The Neurogram - A quantification of real-life hearing impairments using electrophysiology

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1 Motivation

Pure-Tone Audiometry (PTA):

- Assesses hearing thresholds in dB using artificial pure tones (log-spaced between 125 and 8000Hz)
- Information about hearing thresholds is obtained via subjective feedback

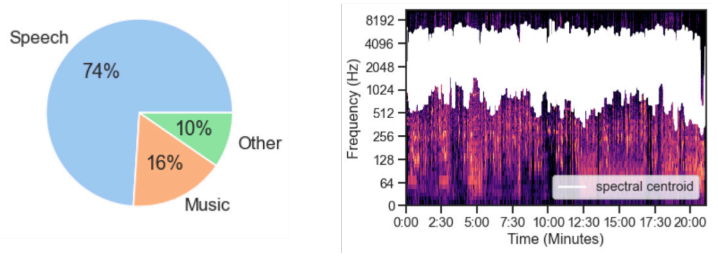
Problem:

- Artificial pure-tones do not reflect real-life listening situations (e.g. cocktail party)
- Supra-threshold hearing loss (i.e. hidden hearing loss) is not captured using PTA
- Subjective feedback problematic for babies or old people suffering from dementia

2 Material & Methods

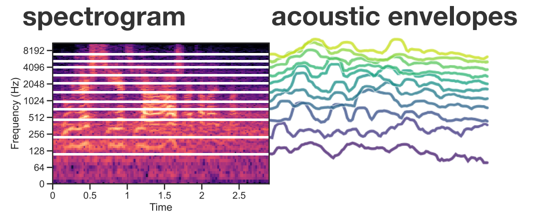
- N=43 subjects
- Age = 43.49
- Online Hearing Assessment
- Stimulus material: radio play (~20 min)
- 306 channel MEG system

audio material (radio play)

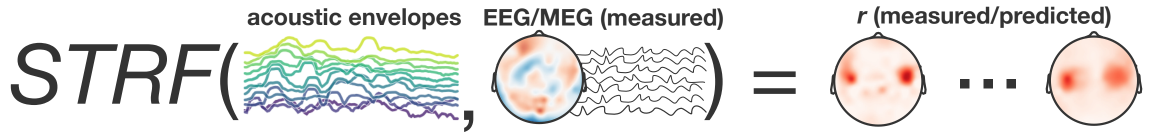


Analysis Procedure

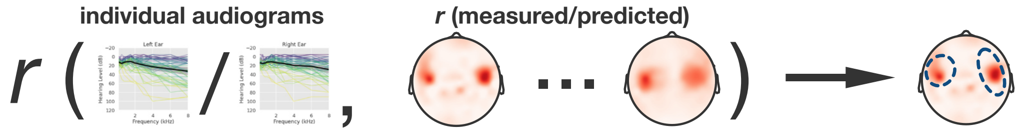
1) Acoustic Feature Extraction



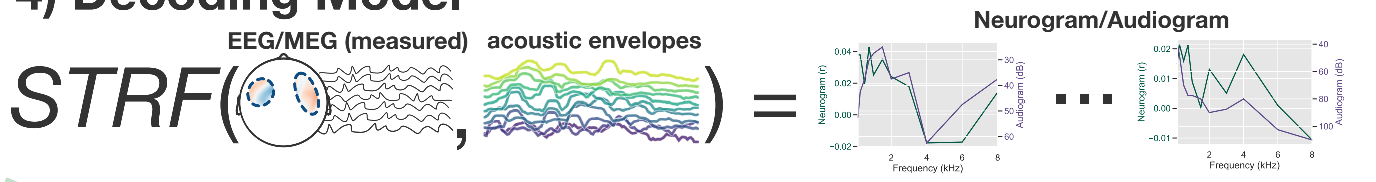
2) Encoding Model



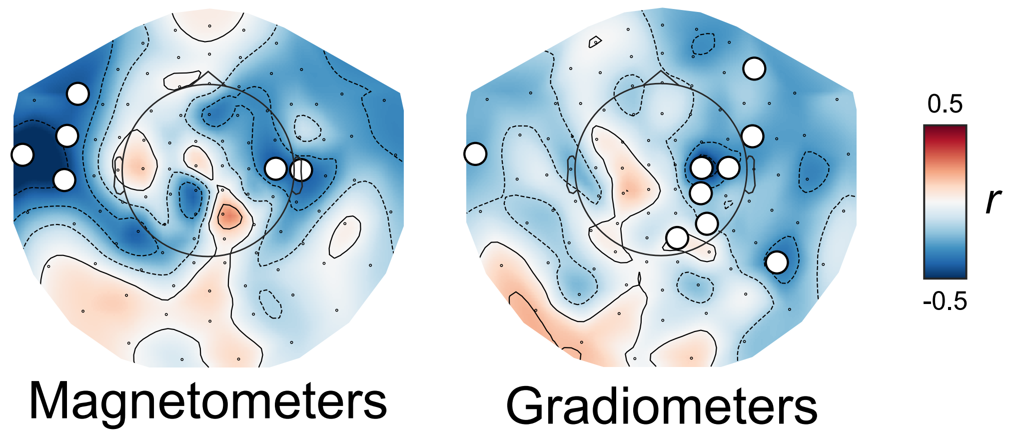
3) Audiogram | EEG/MEG Prediction

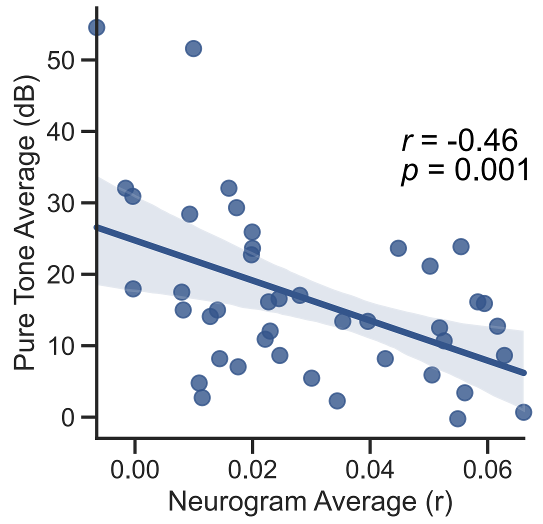


4) Decoding Model



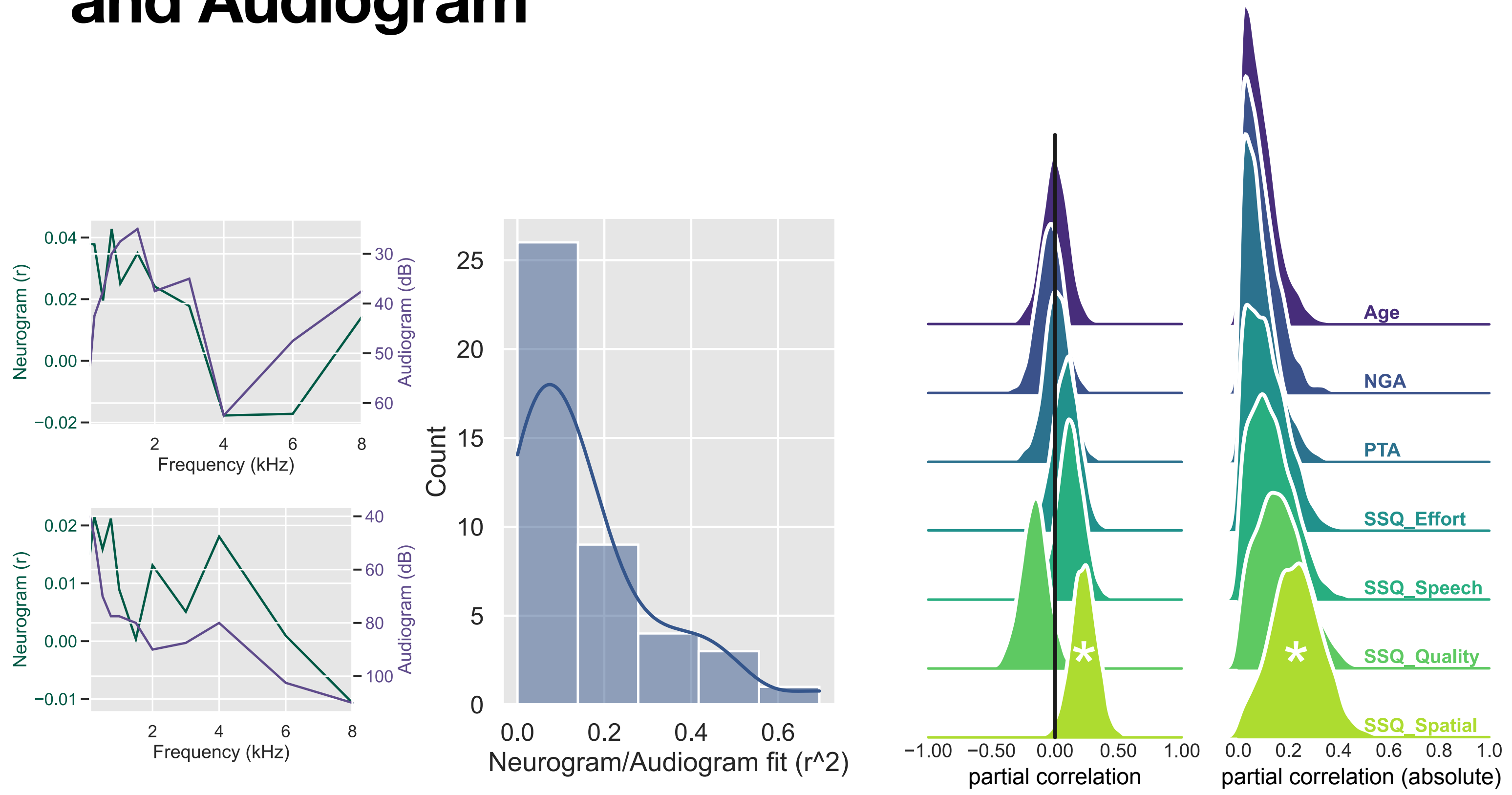
3 Spectrogram reconstruction accuracy at selected channels can be related to individual hearing levels





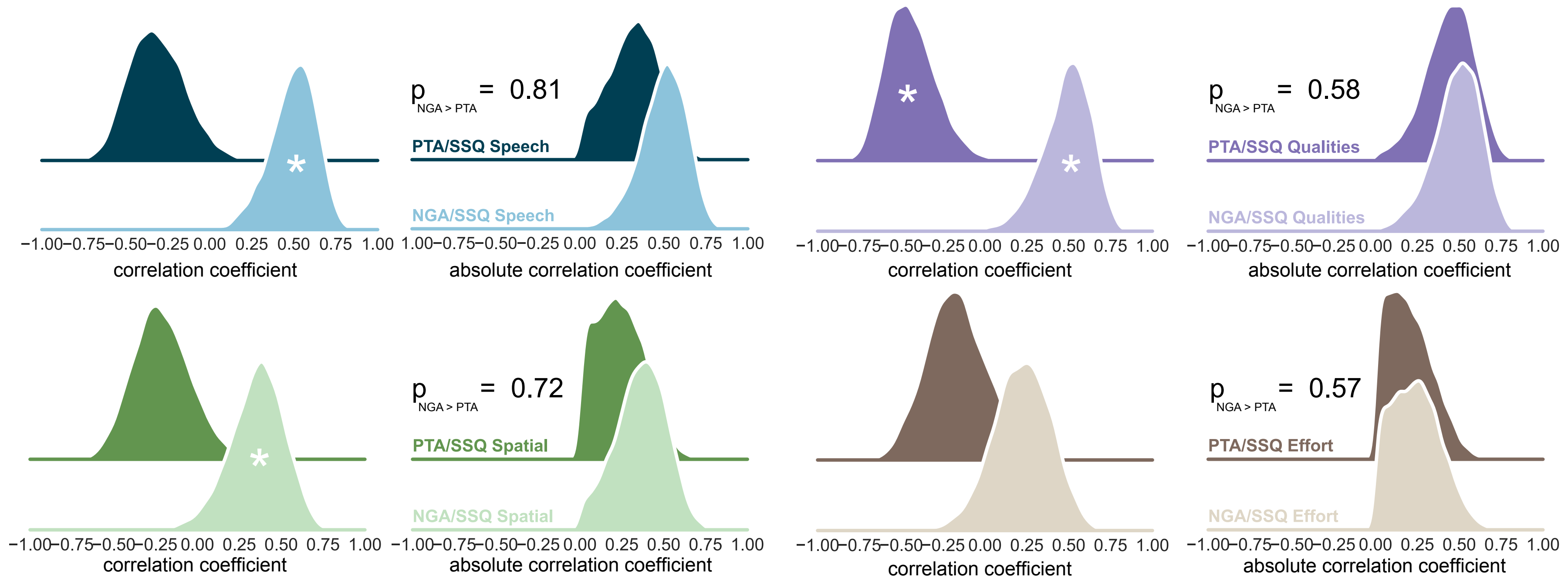
- Channels with spectrogram encoding accuracies that correlate with pure-tone audiometry scores are selected for reconstruction
- Spectrogram reconstruction accuracy at selected channels is negatively related to pure-tone audiometry scores

5 Spatial hearing is the best predictor for a strong relationship between Neurogram and Audiogram



- High variance in goodnes of fit (R^2) between Neurogram and Audiogram across subjects
- Using several predictors (SSQ-Scores, Age etc.) to explain the goodness of fit we find that:
  - Goodness of Neurogram/Audiogram fit is explained best by subjective reports of spatial hearing abilities

4 Neurogram scores are stronger related to subjective reports of hearing impairment than audiogram scores



- Subjective reports of hearing impairment were assessed via the speech, spatial and qualities of hearing scale (SSQ) and correlated with neurogram average and pure-tone average scores
- Posterior distributions for the correlation coefficients of neurogram average and pure-tone average scores with the SSQ scales are compared
- Neurogram average scores are stronger related to SSQ scores than audiogram average scores