AUDITORY IMPLANTS

The interplay of Forward Focus and Advanced Combination Encoder CI coding strategies in noisy conditions

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Abstract

Hearing in noise is challenging for cochlear implant users and requires significant listening effort. This study investigated the influence of Forward Focus (FF) and number of maxima of the Advanced Combination Encoder (ACE) strategy, as well as age, on speech recognition threshold and listening effort in noise. Another aim of this study was to measure how age affects the speech recognition threshold (SRT_{50}) of the Oldenburg Sentence Test (OLSA) and the listening effort at the corresponding signal-to-noise ratio (SNR_{cut}) in normal hearing listeners across age.

Thirty-three cochlear implant recipients were included, ninety-nine participants with age-related hearing loss in the 18–80 years age range, equally distributed in the 18–30, 31–40, 41–50, 51–60, 61–70, and 71–80 age groups, were included as control group. For the normal hearing listeners, speech recognition in noise decreased with age and became significant from the age group of 50–51. The decrease in SRT_{50} with age was greater for icra5 noise than for olnoise. For all age groups, SRT_{50} and SNR_{cut} were better for icra5 noise than for olnoise [1].

In CI users, Forward Focus significantly improved the SRT_{50} when noise was presented from the back, independent of subject age. The use of 12 maxima further improved the SRT_{50} when Forward Focus was activated and when noise and speech were presented frontally.

The measured age-related reference data for SRT_{50} and SNR_{cut} can be used in further studies in listeners with age-related hearing loss and hearing aid or implant users.

Objectives

To evaluate the effects of Forward Focus (FF) and number of ACE maxima on speech recognition and listening effort when fluctuating noise is presented from the front or the back.

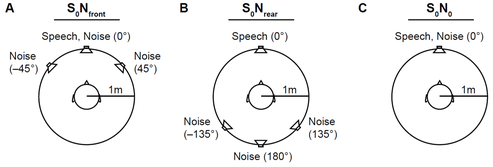
Investigation age effects between age a younger group and an older group of CI users

To compare the results to age-matched reference data of normal-hearing listeners [1].

We hypothesized that an increased number of ACE maxima would increase the spectral information of the CIs and therefore could reduce listening effort in noise and that the increased SNR by using FF would reduce listening effort in noise as well.

Methods

- Nucleus CI users, 14 ≤ 40 years, 18 > 40 years
- Forward Focus: On/Off; ACE maxima: 8 or 12
- Speech in noise perception: Oldenburg Sentence Test
- Listening effort: ACALES



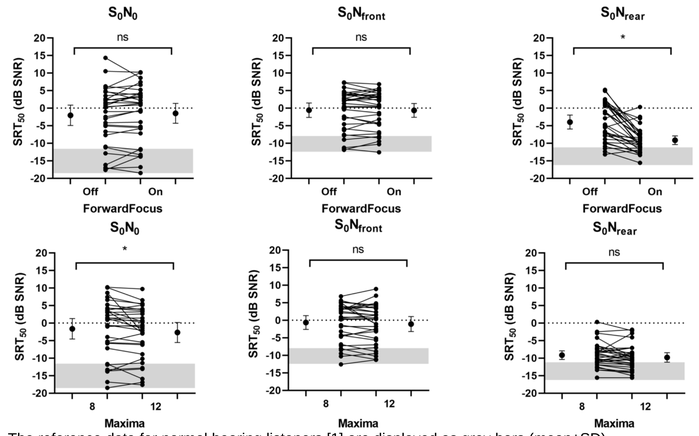
Results

Effect of Forward Focus on speech perception in noise

- Significant improvement in S_0N_{rear} condition
- No age effect

Effect of ACE maxima on speech perception in noise

- Significant improvement in S_0N_{rear} condition
- No age effect



The reference data for normal hearing listeners [1] are displayed as grey bars (mean±SD).

Significant more **listening effort** in older CI users group

FF: significantly reduced listening effort (2.4 dB) in the older age group; no ACE maxima effect [2]

Conclusion

- Forward Focus can significantly improve speech recognition in the presence of multiple noise sources presented from the rear, which can improve hearing in daily life.
- Forward Focus reduced listening effort in older CI users, for whom the listening effort is larger compared to younger and normal-hearing listeners.
- The number of ACE maxima decreased the speech recognition threshold in noise if speech and noise were frontally presented and did not affect listening effort.

References

[1] Rahne T, Wagner TM, Kopsch AC, Plontke SK, Wagner L (2023). Influence of Age on Speech Recognition in Noise and Hearing Effort in Listeners with Age-Related Hearing Loss. J Clin Med 12, 6133

[2] Wagner TM, Wagner L, Plontke SK, Rahne T (2024) Enhancing Cochlear Implant Outcomes across Age Groups: The Interplay of Forward Focus and Advanced Combination Encoder Coding Strategies in Noisy Conditions. J Clin Med 13 (5), 1399.

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