Focus On

No. 2

A New Benchmark: Speech Perception in Everyday Life

Speech level varies or fluctuates over time. This happens during a conversation or discussion in everyday life. However, speech tests are normally performed at a fixed speech level. This means that classical speech tests do not appropriately challenge a CI system and cannot represent real-life listening situations with varying signal levels. In this paper, the results of two studies investigating speech perception at fixed and fluctuating levels are reviewed and discussed. **The results of these studies demonstrate superior and uncompromised performance for users of the OPUS 2 processor in everyday life without the need to make adjustments to the processor. Superior performance is also confirmed by a third study discussed in this paper.**

Influence of the Front End Processing on Speech Perception with Cochlear Implants of Various Manufacturers

This study[1] assesses the affect of front-end processing in cochlear implant systems on speech perception under fluctuating-level conditions. In a novel approach to speech testing, this study presented sentences at levels that pseudo-randomly varied from 65 dB SPL.

Methods

The study population (n=55) was divided into five equal groups of experienced adult cochlear implant users: group 1 with the Advanced Bionics Corporation Auria®BTE processor, group 2 with the Advanced Bionics Corporation Harmony® processor, group 3 with the Cochlear Corporation Esprit 3G® processor, group 4 with the Cochlear Corporation Freedom® processor, and group 5 with the MED-EL Corporation OPUS 2 processor. These groups were matched based upon age and duration of deafness. Esprit users had a longer duration of CI use than all other tested groups.

Sentences were taken from the HSM test material, with the presentation level of each sentence randomly varied by either 0, +10, or -10 dB in Experiment 1 and by 0, +15 or -15 dB in Experiment 2. The nominal (0 dB roving) presentation level was 65 dB SPL for both experiments, yielding ranges of 55 to 75 and 50 to 80 dB SPL. Competing un-modulated speech shaped noise was used to estimate Speech Reception Threshold (SRT) across a block of 30 sentences.

Results

Results from both experiments are displayed as the Speech Reception Threshold (SRT) for all five groups (Figure 1). The speech reception threshold (SRT) is a measure of how much noise a subject can tolerate and still understand 50% of speech correctly. Lower SRTs indicate better speech perception in noise. The smaller the SRT is, the more difficult the listening situation is. An SRT of 0 dB means that speech and noise are presented at the same level, while an SRT of +10 dB means that speech is 10 dB louder than the presentation level of the noise.

Statistical analysis reveals significant differences in performance for the 3G and OPUS 2 processors. Only MED-EL users could still understand 50% of speech when noise was presented at levels louder than speech. Additionally, only MED-EL users continued to improve as the listening condition became progressively more challenging. As evidenced by this independent research study, MED-EL audio processors provide outstanding hearing results, specifically in challenging listening situations.

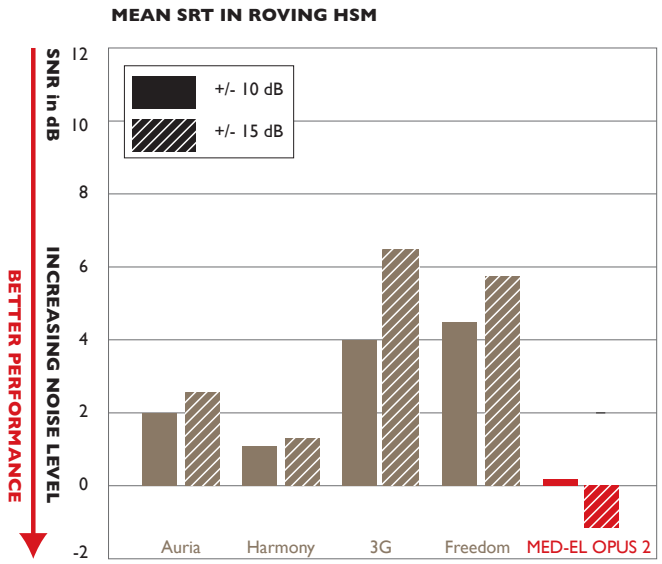

Figure 1

Adapted from Haumann et al., 2008

Performance with the OPUS 2 Processor in a Roving-level Speech Test

This study[2] aimed at comparing speech perception under fixed-level and fluctuating-level (or roving-level) conditions and built upon the test method used in the study by Haumann et al.[1]

Methods

The study population consisted of seven experienced users of the OPUS 2. To assess speech perception at fixed speech levels, adaptive OLSA sentence tests were performed at speech levels of 50 dB, 65 dB, and 80 dB. To assess speech perception at roving speech levels, a test was performed in which three adaptive OLSA sentence tests presenting speech at 50 dB, 65 dB, and 80 dB, respectively, were randomly interleaved. Thus, in this test, similar to the method used by Haumann et al., the presentation level of each sentence randomly varied by 0, +15 or -15 dB. Subjects were not allowed to make any processor adjustments during the tests but had to rely only on the Automatic Sound Management featured in the OPUS audio processors.

Results

The results of both the fixed-level tests and the roving-level tests are shown in Figure 2. Speech perception was not significantly affected by level within both the fixed-level speech tests and the roving-level speech tests. In addition, speech perception did not differ significantly between the fixed-level tests and the roving-level tests.

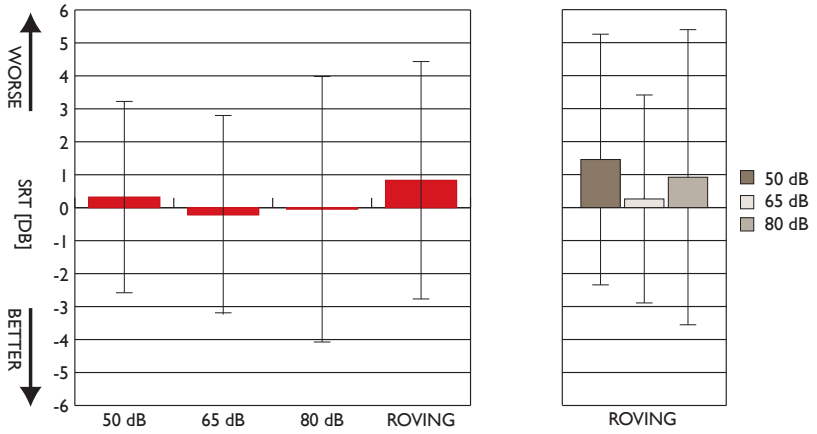

Figure 2

Speech Discrimination Scores Using the Latest Generation of Speech Processors

This study[3] aimed to determine that similar speech perception scores can be achieved by using different processor types, as patients have been advised in the past. In fact, the study found a trend towards better speech perception with the OPUS 2 processor.

Methods

Speech perception was evaluated in seven users (average duration of deafness 6.7 years) of the MED-EL Corporation OPUS 2 processor, 40 users (avg. DOD 8.3 years) of the Cochlear Corporation Freedom® processor, and three users (avg. DOD 2.8 years) of the Advanced Bionics Corporation Harmony® processor, using BKB sentences in quiet and noise, the CUNY sentences with lip reading, and AB words. Speech tests were also performed in users of previous generation audio processors, namely in 38 users (avg. DOD 9.0 years) of the MED-EL Corporation TEMPO+ processor, 89 users (avg. DOD 11.8 years) of the Cochlear Corporation Esprit 3G® processor, and ten users (avg. DOD 9.3 years) of the Advanced Bionics Corporation Auria® processor.

Results

Results for all tests are shown in Figure 3. Scores were highest for users of the OPUS 2 processors across all tests and the authors stated that there was "a trend towards better speech discrimination for patients using the OPUS 2 device".

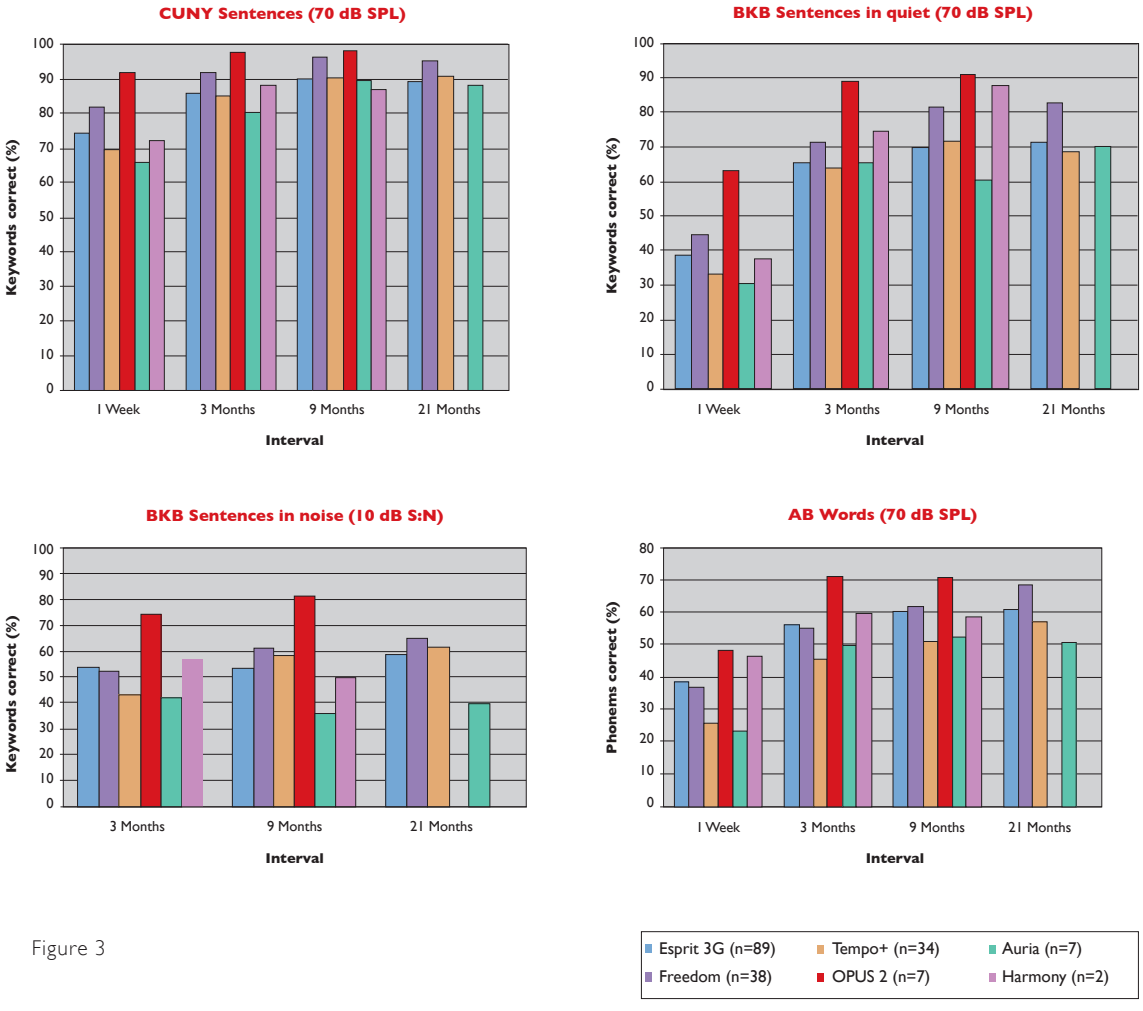

Figure 3

Discussion & Conclusions

The roving level tests presented here represent everyday life situations better than fixed level tests. In the study by Haumann et al.[1], although the subjects did not differ concerning demographics, statistically significant differences between devices were found. The dual loop Automatic Gain Control and wider Input Dynamic Range used by Advanced Bionics and MED-EL processors seem to yield advantages for varying acoustical situations. The study demonstrated superior performance with the OPUS 2 processor. Only MED-EL users could still understand 50% of speech when noise was presented at levels louder than speech. Additionally, only MED-EL users continued to improve as the listening condition became progressively more challenging. As evidenced by this independent research study, MED-EL audio processors provide outstanding hearing results, specifically in challenging listening situations.

The study by Nopp et al.[2] further substantiates the results of the Haumann et al. study[1]. The results demonstrate that users of the OPUS 2 processor can understand soft and loud speech equally as well as normal speech without the need for processor adjustment. The results further demonstrate that OPUS 2 users can also understand fluctuating speech equally as well as fixed speech, again without the need to adjust the processor. Superior performance of the OPUS 2 processor as found in the study by Haumann et al.[1] is confirmed in the study by Brough et al[3]. The results demonstrate a trend towards better speech perception in quiet and in noise for users of the OPUS 2 processor.

In conclusion, the results of the studies presented above show that performance with the OPUS 2 processor remains uncompromised at fixed levels ranging from soft to loud, and even in speech fluctuating between soft and loud. The results also demonstrate superior performance of the OPUS 2 processor. Since the OPUS 1 processor is technically identical to the OPUS 2 as far as these studies are concerned, the results should be applicable to the whole range of OPUS audio processors.

Interpretation

The study results reported here are testaments to the long-standing commitment by MED-EL to advancing state-of-the-art technology in hearing implants. MED-EL's highly sophisticated Automatic Sound Management, as well as pioneering Fine Structure Processing (FSP*) strategy are just two examples of the industry's leading research and development efforts. The Automatic Sound Management technology provided by OPUS audio processors ensures that both soft and loud sounds are heard clearly and comfortably in all listening situations. Features such as the Adaptive Sound Window and the Dual-Loop Automatic Gain Control (AGC) support the best possible performance. The FSP strategy* is the first strategy designed to provide temporal fine structure coding in the low frequencies with cochlear implants.

While some cochlear implant systems require the user to adjust switches and select special programs to adjust for difficult listening situations, OPUS audio processors make all adjustments automatically, based on the listener's environment using Automatic Sound Management. Although users can still make adjustments if desired, the system is designed for carefree listening, regardless of the acoustic environment.

References

1 Haumann et al., 8th International Conference of the European Society of Paediatric Otorhinolaryngology, Budapest, 8–11 June 2008

2 Nopp et al., 9th Europ. Symposium on Paediatric Cochlear Implantation, Warsaw, 14–17 June 2009

3 Brough et al., British Cochlear Implant Group Annual Conference, Cambridge, 22–23 June 2009

* FSP is not indicated for use by prelingual children in the US.

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