Supplemental material

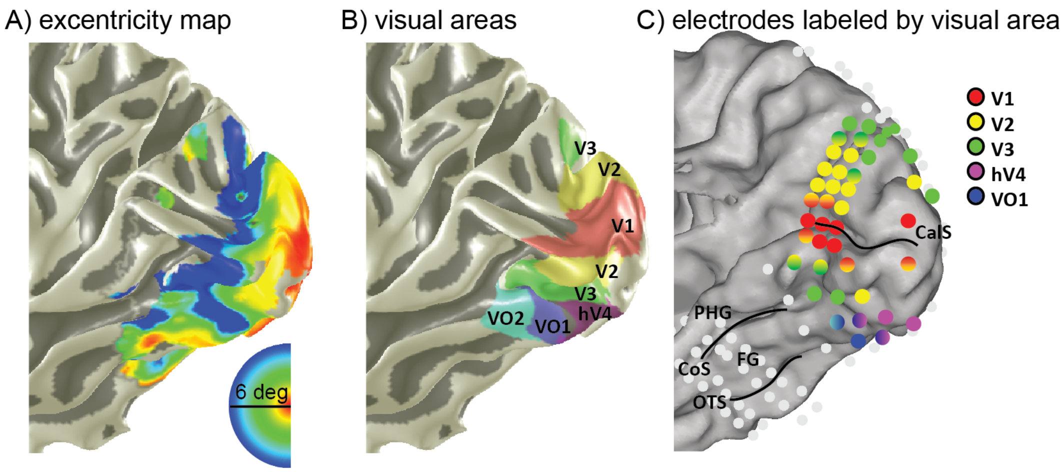

Figure S1: Visual areas in subject 1. **A)** Eccentricity map from fMRI scan (Winawer et al., 2013). **B)** Labels of visual areas derived from this visual field mapping experiment (eccentricity + polar angle maps). **C)** ECoG electrodes labeled according to the visual field maps, verified with ECoG. CalS = Calcarine sulcus, PHG = parahippocampal gyrus, CoS = collateral sulcus, FG = fusiform gyrus, OTS = occipital temporal sulcus.

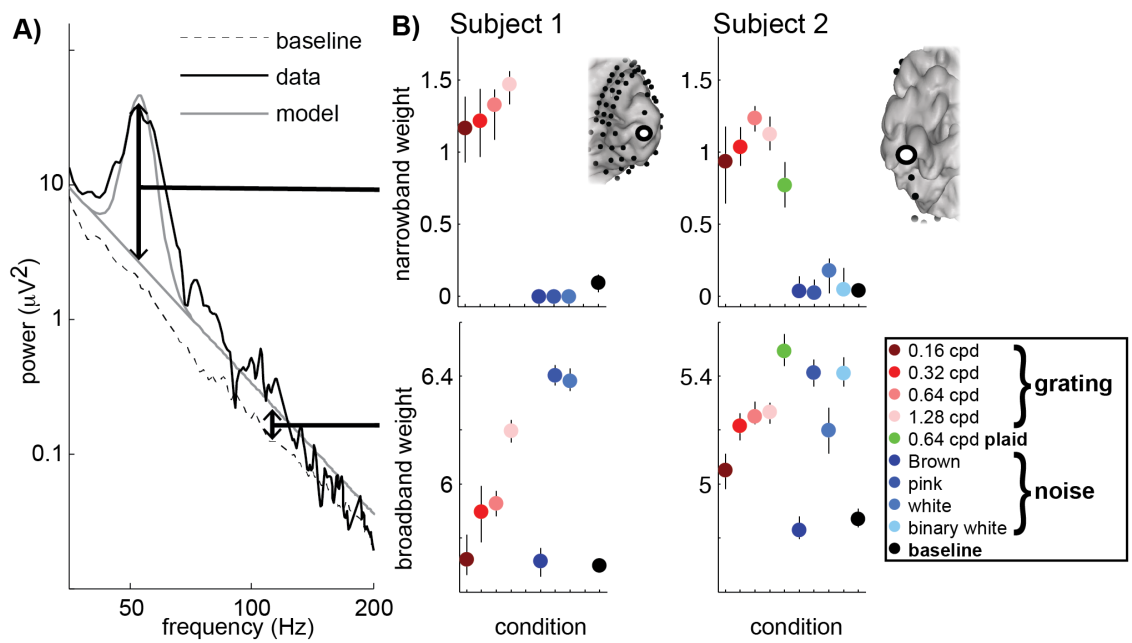

Figure S2: A) A power law plus Gaussian (model) was fitted to the average power spectra of each condition (data) in log-log space, resulting in respectively a weight for broadband plus narrowband increases compared to baseline. For each condition C with N_c trials, N_c trials were drawn randomly with replacement and averaged. The model (power law + Gaussian) was fitted to the average log power spectrum from these trials. This was repeated 100 times to calculate confidence intervals. **B)** For one early visual electrode in subject S1 and subject S2 the average narrowband and broadband weights and 95% confidence interval are shown.

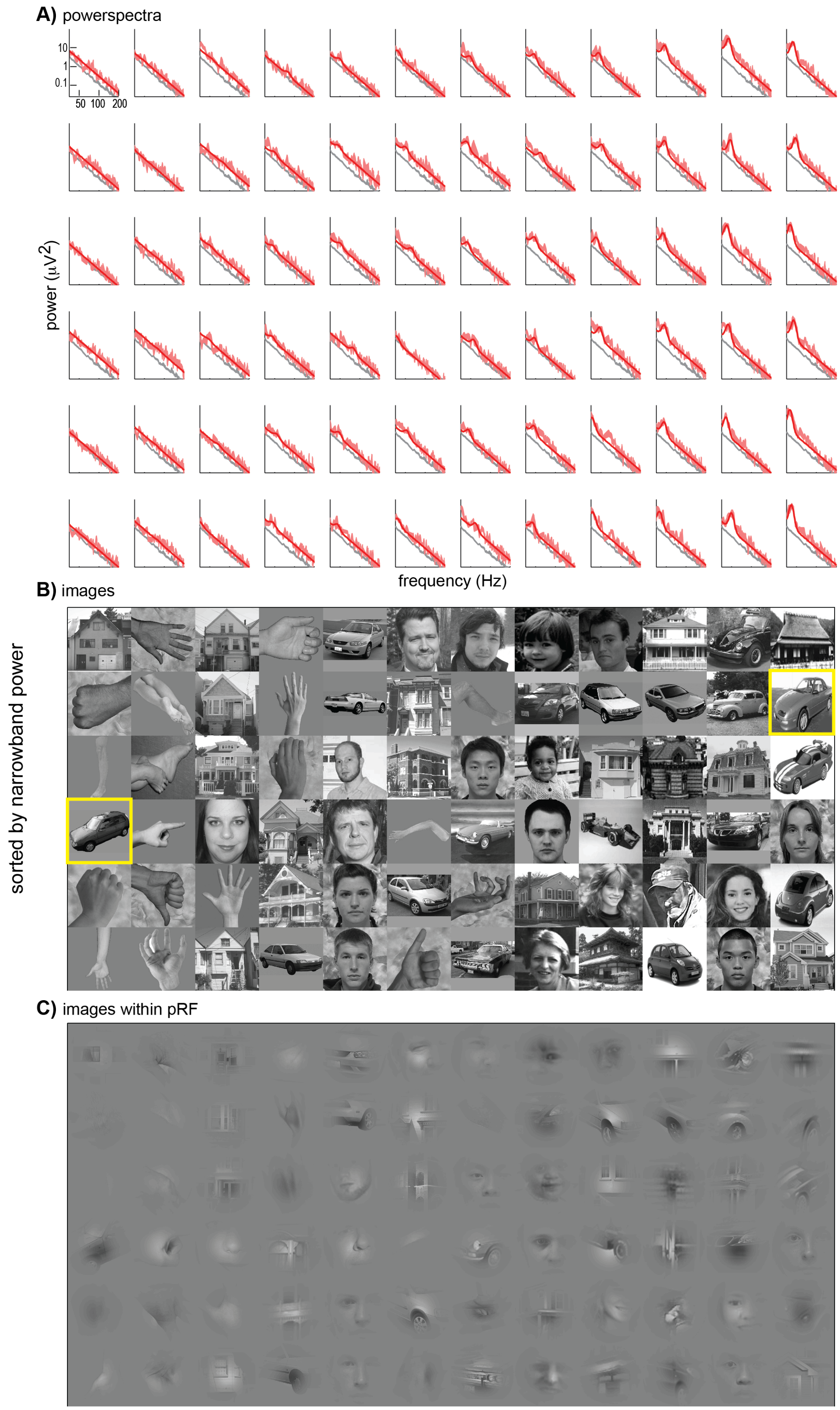
A) powerspectra
10
1
0.1
50 100 200
power (μV2)
frequency (Hz)
B) images
sorted by narrowband power
C) images within pRF

Figure S3: Power spectra and images ordered by narrowband power. Subject 3 viewed 72 images of faces, houses, cars and limbs, repeated 5-6 times each, while fixating a dot in the center of the screen (Parvizi et al., 2012, Jacques et al., 2013). All images (10x10°) were shown for 1000ms and the inter stimulus interval varied from 600-1400 ms. From an electrode in foveal V1 (determined by fMRI and ECoG retinotopic mapping, (Winawer et al., 2013)) the power spectra were calculated for the stimulus intervals and for a 500 ms pre-stimulus baseline. Power spectra were averaged across repeated images and were decomposed into narrowband gamma and broadband components (see Methods).

A) The 95% confidence intervals of the power spectra were calculated by bootstrapping the spectra of the repeated images 1000 times. These confidence intervals are displayed on a log-log plot ordered by narrowband gamma power with the smallest value in the upper-left, the largest value in the lower right, and decreasing down the columns and then rows. The confidence intervals are shown in light red and the baseline periods are shown in gray. The baseline is identical for every image. The model fits (power law plus Gaussian) are plotted as a red line. The images with yellow outlines are plotted in main text Figure 6. **B)** Images sorted by narrowband power, in same manner as A). **C)** Image windowed by the Gaussian population receptive field, sorted by narrowband power, as in A.

Broadband and narrowband estimates were reliable for the repeated images. If the model was fitted on the average power spectrum from the even and odd images the narrowband weights correlated with $r=0.78$ ($p<0.001$) and the broadband weights correlated with $r=0.79$ ($p<0.001$).

To estimate whether narrowband and broadband power was significant for each image, the power spectra for each image were bootstrapped 100 times and the model was fitted to estimate confidence intervals for the narrowband and broadband weights. If 95% confidence intervals were not overlapping with the confidence interval from the baseline period (gray), it was considered significant. Out of 72 images, 40 elicited significant gamma oscillations, 69 elicited significant broadband power increases. In the other foveal V1 electrode that was measured, 39 images elicited significant gamma oscillations, 68 elicited significant broadband power increases.

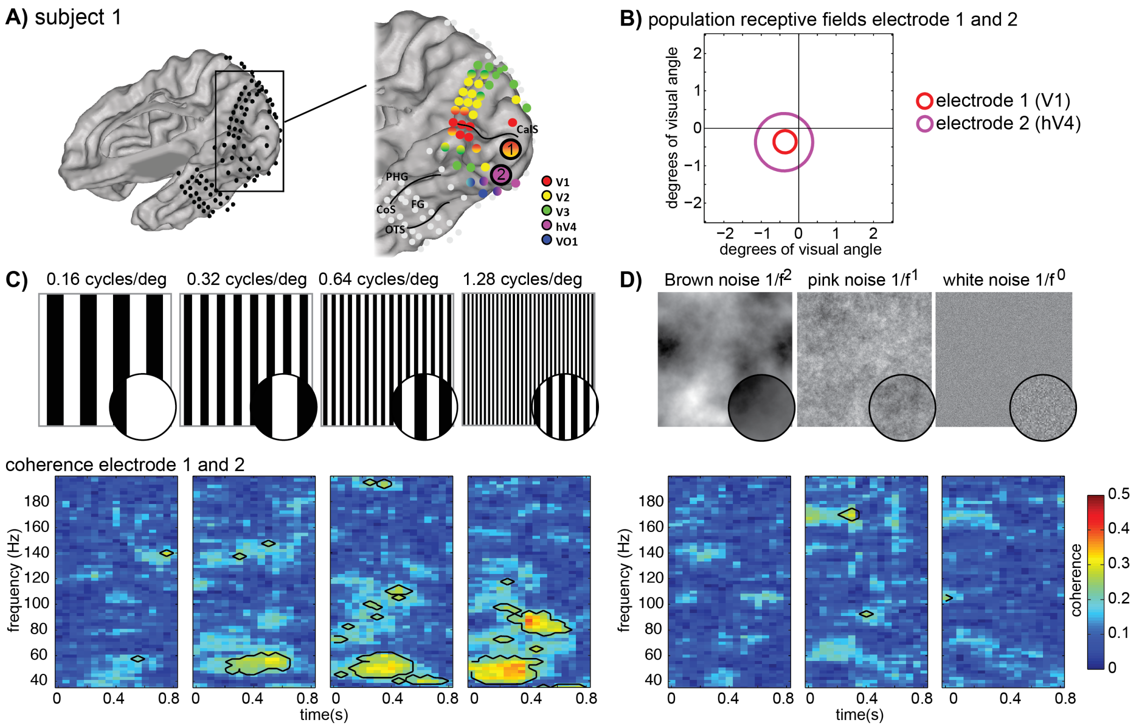

Figure S4: Coherence between V1 and hV4. Subject 1 had electrodes covering large areas of visual cortex and we calculated the coherence between two electrodes with overlapping population Receptive Fields (pRFs), one on the V1/V2 boundary and one on hV4.

To calculate coherence, we used the Chronux toolbox (http://www.chronux.org/, (Mitra and Bokil, 2008)). The coherence is the absolute value of the coherency *C(f)*: $C(f) = \frac{S_{XY}(f)}{\sqrt{S_{XX}(f)S_{YY}(f)}}$, where S_{xy} is the cross spectrum and S_{xx} and S_{yy} the power spectra for signals from 2 electrodes *X* and *Y*:

$S_{XY}(f) = \frac{1}{K}\sum_{k=1}^{K} X_k(f) Y_k^*(f)$, where Y_k* is the complex conjugate of Y_k.

$$S_{YY}(f) = \frac{1}{K}\sum_{k=1}^{K} |Y_k(f)|^2$$

$$S_{XX}(f) = \frac{1}{K}\sum_{k=1}^{K} |X_k(f)|^2$$

The power spectra and cross spectra of the signals x and y were calculated by the Fourier transform with 5 orthogonal Slepian tapers (Percival and Walden, 1993), for example for X_k:

$X_k(f) = \sum_{n=1}^{N} w_n(k) x_n e^{-2\pi i f t}$ where $w_n(k)$ is the kth Slepian tapering function.

The coherence was estimated from 35 to 200 Hz in steps of 1 Hz, using a 400 ms window with 50 ms step size. The bandwidth of the tapers was set in such a way that there was a smoothing in the frequency range over +/-7.5 Hz.

A) Brain rendering with electrodes in subject 1. The electrodes on the V1/V2 boundary (electrode 1) and hV4 (electrode 2) are plotted larger. **B)** The pRFs from these two electrodes were derived from previous ECoG work (Winawer et al., 2013). The pRFs are plotted with 2 standard deviations around the center and are overlapping. Crosshairs are drawn on the center of the screen. **C)** Coherence between these two electrodes for gratings. **D)** Coherence between these two electrodes for noise patterns. The 95% confidence intervals were calculated by a Jackknife procedure and corrected for multiple comparisons across time and frequency. A black outline indicates that the 95% confidence interval did not include zero. Note the clear presence of significant coherence in the gamma range (35-80 Hz) for the gratings.