Supplementary Material for Voxel-Level Functional Connectivity using Spatial Regularization

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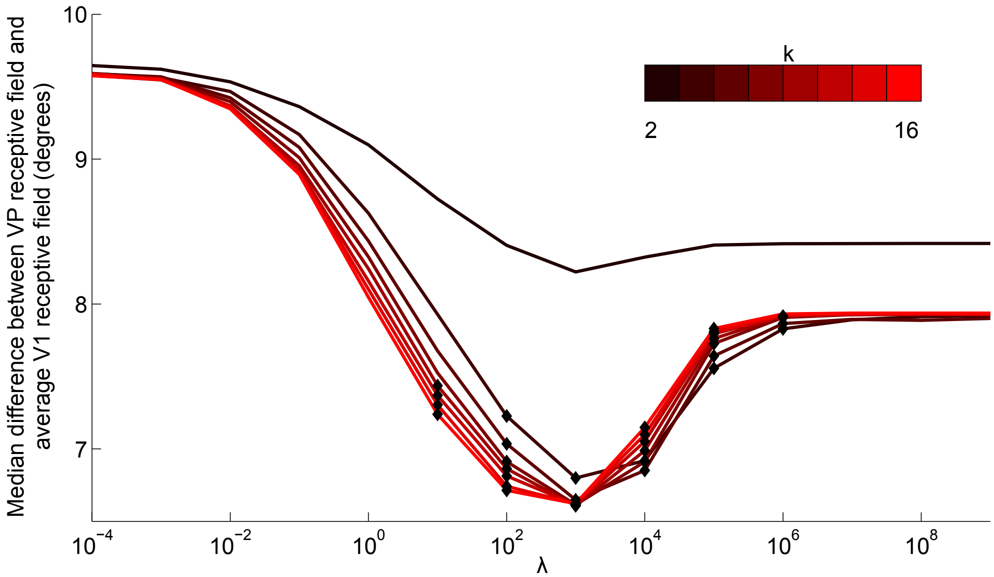
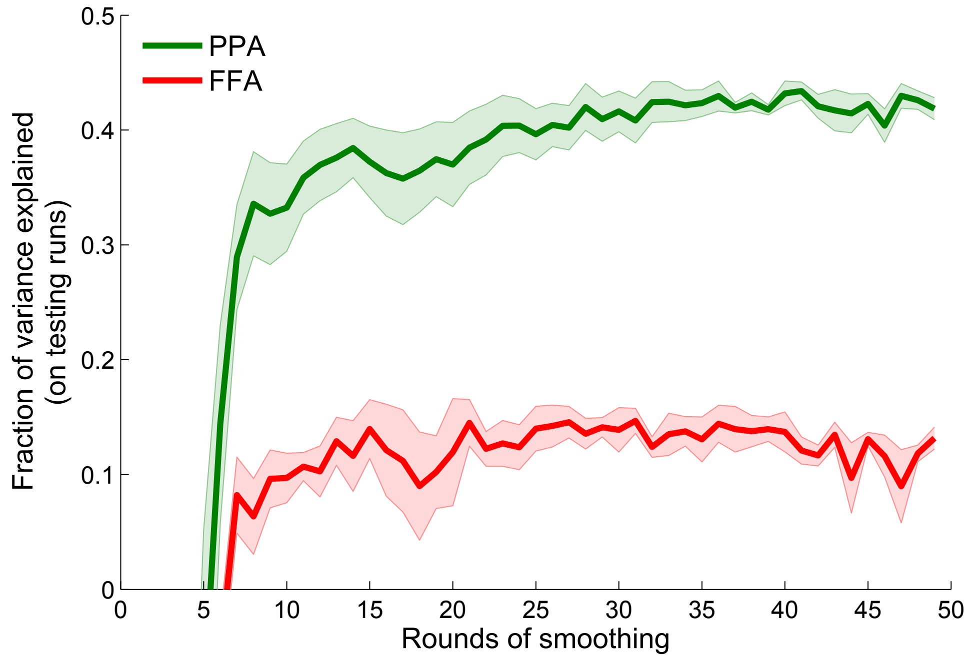
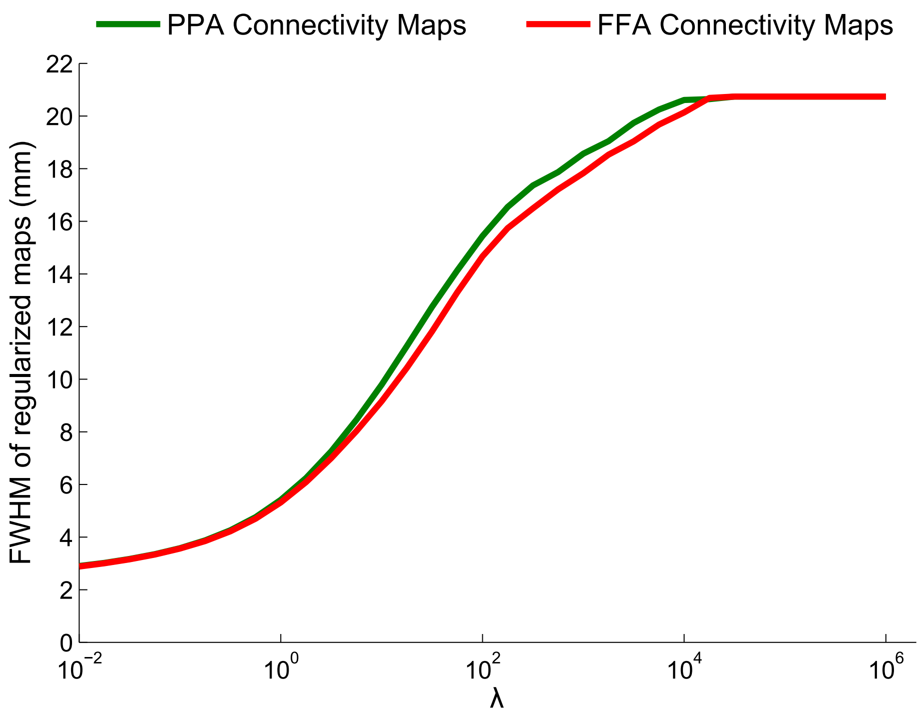


Supplementary Figure 1: Effects of λ and k parameters on V1-VP connectivity.

We calculate the median difference between the VP receptive fields and the receptive fields generated by the V1 connectivity map for the VP voxels, averaged across subjects (smaller is better). Each curve corresponds to a k value between 2 and 16, and the x-axis corresponds to the λ value (log scale). Diamonds indicate (λ, k) combinations that give a significant reduction in error, compared with using a single weight for all voxels ($\lambda \to \infty$) ($t(12) > 1.78, p < 0.05$, one-tailed t-test). Improvement over the traditional approach is observed over a wide range of λ values (10^1 through 10^6), and for all $k > 2$.



Supplementary Figure 2: hV4 connectivity results using only pre-smoothing. To demonstrate that spatial regularization is not equivalent to pre-smoothing, we smoothed the input data and then learned hV4 connectivity weights without regularization ($\lambda = 0$). This smoothing was performed by iteratively averaging the timecourse of a voxel with those of its neighbors, for a given number of rounds ($k = 10$). The generalization performance of the learned hV4 maps on held-out testing data is plotted for seed regions PPA and FFA. In both cases, the generalization accuracy simply asymptotes as smoothing increases, and we are unable to identify non-constant maps that give better performance than constant maps. Our results with regularization (Fig. 5, top) are qualitatively different, since intermediate values of λ give a peak in prediction accuracy (achieving a performance level higher than any amount of pre-smoothing). The shaded region indicates standard error.



Supplementary Figure 3: Smoothness of learned maps as a function of λ.

To quantify the relationship between the regularization strength λ and spatial smoothness, we compute the average FWHM (full width at half maximum) for the learned hV4 connectivity maps (Worsley et al. 1992). As $\lambda \to 0$, maps vary at the scale of individual voxels, while as $\lambda \to \infty$, maps are constant across the entire ROI.

Worsley, K.J., Evans, A.C., Marrett, S., Neelin, P., 1992. A Three-Dimensional Statistical Analysis for CBF Activation Studies in Human Brain. J Cereb Blood Flow Metab 12, 900-918.