Visualizing fMRI BOLD Responses to Diverse Naturalistic Scenes using Retinotopic Projection, Supplementary Material

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Details of fMRI scanning protocols

Prior fMRI data (Kay et al.,2008 and Naselaris et al.,2009) were collected at the Henry H. Wheeler, Jr. Brain Imaging Center (BIC) at University of California, Berkeley using a 4 T INOVA MR scanner (Varian, Inc.) and a quadrature transmit/receive surface coil (Midwest RF, LLC). Data were acquired using interleaved coronal slices that covered occipital cortex: 18 slices, slice thickness 2.25 mm, slice gap 0.25 mm. A single-shot gradient echo EPI sequence was used with TE = 28 ms, TR = 1000 ms, flip angle = 20 degrees, matrix size = 64 x 64, field-of-view 128 mm x 128 mm. The nominal spatial resolution of the functional data was 2 mm x 2 mm x 2.5 mm.

New data for this study were acquired at the BIC using a 3 T Siemens TIM/Trio (Siemens Medical Systems, Inc.) scanner with a 32-channel receive-only head coil. The full head coil was used for Subject 4 for all scans. The full head coil was used for Subjects 2 and 5 for the first of three days of scanning, after which the upper half of the coil was removed in order to provide an unobstructed visual field. Data from the occipital cortex were then obtained with the bottom half of the coil, corresponding to 16 receive channels. The same scan protocol was used for the full and half coil acquisitions. FMRI data were obtained using a simultaneous multislice EPI pulse sequence from the Center for Magnetic Resonance Research at the University of Minnesota (MB-EPI version R012 compiled for syngo MR version B17A) (Moeller et al., 2010). Six simultaneous slices were obtained without in-plane acceleration. A 6/8th partial Fourier acquisition in the phase encoding direction was used to produce TE = 30.2 ms. The TR was 900 ms for 60 interleaved slices of 2 mm thickness, no slice gap, prescribed axially. Following four dummy scans to establish a T1 steady state, a total of 340 volumes were obtained per run. Presaturation was used to reduce scalp fat signals. Excitation flip angle was 20 degrees and the final images were obtained with a root-sum-of-squares combination of the 16 or 32 separate receive channels. Prescan normalization was used to reduce heterogeneity of the receive bias field in the final images. The in-plane field-of-view was 212 mm x 212 mm. The nominal spatial resolution of the functional data was 2 mm x 2 mm x 2 mm.

Alternative method for retinotopic projection

The retinotopic projection methods described in the Methods section involve using a two-dimensional image of the voxel receptive field (RF). However, when a relatively small amount of RF mapping data is available (for example, in an early part of a study), it can be difficult to make a good estimate of RF size even if localizing RF peak locations is possible. For this situation,
another method of retinotopic project was devised which relies only on the RF peak locations. The method is as follows: for each pixel in the retinotopic projection image, the intensity level is the unweighted average of the activations of the \( n \) voxels with the nearest RF peak locations. If \( n = 1 \), this results in a Voronoi tessellation in the image where each pixel represents the activation of a single voxel. If \( n = 15 \) or greater, the result is retinotopic projection that closely resembles those produced with the technique described in the \textit{Methods} section.