Realising the Head-shadow Benefit to Cochlear Implant Users

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Abstract:

Cochlear implant (CI) users struggle to understand speech in noise. They suffer from elevated hearing thresholds and, with practically no binaural unmasking, they rely heavily on better-ear listening and lip reading. Traditional measures of spatial release from masking (SRM) quantify the speech reception threshold (SRT) improvement due to the azimuthal separation of speech and interferers when directly facing the speech source. The Jelfs et al. (2011) model of SRM predicts substantial benefits of orienting the head away from the target speech.

Audio-only and audio-visual (AV) SRTs in normally hearing (NH) listeners and CI users confirmed model predictions of speech-facing SRM and head-orientation benefit (HOB). The lip-reading benefit (LRB) was not disrupted by a modest 30° orientation. When attending to speech with a gradually diminishing speech-to-noise-ratio (SNR), CI users were found to make little spontaneous use of their available HOB. Following a simple instruction to explore their HOB, CI users immediately reached as much as 5 dB lower SNRs. AV speech presentation significantly inhibited head movements (it nearly eradicated CI users’ spontaneous head turns), but had a limited impact on the SNRs reached post-instruction, compared to audio-only presentation. NH listeners age-matched to our CI participants made more spontaneous head turns in the free-head experiment but were poorer than CI users at exploiting their HOB post-instruction, despite their exhibiting larger objective HOB. NH listeners’ and CI users’ LRB measured 3 and 5 dB, respectively.

Our findings both dispel the erroneous beliefs held by CI professionals that facing the speech constitutes an optimal listening strategy (whether for lip-reading or to optimise the use of microphone directionality) and pave the way to obvious translational applications.


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Research summary
Biography:

My primary interest is in finding new ways to help the hearing impaired better understand speech in the most challenging situations, i.e. when noise and reverberation conspire to make speech almost unintelligible. Every little helps, every dB of improvement in speech reception threshold counts. A collection of small benefits can indeed make the difference between a unilaterally deaf person, a hearing aid user or a cochlear implant user being totally isolated or happily involved in face-to-face conversations in typically noisy social settings.

One approach is to help the hearing impaired make the best of the hearing they have, in combination with a given acoustic scene (e.g. my PhD). Another is to examine how sound coding could be improved so as to more faithfully transduce acoustical signals into the brain (e.g. my Postdoc).