

# The investigation of saccade parallel programming using a novel double-step paradigm: an fMRI study

## Introduction

- ❖ Saccade parallel programming: WHEN & WHERE
  - ❖ WHEN → Temporal trigger
  - ❖ WHERE → Target representation and vector calculation
- ❖ Frontal eye field (FEF) & parietal eye field (PEF) → saccade parallel programming (Hu & Walker, 2011)
- ❖ Saccadic system can represent more than targets simultaneously (McPeck et al., 2000), even if vector changes later

## Method

- ❖ 15 fully informed and consenting healthy adults (7 female, age = 19-37).
- ❖ 3T Siemens Trio (EPI scan: TR = 3s, TE = 32 ms, 3x3x3 mm, volume = 74 / block).
- ❖ 2 sets of instructions:
  - ❖ Double-step go/change condition & single condition
  - ❖ Double-step-return go/change condition & single-return condition

## Double-step task

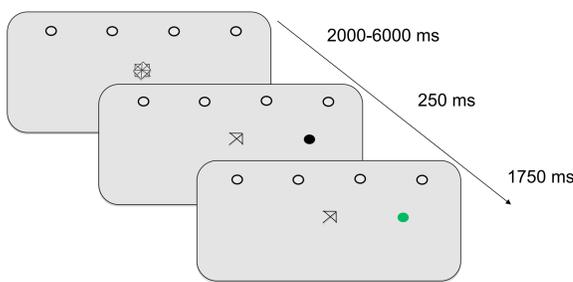


Figure 1a. A trial of the double-step GO condition

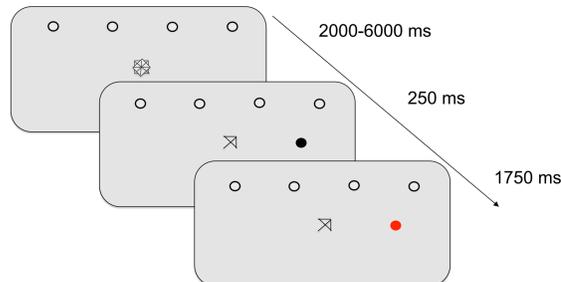


Figure 1b. A trial of the double-step CHANGE condition

## Single-step task

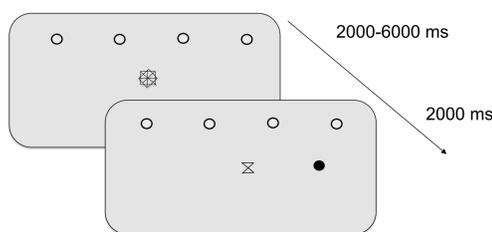


Figure 1c. A trial of the reflexive control condition

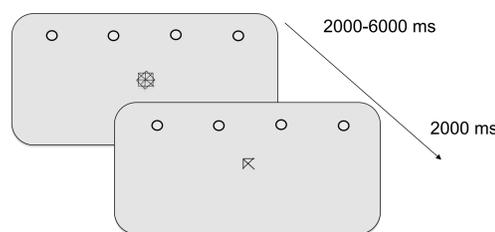


Figure 1d. A trial of the voluntary control condition

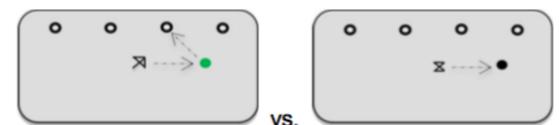


Figure 2a. Remapping but not change of plan

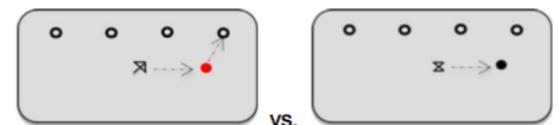


Figure 2b. Change of plan but not remapping

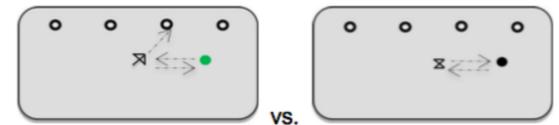


Figure 2c. No remapping & no change of plan

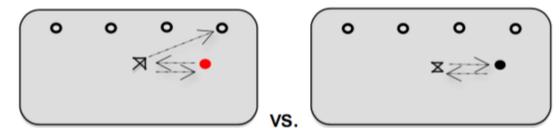


Figure 2d. Change of plan & remapping

## Results

### Saccade target remapping

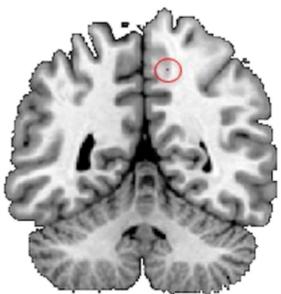


Figure 3a. R-parietal region



Figure 3b. R-temporal gyrus



Figure 3c. R-hippocampus region

### Saccade change of plan



Figure 3d. L-lateral prefrontal

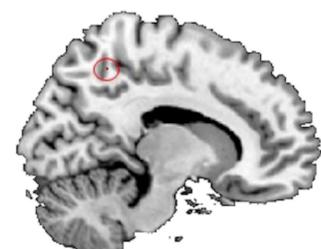


Figure 3g. R-PEF



Figure 3f. R-cingulate caudate

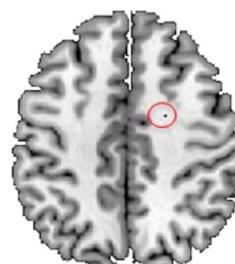


Figure 3e. R-FEF

Uncorrected,  $p < .001$

## Discussion

- ❖ Parietal region: spatial saccade target representation using eye-centred frame (Andersen, 1995)
- ❖ Hippocampus region: storing initial vector & recalculate new metric
- ❖ Temporal region: saccadic suppression / inhibition of return: double-step return condition
- ❖ FEF: temporal control
- ❖ Lateral PFC & ventromedial frontal cortex: monitor executive control, task switching & decision making

### References:

- Andersen, R. A., (1995). Encoding of intention and spatial location in the posterior parietal cortex. *Cerebral Cortex*, 5, 457-469.
- Hu, Y., & Walker, R. (2011). The neural basis of parallel saccade programming: an fMRI study. *Journal of Cognitive Neuroscience*, 23, 3669-3680.
- McPeck, R. M., Skavenski, A. A., & Nakayama, K. (2000). Concurrent processing of saccades in visual search. *Vision Research*, 40, 2499-2516