

Supplementary Information for

Decoding of the other's focus of attention by a temporal cortex module

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Supplementary text
Figures S1-S5
Legend for Movie S1

Other supplementary materials for this manuscript include the following:

Movie S1

Supplementary Information Text

Low spatial selectivity of face-selective neurons

We also recorded the activity of the same pSTS neurons tested in the two active tasks during passive vision of face and non-face stimuli in order to compare them with classical face-selective neurons. 23 out of 334 neurons tested exhibited significantly stronger responses to the passive vision of faces than to non-face stimuli ($p < 0.05$; Wilcoxon signed-rank test comparison of mean response to faces and non-face stimuli). Out of this total of 23 face-selective neurons sampled from both monkeys, only 6 were from the set of 109 gaze following neurons with spatial selectivity. **Fig. S1A** compares the population response of these face-selective neurons in the three tasks, as well as the amount of their spatial modulation for correct and incorrect trials. As can be seen, the average SSI values were very similar and statistically not different for correct and incorrect trials. Also, the response profiles for the most preferred and least preferred targets did not show any significant difference in the spatial cueing period (Mann Whitney U test, $p > 0.05$). Hence, these neurons cannot have immediate relevance for the behavioral choices.

Abstract symbol-matching responses

We also investigated if neurons activated in the identity mapping task might also be responsive to learned associations between non face images and spatial locations. To this end, we trained the monkeys to associate four abstract symbols (square, circle, triangle, star) almost the same size ($5^\circ \times 5^\circ$) with the four targets. The trial structure and timing were similar to the one in GF and IM task respectively with the exception that there was no change in the color of the central fixation which could serve as a rule and the four abstract symbols were presented right after the same portrait fixation face used in the previous tasks. As this control task was usually run at the end of a session, once sufficient data in the three main tasks had been collected, only a minority of neurons could be tested on this abstract symbol mapping control. In many other cases, the monkeys were no longer motivated to work or the quality of the spike isolation had deteriorated too much. We only considered neurons for which we had collected at least 8 correct trials for each of the four spatial targets. Both monkeys learned the task well and their performance was very similar to their performance in the gaze-following and identity-mapping tasks (monkey T: mean \pm std= $73 \pm 1\%$, monkey L: mean \pm std= $74 \pm 2\%$ correct). In total, we could test 131 out of the 426 neurons tested on the gaze following and the facial identity mapping task (44 neurons from monkey L and 87 from monkey T) in the symbol mapping task. Only 8 out of the 131 neurons (2 from monkey L, 6 neurons from monkey T) exhibited spatial selectivity, characterized by significant target specific responses in the spatial cueing period (1-way ANOVA (Kruskal-Wallis test, $p < 0.05$). In 3 of the 8 neurons, the number of error trials was sufficiently large to allow a comparison of the responses between correct and incorrect trials. These comparisons did not reveal any significant difference (Mann Whitney U test, $p > 0.05$). Hence, rather than reflecting spatial selectivity, these neurons may exhibit more elementary visual responses evoked by particular abstract objects. On the other hands, given the low probability of neurons showing significant responses to the presence of abstract symbols (8 out of 131 neurons tested; i.e. 6% of the population), these neurons may simply be statistical artifacts.

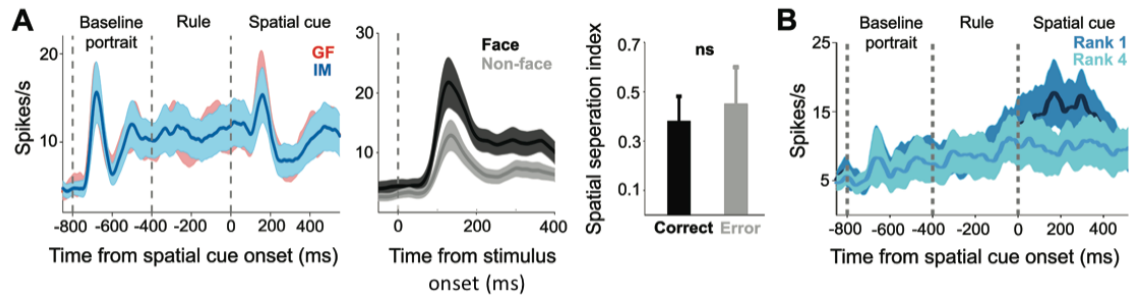


Fig. S1. Population response profile of passive face-selective and IM neurons

(A) The population discharge profiles of classical face-selective neurons, exhibiting a significantly larger response to faces as compared to non-face stimuli when tested in the passive viewing task. Both profiles show significant responses to the presence of the portraits in both the baseline portrait and the spatial cueing periods, yet, without any difference between the gaze following and the identity matching tasks. Moreover, the population discharge did not differentiate between the most and the least preferred targets, no matter if spatial choices were correct or not. Hence, they hardly contribute to shaping monkeys' spatial choices. **(B)** The population discharge profile of the spatially selective IM neurons did not differentiate significantly between the most preferred and the least preferred IM targets. Error bars and shaded areas represent standard error in all subfigures.

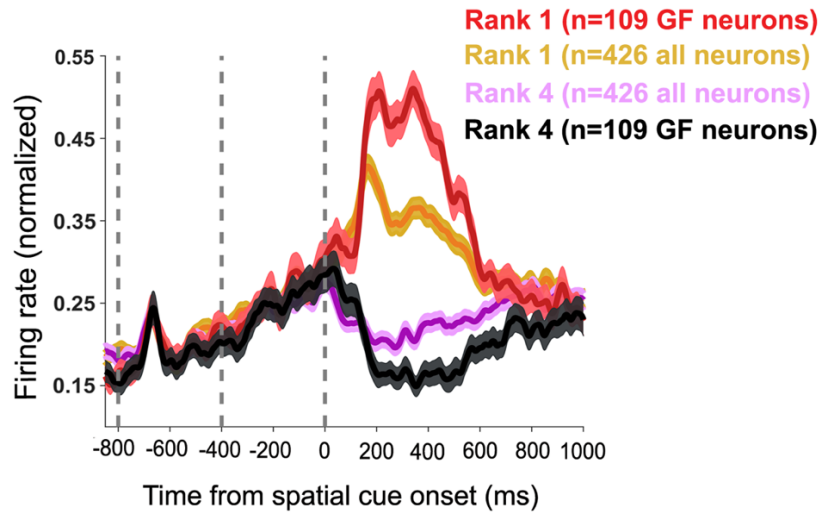


Fig. S2. Comparing the population response profiles of GF neurons with those of all neurons in the gaze following task

Population response of all task selective neurons (GF neurons, IM neurons and all others) from both monkeys for the target eliciting the strongest response (Rank 1) in the spatial cueing period and for the target evoking the weakest response (rank 4). The two profiles are still able to separate preferred and non-preferred targets (Mann-Whitney U-test, $p < 0.05$), although the contrast is smaller than the one obtained when restricting the population analysis to gaze following Neuron's (see **Fig. 3A**).

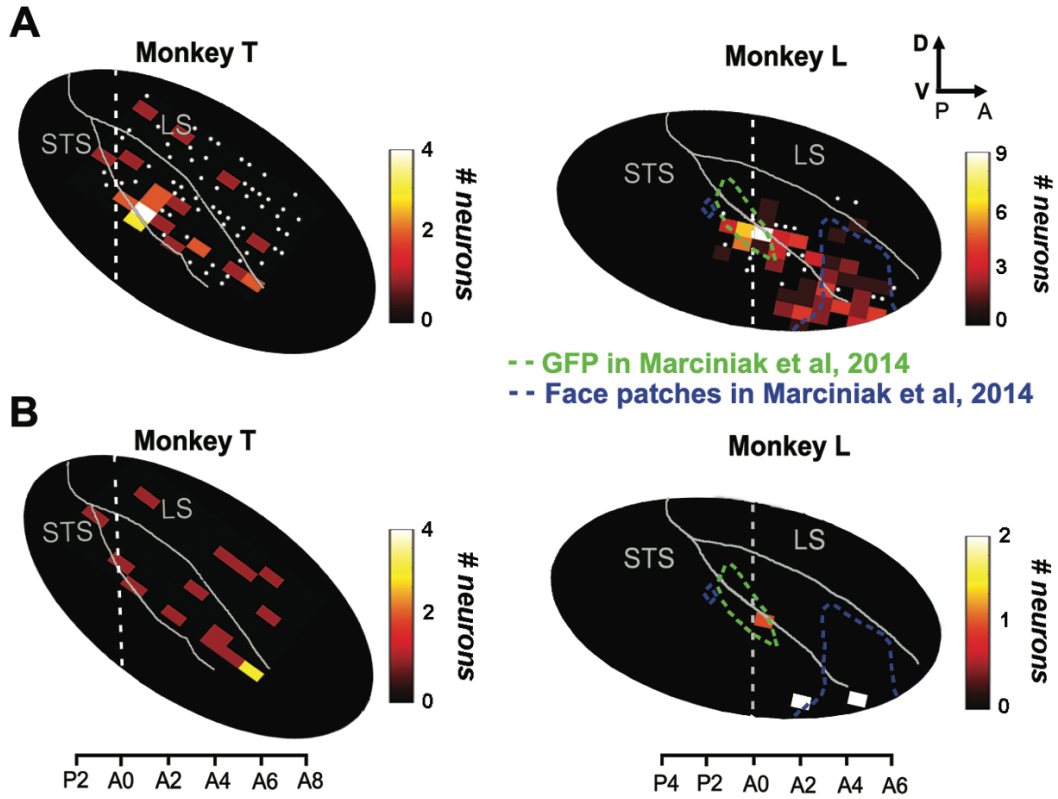


Fig. S3. Topography of GF and face selective neurons

(A) Un-smoothed 2D density maps of GF neurons in the pSTS of the two monkeys. (B) Un-smoothed 2D density maps of the face-selective neurons in the two monkeys. Boundaries of the GFP and face patches in monkey L have been adapted from previous fMRI work published by Marciniak et al., 2014. The white dots depict recording sites which did not yield task related neurons.

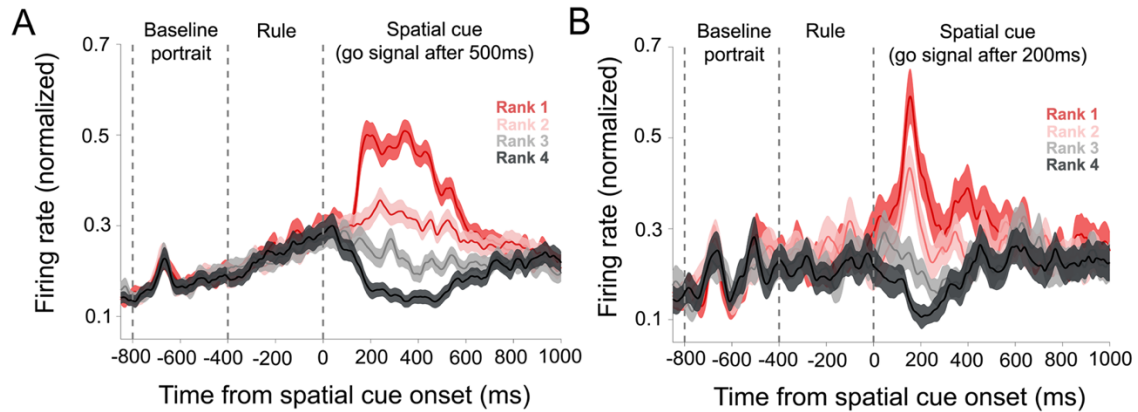


Fig. S4. Population responses of spatially-selective GF neurons

(A) Population responses of 81 GF neurons from monkey L for the target eliciting the strongest response (rank 1) in the spatial cue period for 500ms, the second strongest (rank 2), the third (rank 3) and the fourth strongest response (rank 4). The population discharge associated with the two most preferred targets exhibited an increase in discharge rate, the ones associated with the least preferred targets a suppression. **(B)** Population responses of 28 GF neurons from both monkeys for the target eliciting the strongest response (rank 1) in the spatial cue period for 200ms, the second strongest (rank 2), the third (rank 3) and the fourth strongest response (rank 4). The population discharge associated with the two most preferred targets exhibited an increase in discharge rate, the ones associated with the least preferred targets a suppression.

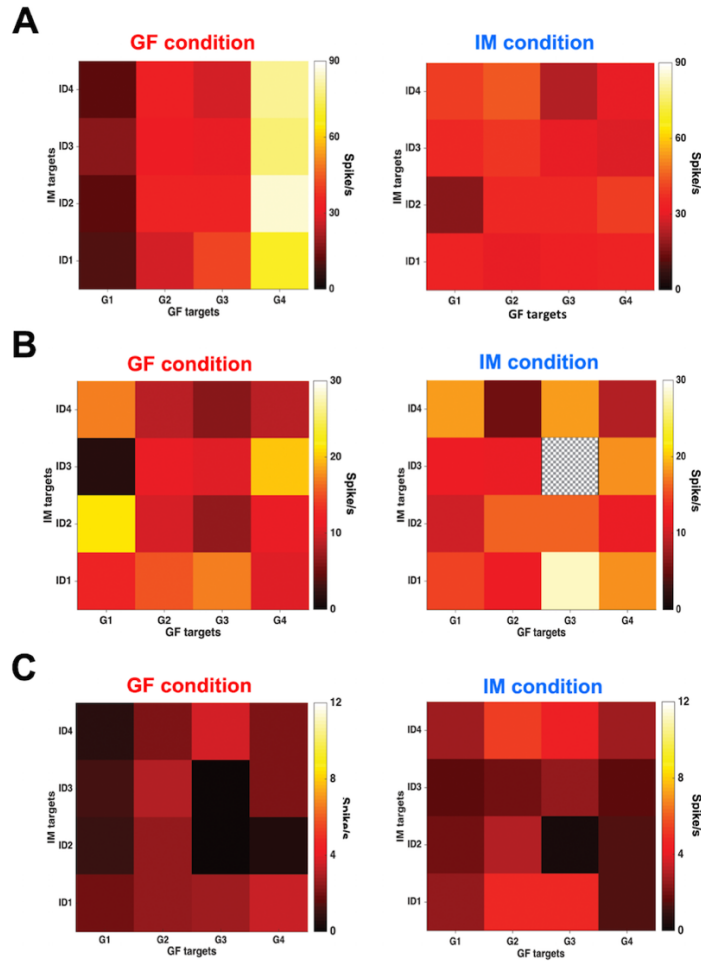


Fig. S5. Matrix of response profiles of the three exemplary neurons of Fig. 2A to each of the 16 stimuli

(A) Matrix of the average discharge rates in the spatial cueing period for the GF neuron presented in Fig. 2A tested for gaze following (left) and identity mapping (right). The responses were very similar across columns and the strongest responses were evoked by spatial target G4, no matter which of the 4 identities was involved. The same neuron, when tested in the identity mapping condition (right), lacked a comparable preference for any of the 16 possible combinations of identities x spatial targets. **(B)** The exemplary IM neurons of Fig. 2A exhibits a relatively complex pattern of interaction between the gaze and the identity cues. However, this complexity notwithstanding, the overall IM response was on average highest for ID1. The matrix element highlighted by puncturing stands for a condition, in which no correct response could be collected. In general, the number of correct trials per condition was low (on average around 4), which is why more complex matrix patterns like the one shown in B must be treated with caution. **(C)** The same exemplary face-selective neuron, shown in Fig. 2A, exhibits similar matrix patterns for gaze following and identity mapping, i.e. it neither cares for facial identity mapping nor for gaze direction.

Movie S1.

Exemplary neuron exhibiting a burst of activity for shifts of the experimenter's gaze to the left.