Supplementary Information for:

An illusion predicted by V1 population activity implicates cortical topography in shape perception

Melchi M. Michel[1], Yuzhi Chen[2,3,4], Wilson S. Geisler[2,3], & Eyal Seidemann[2,3,4]

[1]Department of Psychology, Rutgers University

[2]Center for Perceptual Systems, [3]Department of Psychology, [4]Section of Neurobiology, University of Texas at Austin
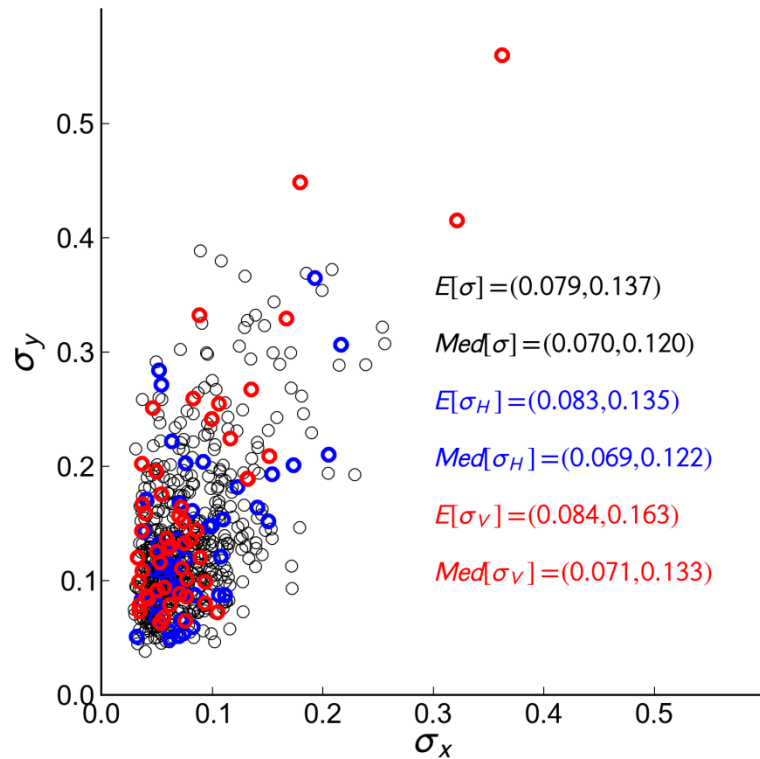
Supplementary Figures
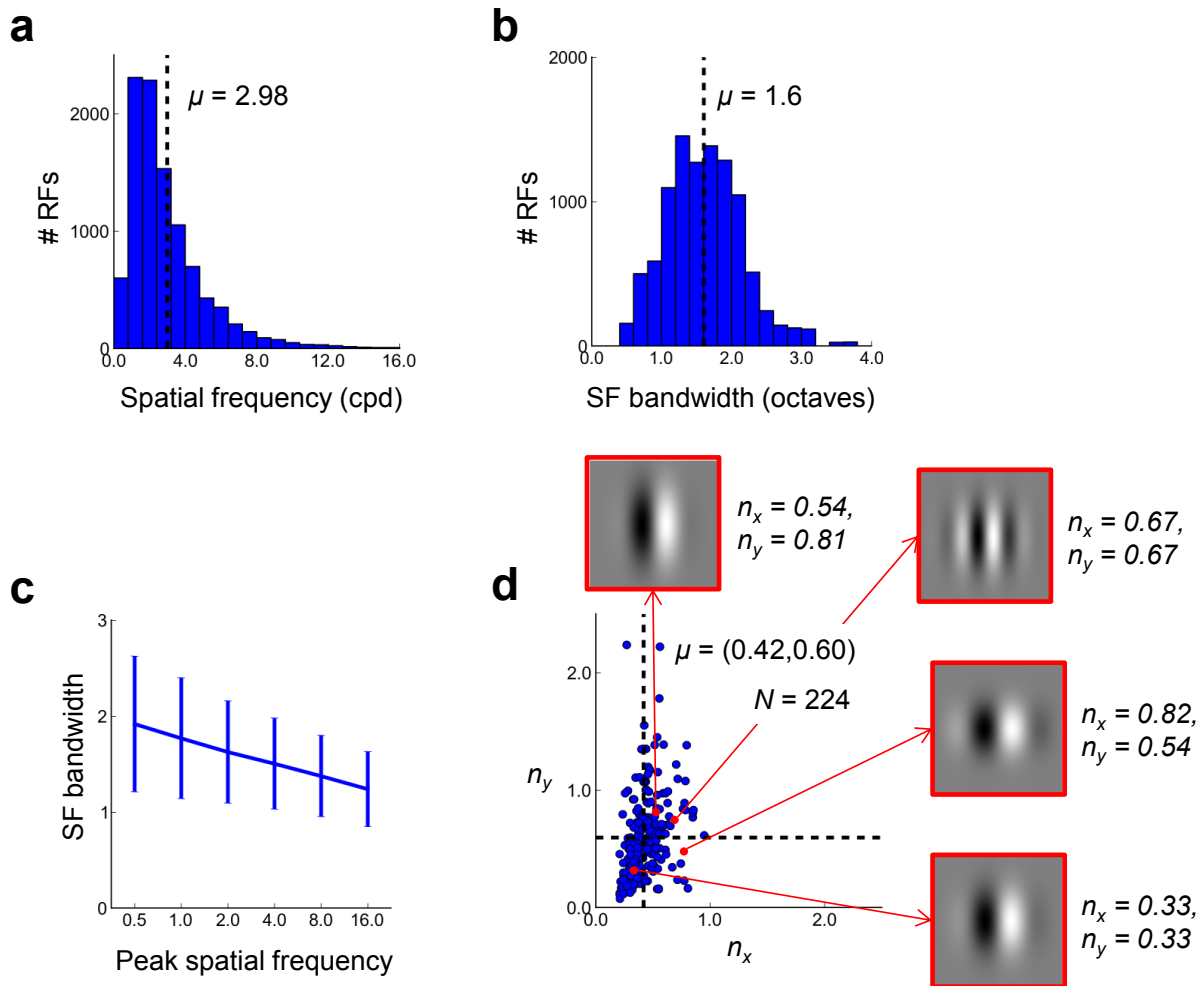
Supplementary Figure 1. Summary of receptive field parameters used in simulations. For each of our simulations, we randomly sampled a population of 10,000 unique receptive fields, each of which tiled a 2°x 2° portion of the visual field. Panels (a) and (b) show frequency histograms for the peak spatial frequency and spatial frequency bandwidth, respectively, obtained in an example simulation. c) The dependence between peak spatial frequency and spatial frequency bandwidth in our population of receptive fields imposed by our sampling method (see *V1 Population Response Model*). This closely approximates the dependency measured using single-cell electrophysiology.[23] d) Normalized Gabor receptive field shapes.[24] Here, n_x represents the Gaussian size constant (in wavelengths) along the bandpass direction while n_y represents the size constant along the lowpass direction. For simplicity, samples for particular parameter combinations are shown in a single orientation and phase. In simulations, receptive field orientations were chosen randomly, and each receptive field was implemented as a sine and cosine phase pair.
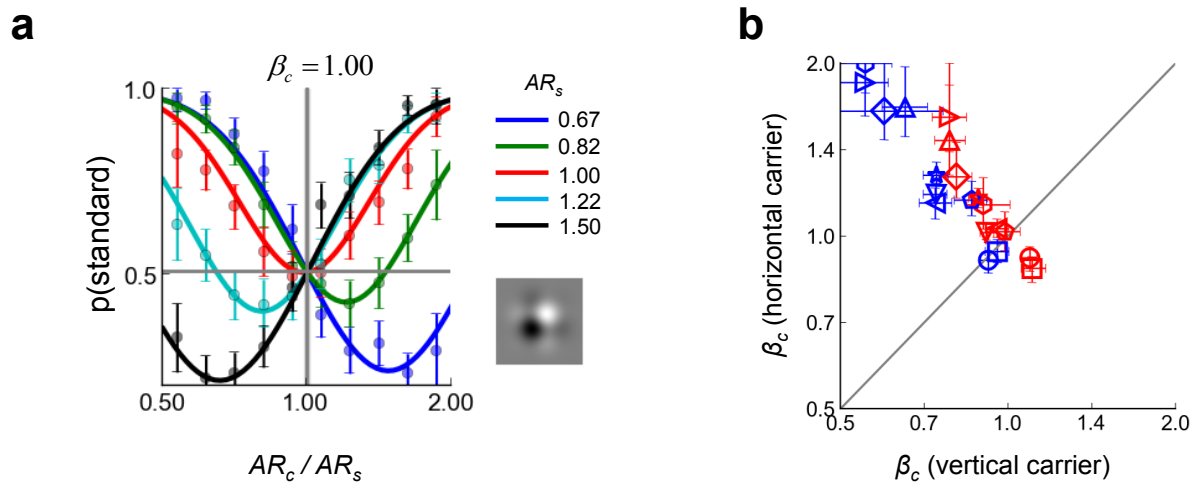
Supplementary Figure 2. Supplementary psychophysical results. a) Psychometric functions in the control condition with a 2 cpd plaid as the comparison stimulus. As in Fig. 6, the gray vertical lines and shaded regions represent the estimated PSEs and their 95% confidence intervals. b) Individual PSEs for the vertical (abscissa) and horizontal (ordinate) carriers with 95% confidence intervals for each of our 10 human observers. Each shape represents an individual observer. Blue shapes represent PSEs for the 2 cpd stimuli and red shapes for the 4 cpd stimuli. Eight of ten subjects demonstrated the significant effect of carrier orientation on perceived aspect ratio at an individual level.

Supplementary Figure 3. Fixational eye movements across conditions. Each black marker (*N* = 630) represents the vertical (σ_y) and horizontal (σ_x) standard deviations (SDs) of eye position within a given trial, for all conditions and experimental blocks represented in Figs. 3g and 4a. Overlaid blue markers represent trials in which a 2cpd horizontal Gabor was presented (*N* = 52), while red markers represent trials in which a 2cpd vertical Gabor was presented (*N* = 52). The mean and median values are indicated for the overall distribution of SDs (black text) and for each of the 2 cpd Gabor conditions (blue and red text). Neither the SD along the horizontal direction (unpaired *t*(102) = 0.015, *p* = 0.99), nor the SD along the vertical direction (unpaired *t*(102) = 0.270, *p* = 0.79) varied significantly as a function of Gabor carrier orientation.