Perceived contrast of filtered natural images

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In previous work which has involved altering the amplitude-spectral slope of natural images and measuring object discrimination in images with different values of the spectral slope, we found optimal object discrimination when the slope values are natural (typically around 1.2). Performance is worse when the slopes are markedly steeper or shallower. Object discrimination was measured within sequences of morphed images. However, we noticed that the "natural" images (slopes around 1.2) appeared to have a higher perceived contrast than the blurred or whitened images (with steeper and shallower slopes respectively). Neither the Fourier amplitude content of these "natural" images, nor that Fourier amplitude content weighted by the observer's contrast sensitivity function, suggest any kind of maximum for the "natural" images. Thus, it seems that there is a nontrivial dependence of perceived contrast on the degree to which the spectral characteristics of an image are "natural".

A possible model which might account for such a result is the suggestion (D. J. Field and N. Brady, 1997, Vision Research, 37, 3367-3383) that natural images stimulate the bank of cortical filters to a roughly equal extent. We tested this model by selecting images whose unmodified amplitude slopes increasingly departed from the value of 1.2. A simple "filter bank" model would predict that contrast would peak for slopes around 1.2 even if these were produced by modifying the image. Instead, we found that the unmodified, "natural" image has the highest contrast even if its slope is markedly different from 1.2. Thus, perceived contrast cannot be simply predicted by second-order image statistics and associated cortical filter models.

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