Supplementary On-line Material (Banks, Gepshtein, & Landy)

Monocular Control Experiment

We presented the same stimuli as in the binocular experiments, but observers viewed them monocularly (left eye in half of the experiment and right eye in the other half). The task was the same as in the binocular experiments: identify the orientation of the disparity-modulation waveform. Viewing distance was 154 cm. The stimuli had one of four dot densities: 23.3, 52.3, 93.0, and 145.0 dots/deg^2. We used the method of constant stimuli. In each block of trials, the spatial frequency of disparity modulation was chosen randomly from 1.3, 1.7, 2.0, 2.4, 2.7, and 3.0 c/deg at a fixed dot density. Thirty trials were presented for each condition. No feedback was provided. Of the six observers who participated in the binocular experiments, four participated in the monocular control experiment. Discrimination performance did not differ significantly from chance except for the highest-frequency stimulus at the highest dot density.

Fig. S1: Additional Data

Spatial stereoresolution as a function of dot density. The highest discriminable corrugation frequency is plotted as a function of the dot density. Each panel shows results from one observer. Results from two more observers are shown in Fig. 2 in the main text. The filled diamonds represent the measured resolution when the disparity amplitude was 16 min arc and the open squares the resolution when the amplitude was 4.8 min arc. The solid lines represent the Nyquist sampling limit f_N of the dot pattern (Eqn. 1). Viewing distance was 39 cm.

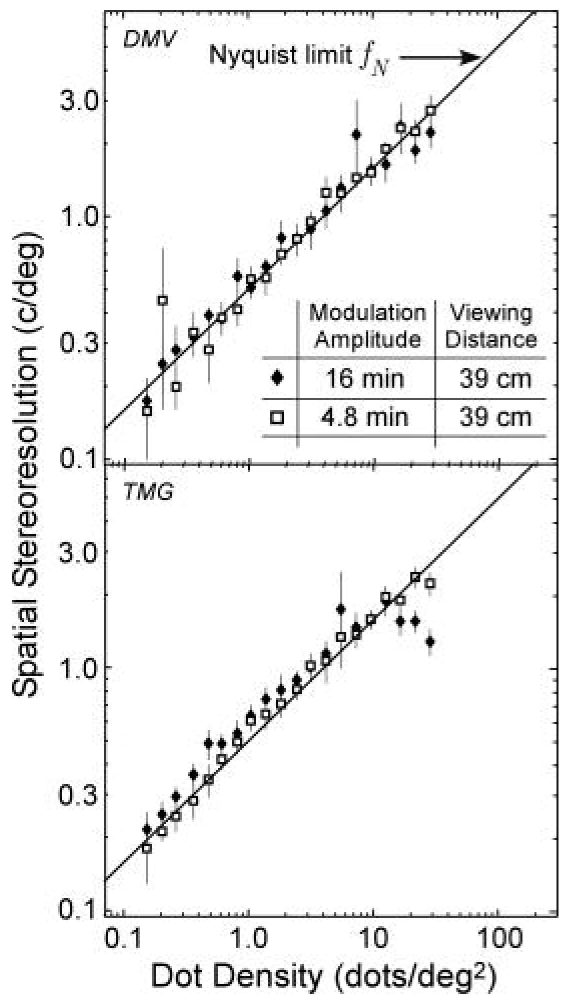

Figure S1

Number of Required Samples for Ideal Discriminator

How might an observer carry out the discrimination task in these experiments? The amplitude of the sine wave was fixed, but its spatial phase, corrugation frequency, and orientation were not. Dot positions varied trial by trial. If we assume that the dot correspondences between the two eyes were determined perfectly, the orientation discrimination (+/-20°) could in principle be done with far fewer measurements than implied by the Nyquist limit. One might expect that an ideal observer could perform the task from just three points, to infer the three unknown aspects of the stimulus: phase, frequency, and orientation. This observer needs only to determine the unique sine wave that passes through the three measured 3D locations. It turns out that three points do not suffice, but only a few more are needed. The fact that the data fall near the Nyquist limit indicates that human observers require many more measurements and therefore do not use this ideal strategy.

Fig. S2: Additional Data

Spatial stereoresolution as a function of dot density at two viewing distances. The open squares represent the measured resolution at a viewing distance of 39 cm and the filled circles the resolution at a distance of 154 cm. The solid lines represent the Nyquist sampling limit (Eqn. 1). Disparity amplitude was 4.8 min arc. Results from two more observers are shown in Fig. 4 in the main text.

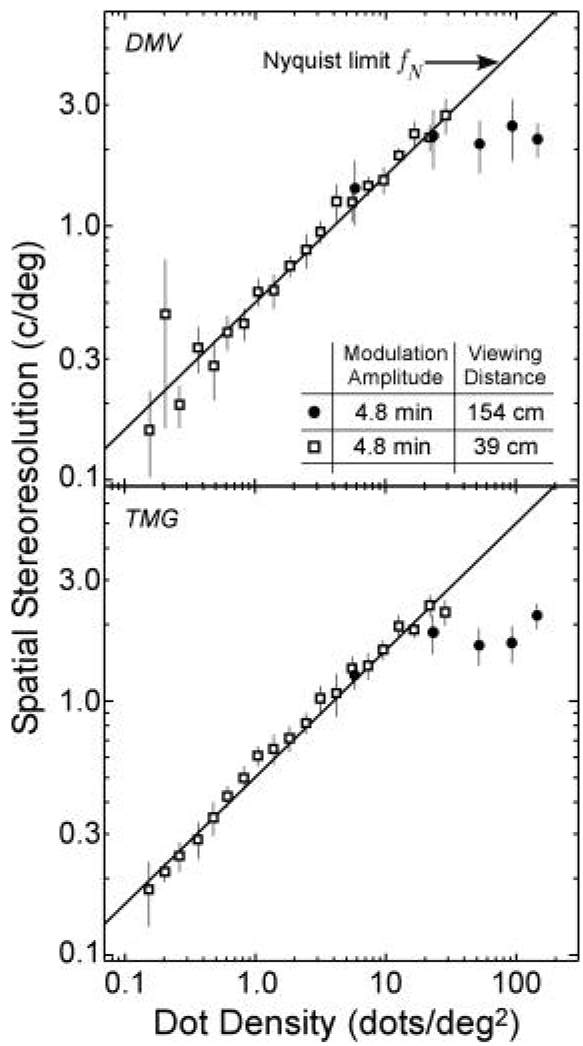

Figure S2

Fig. S3: Additional Data

Spatial stereoresolution as a function of dot density at different retinal eccentricities. The stimuli were a full field of random dots with a small region in which the disparity modulation was present. The filled diamonds represent the measured resolution at fixation (eccentricity = 0°), the filled squares the resolution at the intermediate eccentricity, and the open diamonds the resolution at the large eccentricity. The solid lines represent the Nyquist limit. Disparity amplitude was 16 min arc, viewing distance was 39 cm, and stimulus duration was 250 msec. Results from two more observers are shown in Fig. 6 in the main text.

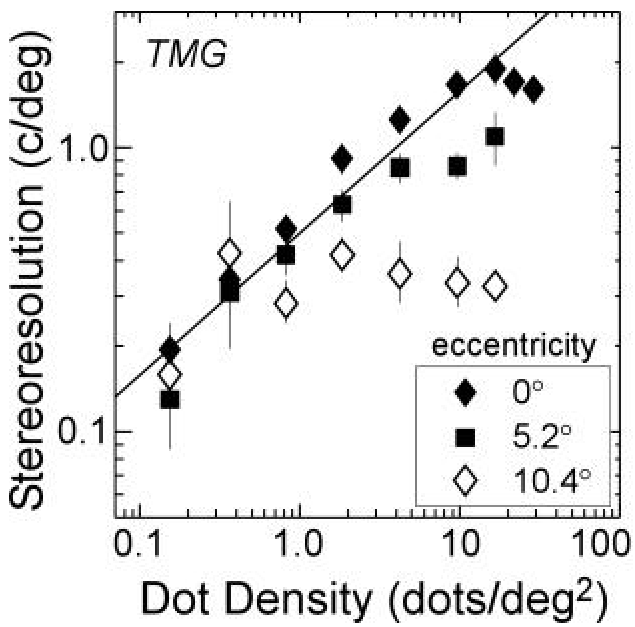

Figure S3

Contrast-polarity Experiment

To determine if space-average luminance affected stereoresolution, we presented three types of random-dot stereograms: 1) gray background with half bright and half dark dots, 2) gray background with bright dots, and 3) gray background with dark dots. Background luminance was 1.75 cd/m^2 and luminous intensities of bright and dark dots were $+2.68\times10^{-6}$ and -2.48×10^{-6} cd relative to background. Resolution thresholds were measured for the three stereograms at six dot densities. Disparity amplitude was 4.8 minarc and duration was 1500 ms. Viewing distance was 154 cm. Fig. S4 shows thresholds as a function of dot density: unfilled diamonds for bright-dark stereograms, filled squares for bright-dot stereograms, and filled circles for dark-dot stereograms. Even though the stereograms differed in average luminance, resolution was the same at each density. These results show that small changes in average luminance do not affect stereoresolution. Thus, we believe that the co-variation of dot density and average luminance in the main experiments (Figures 2 and 4) did not affect the results.

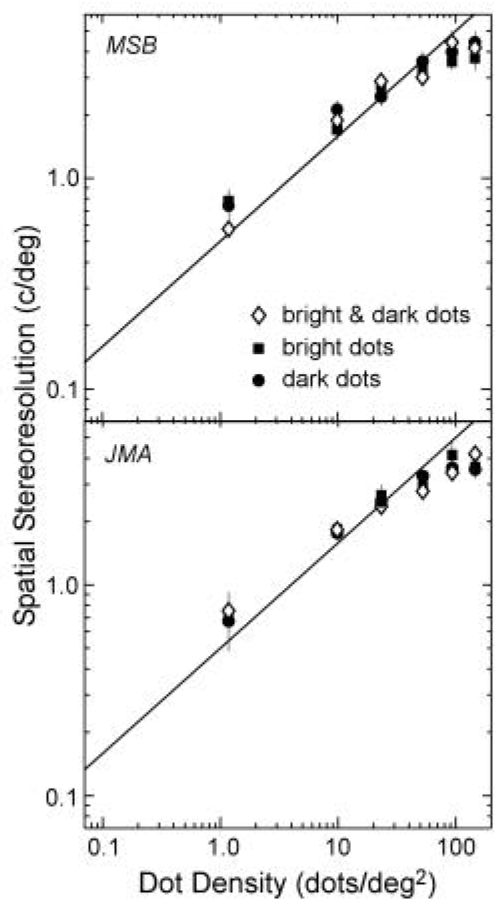

Figure S4