Poster
241.05

Speech intelligibility changes the temporal evolution of neural speech tracking

Ya-Ping Chen[1,2], Fabian Schmidt[1,2], Anne Keitel[3], Sebastian Rösch[4], Anne Hauswald[1,2,a], & Nathan Weisz[1,2,a]

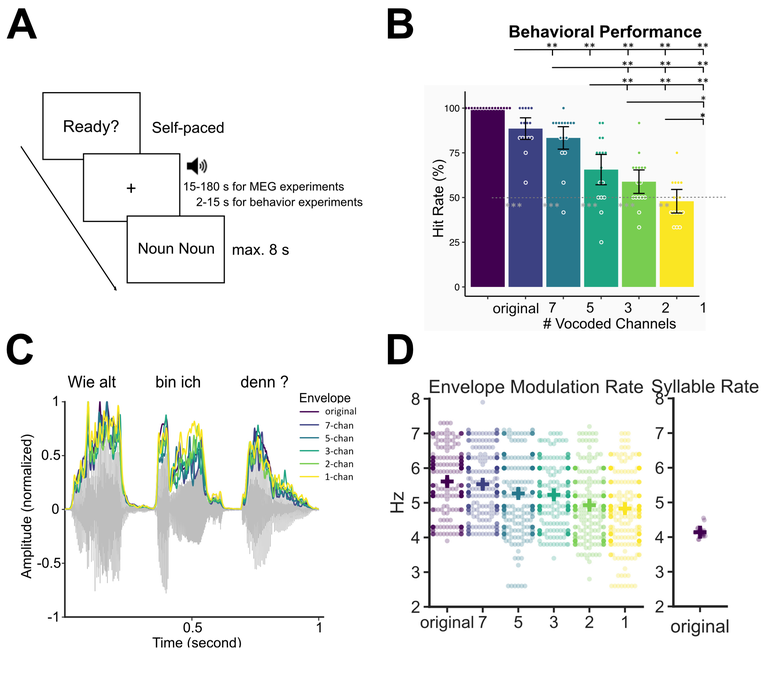
1. Centre for Cognitive Neuroscience, University of Salzburg, 5020 Salzburg, Austria; 2. Department of Psychology, University of Salzburg, 5020 Salzburg, Austria
3. Psychology, School of Social Sciences, University of Dundee, DD1 4HN Dundee, UK; 4. Department of Otorhinolaryngology, Paracelsus Medical University, 5020 Salzburg, Austria
a. Anne Hauswald and Nathan Weisz are joint senior authors on this work.

Salzburg Brain Dynamics Lab – University Salzburg – Centre for Cognitive Neuroscience

Introduction

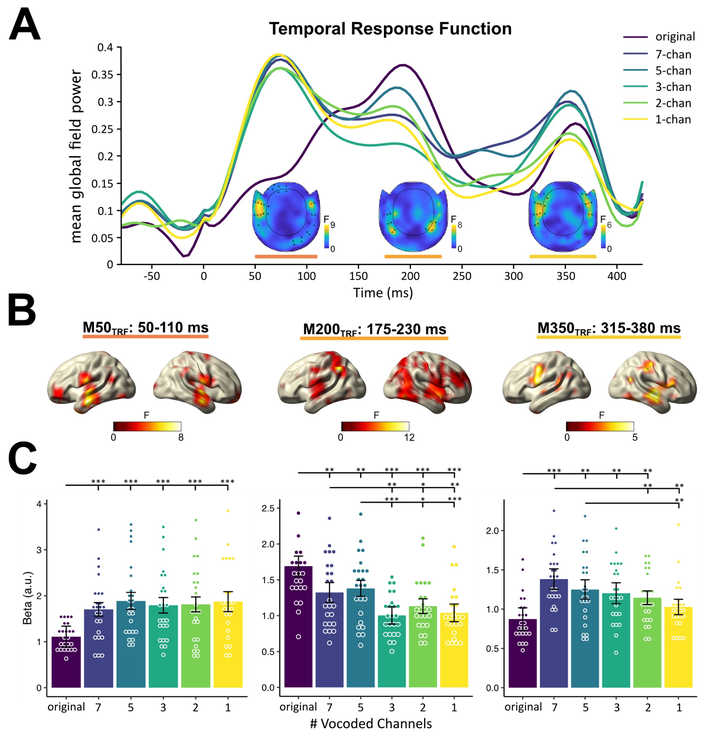
- Neural speech tracking of degraded speech has been used to advance the understanding of how brain processes and speech intelligibility are interrelated, however the temporal dynamics of neural speech tracking are not clear.
- Here we exploited temporal response functions (TRFs) and generated signal-degraded speech to depict the temporal evolution of speech intelligibility modulation on neural speech tracking.
- In addition, we inter-related facets of neural speech tracking (e.g., speech envelope reconstruction, speech-brain coherence, and components of broadband coherence spectra) to endorse our findings in TRFs.

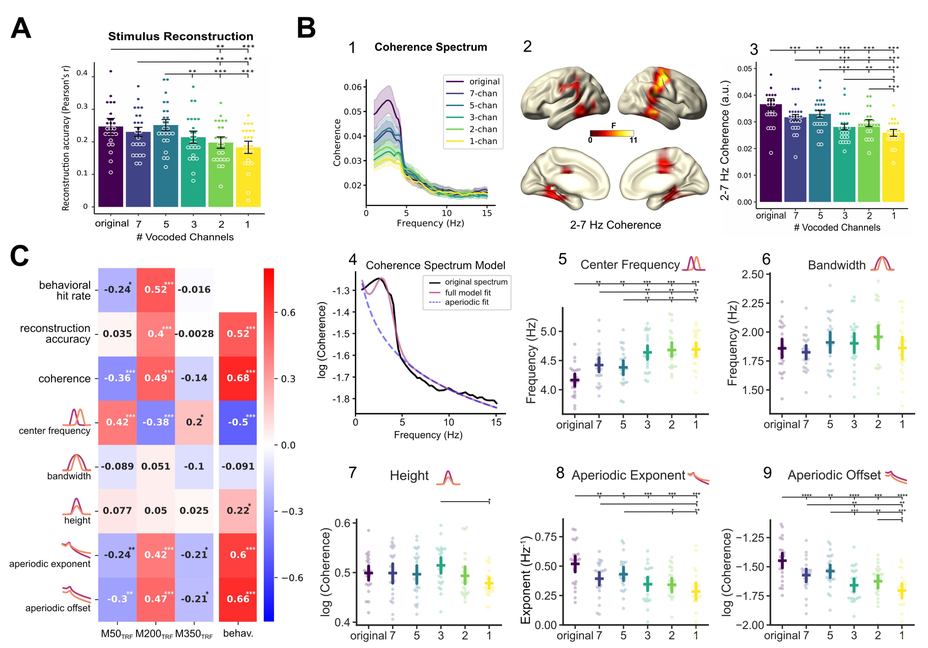
Methods



- There were 24 healthy adults participating in an MEG experiment, and 17 of them also participated in a behavior experiment.
- In both tasks, there were six levels of vocoding conditions (original, 7-, 5-, 3-, 2-, and 1-channel).
- Participants were required to indicate which word is the last noun they heard in the last sentence.

Results





- TRF analysis yielded marked temporally differential effects of vocoding: reduction of intelligibility went along with large increases of early peak responses (~50-110 ms, $M50_{TRF}$), but strongly reduced responses around 175-230 ms ($M200_{TRF}$).
- For the late responses 315-380 ms ($M350_{TRF}$), the maximum response occurred for degraded speech that was still comprehensible then declined with reduced intelligibility.

- Through parameterizing speech-brain coherence spectra, we observed that the center frequency of the coherence increased as speech intelligibility decreased.
- TRF effects are related to center frequency modulation, and this suggests altered tracking of lower or higher level speech features.

Conclusion

- In this study, we demonstrate that at least three neural processing stages ($M50_{TRF}$, $M200_{TRF}$, and $M350_{TRF}$) are affected when processing continuous degraded speech.
- Only $M200_{TRF}$ highly correlates with behavior and other neural measures (i.e., speech brain coherence) of speech intelligibility.
- We also indicate that both $M50_{TRF}$ and $M200_{TRF}$ can reflect shifts in the neural speech tracking from more linguist level to more acoustic level as speech intelligibility declined which is supported by the effect of center frequency of coherence.

References

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- Schmidt, F., Chen, Y.-P., Keitel, A., Rösch, S., Hannemann, R., Serman, M., Hauswald, A., & Weisz, N. (2021). Neural speech tracking shifts from the syllabic to the modulation rate of speech as intelligibility decreases. *BioRxiv*, 2021.03.25.437033.

Acknowledgement

This research was supported by the Austrian Science Fund (FWF, P31230, P26_P34237). We thank Manfred Seifter and Bernadette Eckart for their support during data collection.

Preprint

Contact: ya-ping.chen@plus.ac.at