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# Using cortical auditory evoked potentials in middle ear and bone conduction implant users: An objective method to optimize the fitting.

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## Introduction

**Cortical Auditory Evoked Potentials (CAEPs)** are generated by the auditory cortex in response to sounds.

This **objective measure** of sound perception was successfully applied to cochlear implant fitting procedures (Tavora-Vieira et al., 2022).

This study assessed the feasibility of using this method with **middle ear implant (MEI) and bone conduction implant (BCI) users.**

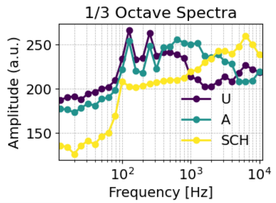
## Materials & Methods

### Participants

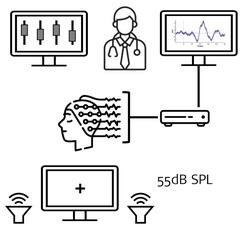
Fifteen adult BC and AMEI users (M = 50.3, SD = 12.85) participated. All subjects had a MED-EL implant and sound processor (MED-EL, Innsbruck, Austria). Three participants were Vibrant Soundbridge users, twelve Bonebridge users.

### Stimuli

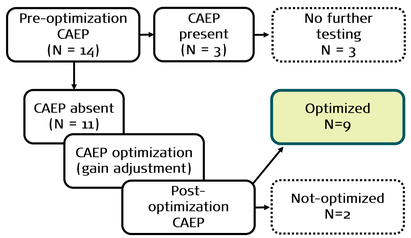
Stimuli were three LING sounds, chosen to cover the auditory spectrum relevant for human hearing.




### Setup

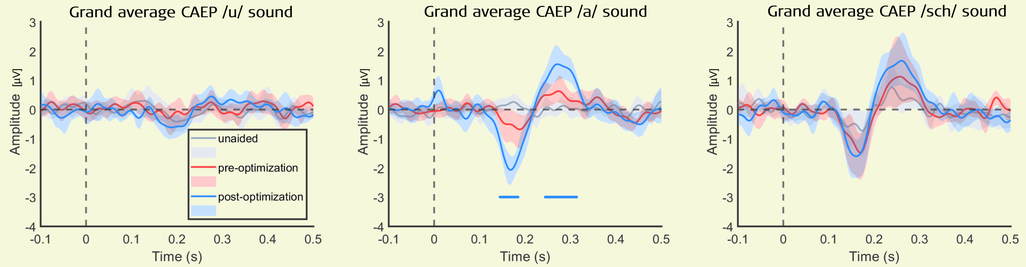



### CAEP optimization




## Pre- vs post-optimization EEG results

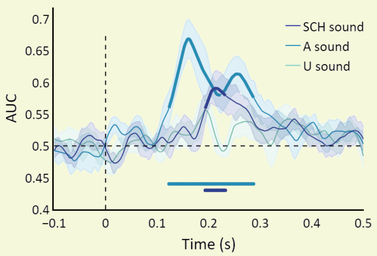
### CAEP univariate results



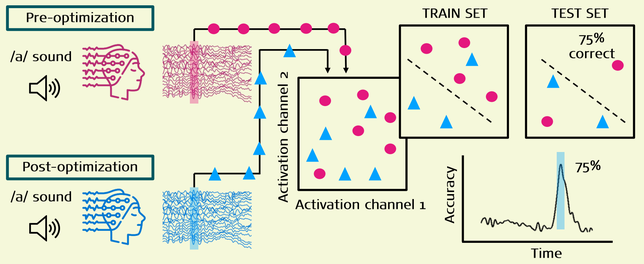

CAEPs to various sounds and conditions were recorded from electrode Cz. The solid line represents the mean response, with shading showing the 95% confidence interval. Highlighted sections indicate significant pre- vs post-optimization differences (cluster-corrected $p < .05$).

The /a/ sound was the only one showing a significant pre- vs post-optimization CAEP difference at 144-185ms (N1 window) and 244-313ms (P2 window) ($p < .05$, cluster-corrected).

### CAEP multivariate results




Timecourse of classification performance (pre- vs post-optimization). The solid line shows mean performance, with shading as the 95% confidence interval. Highlighted sections indicate when classification was significantly above chance (.5; cluster-corrected $p < .05$).

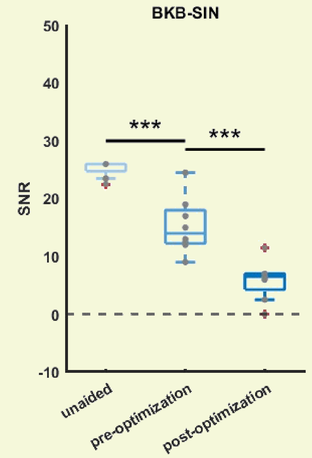



Machine learning results show above-chance pre- vs post-optimization classification for the /a/ sound (N1-P2 range, 123-289ms) and the /sch/ sound (P2 range, 193-234ms) ($p < .05$, cluster-corrected), confirming this approach's greater sensitivity to condition differences.

## Pre- vs post-optimization hearing performance

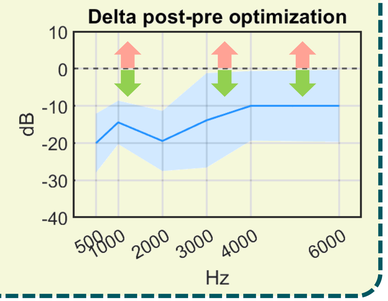
### Speech-in-noise results

ANOVA on BKB-SIN outcomes showed a significant effect of condition ($F(2, 21) = 60.69$, $p < .001$). Planned post-hoc comparisons evidenced significant improvements (all *p*s <. 001) in functional hearing, with an overall post- minus pre-optimization gain of -9.38 dB SNR.




### Audiometric results

An average improvement of -14.62 dB HL could be observed in the post- minus pre-optimization audiometric threshold, with various magnitudes at different frequencies.




## Conclusions

The current study provides the **first evidence** supporting the use of CAEPs for the optimization of MEI and BCI adult users' fitting maps ultimately resulting in significant improvements in hearing performance.

Távora-Vieira, Wedekind A. & Voola M. 2022. Single-Sided Deafness: Using Cortical Auditory Evoked Potential to Improve Cochlear Implant Fitting. *Otology & neurotology*, 43, e976-e983.

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