

# Attentional Modulations of Alpha Power in Sound Localization: The Role of Spatial Information

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## BACKGROUND

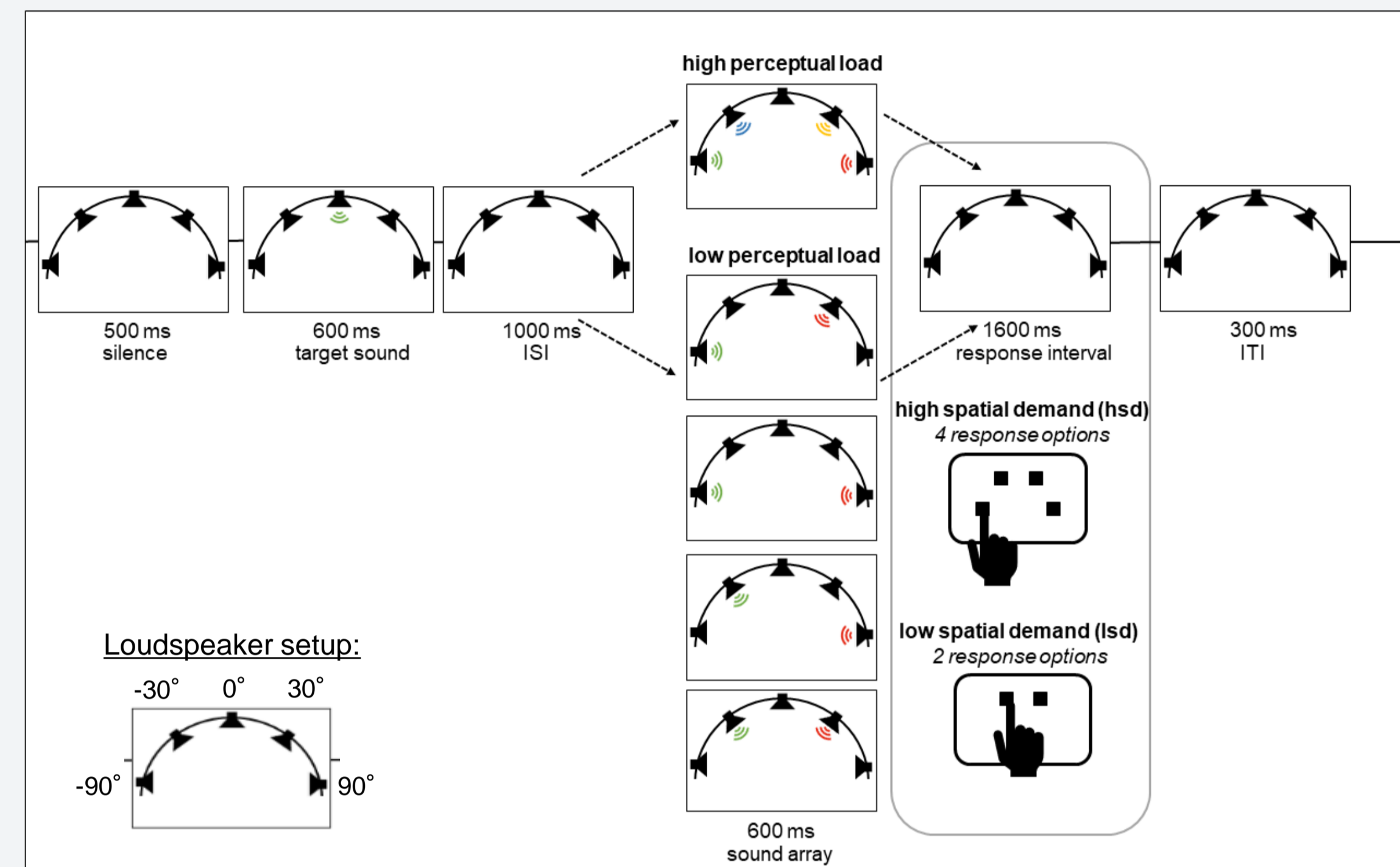
- Asymmetric modulations of alpha power oscillations (i.e., alpha lateralization) have been associated with the deployment of selective attention<sup>[1]</sup>.
- That is, alpha power decreases contralateral to the attended stimulus and / or increases over ipsilateral scalp sites.
- While in the visual domain, the retinotopic representation of space allows for focal modulations that depend on target eccentricity<sup>[2]</sup>, the spatial specificity of auditory alpha modulations remains less clear.
- We previously demonstrated that auditory alpha lateralization is limited to situations in which the spatial location of the target is task-relevant.<sup>[3]</sup>
- Here, we investigated to what extent expectations regarding the *spatial demands* of the task shape the attentional modulation of alpha power.

## REFERENCES

- [1] Thorpe, D'Zmura, Srinivasan (2012). *Brain Topogr*, 25, 39 – 54.  
 [2] Popov, Gips, Kastner, Jensen (2019). *Human Brain Mapping*, 40, 4432-4440.  
 [3] Klatt, Getzmann, Wascher, Schneider (2018). *Biol Psych*, 138, 133-145.  
 [4] Marcell, Borella, Greene, Kerr, Rogers, (2000). *J Clin Exp Neuropsych*, 22, 830-864.  
 [5] Bae & Luck (2018). *The Journal of Neuroscience*, 38, 409-422.

## METHODS

### Sound Localization Task

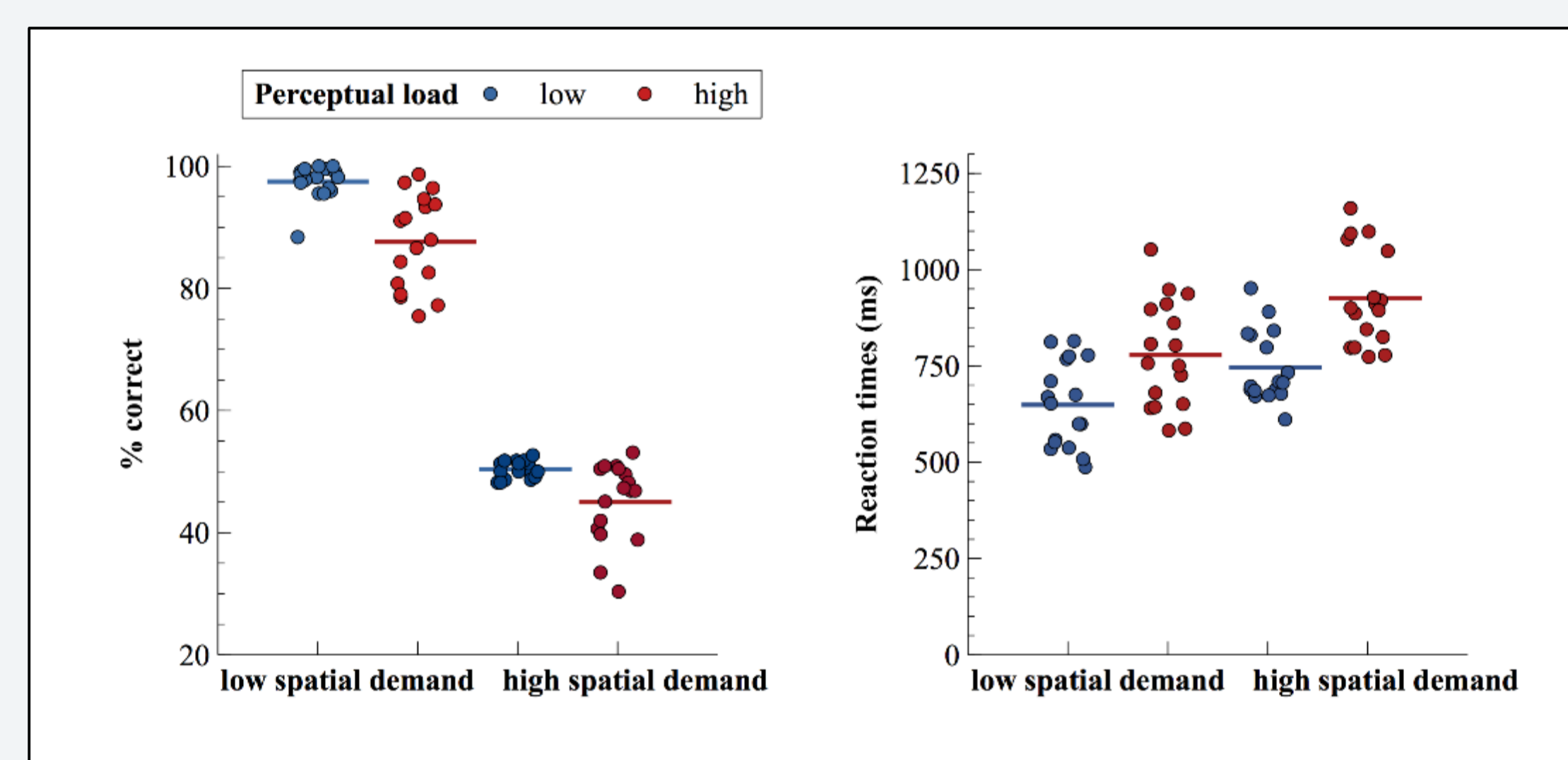


- Spatial demand** varied block-wise
  - **Low spatial demand (lsd)**: indicate target position as left vs. right vs. not present (no button press)
  - **High spatial demand (hsd)**: indicate exact target position as inner left / right vs. outer left / right vs. not present
- Perceptual load** varied randomly within block
  - Two-sound array (low load) vs. four-sound array (high load)

**Sample:** 17 subjects (9 female), mean age 23.3 years (range 19-30)

**Stimuli:** 8 animal vocalizations<sup>[4]</sup>

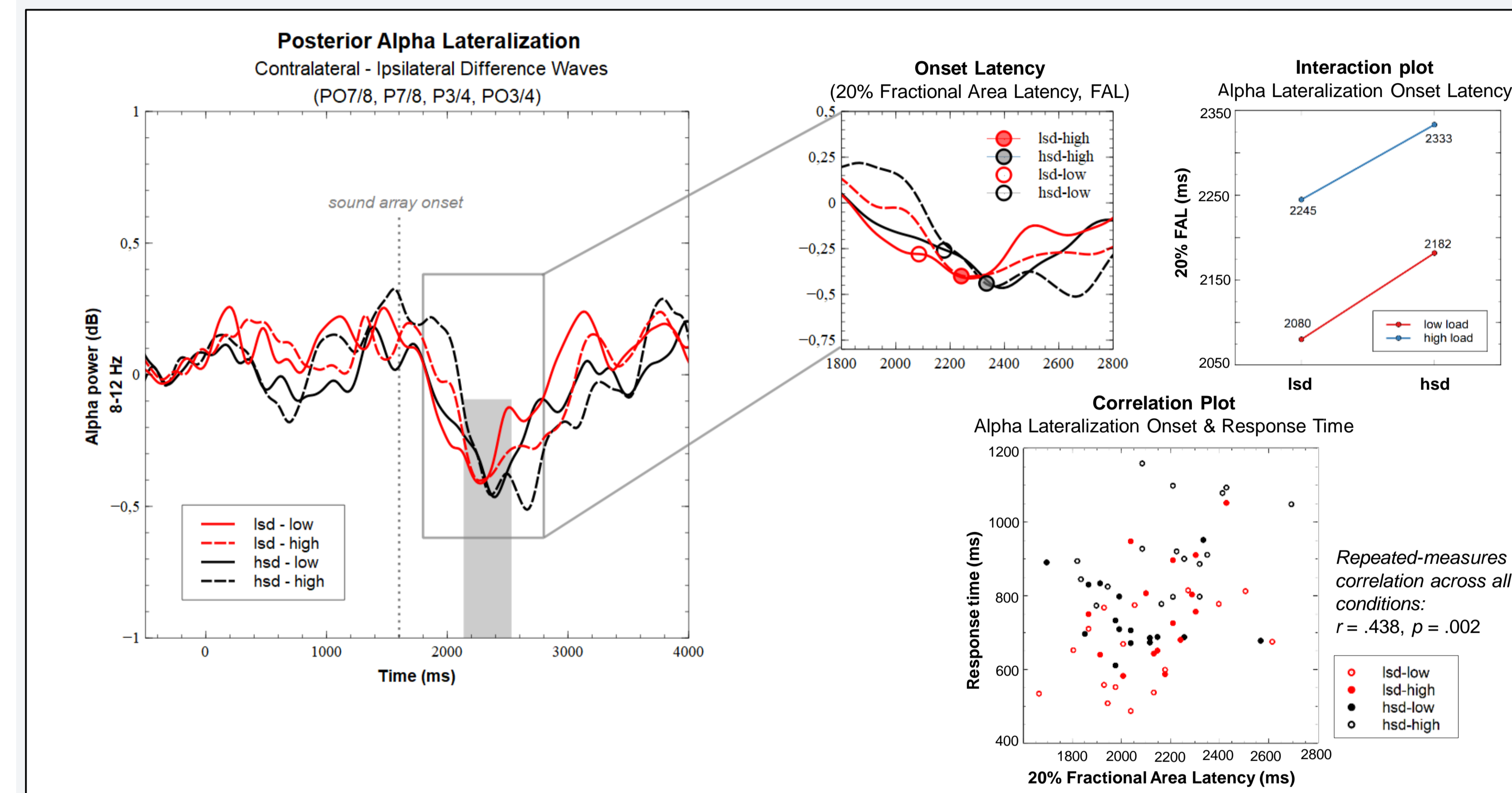
## BEHAVIORAL RESULTS



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

## EEG RESULTS I: POSTERIOR ALPHA LATERALIZATION



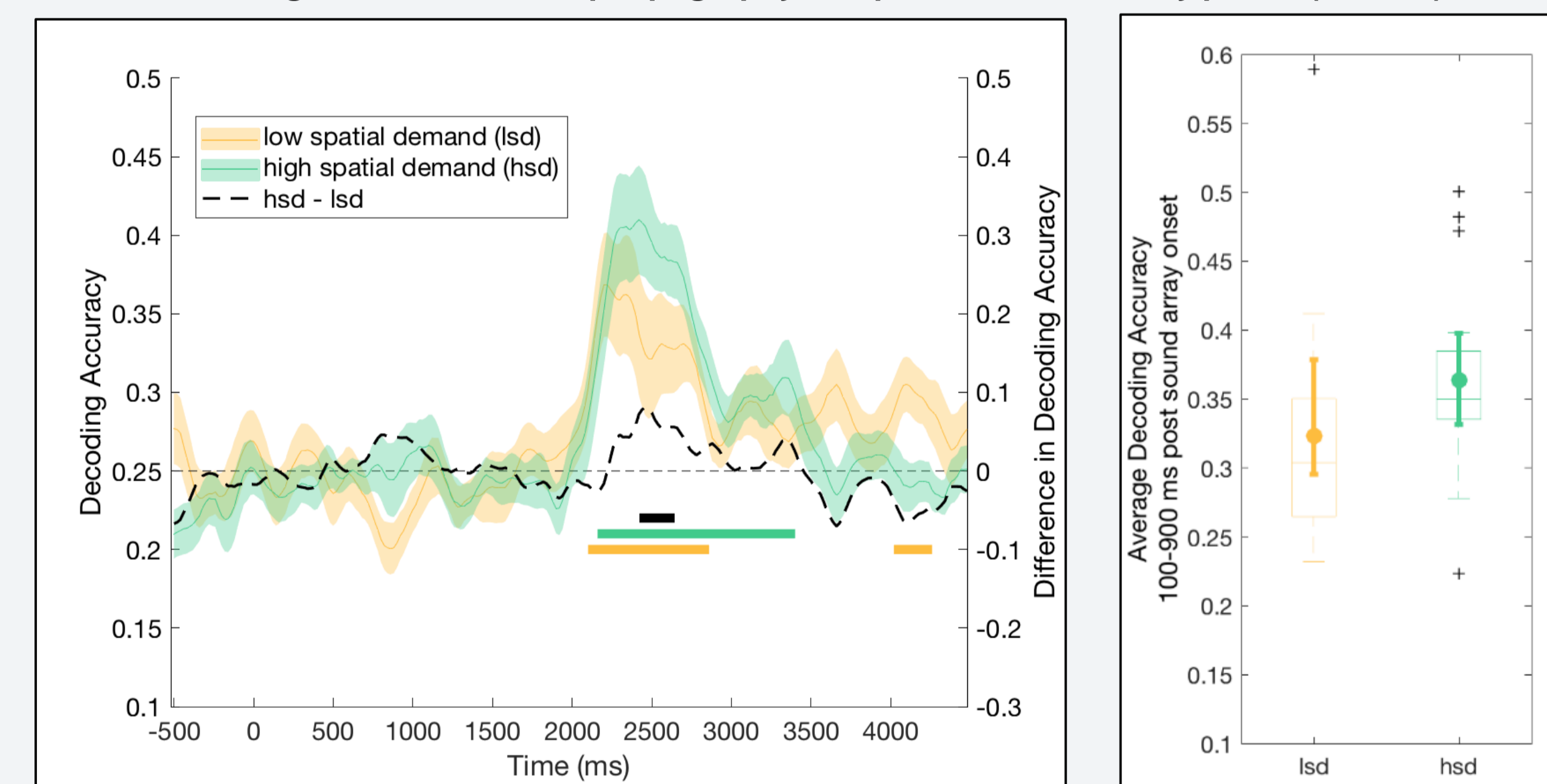
- Alpha Lateralization Magnitude** is *not* modulated by spatial demand or perceptual load
- Alpha Lateralization Onset Latencies** (i.e., 20% Fractional Area Latency) significantly vary with spatial demand and perceptual load
- Significant correlation:** Earlier Alpha Lateralization onsets coincide with faster response times

## EEG RESULTS II: DECODING SPATIAL LOCATION

### Decoding Analysis:

- Support vector machine (SVM) and error-correcting output codes (ECOC)
- Binary classifiers, decoding the *exact target location*
- Note: code adapted from [5]

### Decoding based on the scalp topography of alpha-band oscillatory power (8-12 Hz)



Note: Horizontal bars indicate significant time windows as indicated by cluster-permutation statistics

- Higher decoding accuracy in hsd-blocks**
  - The "amount" of spatial information reflected in the scalp topography of alpha-band power varies with spatial demand

## CONCLUSION

- Altogether, this emphasizes that auditory attentional modulations of alpha power are sensitive to the task-relevance of spatial information.
- While this was not reflected in the magnitude of mean oscillatory power over posterior scalp, both **alpha lateralization onset latencies** as well as the **amount of spatial information that is reflected in the scalp distribution of alpha power** seems to **vary depending on the spatial demands of the task**.