Invisible articulatory features are encoded in brain activities while listening to speech

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Objectives
Speech processing entails a complex interplay between bottom-up entrainment to the quasi-rhythmic properties of speech acoustics and top-down modulation guiding attention in time and aiding selection of the most relevant input subspaces. Top-down signals are believed to originate mainly from motor regions, yet similar activities have been shown to tune attentional cycles also for simpler, non-speech stimuli. Here we examined whether neural signals encode detailed articulatory information, pointing to the involvement of a domain-specific mechanism during speech listening.
Materials
We measured electroencephalographic (EEG) data while participants listened to sentences for which articulatory kinematics of lips, jaws and tongue were also available (via Electro-Magnetic Articulography, EMA).
Methods
We captured the patterns of articulatory coordination through Principal Component Analysis (PCA) and used Partial Information Decomposition (PID) to identify whether the speech envelope and each of the kinematic components provided unique, synergistic and/or redundant information regarding the EEG signals.
Results
Interestingly, tongue movements contain both unique as well as synergistic information with the envelope that are encoded in brain signals.
Discussions
We demonstrate that during speech listening the brain retrieves highly specific and unique motor information.
Conclusion
These results suggest that the brain reconstruct articulatory information that is never accessible through vision, thus leveraging on audio-motor maps that arise most likely from the acquisition of speech production during development.

References:

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