Investigating Neurophysiological Sources of Multimodal Neuroimaging in Humans

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Introduction

In this study, we investigated the extent to which the spatiotemporal dynamics of brain activity obtained by EEG or fMRI, or the EEG-fMRI fusion are consistent with that of neural activity obtained by ECoG.

Method

fMRI and EEG data were collected separately. The stimulus set contains 125 images from five categories, including animals, chairs, faces, fruits and vehicles. Multivariate pattern analysis was used to examine category selectivity and robustness to changes in scale and rotation in visual areas (Fig. 1) and over the whole brain.

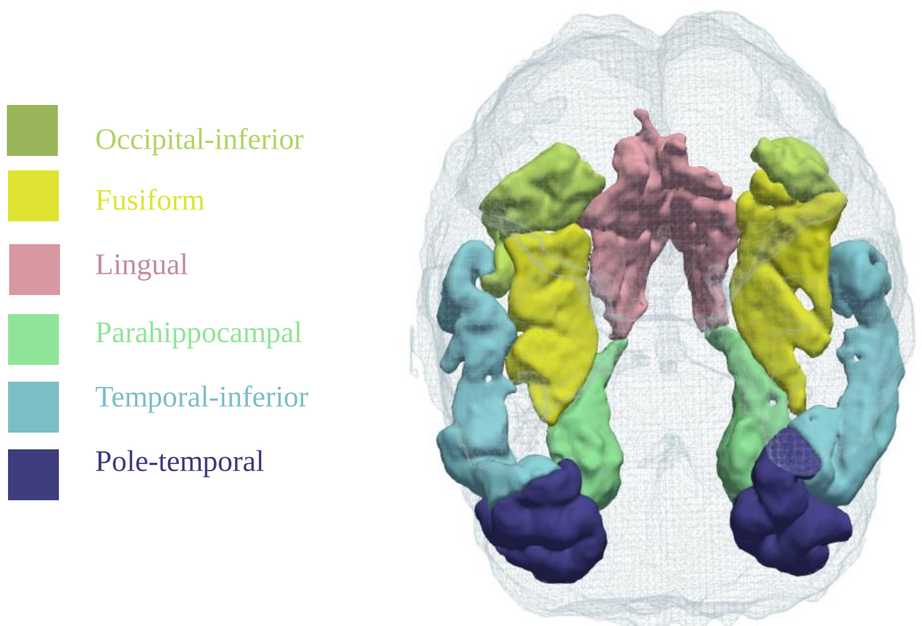

Figure 1. Brain visual regions.

Result

We compared patterns of category selectivity between ECoG and fMRI responses. In both fMRI and ECoG, selectivity was higher for faces than other categories in occipital-inferior and fusiform (Fig. 2). Category information can be readout robust to face variations in occipital-inferior, fusiform in both fMRI and ECoG.

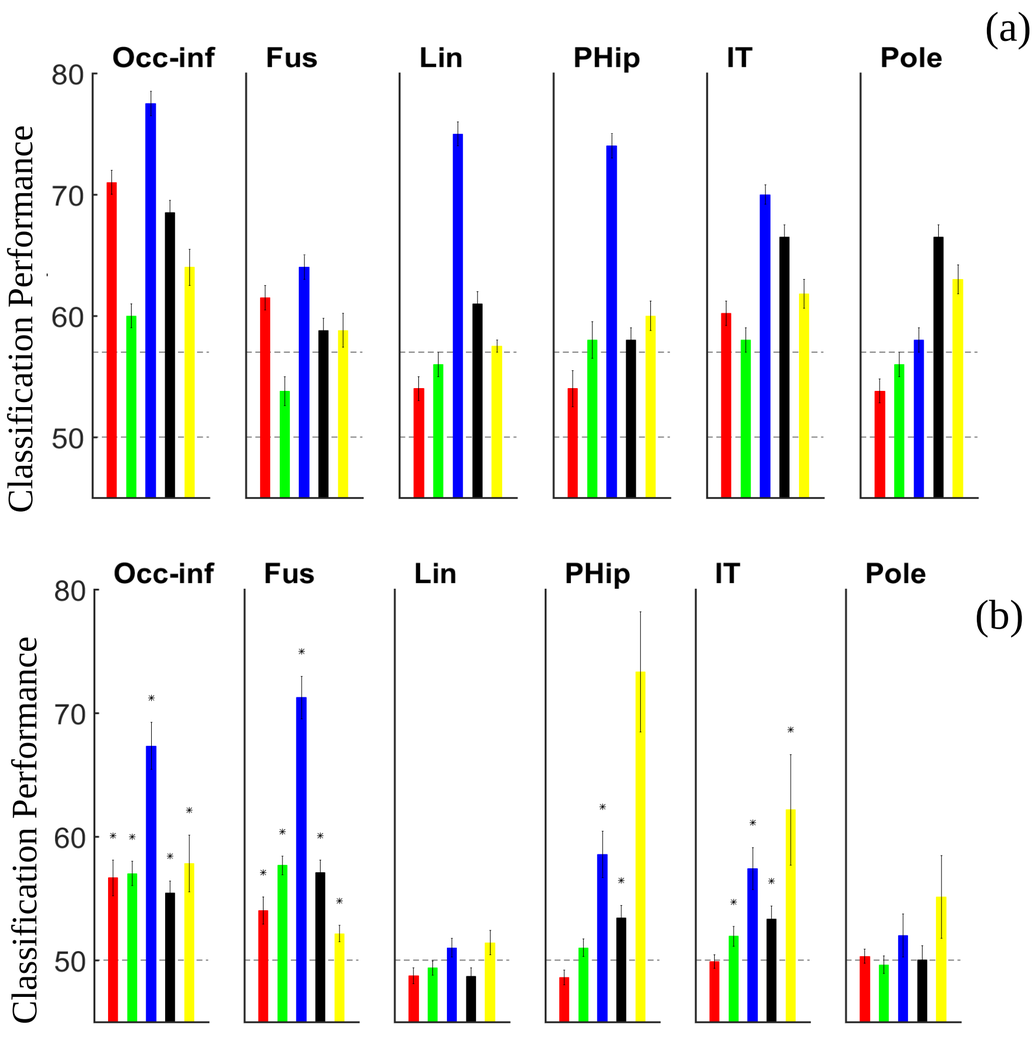

Figure 2. Binary classification performance for category selectivity. (a) ECoG (b) fMRI.

Comparing whole-brain EEG with the ECoG data from ensemble of category selective electrodes, regardless of their location, the temporal dynamics of classification performances are highly similar between EEG and ECoG (Fig. 3).

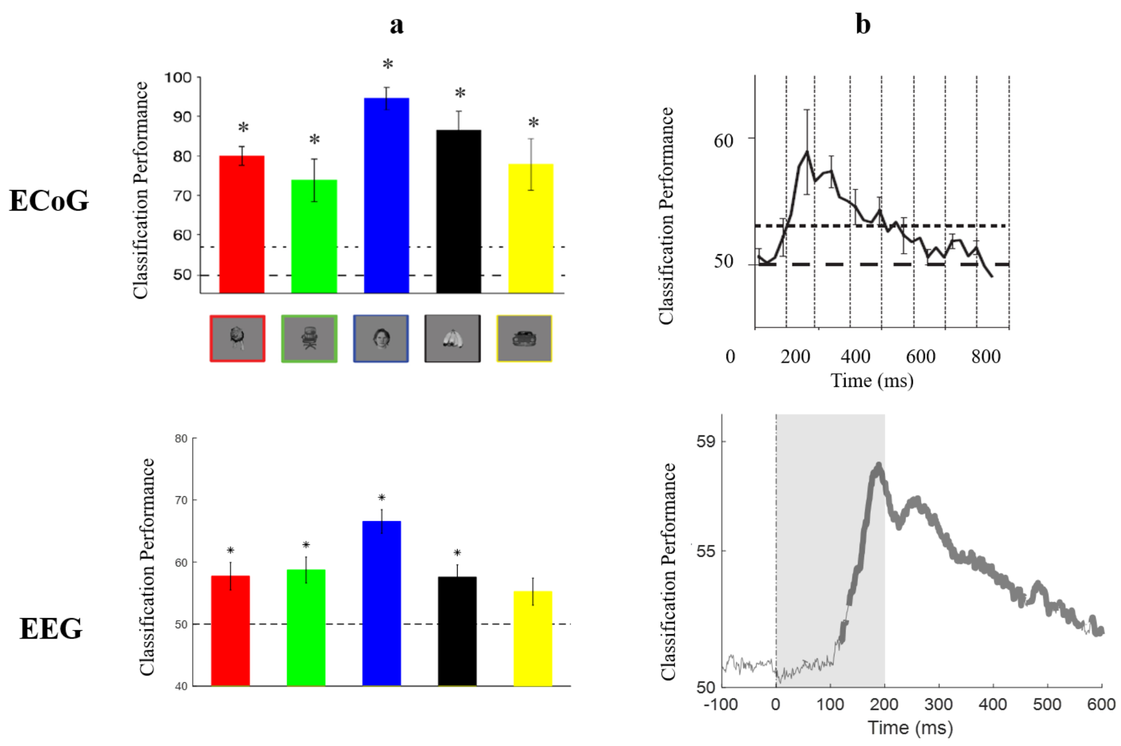

Figure 3. Binary classification performance for category selectivity.

looking at the spatiotemporally resolved picture of brain dynamics using EEG-fMRI fusion, we observed a similar latency in brain activity between ECoG responses and ROI-based fusion in occipital-inferior, fusiform and lingual, but not in parahippocampal, temporal-inferior and pole-temporal (Fig. 4).

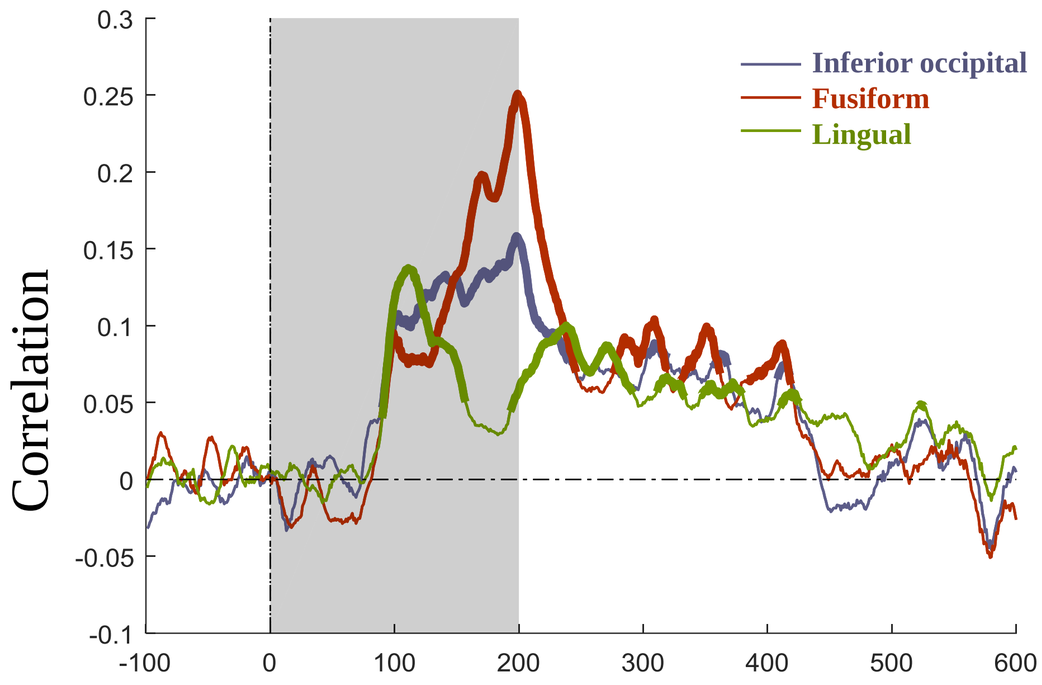

Figure 4. Time course of EEG – fMRI fusion.

Conclusion

We tried to identify the consistencies and inconsistencies between EEG, fMRI and their fusion with the underlying neural responses, as measured by ECoG. In brain areas with higher signal to noise ratio, fMRI results are more consistent with that of ECoG. Combining EEG with fMRI data, temporal dynamics of deep brain areas had the least pattern similarity with that of ECoG.