— WHITE PAPER

Signia IX with pioneering multi-stream technology delivers 22% better speech understanding in noisy group conversation than a competitor with an AI co-processor-driven platform

Signia Integrated Xperience (IX) with RealTime Conversion Enhancement was developed to address one of the most important needs of hearing aid wearers: the ability to follow and ultimately contribute to dynamic group conversations in background noise. In this paper, we report on a study where the speech understanding performance obtained with Signia IX in a noisy group conversation was compared to the performance provided by a newly launched competitor hearing aid with an AI co-processor-driven platform. The results demonstrated that Signia IX achieved a statistically significant improvement in speech reception threshold, outperforming the competitor by 1.4 dB in a modified OLSA test. This difference translates to a remarkable 22% enhancement in speech understanding. Notably, 77% of the 27 participants performed better with Signia IX compared to the competitor.

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Take-away messages

- This human performance study confirms the hearing performance effects suggested by previous results from a technical study comparing Signia IX to leading competitors.
- This study involved simulating a group conversation in noise using alternating speakers from multiple angles.
- Signia IX provided a mean speech reception threshold (SRT50) that was 1.4 dB better (lower) than the mean SRT50 provided by a competitor with an AI co-processor. This difference is statistically significant and corresponds to 22% better speech understanding for the average wearer.
- The result was highly replicable, with 77% of participants performing better with Signia IX than with the competitor.
- This result shows the strong benefit of RealTime Conversation Enhancement's ability to track and enhance multiple talkers in real-time, delivering better outcomes in a noisy group conversation than a leading competitor powered by an AI co-processor.

Introduction

In a survey of almost 15,000 people, in which the vast majority of respondents had a self-reported hearing loss, "hearing friends and family in noise" was found to be the most desirable hearing aid attribute, with 88.3% of respondents rating this attribute to be very or extremely important (Manchaiah et al., 2021). This result corresponds well with MarkeTrak 22 data, which showed that hearing aid wearers reported their lowest level of listening satisfaction in noisy group conversations (Picou, 2022). Together, these results indicate what every hearing care professional (HCP) who fits hearing aids knows: Participating in a group conversation in noise is one of the most challenging listening situations for people with hearing loss—and often the situation where hearing aid wearers need the most help from their hearing aids.

With the introduction of Signia Integrated Xperience (IX) with RealTime Conversation Enhancement (RTCE), Signia has taken a major leap forward in overcoming the challenges faced by wearers of traditional hearing aids in noisy group conversations. Beyond the basic difficulty of understanding speech in noise, these challenges are amplified by the dynamic nature of group conversations—where different talkers can move around, take turns speaking, or the wearer themselves naturally turns their head. All these factors make group conversations highly dynamic and challenging to follow.

These challenges are effectively addressed by the Signia Integrated Xperience (IX) platform. Signia's unique split processing technology enables background sounds to be processed independently from speech, allowing noise to be reduced without distorting the clarity of speech.

Just as importantly, the IX platform's groundbreaking multi-stream technology dynamically enhances multiple talkers in real-time. In fact, Signia IX is the only hearing aid platform in the world capable of tracking and enhancing multiple talkers simultaneously during a conversation. For a more detailed description of split processing and RTCE, see Jensen et al. (2021) and Jensen et al. (2023), respectively.

The perceptual wearer benefits of activating RTCE have been investigated and documented in several studies, conducted both in the lab and in the real world (e.g., Jensen et al., 2023; Folkeard et al., 2024; Korhonen & Slugocki, 2024; Slugocki et al., 2024). A relevant question is: How does the Signia IX multi-stream processing compare to the single-stream processing approaches used by competitors? The question has become even more relevant after the recent launches of competitor hearing aids with Artificial Intelligence (AI)-based noise reduction solutions, claimed to improve wearers' speech-in-noise performance.

When developing the appropriate test setups for benchmark comparisons, it needs to be considered that, for hearing aid wearers, one of the most relevant and difficult scenarios is a dynamic group conversation in background noise. This represents a particularly challenging benchmark for hearing aids, and we believe it should be the standard to aspire to—testing devices in realistic and demanding situations rather than static lab environments.

To accurately replicate this type of scenario in a lab, certain key conditions must be met. Target speech should alternate from different directions to reflect the dynamic turn-taking of multiple talkers in a real-world conversation. Additionally, the background noise must be realistic, ideally including a mix of environmental noise and distracting speech. Demonstrating benefits under these dynamic and realistic conditions provides greater confidence that the advantages of Signia IX will translate effectively to real-world use.

In a recent technical study, the signal-to-noise ratio (SNR) performance of Signia IX was compared to the performance of four key competitor hearing aids where the hearing aids were placed on the ear of a KEMAR and subjected to a simulated group conversation in background noise, according to the test guidelines outlined above. At the time of the measurements, each of the competitor products was the most recent premium product from their respective manufacturers. The results showed a clear benefit of Signia IX, which provided a 3.2 dB higher output SNR than the closest competitor. For more details on the study, see Jensen et al. (2024).

While a technical SNR improvement provided by hearing aids often can be linked to improved speech understanding, other factors may affect the real-world speech perception of the hearing aid wearer. For example, individual variations in hearing loss, auditory processing capabilities, and attention mean that a given change of the SNR will have a different impact on speech understanding for different listeners. Accordingly, to fully assess the speech understanding performance provided by hearing aids, they also need to be assessed directly in a study with human participants. Thus, to investigate whether the observed technical SNR benefit of Signia IX translates into a meaningful speech understanding benefit, we conducted a study to compare the speech understanding performance of Signia IX in a noisy group conversation scenario against the best-performing competitor in the SNR study. Notably, this competitor was also the most recently launched device and featured an AI co-processor. In this paper, we will describe the hearing performance study and present and discuss the results.

Methods

Participants

An a priori power analysis performed using G*Power 3.1.9.7 showed that 20 participants would allow detection of a 1 dB difference in the OLSA speech test (see below) with a significance level of 5% and a statistical power of 80%, assuming a standard deviation of 1.5 dB on the individual differences.

Twenty-seven participants (7 females, 20 males) took part in the study. Their mean age was 64 years (range: 23-82 years), and they all had a mild-to-moderately-severe sensorineural hearing loss, with the mean audiogram shown in Figure 1. They were all experienced hearing aid wearers.

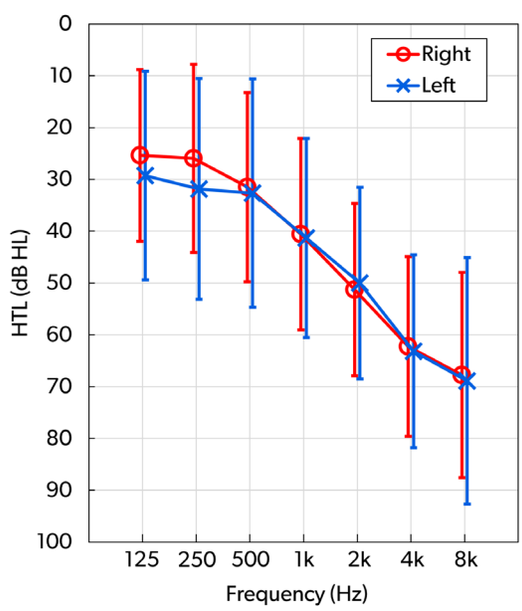

FIGURE 1 Mean audiogram for left and right ear for the 27 participants. Error bars indicate ± one standard deviation.

Hearing aids

The participants were fitted bilaterally with two different hearing aids: Signia Pure C&G T 7IX, and a competitor's newly launched premium RIC hearing aid with an AI co-processor-driven platform. This specific product was the best-performing competitor in the SNR study in which Signia IX outperformed four different competitors' hearing aids (Jensen et al., 2024). In accordance with the nomenclature used in that study, the competitor hearing aid will be referred to as Brand A1.

Both hearing aids were individually programmed according to the NAL-NL2 rationale (adult, non-tonal, experienced wearer, 100% acclimatization), and all fittings were completed with closed couplings (power domes/sleeves). All processing channels were enabled, with frequency compression/lowering features deactivated. The volume controls were disabled to keep the prescribed gain fixed. During testing, both test hearing aids were set in a manual speech-in-noise program that assured all noise reduction features were always activated.

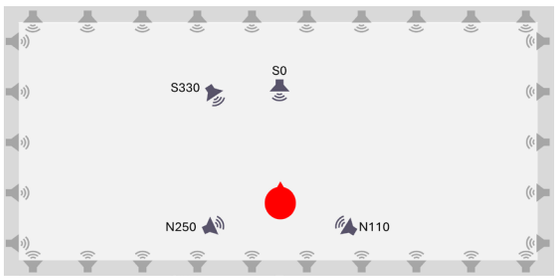

FIGURE 2 Test setup where hidden loudspeakers were used to create a canteen background, while target speech (S) and interfering speech noise (N) was presented from specific loudspeakers around the participant.

Speech test

The aim of the test was to simulate a group conversation in a noisy background and assess the ability of the participants to understand conversational speech with the different test hearing aids.

The test setup was established in the Wonderful Sound Lab (Holland et al., 2024). This room is equipped with 45 loudspeakers, of which most are hidden behind acoustically transparent panels, which allow a realistic simulation of a wide variety of acoustic scenarios.

In this test, a canteen background scenario was established at a level of 65 dBA (measured at the position of the participant, without the participant being present). The test setup is illustrated in Figure 2. To simulate a group conversation in the canteen scenario, target speech was presented alternating from two loudspeakers at 0° and 330° (positioned 1.2 m and 1.3 m from the participant, respectively), while loudspeakers at 110° and 250° (both positioned 0.6 m from the participant) presented continuous interfering speech. The total noise level of the canteen noise and the interfering speech was 73 dBA at the position of the participant.

The test method used to assess speech understanding was the standardized German Oldenburger Satztest (OLSA; Wagener et al., 1999). The target speech was OLSA sentences presented alternating from the two target loudspeakers. During the test, the participant was allowed to move their head freely, as they would in a normal real-world conversation. The task of the participant was to repeat each sentence verbally. Depending on the number of words repeated correctly, the level of the following sentence was changed adaptively to allow determination of the signal-to-noise ratio (SNR) where 50% of the words could be repeated correctly. This SNR is the outcome of the test and is referred to as the speech reception threshold for 50% (SRT50).

Prior to the actual test, a training round was completed to familiarize the participants with the OLSA test procedure. After completing the training, the two test hearing aids were tested using 30 OLSA sentences for each condition. The test order of the hearing aids was counterbalanced across participants.

Results

The results of the test are shown in the bar graph in Figure 3. It shows the mean SRT50 across the 27 participants for each of the two test hearing aids. Since the SRT50 indicates the SNR where 50% of the words could be repeated correctly, a lower SRT50 value means better performance.

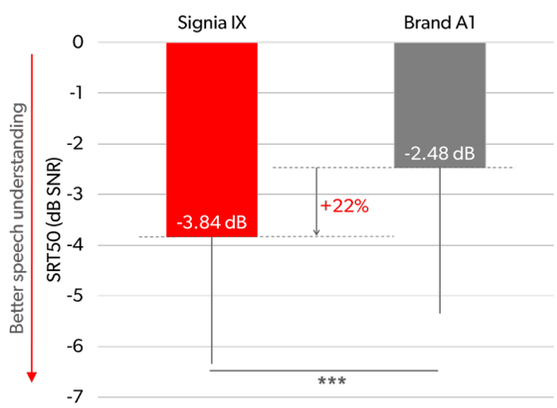

FIGURE 3 Mean SRT50 values for the two test hearing aids (Signia IX and Brand A1) across the 27 participants. The error bars indicate one standard deviation, *** p < .001.

The mean SRT50 for Signia IX was -3.84 dB, while it was -2.48 dB for Brand A1. That means Signia provided a mean benefit of 1.4 dB compared to the competitor device. This benefit is statistically significant according to a two-sided paired t-test ($t(26) = 4.94$, $p < .001$).

The difference in SRT50 can be converted to a difference in speech understanding when the slope of the performance-intensity (P-I) function (the psychometric function) is known, and when linearity of the P-I function within the SNR range of interest is assumed. By applying the slope value of 16 percent/dB for the OLSA test, which was published by Wagener & Brand (2005), the 1.4 dB SRT50 benefit of Signia IX corresponds to a speech understanding improvement of 22%. The magnitude of this benefit is clinically significant.

The individual SRT50 differences were calculated by subtracting the SRT50 for Signia IX from the SRT50 for Brand A1. In this way, a positive value of the difference indicates a benefit of Signia IX, while a negative value indicates a benefit of Brand A1. The individual differences are plotted in Figure 4, where the participants are ordered according to their individual difference.

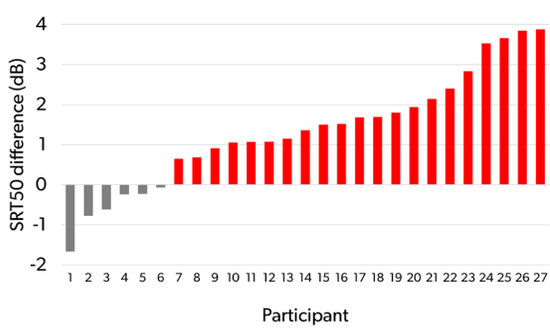

FIGURE 4 Individual SRT50 differences. Positive values indicate a benefit of Signia IX (marked in red), while negative values indicate a benefit of Brand A1 (marked in grey). Participants have been numbered according to the rank of their individual difference.

As shown in Figure 4, 21 out of the 27 participants (77%) experienced an improvement with Signia IX compared to the competitor hearing aids. Figure 4 also shows that higher magnitudes of benefit were obtained with Signia IX, improving the SRT50 by as much as 3.9 dB for some participants. In comparison, among the six participants performing better with Brand A1, the highest benefit was 1.8 dB whereas the benefit for the remaining five participants was below 1 dB.

Discussion

The results from this study show a clear speech understanding benefit of Signia IX with RealTime Conversation Enhancement when compared to a competitor hearing aid with an AI co-processor-driven platform. As explained in the Results section, the observed SNR50 benefit of 1.4 dB can be converted to a 22 percentage-point increase in speech understanding.

The results of this study are consistent with the outcome of the technical comparison of the two hearing aids (Jensen et al., 2024), which showed Signia IX provided a 3.2 dB higher output SNR in a simulated group conversation in noise compared to the Brand A1 hearing aids. Improving the SNR is an important prerequisite for improving speech understanding, and the effect is clearly demonstrated in this study. As mentioned in the Introduction, there are a number of reasons why a one-to-one relationship between SNR and speech understanding (e.g., as measured by the SRT50) cannot be assumed. It is also important to note that the test setups in the two studies were different, and there were variations in the input SNRs used for testing. However, both studies lead to the same overall conclusion: Signia IX provided significantly better speech in noise performance than the competitor.

When looking for possible explanations for the superiority of Signia IX in the noisy group conversation scenario, a few important key characteristics of the IX signal processing come to mind. The multi-stream processing approach applied in Signia IX is fundamentally different than the conventional single-stream processing approach applied by Brand A1 and other competitor hearing aids. Signia IX's split processing allows independent processing of the speech that the wearer wants to focus on, separate from the surrounding sounds. Contrary to the single-stream approach, split processing creates a clear contrast between the speech and the surroundings. This approach enables the wearer to hear the speech prominently while still being immersed in their surroundings. On top of this, RealTime Conversation Enhancement performs a detailed analysis of the conversation scenario, and multiple focus streams are steered towards and locked onto relevant conversation partners, allowing the wearer easy access to speech streams from more than just one talker in front of the wearer, even when the talkers move around or when the wearer turns their head.

Summary

In this study, we investigated the ability of Signia IX and a premium competitor RIC hearing aid with an AI co-processor-driven platform to provide speech understanding in a noisy group conversation. The assessment was done with a modified version of the standardized Oldenburger Satztest (OLSA), where target speech was presented from alternating directions in a background of canteen noise and interfering speech to simulate a realistic dynamic group conversation in noise.

Twenty-seven people with hearing loss took part in the study. The results showed that the mean speech reception threshold (SRT50) with Signia IX was 1.4 dB better (lower) than with the competitor. The mean SRT50 reduction was highly significant and corresponds to a 22% increase in speech understanding. In the test, 77% of the individual participants performed better with Signia IX than with the competitor hearing aids.

This study confirms that the technical SNR improvement provided by Signia IX, which was found in a previous study, translates into a speech understanding benefit for the wearer in a noisy group conversation.

The results of this study indicate that the multi-stream processing offered by Signia IX's RealTime Conversation Enhancement provides a significant speech understanding benefit to the wearer in a dynamic group conversation in background noise.

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