WHITEPAPER
2019

Oticon CROS

SUMMARY

Oticon now introduces Oticon CROS, the first ever wireless CROS/BiCROS solution using an open sound paradigm and with dual-streaming capability via TwinLink™.

Oticon CROS is a unique solution for persons with single-sided deafness and it now makes the advanced signal processing of the OpenSound Navigator™ feature available to even more people with hearing loss.

A 2019 internal study shows the benefit of having dual-streaming capability within a CROS solution. While streaming sound using 2.4 GHz Bluetooth® low energy technology, the CROS transmission (via Near-Field Magnetic Induction) was switched on and off in order to determine whether or not transmission of sound from the test subject's poorer ear side affected a person's awareness of speech in the environment. Results showed a 50% improvement in speech awareness when transmission was active during streaming from an external source.

This tells us that CROS/BiCROS users can benefit greatly from having access to speech information in their environment, also while streaming. Oticon now delivers a unique solution for people with single-sided deafness.

Susanna Løve Callaway, Au.D.
Director of Clinical Audiology,
Oticon A/S, Denmark

Pernille Aaby Gade
Clinical Research
Audiology Assistant
Oticon A/S, Denmark

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The Oticon CROS solution

Oticon CROS is a new solution for persons with single-sided deafness (SSD) or unaidable hearing on one ear. The Oticon CROS solution consists of a hearing aid and a transmitter and it is a non-invasive solution for those who, for medical or other reasons, are not candidates for bone-anchored hearing solutions (BAHS).

The CROS transmitter sends a signal via Near-Field Magnetic Induction (NFMI) to the receiving and compatible Oticon hearing aid located on the better ear. Figure 1 shows the two options, where the better ear can be either normal hearing (CROS fitting), or hearing impaired (BiCROS fitting). The CROS transmitter is a miniRITE T style hearing aid with the necessary functionality to perform advanced signal processing much like an Opn S hearing aid.

OpenSound Navigator

Oticon CROS features a version of the OpenSound Navigator (OSN) that is optimised for this user group. OSN as implemented in Opn S hearing aids has four help levels (Low, Medium, High, and Very high) and a varying degree of available noise reduction in simple and complex environments. Oticon CROS settings differ from default OSN settings due to the unique needs of people with single-sided deafness. OSN in Oticon CROS is implemented with a fixed 0 dB noise reduction setting for simple environments and a -5 dB noise reduction setting for complex environments. The transition setting is High, meaning that the -5 dB noise reduction is provided for users, even in less noisy environments. It is vital that the CROS/BiCROS users have access to noise reduction on their poorer ear side, while simultaneously maintaining access to environmental sounds and thus allowing the best conditions for speech awareness on the poorer ear side.

Dual-streaming and speech awareness

Prevalence data on single-sided deafness can be difficult to come by, but one dataset from the United States shows approximately 60,000 new cases of single-sided deafness arise in the United States each year (Williams, McArdle, & Chisolm, 2012). This is obviously a smaller client group compared to people with bilateral hearing loss and the consequences of SSD can differ quite a bit from bilateral hearing loss. Without the benefit of binaural hearing, people with SSD often struggle with listening in noisy environments and localisation of sounds (Olsen, Hernvig, & Nielsen, 2012). They also struggle with impaired speech understanding, reduced spatial awareness, and they may experience a reduced ability to selectively attend to one sound (Lucas, Katiri, & Kitterick, 2018). These factors cause difficulties when trying to identify the direction of unexpected sounds, and in the Lucas et al study (2018), it led to test subjects reporting that they often incorrectly presumed all sound sources to be located on the better ear side (Lucas, Katiri & Kitterick, 2018).

The functional hearing difficulties associated with SDD may also affect social and psychological well-being (Lucas, Katiri, & Kitterick, 2018). Test subjects of this study reported embarrassment related to social stigma and reduced confidence and belief in their ability to participate in communication. The social consequences

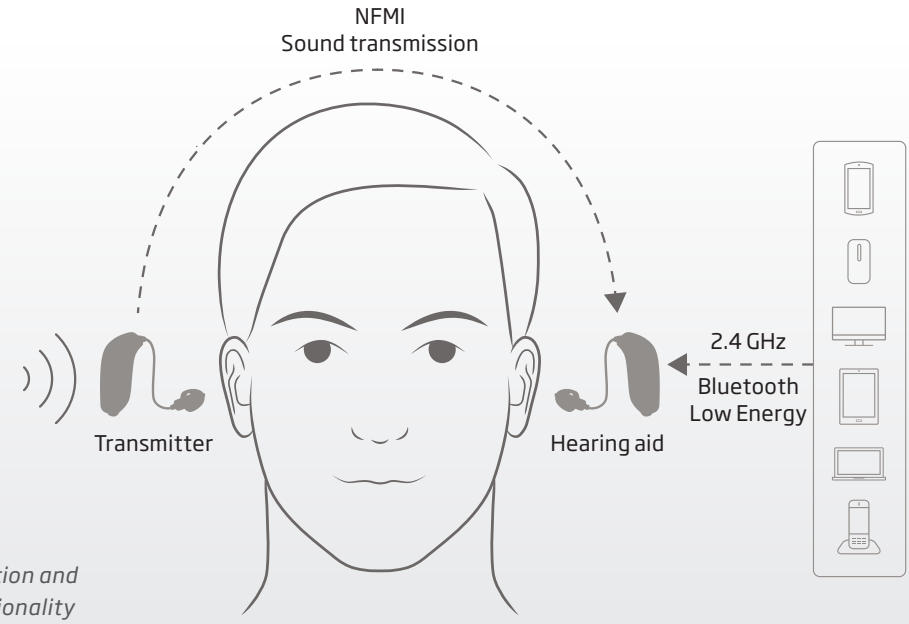

Figure 1.
The Oticon CROS solution and dual-streaming functionality

of SDD resulted in activity limitations and participation restrictions including withdrawal from and within situations.

Consequences of a hearing loss are of vital importance within the Oticon BrainHearing™ paradigm, the main goal being to enable people to communicate freely, interact naturally, and participate actively in life. In light of this, the user of the Oticon CROS solution should experience improved audibility, environmental awareness, and better speech understanding for sounds on their poorer ear side because they now have access to these sounds in their better ear.

Speech awareness study on Oticon CROS

The study described here focused on a different aspect of the Oticon CROS solution, namely its unique ability to stream two sound sources simultaneously and how this can benefit the user. In the study, the outcome measure was speech awareness of target words that were presented at the test subjects' poorer ear side during streaming from an external source. It was hypothesized that test subjects would be significantly more aware of the target words when the transmission of sound via NFMI was active versus inactive, all the while listening to a main sound source from the ConnectClip accessory.

The test subjects were 8 people with SSD, half of them CROS candidates and the other half BiCROS candidates. The average age was 59 years old, spanning from 18 to 80 years of age. Five test subjects had never previously worn a hearing aid or a CROS system, while three wore competitor CROS solutions. All test subjects had been appropriately fitted with the Oticon CROS solution prior to the lab test.

As mentioned, the study included two test conditions: the conditions differed by whether the CROS transmission was turned ON (dual-streaming) [condition 1] or OFF [condition 2]. In both conditions, a ConnectClip streamed a speech signal to the receiver hearing aid worn on the better ear, Figure 2.
In the sound studio, the test subjects were given two simultaneous tasks but were trained in performing the first task before the second was introduced:

The first task was to listen to 1 minute news segments about a variety of unknown topics. These were streamed to the receiver of the CROS device via the ConnectClip, and the test subjects were instructed to pay attention to these. The ConnectClip was placed in front of the test subjects on a KEMAR manikin with the microphone within 20 cm of KEMAR's mouth and the news segments being played out of the mouth.

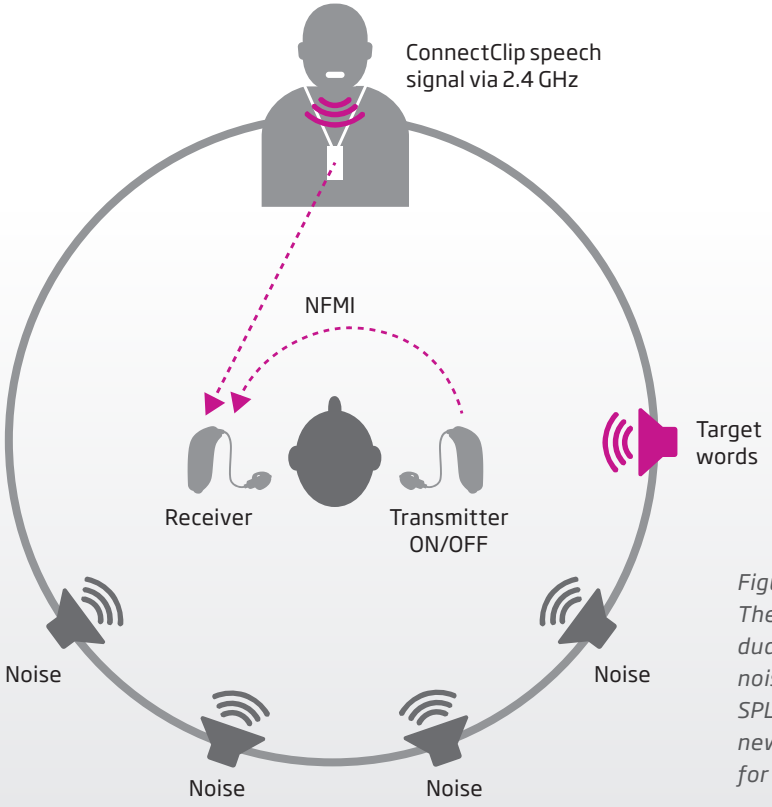

Figure 2.
The sound studio setup in the dual-streaming study. ICRA noise level was a fixed 67 dB SPL while target words and news segment were adjusted for each test person.

After each 1 minute news segment, the test subjects were prompted to answer a question about the segment on a tablet. Once test subjects were comfortable with this task, the second task was added.

The second task was to hear common two-syllable Danish target words presented from a loudspeaker on the transmitter side, and to respond by pushing a button whenever test subjects became aware of a word. These responses were the outcome measure of the test and they indicated the test subjects' awareness of a speech signal on their poorer ear side (Figure 2).

Noise was present throughout the test from a four loudspeaker array behind the test subjects.

The noise was International Collegium of Rehabilitative Audiology (ICRA) noise, presented at a fixed level of 67 dB SPL. The purpose of the noise was to create a realistic real-world situation where a CROS/BiCROS candidate might choose to use an assistive listening device (ConnectClip) to help them hear better.

The news segments were created at Eriksholm Research Center in Denmark and consisted of 26 speech stimuli, each lasting 1 minute. The speaker of the signals was the same female speaker throughout, and no background sounds or sound effects were added to the signal. This signal, streamed from the ConnectClip was adjusted to be presented at a comfortable listening level for each test subject, since it was important that the test subjects heard the signal easily and clearly. This differed from the ICRA noise (fixed at 67 dB SPL)

The second signal, the two-syllable target words, were specifically created for this study and consisted of 208 short, common Danish words or phrasal verbs, e.g. "Cola", "undskyld" (English: "sorry") and "se her" (English: "look here"). The words were adopted from Danish news feeds, and the goal was to use clear words of different types that can be found in many communicational situations. The target words were presented with randomised breaks of 2, 4, 6, and 8 seconds and there were 8 words in each 1 minute test segment. The length of the pauses were varied to prevent predictable time intervals and thus, predictable responses from the test subjects. It was also important that the test subjects had enough time to perceive and respond to the target word before the next target word was presented. A response from the test subject was scored as correct if it was present within 2 seconds of the target word presentation.

For all test subjects, the test had two blocks corresponding to the two conditions (transmission ON versus OFF), after training conditions were completed. Each block consisted of 13 1 minute segments with one news segment and 8 target words within each segment. The two conditions were randomised across test subjects, but the segments and target words were not. Thus, each test subject was subjected to a total of 26 sessions, corresponding to 104 data points per condition (208 in total).

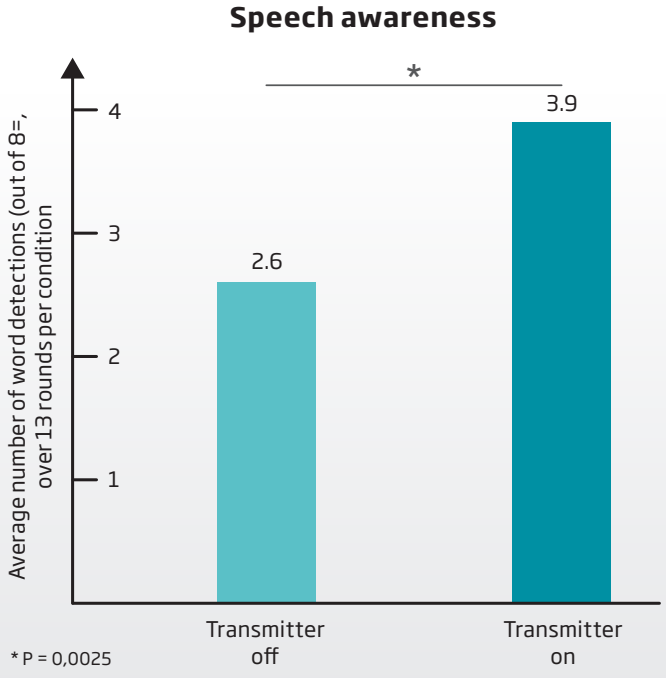

Figure 3.
Results showed a 50% improvement in speech awareness from transmission OFF to ON conditions (P = 0,0025).

To prepare the test subjects on the task, it was necessary to run one training block. The training block also contributed to adjust and pinpoint the individual test subject's level of the target words. The aim was to find the level at which the individual test subject was aware of and responded to approximately 2 out of 8 possible target words. This was to avoid a ceiling effect of condition 1, when the transmitter was turned on. The level of the target words started at 65 dB SPL, and the test leader would raise or lower the level for the signal depending on the test subject's responses until the goal was reached.

Results

This study showed a statistically significant difference in speech awareness ability for test subjects when the transmission of sound was turned OFF (2,6 out of 8 words, or 33%) versus ON (3,9 out of 8 words, or 49%) while streaming from an external source (Figure 3). This meant that the test subjects pressed the button because they detected target words on their poorer side 50% more often when the transmission was ON versus OFF. The results show the intrinsic value of having dual-streaming capability within the CROS solution. In Figure 3, the average improvement for each 1 minute segment is shown for the ON versus OFF conditions. In other words, on average, 3,9 out of 8 words were detected per 1 minute segment for the transmitter ON condition.

This benefit translates to a distinct advantage in real-world situations. An apt comparison is when many telecoil users want the option of being able to keep their hearing aid microphones on while receiving sound through a loop sound. They use this to be able to carry on a conversation with someone sitting next to them in a church, an auditorium, a theater experience, or while watching a film at home. People with single-sided deafness have similar needs while streaming. They do not want to lose control of their environmental awareness (traffic, public situations) and they want to be aware of and attentive to some speaking to them (person sitting on poorer ear side).

Conclusion

Oticon CROS is a new introduction from Oticon and it completes a strong family of products on the Velox S platform. Oticon CROS brings the proven benefits (better speech understanding, less listening effort, and improved memory recall) of the advanced signal processing of OpenSound Navigator to people with single-sided deafness. Furthermore, TwinLink dual-streaming means providing users with improved environmental awareness and speech awareness while streaming. As a matter of fact, a recent study reported in this white paper showed a 50% improvement in speech awareness in a dual-streaming scenario. With TwinLink, Oticon CROS brings a unique, one-of-a-kind feature and advantage to people with single-sided deafness by facilitating easier communication and many day-to-day life scenarios.

References

1. Laura Lucas, Roulla Katiri & Pádraig Thomas Kitterick (2018) The psychological and social consequences of single-sided deafness in adulthood, International Journal of Audiology, 57:1, 21-30, DOI: 10.1080/14992027.2017.1398420
2. Dillon, H. (2001). Hearing Aids. Boomerang Press, Australia.
3. Williams VA, McArdle RA, Chisolm TH. Subjective and objective outcomes from new BiCROS technology in a veteran sample. J Am Acad Audiol. 2012 Nov-Dec;23(10):789-806. doi: 10.3766/jaaa.23.10.5.
4. Self-reported hearing performance among subjects with unilateral sensorineural hearing loss. / Olsen, Steen Østergaard; Hernvig, Lotte Hagen; Nielsen, Lars Holme. In: Audiological Medicine, Vol. 10, 2012, p. 83-92.

6521:UK / 2019.06.04

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