

# Specific enhancement of neural responses to speech through neurofeedback

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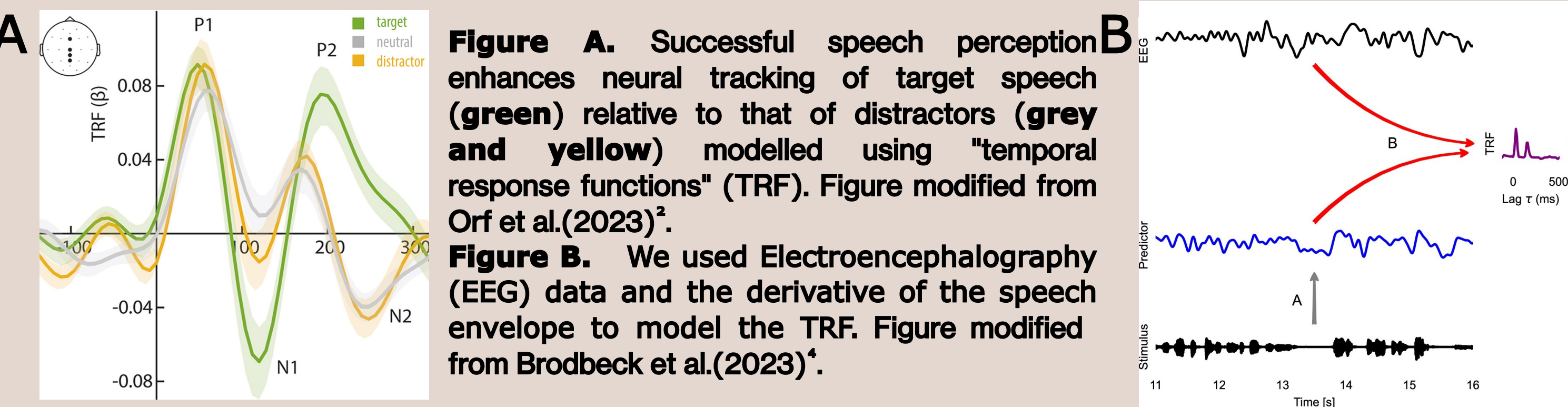
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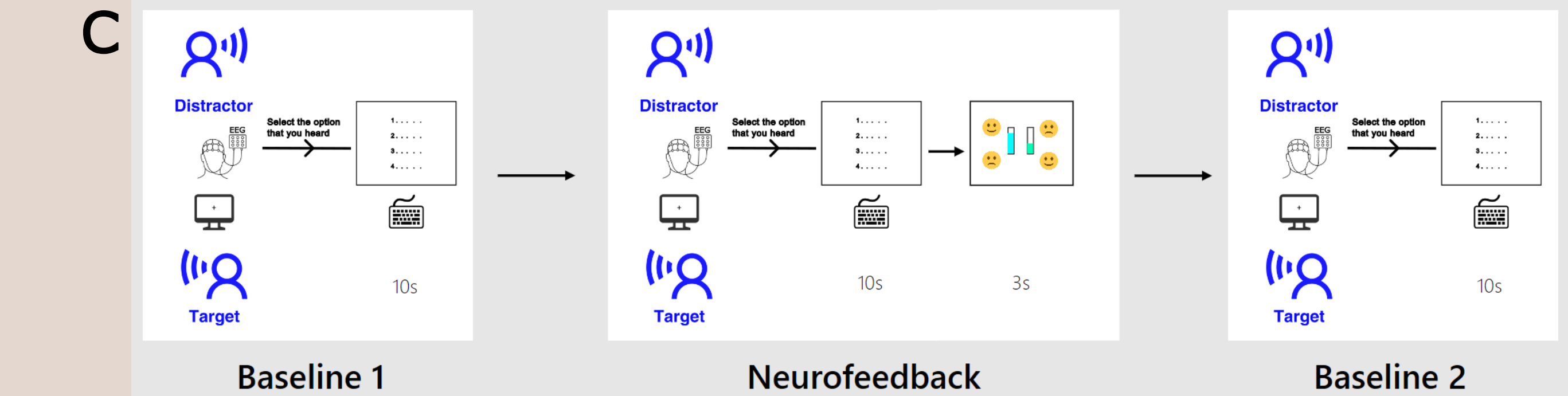
## Background

- When humans age, their hearing declines. This decline is not necessarily caused by actual hearing loss but often by a reduced ability to suppress distracting speakers or noise<sup>1</sup>.
- Successful attention to speech is reflected in “neural tracking”<sup>2</sup> (Fig A). Neural Tracking of speech changes with age, making it an important marker for interventional approaches<sup>3</sup>.
- In this study, we used Neurofeedback to train participants to regulate neural tracking in a "cocktail party" setting, and tested effects on speech perception.



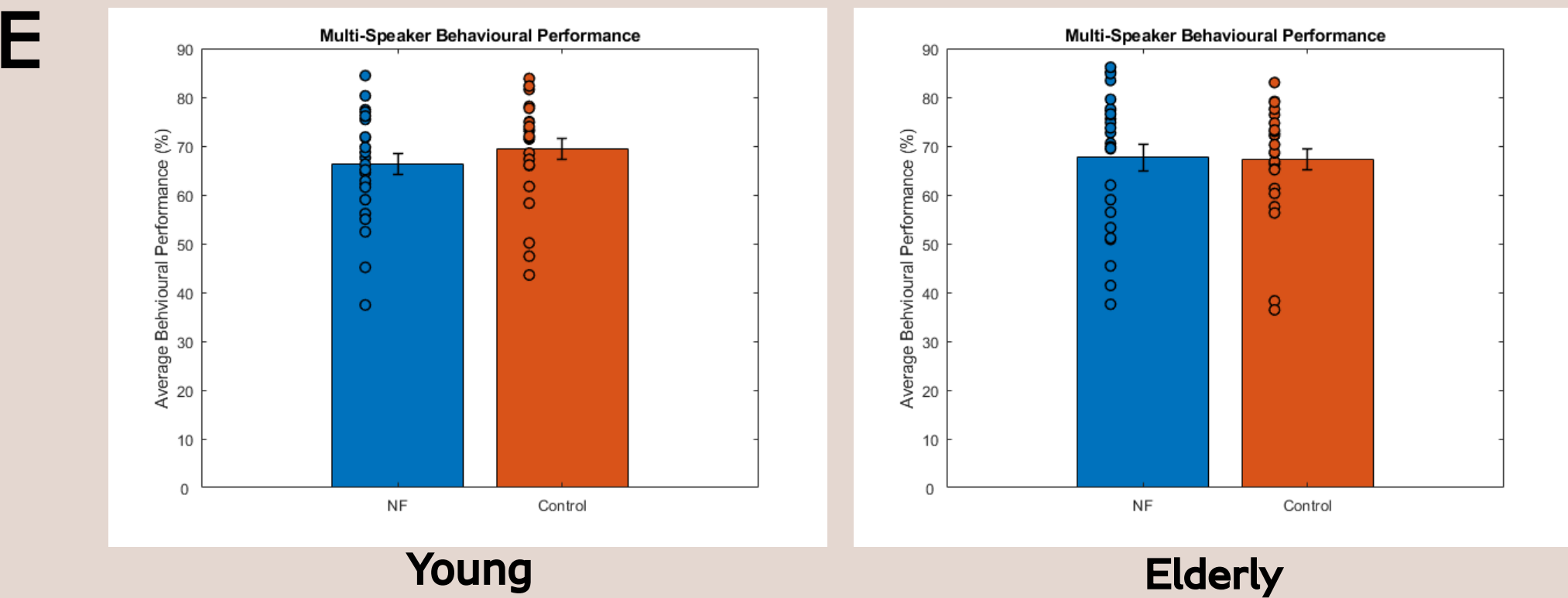
## Methods

- Participants listened to **22s snippets** from two audio books simultaneously and paid attention to one of the two. After each snippet, we tested their comprehension.
- During the experiment, we used EEG to model TRFs to Target and Distractor speech and extracted N1 amplitudes (Fig A and D) for single trials (snippets).
- The experiment was divided into Baseline and Neurofeedback blocks (Fig C). During Neurofeedback blocks, participants received feedback after each trial that reflected their N1 amplitude relative to the range of values measured in all previous trials. They were informed that these values represent their focus of attention and were asked to regulate them.
- Participants were randomly assigned to either a Neurofeedback or a control group with feedback values replayed from another participant.
- 56 participants were collected in the young group (18-35y / **49** participants after exclusion) and 57 participants in the Elderly group (55-75y / **52** participants after exclusion).



## Results

**Figure D.** Effect of focused attention is most prominent for the N1 component used for Neurofeedback. N1 is stronger, slower and more variable in the elderly group.



**Figure E.** Despite changes in TRF as seen in figure H, there are no group level differences in comprehension between neurofeedback conditions and for both age groups.

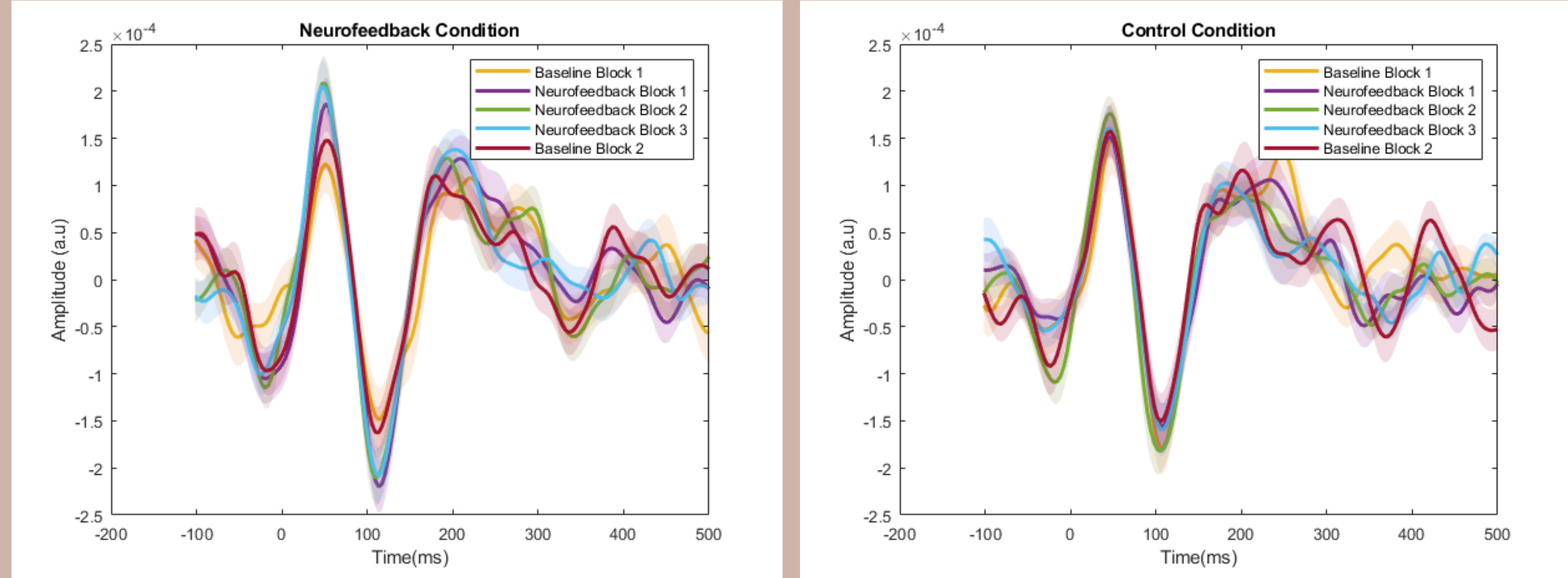
## Summary

- Reliable effects of Neurofeedback on N1 amplitude in younger participants.
- Change in N1 amplitude causes change in comprehension across age groups.
- Analysis still ongoing - Factors such as individual lags and other TRF components to be explored.
- Neurofeedback might support a neural process typically used for compensation in struggling listeners

## Acknowledgements

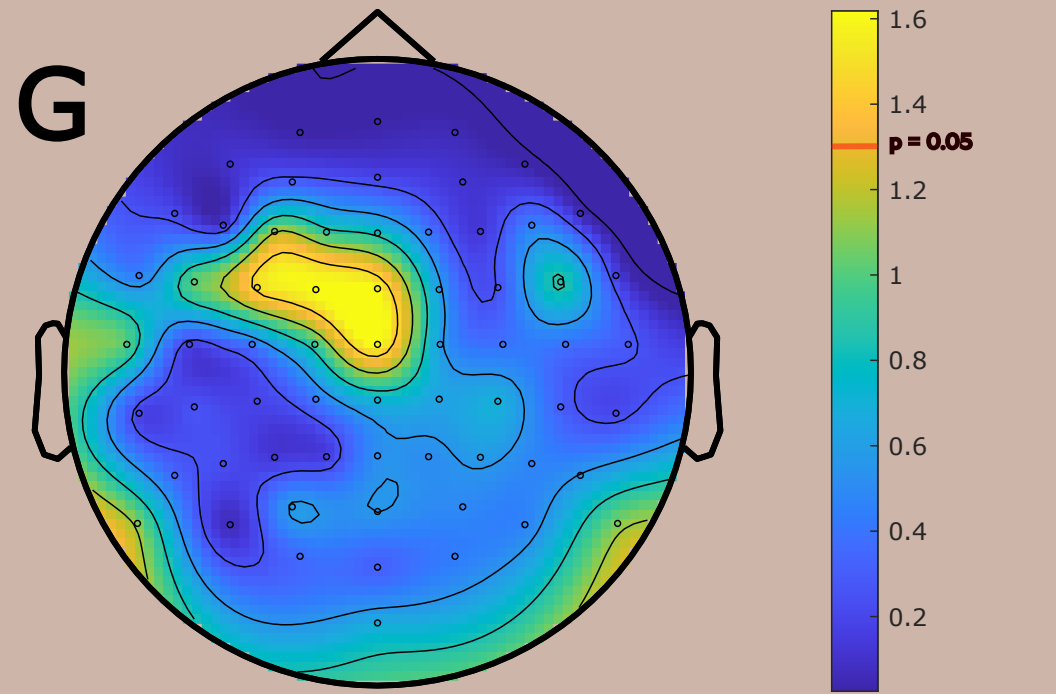
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### F Neurofeedback enhances neural responses to target speech in younger participants

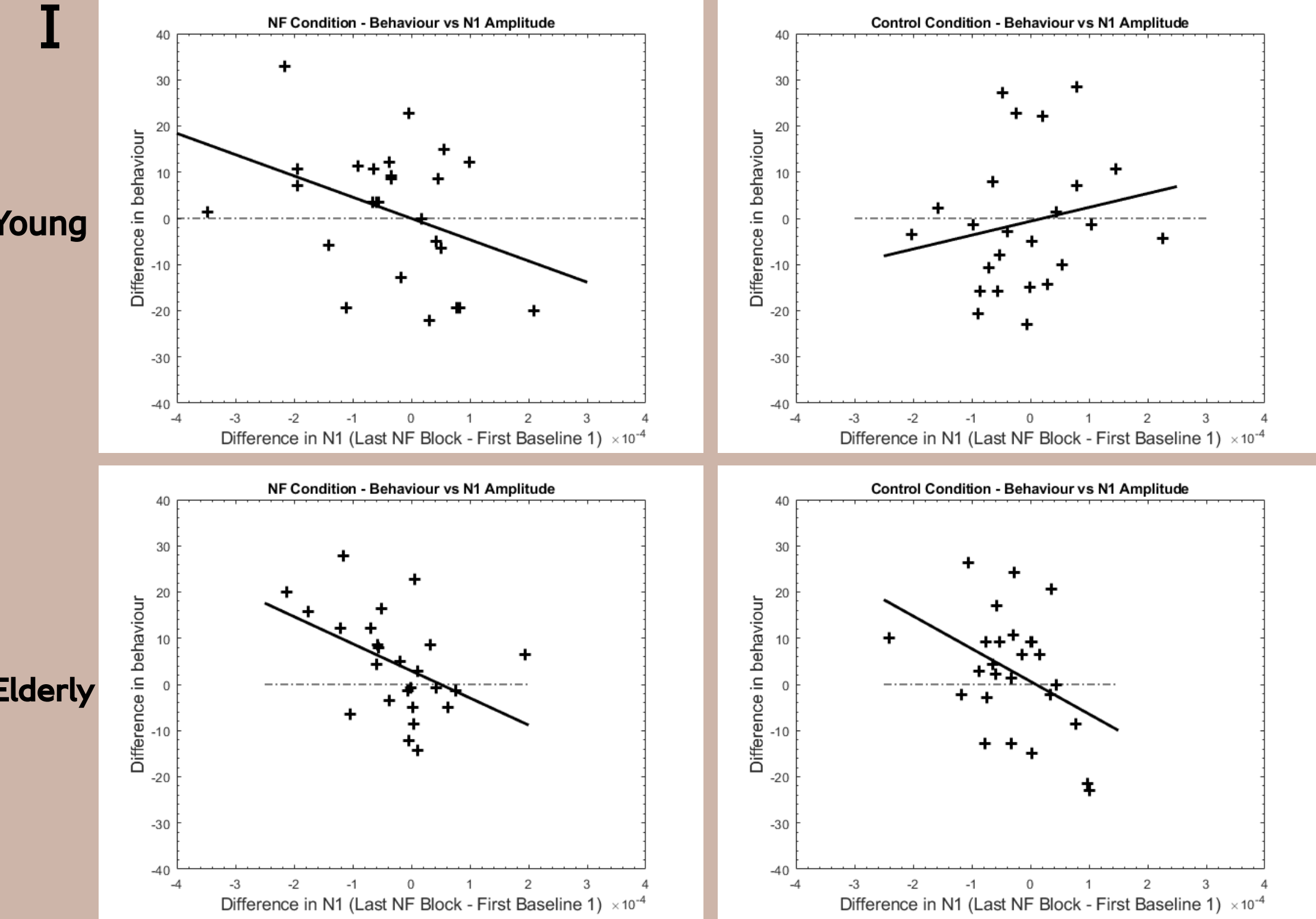
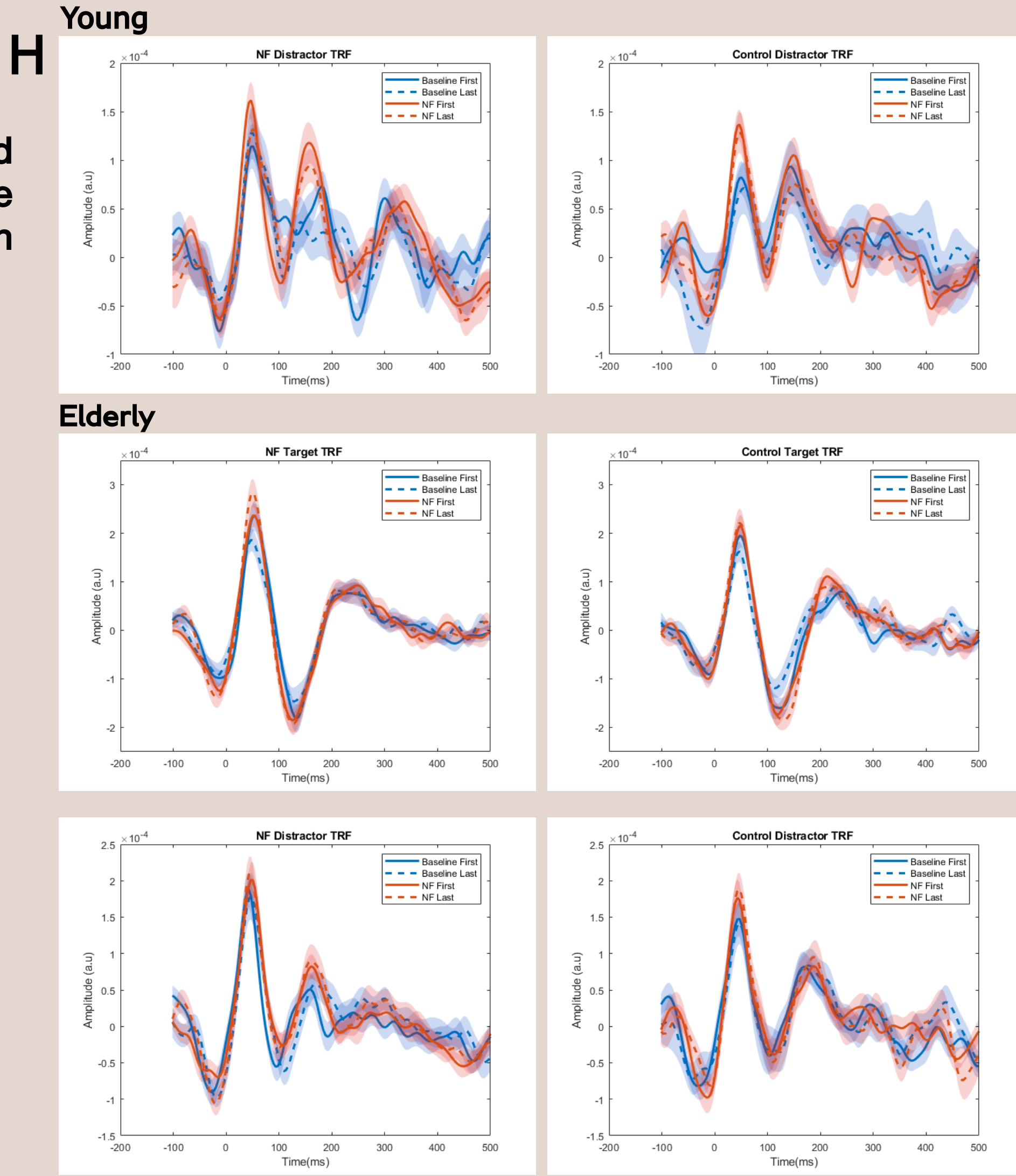


**Figure F.** TRFs to target speech at Channel Fz, for the young group.

**Figure G.** The topo plot shows the log(p-values) of the interaction between the Condition (Neurofeedback or Control) and Type (Baseline or Neurofeedback block) for the N1 amplitudes. The topo plot shows a significant cluster within our fronto-central channels of interest.



**Figure H.** TRFs to target and distracting speech across the different experimental blocks in fronto-central electrodes.



**Figure I.** Changes in N1 amplitudes and comprehension are significantly correlated for the Neurofeedback condition in the young group ( $\rho = -0.3825$ ,  $p = 0.05$ ) and for Neurofeedback ( $\rho = -0.4510$ ,  $p = 0.02$ ) and Control ( $\rho = -0.4044$ ,  $p = 0.04$ ) conditions in the elderly group.

## References

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