

Edge Mode Performance that Stands Out in Noise



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Key takeaways:

- The DNN-enhanced Edge Mode Reduce Noise delivers an average significant 3.4 dB SNR improvement over Personal program and an average 2 dB SNR improvement over Edge Mode Best Sound, when benchmarked in a high-noise environment.
- Aided SNR comparison showed significantly better performance compared to other flagship brands with DNN processing.

Introduction

Edge Mode is a proprietary feature innovated by Starkey to support speech understanding and listening comfort in demanding listening situations. The feature is grounded in the principle that effective listening is influenced not only by environmental acoustics, but also by the individual's listening intent. Whereas many hearing aid systems rely solely on fully automated algorithms to predict optimal settings, Starkey's approach recognizes the importance of user preference in shaping the listening experience. Edge Mode provides user-selectable controls that enable further personalization of the hearing aid behavior in response to situational listening demands.

The feature is especially beneficial in complex sound environments where more aggressive and highly focused processing strategies may be required to either emphasize speech or provide listening comfort. In its automatic default mode, Edge Mode Best Sound, Edge Mode continuously adjusts hearing aid parameters in real time based on the detected acoustic scene. The Enhance Speech option

directs processing resources toward maximizing speech clarity, while the Edge Mode Reduce Noise option prioritizes overall listening comfort.

Since its introduction, Edge Mode has been supported by clinical findings demonstrating improvements in speech intelligibility reductions in listening effort, and overall preference for the feature (*e.g. Harianawala, et al., 2020; Rakita & Harianawala, 2021; Jaekel & Xu, 2024 a, b; Fitzgerald, et al., 2025*). The latest generation of Edge Mode builds upon this evidence base with an updated deep neural network (DNN) model designed to deliver improved outcomes especially in high levels of noise.

Hearing aids generally support communication in challenging listening environments through advanced signal-processing strategies. As these technologies become increasingly complex, objective benchmarking plays a critical role in evaluating and comparing system performance under controlled conditions.

Objective benchmarking enables repeatable, standardized assessment by isolating device processing effects from listener-related variability.

In contrast to listener-based evaluations, which can be influenced by cognitive load, fatigue, learning effects, and individual differences, objective methods provide consistent measurement outcomes across repeated trials and test configurations. This consistency is especially important for competitive comparison and longitudinal performance tracking.

Additionally, benchmarking approaches allow performance to be evaluated across a wide range of acoustic environments, including dynamic and complex noise conditions that represent real-world use cases. By maintaining precise control over input signals and test parameters, objective benchmarking ensures that observed differences can be attributed to processing strategies rather than test-retest reliability.

This paper outlines two studies that used objective benchmarking techniques to evaluate the advantages of Edge Mode in comparison to the default program, and a competitive comparison with other brands in complex, high-noise environments.

Study 1

Although Edge Mode was developed to optimize performance in challenging acoustic situations, listening demands vary across hearing aid users and throughout the day. Daily environments can range from predominantly quiet settings to consistently loud or noisy contexts, and default configurations may not be enough to provide optimal benefit across all use cases.

In this study, a comparison of the DNN-enhanced Edge Mode Reduce Noise feature is compared to the Personal program and Edge Mode Best Sound settings to investigate potential advantages of the improvement to patients in complex, high-noise environments.

Testing in high-noise environments (above about 75 dB SPL on average) is essential because it reflects the sound levels patients may encounter in their day-to-day life. Real-world listening situations such as restaurants, social gatherings and urban settings may reach 65 to 85 dB SPL or higher (*Rusnock & Bush, 2012*), levels at which communication becomes very difficult. These types of high-noise situations usually result in variable amounts of listening fatigue. Therefore, objective measures were leveraged to provide a fair assessment of the hearing aid features.

Laboratory measurements of aided signal-to-noise ratio (SNR) were carried out using Omega AI+ 24 RIC RT fit to an N3 hearing loss (*Bisgaard et al, 2010*) with power domes on a Brüel & Kjær Head and Torso simulator manikin.

An 8-speaker array was used to play diffuse noise with speech emanating from the front (*Figure 1*). This setup was designed to replicate interactions under high-noise conditions, in which patients would naturally orient toward their conversation partner for face-to-face conversation to compensate for reduced auditory clarity and to take advantage of visual and nonverbal cues.

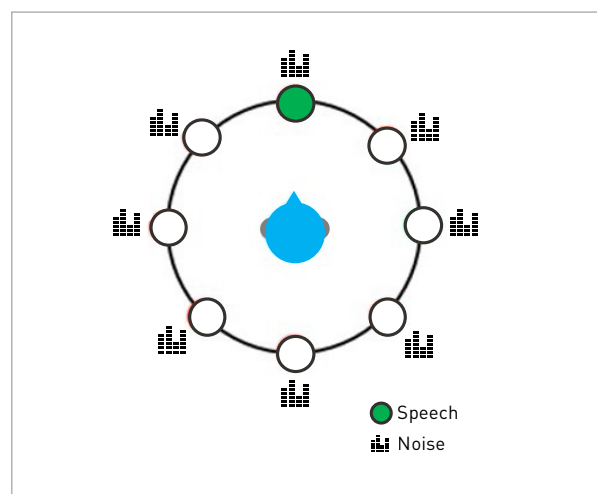


Figure 1: Acoustic setup used for evaluation. Location of speech signal is from the front (0°), with diffuse real-world noise played through 8 loudspeakers.

Table 1: A summary of the acoustic test matrix, detailing 18 distinct conditions created by sequentially paired speech and noise levels. The first set of speech and noise levels correspond to the original recorded levels for each ARTE sound file.

ARTE Noise	Speech Level (dB SPL)	Noise Level (dB SPL)
Café 1	74, 72, 75	71, 75, 75
Café 2	75.2, 72, 75	71.7, 75, 75
Dinner Party	75.2, 72, 75	72.8, 75, 75
Train Station	77.2, 72, 75	77.1, 75, 75
Foodcourt 1	77.7, 72, 75	78.2, 75, 75
Foodcourt 2	78.3, 72, 75	79.6, 75, 75

Testing was done using 6 noise files from the Ambisonics Recordings of Typical Environments (ARTE) database (Weisser et al., 2019): Café 1, Café 2, Dinner Party, Train Station, Foodcourt 1, and Foodcourt 2. All noise was played from 8 speakers at 0, 45, 90, 135, 180, 225, 270, and 315 degrees (Figure 1). Speech used was in the form of the Connected Speech Test (CST) passage played at 0 degrees ranging in SNR from -3 to +3 dB SNR. A total of 18 combinations of speech and noise levels were evaluated (Table 1). Test conditions and stimulus levels were intentionally designed to replicate highly challenging, real-world listening environments with elevated noise levels. A total of 6 noise types were employed, with higher noise intensities to represent a variety of complex and demanding acoustic scenarios.

The aided SNR was calculated with Speech Intelligibility Index (SII)-weighting using the Hagerman method (Hagerman & Olofsson, 2004). The Hagerman method is a well-established and validated approach for estimating the signal-to-noise ratio (SNR) improvement provided by hearing aids. The method involves simultaneous presentation of speech and noise, followed by two measurements, one of which uses phase-inverted noise. By combining the resulting recordings, the processed speech and noise components can be separated from the mixed signal, enabling precise calculation of SNR improvement.

To further quantify speech understanding, the Speech Intelligibility Index (SII) (ANSI, 1997) is applied in conjunction with the Hagerman method. SII accounts for the relative contribution of different frequency bands to speech intelligibility, allowing the calculation of SNR to reflect their differential importance or speech perception. The SNR benefit is shown as the SNR of the aided recording.

For each recording, the stimulus consisted of an initial 47-second segment (including an adaptation period) of combined speech and noise, followed by three analysis repetitions of the same speech and noise material, each 33 seconds in duration: Speech+Noise, Speech-Noise, and -Speech-Noise. The first two repetitions were used to separate the speech and noise components, while the third repetition served to quantify the measurement error. Recordings were included in the final analysis only if the error level was below -10 dB relative to the separated speech and noise signals.

Three different hearing aid settings were evaluated: 1) Default program, 2) Edge Mode Best Sound, and 3) the DNN-enhanced Edge Mode Reduce Noise, with the comparison shown in Figure 2.

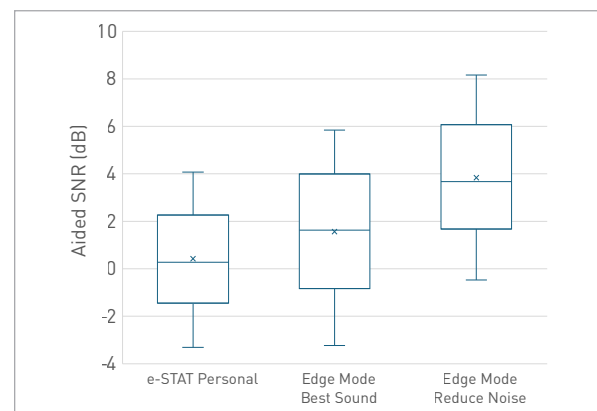


Figure 2: Boxplot of aided SNR across conditions. Boxes represent the interquartile range with the median indicated by the horizontal line and the mean marked by an "x". The Improved Reduce Noise condition demonstrates significantly higher aided SNR benefit relative to e-STAT Personal settings.

The results showed a clear and progressive improvement in aided SNR across three tested conditions under highly challenging noise conditions.

The Default memory condition provided a median-aided SNR of 0.27 dB and a mean value of 0.42 dB. The Best Sound condition demonstrated a measurable enhancement over the Default memory, achieving a median SNR of 1.62 dB and a mean of 1.56 dB, reflecting moderate effectiveness. In contrast, the improved Reduce Noise configuration delivered the strongest performance, with a median aided SNR of 3.67 dB and a mean of 3.84 dB. On average the DNN-enhanced Reduce Noise provided about a 2 dB SNR improvement over Best Sound, and a significant 3.4 dB improvement over the Personal program (paired t-test, $p < 0.01$), with up to 5.4 dB SNR improvement, demonstrating an improvement in aided SNR, particularly in complex, high-noise scenarios where effective noise reduction is critical.

Study 2

The objective of this study was to evaluate and compare the aided SNR performance of the improved Edge Mode Reduce Noise configuration against other major brands with their respective flagship technology marketed as having DNN processing (*commercially available in July 2026*), in challenging high-noise environments (*Table 2*).

Table 2: A list of hearing aids evaluated in Study 2. The sequence of devices listed does not correspond to the alphabetical sequence referred to later in the aided SNR results.

Brand	Model
Starkey	Omega AI+ 24 RIC RT
Oticon	Intent 1 miniRITE
Phonak	Audéo Infinio (Ultra) Sphere 90
ReSound	Vivia 9 microRIE
Widex	Widex Allure AI

The same methodology and test setup for Study 1 was used in this evaluation. In addition, each device was fitted to an N3 hearing loss (*Bisgaard et al, 2010*) using each manufacturer's proprietary fitting formula, with power domes, and selecting power domes as the acoustic coupling in the fitting formula so that the full extent of the processing strategy could be evaluated. Feedback cancellation and any frequency lowering or frequency compression were disabled, and all other features were left at default.

For the Starkey Omega AI+ devices, Edge Mode Reduce Noise was used. For the other brands, each speech-in-noise program corresponded to that brand's flagship speech-in-noise solution meant to be activated in complex, high-noise conditions.

Aided SNR outcomes differed significantly across the conditions evaluated. The improved Edge Mode Reduce Noise condition demonstrated the highest aided SNR, with a mean of 3.84 dB, and a median of 3.67 dB, indicating both strong overall performance and a positive outcome. Brands A and B showed significantly reduced performance (A: mean = 1.96 dB, median = 1.83 dB; B: mean = 1.73, median = 1.87), while Brands C and D exhibited negative SNR values on average, with means of -0.66 dB and -2.17 dB and medians of -1.18 dB and -1.85 dB, respectively.

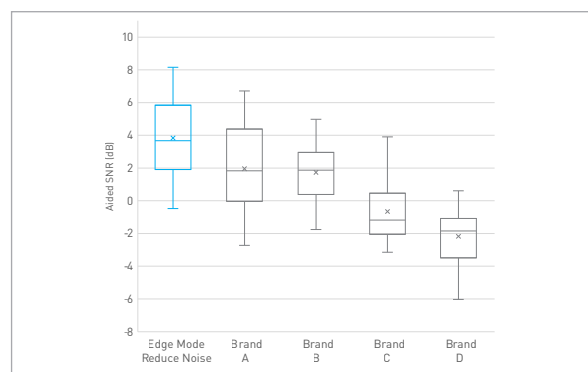


Figure 3: Boxplot of aided SNR shows the distribution of aided SNR for the improved Edge Mode Reduce Noise condition, compared to Brands A, B, C and D. Boxes represent the interquartile range with the median indicated by the horizontal line and the mean marked by an "x". All results were statistically significant from the Edge Mode Reduce Noise condition (paired t-test) with $p < 0.001$.

Statistical comparison revealed that the improved Reduce Noise condition significantly outperformed all other brands with flagship DNN processing evaluated. All brand comparisons against Edge Mode Reduce Noise were statistically significant (paired t-test), with $p < 0.001$.

Conclusion

Under controlled laboratory conditions designed to replicate highly challenging, high-noise listening environments, the improved Edge Mode Reduce Noise configuration demonstrated superior aided SNR outcomes relative to Personal program, Edge Mode Best Sound, and competitor solutions that incorporate DNN processing. While two competing brands demonstrated moderate benefit, all brands evaluated with marketed DNN processing produced substantially lower aided SNR outcomes, demonstrating superior performance of the Edge Mode Reduce Noise feature for highly challenging listening situations.

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Author Biographies



Larissa Taylor, Ph.D., is an Audio Systems Engineer at Starkey. Her primary focus is ensuring the overall sound quality of hearing aids. Larissa started at Starkey in 2022 upon completing her doctorate on listening effort and sound quality with hearing aids at McMaster University, Hamilton, Ontario, Canada.



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