# Field Study News

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# Phonak CROS II

## Improved speech understanding thanks to binaural beamforming

**With the introduction of Phonak CROS II, a binaural adaptive beamformer is available in a Contralateral Routing of Signal (CROS) system, for the first time. The binaural beamformer creates a narrower beam that allows a listener to focus on a particular voice when in a noisy situation. The result is improved speech understanding.**

**This study aimed to investigate speech understanding differences in difficult listening situations with two CROS generations from Phonak. The newer Phonak CROS II, provided more benefit when compared to the Phonak CROS, which has a monaural adaptive beamformer.**

## Introduction

Speech understanding in loud and noisy situations is a big challenge, especially for people with Single-Sided Deafness (SSD) (Schafer et al. 2013). Previous CROS systems, which lacked a directional microphone, did not provide improvements in speech understanding in noise.

The new Phonak CROS II, based on the Phonak Venture Platform, now features Binaural VoiceStream Technology™ which also includes the improved Speech in Loud Noise (SPiLN) program, either as an automatic feature or as a manual program. For the first time, people with SSD can benefit from the improved Signal to Noise Ratio (SNR) that is provided by binaural adaptive beamformers.

The objective of this study was to provide evidence for improved speech understanding in noise by testing the adaptive binaural beamformer, Phonak CROS II, in comparison to a monaural adaptive beamformer, Phonak CROS.

## Method

Twenty subjects participated in this study. All subjects had a hearing loss in one ear, which derived no benefit from a hearing aid. Ten of them had normal hearing in their "better" ear (CROS group) and the other ten had a mild to severe hearing loss in their "better" ear (BiCROS group). Subjects were fitted with a CROS transmitter on the unaidable ear and a hearing aid in the other ear. Table 1 shows the exact aids the two subject groups were fitted with.

| Platform | CROS group | BiCROS group |
|---|---|---|
| Venture (V) | Phonak CROS II/ Phonak Audéo V90-312 | Phonak CROS II/ Phonak Audéo V90-13 |
| Quest (Q) | Phonak CROS/ Phonak Audéo Q90-312 | Phonak CROS/ Phonak Naída Q90-RIC |

**Table 1: The Venture and Quest hearing aids that were fitted to the CROS and BiCROS groups.**

The Phonak CROS II aids were tested in the lab as well as for home trials. Phonak CROS (Quest) aids were tested in the lab only. All hearing aids were programmed according to the subjects' individual hearing loss and the first fit recommended by the fitting software. The acoustic coupling varied from open or closed domes to c-shells, if a closed fit was needed, but was kept consistent across test conditions.

The Oldenburg sentence test (OLSA), was used to measure the Speech Reception Threshold (SRT), i.e. the SNR which yields a speech score of 50% correct. The OLSA was carried out adaptively, starting with an SNR of 0dB at 65 dB SPL noise level. The subjects were seated in the center of a circle of loudspeakers. Cafeteria noise was presented from 90° and 270° azimuth, and speech material was presented from 0° azimuth. The hearing aids were set to different programs: The Phonak Audéo Q and Phonak Naída Q hearing aids were set to a manual Speech in Noise (SPiN) program with UltraZoom (UZ), the monaural adaptive beamformer and Phonak CROS aids were set to Real Ear Sound (RES). The Phonak Audéo V and Phonak CROS II aids had a manual SPiN program and a manual SPiLN program with StereoZoom (SZ) enabled in both aids. Table 2 shows the beamformer setting in the Quest and Venture hearing aids.

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| Product | Manual program | Beamformer name | Beamformer behavior |
|---|---|---|---|
| CROS II / Audéo V | Speech in Noise (SPiN) | UltraZoom / Real Ear Sound | Adaptive monaural |
| CROS II / Audéo V | Speech in Loud Noise (SPiLN) | StereoZoom / StereoZoom | Adaptive binaural |
| CROS / Audéo Q | Speech in Noise (SPiN) | UltraZoom / Real Ear Sound | Adaptive monaural |
| CROS / Naída Q | Speech in Noise (SPiN) | UltraZoom / Real Ear Sound | Adaptive monaural |

**Table 2: Beamformer settings for the different hearing aid combinations used in the study.**

In an extended part of the study, ten further subjects with a mild to severe hearing loss were fitted with the appropriate Venture based custom devices: CROS II-312 Custom and Virto V90-312. To compare the results to Quest, CROS-312 and Virto Q90-312 were used. The same tests including the set up described above was used.

A test and retest of each hearing aid combination was performed, but no significant differences were found. The Shapiro-Wilk-Test showed a normal distribution of the data and therefore the t-test for dependent (correlated) samples was used for the statistical analysis. The p values were adjusted according to Bonferroni (the level of significance ($\alpha$) was set to $\alpha\alpha$ = 0.017).

## Results

The following graphs show the results for speech understanding measured with the OLSA. Two subjects of the BiCROS group were unable to perform the OLSA. One of these subjects relied on lip reading and the other subject had a hearing loss on the better ear that was beyond the fitting range.

Figure 1 shows the SRT in dB for different aids and manual programs for the BiCROS subjects. For this group, the binaural adaptive beamformer of Phonak CROS II resulted in better SRT values than the monaural beamformer of Phonak CROS and CROS II aids. The average improvement of 3.8 dB over the monaural adaptive beamformer of CROS II was significant (p = 0.002, t-test).

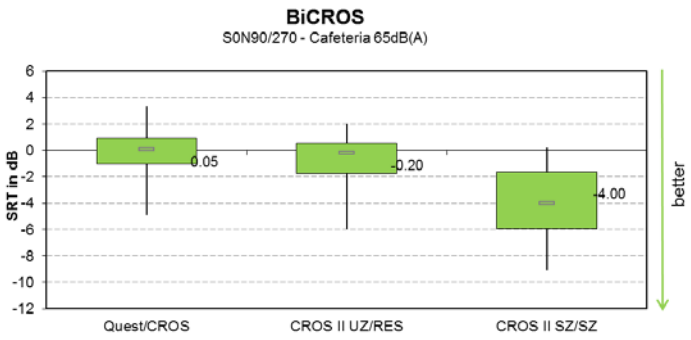


**Figure 1: Speech understanding in noise for BiCROS subjects (n=8) measured with the Oldenburg sentence test (OLSA). The SRT in dB is shown for Phonak CROS II (monaural (UZ/RES) and binaural (SZ/SZ) beamformer settings), and Phonak CROS. The boxplot shows the median, the first and the third quartile, the minimum and the maximum value. Lower values indicate a better performance.**

Figure 2 shows the SRT in dB for the different aids and manual programs for the CROS subjects. No significant SRT differences between the CROS aids were detected. A possible explanation is that the CROS subjects were fitted with an open acoustic coupling. For the binaural adaptive beamformer, a signal with an improved SNR is provided at the output of the hearing aid to improve the speech intelligibility. When using an open acoustic coupling, direct sound leaks through the open ear and the improved SNR is limited due to a masking effect.

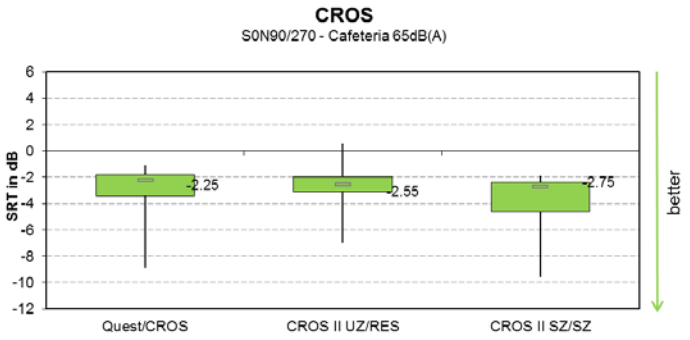


**Figure 2: Speech understanding in noise for CROS subjects (n=10) measured with the Oldenburg sentence test (OLSA). The SRT in dB is shown for Phonak CROS II (monaural (UZ/RES) and binaural (SZ/SZ) beamformer settings)and Phonak CROS. The boxplot shows the median, the first and the third quartile, the minimum and the maximum value.**

Figure 3 shows the SRT in dB for the group of subjects fitted with custom products. CROS II-Custom with the binaural adaptive beamformer shows a significant improvement of 4.3 dB (p < 0.001) over the monaural adaptive beamformer of CROS II-Custom. There was no significant difference between the monaural adaptive beamformers of CROS-Custom and CROS II-Custom.

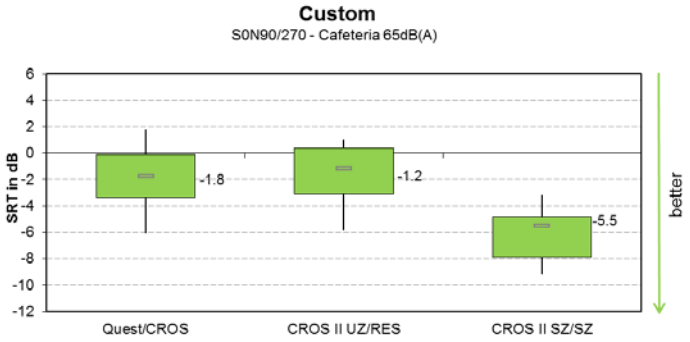


**Figure 3: Speech understanding in noise for BiCROS Custom subjects (n=10) measured with the Oldenburg sentence test (OLSA). The SRT in dB is shown for Phonak CROS II Custom (monaural (UZ/RES) and binaural (SZ/SZ) beamformer settings), and Phonak CROS Custom. The boxplot shows the median, the first and the third quartile, the minimum and the maximum value.**

After one week of home trials, the subjects reported on their experiences with the Phonak CROS II. One subject from the CROS group said: "I could clearly hear and understand more compared to my current hearing aids and to without hearing aids. They sounded more natural and I did not even notice I was wearing hearing aids. This was what I have always been looking for". Another subject from the BiCROS group said: "I was surprised by the hearing aids in a positive way. I was in a big room/hall with

300 people and loudspeaker announcements, but the speech understanding was excellent in that situation. Other hearing aids I have worn often had to be fine-tuned, but this was not necessary with CROS II".

## Conclusion

This study clearly demonstrates, that the binaural adaptive beamformer of Phonak CROS II outperforms the monaural adaptive beamformer of Phonak CROS and CROS II. With the binaural adaptive beamformer of CROS II, subjects showed a benefit objectively and subjectively when in a 'speech in loud noise' situation. Thanks to Binaural VoiceStream Technology™ and StereoZoom, people with SSD will benefit from significant improvements in speech understanding compared to using a monaural adaptive beamformer (SPiN).

In summary, the proven performance of Phonak CROS II should improve life quality for people with SSD.

## References

Schafer, E, Baldus, N, D'Souza, M, et.al, 2013, Behavioral and Subjective Performance with Digital CROS and BiCROS Hearing Instruments, Journal of Rehabilitative Audiology, in press.

## Authors and Investigators

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