Intracranial EEG Processing of Auditory Feedback in Perisylvian Cortex

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Introduction and motivation

The auditory system processes speech differently at acoustic edges and during speech production

· **Onset responses** to the beginning of an acoustic stimulus are localized to posterior superior temporal gyrus (STG) in passive listening tasks[1]

· **Speaker-induced suppression** refers to the cortical suppression of responses to auditory feedback that are consistent with the speaker's expectations during speech production[2]

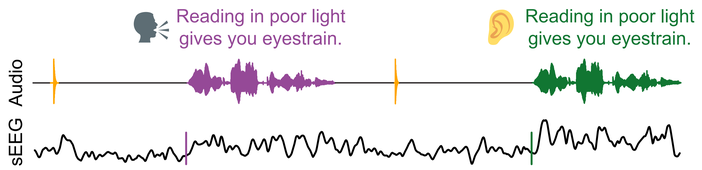
· **Q1**: Are onset responses necessary during speech production, or are they suppressed due to feedforward modeling?

· **Q2**: How does speaker-induced suppression interact with other aspects of the perceptual system (e.g., linguistic abstraction[3], speaker expectancy effects[4])?

A dual speech perception-production task

· Participants read sentences aloud (**production**), then listened to playback of their reading (**perception**). A control **click** sound was played between trials

· Because **perception** trials were generated via audio from the **production** trials, spectral and temporal information were controlled



Stereo-electroencephalography (sEEG) recordings

· n=17 (9F, age 16.6±6.4, range 8-37) patients with intractable epilepsy implanted with intracranial grid/depth electrodes for clinical monitoring

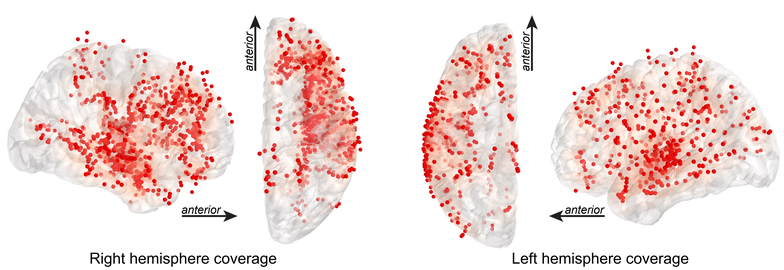
· Data collected at Dell Children's Medical Center (n=13), Texas Children's Hospital (n=3), and Dell Seton Medical Center (n=1)

· n=2044 electrodes total

· High gamma analytic amplitude (Hγ) extracted for use in analysis

· Fit linear encoding models to assess phonological feature tuning

· Unsupervised clustering (cNMF) to identify response profiles



Right hemisphere coverage

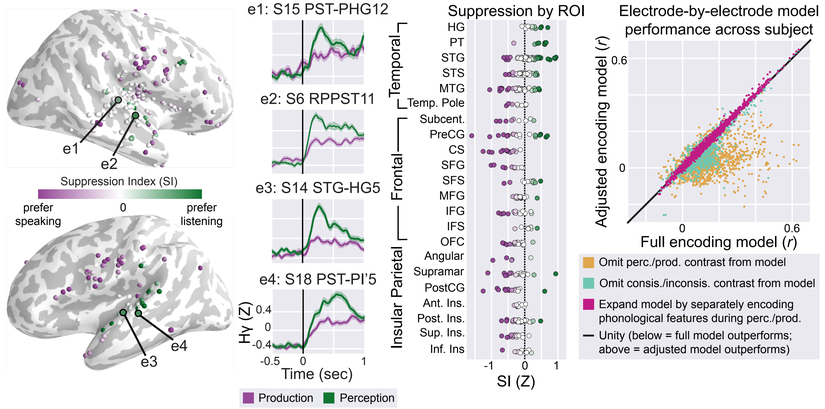
Left hemisphere coverage

Onset responses are selectively suppressed during speech production

· Single electrodes in bilateral auditory cortex (AC) preferentially responded to speech perception at sentence onset

· These **onset suppression** electrodes responded to speech production too, but these responses were suppressed at sentence onset

· Phonological features are encoded similarly during perception and production despite onset suppression

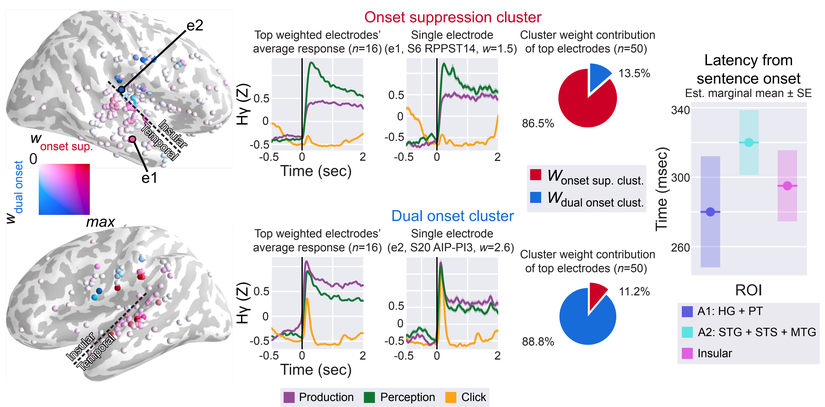


A non-selective "dual onset" auditory region in posterior insula

· Posterior insula responded at onset to speech production *and* perception

· These **dual onset** electrodes had similar latencies to AC **onset suppression** electrodes, in some instances responding earlier

· cNMF factorization reveals **onset suppression** and **dual onset** response profiles are functionally and anatomically distinct

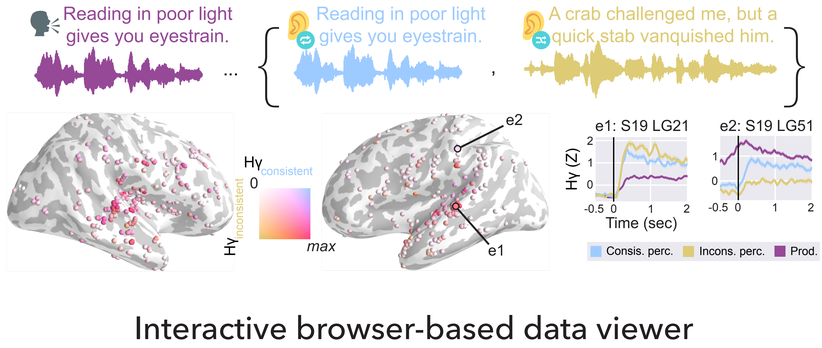


Consistency manipulation during speech perception reveals weaker suppression effects

· We included a playback consistency manipulation to assess similarity between feedback suppression during speech production and top-down predictive processing mechanisms

· **Consistent** playback trials were immediate playback of the prior prod. trial; **inconsistent** playback trials were randomly selected prior prod. trials

· Some AC electrodes showed preference for **inconsis.** > **consis.** playback and some sensorimotor cortex electrodes showed preference for **consis.** > **inconsis.** playback, but these effects were small



Interactive browser-based data viewer

Scan this QR code to navigate our dataset on an interactive 3D brain:

Conclusion

· This work uses high-resolution sEEG to expand our understanding of how auditory areas process feedback during speech production

· Absent onset responses during speech production suggests a role in stimulus orientation rather than phonological encoding

· Auditory responses in posterior insula may reflect a direct projection from auditory thalamus in parallel with temporal cortex[5]

Acknowledgements & References

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