Colour vision

Colour

Colour: a private experience...

Definition:

- Additive mixture: light
- Subtractive mixture: ink or paint

Photoreceptors:

Rods: monochromatic

Cones: trichromatic

—trichromatic theory:

Young and Helmholtz

vs

—principle of univariance

Physiology

Ganglion cells and LGN

- Concentric single opponent cells
- Concentric non-opponent cells

Striate cortex (Hering)

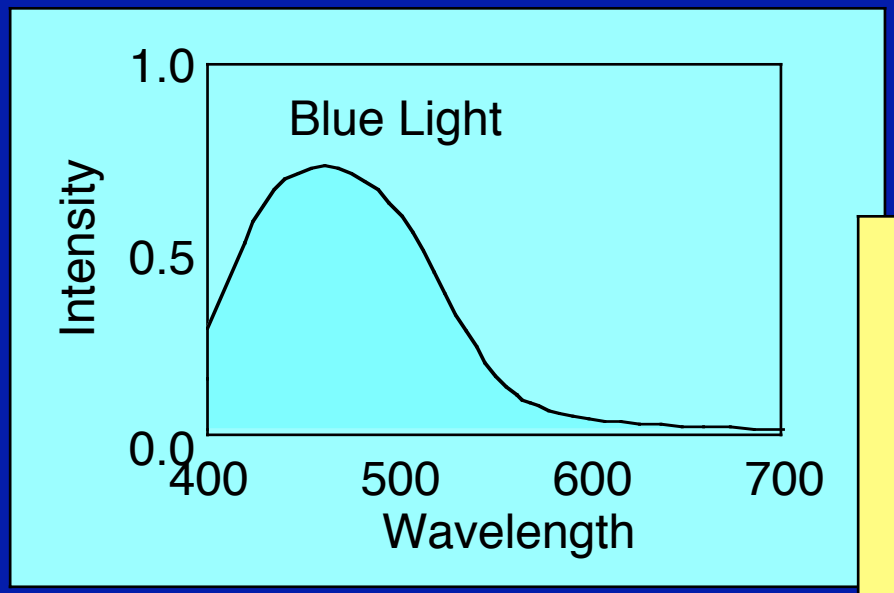
- Purely opponent cells
- Double opponent cells

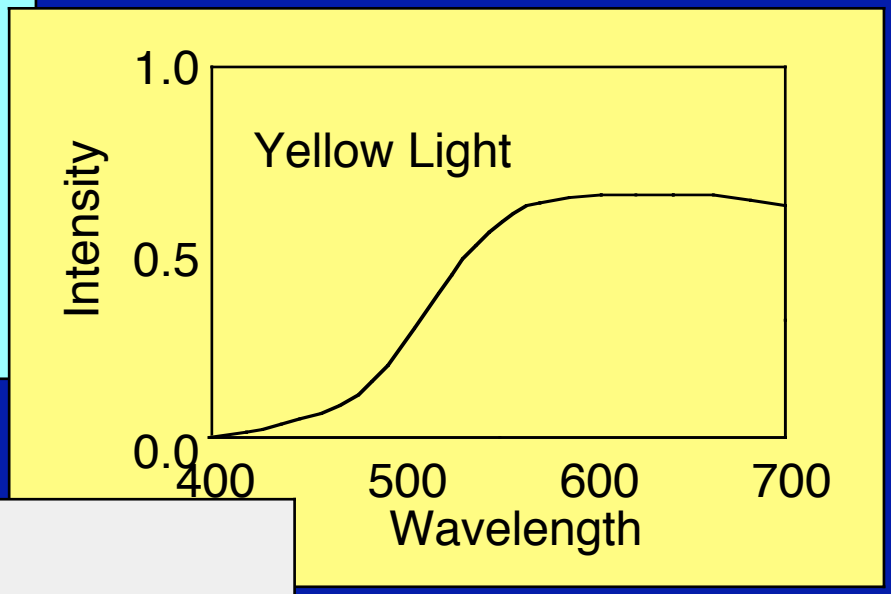
Psychophysical evidences for physiology

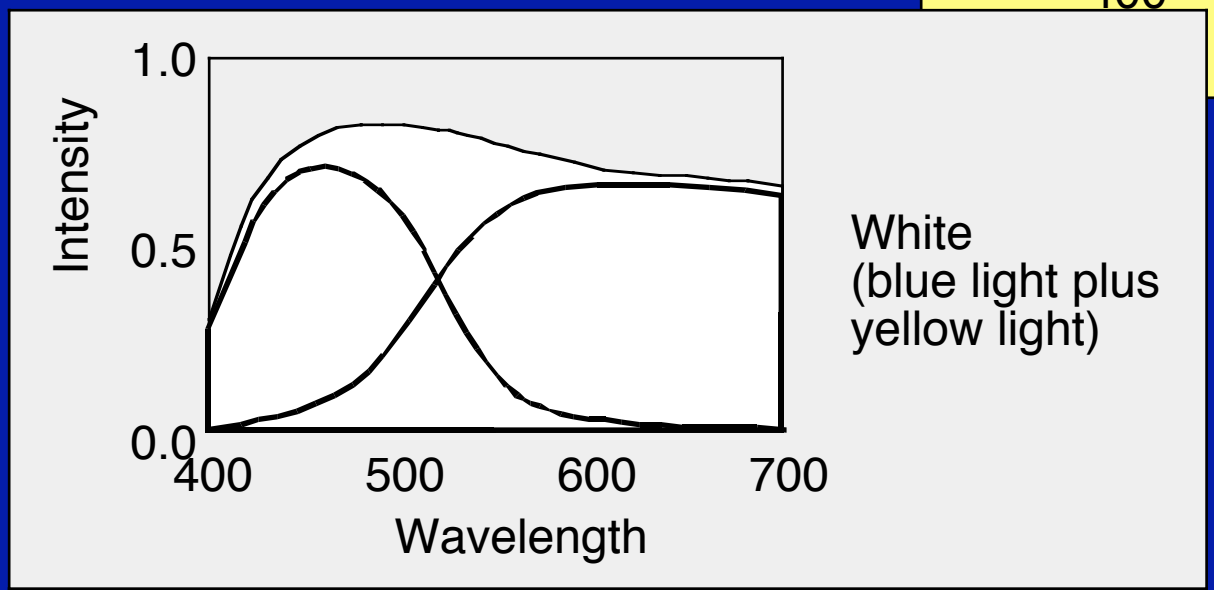
- Negative afterimages
- Colour constancy

Additive colour mixing

light

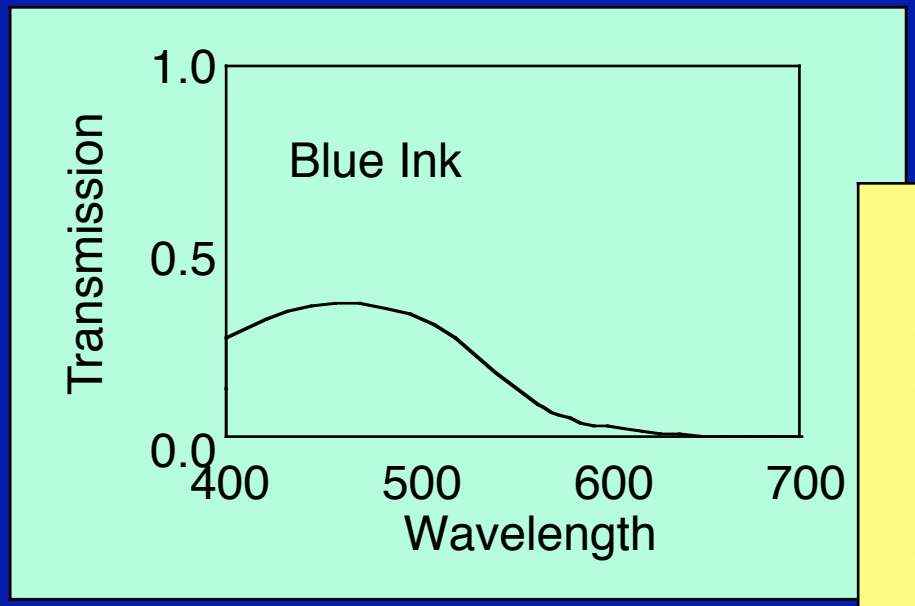


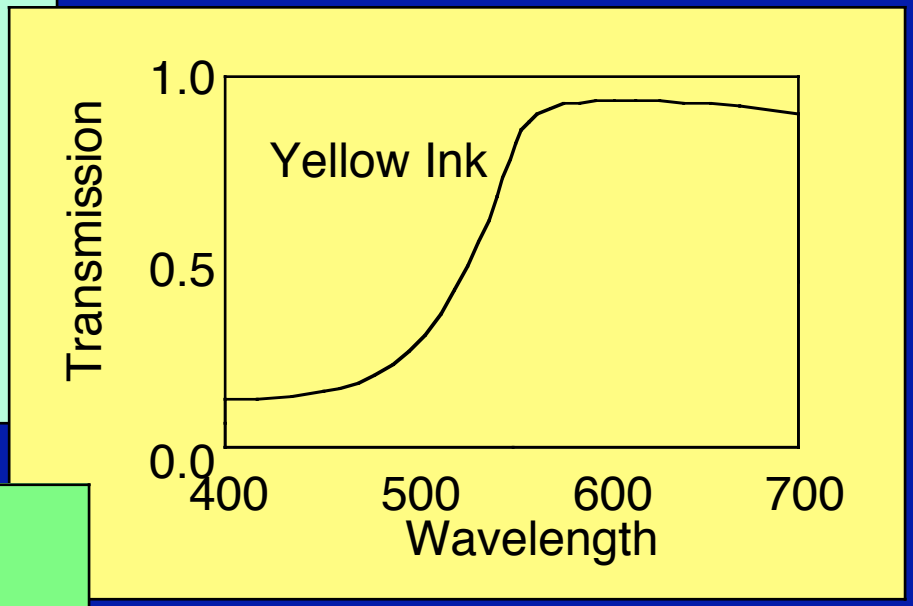


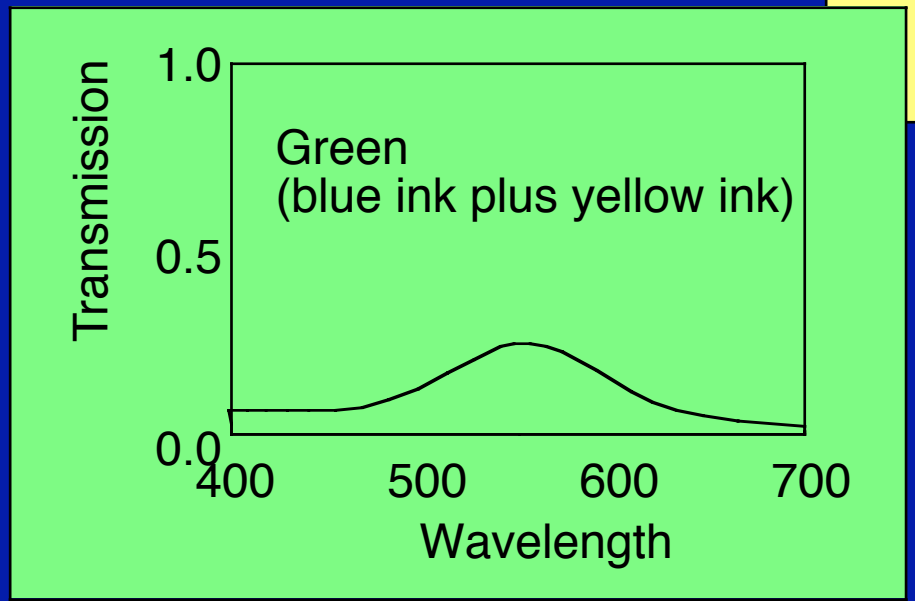


Subtractive colour mixing

paint

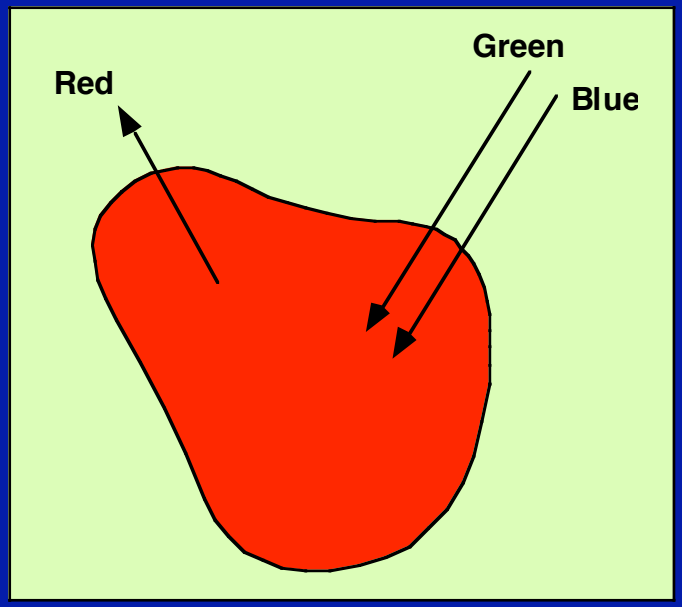






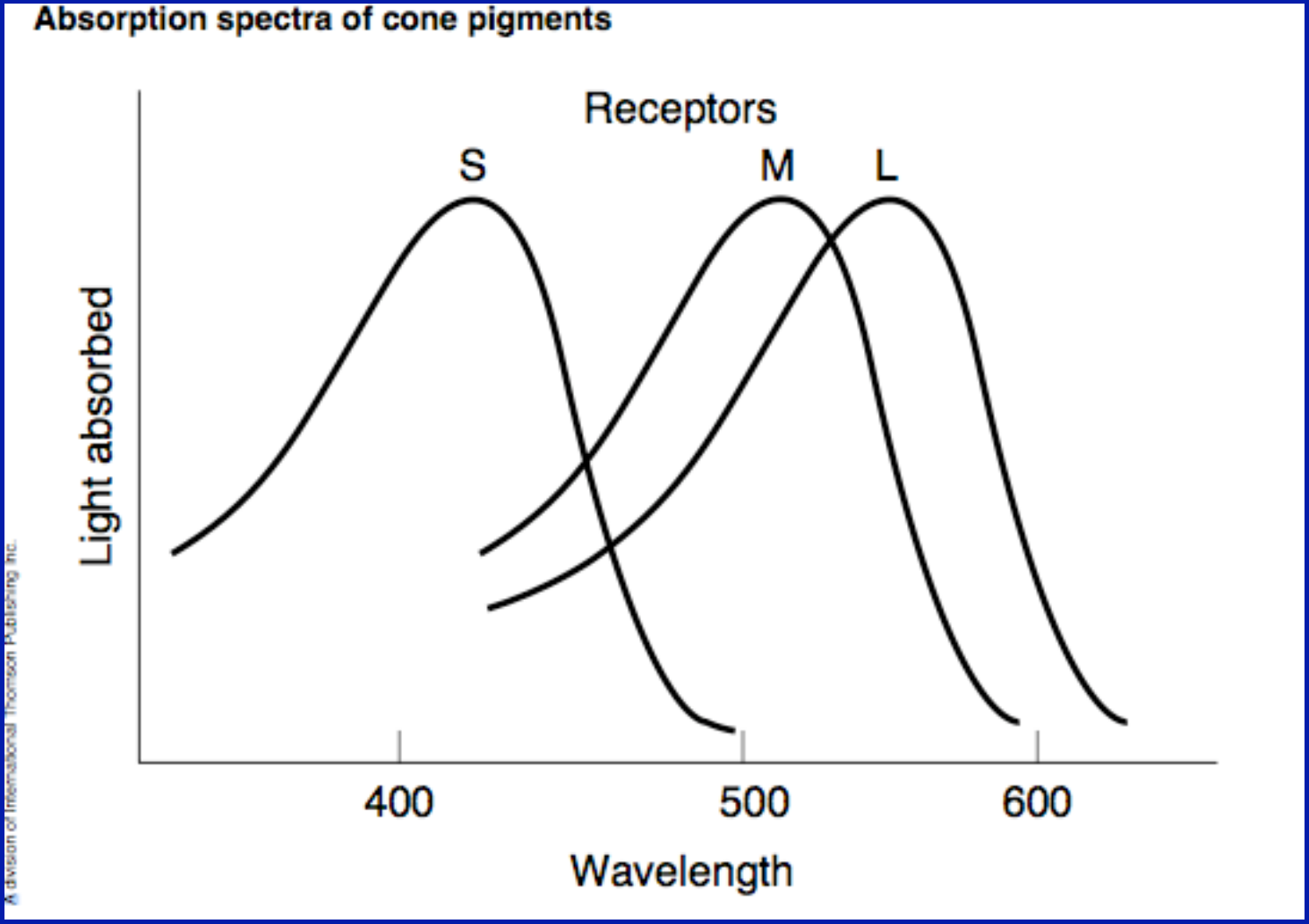
filters

Paint reflects colours (wavelength)



Photoreceptors absorb "colours"

Light of different wavelengths



Photoreceptors absorb "colours"

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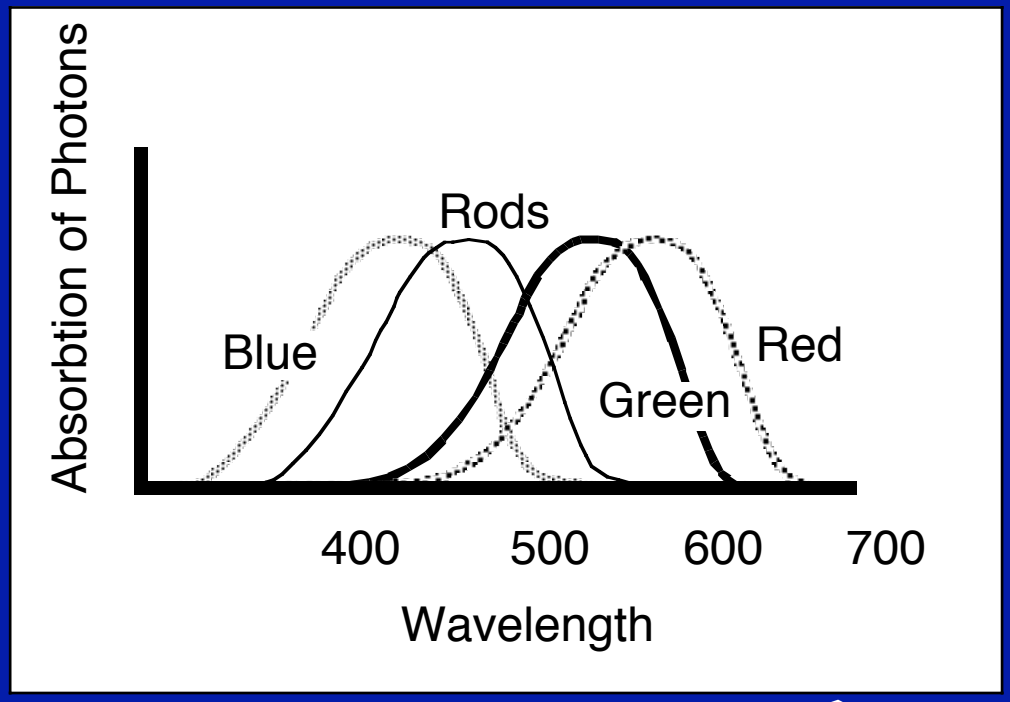


Colour deficiencies

Monochromatism

One receptors wavelength selectivity

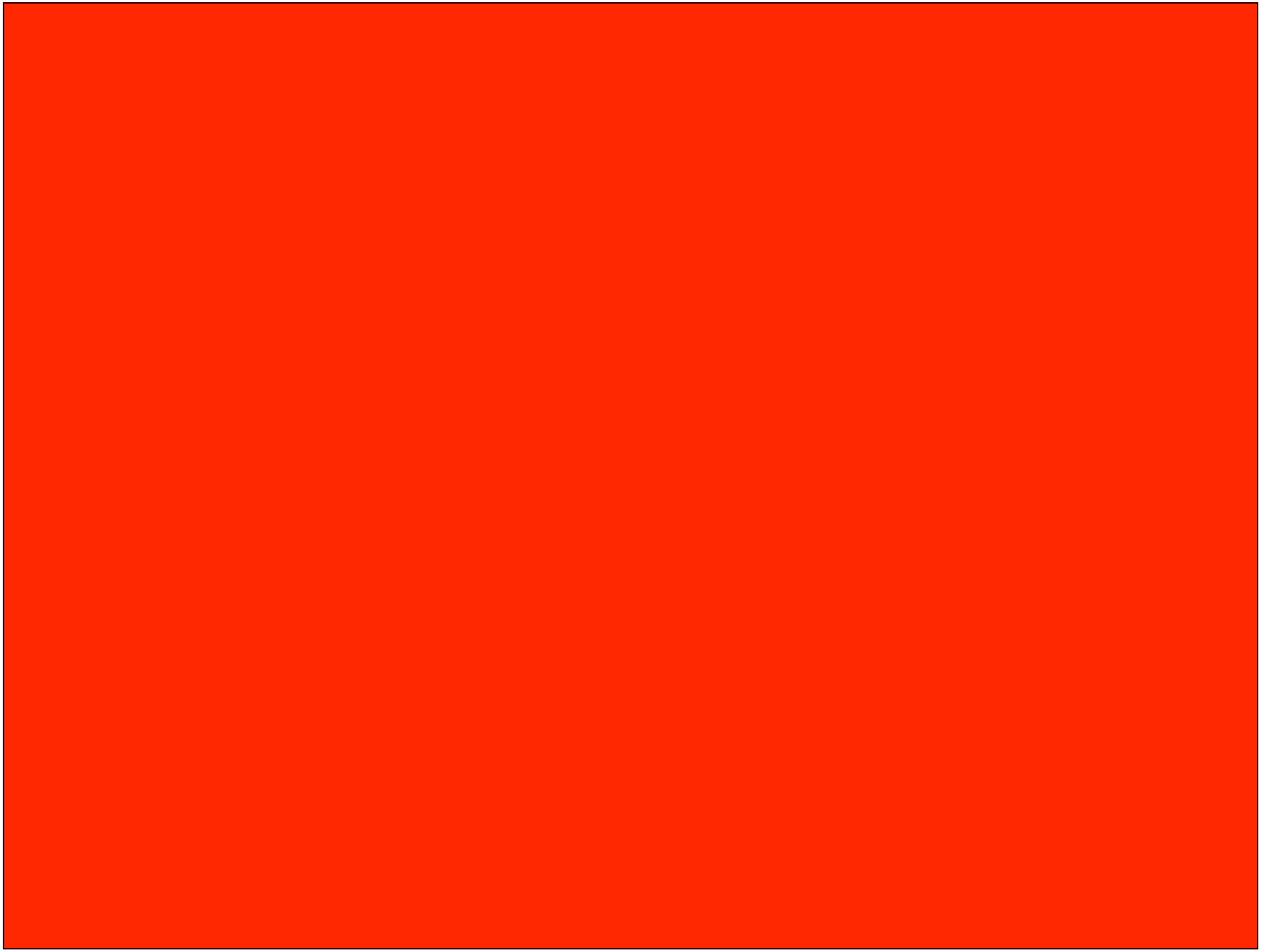
Dichromatism

Two receptors wavelength selectivity

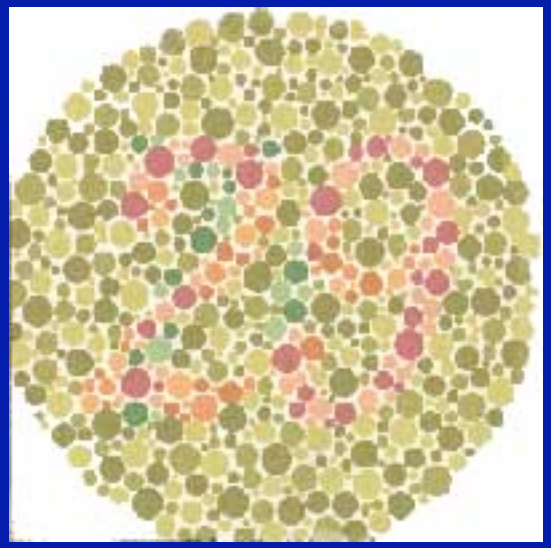
Tritanope

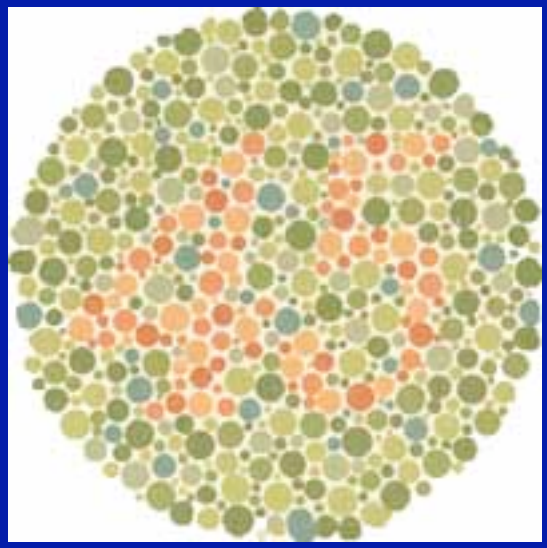
Protanope

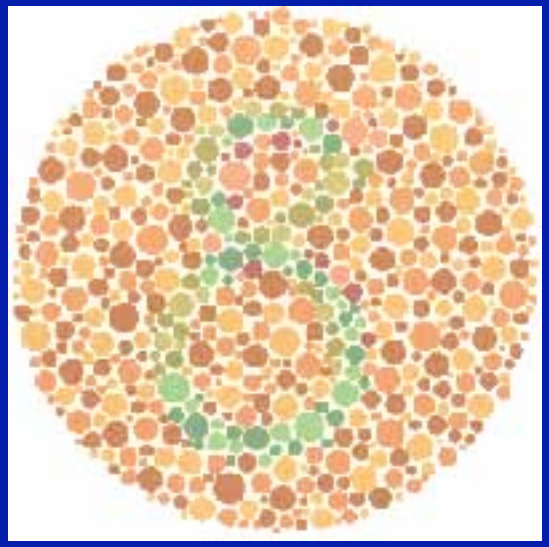
Deuteranope



Ishihara Test







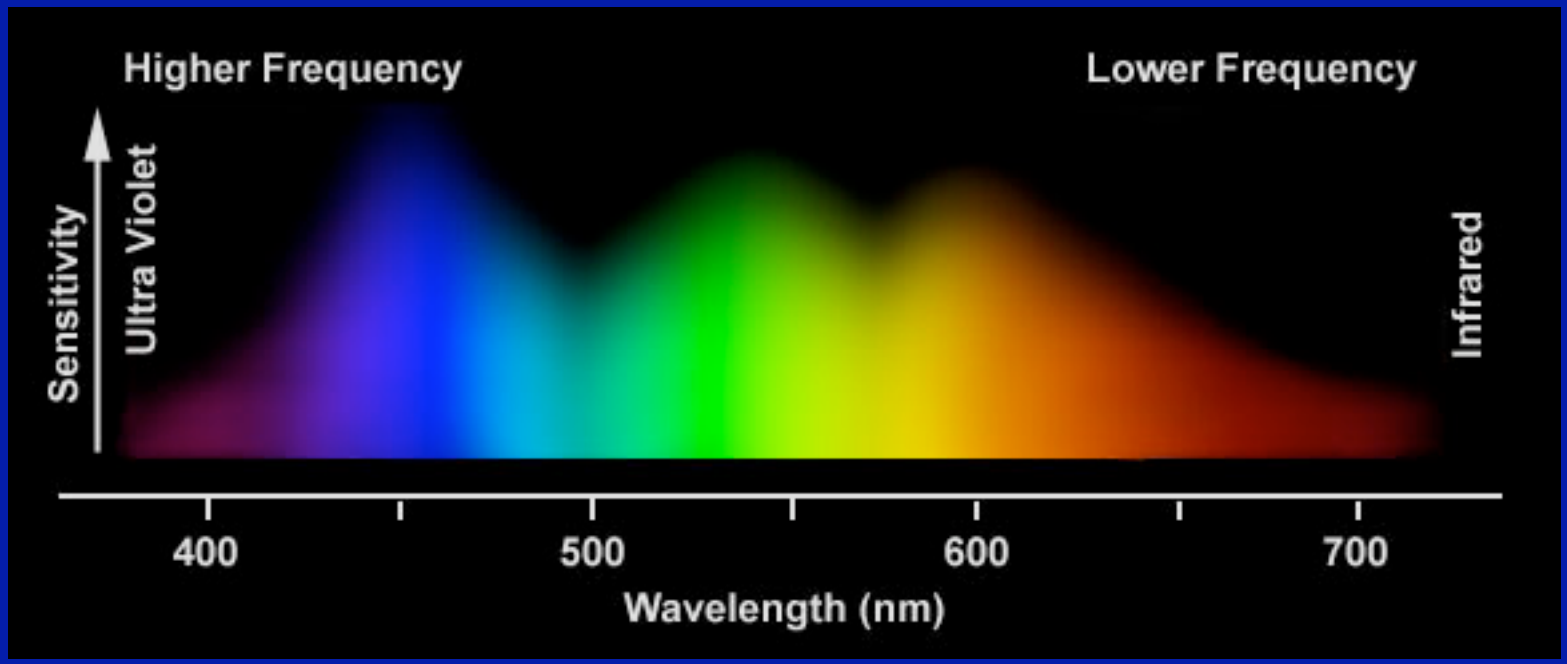
The world.

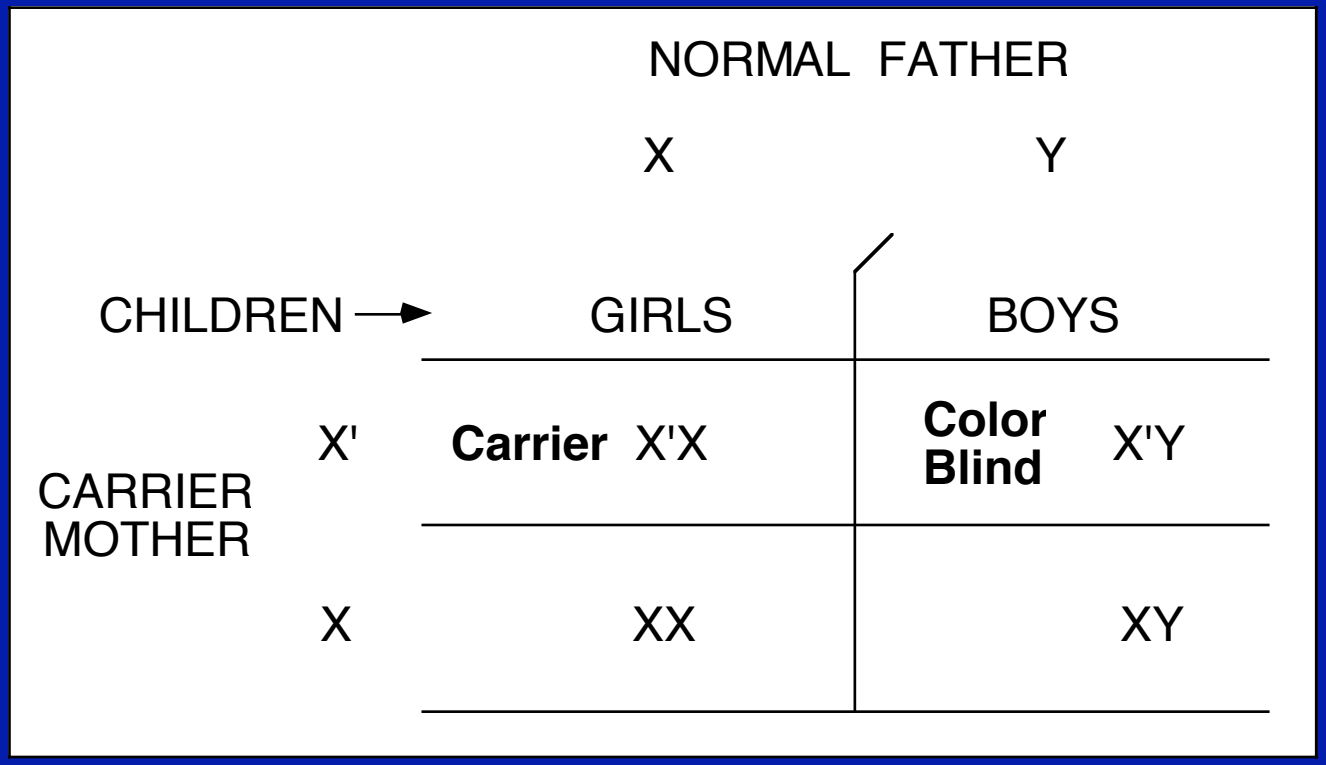
How the world looks to a person with a red/green color deficit (deuteranopia).

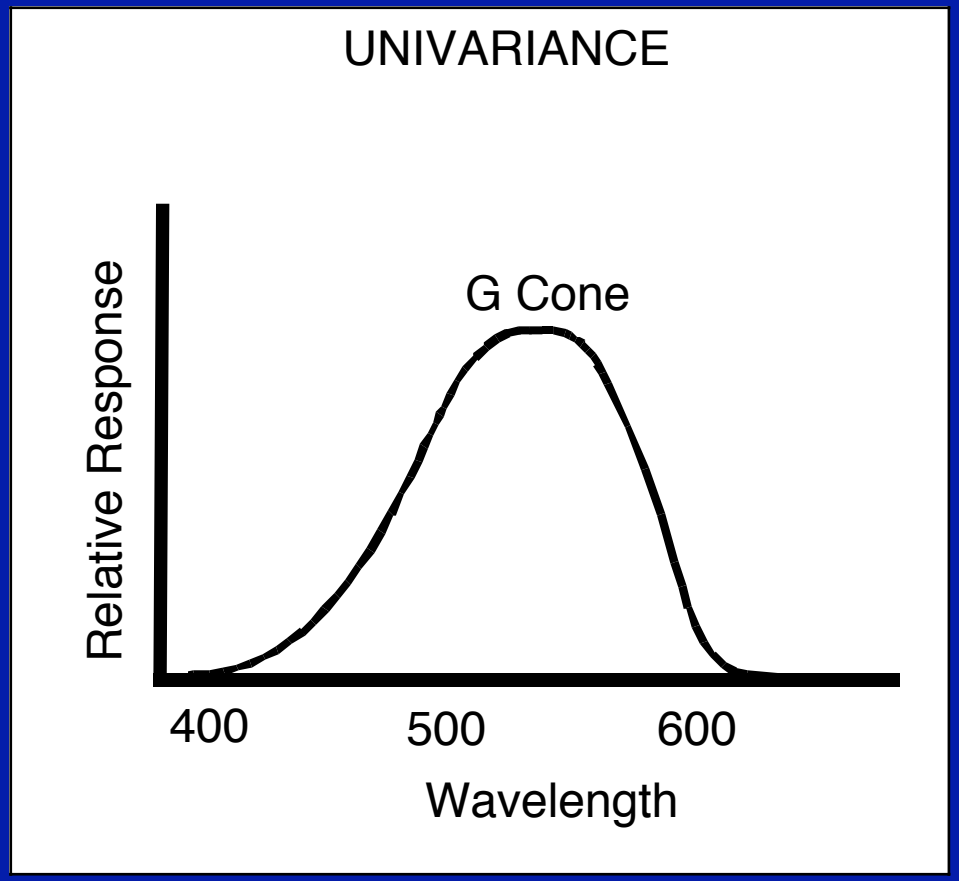
How the world looks to a person with a blue/yellow color deficit (tritanopia).

http://www.vischeck.com/showme.shtml

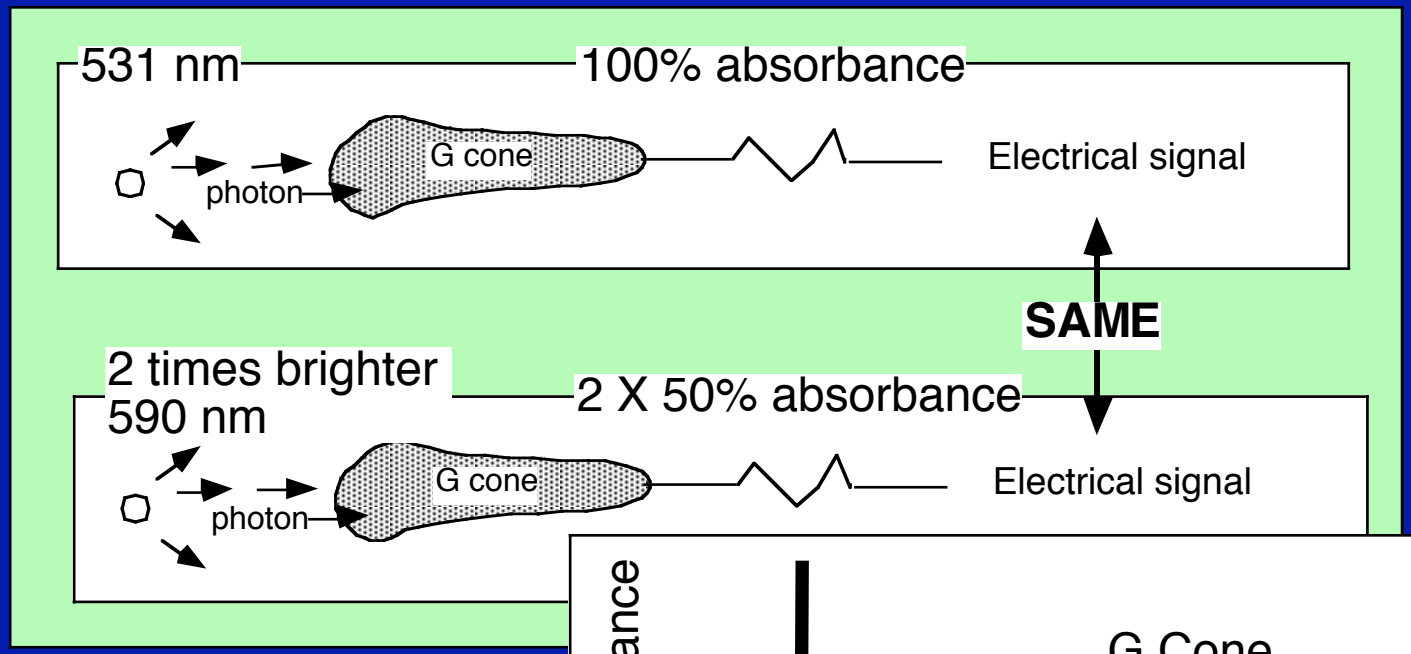
Cones sensitivity

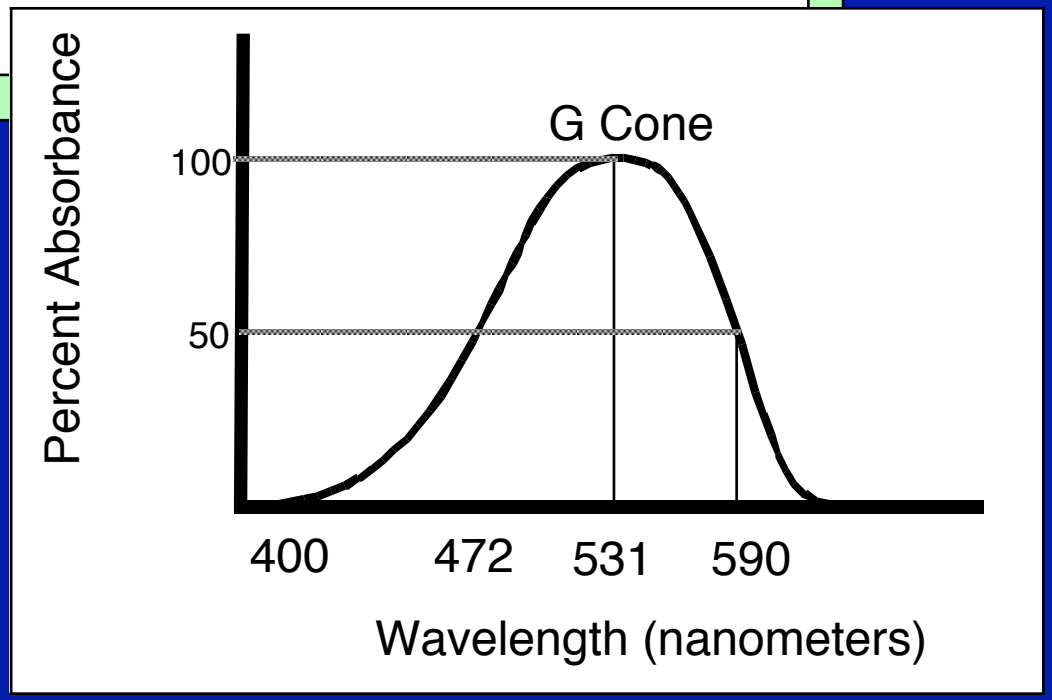



NORMAL FATHER
X
Y
CHILDREN →
GIRLS
BOYS
X'
Carrier X'X
Color Blind X'Y
CARRIER MOTHER
X
XX
XY


UNIVARIANCE
G Cone
Relative Response
400
500
600
Wavelength

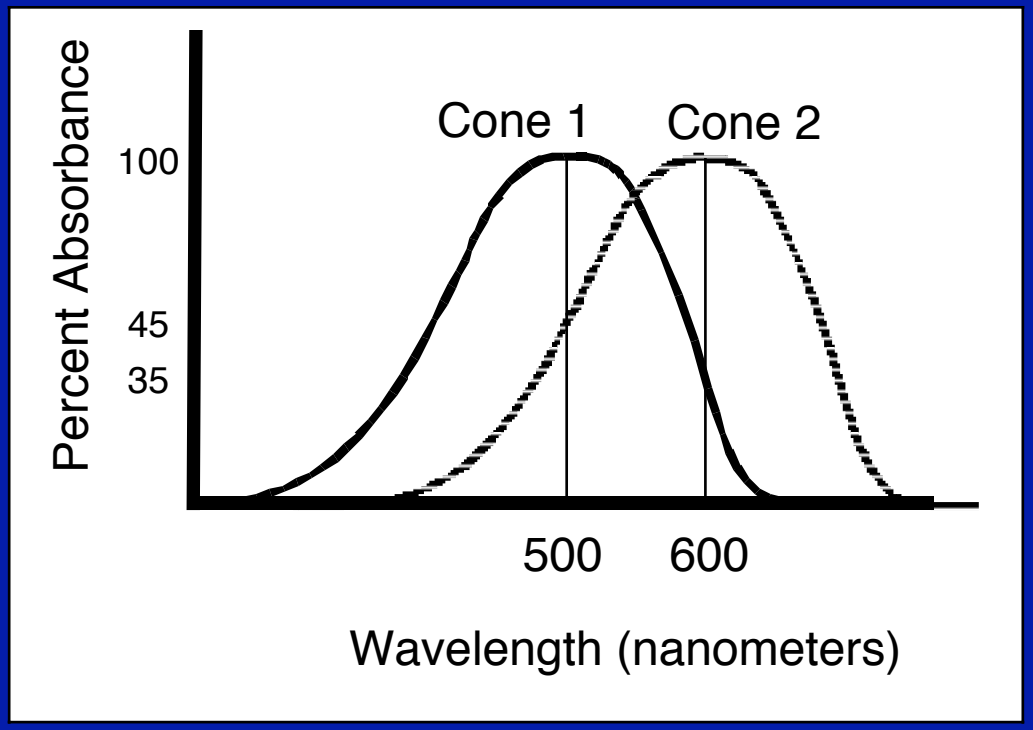
Principle of univariance





One wavelength selectivity

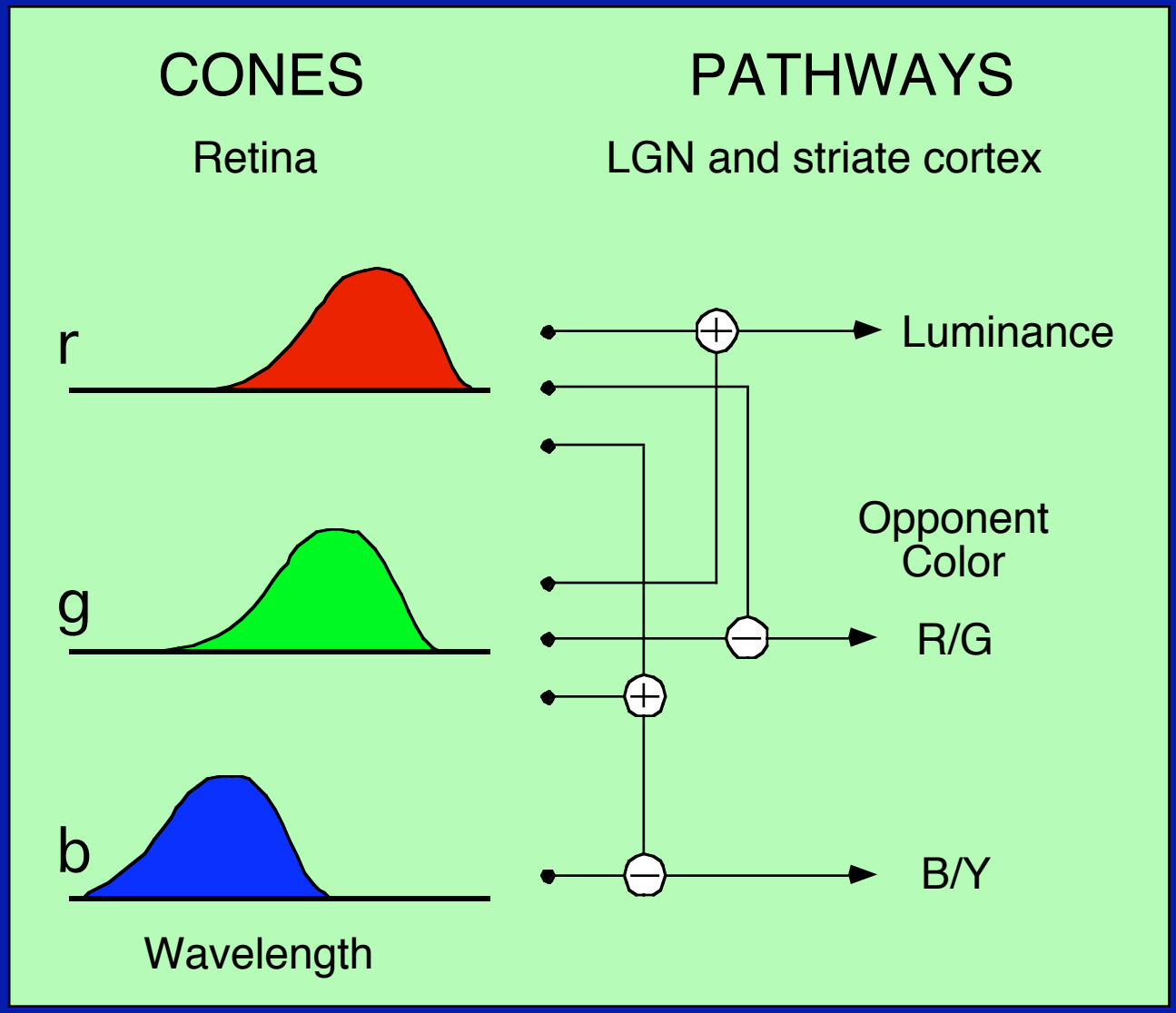
NO COLOUR



wavelength (nm)	**Cone 1**	**Cone 2**
500	100%	45%
600	35%	100%

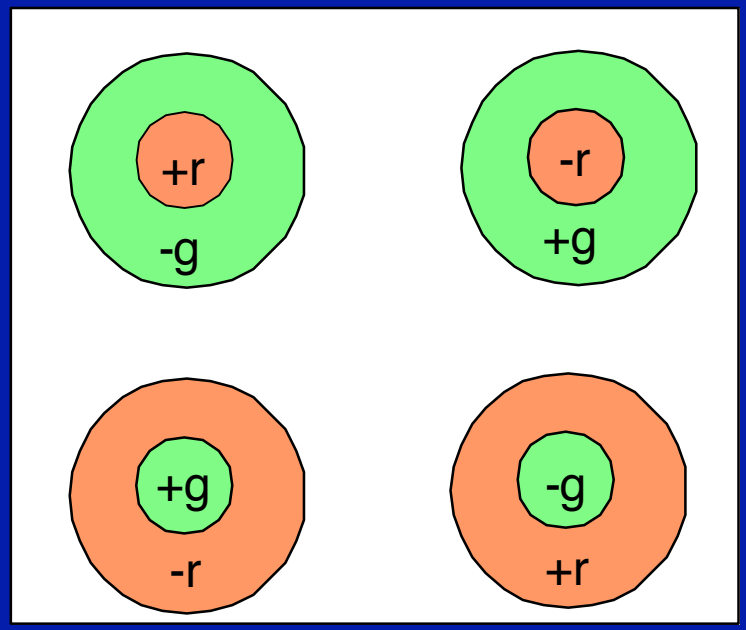
Trichromatic Theory: Young & Helmholtz

Opponent Theory: Hering



Opponent and non-opponent receptive fields of cells in the retina and LGN

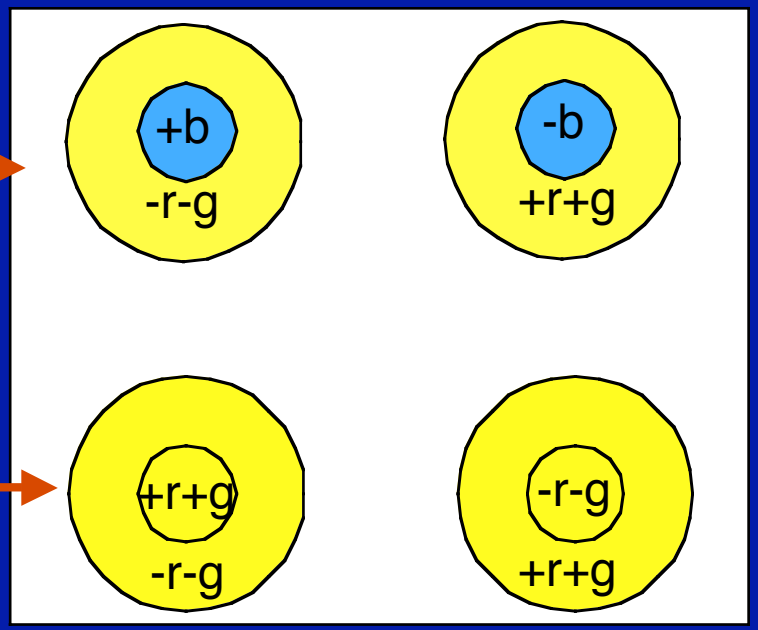
Red/Green
Opponent cells



Opponent and non-opponent receptive fields of cells in the retina and LGN

Blue/Yellow Opponent cells

Non-Opponent cells



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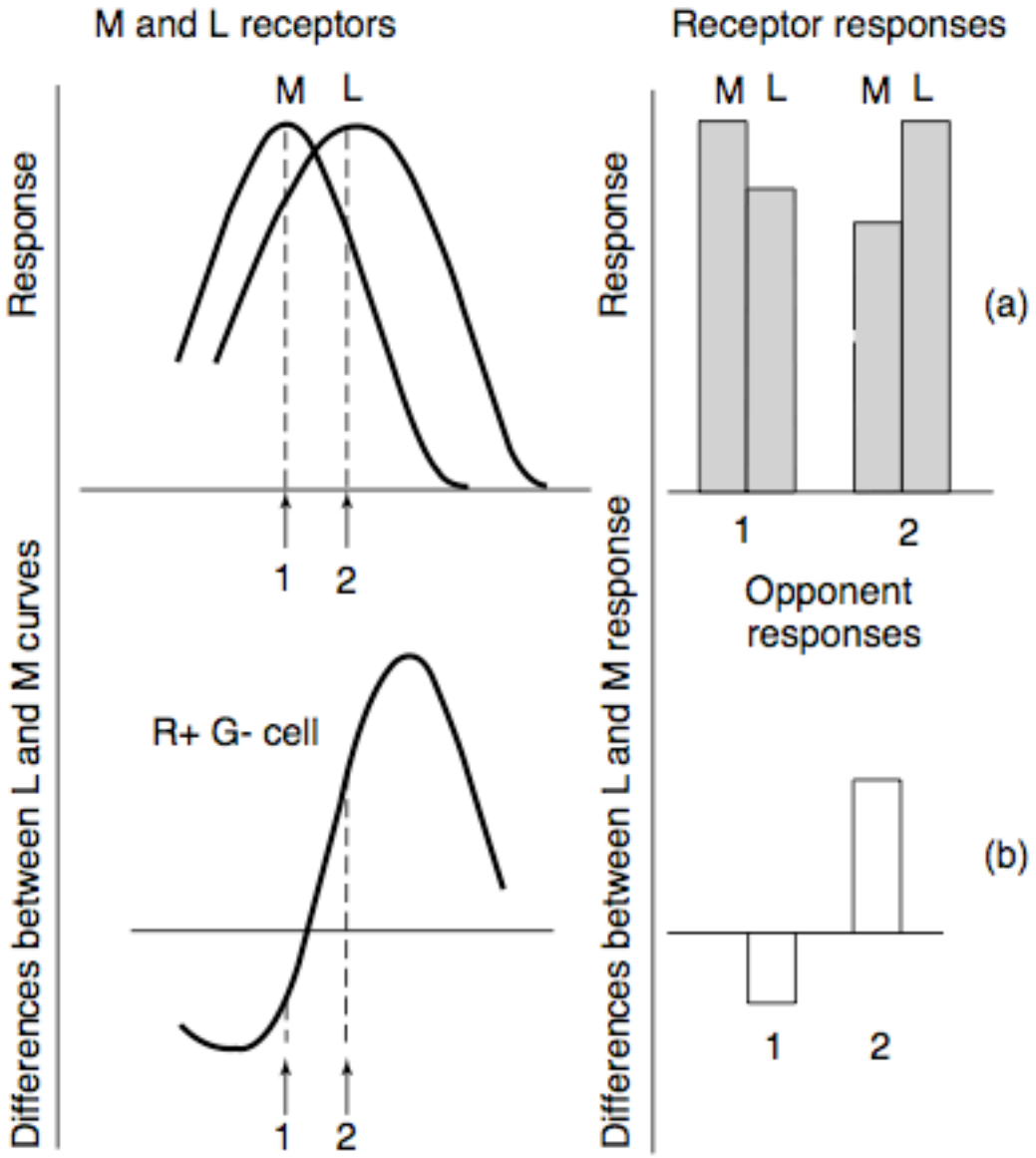
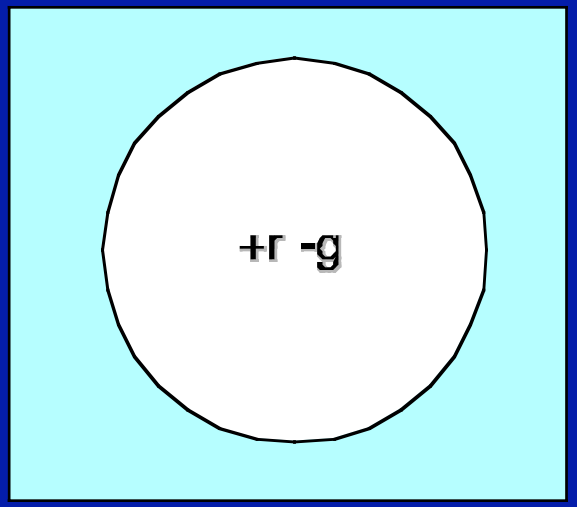
Trichromatic vs. opponent-process responses



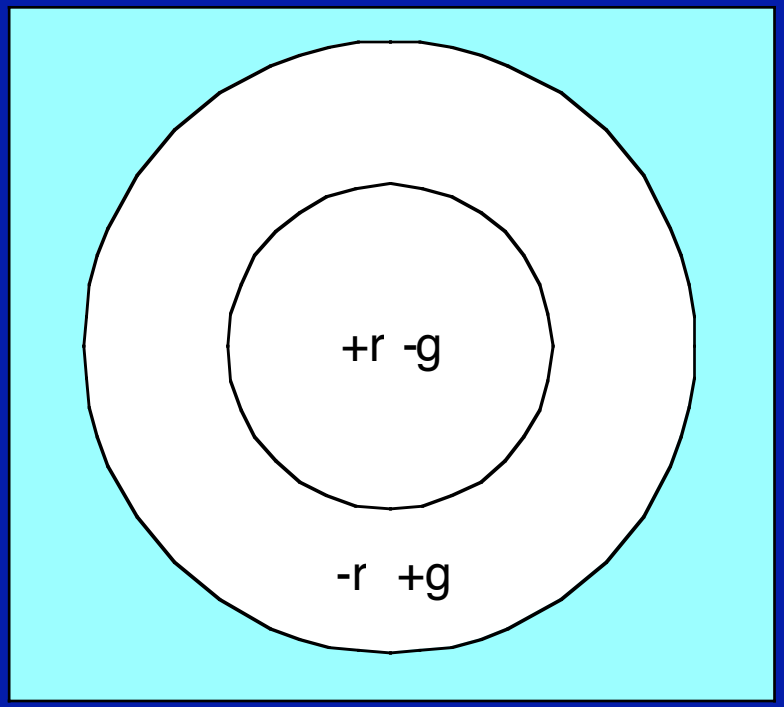
Colour cells

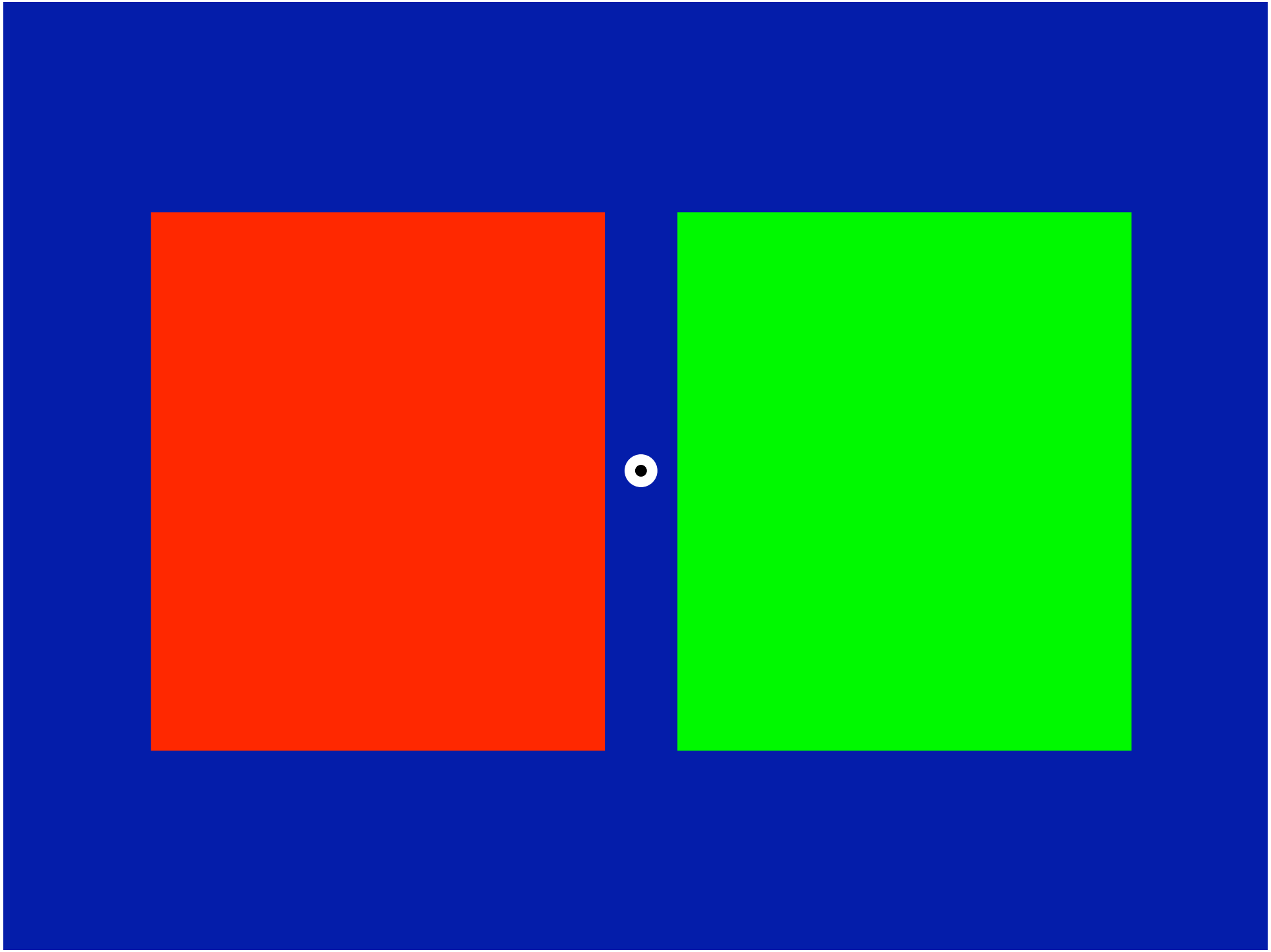
Opponent receptive fields in striate cortex

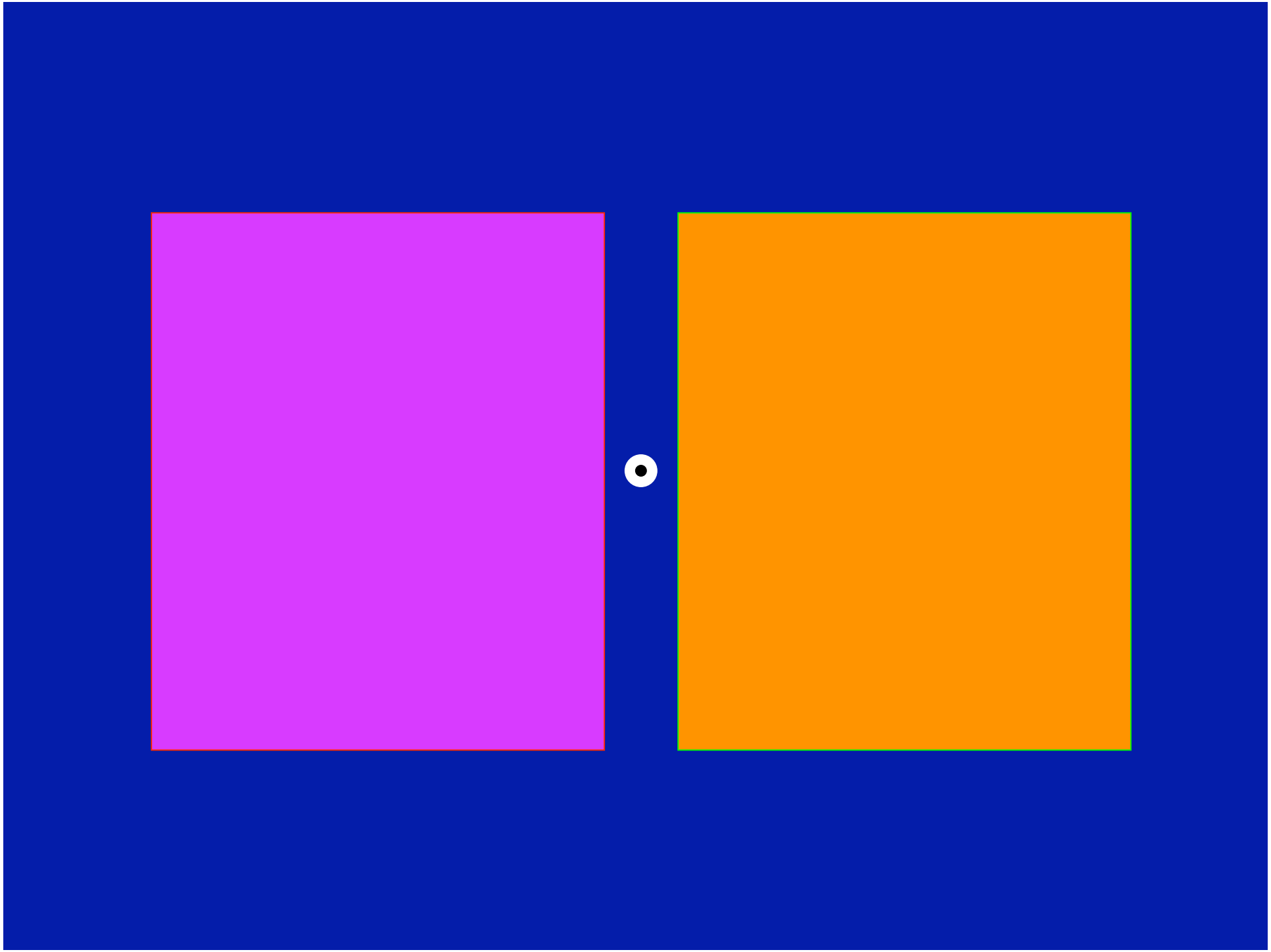
Purely opponent cells

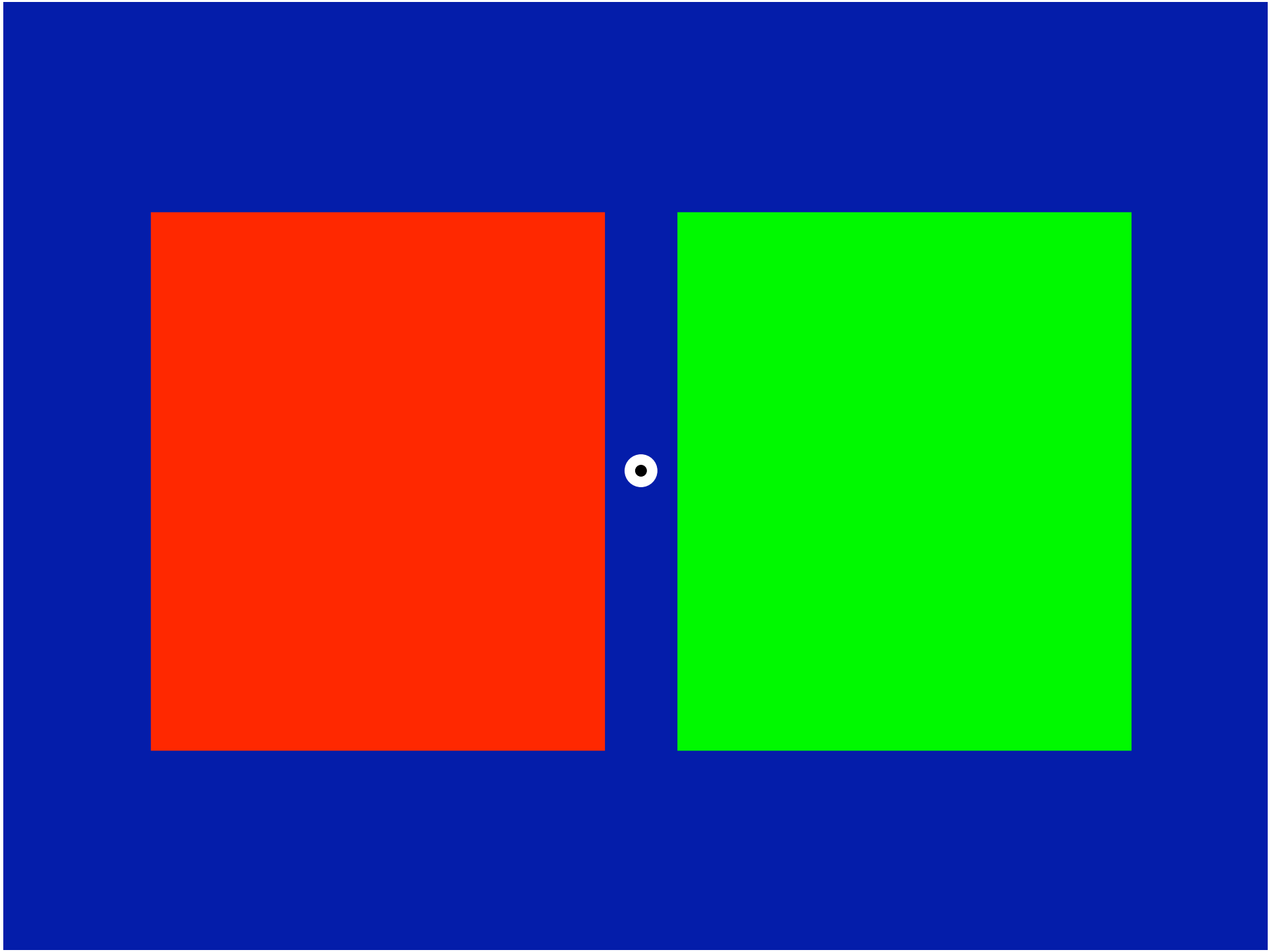


Double opponent cells

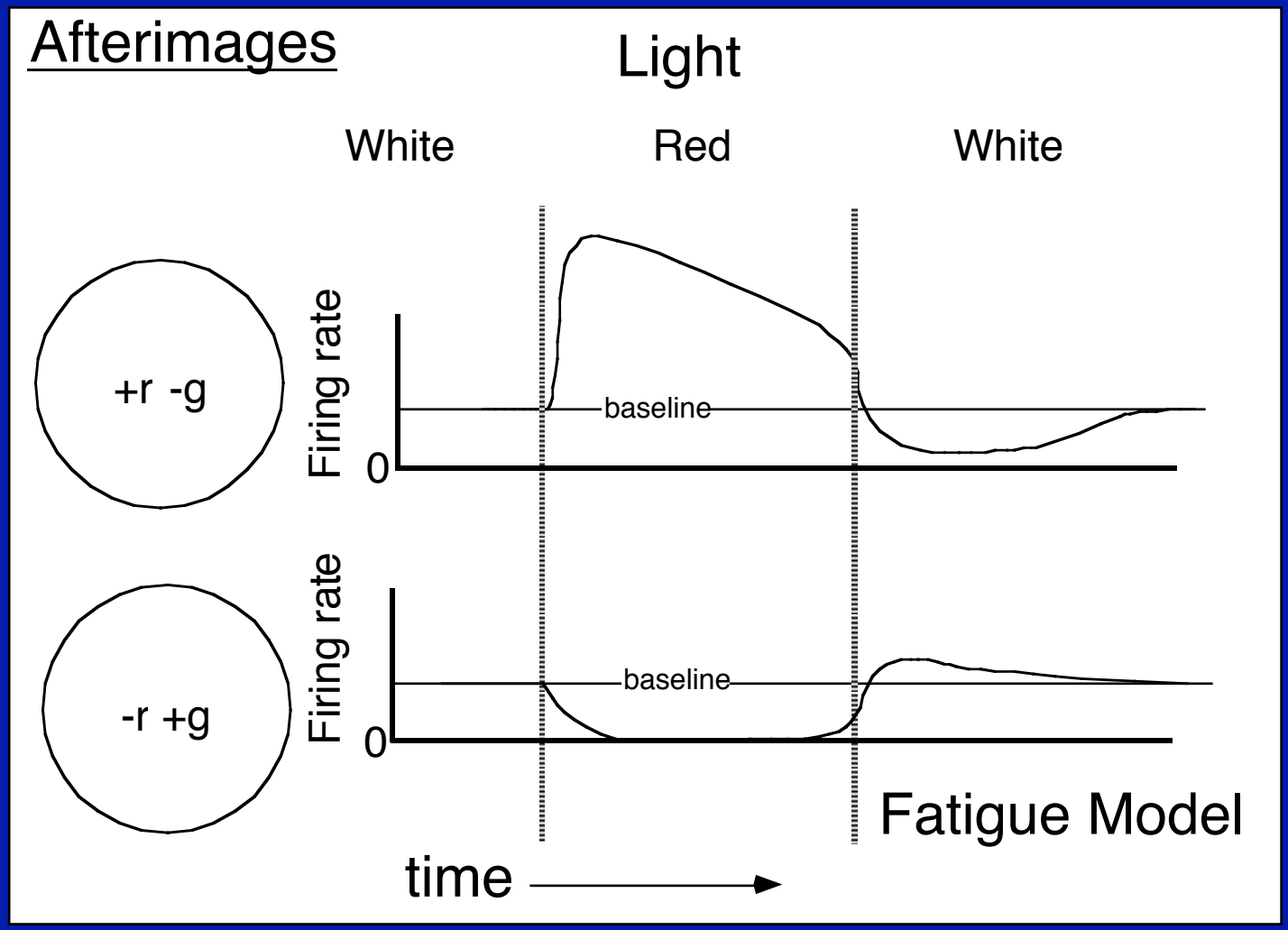


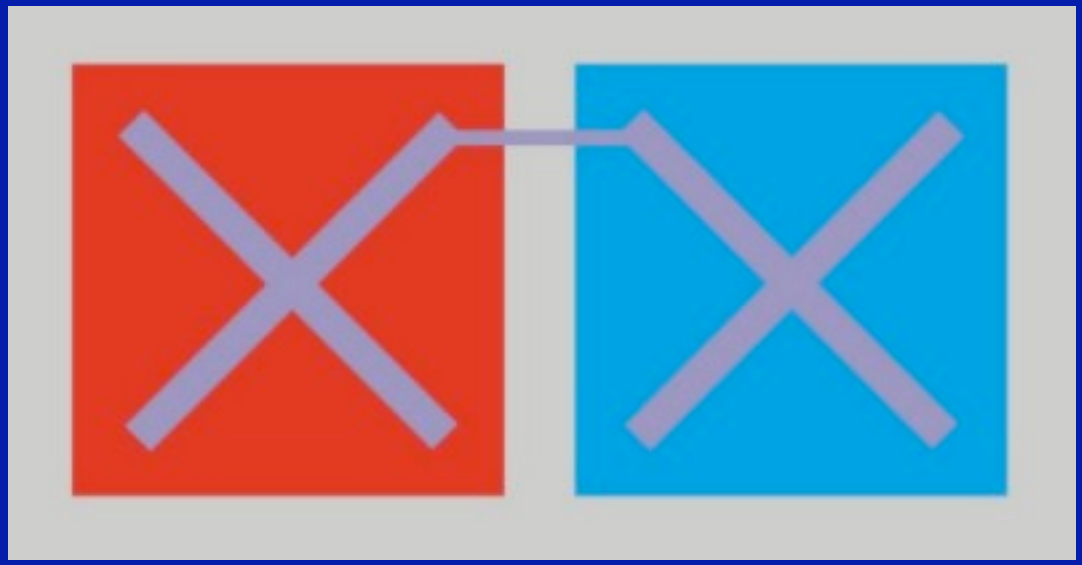


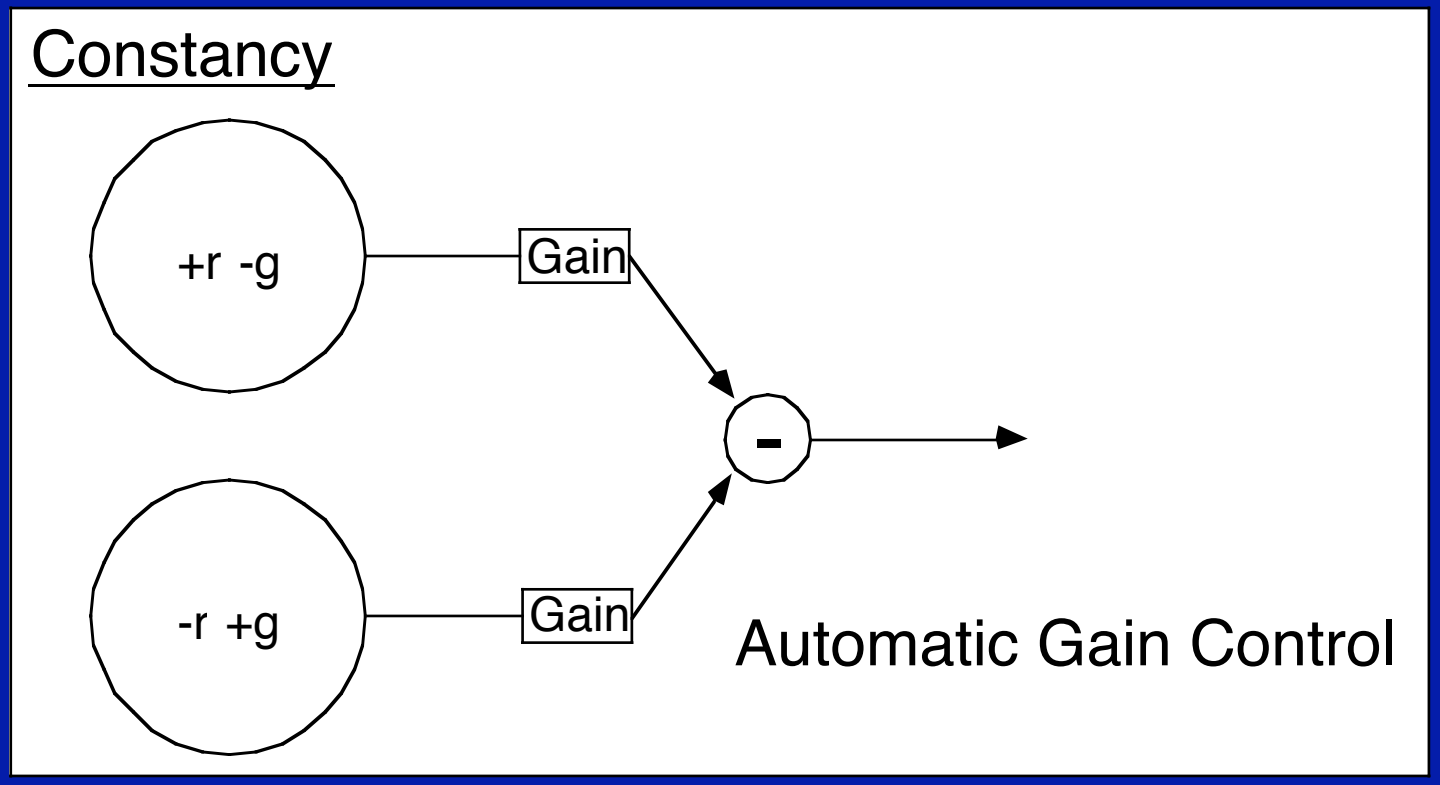




Afterimages






Constancy
+r -g
Gain
-
-r +g
Gain
Automatic Gain Control