Improving language outcomes with bilateral cochlear implants

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Background

Compared to unilateral cochlear implantation (CI), bilateral CI improves spoken language outcomes in deaf children. It remains unclear whether this is due to having bilateral auditory input or true binaural processing[1]. In our lab, we are developing a non-invasive technique that may be used to gain further insight into neural binaural processing with bilateral CI[2].

Methods

- Eleven adults with normal hearing
- Simulation of bilateral CI-stimulation
  - Filtered clicks trains (78 pps)
  - Interaural phase difference (IPD) changing from 0° to 180°at 7.1 Hz
- EEG measures
  - Multichannel recordings (Biosemi)
  - Referenced to Cz
  - Denoised using spatial filtering[3]
  - Significant response = significant Hotelling's T2 test[4] at ≥5% of channels

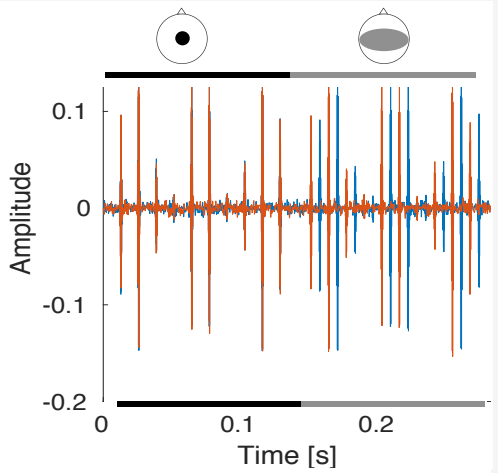

Fig 1: Stimuli in time domain

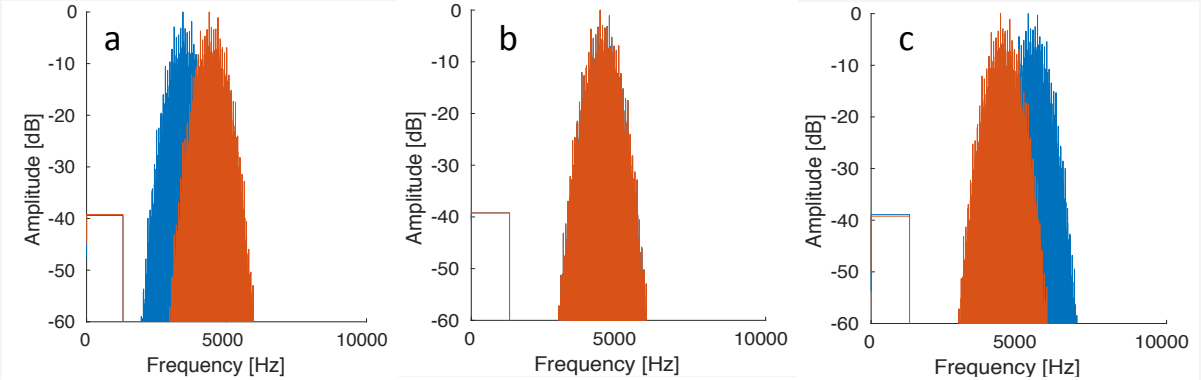

Fig 2: Stimuli in frequency domain for (b) matched and (a-c) mismatched conditions

Results

- Smaller responses were obtained for mismatched bilateral input

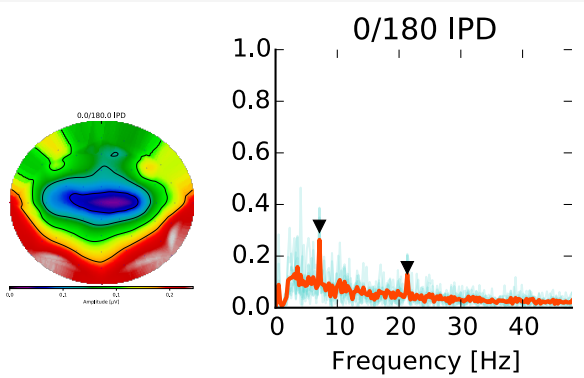

Fig 3: Topography and evoked responses evoked by matched condition

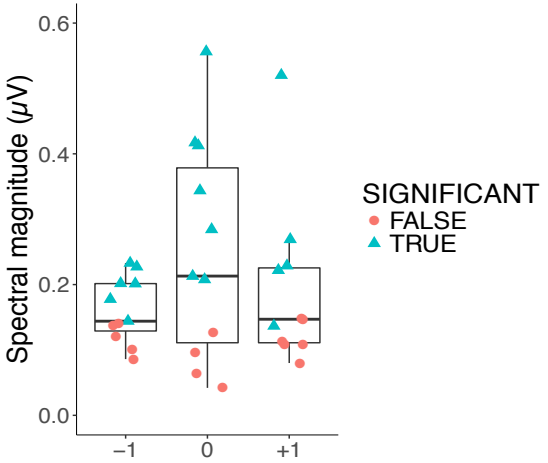

Fig 4: Responses were smaller for -1 than 0 kHz offset ($t(8.2)=-2.71$, $p=0.03$), +1 vs. 0 kHz were borderline non-significant ($t(7.8)=2.04$, $p=0.08$).

Conclusions

- EEG responses can be obtained to simulation of bilateral CI
- Mismatched auditory inputs reduced the magnitude of the responses
- The technique may be used to (1) assess whether children with better matched CIs have better outcomes and (2) match interaural electrode pairs

References:
[1] Sarant et al., 2014, Ear Hear
[2] Haywood et al., 2015, Trends Hear
[3] de Cheveigné and Simon, 2008, J Neurosci Methods
[4] Picton et al., 2003, Int J of Audiol

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