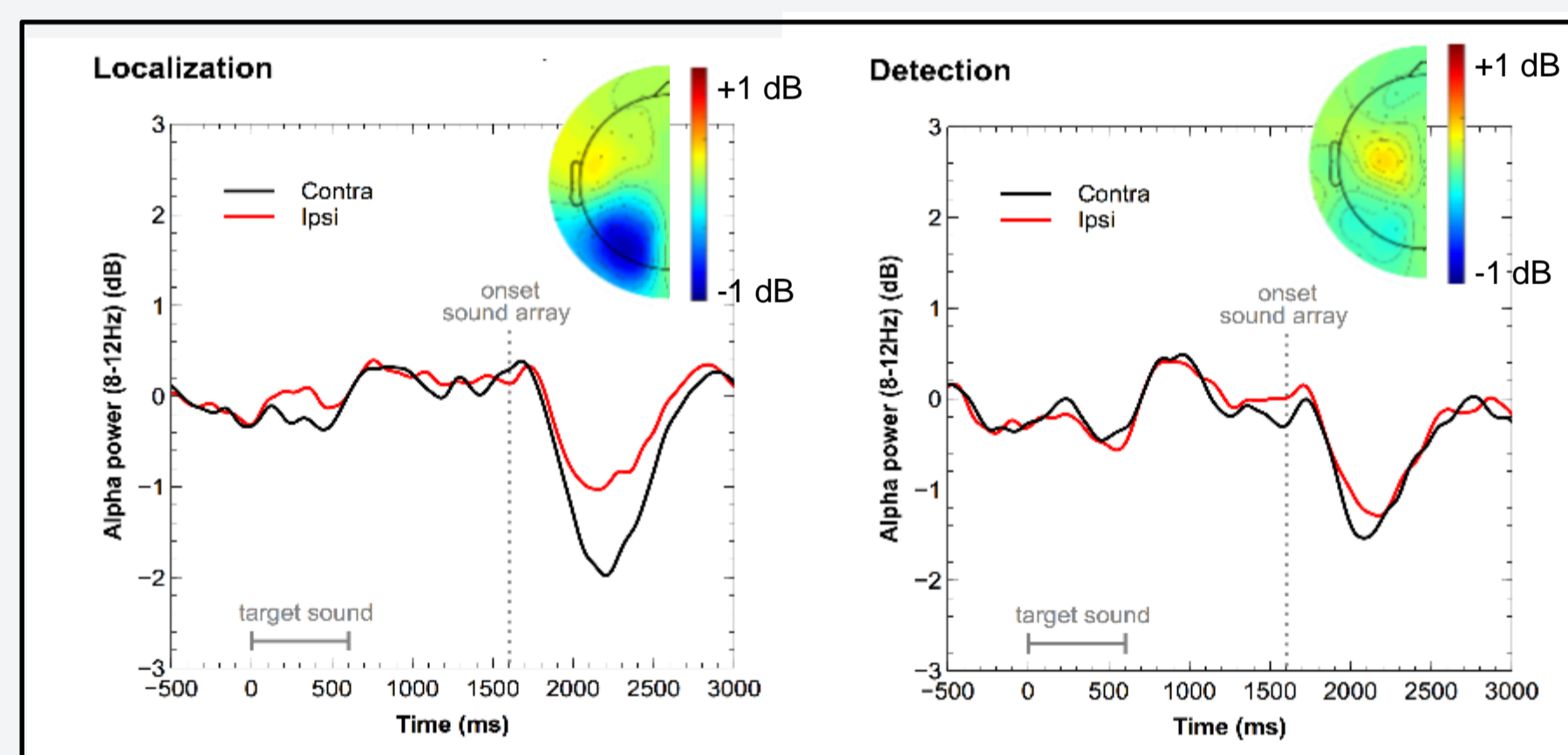


# The Timing of Attentional Alpha Power Modulations Predicts Sound Localization Performance in Complex Auditory Scenes

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## BACKGROUND

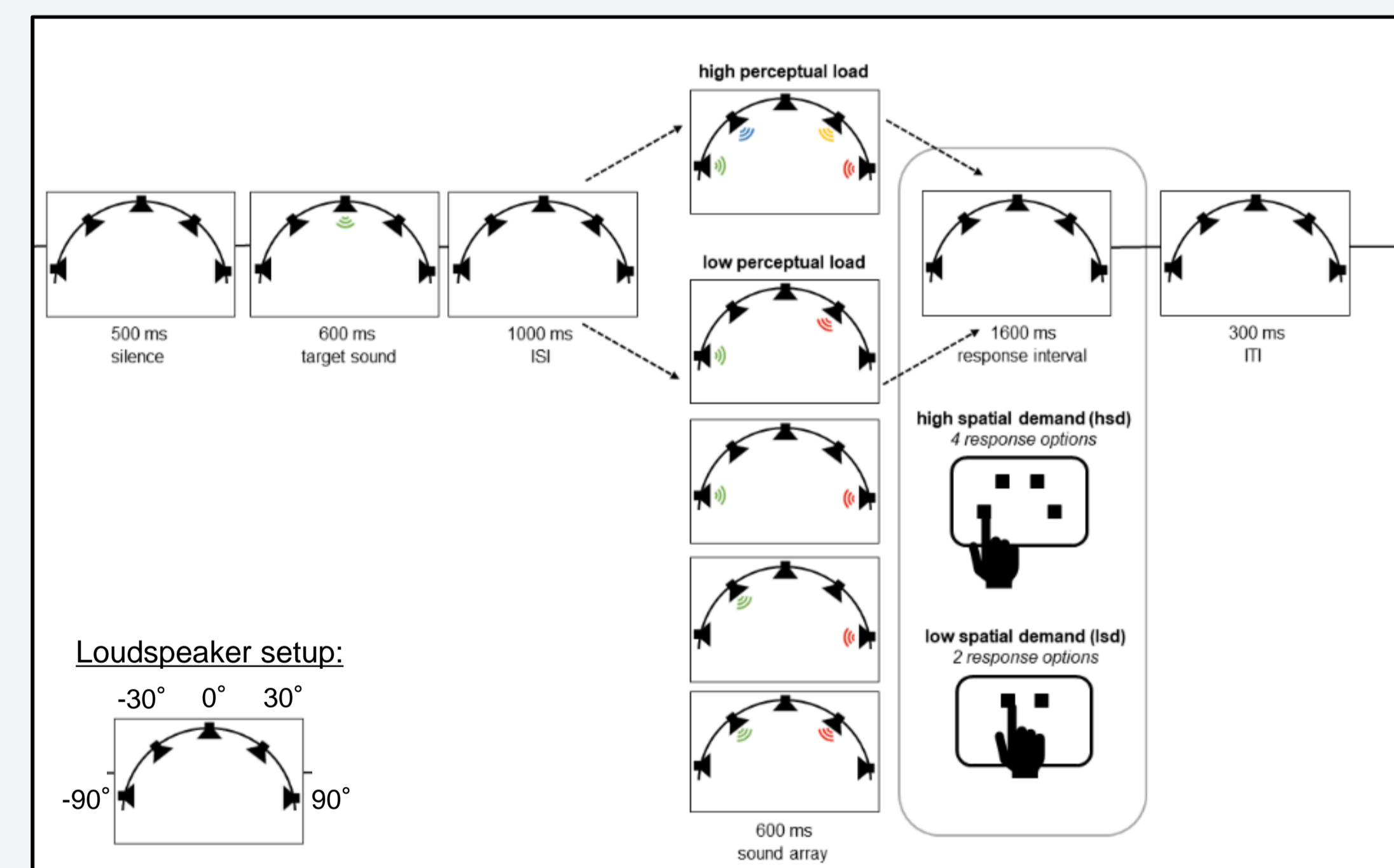
- Asymmetric modulations of alpha power oscillations (i.e., alpha lateralization) have been associated with the deployment of selective attention<sup>[1]</sup>.
- That is, alpha power decreases contralateral to the attended stimulus and / or increases over ipsilateral scalp sites.
- In a previous study<sup>[2]</sup>, we showed that in the auditory domain, alpha lateralization emerges in spatially-specific sound localization, but not in a simple sound detection task (cf. Figure below).
- In addition, alpha lateralization was present and notably, of comparable magnitude in the response-locked ERSPs<sup>[2]</sup>.
- We hypothesized that alpha lateralization reflects attention to a (potentially supramodal) map of spatial locations that guides the preparation of a response.
- To follow up on this, the present study modulates spatial demand and perceptual load in a sound localization task, while recording the EEG.



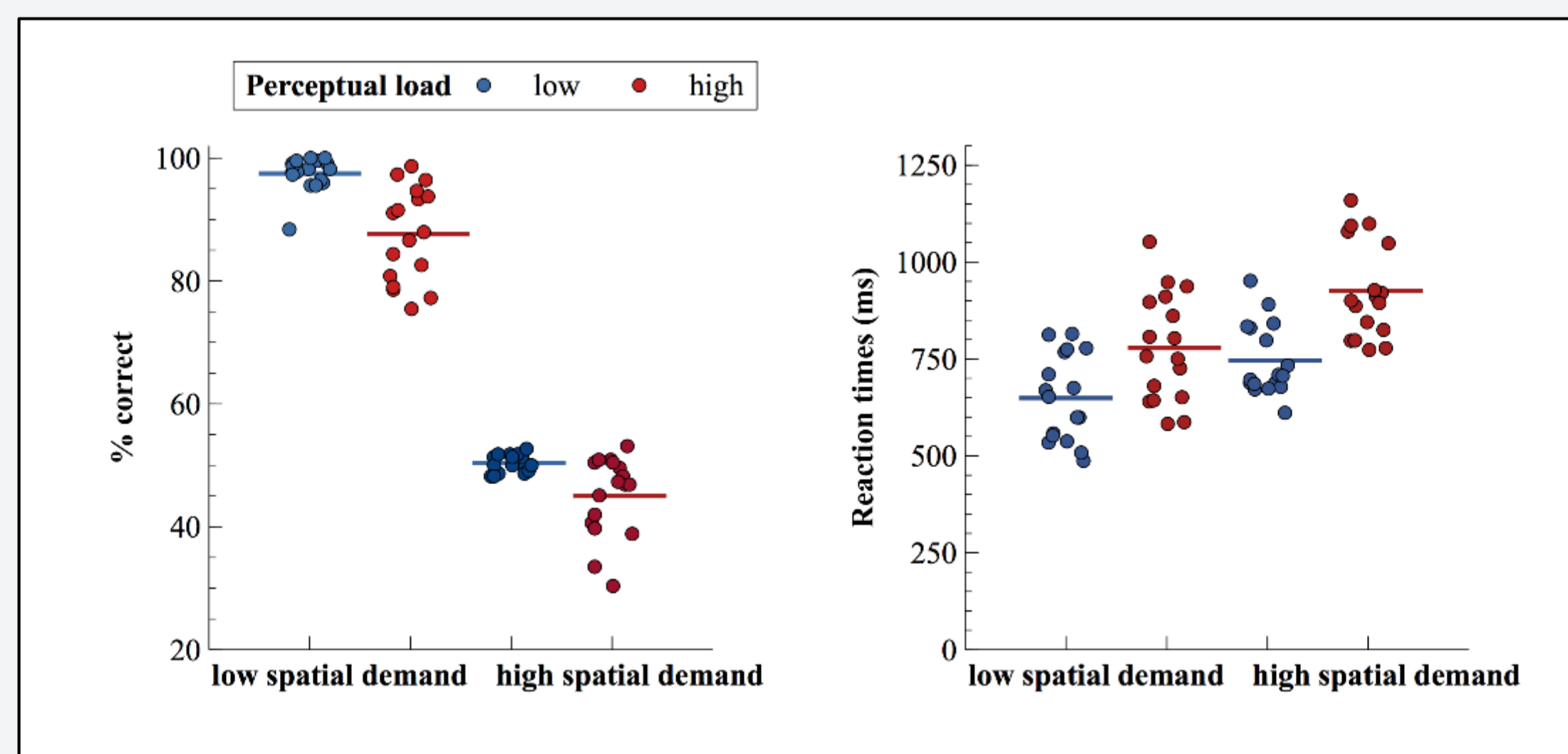
Adapted from Figure 5 in Klatt et al. (2018), Biological Psychology<sup>[2]</sup>

## METHODS

- Sample:** 17 subjects (9 female), mean age 23.3 years (range 19-30)
- Sound Localization Task:** 2 x 2 repeated-measures design
  - Perceptual load (low vs. high):** varied randomly within blocks
  - Spatial demand** varied block-wise
    - **Low spatial demand (lsd):** indicate target position as left vs. right vs. not present (no button press)
    - **High spatial demand (hsd):** indicate exact target position as inner left / right vs. outer left / right vs. not present
- Stimuli:** 8 animal vocalizations<sup>[3]</sup>
- Behavioral Measures:**
  - Response times
  - Accuracy (% correct)
- EEG Measures:**
  - Alpha Lateralization & posterior desynchronization (mean oscillatory power), Onset Latency (20% Fractional Area Latency, short: FAL)



## BEHAVIORAL RESULTS



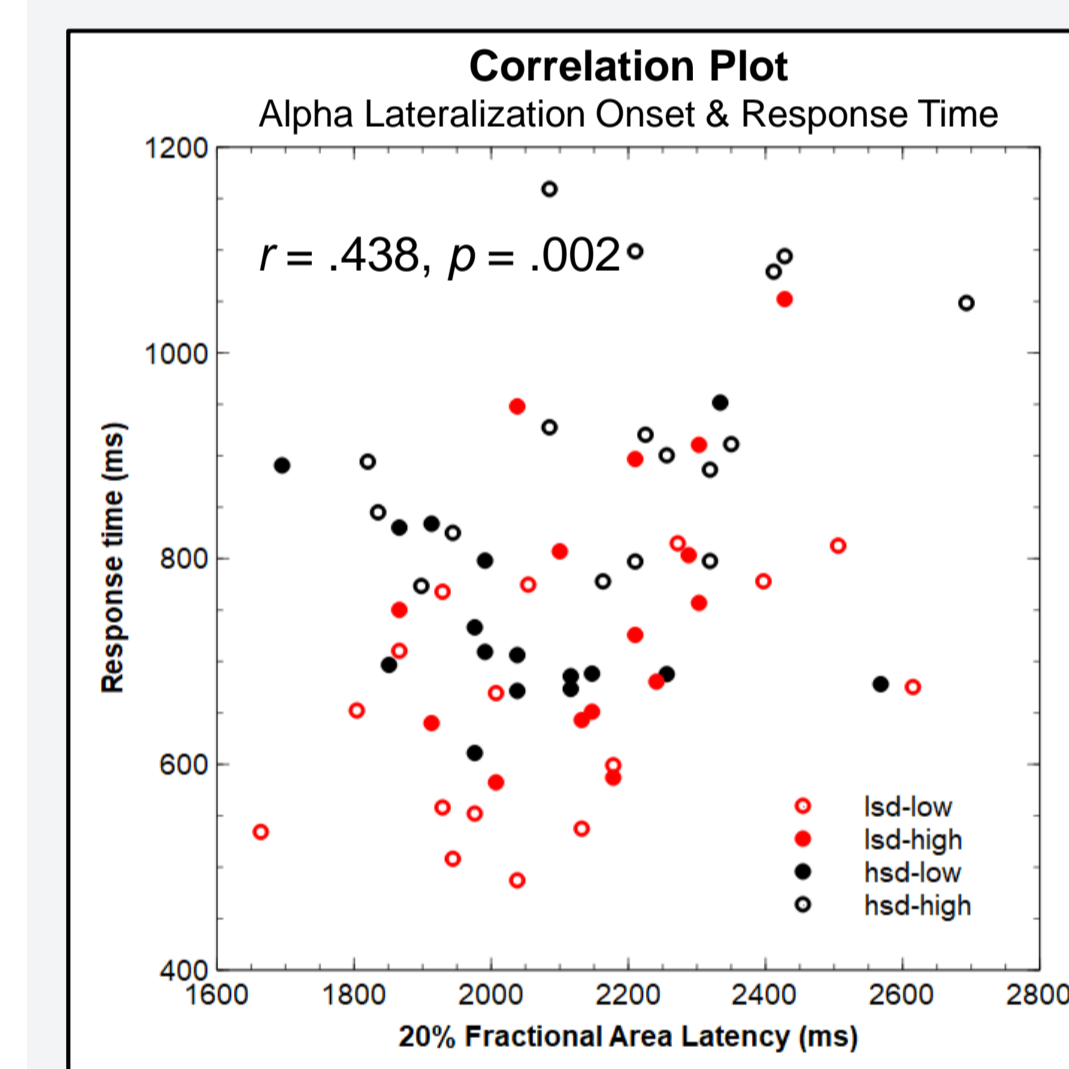
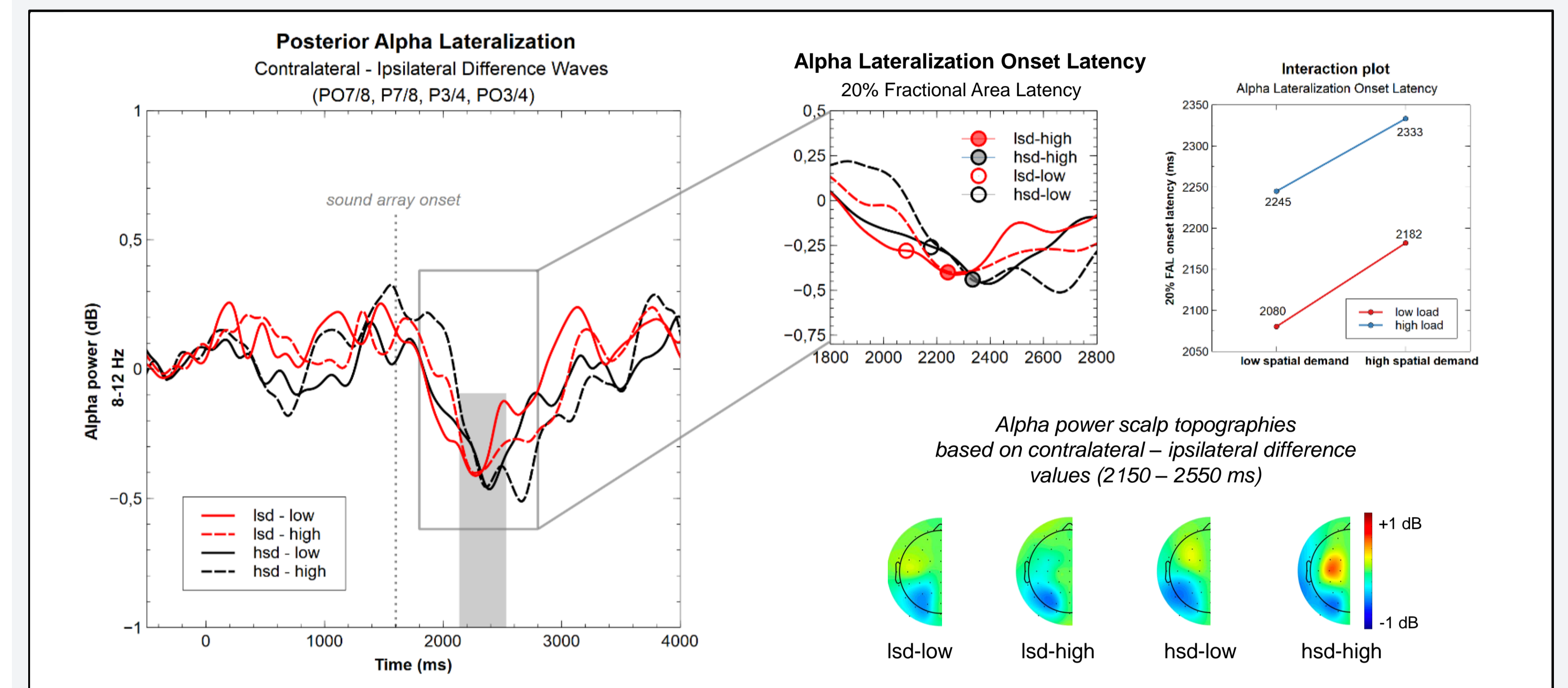
Note that chance level is 33.3% in low spatial demand trials and 20% in high spatial demand blocks.

- Performance is faster & more accurate in *lsd* vs. *hsd* blocks
- Performance is faster & more accurate in *low* vs. *high* perceptual load trials
- The difference in accuracy between *low* & *high* perceptual load is greater in *lsd* compared to *hsd* blocks.

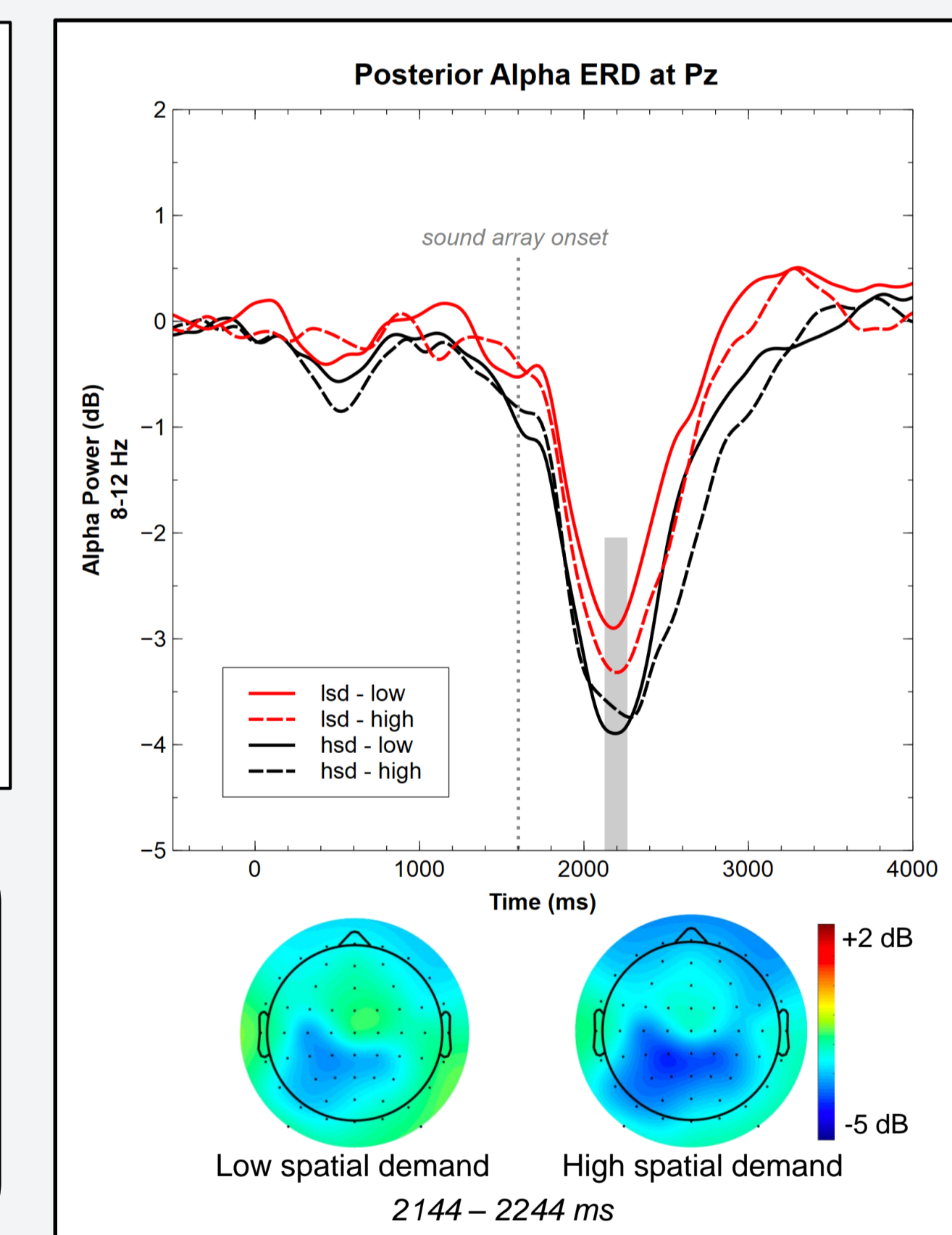
## REFERENCES

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- Klatt, Getzmann, Wascher, Schneider (2018). *Biol Psych*, 138, 133-145.
- Marcell, Borella, Greene, Kerr, Rogers, (2000). *J Clin Exp Neuropsych*, 22, 830-864.

## EEG RESULTS: ALPHA POWER OSCILLATIONS



- Significant correlation:** Earlier Alpha Lateralization onsets coincide with faster response times



- Alpha Lateralization Magnitude** is *not* modulated by spatial demand or perceptual load
- Alpha Lateralization Onset Latencies** (i.e., 20% Fractional Area Latency) significantly vary with spatial demand and perceptual load
- Posterior event-related desynchronization (ERD) of alpha power** is greater for high vs. low spatial demand blocks → reflects cognitive resources

## CONCLUSION

- Alpha Lateralization onset varies with perceptual load & spatial demand. Moreover, across conditions, subjects with earlier Alpha Lateralization onset respond faster.
- The results support the hypothesis that alpha lateralization reflects the attentional access to a „spatial response template“ or a map of spatial locations that guides behavioral output.

*Timing* of oscillatory dynamics in the alpha-band – *but not magnitude* – appears to promote efficient attentional selection in complex auditory scenes