Poster # 130

Cochlear implantation for single-sided deafness improves speech perception in both CI and non-CI ears: A longitudinal EEG study

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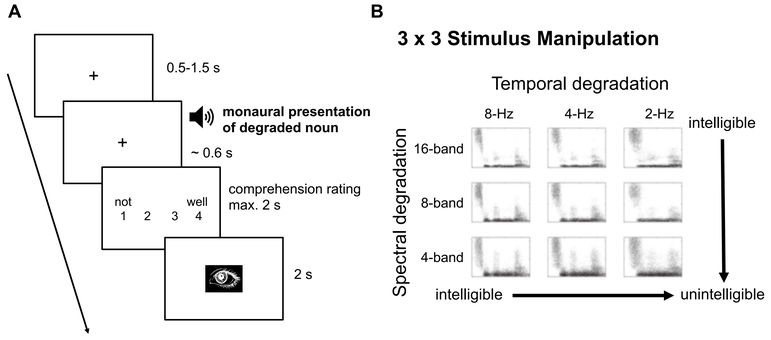
Introduction

- Studies have shown that individuals with a cochlear implant (CI) for treating single-sided deafness have experienced improved speech perception in noise.
- However, it is not clear how single-sided CI users' speech perception improves and how neural speech representation of speech intelligibility changes over time.
- Here, we applied representation similarity analysis (RSA) to depict how neural representation of degraded nouns changes over time.

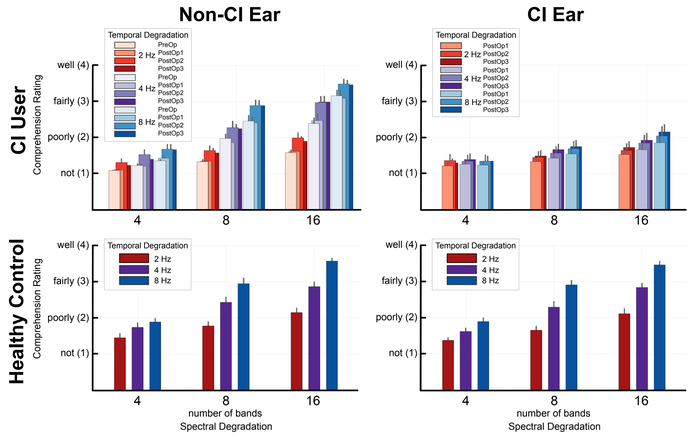
Methods

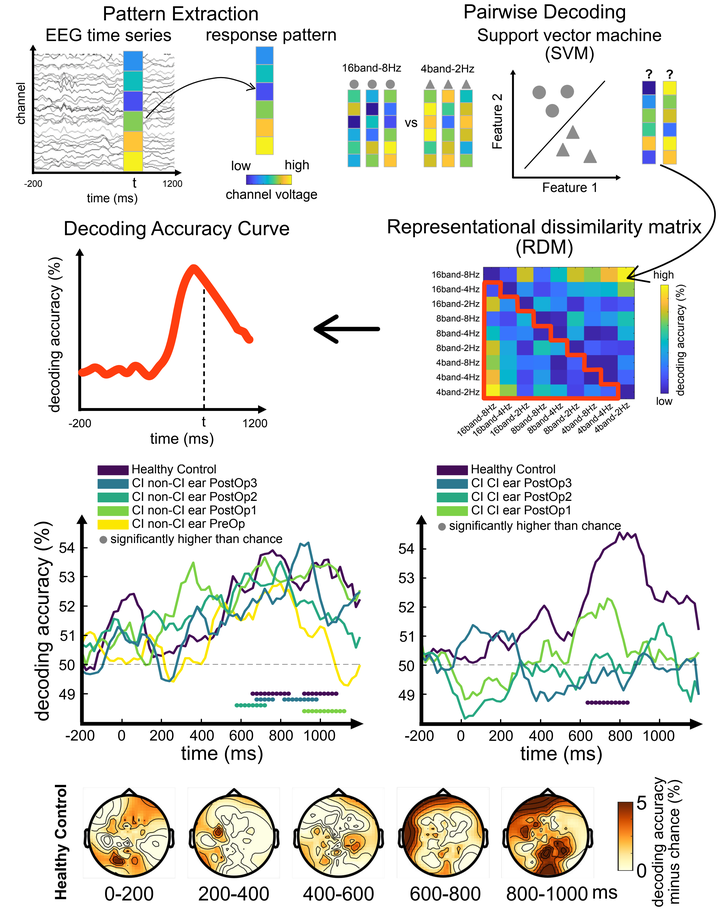


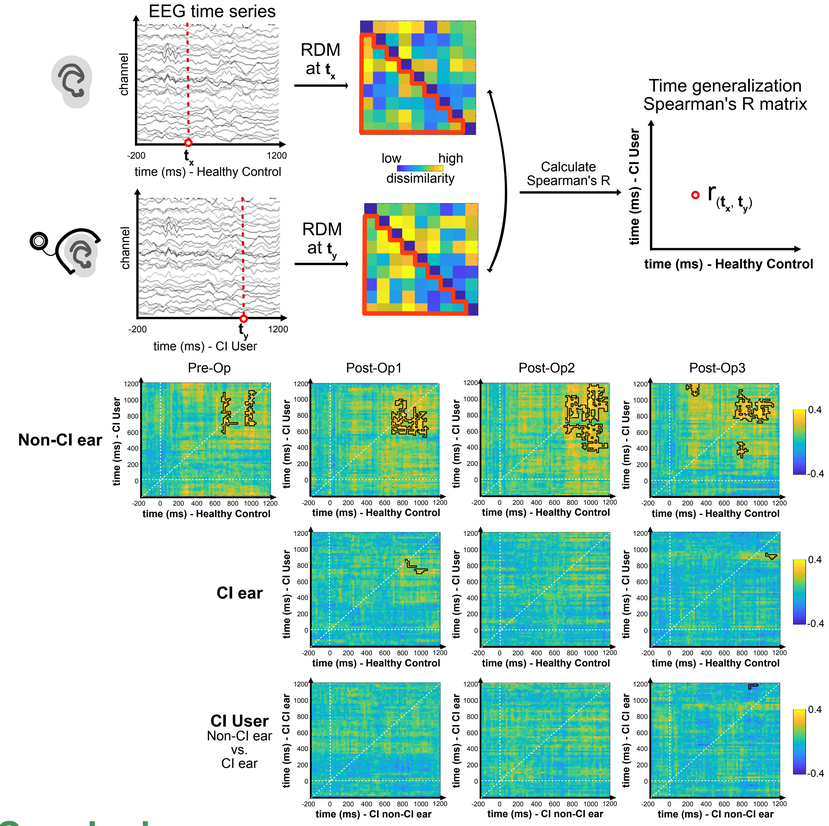
- Participant
  - 10 single-sided cochlear implant users (5 right-sided + 5 left-sided)
    - 4 female, mean age 46.9 (27-63)
  - 10 age-and-sex matched controls
    - 4 female, mean age 48.2 (29-61)
- Stimuli
  - 216 standard German nouns presented monaurally to each ear
    - 3 levels of temporal smoothing x 3 levels of spectral degradation
- EEG measurement
  - 128 channel EEG (ANT-Neuro system)
  - 1 session for healthy controls
  - 4 sessions for CI users
    - Pre-op (only healthy ear) & 3 Post-op (3, 6 & 12 months)

CI Sub ID	Side of Deafness	Age at CI Activation (yrs)	Duration of Deafness (yrs)
CI1	L	27	1.0
CI2	R	36	1.7
CI3	L	42	1.6
CI4	R	45	4.6
CI5	R	48	0.8
CI6	L	48	1.5
CI7	L	50	1.5
CI8	L	54	1.2
CI9	R	56	1.3
CI10	R	63	1.4

Results







Conclusion

- The present study shows that auditory cortical speech processing after CI implantation gradually normalizes towards generally normal functioning within months.
- The CI benefits not only the CI ear but also the non-CI ear.
- These novel findings highlight the feasibility of tracking neural recovery after auditory input restoration by advanced multivariate analysis methods like RSA.

References

- Obleser, J., & Weisz, N. (2012). Suppressed alpha oscillations predict intelligibility of speech and its acoustic details. *Cerebral Cortex*, 22(11), 2466–2477.
- Peter, N., Kleinjung, T., Probst, R., Hemsley, C., Veraguth, D., Huber, A., Caversaccio, M., Kompis, M., Mantokoudis, G., Senn, P., & Wimmer, W. (2019). Cochlear implants in single-sided deafness—Clinical results of a Swiss multicentre study. *Swiss Medical Weekly*, 149, w20171.

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