

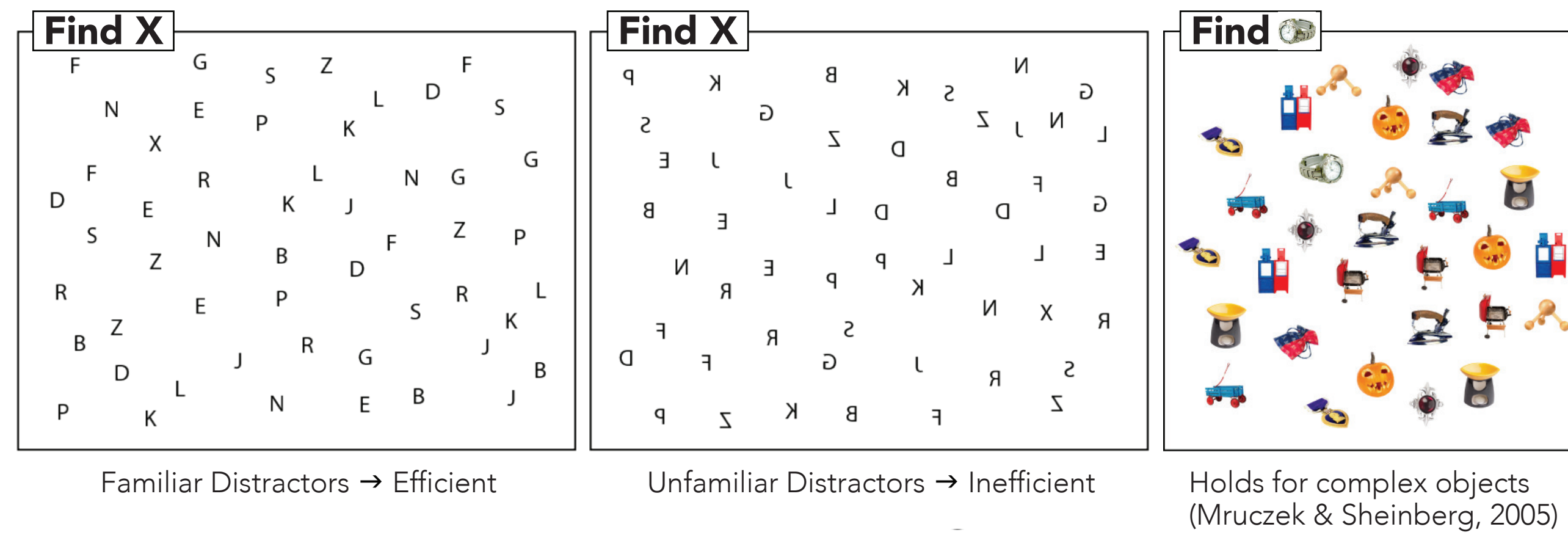
Novel objects in a rapid serial visual presentation (RSVP) stream elicit an attentional blink

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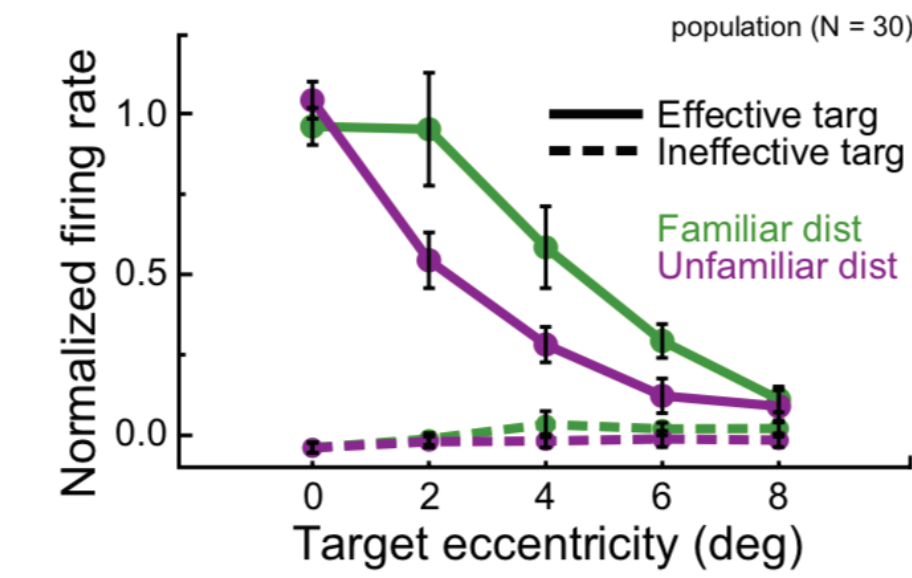
Motivation

Visual search is faster and more efficient when the distractors are highly familiar.



Search efficiency linked to functional receptive field size in inferior temporal cortex.

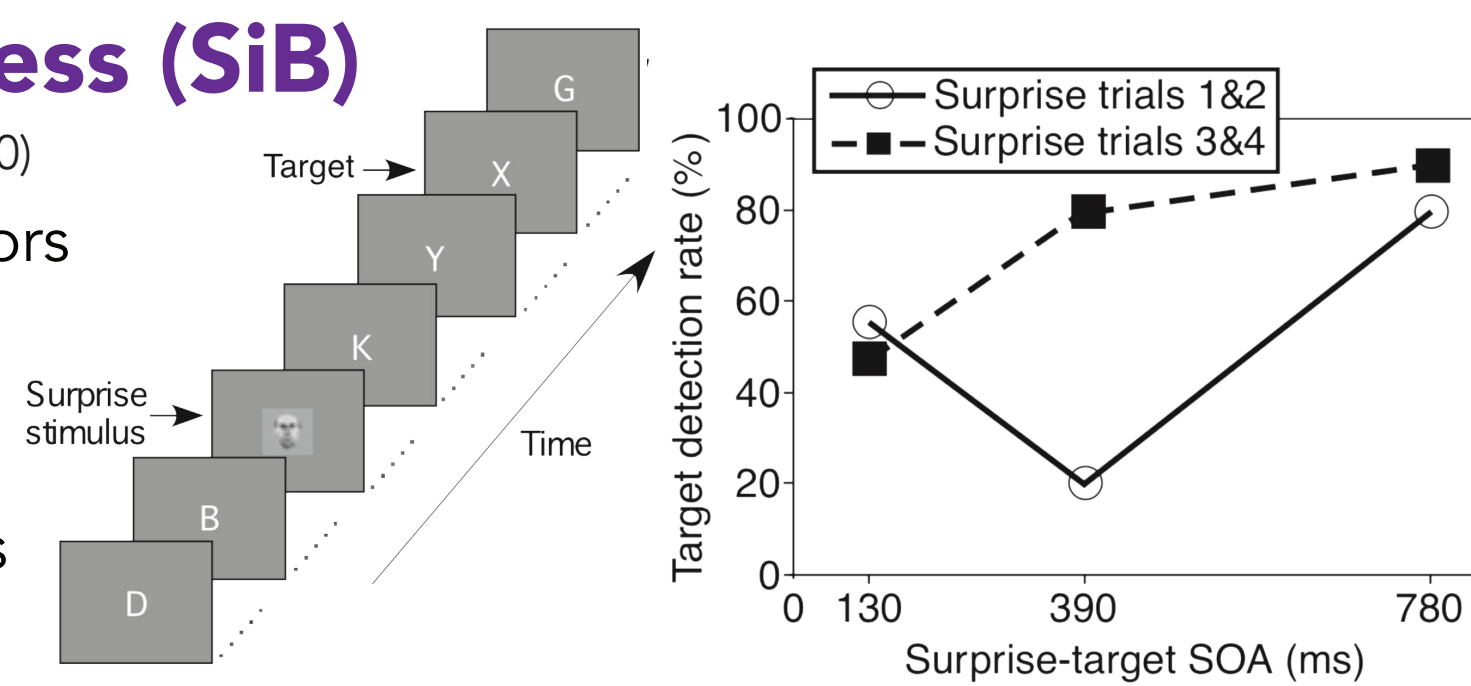
(Mruzek & Sheinberg, 2007)



Surprise-induced blindness (SiB)

(Asplund et al., 2010; see also Manahova et al., 2020)

- Unexpected, task-irrelevant distractors disrupt serial search.
- Large effect at ~390 ms, but quickly habituates after ~2 trials.
- Modest effect at ~130 ms, persists over many trials.
- But, **categorically distinct** distractors.



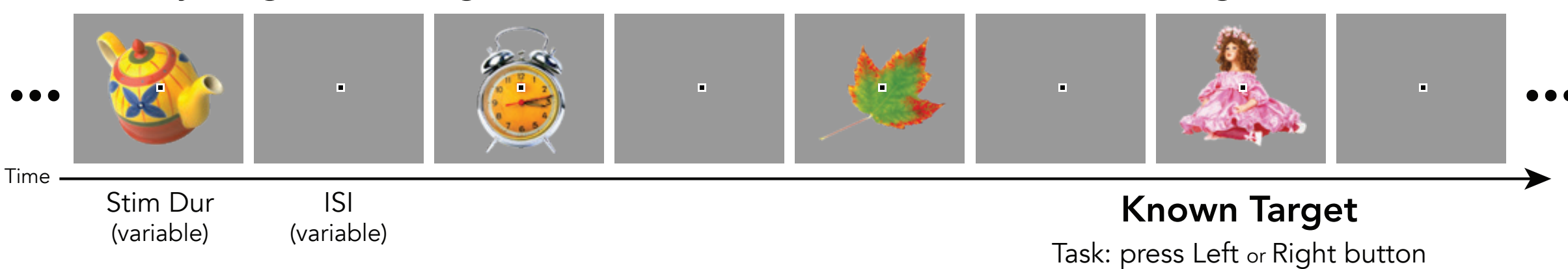
Does object familiarity affect serial search? Do novel objects (from same category) induce a blink?

Building in Familiarity

- 14 participants, 6 sessions on separate days
- Images randomly assigned as targets (8), familiar distractors (20), or novels (2 per run)

Serial Search (RSVP) Task

- Identify targets amongst a continuous stream of distractor images



Day 1: Target Training

Learn response (left/right) associated with each of 8 target images

- 5 runs targets-only, Stim dur until response, auditory & visual feedback
- 8 targets x 10 reps = 80 trials/run
- 5 runs RSVP, 400/400 ms (Stim/ISI dur), "familiar" distractors, auditory feedback
- Target appears every ~1.6 to 3.2 s
- 2 sides x 20 reps = 40 trials/run + 1 catch (no target) trial (at start of run)

Day 2: RSVP Training

- 1 run targets-only, auditory & visual feedback
- 5 runs RSVP, 400/400 ms (Stim/ISI dur), "familiar" distractors, auditory feedback
- 8 runs RSVP, increasing pace from ~300/300 ms → ~100/100 ms (stim dur/ISI)
- Target appears every ~1.6 to 3.6 s
- 2 sides x 20 reps = 40 trials/run + 6 catch trials (1 at start of run)

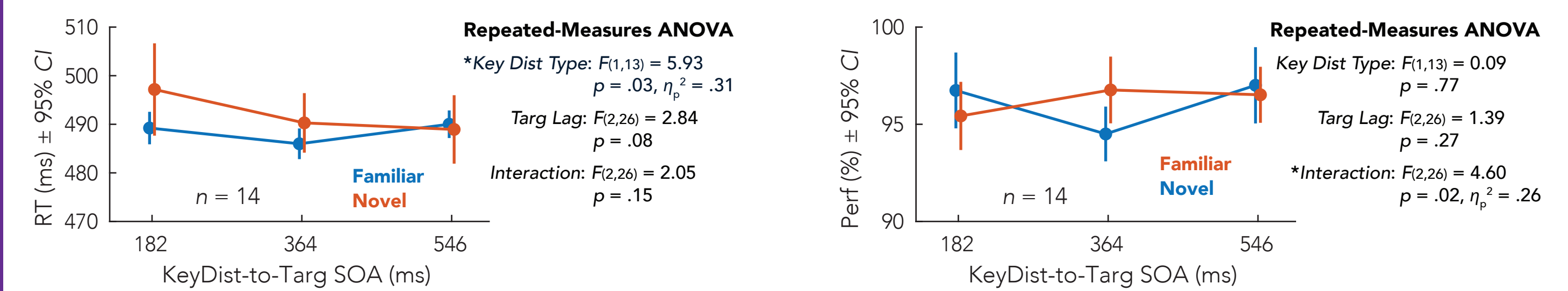
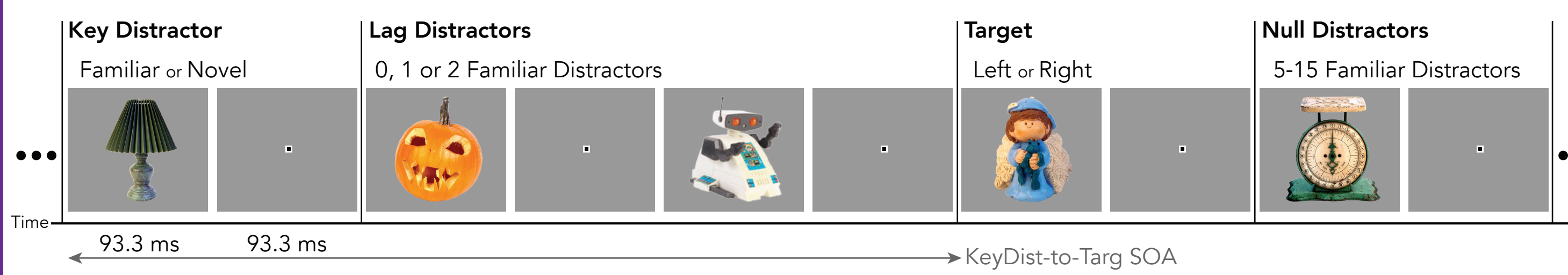
Day 3: Distractor Familiarity Phase

- 1 run targets-only, auditory & visual feedback
- 10 runs RSVP, 93/93 ms (Stim/ISI dur)
- Target appears every ~1.6 to 3.6 s
- 2 sides x 18 reps = 36 trials/run + 12 catch (1 at start of run)

Novel-Induced Attentional Blink

Day 4: Novel Distractor Test Phase 1: Do novel distractor induce an attentional blink?

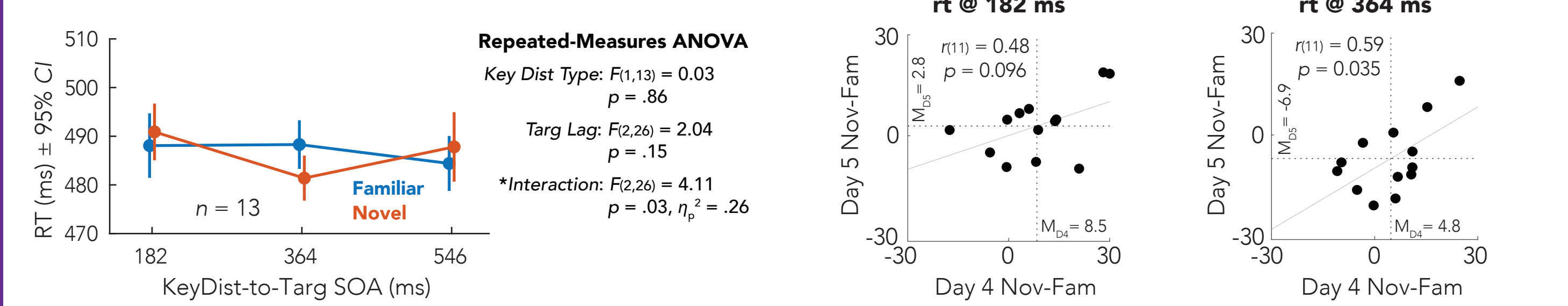
- 1 run targets-only, auditory & visual feedback
- 10 runs RSVP, 93/93 ms (stim dur/ISI), 75 Hz monitor refresh
- Target appears every ~1.2 to 3.8 s
- Target follows **Key Dist** (familiar or novel) with a **Targ Lag** of 1/2/3 images (~180-550 ms)
- New novel distractors selected for every run
- 2 sides x 3 targ lags x 2 key dists x 3 reps = 36 trials/run + 6 catch/key dist type (1 at start of run) → 60 trials/condition/participant



Response to target was slower following a novel distractor. Effect clearest for shorter SOAs. Effects on near-ceiling accuracy unclear.

Day 5: Novel Distractor Test Phase 2: Reliability and persistence of novel-induced blink?

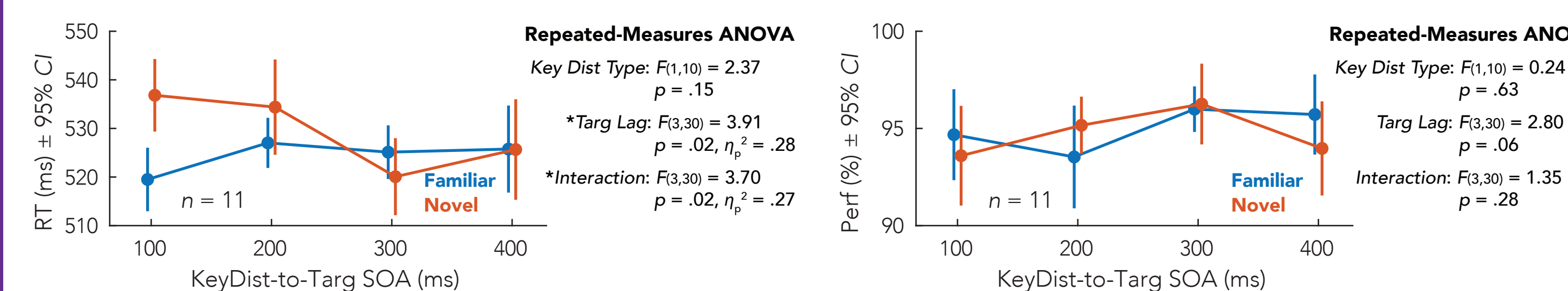
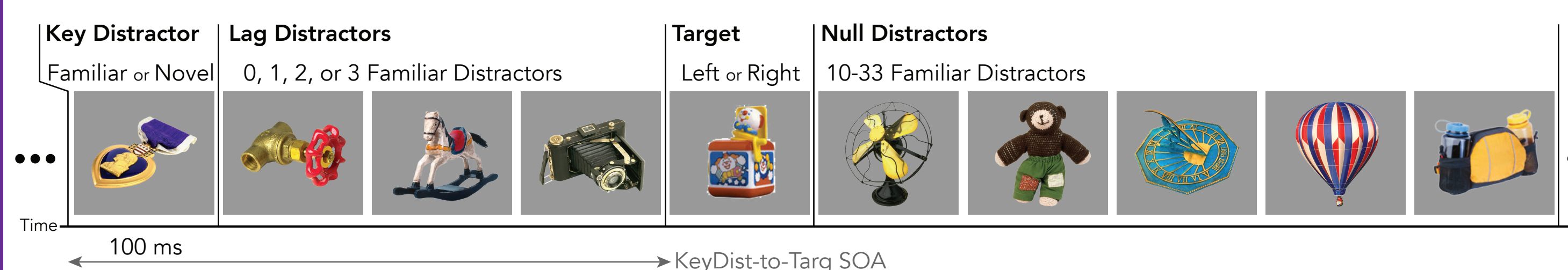
- Replication of Day 4 (above)
- **New novel distractors still selected for every run**
- 2 sides x 4 targ lags x 2 key dists x 3 reps = 48 trials/run + 6 catch/key dist type (1 at start of run) → 60 trials/condition/participant



Novel-induced blink habituated across sessions. Novel images may have acted as cue for upcoming target at long SOA.

Day 6: Novel Distractor Test Phase 2: No ISI to increase temporal resolution and task difficulty.

- Same as above, but 100 ms Stim dur (100 Hz monitor refresh), no ISI, and Targ Lag of 1/2/3/4 images (100-400 ms)
- 2 sides x 4 targ lags x 2 key dists x 3 reps = 48 trials/run + 6 catch/key dist type (1 at start of run) → 60 trials/condition/participant



Clear attentional blink following a novel distractor at shortest SOA (100 ms). Early effect stronger and more resistant to habituation.

Summary

Novel distractors induce a brief "attentional blink" during serial search.

Take-Home Points

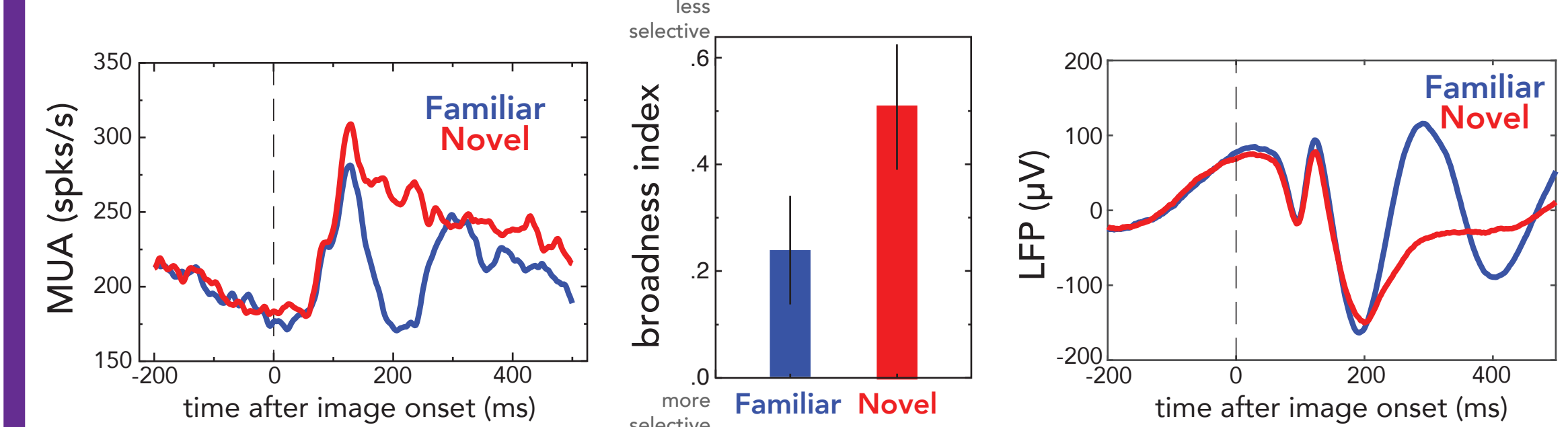
- Persistent effects on reaction time at short SOAs
- Some evidence for habituation at longer SOAs
- Similar to Surprise-induced Blindness (SiB), but cannot be explained by systematic feature differences between distractors and targets.

Future Directions

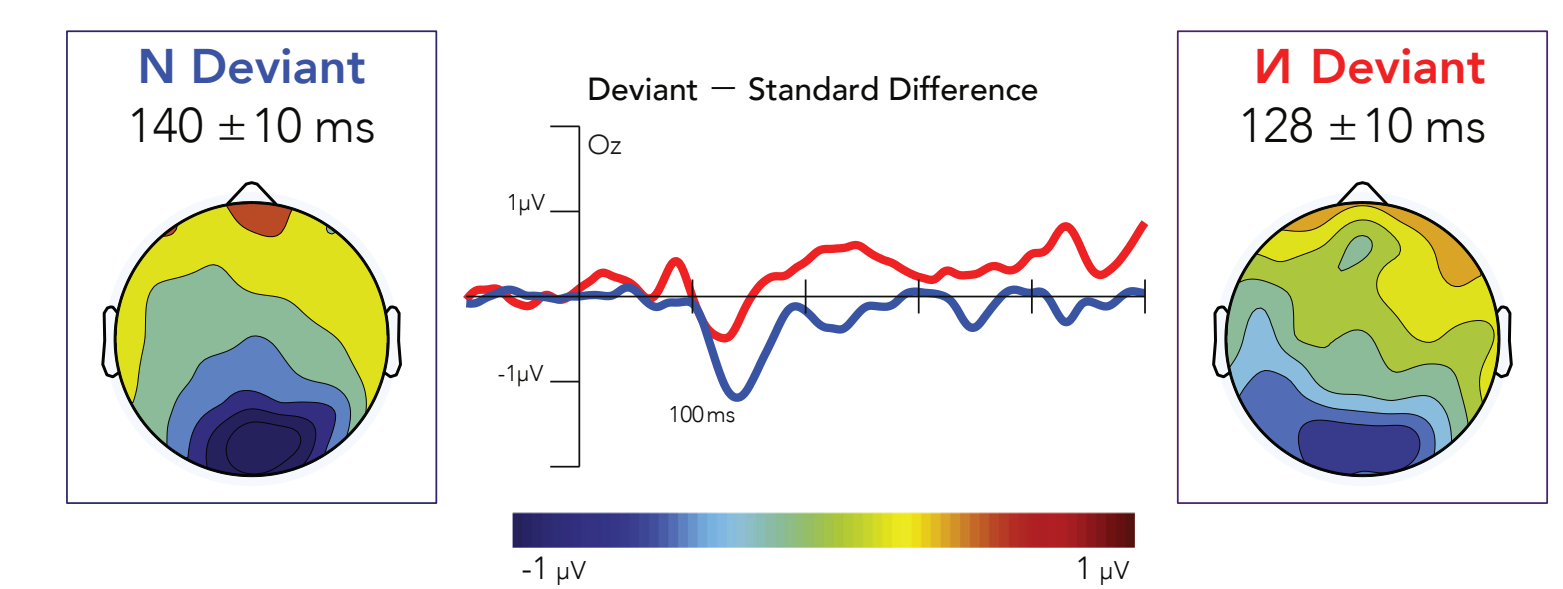
- Redesign task to eliminate predictability of target following novel distractor.
- Near-ceiling performance → Add noise?
- Explore electrophysiological correlates.

Relevant Physiology

Lower spike rates, more selective responses, and stronger LFPs in inferior temporal cortex evoked by familiar objects. (e.g., Anderson et al., 2008)



Unfamiliar objects evoke an earlier visual mismatch negativity (vMMN). (Sulykos et al., 2015)



References and Funding

Anderson B., Mruzek, R.E.B., Kawasaki, K. & Sheinberg, D.L. (2008). *Cerebral Cortex* 18:2540-52. DOI: 10.1093/cercor/bhn015

Asplund, C.L., Todd, J.J., Snyder, A.P., Gilbert, C.M., & Marois, R. (2010). *Journal of Experimental Psychology: Human Perception & Performance*, 36(6): 1372-81. DOI: 10.1037/a0020551

Manahova, M.E., Spaak, E., & de Lange, F.P. (2020). *Journal of Cognitive Neuroscience*, 32(4), 722-733. DOI: doi.org/10.1162/jocn_a_01507

Mruzek, R.E.B. & Sheinberg, D.L. (2005). *Perception & Psychophysics*, 67(6): 1016-31. DOI: 10.3758/bf03193628

Mruzek, R.E.B. & Sheinberg, D.L. (2007). *Journal of Neuroscience*, 27: 8533-45. DOI: 10.1523/JNEUROSCI.2106-07.2007

Sulykos, I., Kecskés-Kovács, K. & Czigler, I. (2015). *Brain Research*, 1626: 108-117. DOI: 10.1016/j.brainres.2015.02.035

Support: Robert L. Ardizzone ('63) Fund for Tenure Track Faculty Excellence