Open questions from last week

- What have studies using simple test stimuli taught us about the responses of visual neurons to natural images?

- What is the luminance and contrast distribution of natural scenes?

- What do deviations from 1/f say about the scale or 'gist' of a scene? What about time-varying images?

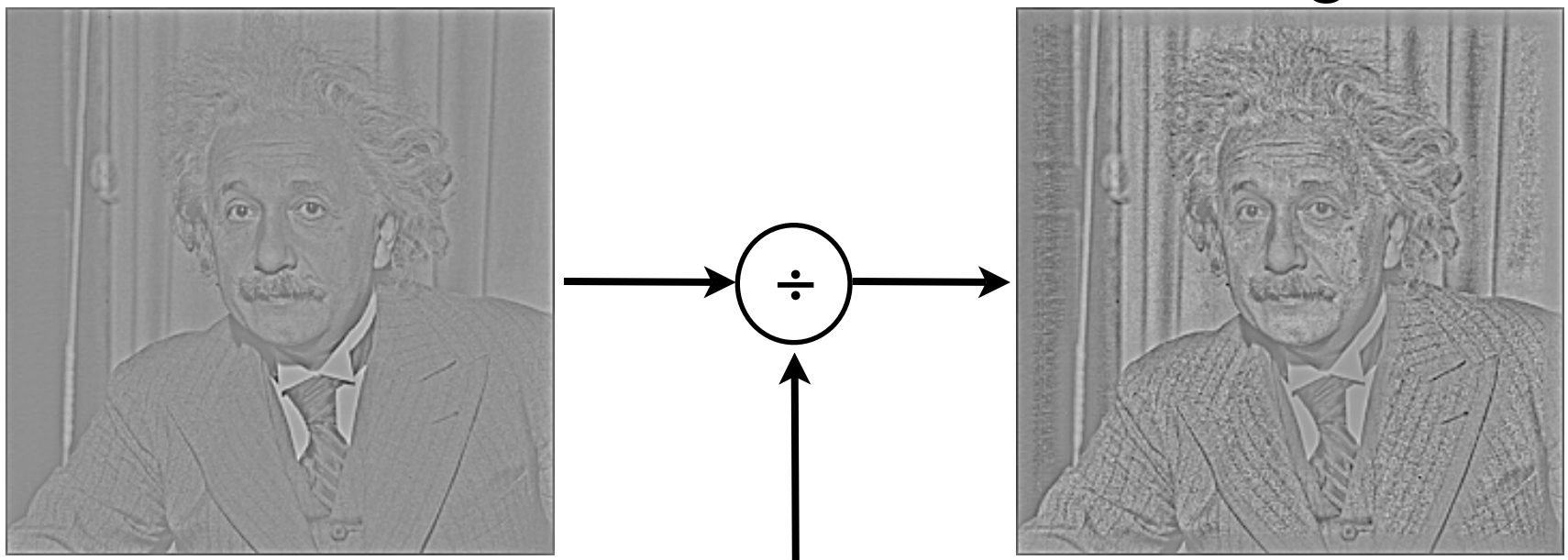
Open questions from last week

- Does the retina/LGN really whiten natural images? What happens at D.C. and low spatial-frequencies?

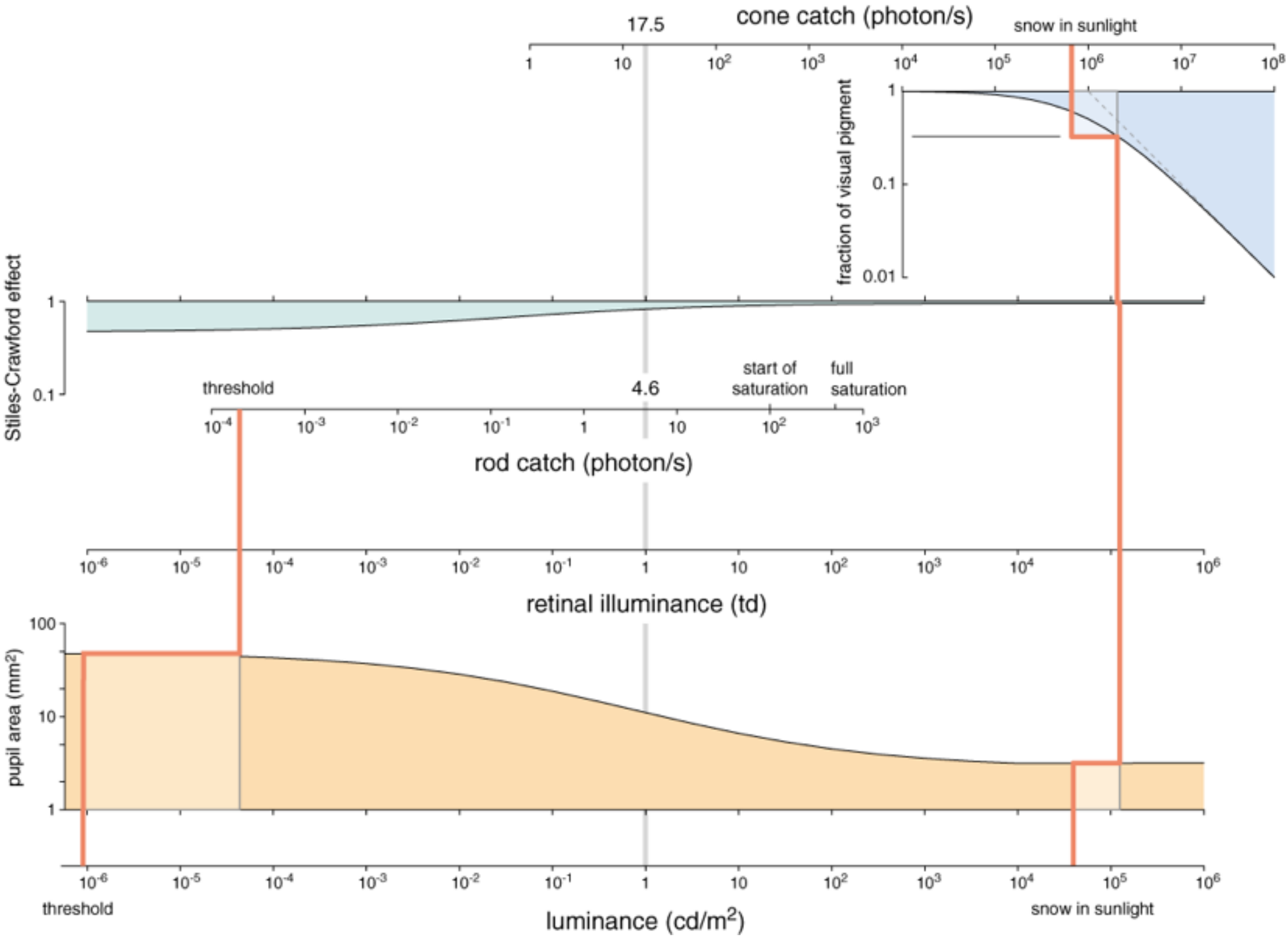
- How to employ contrast normalization as a coding strategy?

whitened image

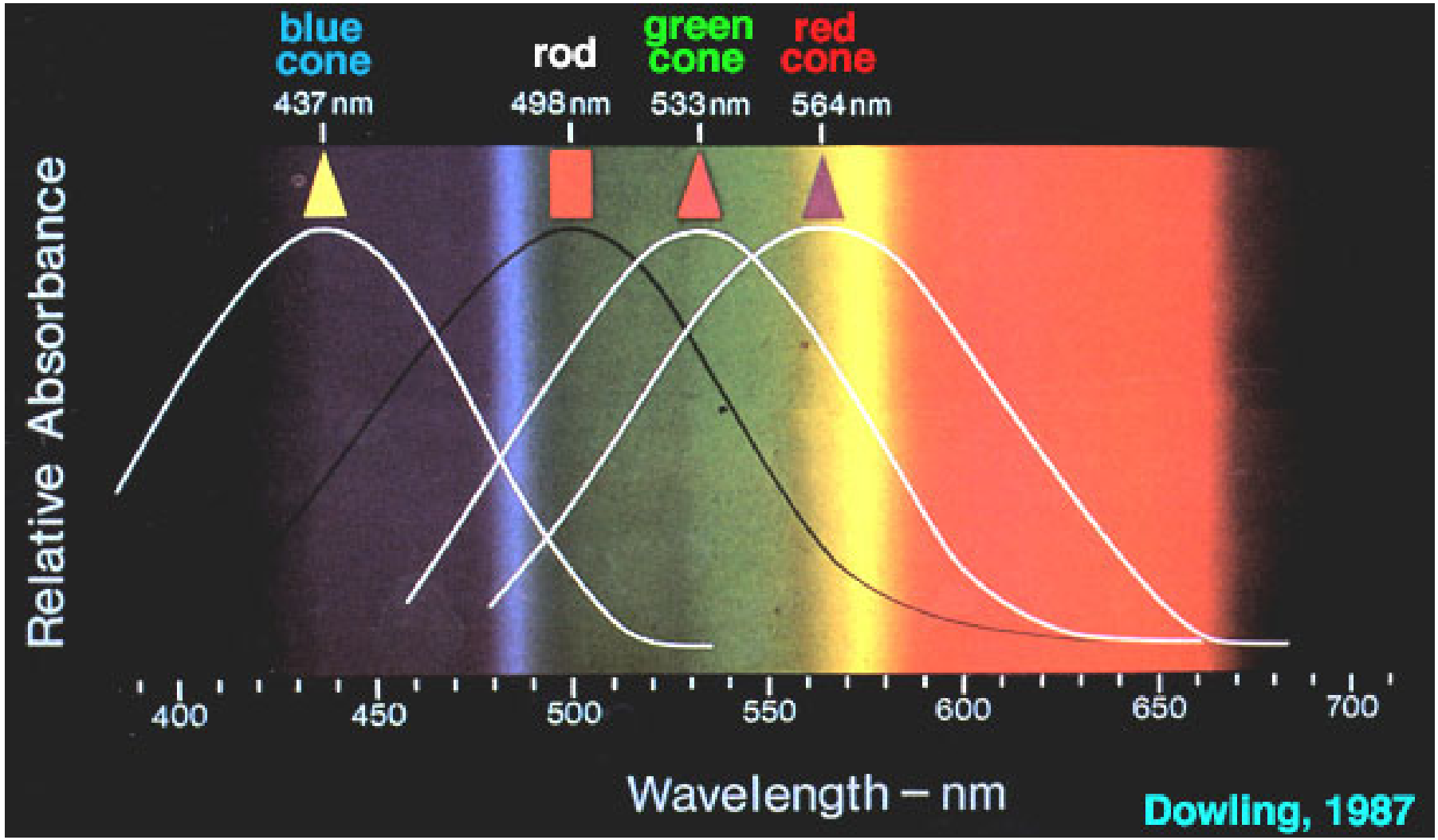
contrast normalized image



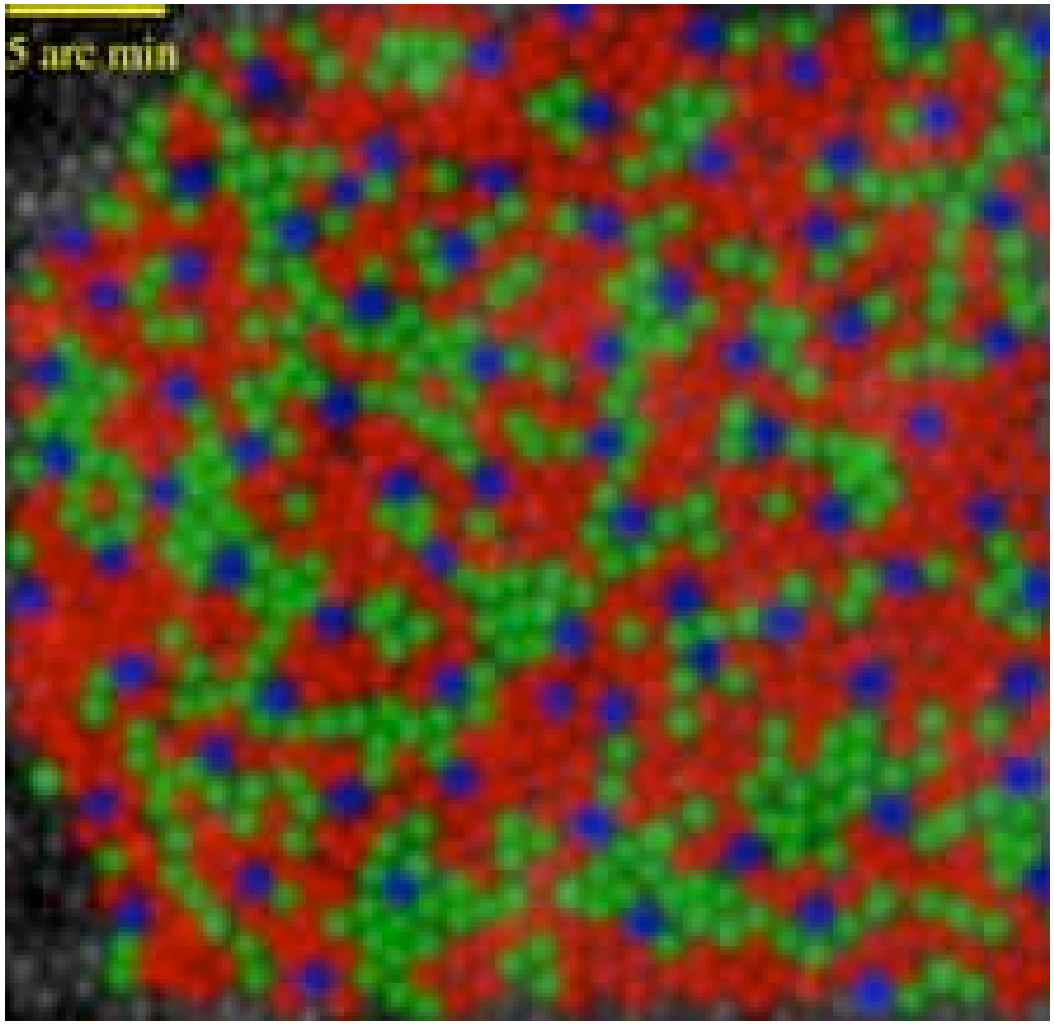
local rms contrast


17.5
cone catch (photon/s)
snow in sunlight
1
10
10^2
10^3
10^4
10^5
10^6
10^7
10^8
fraction of visual pigment
1
0.1
0.01
Stiles-Crawford effect
1
0.1
threshold
4.6
start of saturation
full saturation
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
10^3
rod catch (photon/s)
10^{-6}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
10^3
10^4
10^6
retinal illuminance (td)
100
10
1
pupil area (mm^2)
10^{-6}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
10^3
10^4
10^5
10^6
threshold
snow in sunlight
luminance (cd/m^2)

Human cone sensitivities

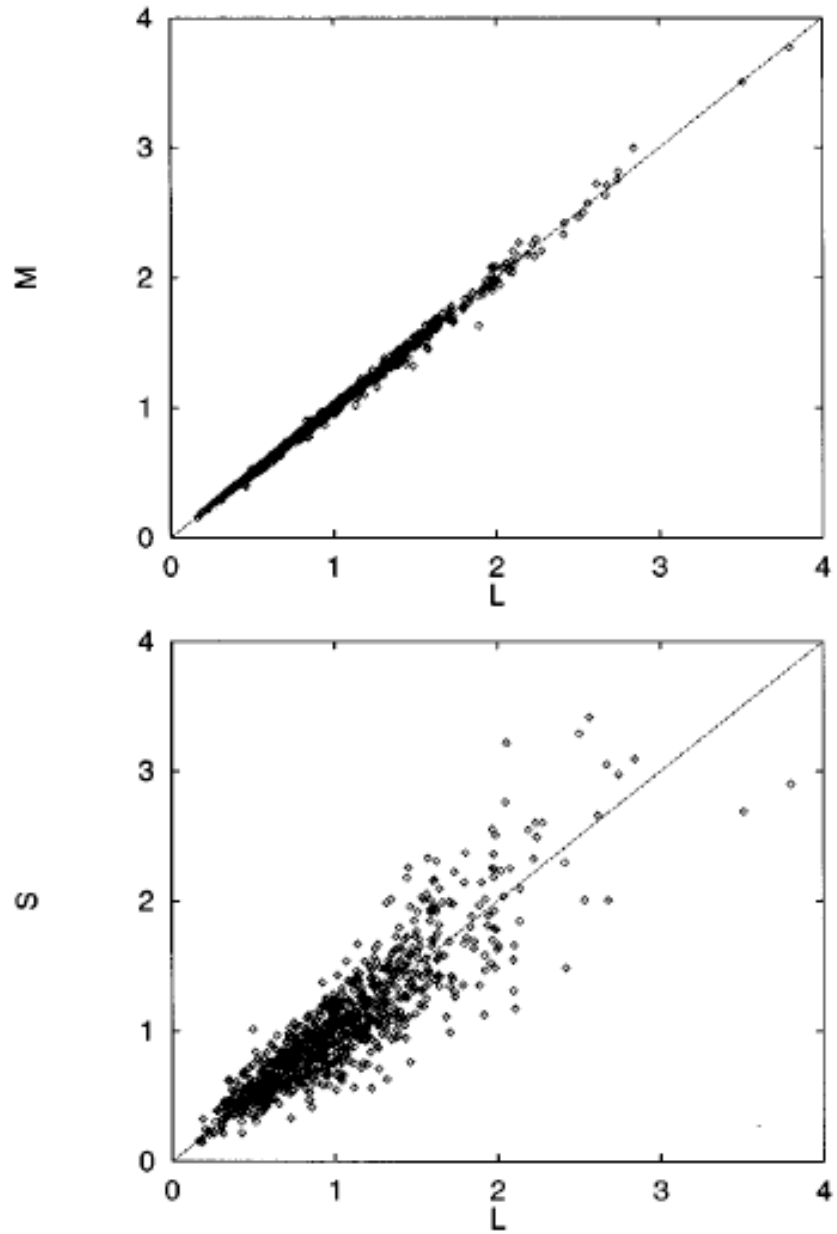


Human cone mosaic
(Roorda & Williams)



Joint statistics of cone responses

(Ruderman et al. 1998)



PCA of cone responses

(Ruderman et al. 1998)

$$\hat{l} = \frac{1}{\sqrt{3}}(\hat{\mathcal{L}} + \hat{\mathcal{M}} + \hat{\mathcal{S}}),$$

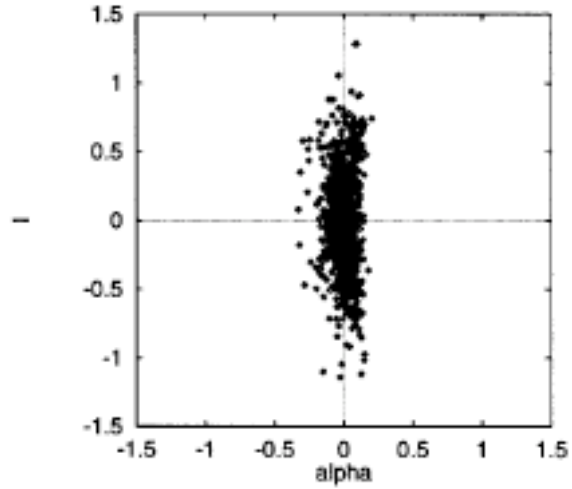
$$\hat{\alpha} = \frac{1}{\sqrt{6}}(\hat{\mathcal{L}} + \hat{\mathcal{M}} - 2\hat{\mathcal{S}}),$$

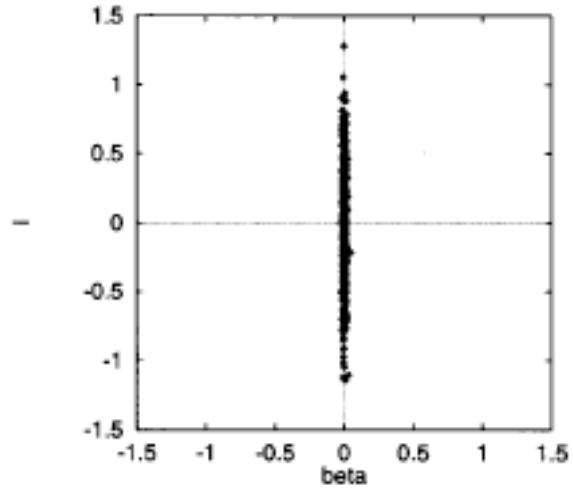
$$\hat{\beta} = \frac{1}{\sqrt{2}}(\hat{\mathcal{L}} - \hat{\mathcal{M}}),$$

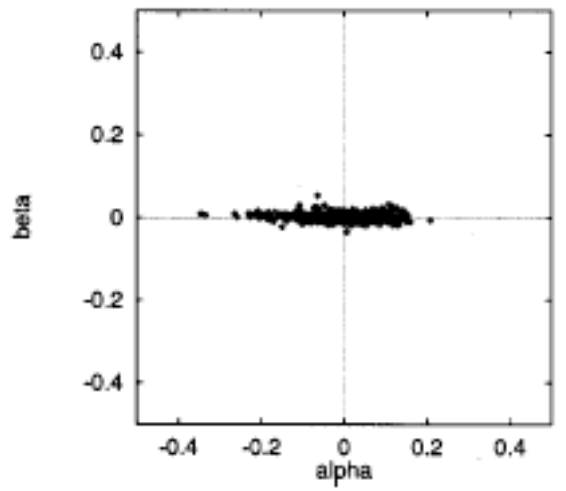
where $\mathcal{L} = \log L - \langle \log L \rangle,$

$\mathcal{M} = \log M - \langle \log M \rangle,$

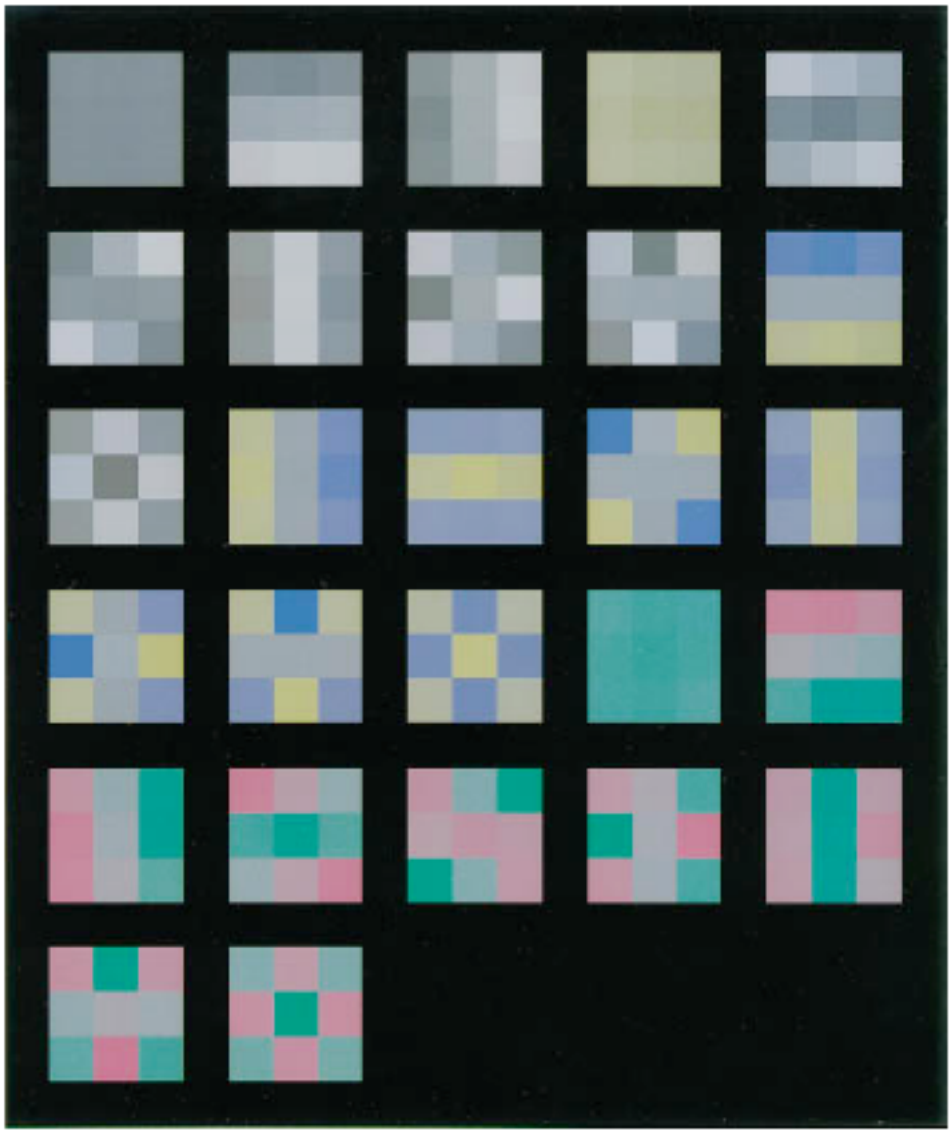
$\mathcal{S} = \log S - \langle \log S \rangle.$

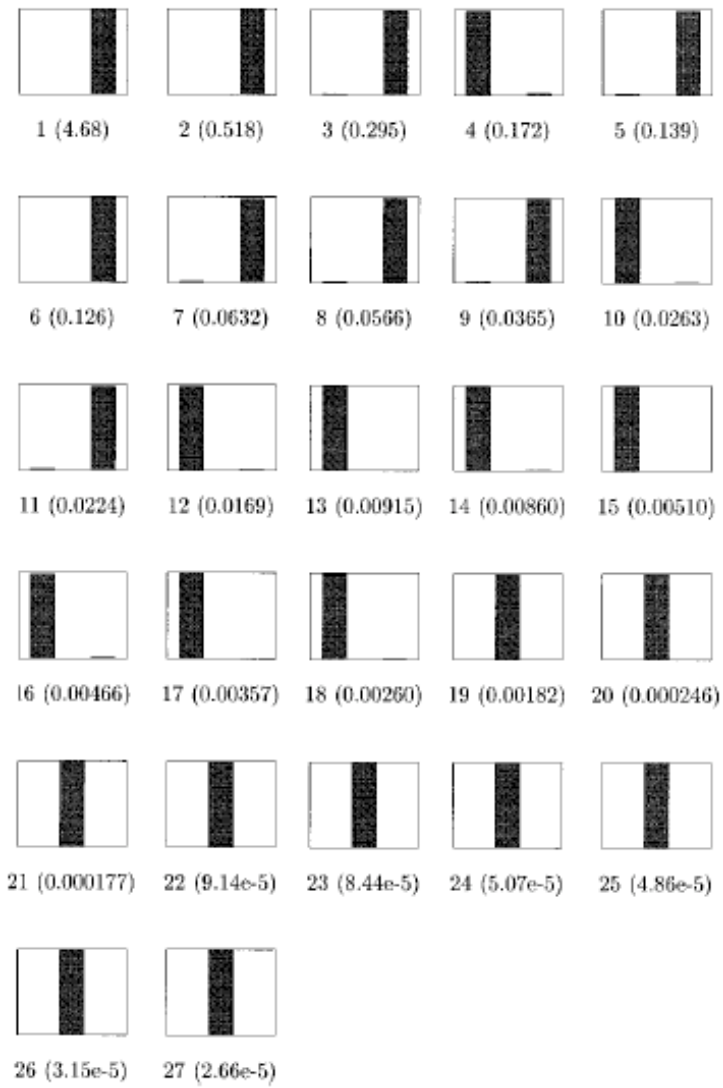






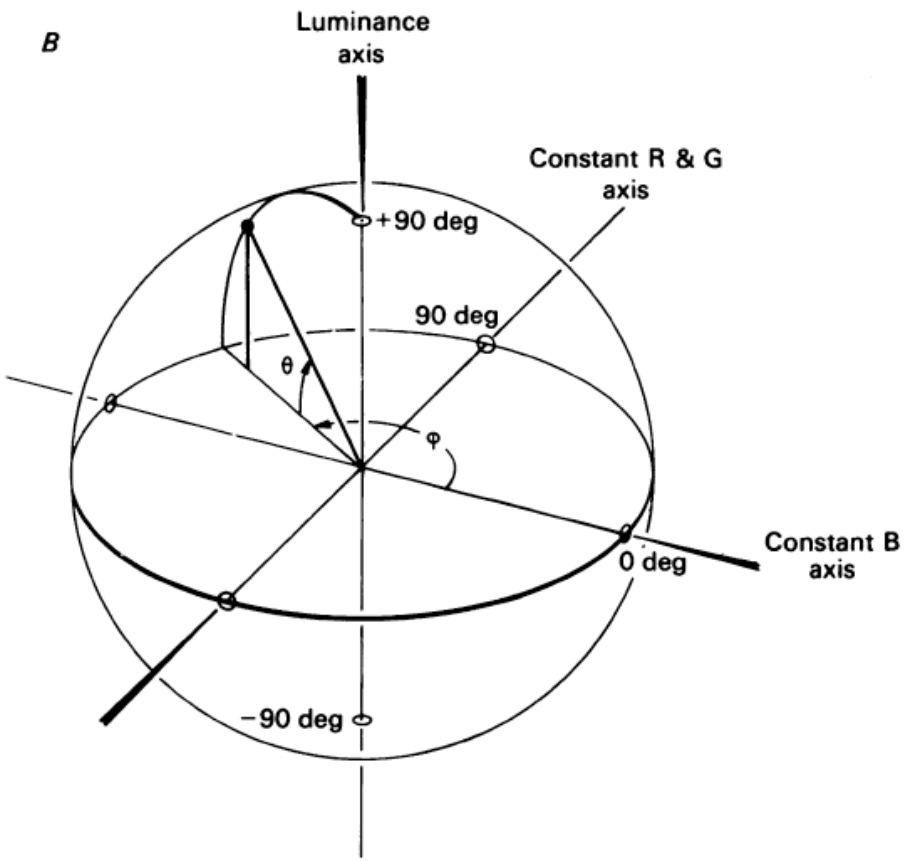
Spatio-chromatic PCA

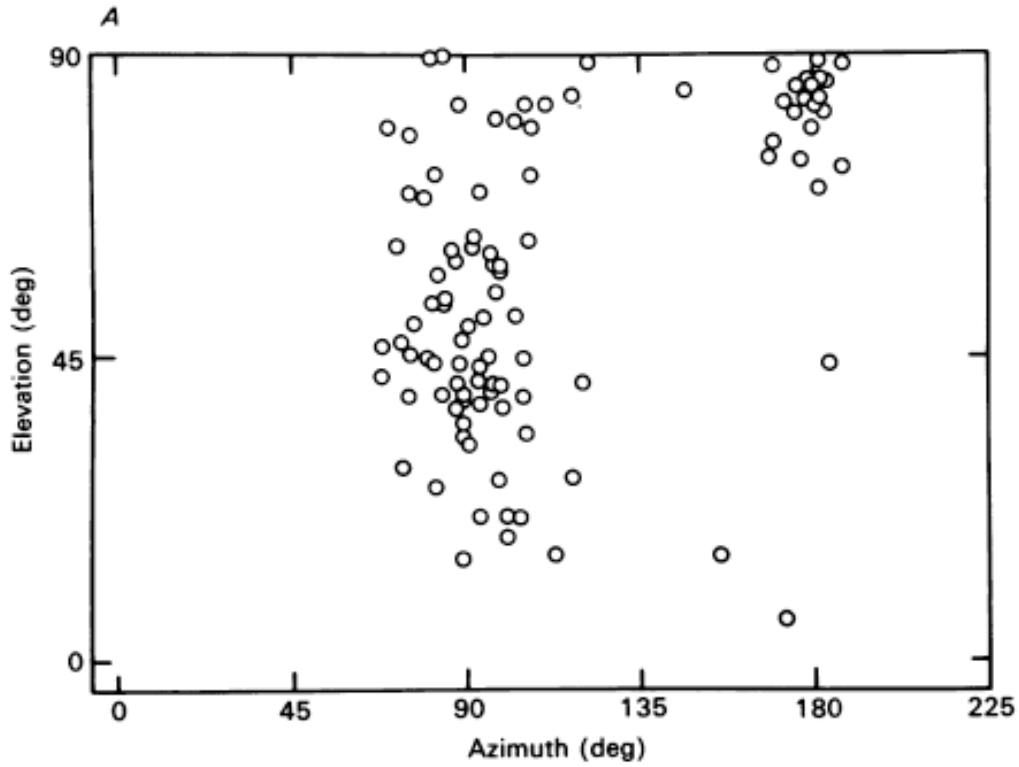


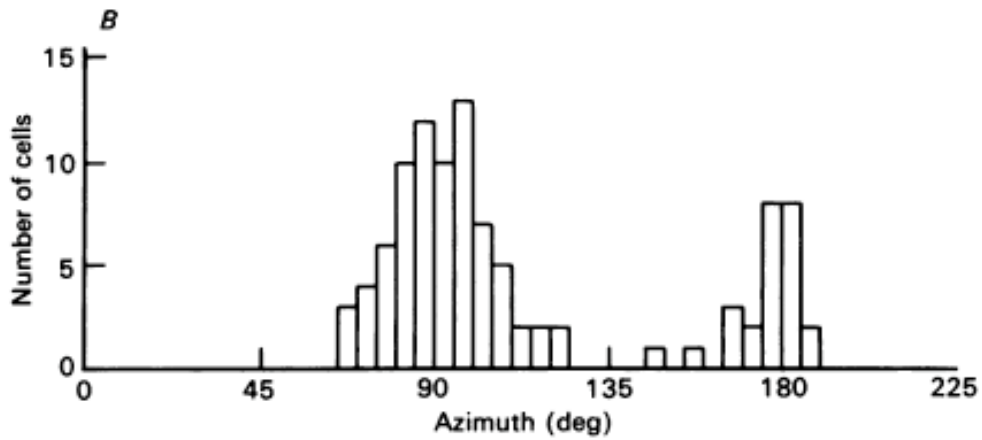


Color opponency in LGN

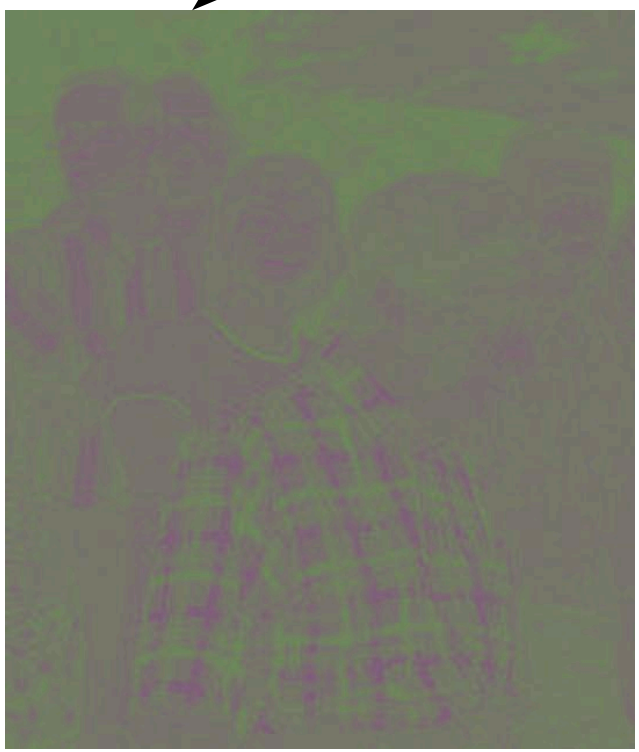
(Derrington, Krauskopf & Lennie, 1984)

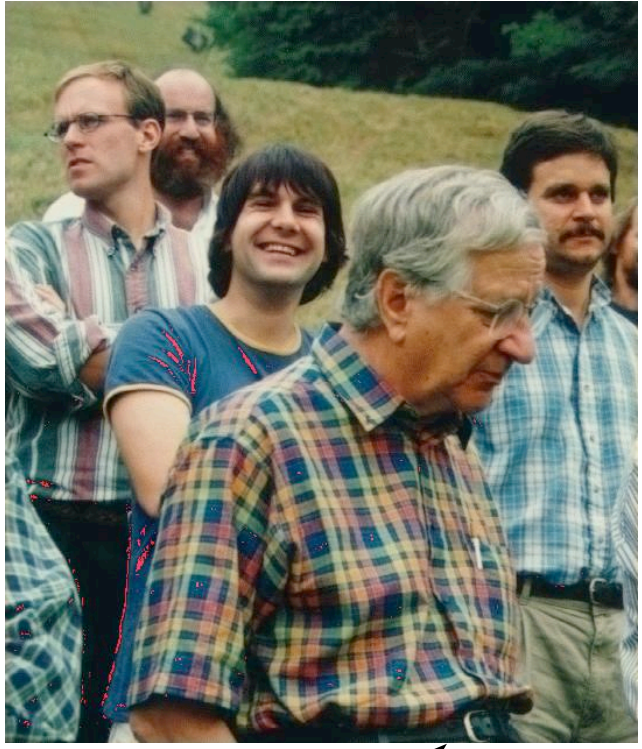




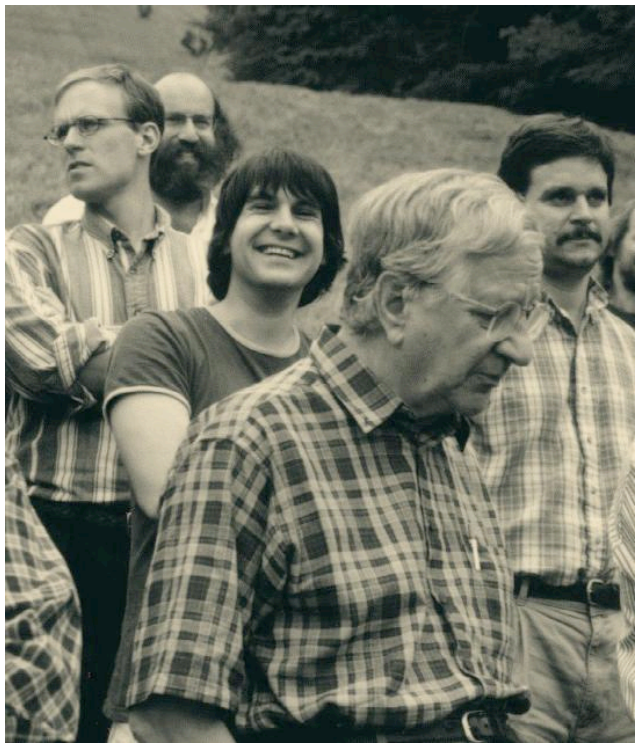


Decomposition into luminance and color-opponent channels





Reconstruction from blurred color-opponent channels



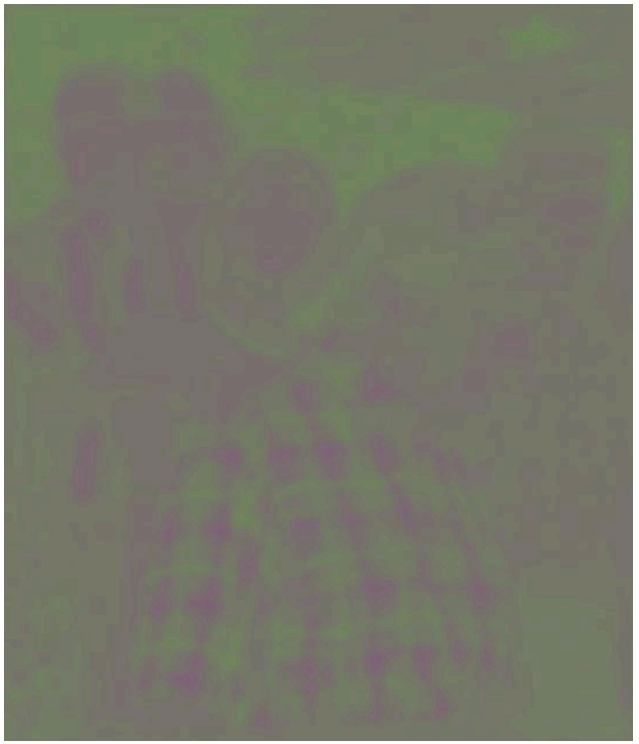
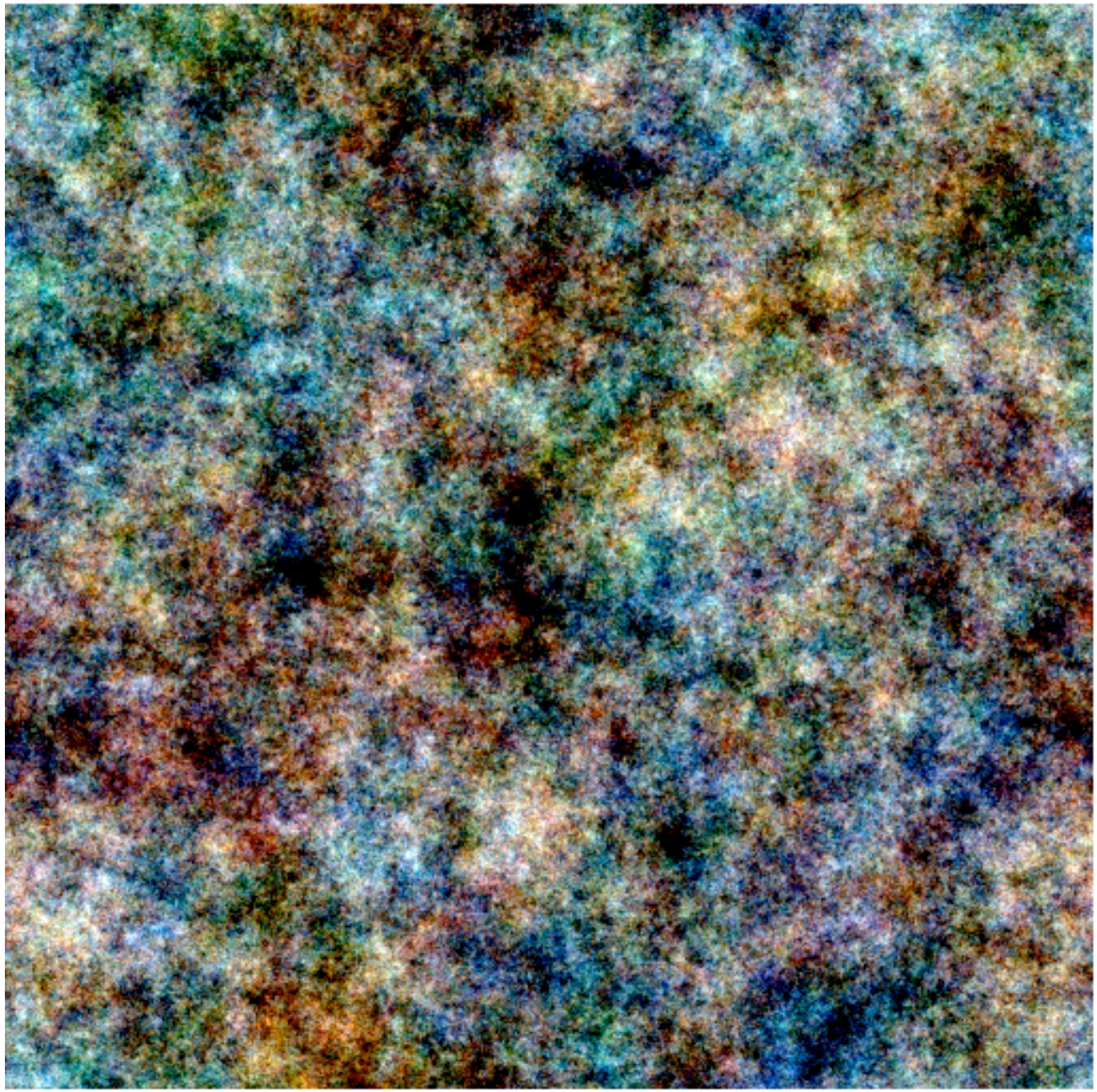
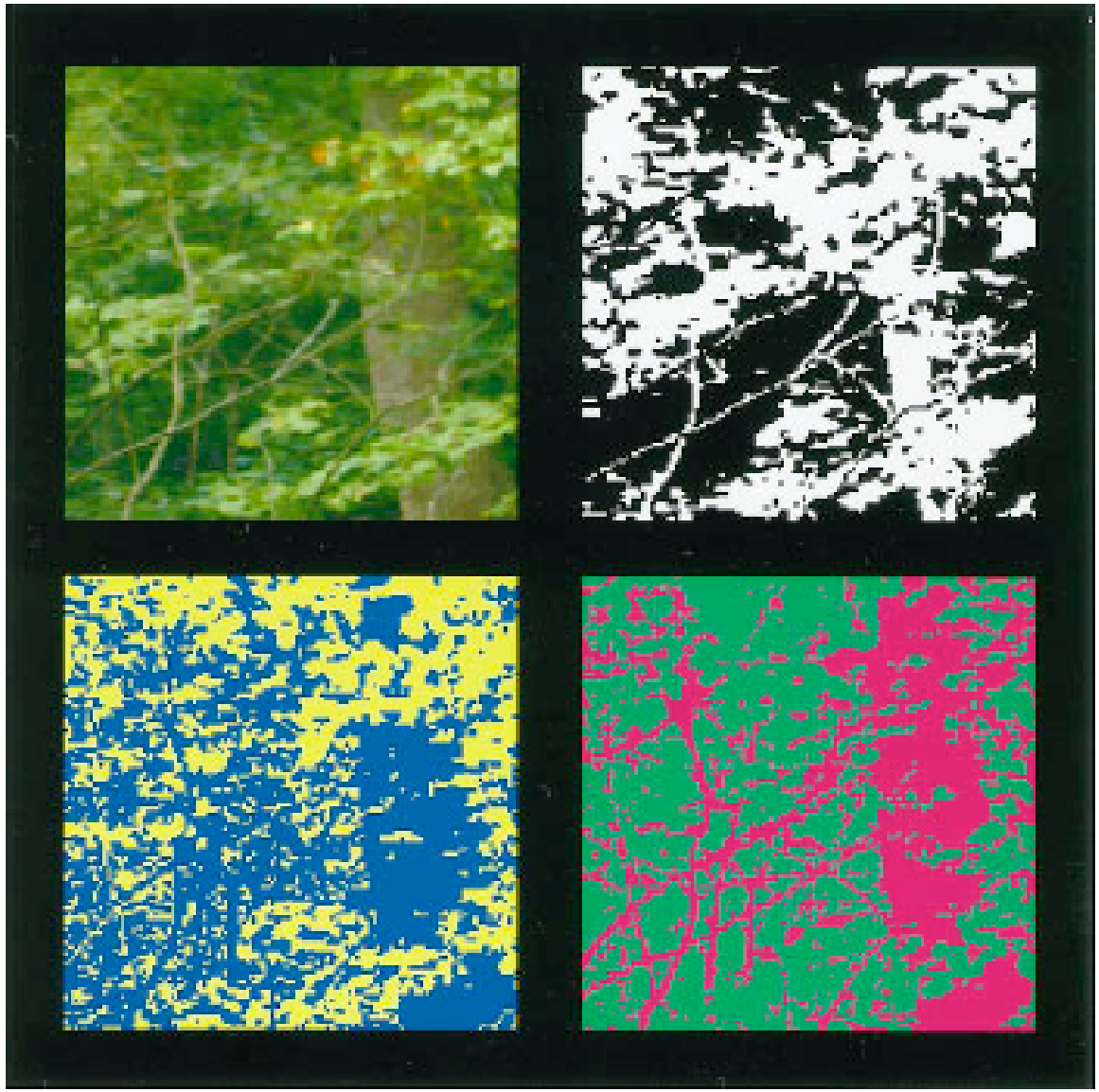


Image synthesis

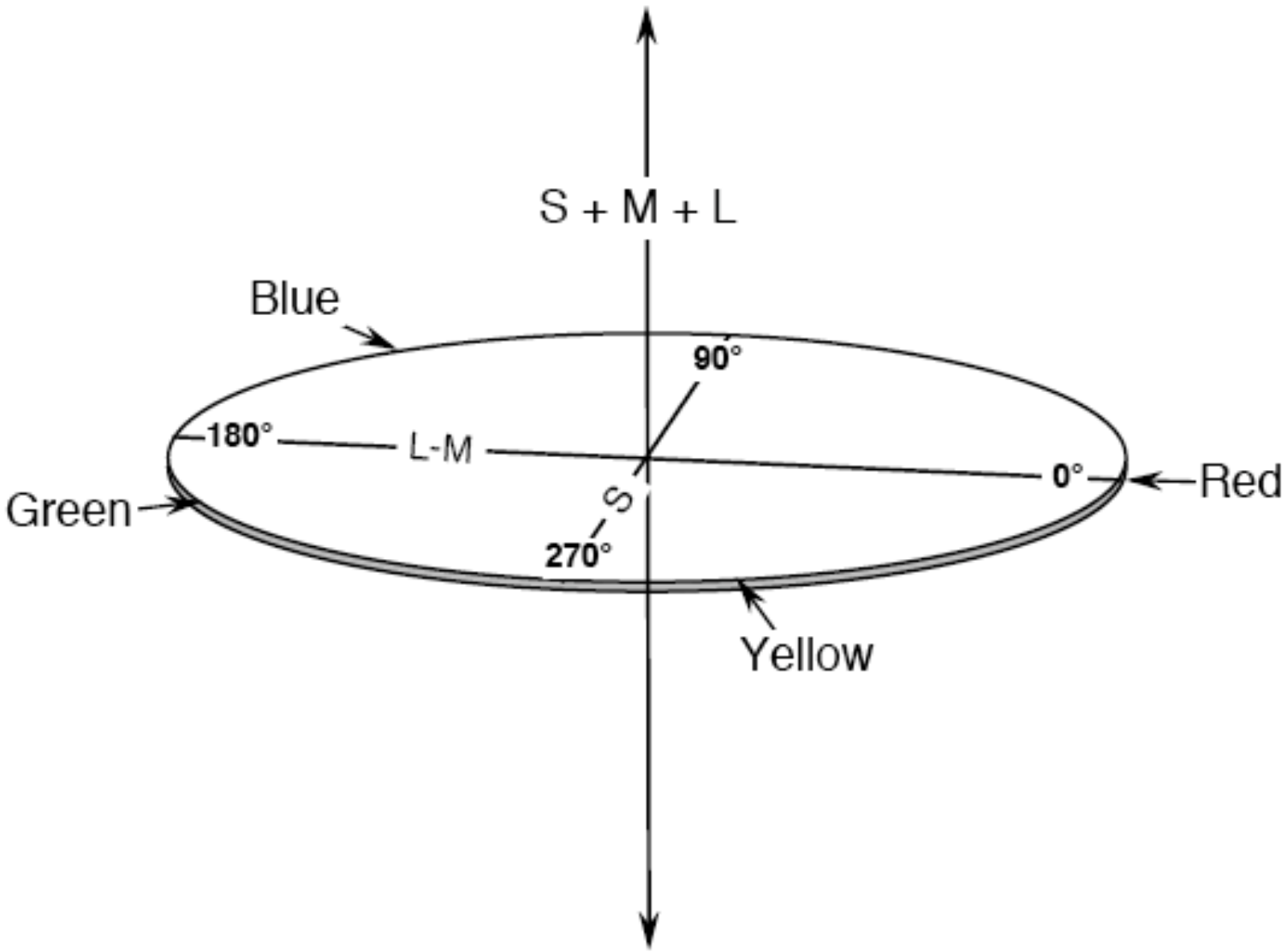


Color edges co-occur with luminance edges



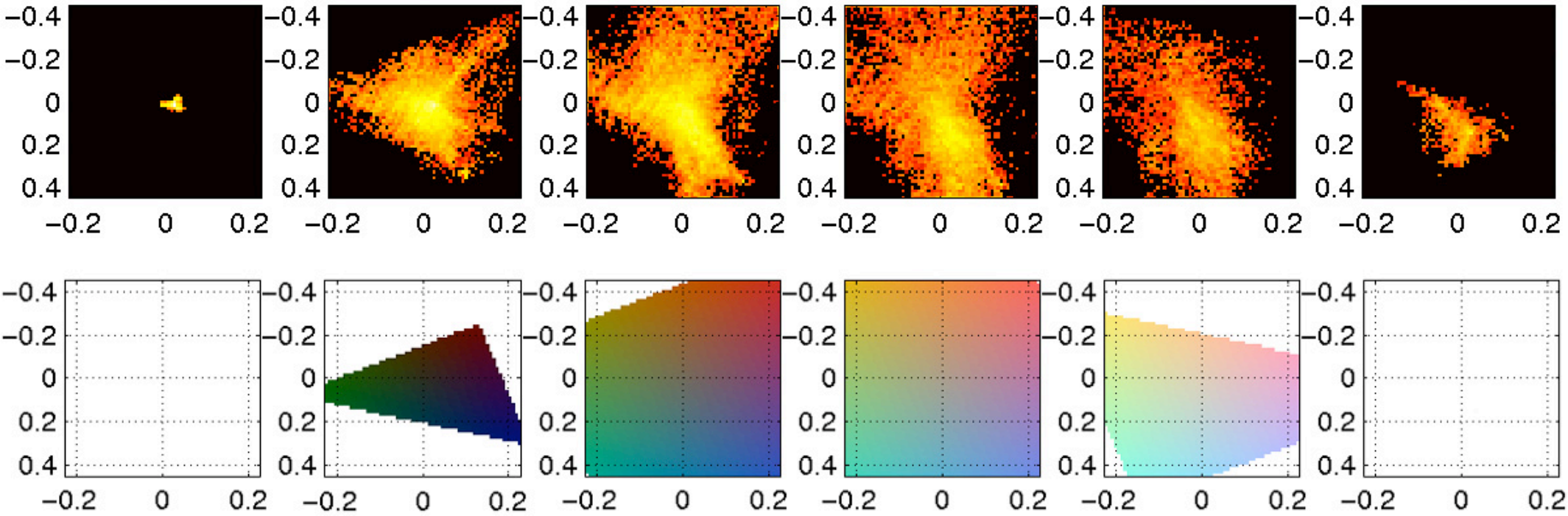
Ruderman et al. (1998)

‘Unitary hues’



Distribution of r,g,b values in Corel natural images suggests basic color categories may exist in data

distribution



colorspace