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Towards patient-centric sound fitting for cochlear implant users

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Abstract:
Introduction: The electrode-neural interface for cochlear implant (CI) recipients is generally far less than ideal. The placement of electrodes relative to the spiral ganglion not only determines the spatial specificity of neural excitation, but also the characteristic frequencies of neural clusters. Large variation in electrode insertion depths across recipients generally results in a unique frequency-place relationship for each CI user. Despite this mismatch, contemporary CI sound processors are usually programmed to assign a generic, pre-defined frequency allocation to the electrode contacts across all users, with the expectation that CI users will accommodate to the frequency-place distortion with experience. The degree of spectral mismatch and an individual's ability to accommodate to the distorted spectral representation of the perceived sound may at least be partially responsible for degraded performance or slower accommodation to electrically-evoked hearing with CIs.
Methods: Five adult post-lingually deafened CI users participated in a semi-chronic study that lasted three months. Electrode placements were derived from patients' CT scans, which were used to create custom frequency-analysis tables for each individual. The frequency fitting strategy aimed at minimizing frequency-place distortions by achieving a balance between frequency matching and frequency compression to provide a physiologically relevant representation of the sound signal. Patients were fitted with these experimental programs and then evaluated on various open-set and closed-set speech recognition tasks in an acute manner as well as following three months experience.
Results: Results indicated that acute performance with the custom frequency allocation scheme was significantly lower than their clinical programs; however, over the course of three months all subjects displayed improvement with the experimental program. By the end of the three-month period, the average speech recognition with the custom maps reached to the same level of performance as of their original clinical map, indicating adaptation to the customized frequency maps. By the end of the study, all participants chose to keep the experimental program either exclusively, or with their old clinical programs.
Conclusion: Perceptual studies with CIs suggest that performance levels continue to improve at least up to two years post-activation of new maps. The data from this study indicate that patient-centric optimization of frequency fitting may hold potential for improving implant outcomes, particularly for recipients with moderate to high degree of frequency-place mismatch. Pitch percepts elicited by cochlear implants that are aligned or not drastically different from the normal cortical acoustic map could improve the bottom-up presentation of acoustic cues that may potentially lead to overall better speech perception.
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Learning Objectives (Complete):

Objective 1*:

: assess the effectiveness of an image-guided, patient-specific frequency allocation strategy that aims to tailor-fit sound processor frequency assignments based on the electro-neural characteristics of each individual.

Key Words for Objective 1*:

: sound processing

Status: Complete

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