Tracking the Evolution of the Memory Trace for Visual Motion

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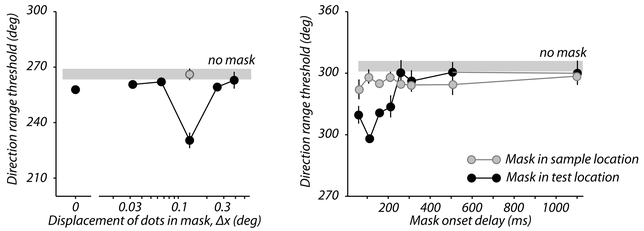
1 Introduction

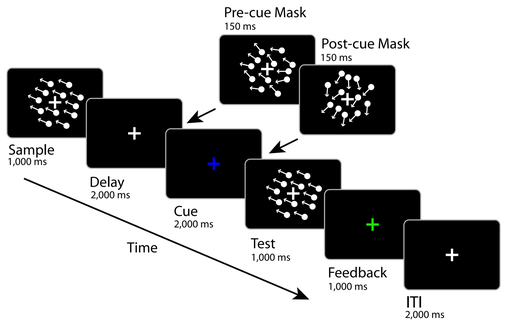
- While often thought to require specialized cortical systems, particularly those in pre-frontal cortex (PFC), recent research has shown working memory may arise through the coordinated recruitment of brain systems involved in sensory, representational, and action-related functions *(Postle 2006)*
- Recent monkey work using a delayed-recognition task for motion direction suggests such a cortical network, with low-level sensory information represented in the middle temporal visual area (MT) and task-related representations appearing in PFC during the memory delay *(Pasternak and Zaksas 2003, Zaksas and Pasternak 2006)*

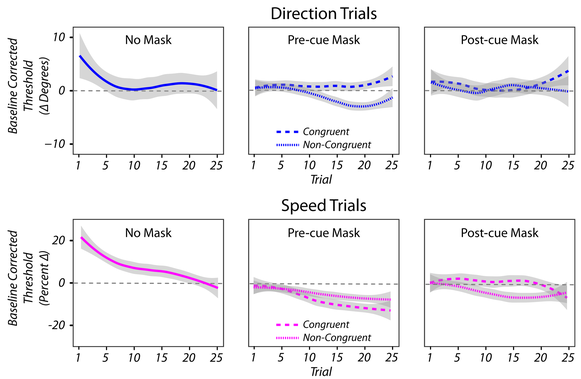


- Can we see determine the representational format of memory storage during the delay period of a motion memory task in human subjects using fMRI?

2 Behavioral Experiment

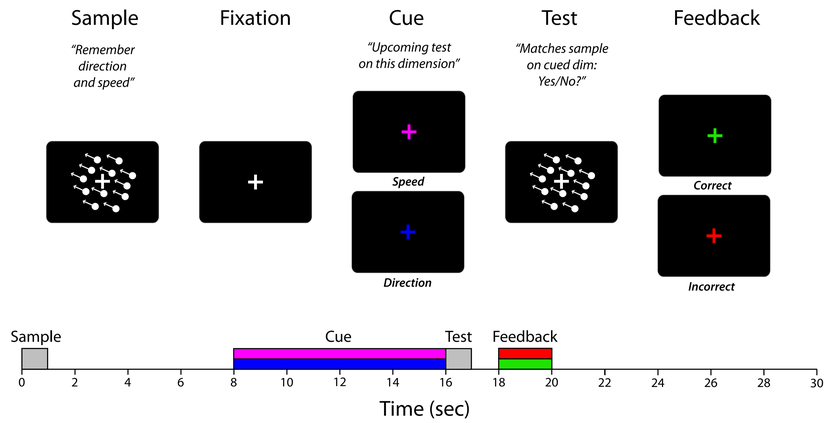
- Delayed-recognition for visual motion task with mid-delay cue (n = 20)
  - Fully crossed design, with factors of cue (direction, speed), mask (congruent, incongruent), mask timing (pre-cue, post-cue) and probe validity (valid, invalid)
  - Adaptive staircase adjusted threshold to achieve 75% performance





- Disruption in performance on direction task after pre-cue mask suggests subjects are maintaining a low-level, sensory based representation early in the delay

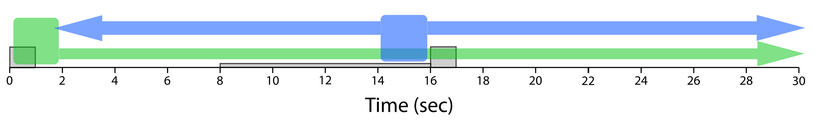
3 fMRI Experimental Design



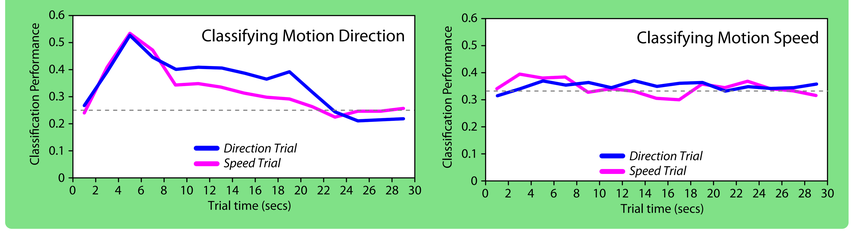
4 Timeseries Classification

Train for low-level sensory-based representation on patterns for sample stimuli (Test forward)

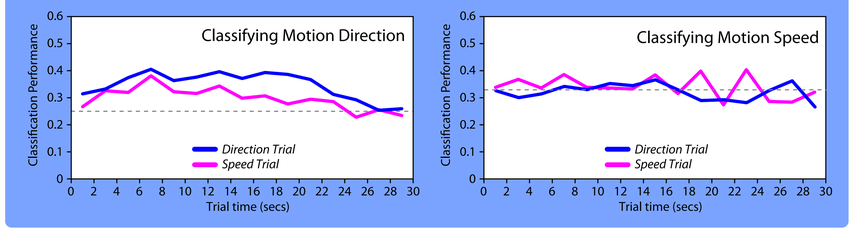
Train for high-level task-relevant representation on patterns just prior to test stimuli (Test bi-directionally)



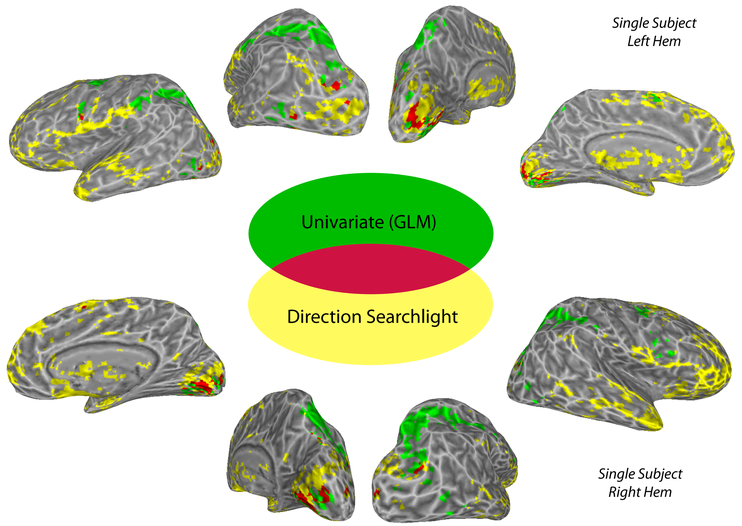
Sensory-based representation decoding (n = 3)



Task-relevant representation decoding (n = 3)

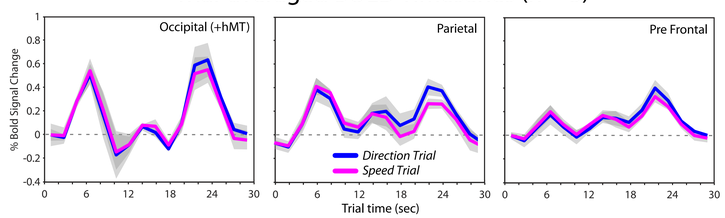


5 Univariate v. Searchlight

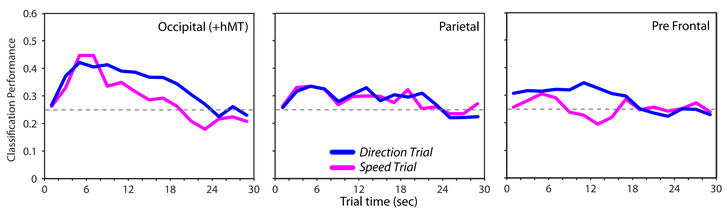


6 ROI Timeseries

Trial-averaged BOLD Timeseries (n = 3)



Motion Direction Decoded Timeseries (n = 3)



7 Summary

- We find evidence for the storage of visual motion information in PFC and posterior visual areas during long delay periods
- We can successfully decode the remembered direction, but not the speed, of visual motion
- These data suggest low-level visual features me be stored in early visual areas, with the representations being recoded into task-revelant representations in PFC in preparation for response

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