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

Fabian Schmidt[1,2], Lisa Reisinger[1,2], Patrick Neff [1,3], Ronny Hannemann [4] & Nathan Weisz[1,2]

1. Centre for Cognitive Neuroscience, University of Salzburg, 5020 Salzburg, Austria
2. Department of Psychology, University of Salzburg, 5020 Salzburg, Austria
3. Institute of Bioengineering, Center for Neuroprosthetics, École Polytechnique Fédérale de Lausanne, Switzerland
4. Audiological Research Unit, WSAudiology - Sivantos GmbH, 91058 Erlangen, Germany

## 1 Motivation

**Pure-Tone Audiometry (PTA):**

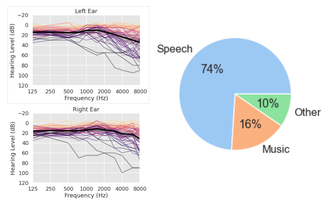
- Assesses hearing thresholds in dB using artificial pure tones (log-spaced between 125 and 8000Hz)
- Information about hearing thresholds is obtained via subjective feedback

**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

## Material & Methods

- N=42 subjects
- Age: *M*=47.16, *SD*=18.64
- Online Hearing Assessment
- Stimulus material: radio play (~20 min)
- 306 channel MEG system

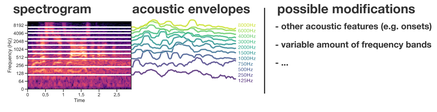




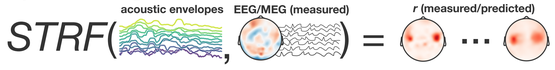


## 2 Analysis Procedure

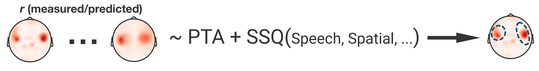
### 1) Acoustic Feature Extraction



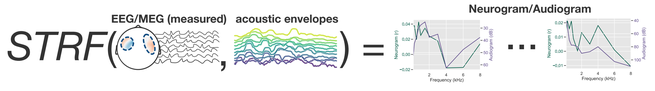

### 2) Encoding Model of acoustic features




### 3) Channel selection based on subjective auditory processing abilities



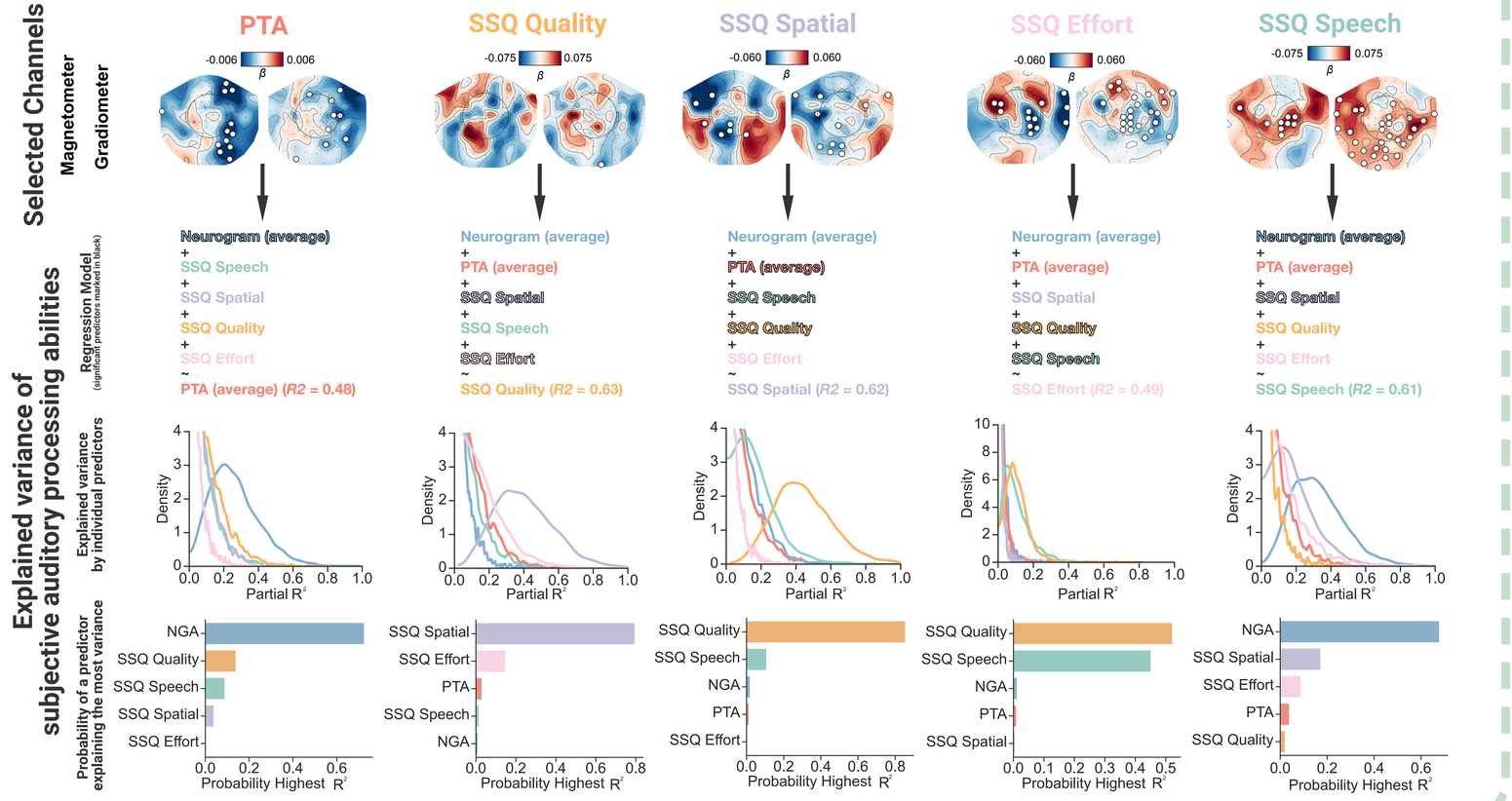

### 4) Decoding Model using selected channels for specific subjective auditory processing ability (a.k.a Neurogram/NGA)



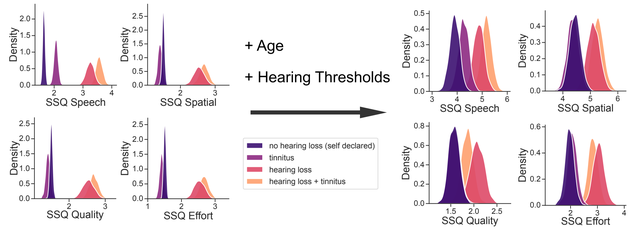

### 5) Predicting subjective hearing ability (e.g. SSQ Speech)

SSQ Speech ~ NGA + PTA + SSQ Spatial + SSQ Quality + SSQ Effort

## 3 Neurogram score explains most of the variance in pure-tone audiometry and subjective speech understanding

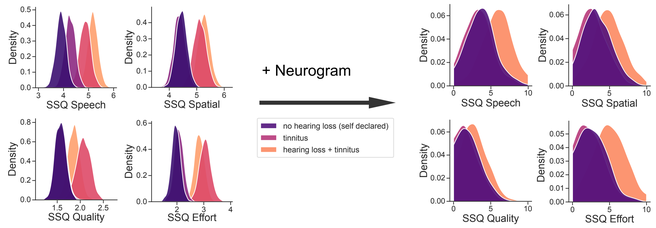



## 4 Differences in subjective hearing reports are not explained by age and acoustic thresholds




Adding age and hearing thresholds as predictors accounts for some, but not all of the differences in subjective hearing abilities

## 5 Closing the gap between "measured" and subjectively reported hearing problems




Adding Neurogram as predictor accounts for residual differences in subjective hearing abilities