

**Supplementary Information for manuscript:
*NeuroGen: activation optimized image synthesis
for discovery neuroscience***

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Supplementary Figures

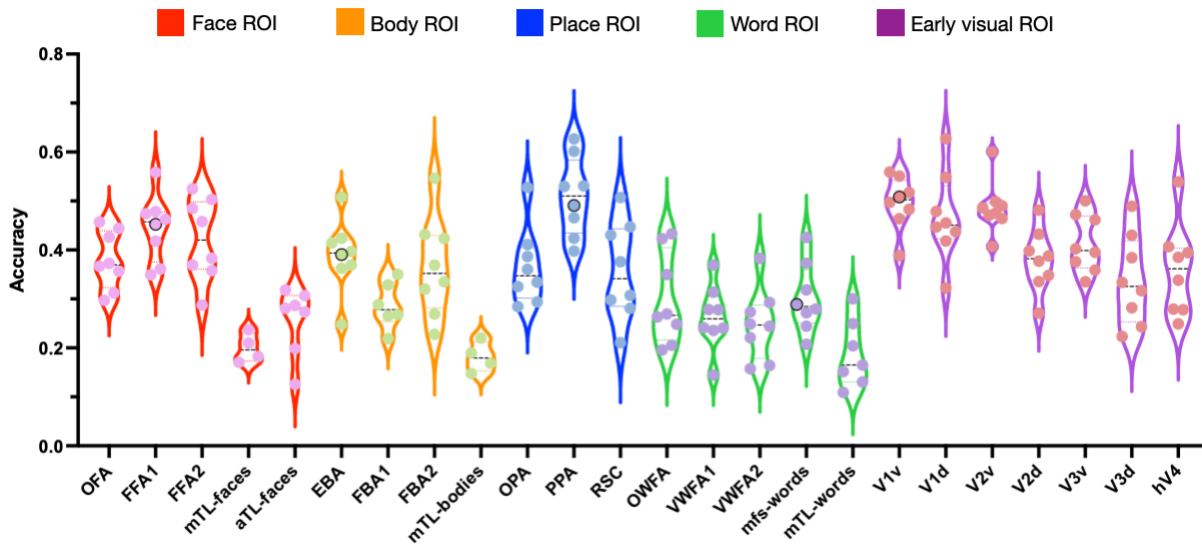


Figure 1: Prediction accuracy for all images in the shared image set (some with image-response pairs), colored by the region category. Each dot inside the violin represents an individual subject.

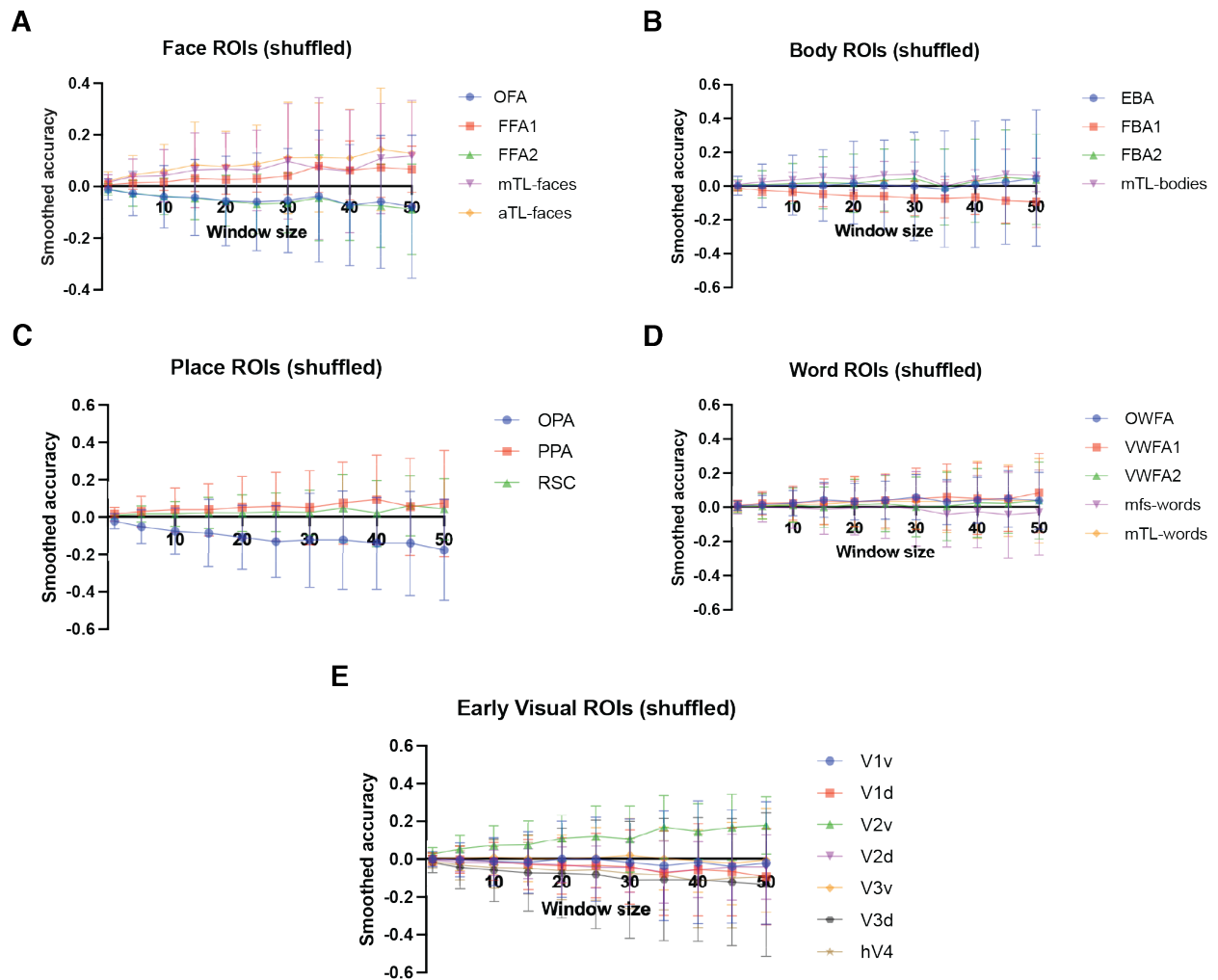


Figure 2: Smoothed accuracy is low and does not increase with window size when the predictions and measurements are uncoupled (predictions are permuted).

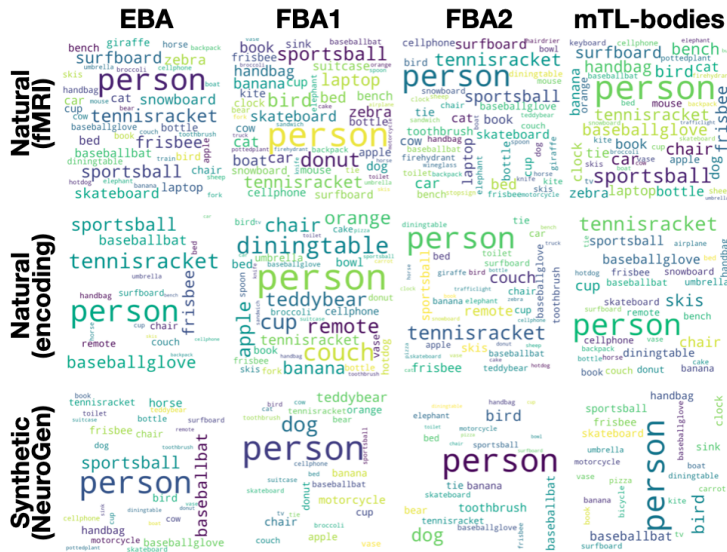


Figure 3: Wordcloud of labels for top 10 natural images ordered by fMRI measurement and encoding model predictions, and top 10 synthetic images by NeuroGen, for body ROIs.

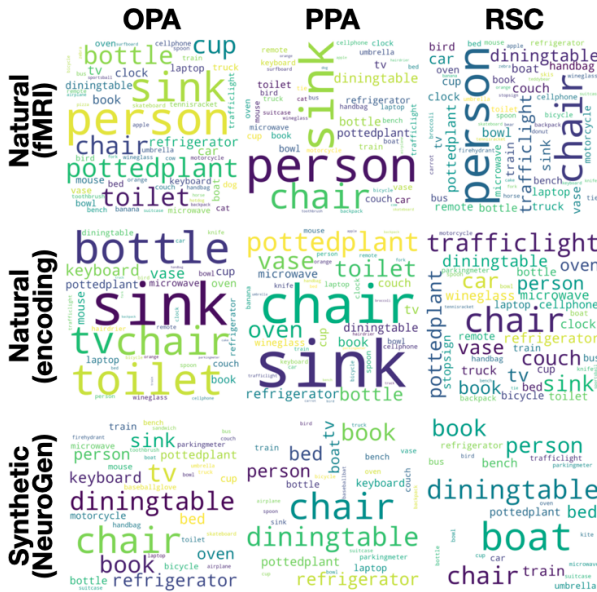


Figure 4: Wordcloud of labels for top 10 natural images ordered by fMRI measurement and encoding model predictions, and top 10 synthetic images by NeuroGen, for place ROIs.

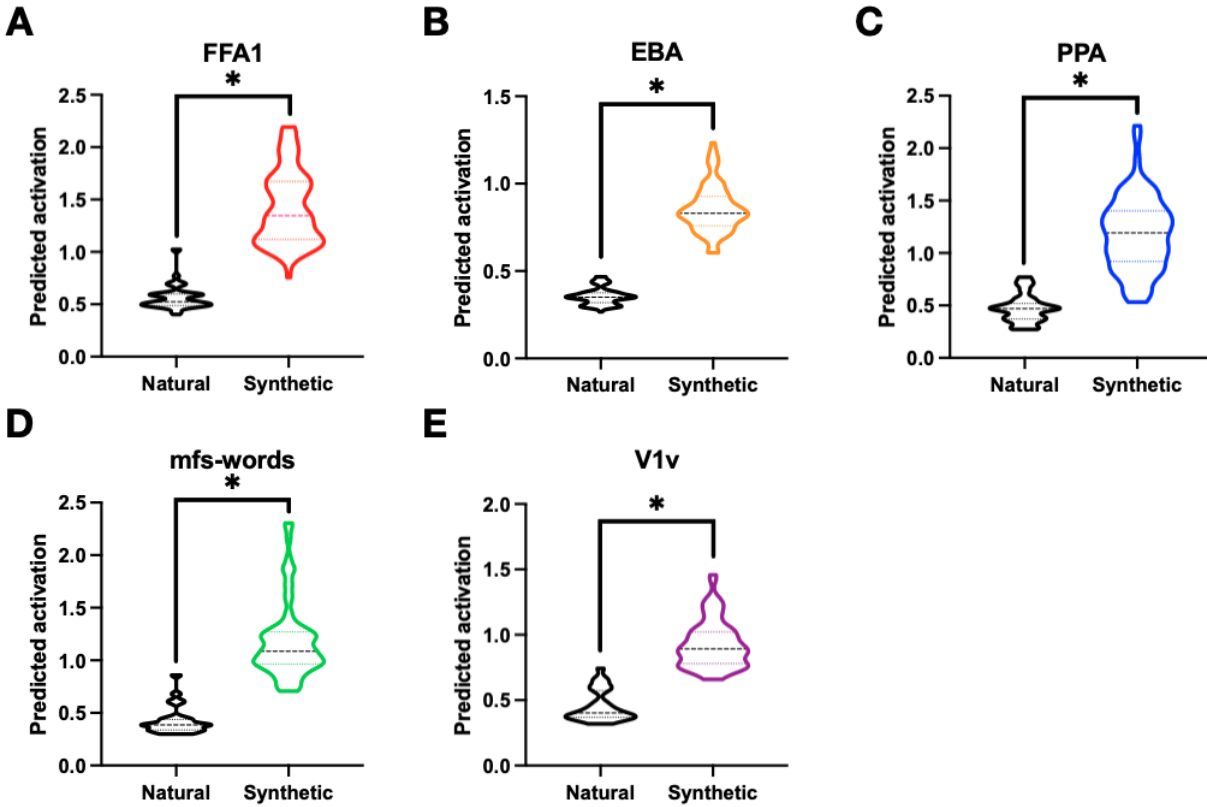


Figure 7: Violin plots show the activation levels for i) predicted activations in response to natural images (derived from the encoding model) and ii) predicted activations from the optimized synthetic images (derived from the NeuroGen framework), for five example ROIs in each category (FFA1, EBA, PPA, mfs-words and V1v). Mann-Whitney test, "*" represents significant difference and "ns" represents no significant difference.

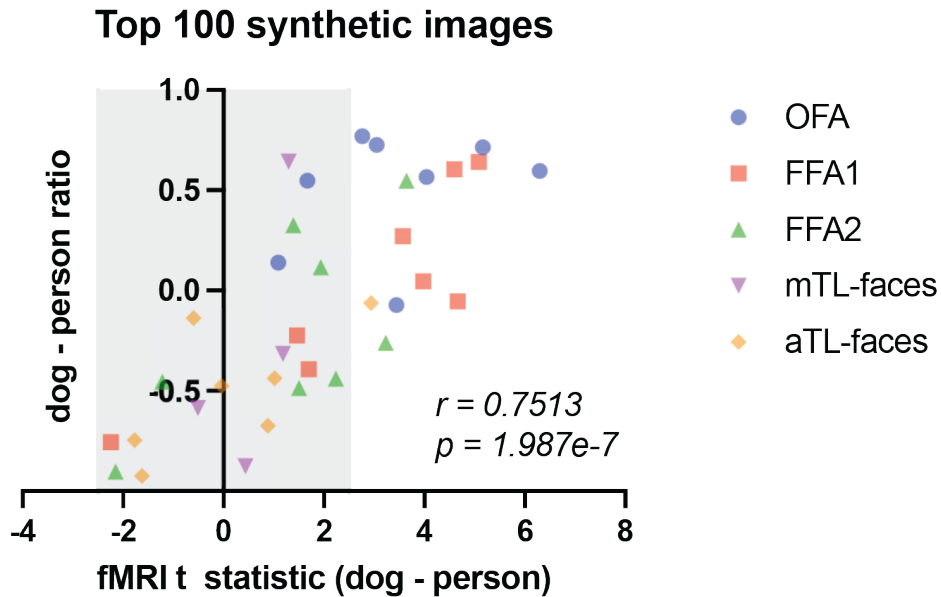
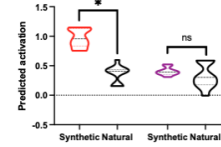


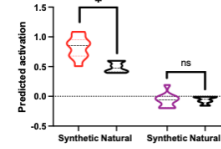
Figure 8: **Relationship of fMRI dog vs person t statistic and dog-person ratio in top 100 synthetic images.** The x-axis displays the dog vs. person preference from the observed fMRI data, quantified by the t-statistic of observed fMRI activations from all natural dog images compared to the observed activations from all natural person images (t-statistics with significant p-values after FDR correction are outside the grey area). The quantities were calculated for each of the five face areas in each of the eight individuals. The y-axis represents the dog vs person preference present in the top 100 synthetic images, calculated by taking the difference in the count of dog images minus the count of person images, divided by the total count of dog and person images. Values close to -1 indicate strong person preference and values close to 1 indicate strong dog preference. A significant correlation exists between the observed dog-person preference from the entire fMRI dataset and the dog-person preference in the top 10 synthetic images from NeuroGen (Spearman $r = 0.7513$, $p = 1.987e - 7$).

A FFA1 & V1v

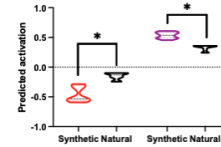
max (FFA1 + V1v)



max (FFA1 - V1v)

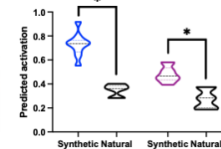


max (-FFA1 + V1v)

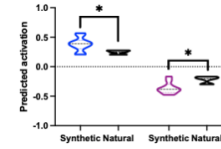
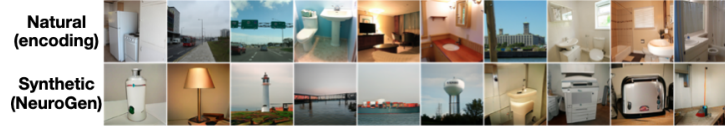


B PPA & V1v

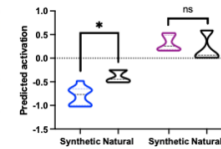
max (PPA + V1v)



max (PPA - V1v)

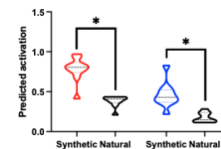


max (-PPA + V1v)

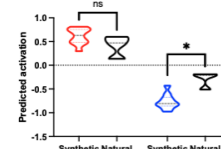


C FFA1 & PPA

max (FFA1 + PPA)



max (FFA1 - PPA)



max (-FFA1 + PPA)

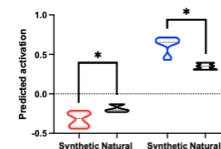


Figure 9: Top 10 natural images and synthetic images of dual optimization for region-pairs A FFA1 and V1v, B PPA and V1v and C FFA1 and PPA. Violin plots show the comparisons of predicted activation between top 10 natural images and synthetic images.

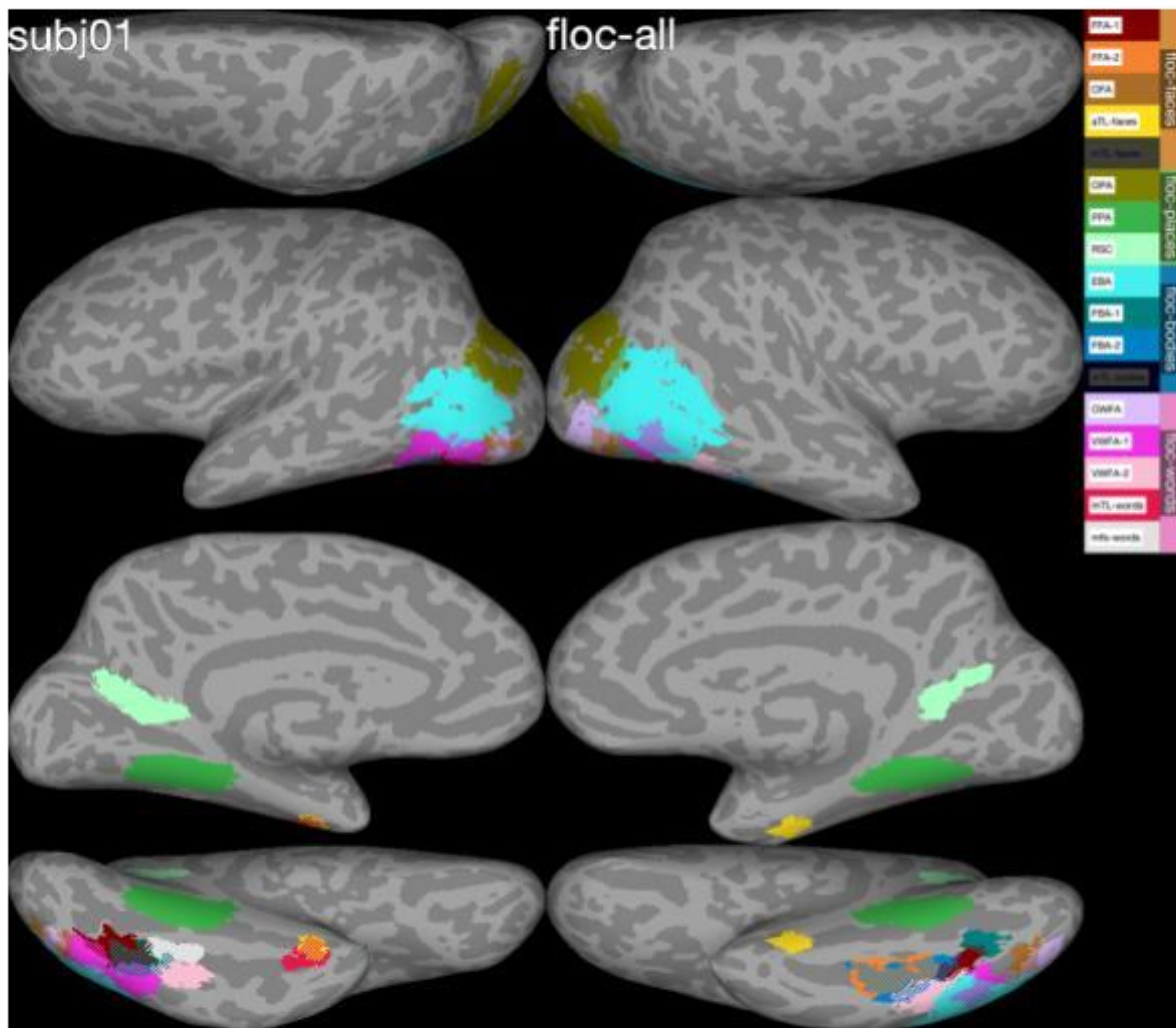


Figure 10: ROI definitions for subject 1.

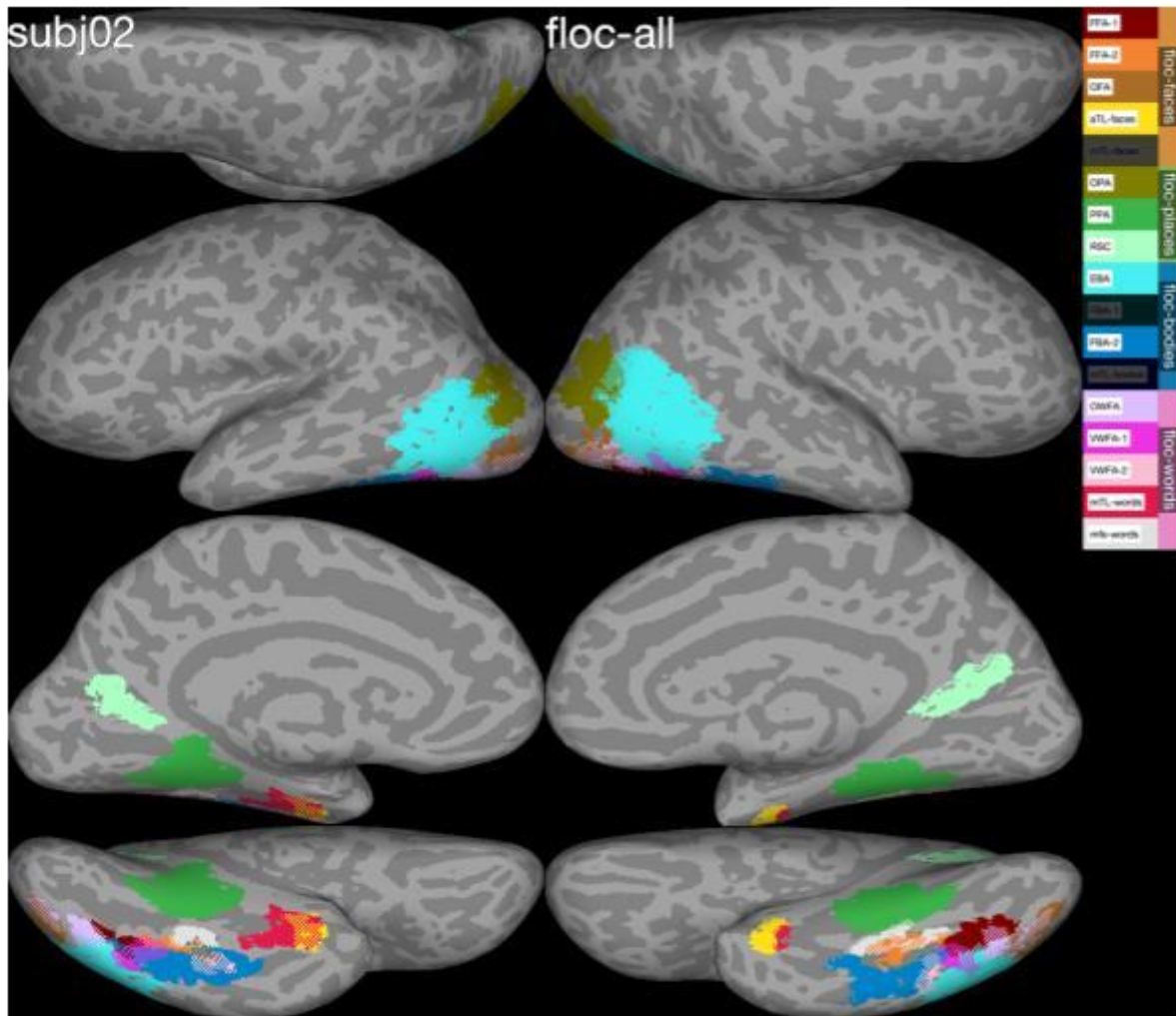


Figure 11: ROI definitions for subject 2.

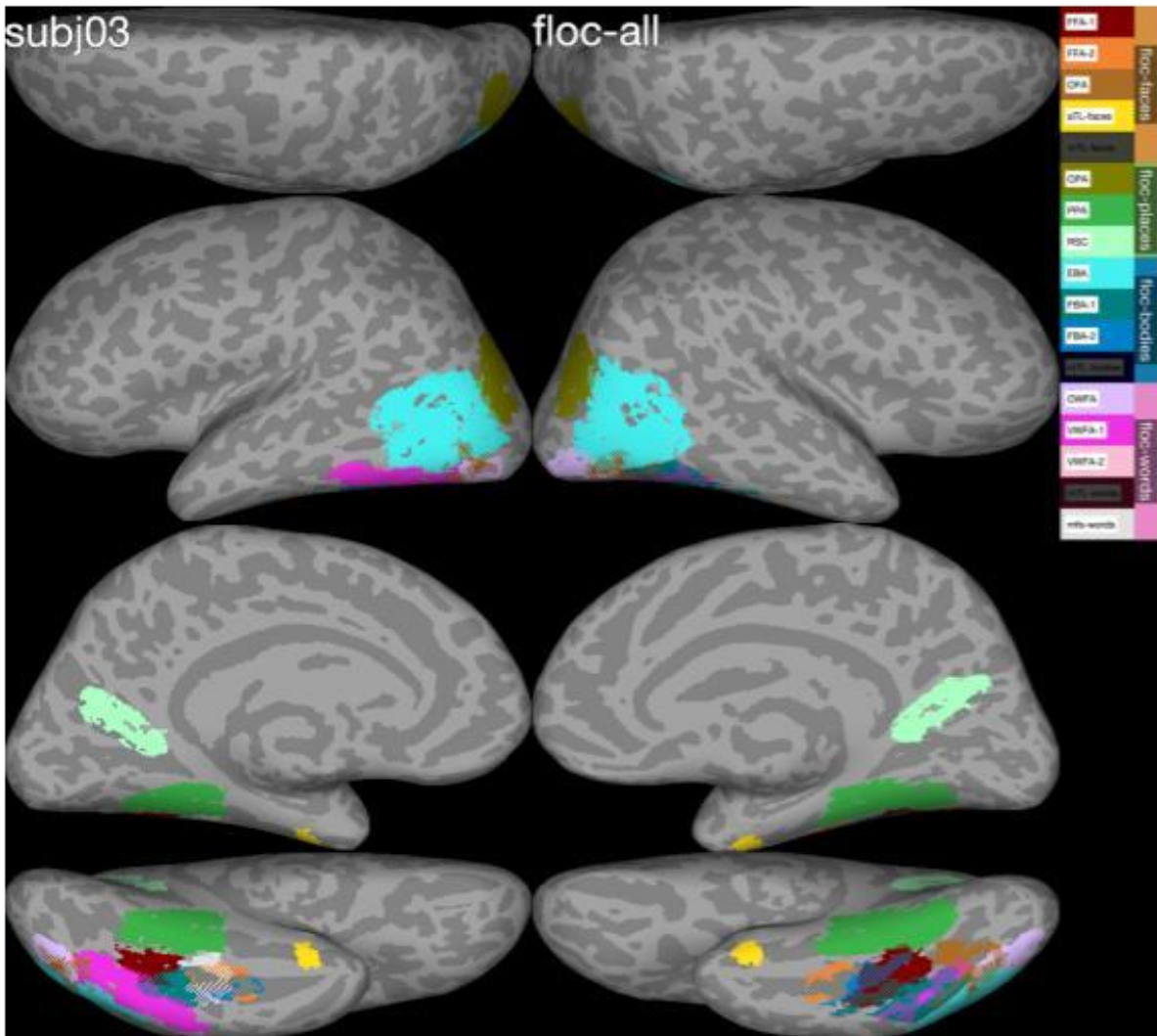


Figure 12: ROI definitions for subject 3.

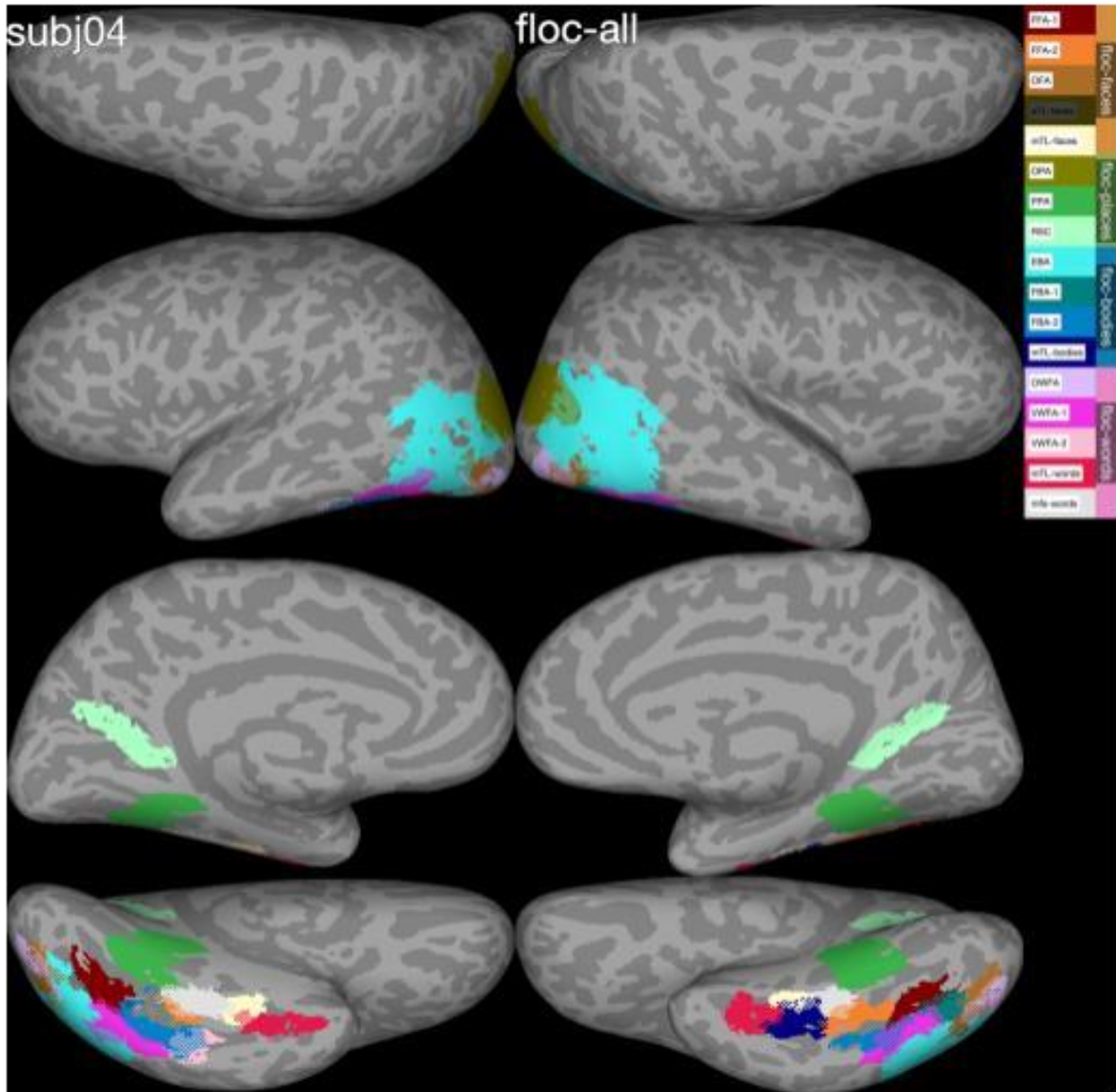


Figure 13: ROI definitions for subject 4.

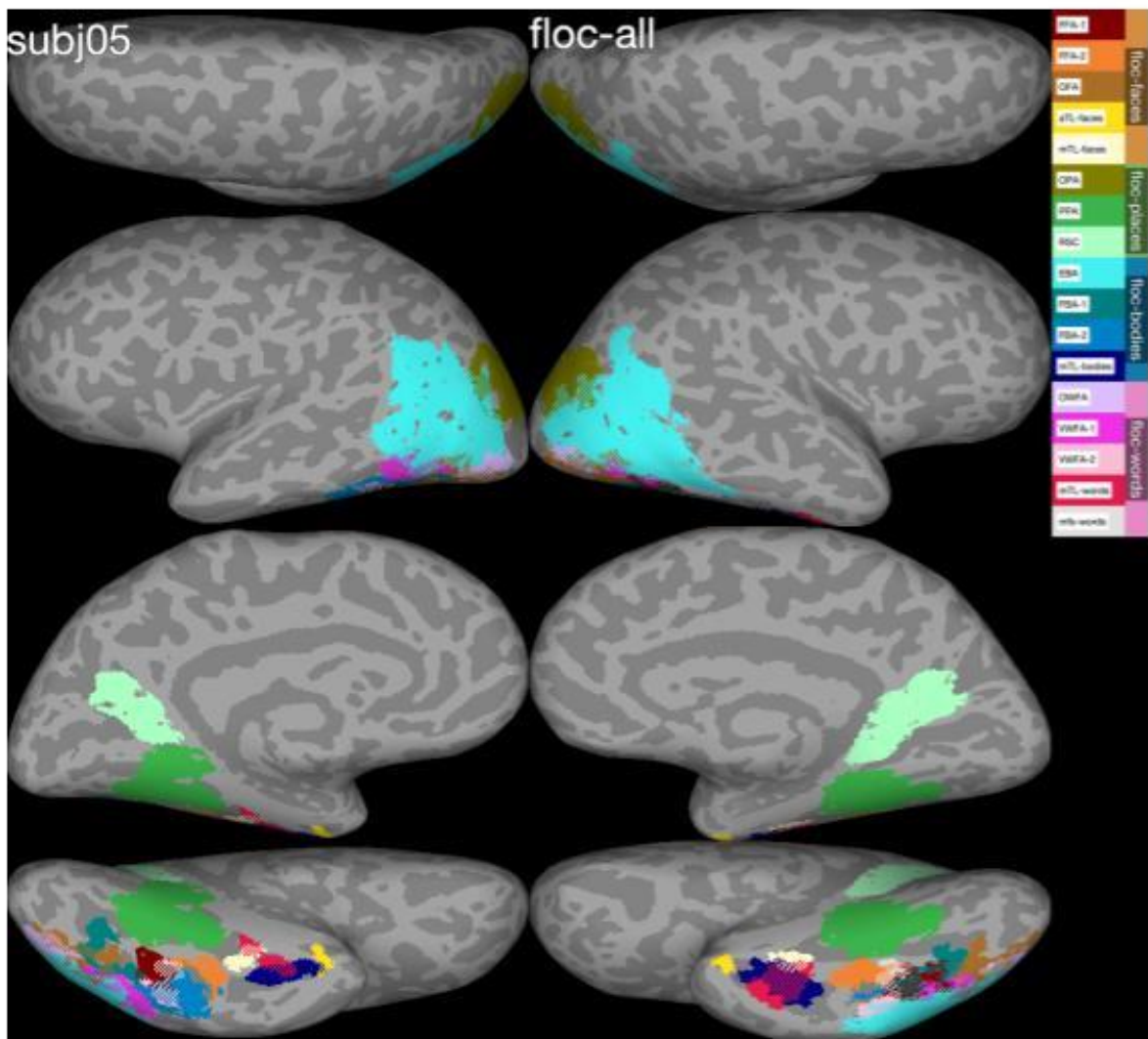


Figure 14: ROI definitions for subject 5.

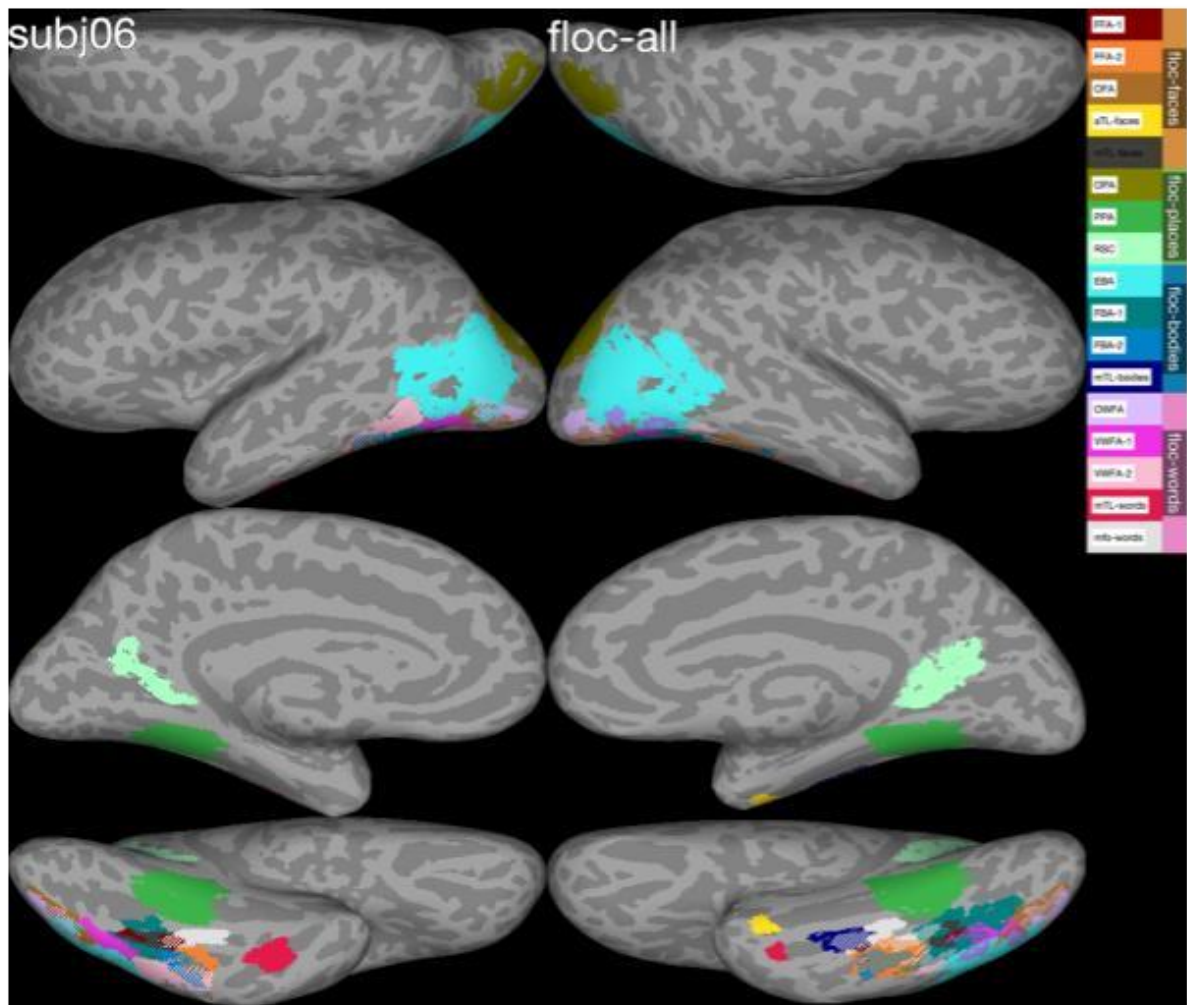


Figure 15: ROI definitions for subject 6.

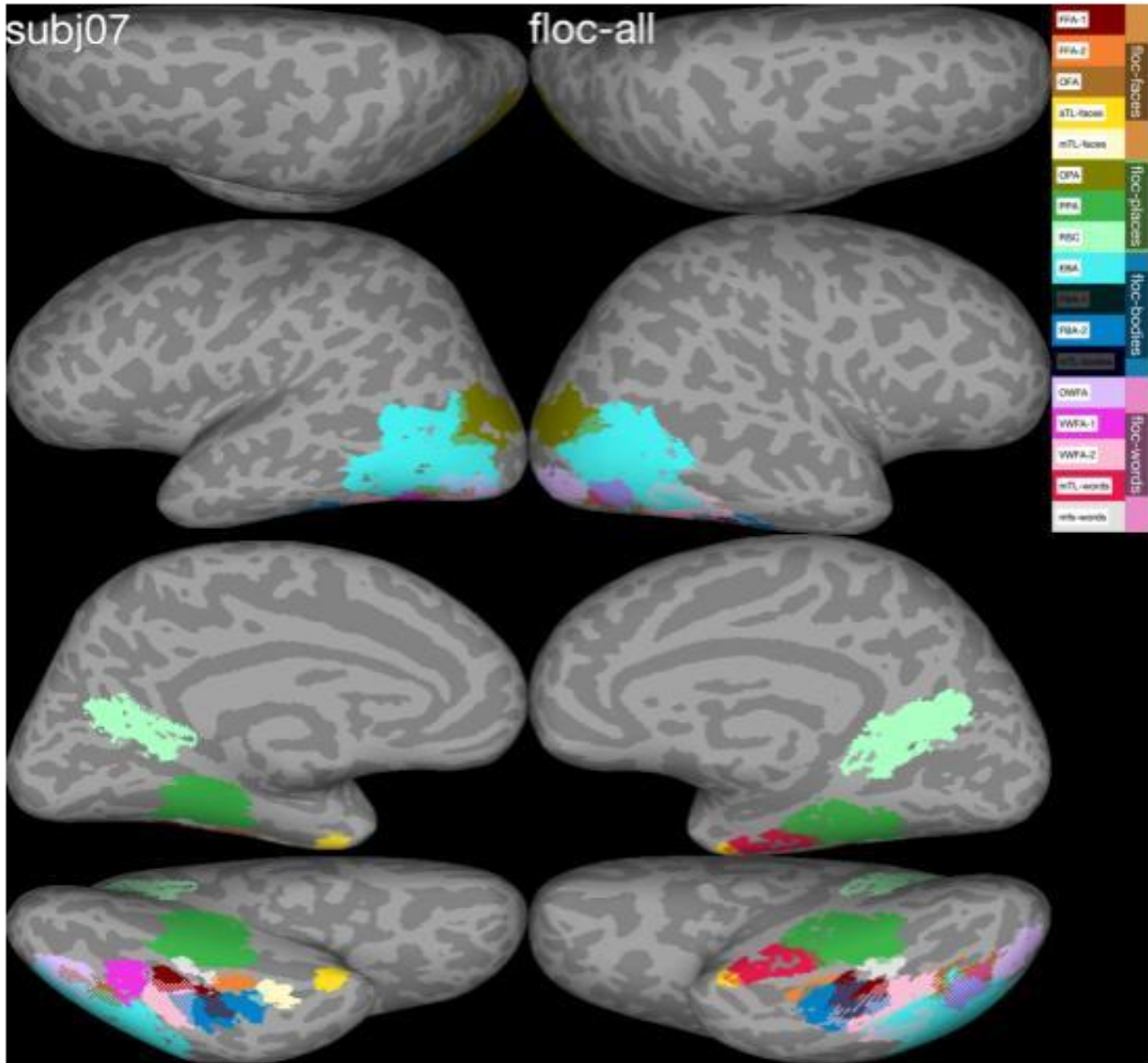


Figure 16: ROI definitions for subject 7.

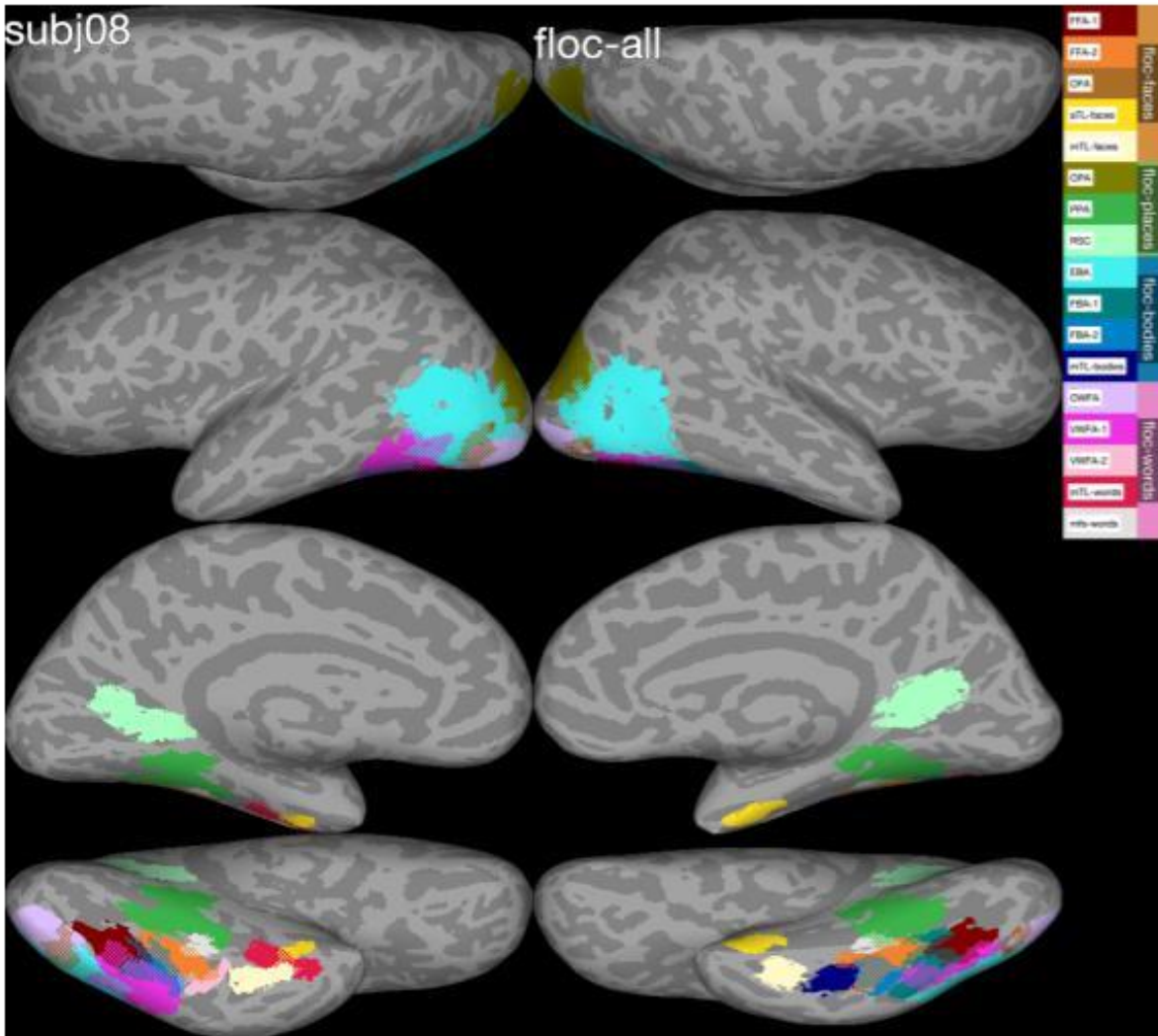


Figure 17: ROI definitions for subject 8.

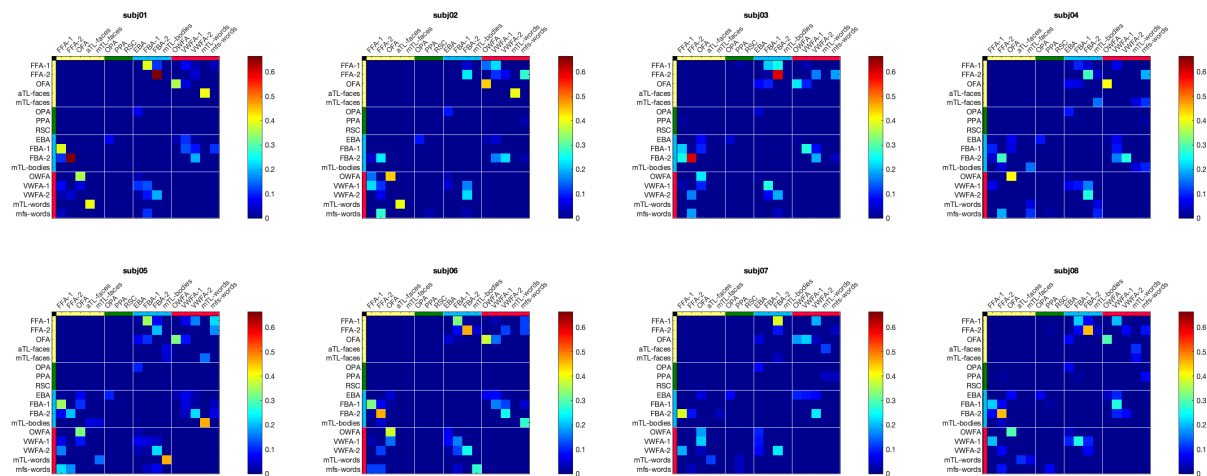


Figure 18: Heatmap of the Dice overlap of regions from different categories for each individual.