THE HUMAN V1–V2–V3 VISUOTOPIC MAP COMPLEX MEASURED VIA FMRI AT 3 AND 7 TESLA*

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Abstract

Macaque 2DG and microelectrode studies established the detailed nature of V1 visuotopy, but fMRI provides the principle source of its measurement in the human. A recent extension of the classical monopole map ($w = \log(z + a)$), termed the *wedge–dipole* model, provides a five parameter model that efficiently summarizes the foveal, parafoveal, and peripheral topographic structure of the V1-V2-V3 complex in the macaque, including local anisotropy (i.e., azimuthal shear). To characterize the human visuotopic map, we collected visuotopy data via fMRI at 3T and 7T and used this model to fit the data. We constructed a custom multi-channel surface coil, used an eye fixation 2AFC behavioral task with real-time performance feedback, developed a phase encoding stimulus consisting of a dynamic spatial noise pattern matched to cortical magnification factor, and employed optimal quasi-isometric brain flattening to obtain flat representations of the 2D cortical surface [see Balasubramanian *et al.*, this meeting]. The wedge–dipole model is necessary if peripheral data is available, but for currently feasible visual stimulation a wedge–monopole is appropriate. We estimate the parameter characterizing the fovea to be $a = 0.7 \pm 0.1$ (mean $\pm$ std., over ten hemispheres) in agreement with independent human V1 magnification factor estimates [Horton & Hoyt, 1991] as well as the only other human fMRI study to measure the 2D V1 mapping [Duncan & Boynton, 2003]. The topographic shear parameters [Balasubramanian *et al.*, 2002] for V1, V2, and V3 are estimated to be $\alpha_1 = 0.9 \pm 0.2$, $\alpha_2 = 0.5 \pm 0.2$, and $\alpha_3 = 0.4 \pm 0.1$. The consistency of these values across fMRI subjects, and the close agreement with independent non-fMRI estimate for V1, supports the results presented here—the first 2D characterization of visuotopy in the human V1-V2-V3 complex.

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