Representational similarity analysis of EEG reveals multiple spatiotemporal dynamics of auditory selective attention

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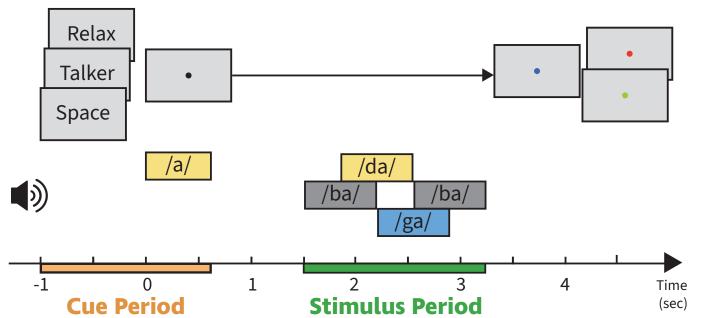
Do ERP and alpha power reflect separate neural mechanisms of auditory attention?

Attention can target space (where) or talker (who), and it evolves over time.

Different EEG features capture distinct aspects of attention across brain regions: event-related potential (ERP) is a transient stimulus-driven response in frontocentral area [1, 2], alpha power is induced oscillation related to sustained attention in posterior area [3, 4].

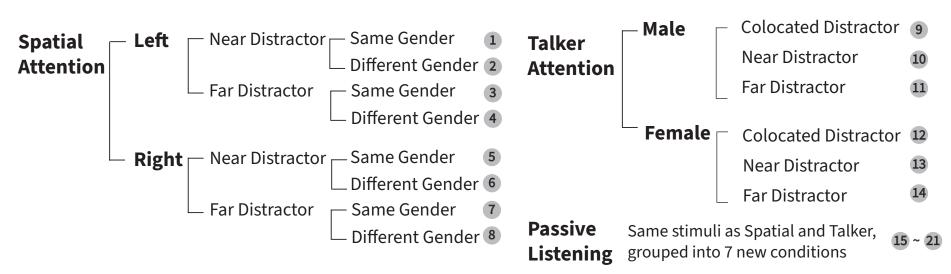
Representational similarity analysis (RSA) provides a common similarity framework for comparing neural features [5], but its application to internal attentional states remains limited [6].

Condition-rich auditory attention task (N=27)

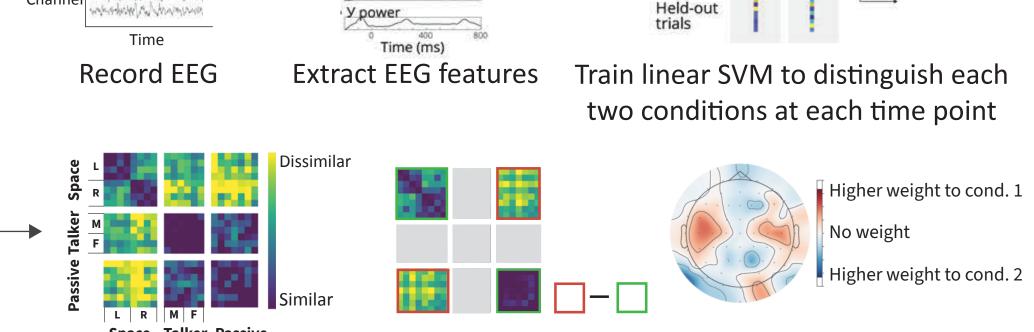


In the cue period, a visual task cue followed by the auditory target cue. In the stimulus period, target syllable was embedded in multi-talker babble (/ba/, /da/, and /ga/), and subjects reported the target.

Sounds were spatialized to five positions with four possible talkers.



Representational Similarity Analysis (RSA)



1. Pairwise dissimilarity among all conditions

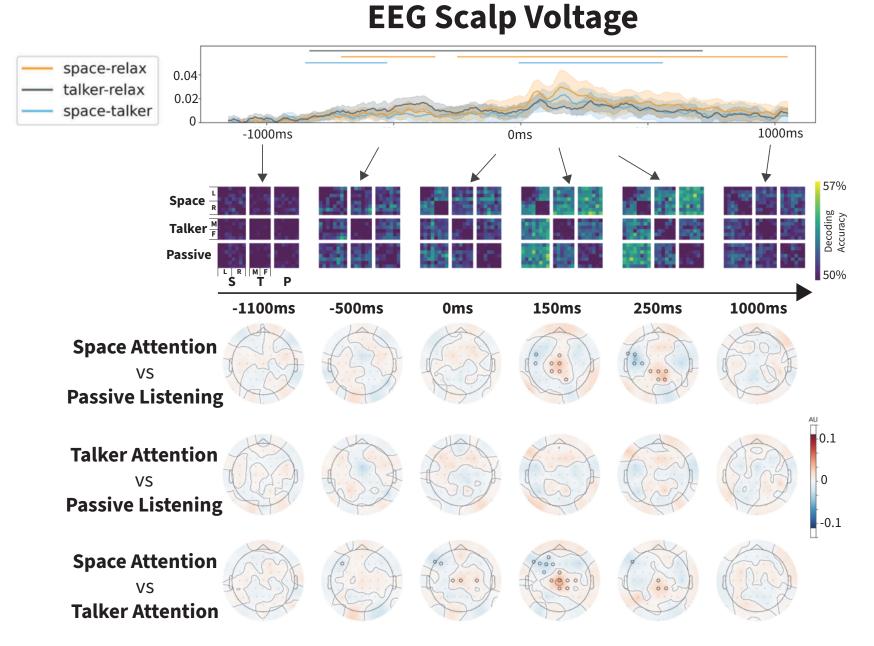
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> 2. Dissimilarity between condition groups

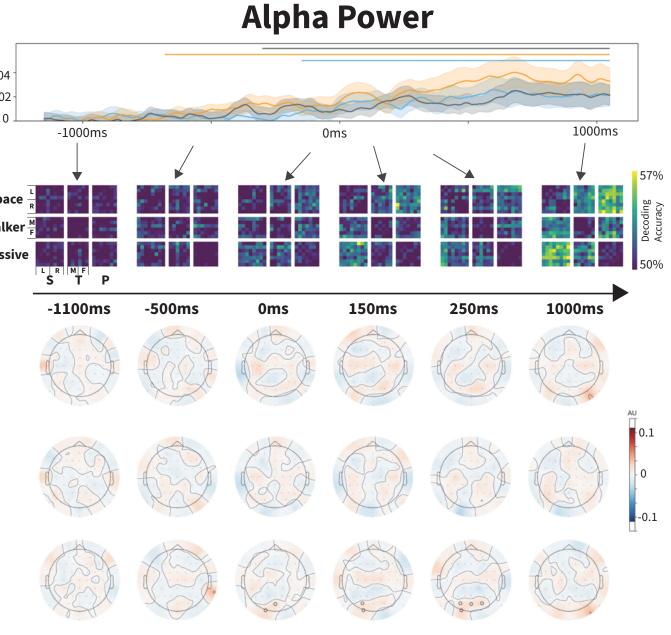
3. Spatial distribution of classification weights

Yes, there are 1) time-locked, ERP-like transient responses to cues and targets 2) persistent oscillatory activity in alpha band

Cue Period: preparing to attend



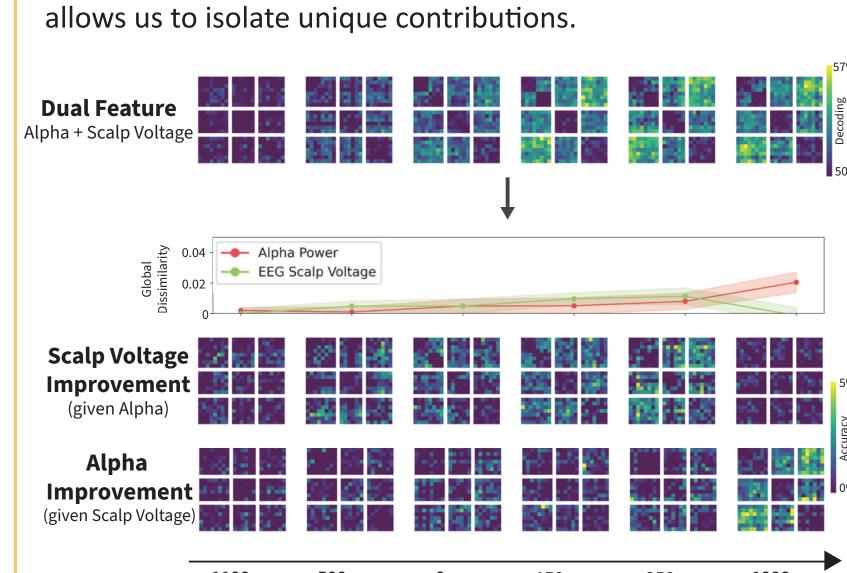
- EEG scalp voltage showed transient dissimilarity 100 300ms after the target cue (like N1-P2 complex).
- Significant clusters in frontotemporal regions.



- Alpha power exhibited sustained, gradually developing pattern.
- Significant clusters in posterior regions.

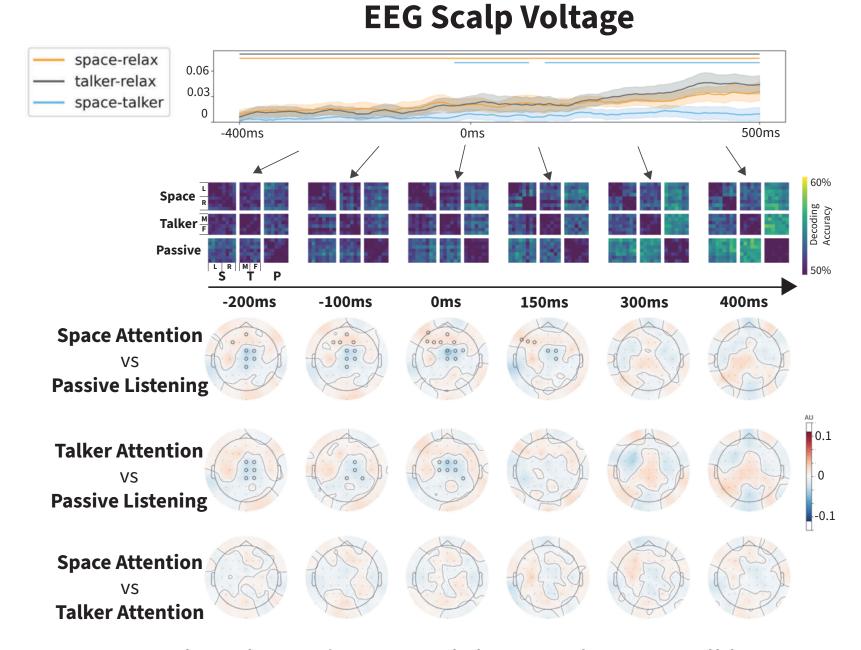
which make unique contributions to attention.

Comparing single feature RDMs to joint (dual feature) RDMs

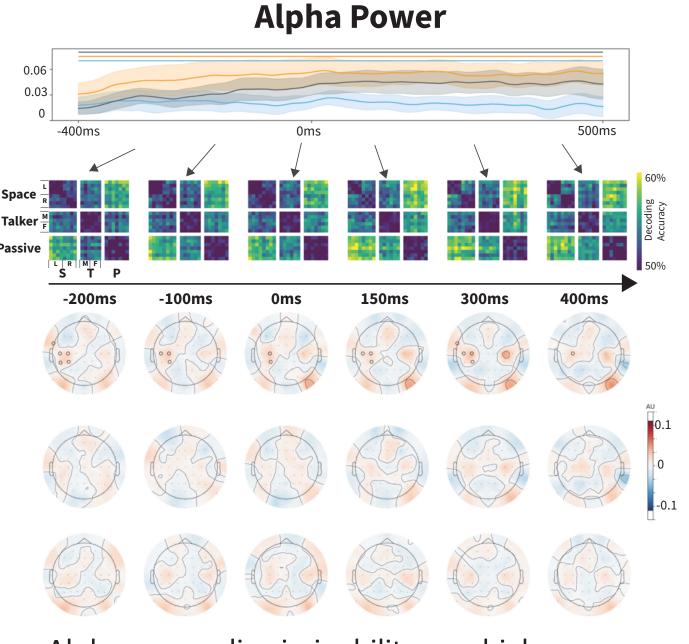


- Alpha power contributions increased over time.
- EEG scalp voltage contributed immediately after the target cue.

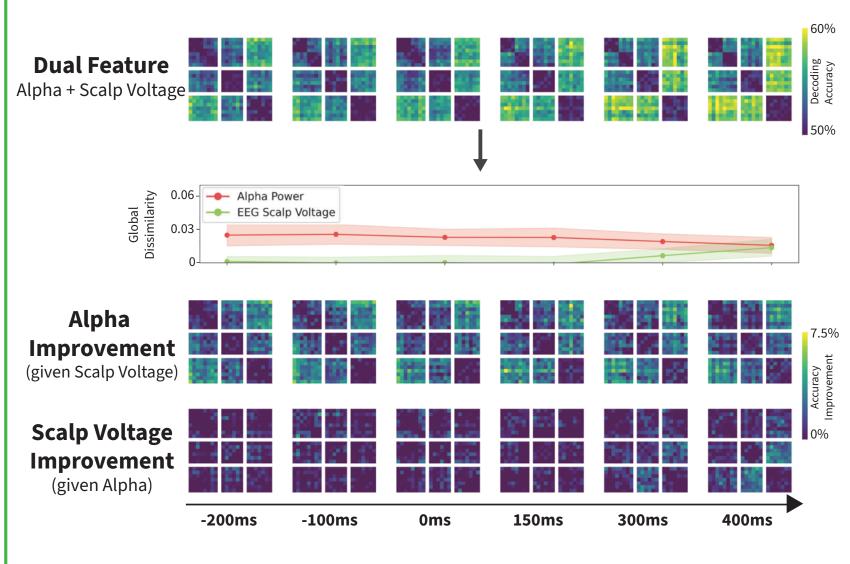
Stimulus Period: identifying the target



• EEG scalp voltage discriminability was low overall but increased 300 – 400ms after the target syllable onset (like P300).



- Alpha power discriminability was high throughout the period.
- Significant clusters in temporal regions, with some trends in posterior areas.



- Alpha power dominated the representational pattern throughout the period.
- EEG scalp voltage contributed around 300 400ms after the target syllable onset.

Acknowledgement MURI N00014-19-12332 [5] Kriegeskorte, N. (2008). Representational similarity analysis – connecting the branches of systems neuroscience. Frontiers in Systems Neuroscience.