

Do models hear the noise? Predicting the outcome of the German matrix sentence test for subjects with normal and impaired hearing

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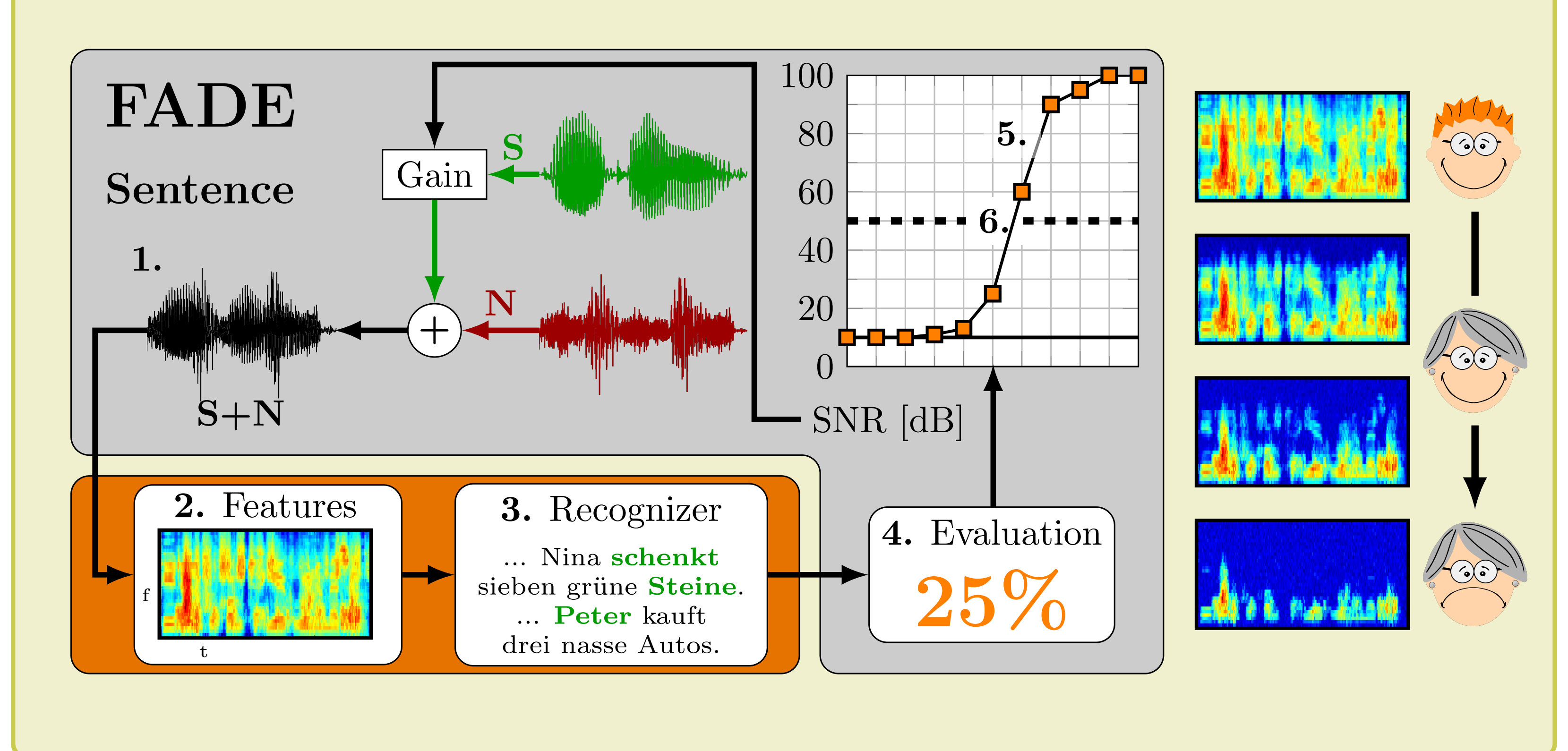
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SUMMARY

Impaired hearing negatively affects speech reception with the pure tone audiogram as the main measure for diagnostics of hearing impairment. In [5] speech reception thresholds in noise (SRTs) of 315 (hearing-impaired) ears were examined. Two domains with different linear dependences of the outcome were identified, i.e., effectively (a) listening in noise, and (b) listening in quiet. The goal here is to predict the outcome using the framework for auditory discrimination experiments [FADE, 4] and the speech intelligibility index (SII). Both succeeded in predicting the characteristic change in the slope, but over-all, FADE was found to be more accurate than the SII. However, both models indicated that the absolute hearing threshold is not enough to explain impaired speech reception, and further supra-threshold parameters need to be considered.

MODEL



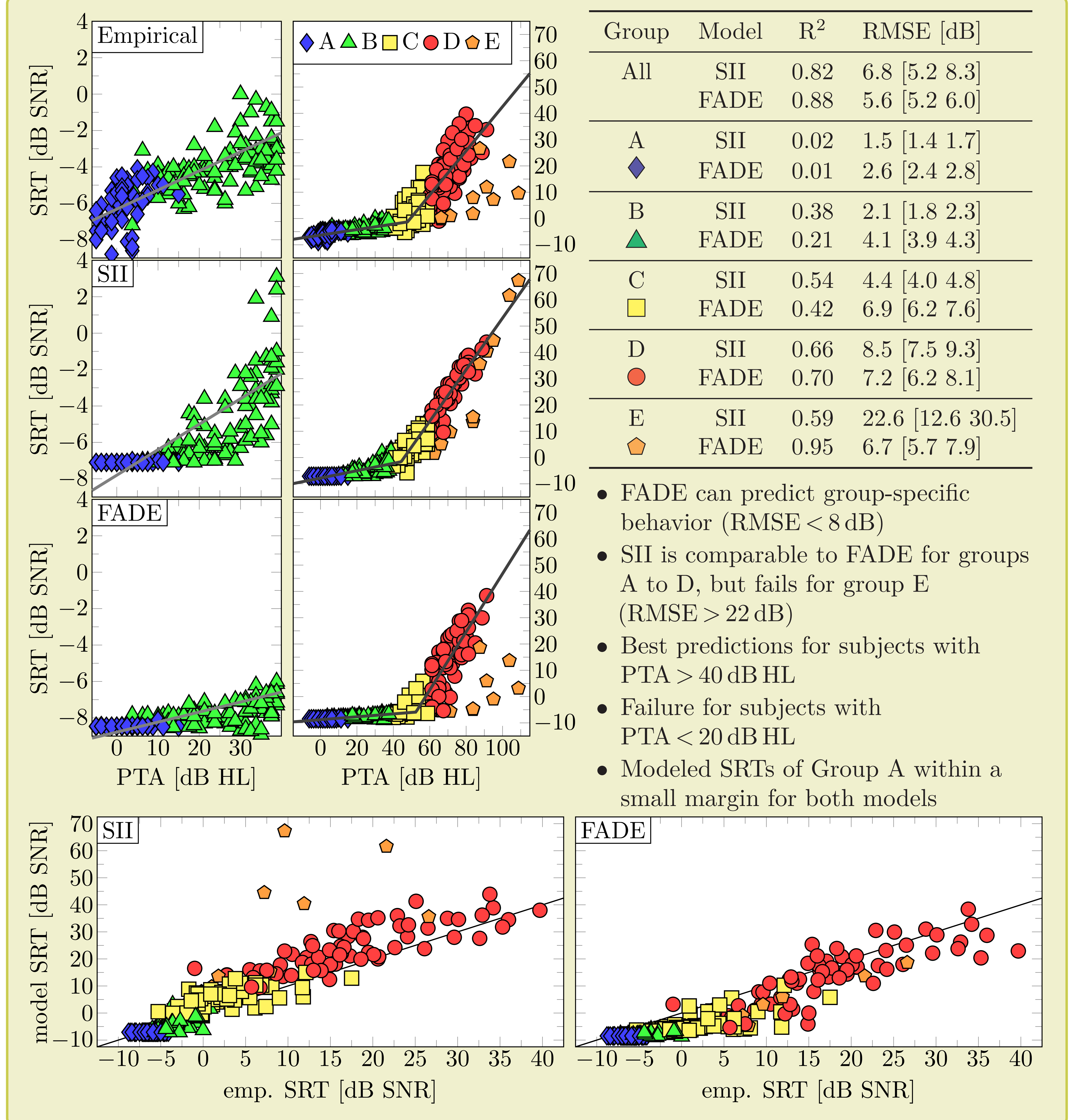
METHODS

- Empirical SRTs measured with 315 subjects using the German matrix sentence test [2].
- Four listener groups from normal (A) to severe hearing impaired (D), and one group with special cases (E).
- Stationary noise masker at 65 dB SPL.
- Models: FADE and the SII.
- Only absolute hearing thresholds used for modeling
- Empirical hearing thresholds raised by 7.5 dB for FADE based on prior study [3].
- Standard implementation of the SII [1] used.

DISCUSSION

- Models can hear noise. The SII showed a smoother transition between listening in noise and listening in quiet than FADE
- FADE could predict the SRTs of all groups of hearing-impaired including listeners with intense slope drops in threshold at high frequencies (group E). The SII underestimate the SRTs for group E.
- FADE still had a negative bias although the empirical hearing thresholds were raised by 7.5 dB.
- Both models predicted SRTs within a 2 dB margin for group A, which indicates that they miss factors different than pure tone threshold which contribute to differences across normal-hearing listeners.

RESULTS



CONCLUSION

- FADE can predict the speech reception thresholds of all subjects and shows an interaction between pure tone average and the noise level.
- The current performance is not satisfying, but FADE offers a promising solution towards precise predictions as it is an open-ended model.
- The accuracy of the standard measure of the absolute hearing threshold (± 5 dB) might unmask as insufficient for precise individual predictions.

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 [3] B. Kollmeier, M. R. Schädler, A. Warzybok, B. T. Meyer, and T. Brand. Sentence recognition prediction for hearing-impaired listeners in stationary and fluctuation noise with FADE: Empowering the attenuation and distortion concept by Plomp with a quantitative processing model. *Trends in Hearing*, 20(0):2331216516655795, sep 2016.
 [4] M. R. Schädler, A. Warzybok, S. D. Ewert, and B. Kollmeier. A simulation framework for auditory discrimination experiments: Revealing the importance of across-frequency processing in speech perception. *The Journal of the Acoustical Society of America*, 139(5):2708-2722, may 2016.
 [5] N. Wardenga, C. Batsoulis, K. C. Wagener, T. Brand, T. Lenarz, and H. Maier. Do you hear the noise? The German matrix sentence test with a fixed noise level in subjects with normal hearing and hearing impairment. *International journal of audiology*, 54(sup2):71-79, 2015.

