Evaluation of bilateral implantation and a new binaural sound coding strategy in realistic sound environments

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The aim of this study was to investigate the benefit of bilateral cochlear implantation in terms of speech intelligibility in noise in typical lab settings and in realistic sound environments.

Speech reception thresholds (SRTs) were measured in 10 bilateral cochlear implant (CI) subjects and 10 normal hearing (NH) listeners using the Oldenburg sentence test. SRTs were assessed in typical laboratory conditions: binaural summation (BS), spatial release from masking symmetric (SRM-S) and asymmetric (SRM-A) and squelch (SQ). Finally, SRTs were measured in two realistic sound environments rendering a cafeteria noise with the TASCAR library using seventh-order Ambisonics decoded to a 16 loudspeaker array [1]. Each condition was measured for unilateral and bilateral CI use or in NH listeners using one or both ears.

Bilateral CI users obtained an SRT benefit using the second implant only in the SRM-A condition. NH listeners however obtained SRT benefits when using both ears in the SRM-A, SRM-S and SQ conditions. The overall speech intelligibility improvements in the in the realistic environment synthesized through TASCAR show modest improvement in bilateral cochlear implant users and demonstrate a clear benefit in NH listeners. These results demonstrate the lack of binaural (note that this is different than bilateral) benefits of using two CIs and the good correspondence between the lab settings and the realistic environments.

The results observed in normal hearing and bilateral CI subjects are supported by instrumental measures based on the deterministic binaural short-time objective intelligibility (DBSTOI) [2] measure. The sounds were processed with a vocoder to model hearing after bilateral implantation and without vocoder to simulate normal hearing before analyzing them with DBSTOI. The DBSTOI was able to predict differences in measured performance between normal hearing and CI users. The DBSTOI has been used to optimize a sound coding strategy for binaural processing in CI users.

This work received funding from the DFG Cluster of Excellence EXC 1077/1 "Hearing4all" and the German Research Foundation (DFG) - Project number: 381895691

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