Introduction
Recent studies have found cortical responses in the high gamma range (70-200 Hz) to continuous speech in MEG (Hertrich et al.2009, Kulasingham et. al. 2020), and EEG (Canny et al. 2021). This is similar to cortical Frequency Following Responses (FFRs) (Coffey et. al. 2016) which may originate from the thalamorecipient layers of cortex (Gnanateja et. al. 2021). Attentional modulation has been found for both high frequency cortical FFRs (Hartmann et. al. 2019) and low frequency cortical pitch tracking (Brodbeck and Simon 2022).

Here, we report our previous work on high gamma MEG temporal response functions (TRFs) to continuous speech (Kulasingham et. al. 2020), and extend it to investigate high gamma TRFs to: Male vs. female speech; Attended vs. unattended speech in a cocktail party paradigm.

Methods

Study #1 (Kulasingham et. al. 2020)
- MEG responses of 17 younger and 23 older subjects listening to continuous speech by a male speaker.

Study #2
- MEG responses of 22 younger subjects listening to simple, continuous, rhythmic sentences and equations spoken by male and female speakers.
- Preiously published dataset - Kulasingham et. al. 2021
- Subjects attended to one speaker during cocktail party conditions

Results - Study #1

Cortical Origin of High Gamma TRFs
- Cortical ROI has stronger responses compared to subcortical ROI
- TRFs are right lateralized, agreeing with cortical FFR studies

TRFs to speech envelope vs. carrier
- Envelope TRFs are significantly stronger than carrier TRFs

TRFs to low pitch vs. high pitch segments
- Speech separated into low vs. high pitch segments around midpoint of 98 Hz
- TRFs jointly estimated for high and low pitch segments
- Low pitch TRFs are much stronger than high pitch TRFs
- TRF frequency spectrum peaks at 50-90 Hz

Discussion
- This work investigates high gamma cortical responses to continuous speech using MEG.
- High gamma responses to the high frequency modulations of the speech envelope are stronger than to the carrier.
- High gamma responses are strongest to the low pitch segments of speech below 100 Hz.
- Accordingly, high gamma responses are present for male speech, but not for female speech.
- High gamma responses exist for both attended and unattended speech, consistent with low-level pre-attentive processes.
- TRF peak amplitudes are modulated by attention, perhaps indicating top-down attentional mechanisms.
- Further work must be done to investigate these early (<50 ms) attention modulated responses.

References
Kuchinsky, S., et al. Auditory-Cognitive Training Improves the Neural Encoding of Speech for Older Adults with Normal Hearing. ARD (2016)
Hertrich, I., et al. Magnetic brain activity phase-locked to the envelope, the syllable onsets, and the fundamental frequency of a perceived speech signal. Psychophysiology (2021)
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