

Visual Analytics

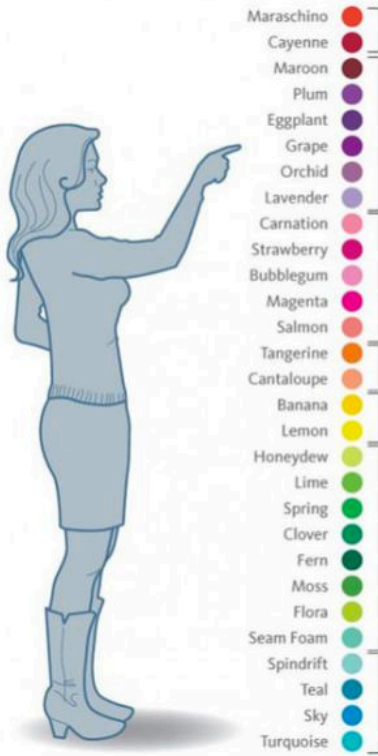
Colors

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30 March 2015

How many color?

Female



Male



Dog



Programmer

- Gray #f94433
- Gray #ac203b
- Gray #85343d
- Gray #874994
- Gray #663c84
- Gray #8c2590
- Gray #a16799
- Gray #af99c7
- Gray #f38da3
- Gray #d2157b
- Gray #ec90b7
- Gray #e90086
- Gray #f57d7e
- Gray #f27727
- Gray #fc9b7b
- Gray #f7d305
- Gray #f1e311
- Gray #ccdf62
- Gray #68bd46
- Gray #0aae4f
- Gray #069665
- Gray #057054
- Gray #3ba246
- Gray #abc37
- Gray #68c3b2
- Gray #8bccd0
- Gray #0687a7
- Gray #078dca
- Gray #0fb8b5

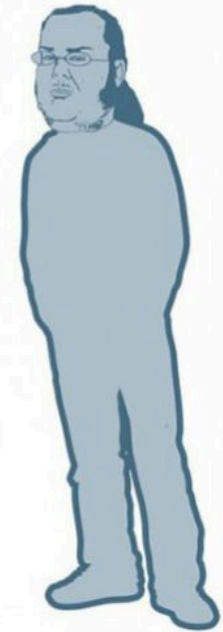


Photo Receptor Cells

- Two types of light sensitive cells
 - **Rod Cells** (~120M)
 - Provide low-light vision
 - Peripheral vision
 - Almost no role in color vision
 - **Cone cells** (~6M)
 - Provide normal vision
 - Three sub-types of cells
 - Sensitivity to different light wavelengths
 - Used for colored vision

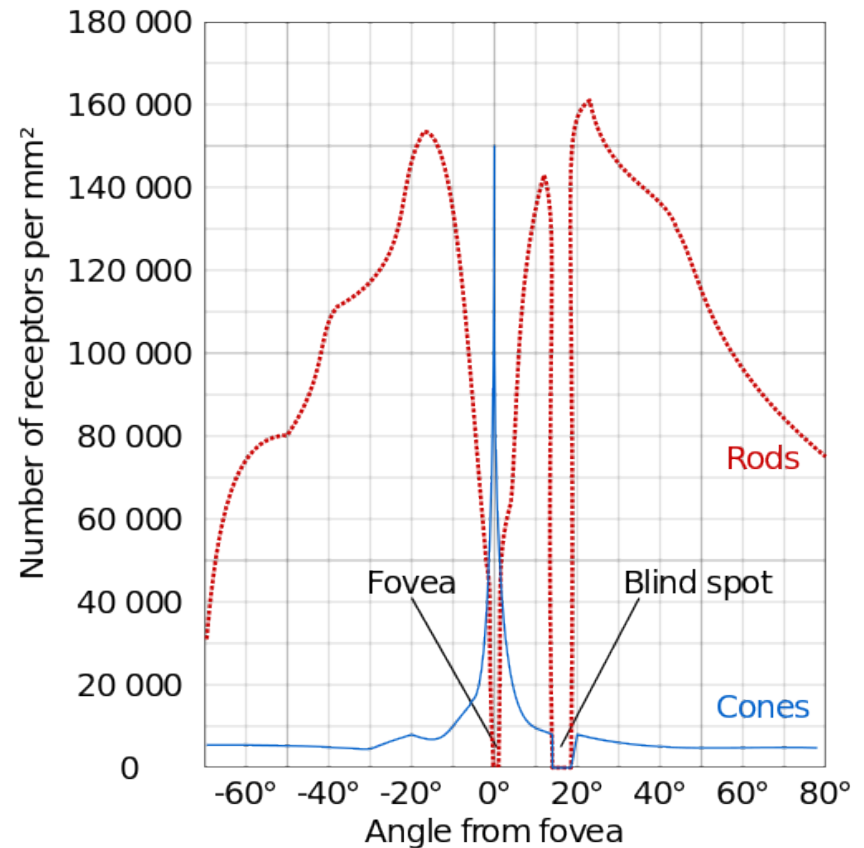
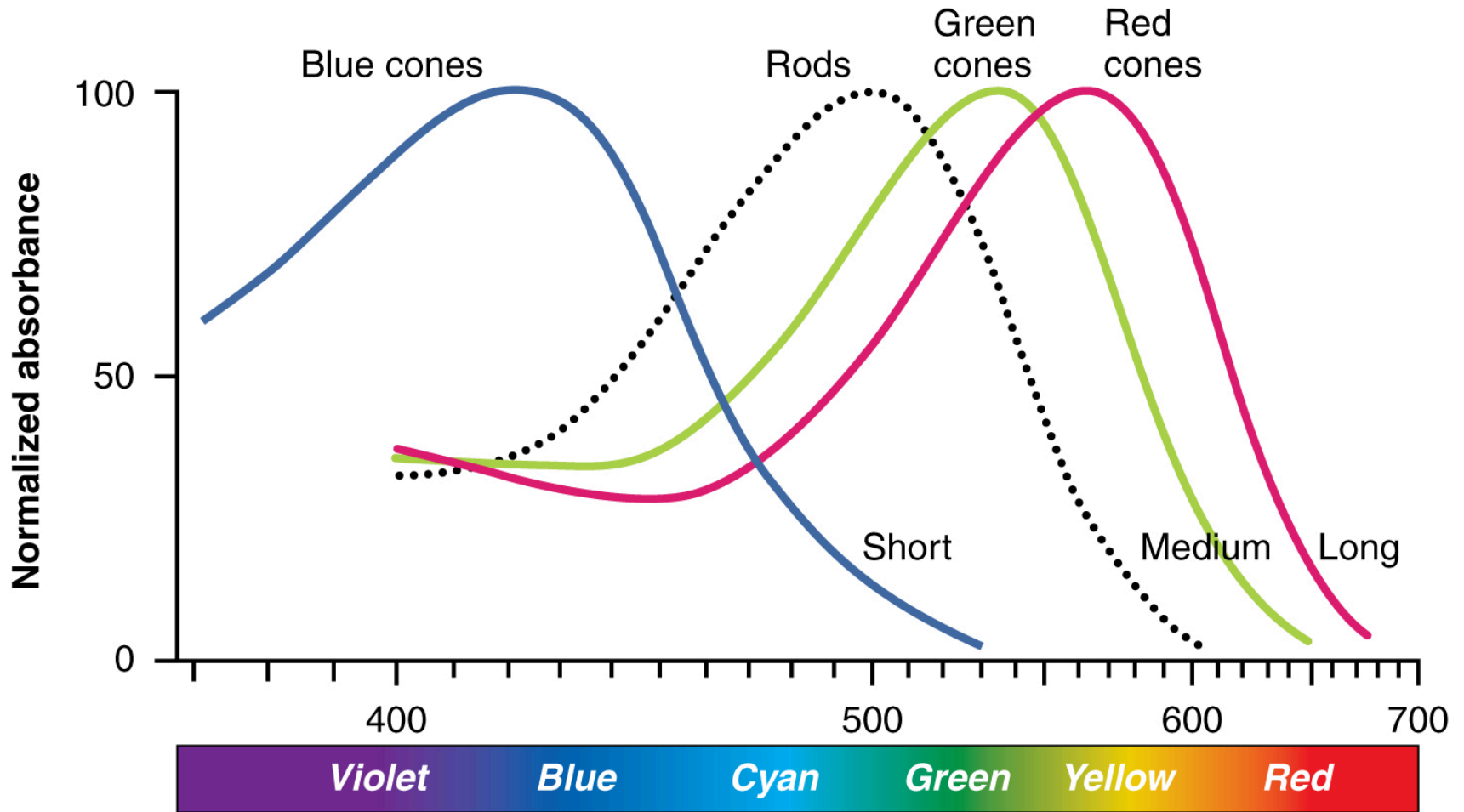


Photo Receptor Cells



Vision System(s)

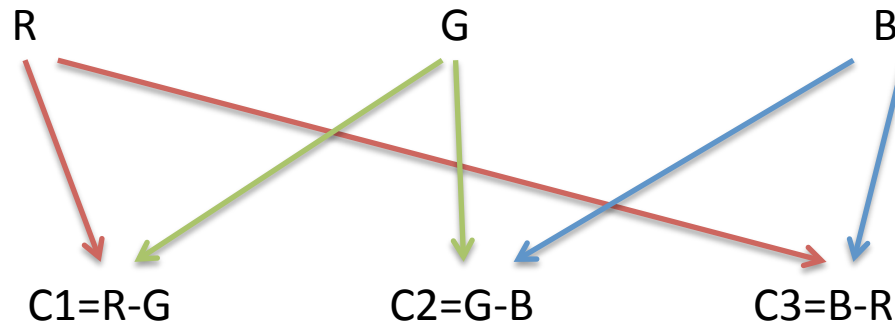
- Low light vision is managed by rods
- Scotopic vision system
- Peak of efficiency around 500nm
- Cannot distinguish colors
- Activation requires a long time
- Normal light vision
- Photopic vision system
- Peak of efficiency at 560nm

Color Model

- Young-Helmoltz Theory (19th century)
 - Separate Red, Green, Blue receptors
 - Actually, three receptors type exist
 - Red and Green are located mainly in green-yellow zone
 - Sometimes named as Long, Medium, Short wavelength receptors
 - Eye present different proportions of R,G,B receptors (40:20:1)

Opponent Color Theory

- Based on estimation of opposite readings
 - red-green comparison
 - blue-yellow comparison
 - dark-light comparison



$$C1+C2+C3=0$$

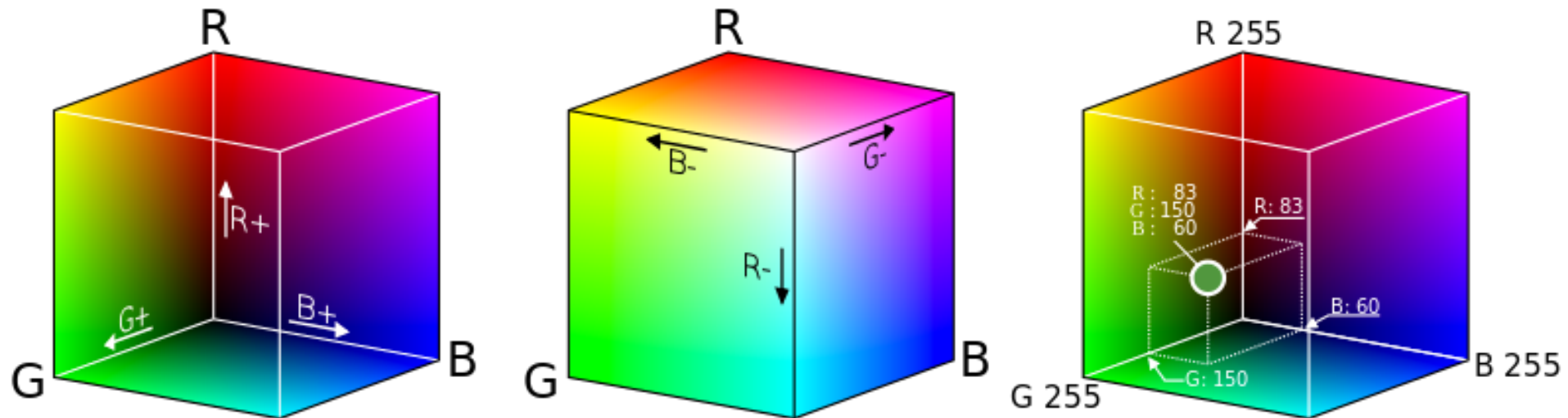
$$C1=R-G$$

$$C3-C2=B-R-G+B=2B-(R+G)$$

$$A = 2R+G+B/20$$

RGB Color Model

- Based on direct specification of three primary colors
- Additive model, each component is summed with the others

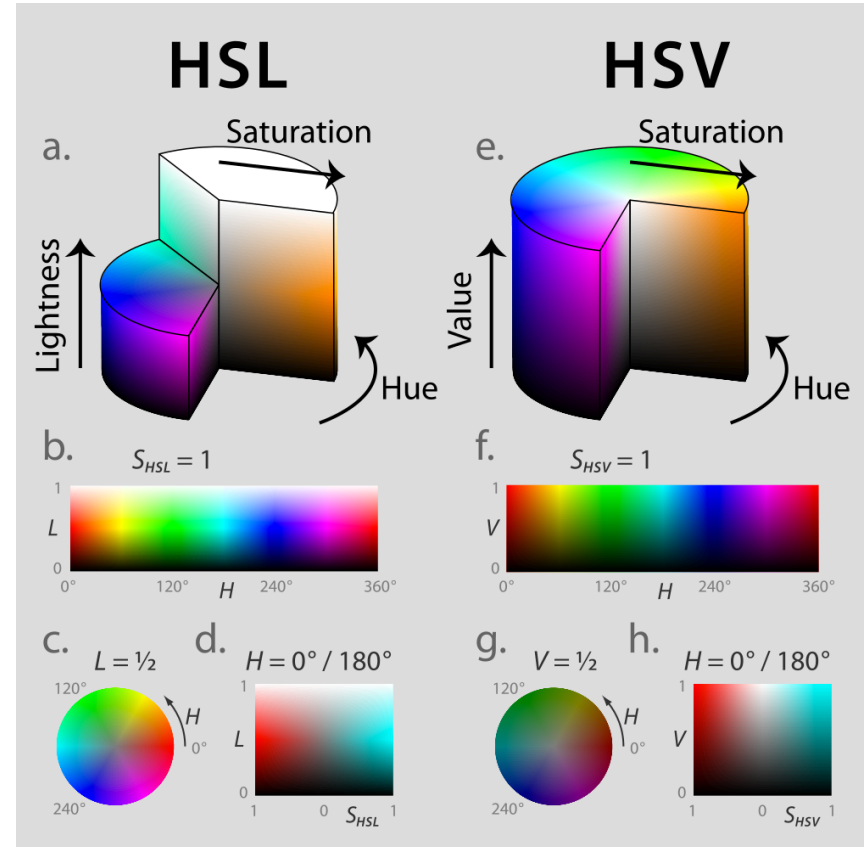


RGB Color Model

- R,G,B values may be expressed in range [0,1]
- Some applications use the range[0,255]
- Usually a hexadecimal notation is used for range [0,ff]
- Not really intuitive: how to define brown?

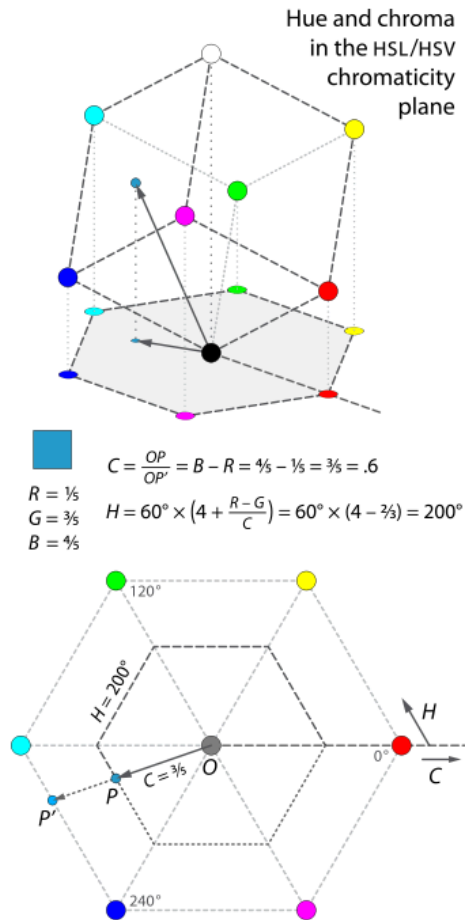
HSV Color Model

- Based on the intuitive concepts of
 - Hue
 - Saturation
 - Value
- Component values are expressed in ranges $[0,1]$ or $[0,255]$

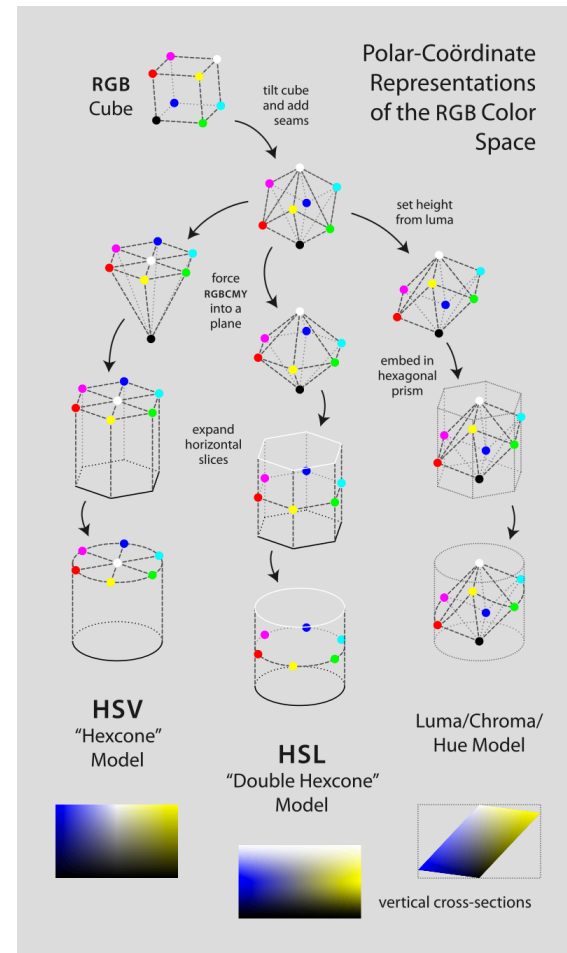


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RGB and HSV



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