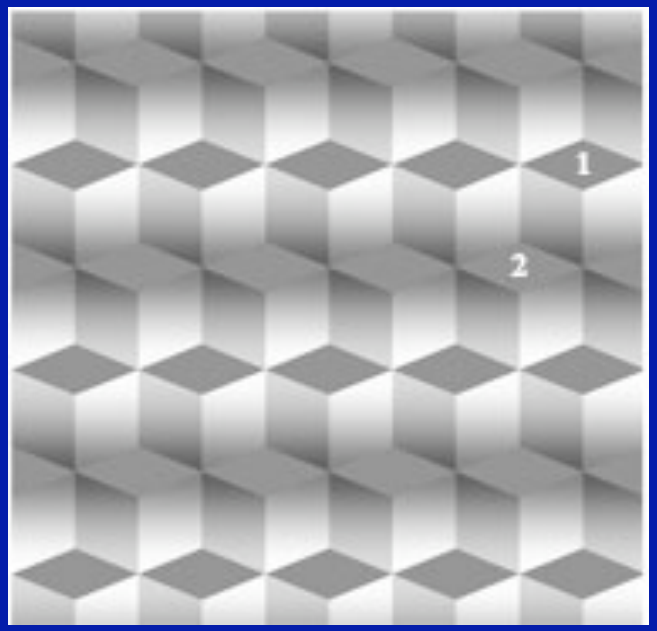
Brightness & Contrast

Definitions:



1 & 2?

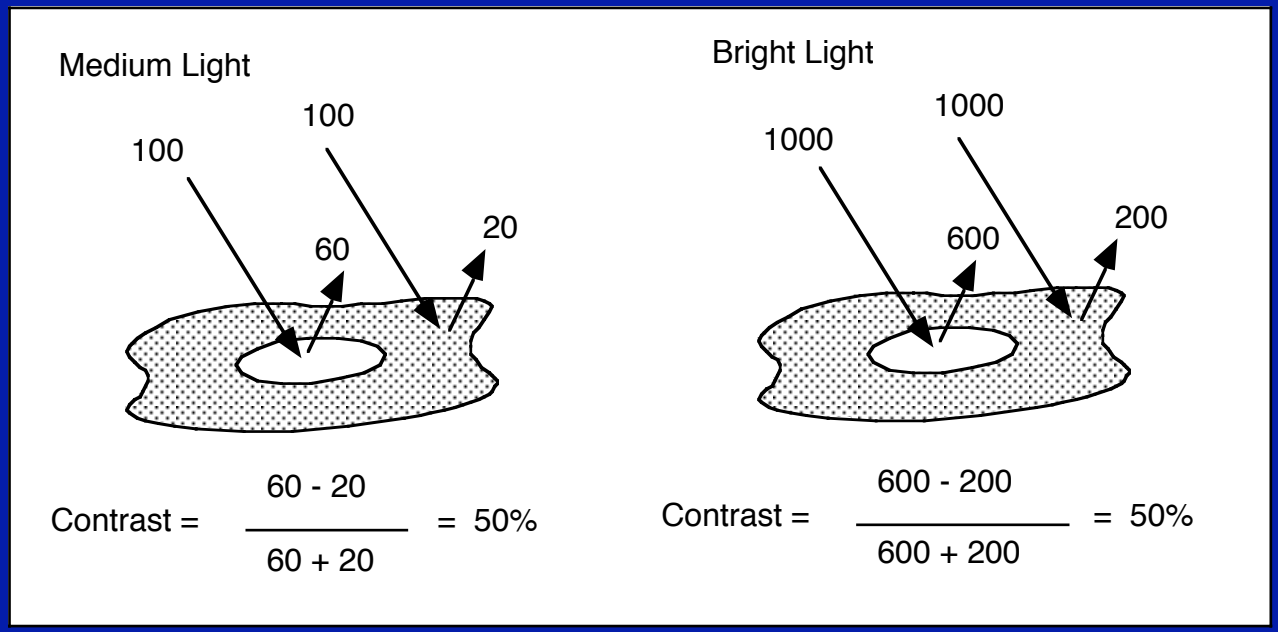
Intensity
Brightness
- illumination
- reflectance
Lightness
Contrast

Physical contrast =

$$\frac{\text{Difference in intensity of the 2 areas}}{\text{Sum of intensity of the 2 areas}}$$

$$\frac{I_1 - I_2}{I_1 + I_2}$$

Contrast is independent of light level

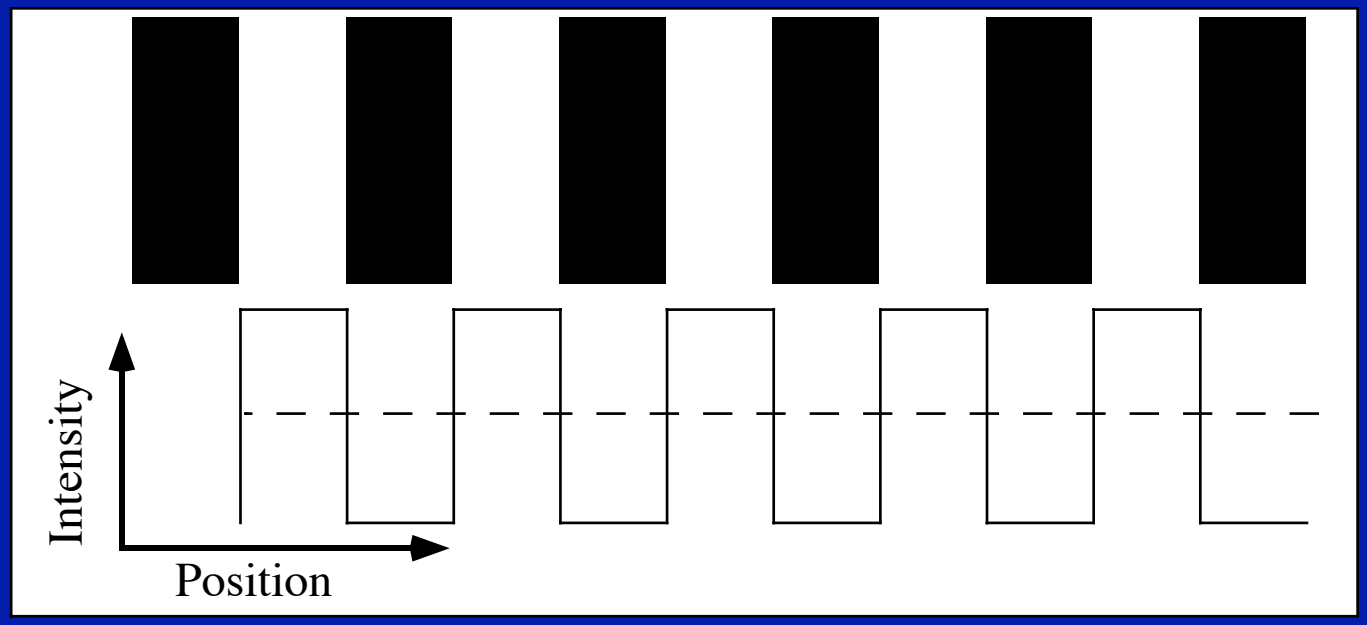


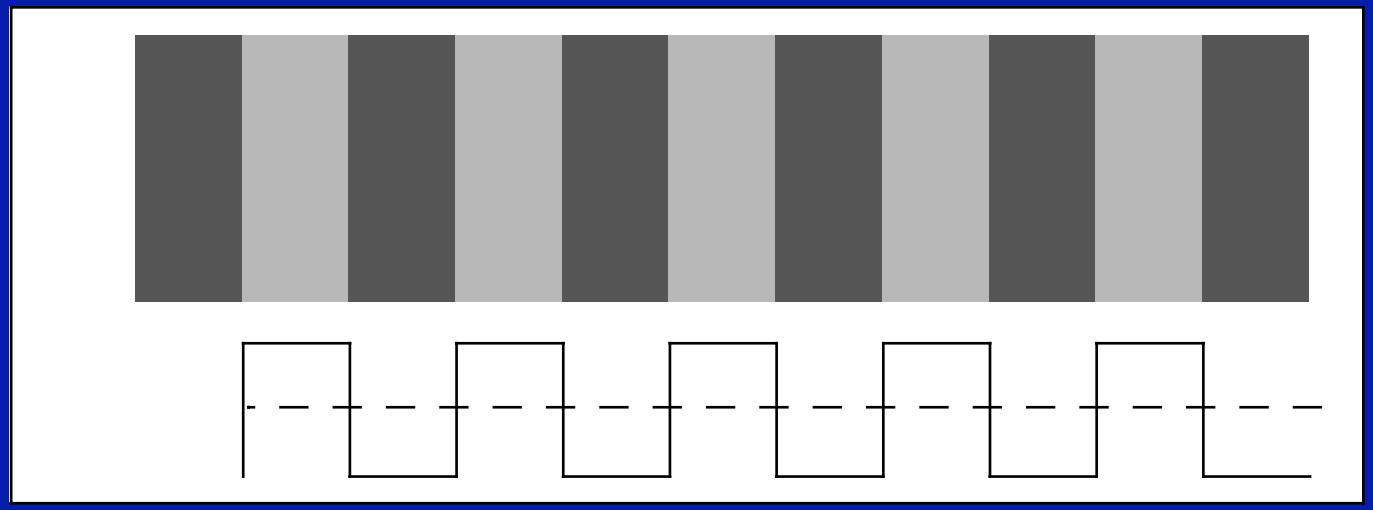
Spatial frequency vs. perception of contrast:

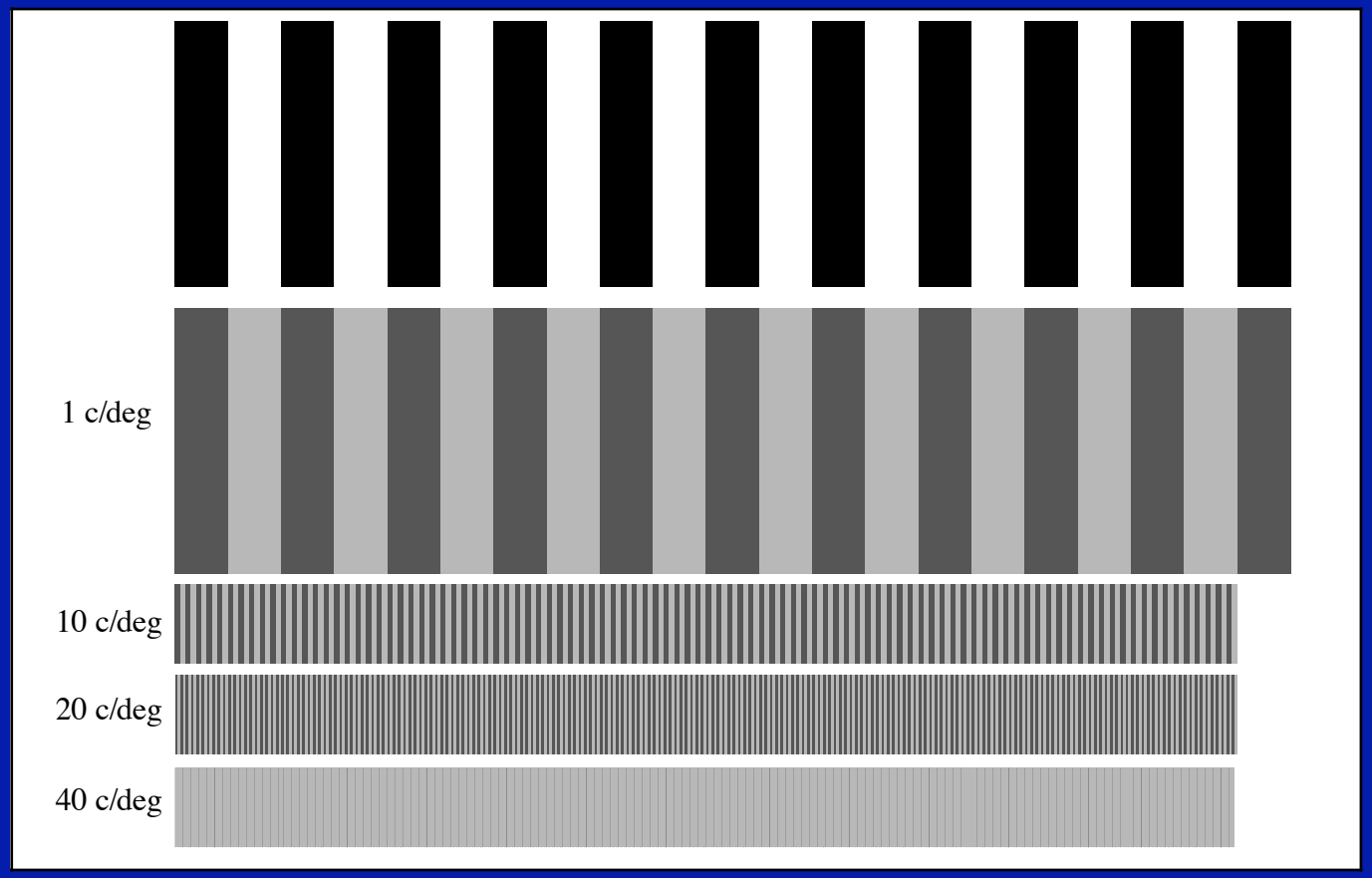
Contrast Sensitivity function

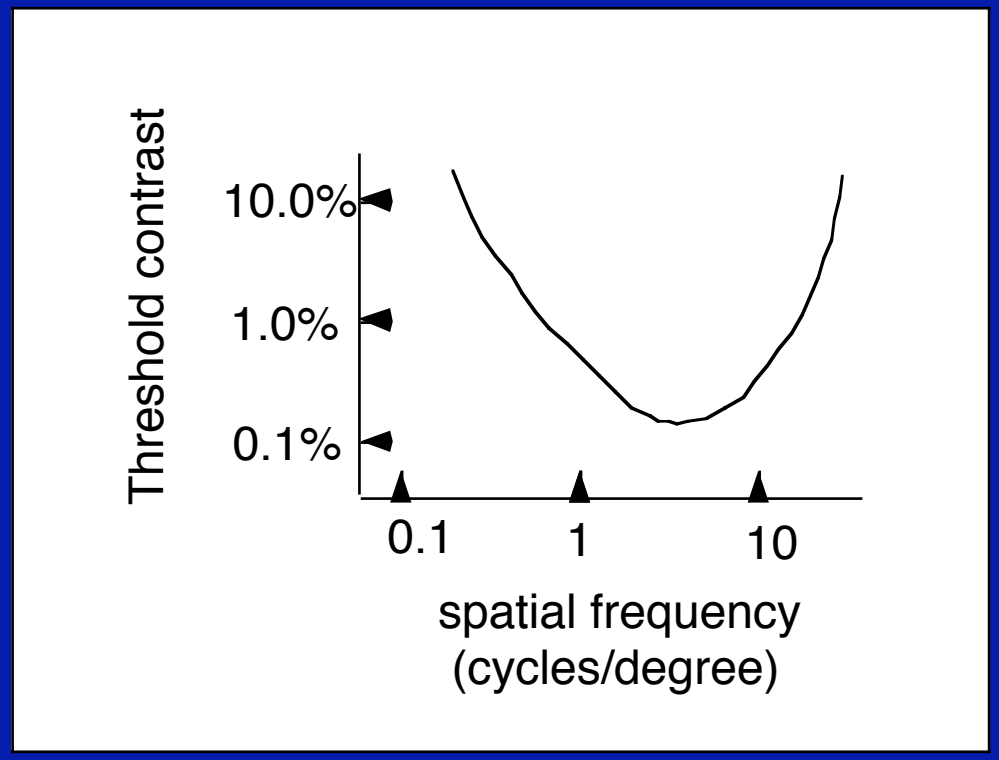
Experiment:

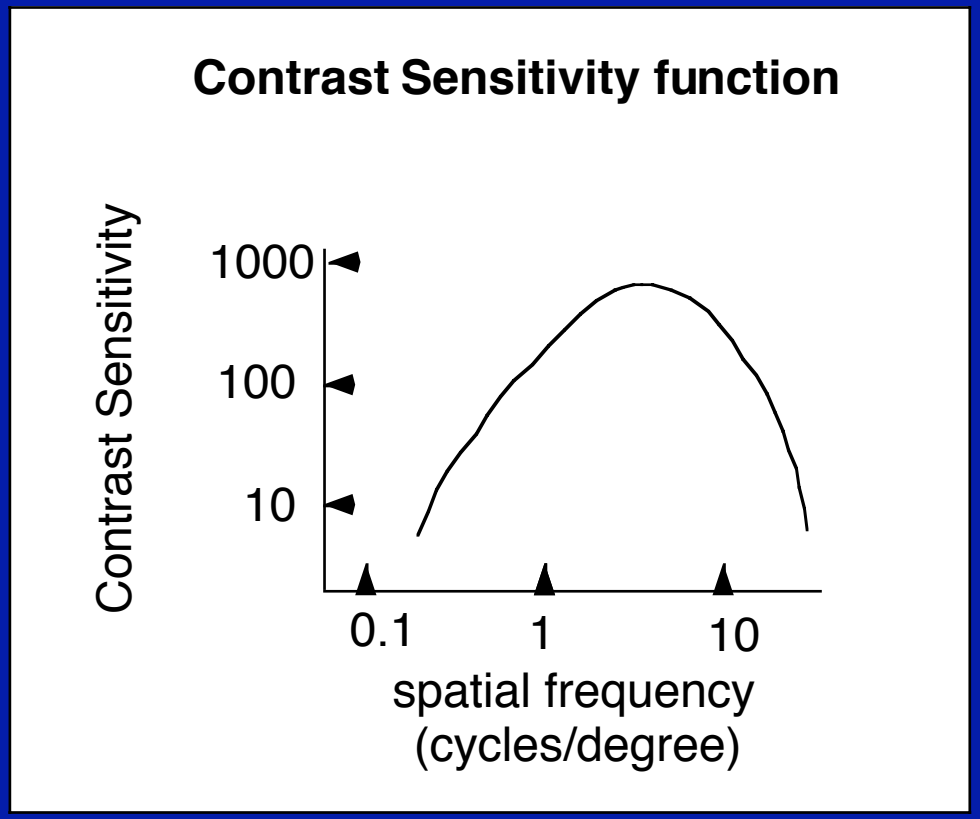
Blakemore and Campbell


Intensity
Position

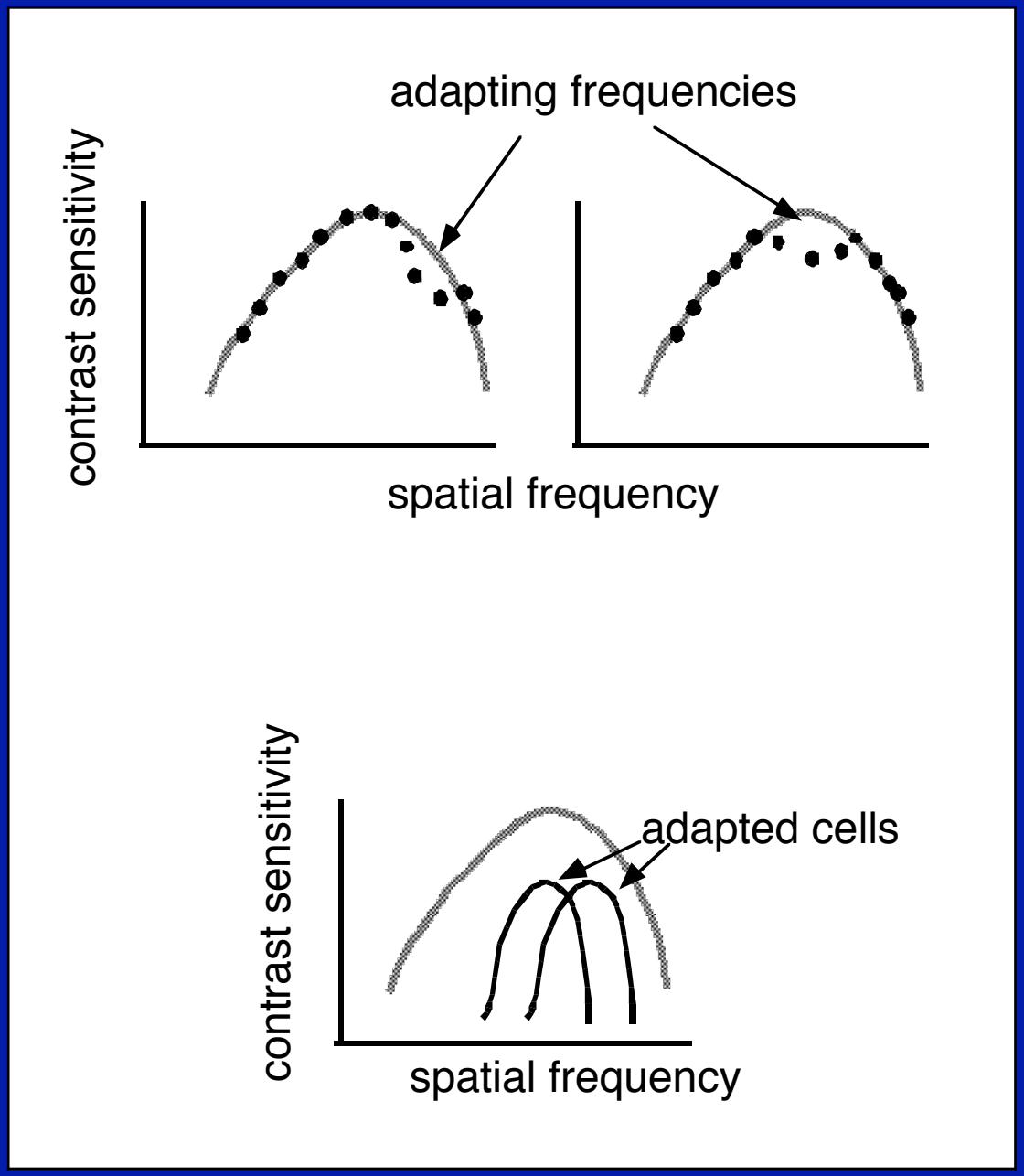


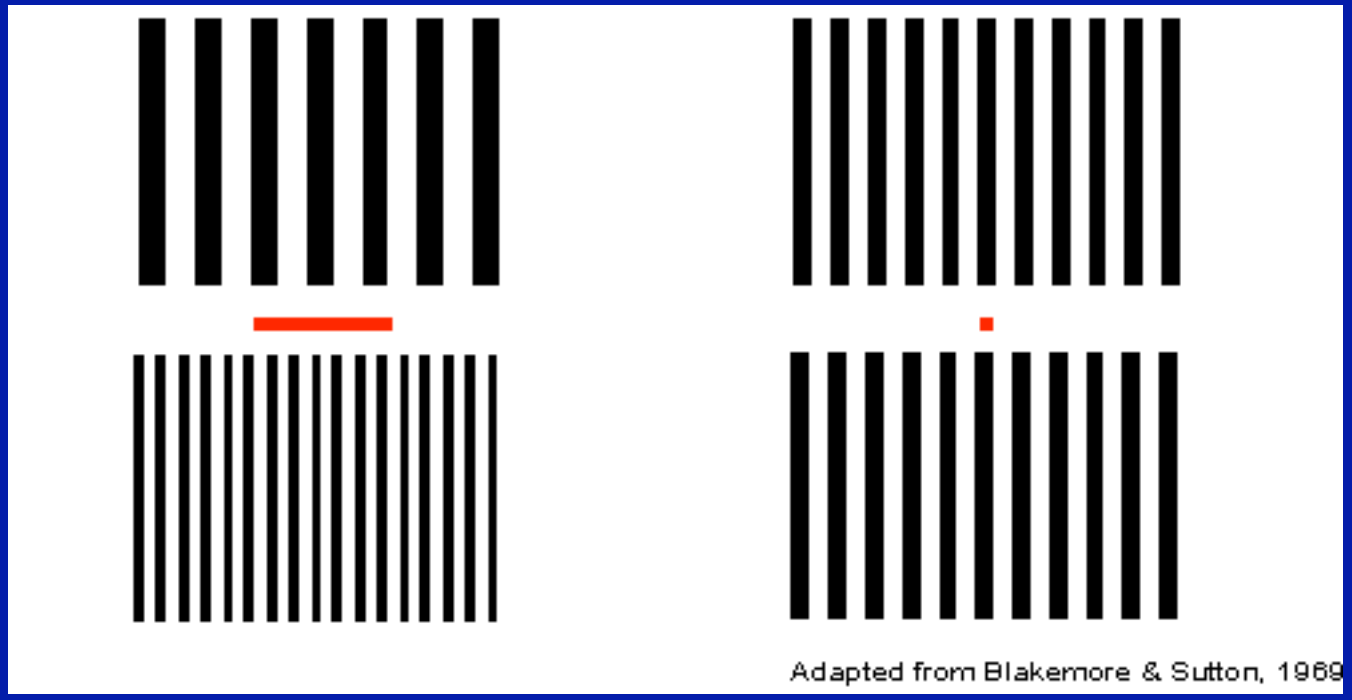

1 c/deg
10 c/deg
20 c/deg
40 c/deg

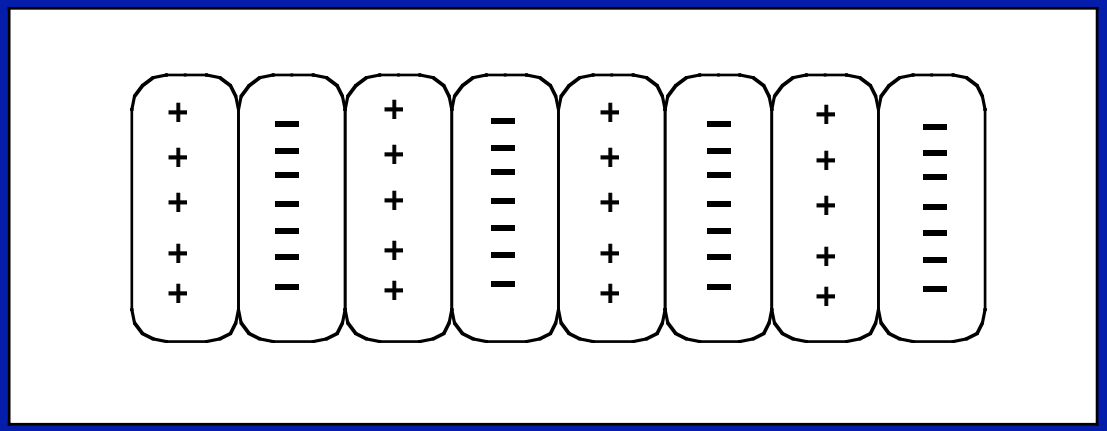

Threshold contrast
10.0%
1.0%
0.1%
0.1
1
10
spatial frequency
(cycles/degree)

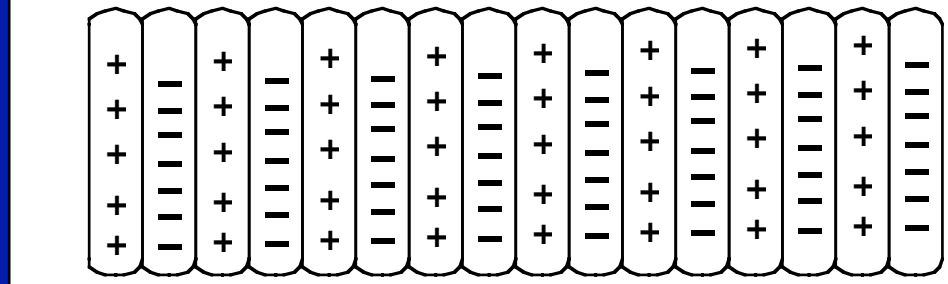

Contrast Sensitivity function
Contrast Sensitivity
1000
100
10
0.1
1
10
spatial frequency
(cycles/degree)

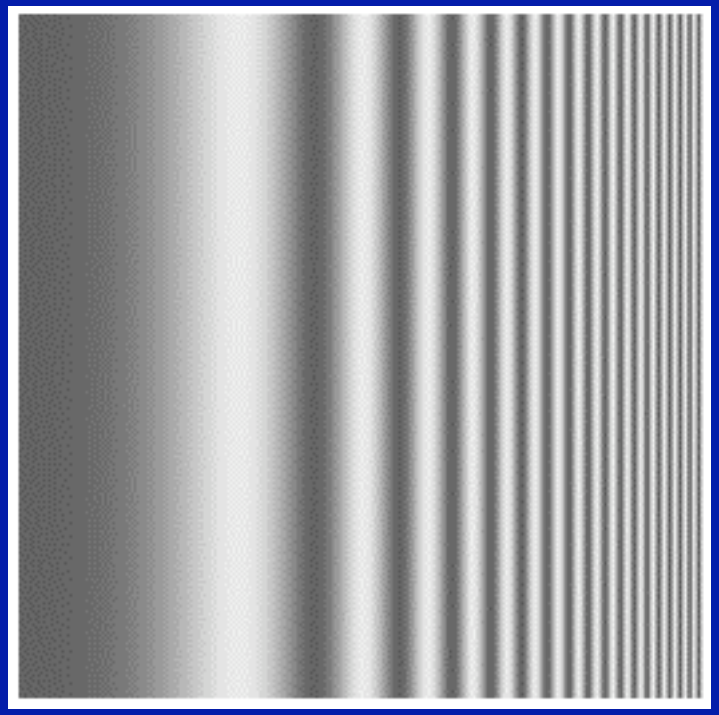
Campbell & Blakemore experiment

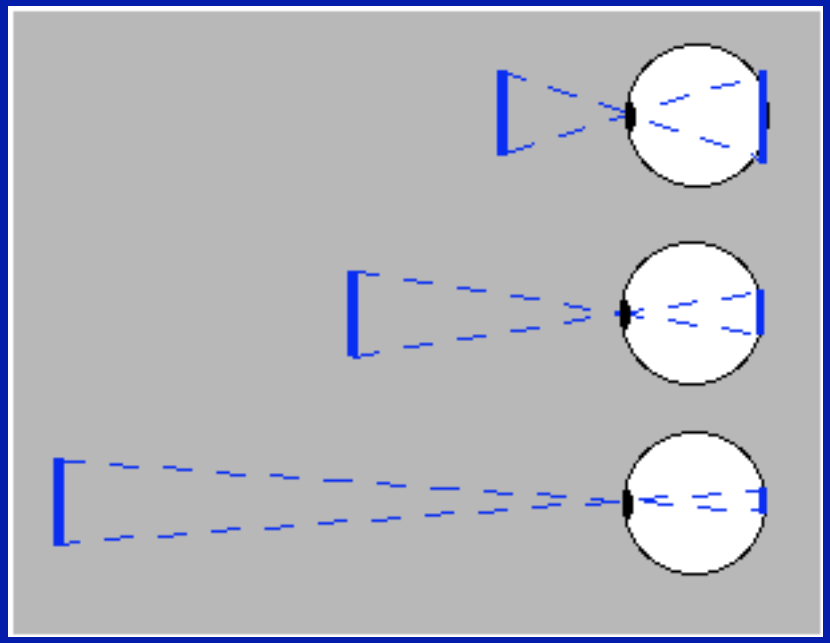



Adapted from Blakemore & Sutton, 1969







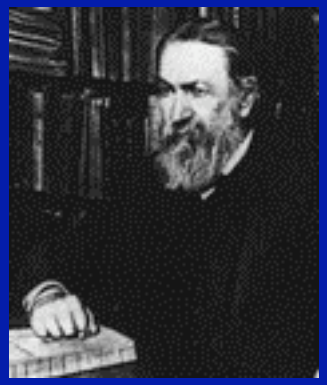


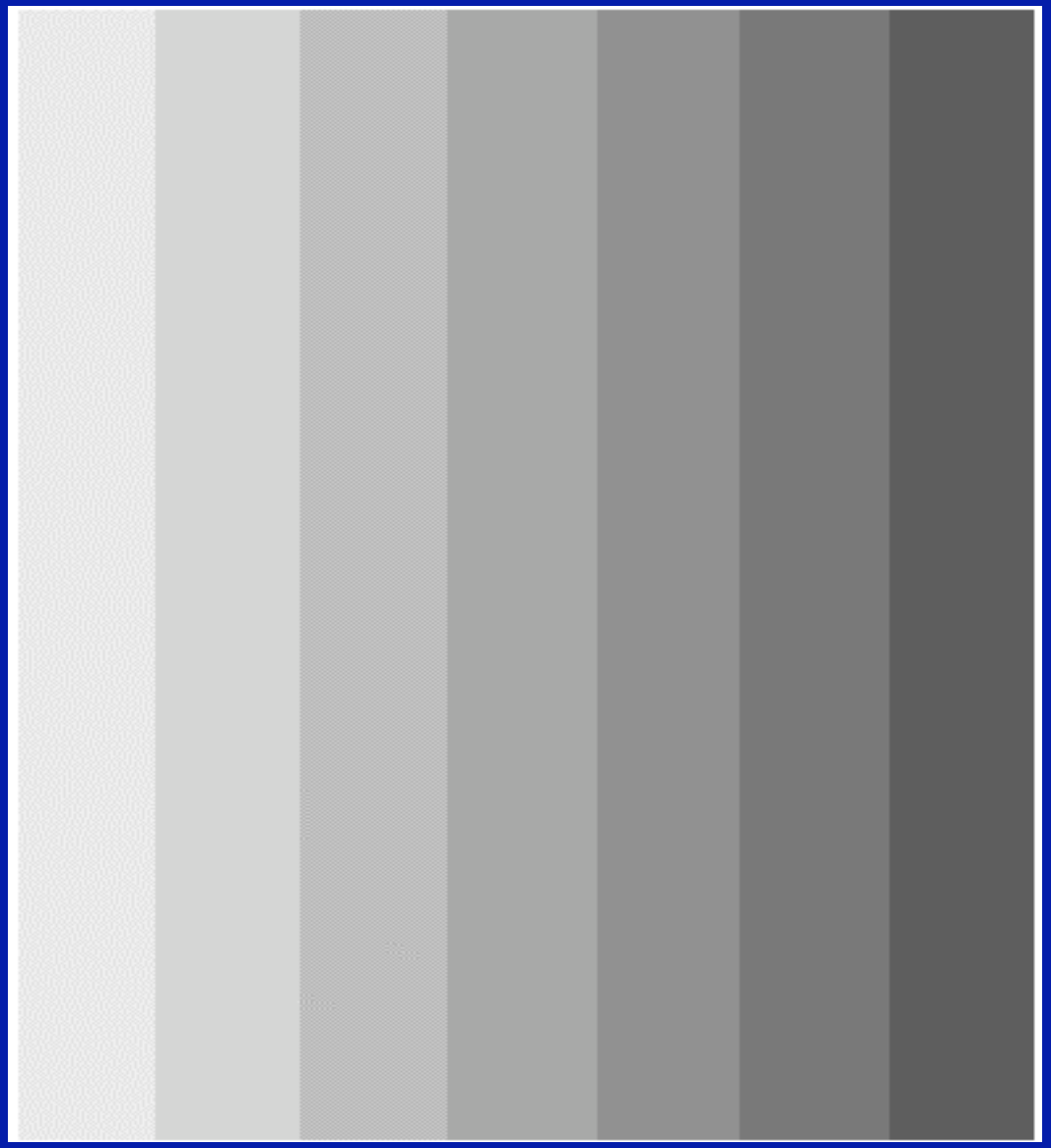
The size of the proximal image is inversely proportional to the square of the viewing distance. In other words, when we increase the viewing distance by a factor of 2, we decrease the size of the image on the retina by a factor of 4.

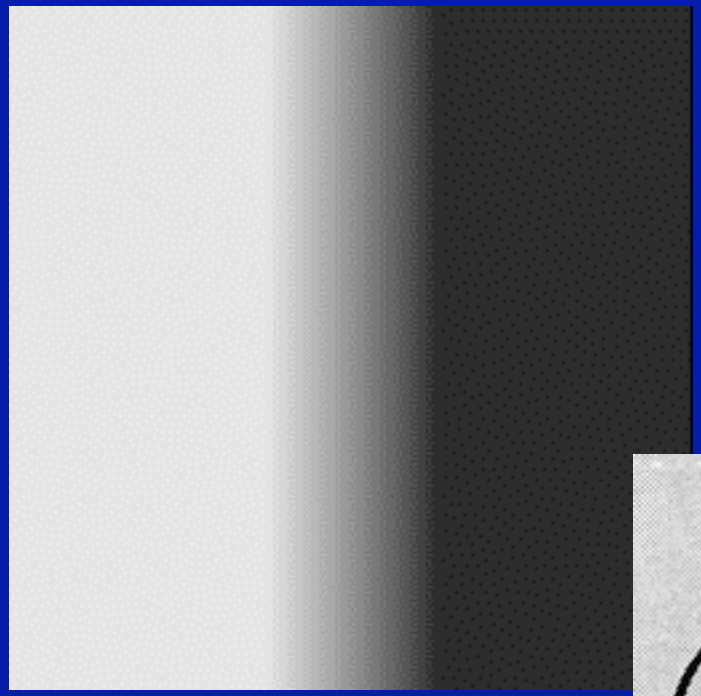
Physiology (brain activity):

Mach Band
Simultaneous contrast
Hermman Grid
The Craik-O'Brien-Cornsweet illusion

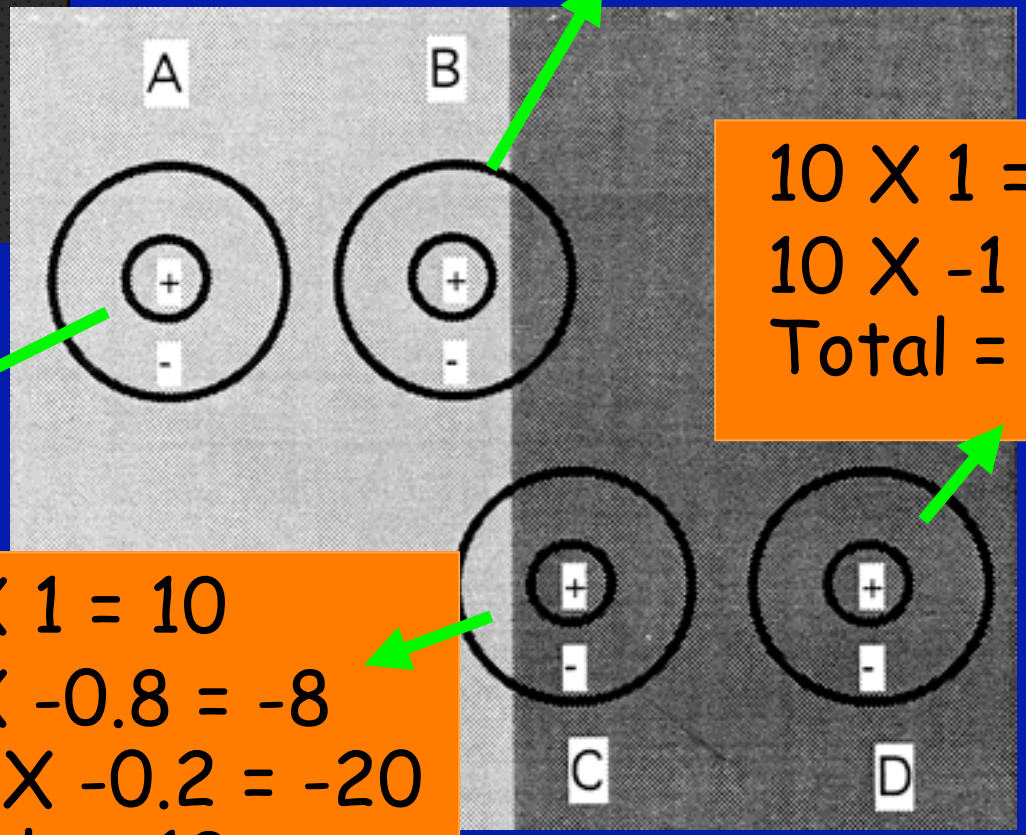
Mach Bands







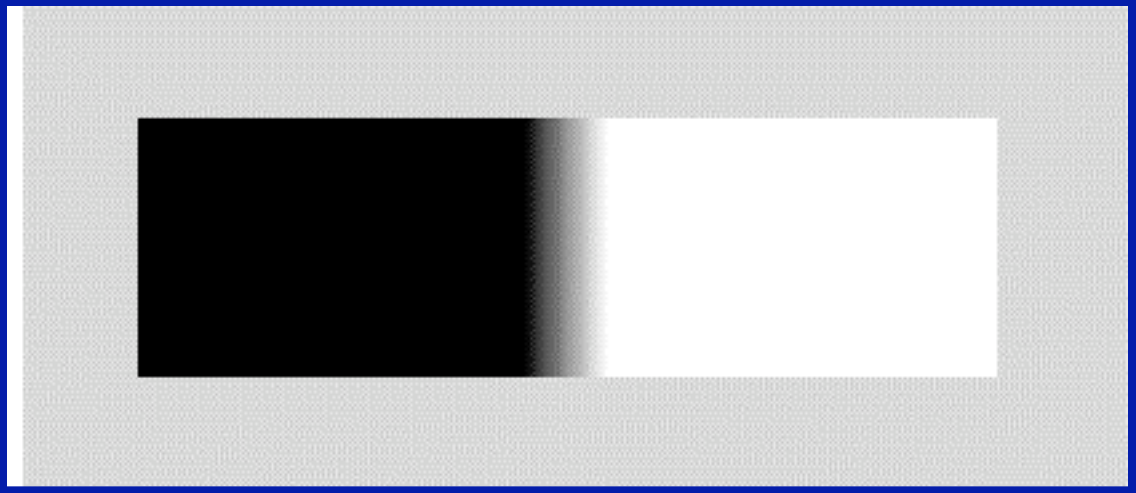
100 X 1 = 100
100 X -0.8 = -80
10 X -0.2 = -2
Total = 18

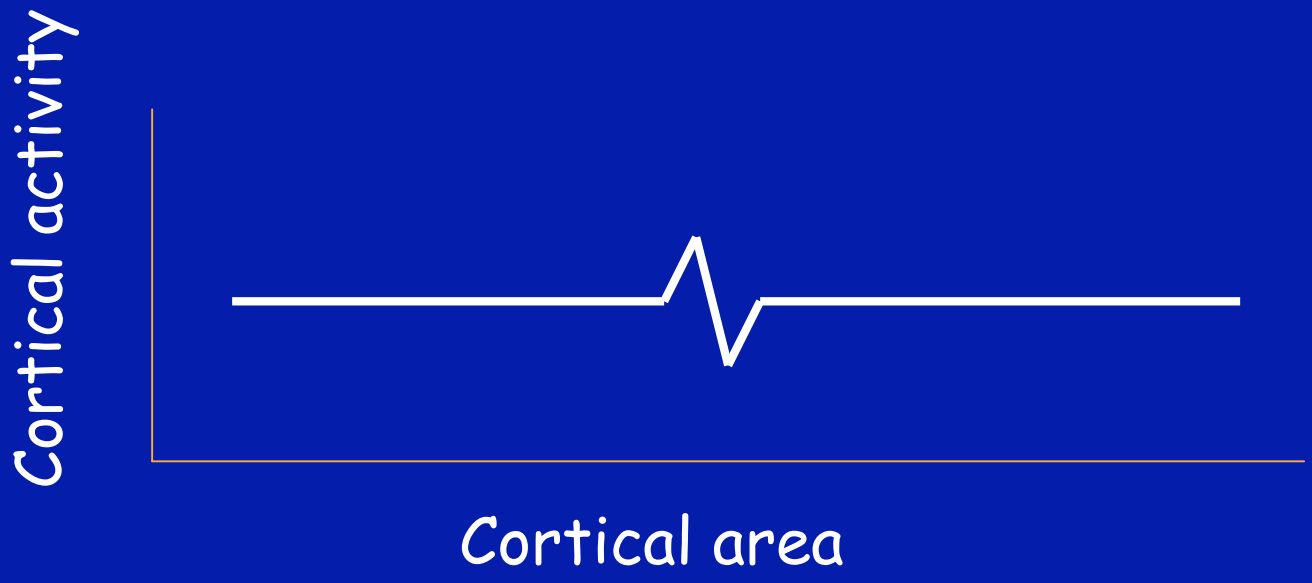


10 X 1 = 10
10 X -1 = -10
Total = 0

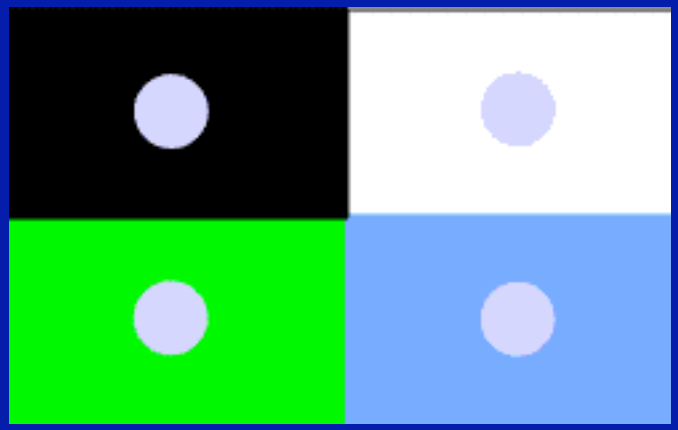
100 X 1 = 100
100 X -1 = -100
Total = 0

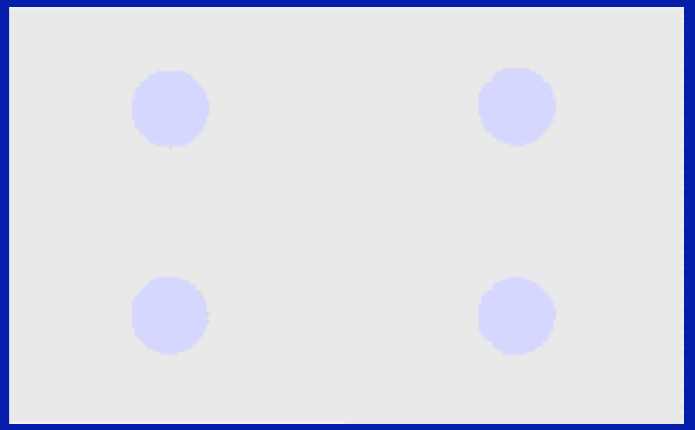
10 X 1 = 10
10 X -0.8 = -8
100 X -0.2 = -20
Total = -18



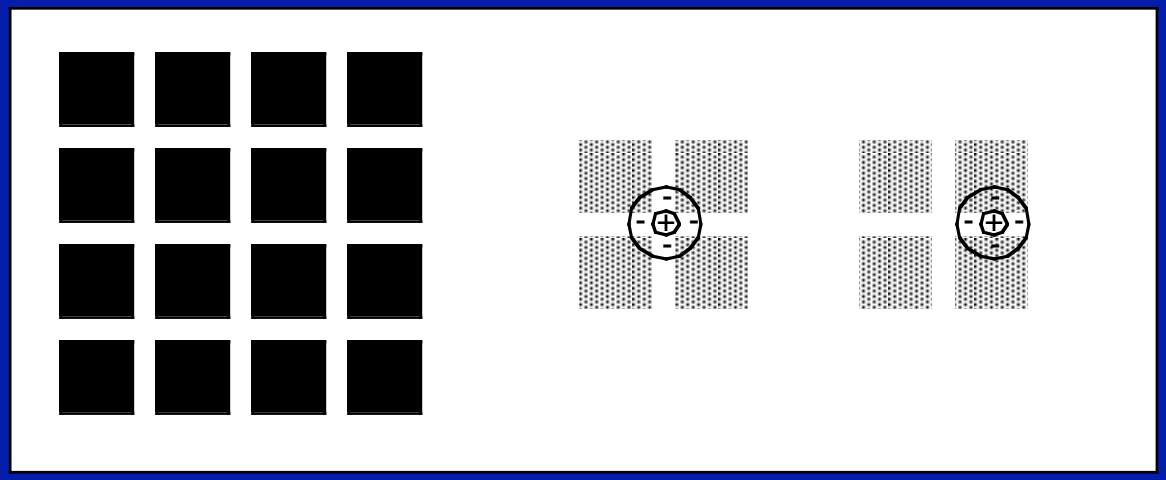

Cortical activity
Cortical area

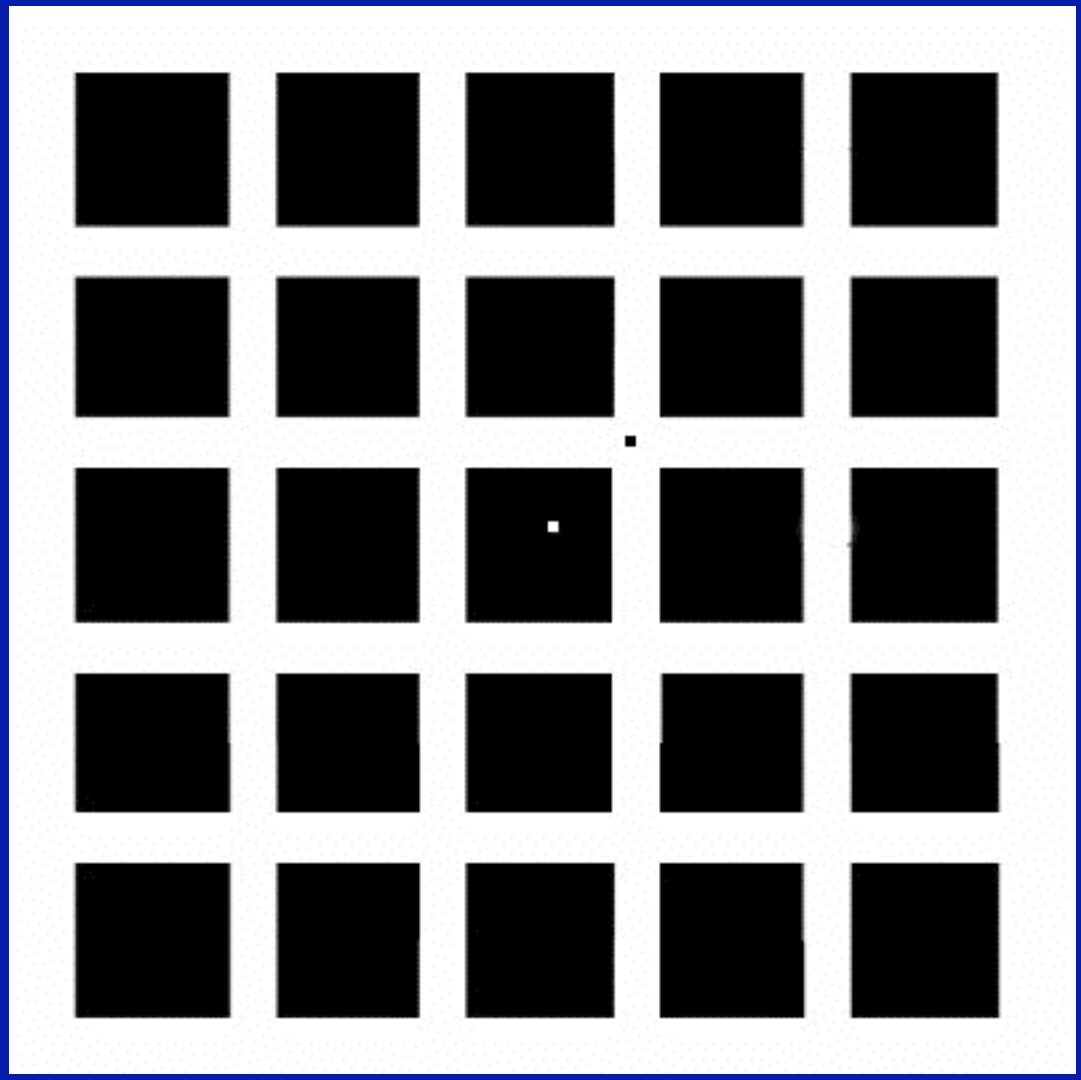
Simultaneous contrast



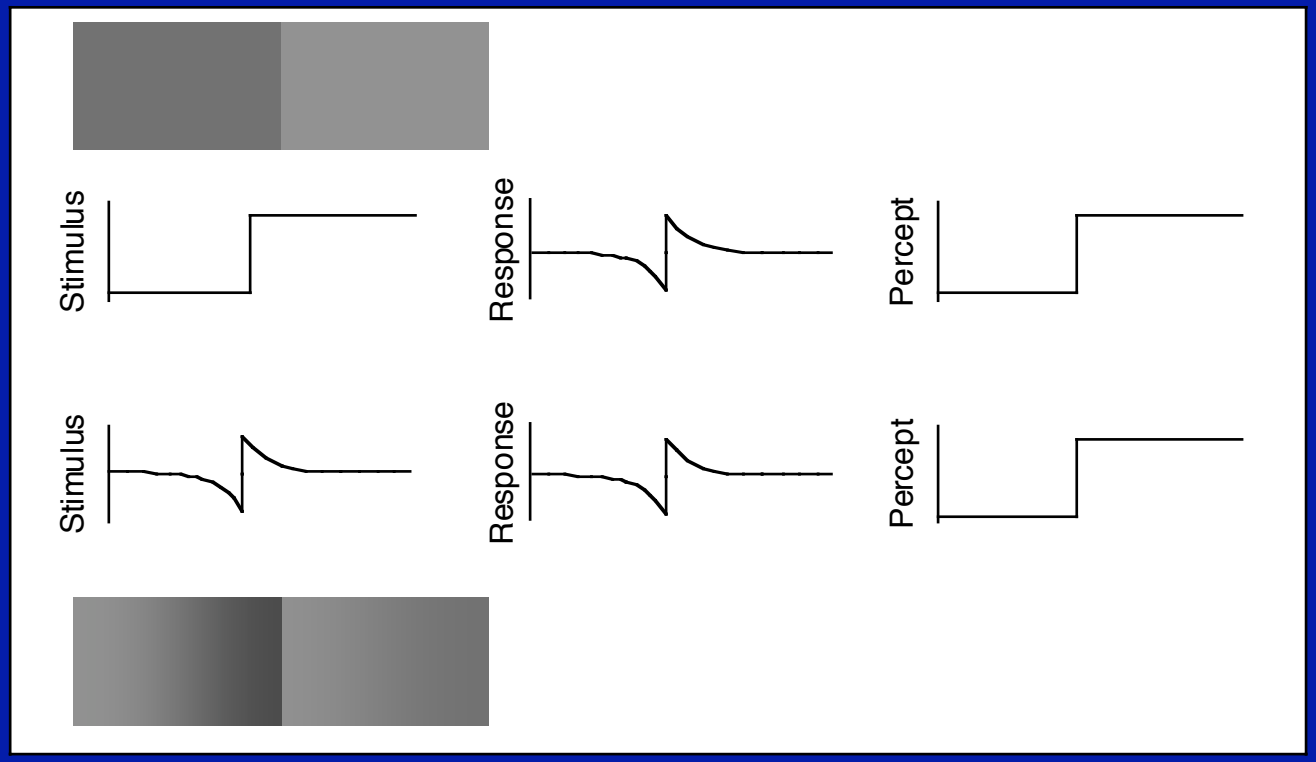


Hermann Grid

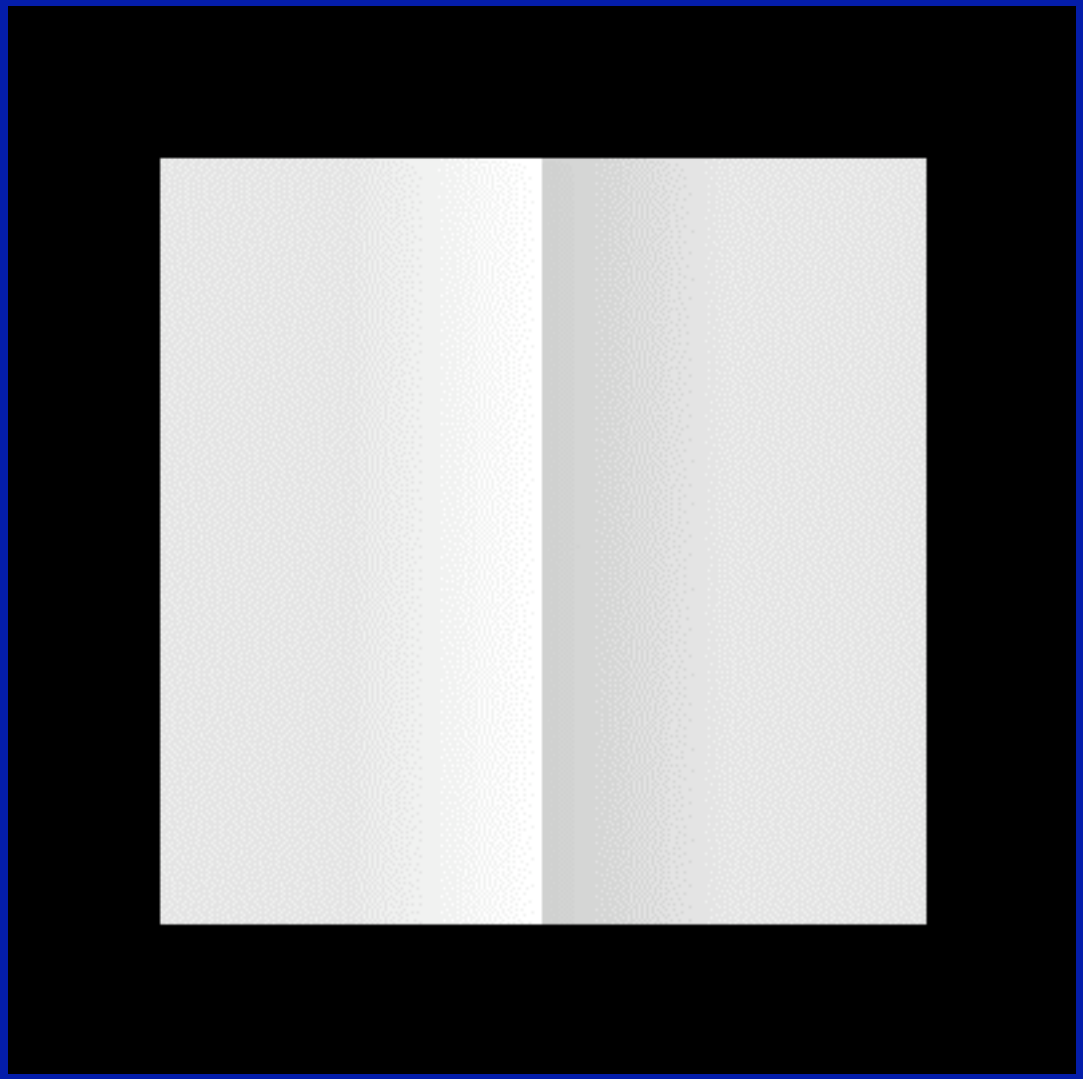


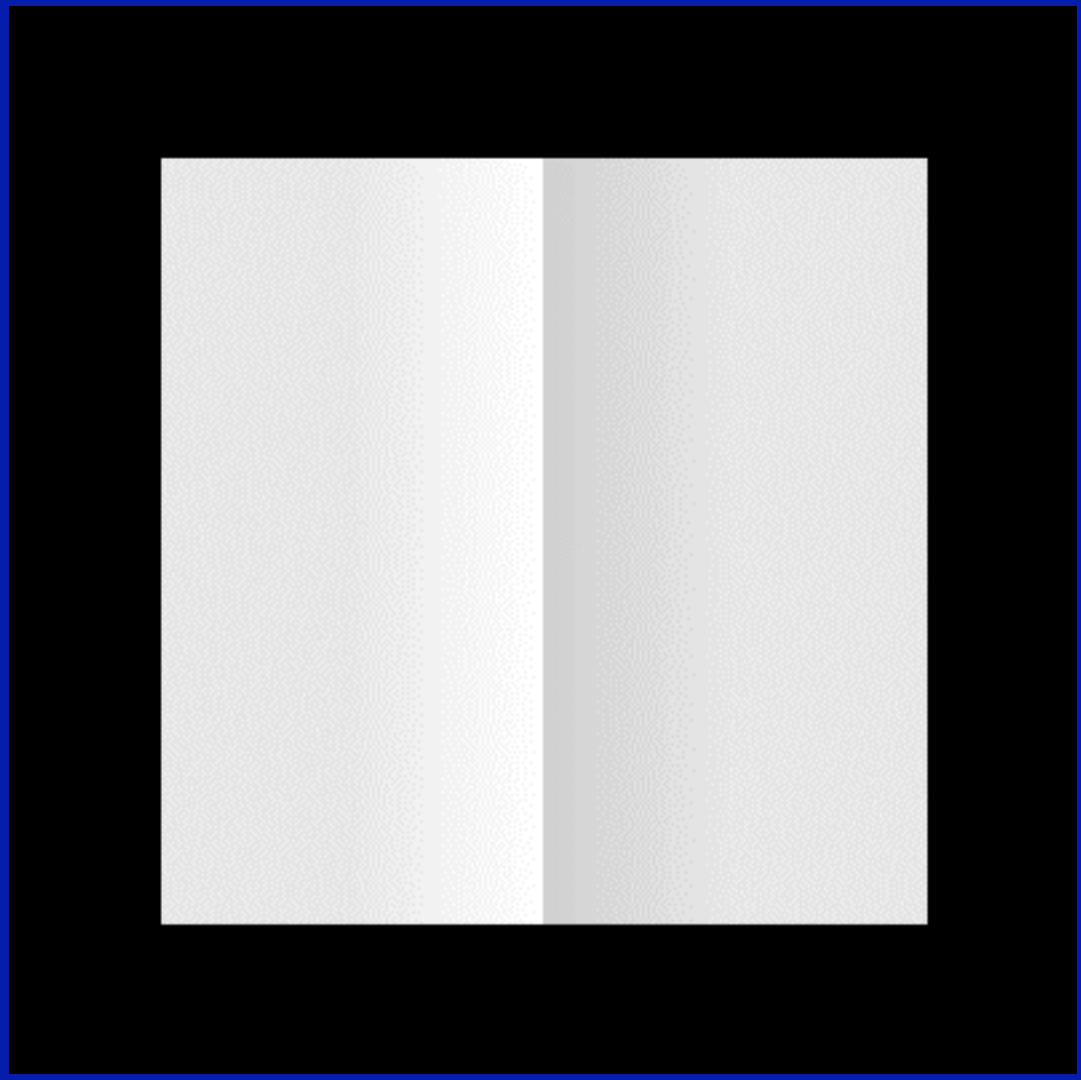


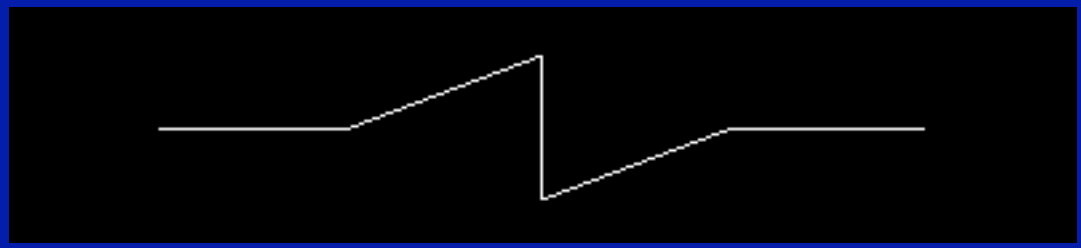
The Craik-O'Brien-Cornsweet illusion

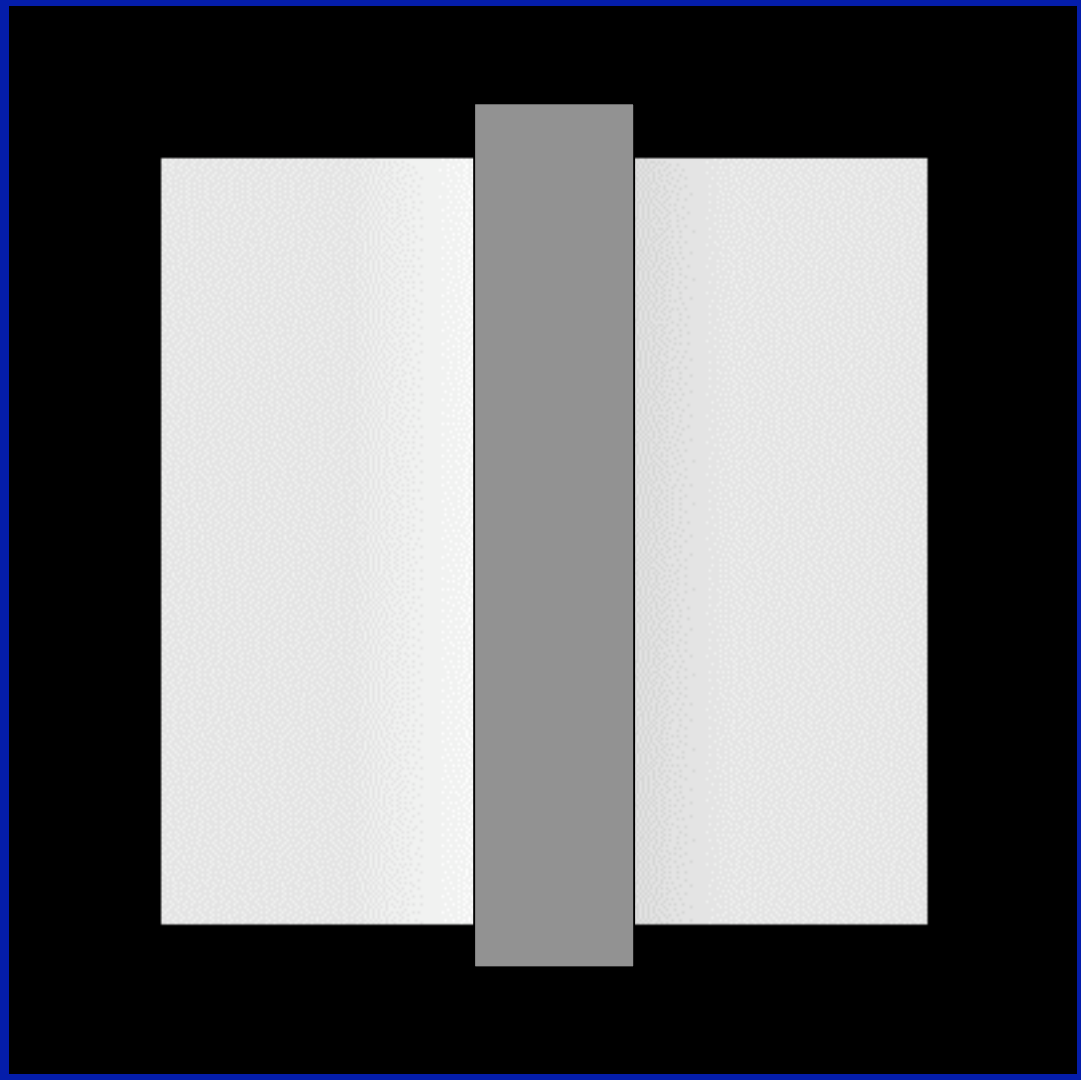


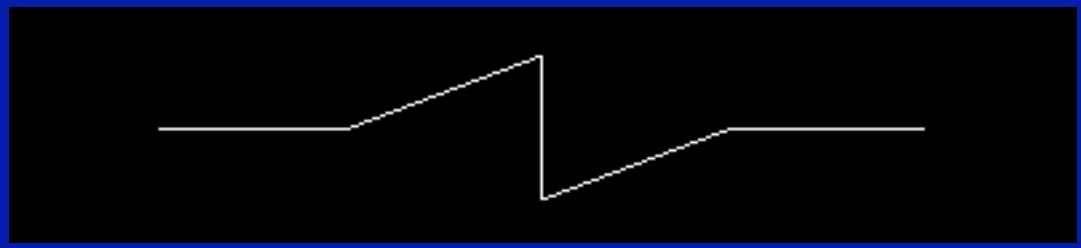
The Craik-O'Brien-Cornsweet illusion



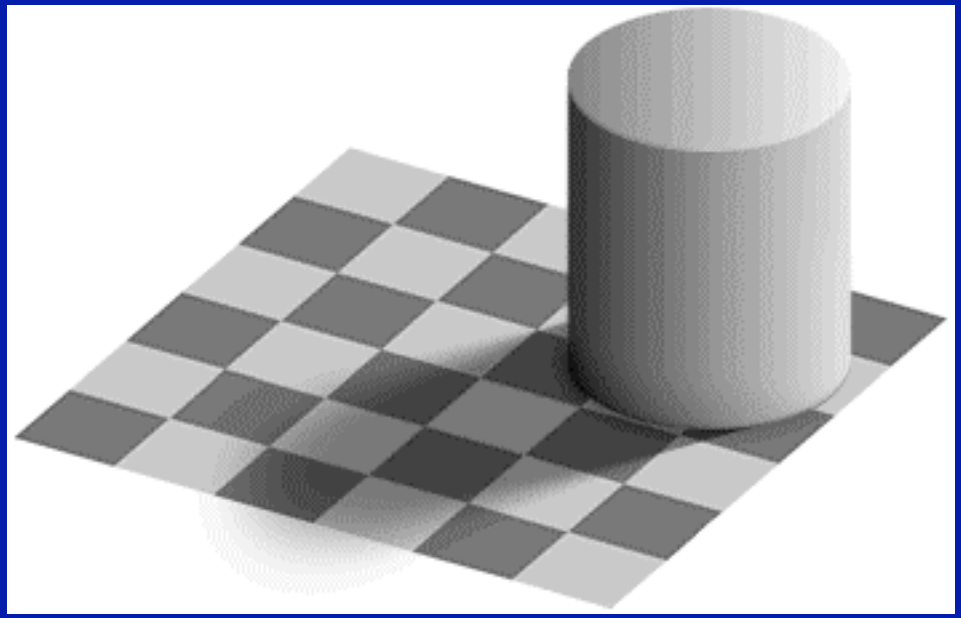








For more… See Ted Adelson



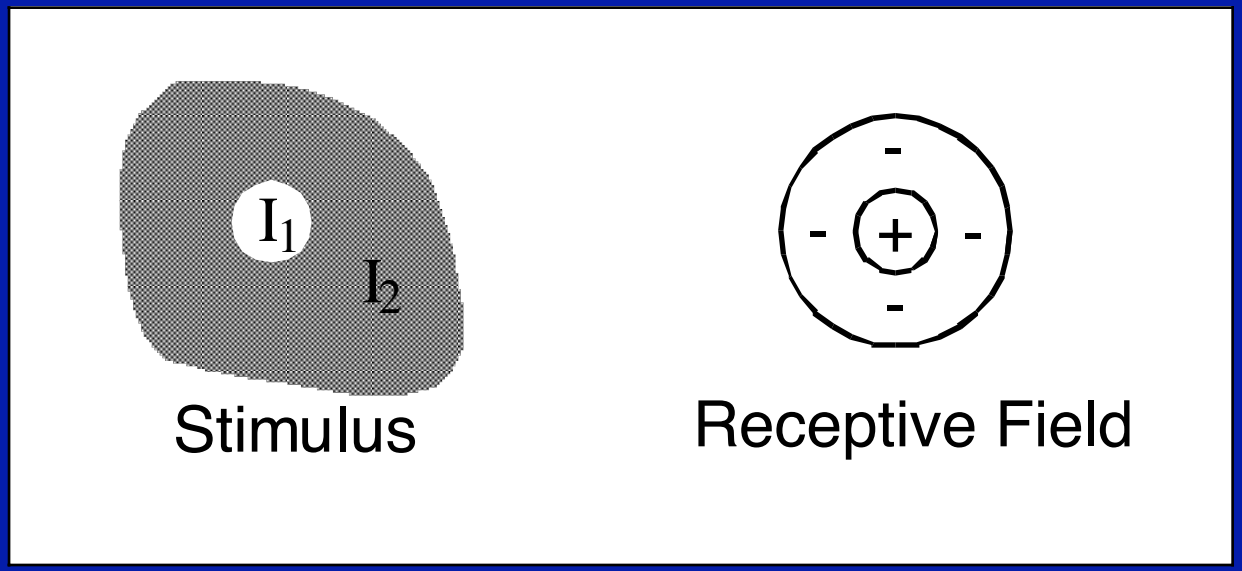
Mean intensity vs. contrast:

Operating curve

Experiment: Schweitzer-Tong

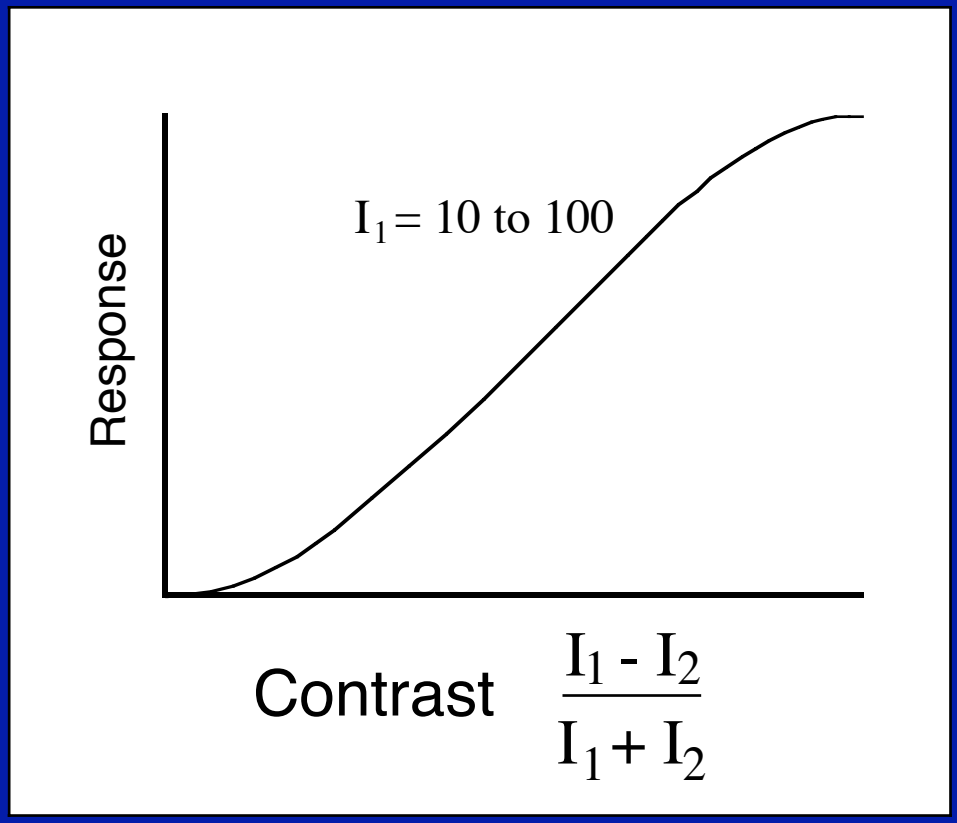
Constancies (lightness, colour)

Experiment: Schweitzer-Tong



Operating curve

One receptor: **Wide** range of mean luminance



Operating curve

Many receptors: **Small** range of mean luminance