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Supplemental Information

Revealing Detail along the Visual Hierarchy:

Neural Clustering Preserves Acuity from V1 to V4

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Supplementary Figures

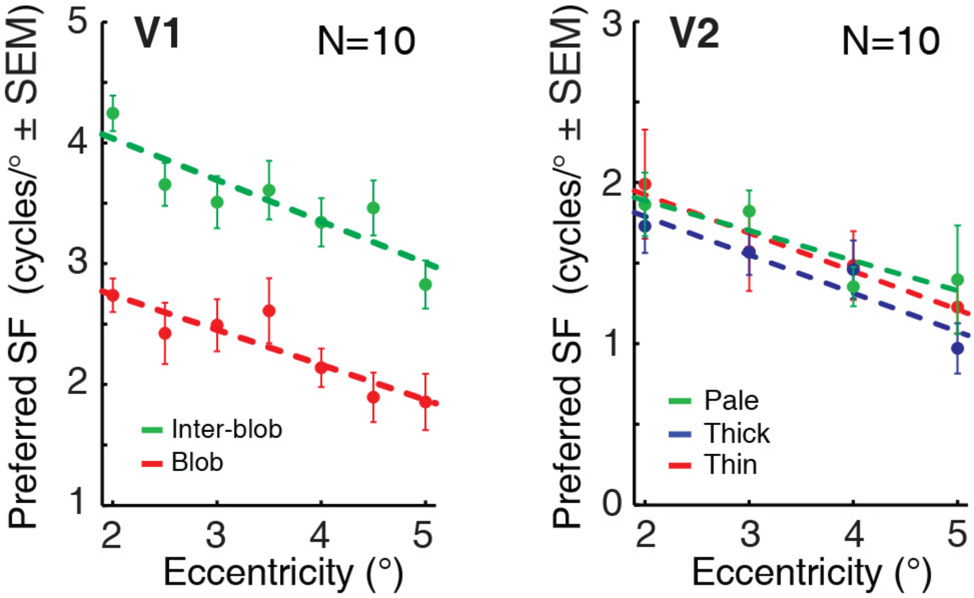

Figure S1. The comparison of the inverse relationship with respect to eccentricity between blobs and inter-blobs in V1 and across three functional stripes in V2. (Related to Figure 3). N = hemispheres.

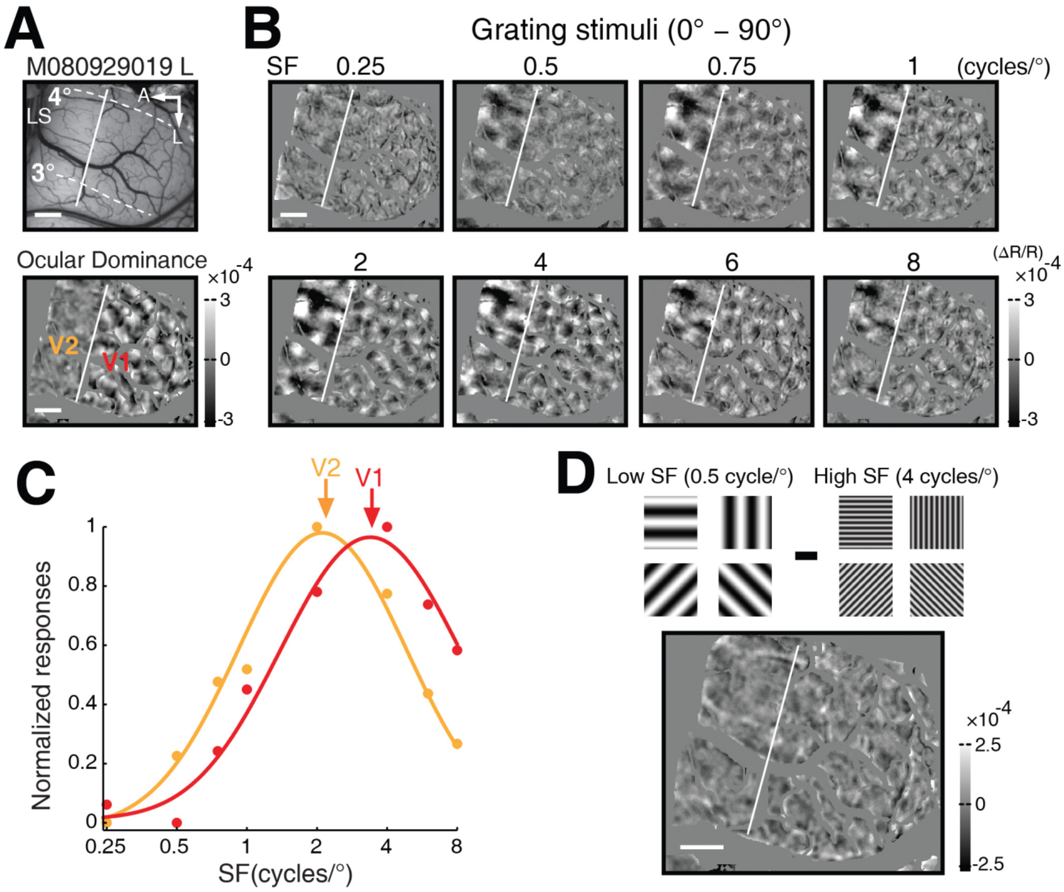

Figure S2. The SF-selective responses in V1 and V2 from another example monkey. (Related to Figure 5). **(A, B)** The simultaneously recorded V1 and V2 areas (V4 area presented in Figure 4) in response to drafting sine-wave gratings at different SFs (0.25 to 8 cycles/°). The white line represents the border of V1 and V2. The grey scale bar represents the illumination reflectance change (ΔR/R). L: lateral. A: anterior. LS: lunate sulcus. Scale bar: 1 mm. (**C**) The SF tunings of V1 and V2. The responses were normalized to the maximum responses of V1 and V2 areas, respectively. (**D**) The SF preference domains of V1 and V2, computed in the same way as that for the simultaneously recorded V4 presented in Figure 5A. Unlike V4, there was no clear high-SF preference domains after the subtraction between low and high SF population responses within V1 and V2.

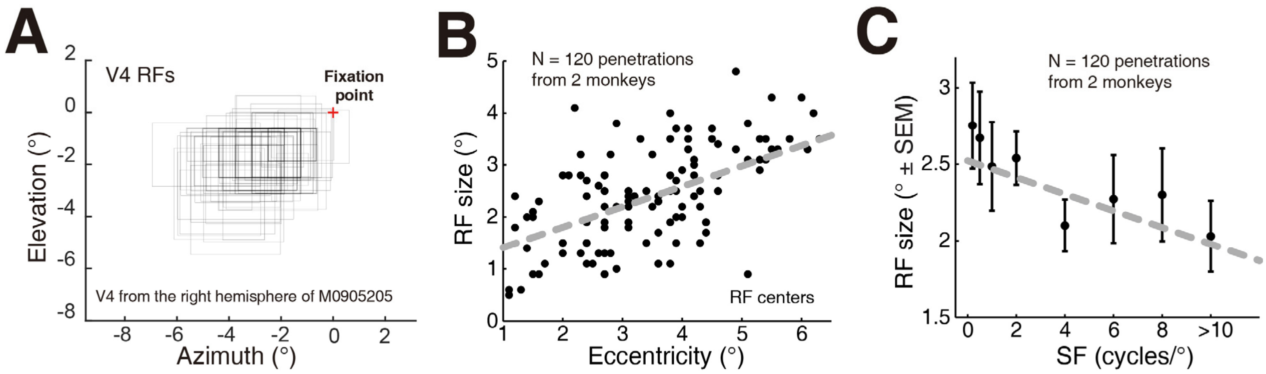

Figure S3. Electrophysiological recordings in awake macaque V4. (Related to Figure 6). **(A)** The RFs of the recorded V4 units from the right hemisphere of the Monkey 0905205. **(B)**RF size of V4 neurons plotted against retinal eccentricity within V4; dotted line: Pearson ρ = 0.54, P = 1.3×10^{-10}. This result is consistent with the results reported by Desimone and Schein in 1987 (Desimone and Schein, 1987). Note that the averaged RF size of higher-SF neurons in V4 (SF >= 4 cycles/°, mean RF = 2.2 ± 0.1°, N = 32) is larger than that of V1 neurons at comparable eccentricities (~ 1.1°) (Freeman and Simoncelli, 2011; Gattass and Gross, 1981). **(C)** RF sizes of V4 neurons are plotted against their SF preferences; dotted line: Pearson ρ = −0.84, P = 0.009.

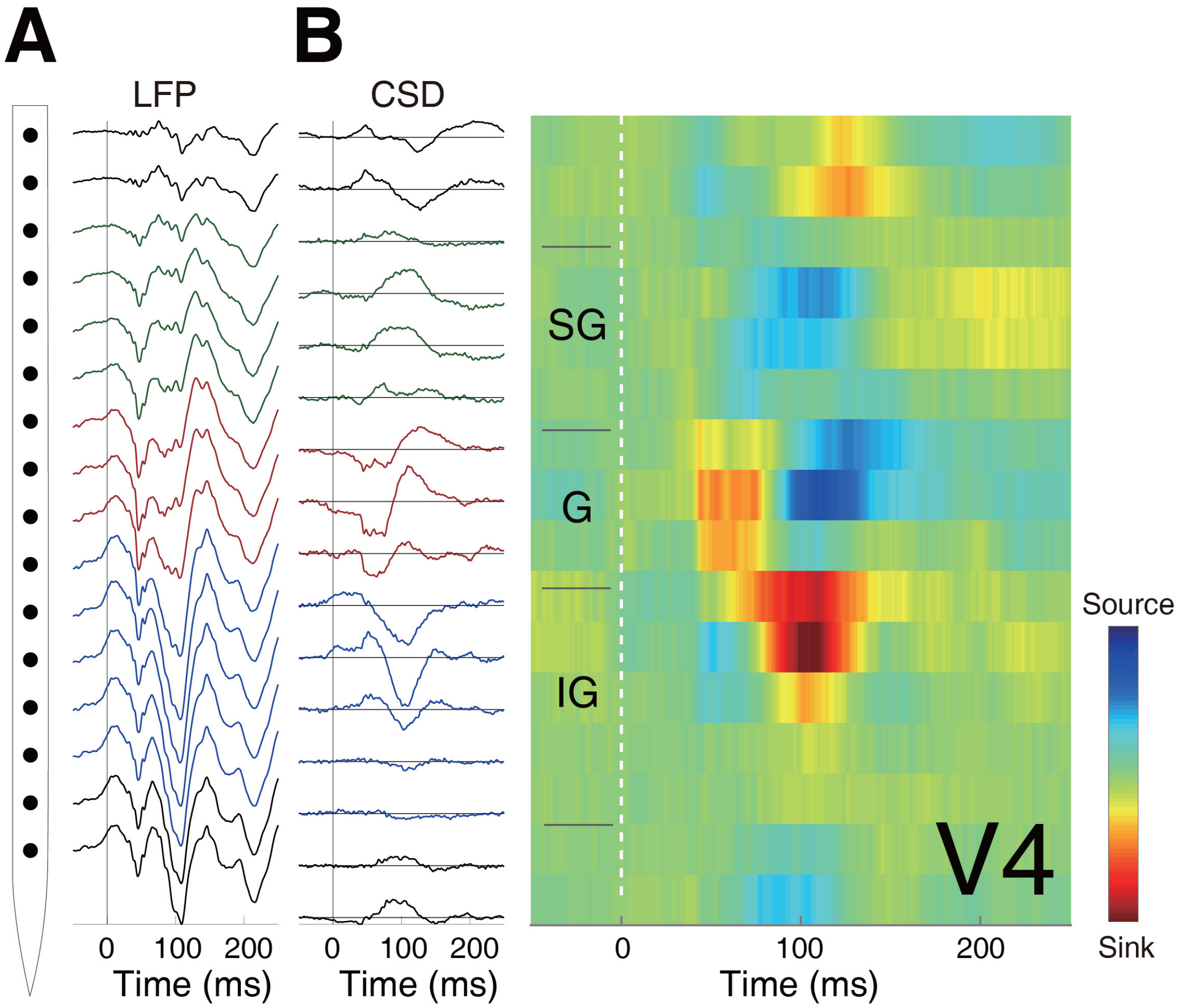

Figure S4. Current source density (CSD) analysis for discriminating cortical granular (G), supra– and infra–granular layers (SD and IG). (Related to Figure 6). **(A)** LFP filtered signal responses at each laminar recording site in a low SF domain. **(B)** CSD response profiles in 2D (left) and 3D (right) detailing the current sources (blue) and sinks (red; data not interpolated).

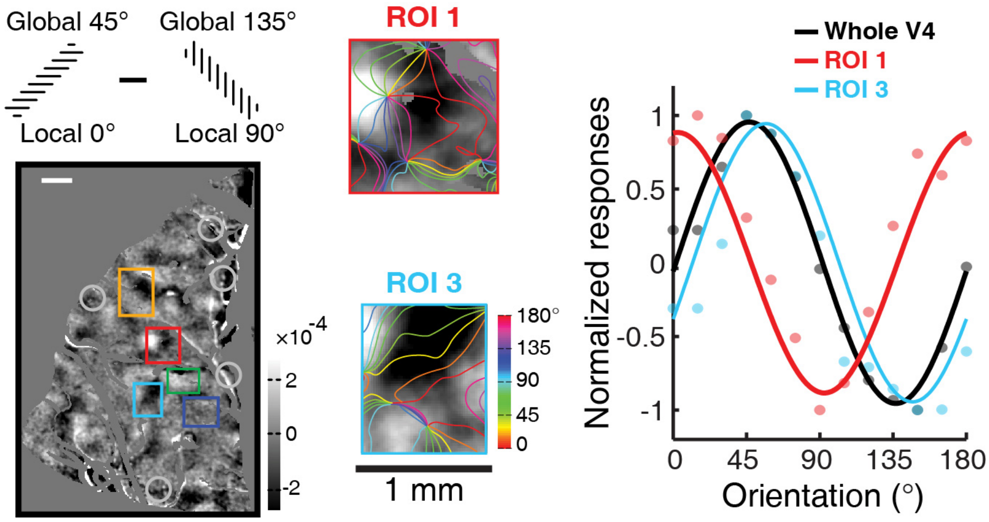

Figure S5. Population responses to drifting-grating and local-global orientation stimuli. (Related to Figure 7). Differential orientation map to local and global orientation stimuli (local 0° and 90°, global 45° and 135°). ROI–1 and 3 are illustrated as example ROIs, from which the differential orientation maps are superimposed by orientation preference maps as shown in **Figure 7C**. Scale bar: 1 mm. Orientation response profiles of ROI–3 and the whole imaged V4 are in register for encoding the global orientations (45° and 135°), whereas that of ROI–1 encodes the local orientations (0° and 90°).

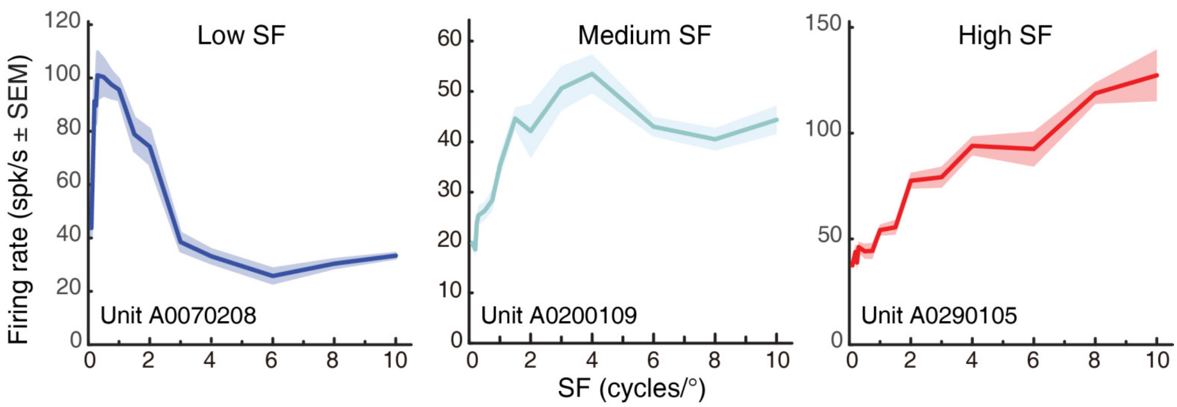

Figure S6. The neural SF tuning curves of the three V4 representative units presented in Figure 7D. (Related to Figure 7).

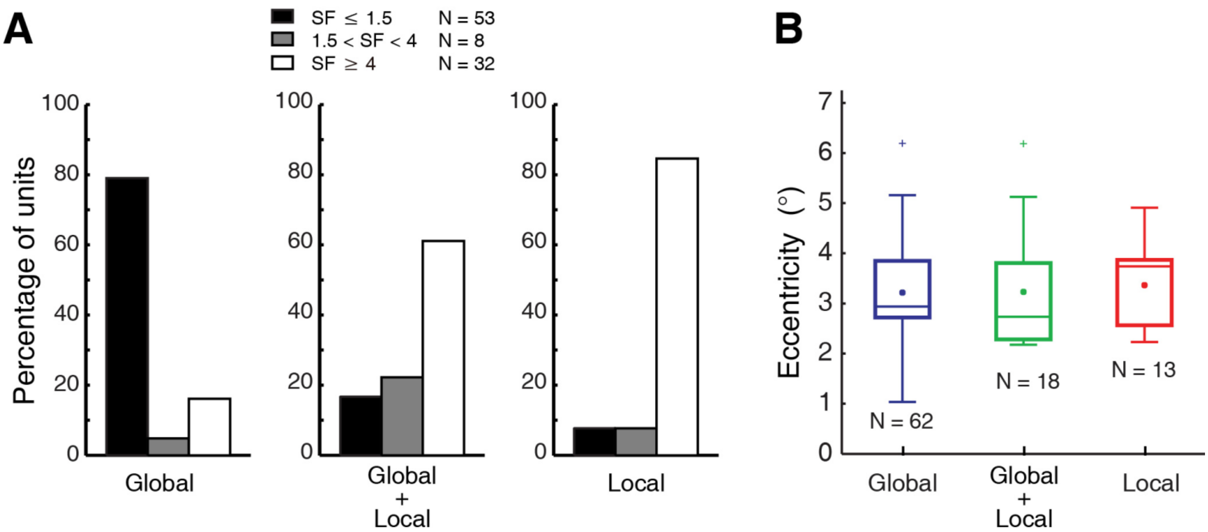

Figure S7. Local and global neural responses in V4 depend on spatial preference, not eccentricity. (Related to Figure 7). **(A)** The percentages of lower (≤ 1.5cycles/°), median (1.5 cycles/° < SF < 4 cycles/°), and higher (≥ 4 cycles/°) SF groups compared across global, global + local and local orientation responses shown in **Figure 7E**. (**B**) No clear relationship between local-global responses and eccentricity.

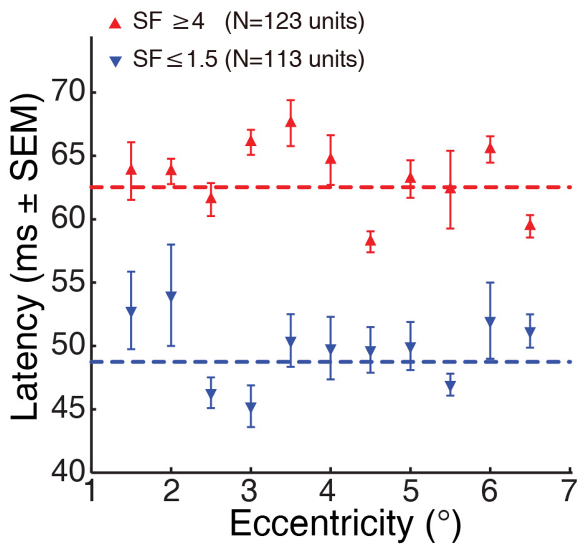

Figure S8. The eccentricity distribution of the response latencies of two neuronal populations preferring low and high SFs in Figure 8B. (Related to Figure 7). The dotted lines present the means of the populations, respectively. Response latencies of higher-SF neurons are always larger than those of lower-SF neurons, regardless their eccentricities (two-tailed paired t-test t = 11.59, P = 4.05×10^{-7}). There is no correlation between eccentricity and latency for either group (P = 0.42 and 0.84 for high and low SF units, respectively, Spearman correlation).