Retinal filtering matches natural image statistics at low luminance levels

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The assumption that the retina's main objective is to provide a minimum entropy representation to higher visual areas (ie efficient coding principle) allows to predict retinal filtering in space–time and colour (Atick, 1992 *Network* **3** 213–251). This is achieved by considering the power spectra of natural images (which is proportional to $1/f^2$) and the suppression of retinal and image noise. However, most studies consider images within a limited range of lighting conditions (eg near noon) whereas the visual system's spatial filtering depends on light intensity and the spatiochromatic properties of natural scenes depend of the time of the day. Here, we explore whether the dependence of visual spatial filtering on luminance match the changes in power spectrum of natural scenes at different times of the day. Using human cone-activation based naturalistic stimuli (from the Barcelona Calibrated Images Database), we show that for a range of luminance levels, the shape of the retinal CSF reflects the slope of the power spectrum at low spatial frequencies. Accordingly, the retina implements the filtering which best decorrelates the input signal at every luminance level. This result is in line with the body of work that places efficient coding as a guiding neural principle.
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