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Persistent activity in the human frontal eye field when maintaining space that is 'off the map'

SfN 2007
302.7



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Background

- Frontal eye field (FEF) maintains spatial positions in working memory through persistent neural activity.
- FEF activity sustains when maintaining visual-cued space.
- Electrophysiological monkey study showed sustained delay activity when maintaining auditory-cued space.

Aims

- Does human FEF activity persist when subjects maintain an auditory-cued spatial location?
- Does persistent FEF activity represent only retinal space?

Methods

Figure 1. Recording and auditory-cued locations.

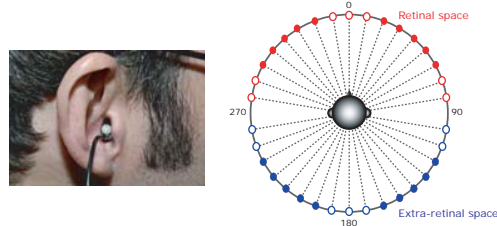
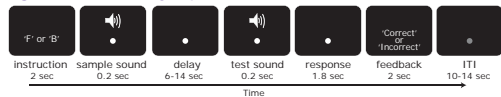


Figure 2. Auditory Spatial WM Task.

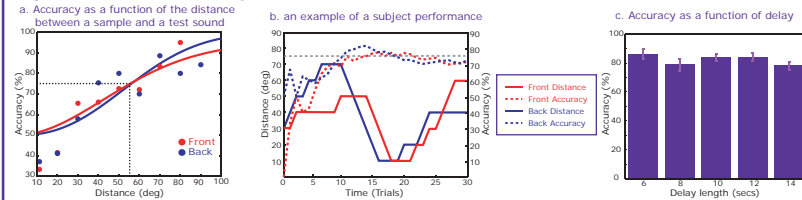


Imaging protocols

Subjects: 13 Subjects (7 males, 6 females)
Scanner: Siemens Allegra 3T head-only scanner
@ Center for Brain Imaging, New York University
Event-related fMRI TR = 2 sec
Eye-position monitored at 60Hz (ASL 504LRO).
Trials with fixation breaks were discarded.

Behavioral Results

Figure 3. Performance by Condition



fMRI Results

Figure 4. Trial Averaged Time Series from ROIs

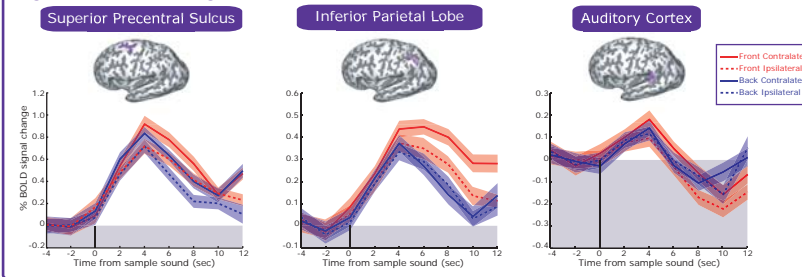


Figure 5. Contralaterality Bias Index (Contra-Ipsi)/(Contra+Ipsi)

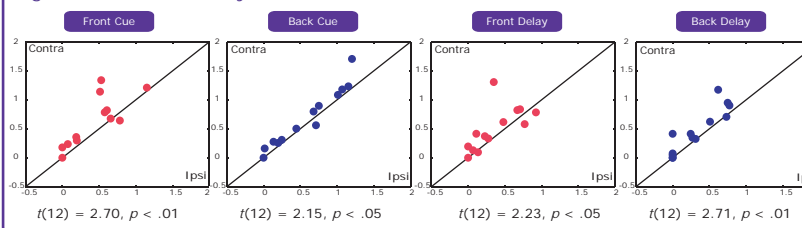


Figure 6. Surface-based statistical maps

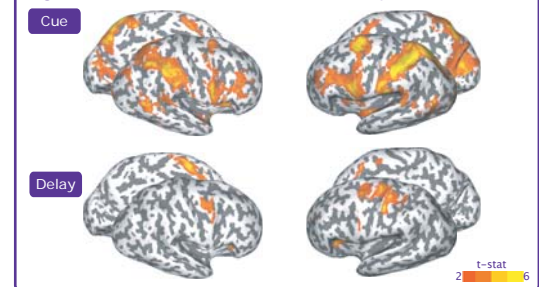
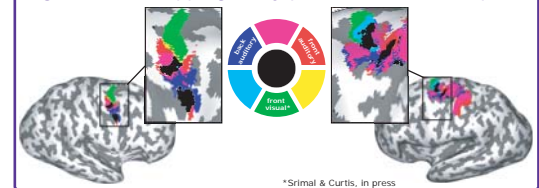


Figure 7. Overlapping delay period activation maps



Summary & Conclusions

- sPCS, putative human FEF, persists when maintaining auditory-cued space, even when the location was behind the subject.
- A contralateral bias was observed in FEF when representing retinal space as well as extra-retinal space.
- In some circumstances, FEF activity may represent space in head-centered coordinates.

References

- Kikuchi-Yorioka Y, Sawaguchi T (2000) Parallel visuospatial and audiospatial working memory processes in the monkey dorsolateral prefrontal cortex. *Nat Neurosci* 3, 1075-1076.
- Srimal R Curtis CE (in press) Persistent neural activity during the maintenance of spatial position in working memory. *NeuroImage*.

Great thanks to NYU Center for Brain Imaging, and Seaver Foundation & NIH R01 EY016407 for support