Neural representations of attention following exogenous and endogenous cues in monkey parietal cortex and thalamus

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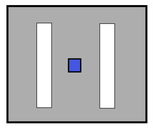
Endogenous and exogenous cueing

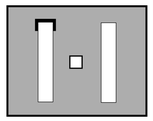
Conflicting results on whether endogenous (endo) and exogenous (exo) cues [1-3]:

- engage different mechanisms at a single attention locus
- recruit the same networks and/or neural populations

Endogenous attention: voluntary, slow-acting, goal-oriented



Exogenous attention: involuntary, fast-acting, at cued spatial location



Do the two cueing types elicit similar attention modulation during sustained attention?

Figure 1: Modified Egly Driver task. Informative cues were presented using peripheral markers at the target location (exo) or using one of four centrally-presented colors (endo). Data were recorded simultaneously using Plexon probes (inset).

References & Acknowledgements

[1] Hopfinger & West. Neuroimage. 2006.
[2] Chica et al. Behavioural Brain Research. 2013.
[3] Fernández et al. Journal of Neuroscience. 2022.

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Behavioral results

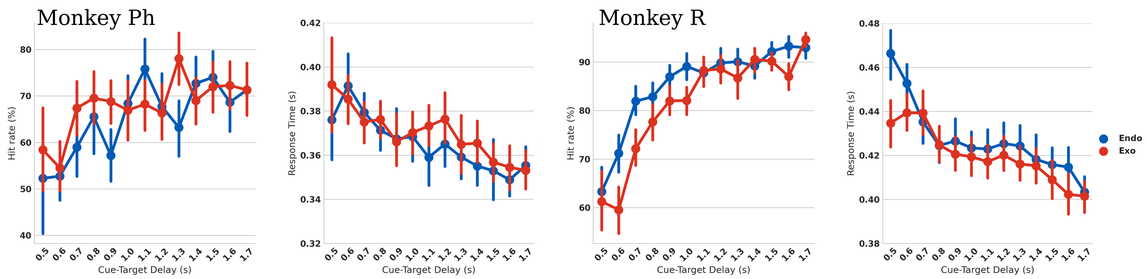
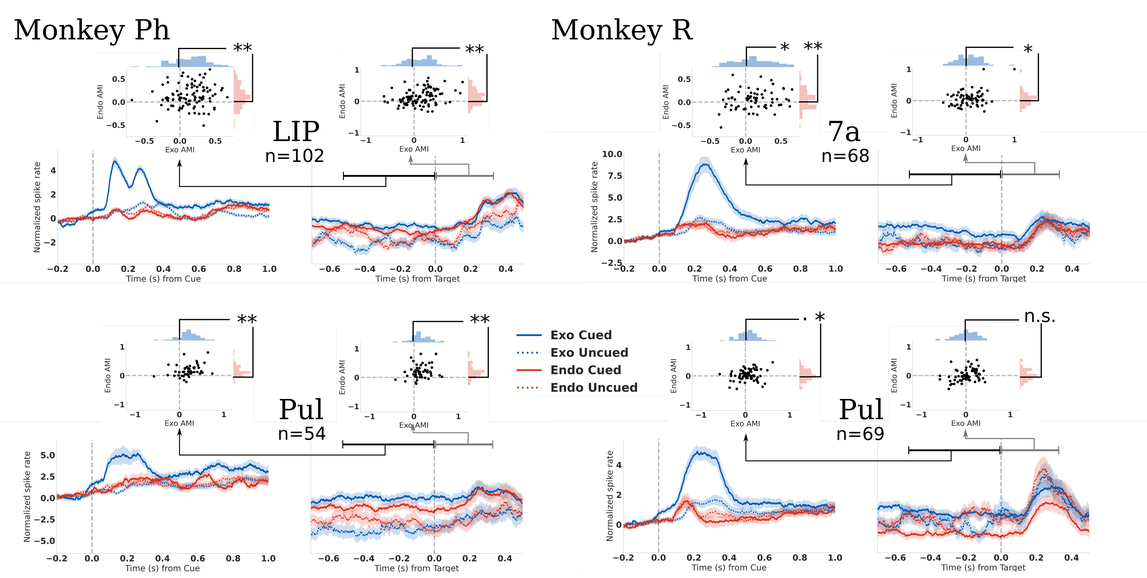


Figure 2: Behavior shows comparable performance to Endo and Exo cues. Hit rate and response time (presented for each monkey) indicate similar performance for the two cue types for trials grouped by cue-target delay. Bars indicate standard deviation.

In line with previous research [2], performance **increased** with longer target delays in **both** exo and endo conditions. Note the use of long cue-target delays in the experiment for both cue conditions.

Non-significant trends of **increased performance in exo-cued** targets compared to endo-cued targets in 1 monkey and **only in short cue-target delays**.

Single-area spiking results



**: Wilcoxon p<0.0001

Figure 3: Spiking activity suggests overlap in representation of sustained responses to Exo and Endo cues. Peri-stimulus time histograms from parietal cortex (top row) and pulvinar (bottom row) indicate a strong attention effect following exogenous cue, with only some units of similar response profile in the sustained activity and target selection periods. Shaded regions indicate standard error of the mean. Attention modulation indices (AMI) were calculated for each unit's response to Exo and Endo cues in each period.

Thalamocortical interactions

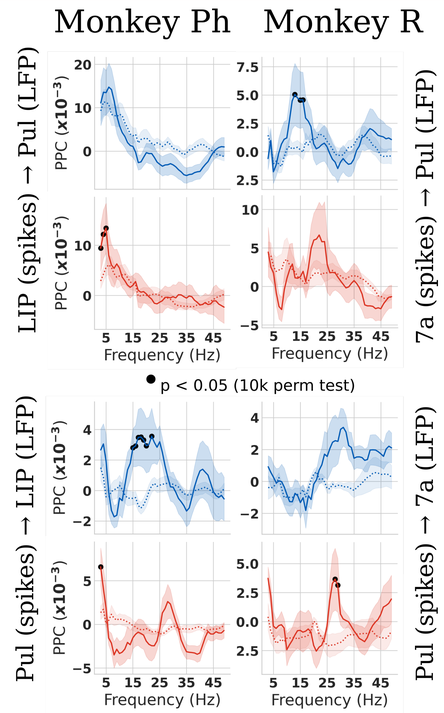


Figure 4: Thalamocortical interactions to Exo & Endo cues. Using complex Morlet wavelets and pairwise phase consistency (PPC), directed thalamocortical interactions were probed during both cueing conditions in the 500 ms window prior to target.

Conclusions

- Informative endogenous and exogenous cues correspond to **similar behavioral performance** in long delays
- Neural activity in monkey parietal cortex and thalamus suggest **overlapping** attention-specific, sustained response profiles in a **subset** of the recorded population
- Thalamocortical activity during the two cueing conditions is inconclusive, but may **suggest different neural mechanisms** that could be carried out by **different networks or subpopulations**