietary Phonak technology that allows two AB Naída CI sound processors, two Phonak hearing instruments—and now a Naída CI sound processor and Naída Link—to be linked wirelessly for streaming full bandwidth audio signals from ear to ear in real time with low power consumption. In addition, AB bimodal listeners benefit from the Adaptive Phonak Digital Bimodal fitting algorithm, which improves hearing by (1) aligning the frequency response of the Naída Link to the acoustic-hearing ear, (2) aligning the

loudness growth between the Naída CI sound processor and the Naída Link, and (3) synchronizing the dynamic behavior between the two devices.

The StereoZoom feature harnesses Binaural VoiceStream Technology to improve speech understanding in extremely noisy circumstances. StereoZoom creates a third-order directional beamforming system by wirelessly connecting the four microphones across the Naída CI Q90 processor and the Naída Link. StereoZoom can improve listening by providing a narrower directional beam than is provided by UltraZoom alone, thus allowing bimodal listeners to focus on a single speaker directly in front of them while reducing interfering noise from the sides, back, as well as from near the front.⁶

This clinical study assessed the benefit of using StereoZoom to improve speech understanding in noise when the bimodal listener is facing the talker. Speech understanding was evaluated in quiet and in noise using the cochlear implant alone, the hearing aid and cochlear implant together, and StereoZoom. Results were compared to assess the benefit provided by bimodal listening and by StereoZoom for communicating in noise when facing the talker.

STUDY METHODS

Subjects

Subjects were 19 experienced adult bimodal listeners. There were 13 men and 6 women. Median age at time of testing was 61 years (range 26 to 83 years). Mean duration of cochlear implant use was 4.9 years (range 1.2 to 12.9 years, median = 2.6 years). Unaided thresholds at 500 Hz ranged from 35-95 dB HL (median = 70 dB HL) in the ear using a hearing aid. For the study, 14 subjects were fit with a Naída Link UP and 5 with a Naída Link RIC using the Phonak Adaptive Digital Bimodal fitting algorithm. Aided thresholds at 500 Hz with the Naída Link ranged from 20-35 dB HL (median = 25 dB HL). Subjects used a Naída CI Q90 sound processor on the implant side.

Materials and Procedures

In quiet, AzBio sentences were presented from the front at 60 dBC in three conditions.

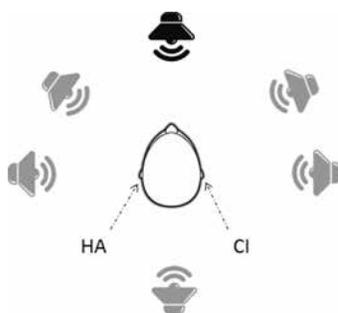
1. With the cochlear implant turned on and the hearing aid turned off (unilateral CI).
2. With the cochlear implant and hearing aid both turned on (bimodal).
3. With the StereoZoom feature turned on (SZ).

Then, with the cochlear implant and hearing aid both on (bimodal condition above), Phonak cantina noise was added to determine a SNR for each subject that yielded an AzBio score of approximately 50% of their score in quiet. That custom SNR was used in to evaluate the benefit of (1) the cochlear implant without the hearing aid (unilateral CI) and (2) enabling StereoZoom (SZ). SNRs ranged from +2 to +15 dB for the 19 subjects. All results are expressed as percent correct.

For all six test conditions, subjects rated ease of listening on a five-point scale ranging from 1 = extremely difficult to 5 = extremely easy.

Test Room Configuration

Subjects were tested in a double-walled sound booth. Sentences were presented from a loudspeaker located at 0° azimuth. Noise was presented from five loudspeakers located at ±60°, ±90°, and 180° azimuth.



Clinical Study Results

AB bimodal listeners benefit from the Adaptive Phonak Digital Bimodal fitting algorithm and StereoZoom when listening to speech coming from in front. In quiet, results show that the hearing aid plus cochlear implant (bimodal) provided an average of 10% improvement in sentence scores compared to using the implant alone. Enabling StereoZoom did not provide additional benefit in quiet compared to the cochlear implant by itself. In contrast, bimodal hearing increased the sentence scores by a remarkable 21% over the cochlear implant alone in noise (Figure 1). Adding StereoZoom provided an additional 21% benefit, thus totally a 42% improvement over the cochlear implant alone. In quiet, subjects reported easier listening with StereoZoom over using the cochlear implant alone, even though the speech scores in the two conditions were the same. In noise, the ease-of-listening ratings were commensurate with the speech scores (Figure 2).

Figure 1

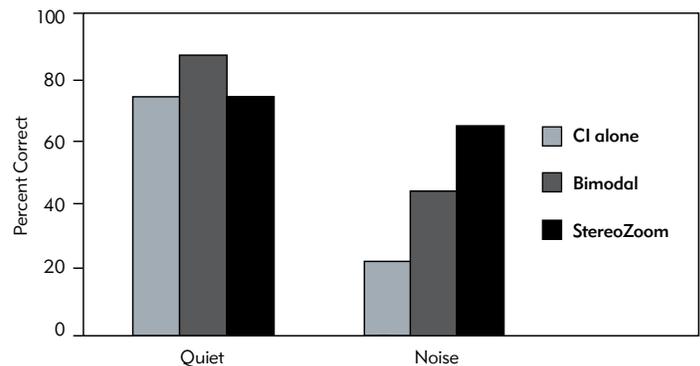
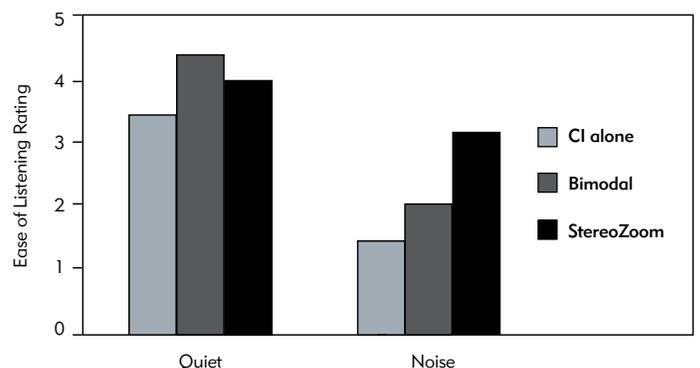
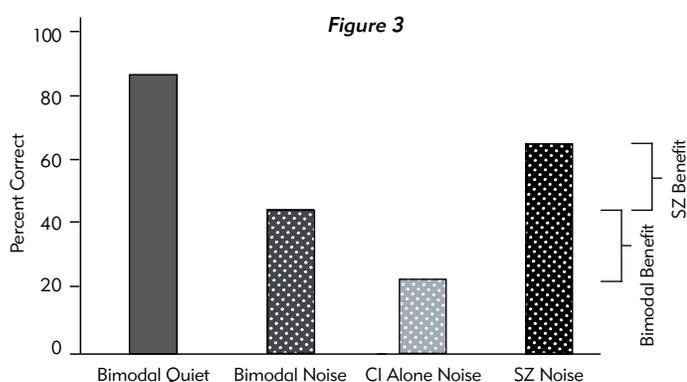


Figure 2



Discussion

For individuals with severe-to-profound hearing loss, providing input to both ears, whether bimodally or with two implants, can provide significant benefit compared to using one implant alone.^{1-5,7-11} The study data indicate that adding a hearing aid to a cochlear implant can improve sentence recognition significantly in a face-to-face conversation, particularly in noise. Moreover, using the focused beamforming capability of StereoZoom further improves the ability to understand speech in noise when the listener is facing the talker (Figure 3).



This study demonstrates that using advanced acoustic signal-processing techniques to increase the signal-to-noise ratio at the input to both ears can strengthen the communication abilities of bimodal listeners who use an AB Naída CI Q90 sound processor and a Phonak Naída™ Link hearing aid. Practically for bimodal listeners, the effect of StereoZoom is to enable better listening in extreme noise when the signal of interest is to the front. StereoZoom is only one implementation of Binaural VoiceStream Technology™. The ZoomControl and DuoPhone features also use Binaural VoiceStream Technology to enhance listening (1) when the talker is on one side of the listener, and (2) when talking on the phone in noisy places. These options, when combined with AB's AutoSound™ OS technology and ClearVoice™* speech enhancement technology, provide a variety of solutions to improve communication every day and

everywhere. Binaural VoiceStream Technology is also available for bilateral Naída CI users and for bilateral Phonak hearing aid wearers.

Note: This study was conducted at Advanced Bionics facilities in Valencia, California, USA.

**Not approved for pediatric use in the United States.*

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