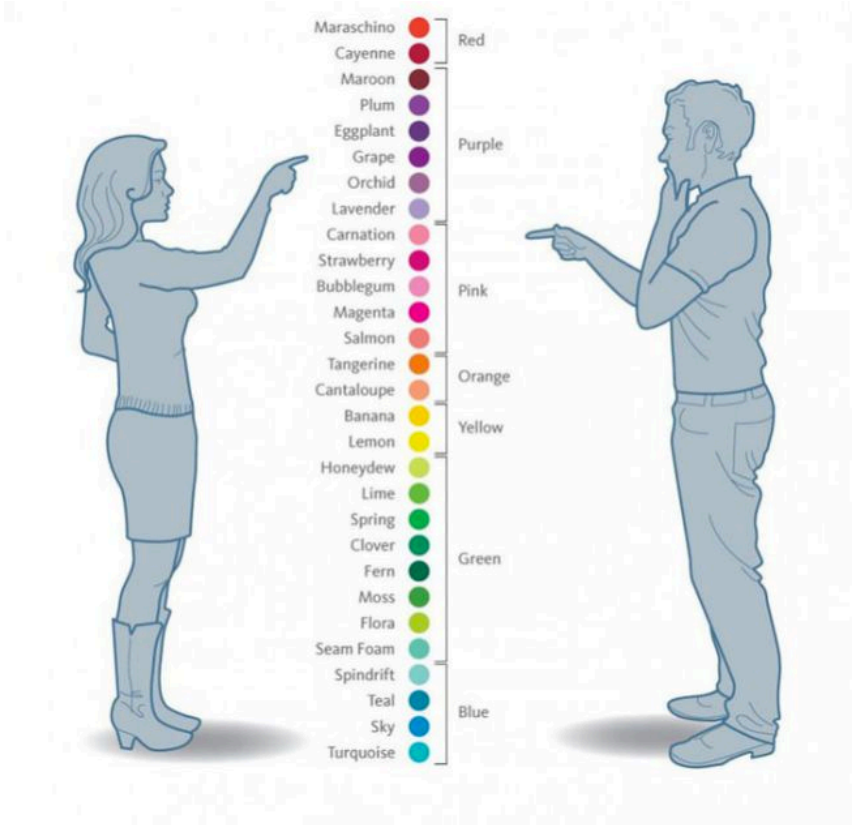
Visual Analytics
Colors (continued)

S. Rinzivillo

20 April 2015

How many color?

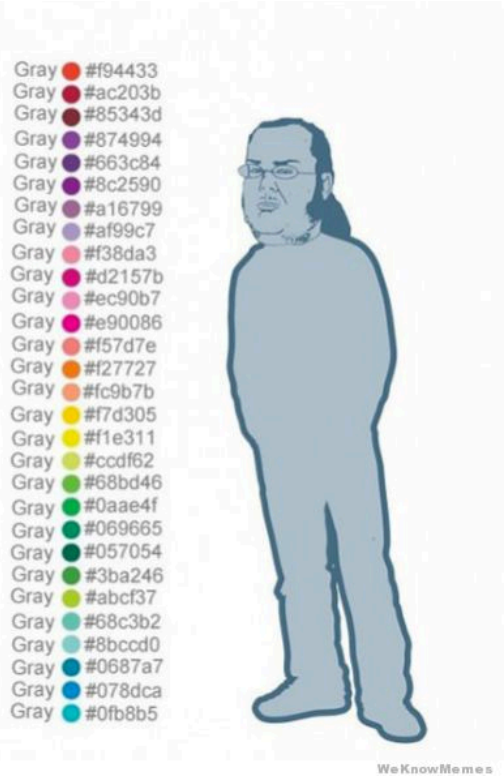
Female



Male

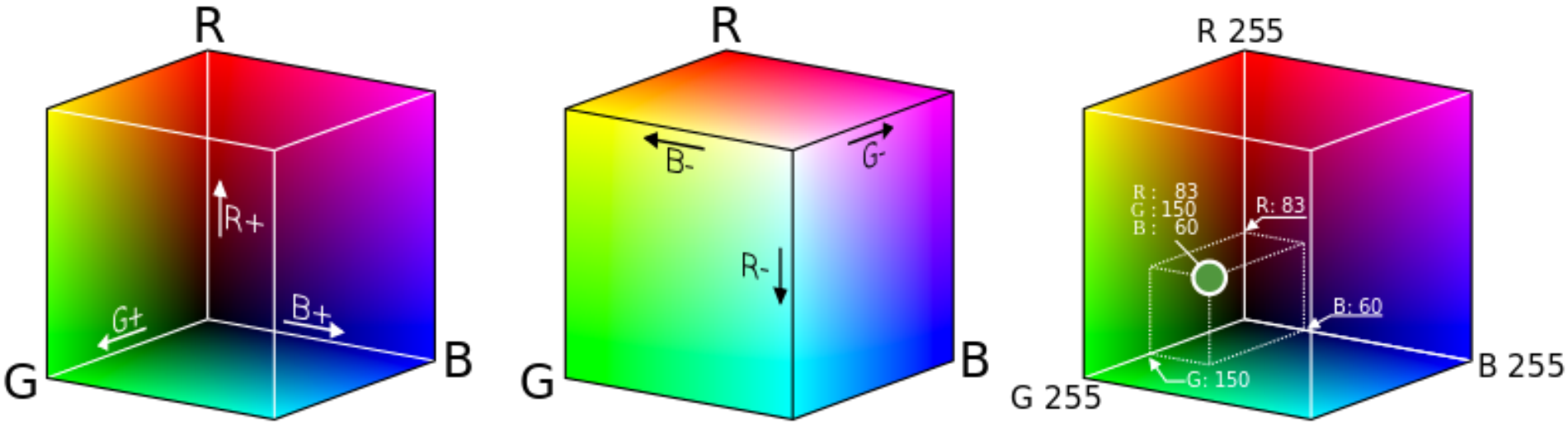
Dog

Programmer



RGB Color Model

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



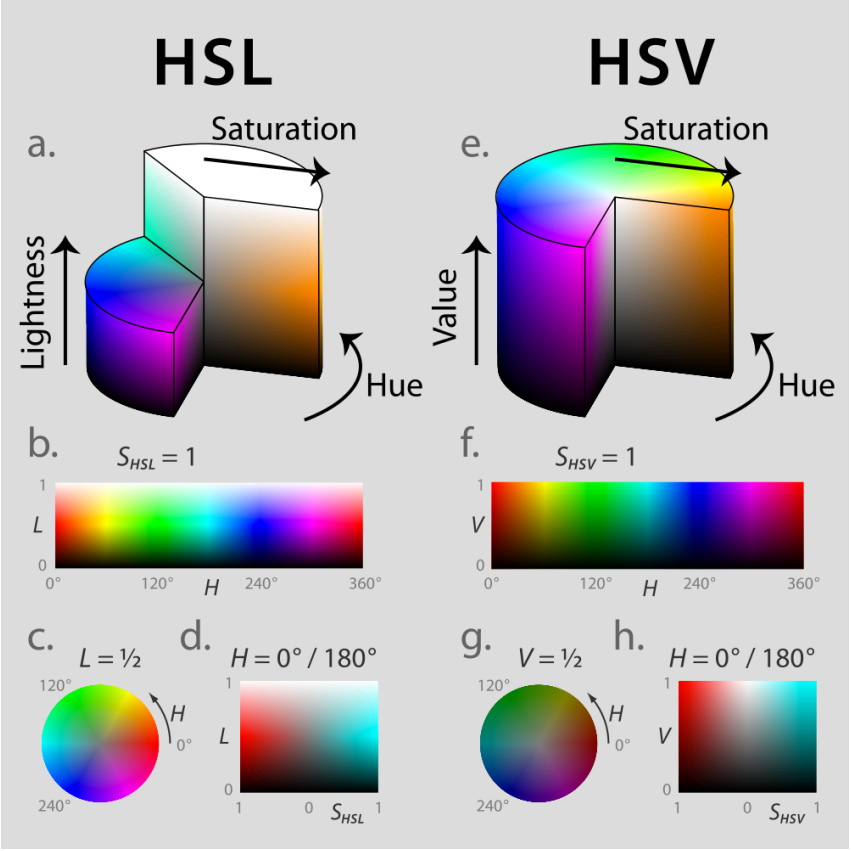
"RGB color cube" by User:Maklaan - Own workbased on:RGB_farbwuerfel.jpg by Horst Frank. Licensed under CC BY-SA 3.0 via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:RGB_color_cube.svg#/media/File:RGB_color_cube.svg

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?

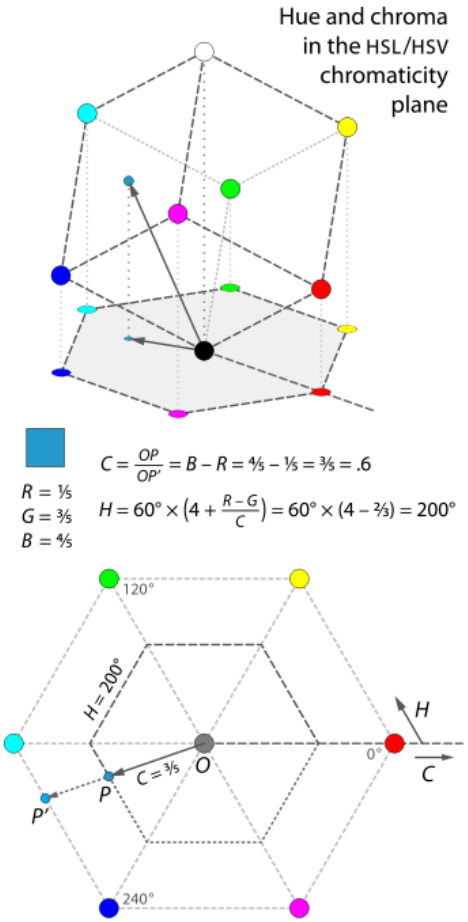
HSV Color Model

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

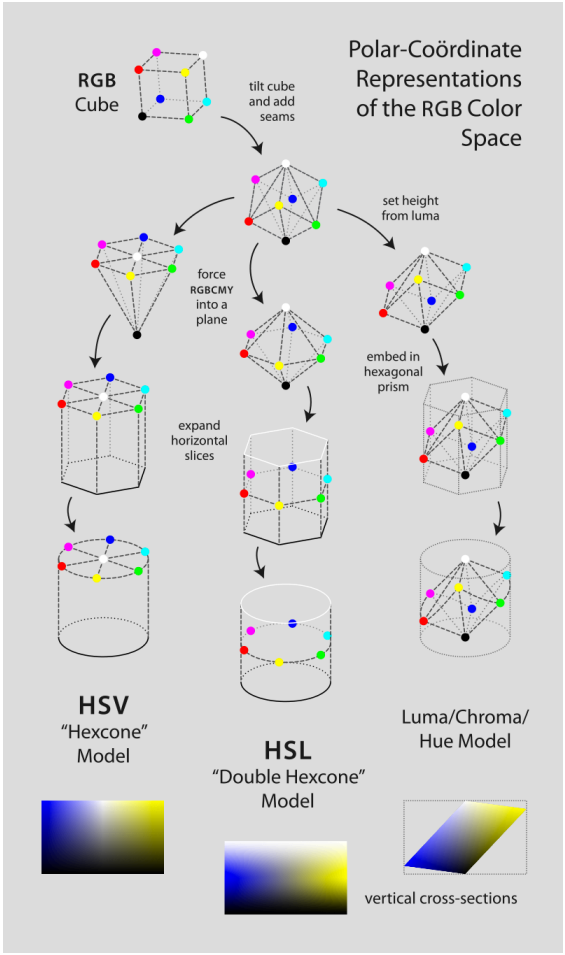


"Hsl-hsv models" by Jacob Rus - Own work. Licensed under CC BY-SA 3.0 via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:Hsl-hsv_models.svg#/media/File:Hsl-hsv_models.svg

RGB and HSV



"HSL-HSV hue and chroma" by Jacob Rus - Own work. Licensed under CC BY-SA 3.0 via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:HSL-HSV_hue_and_chroma.svg#/media/File:HSL-HSV_hue_and_chroma.svg



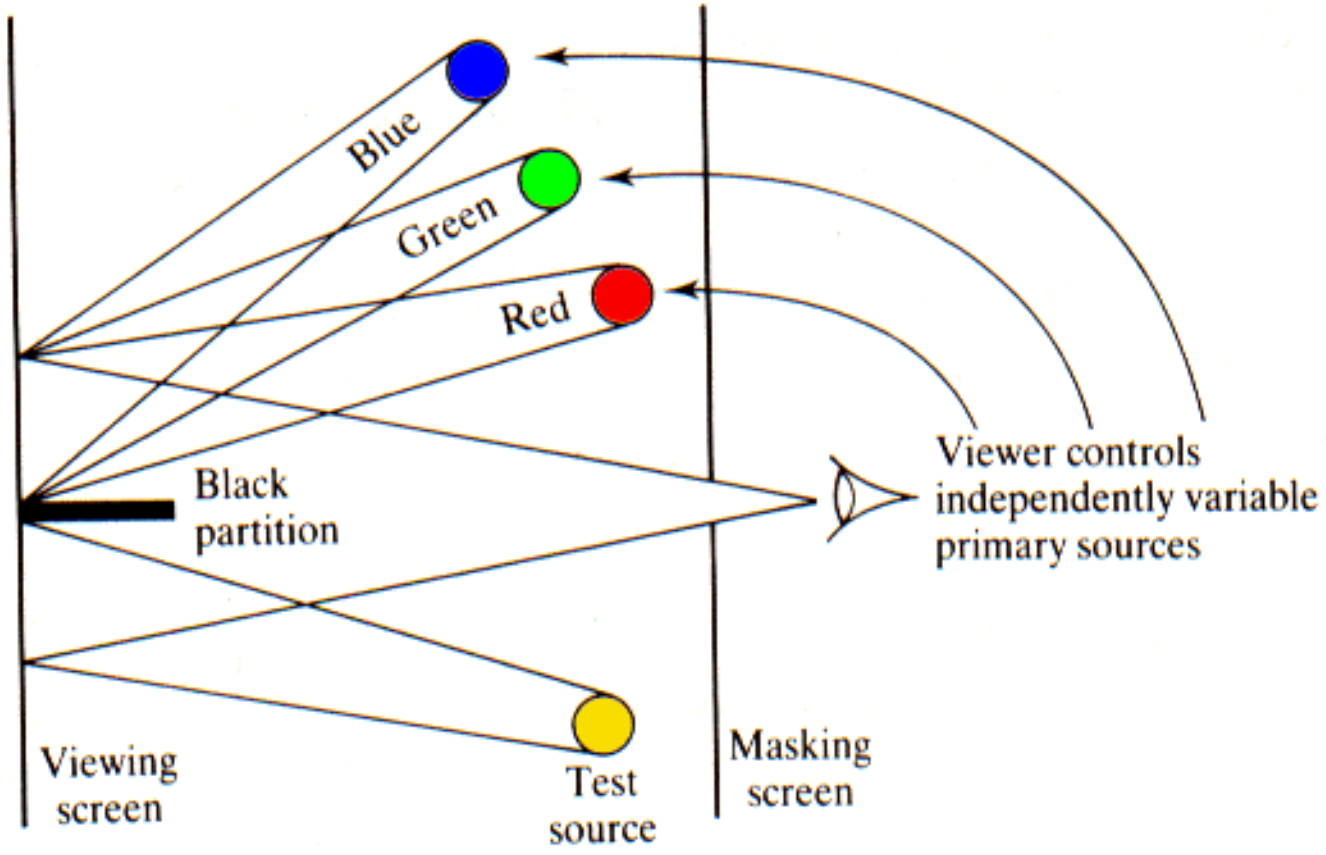
"Hsl-and-hsv" by Jacob Rus - Own work. Licensed under CC BY-SA 3.0 via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:Hsl-and-hsv.svg#/media/File:Hsl-and-hsv.svg

COLOURIMETRY

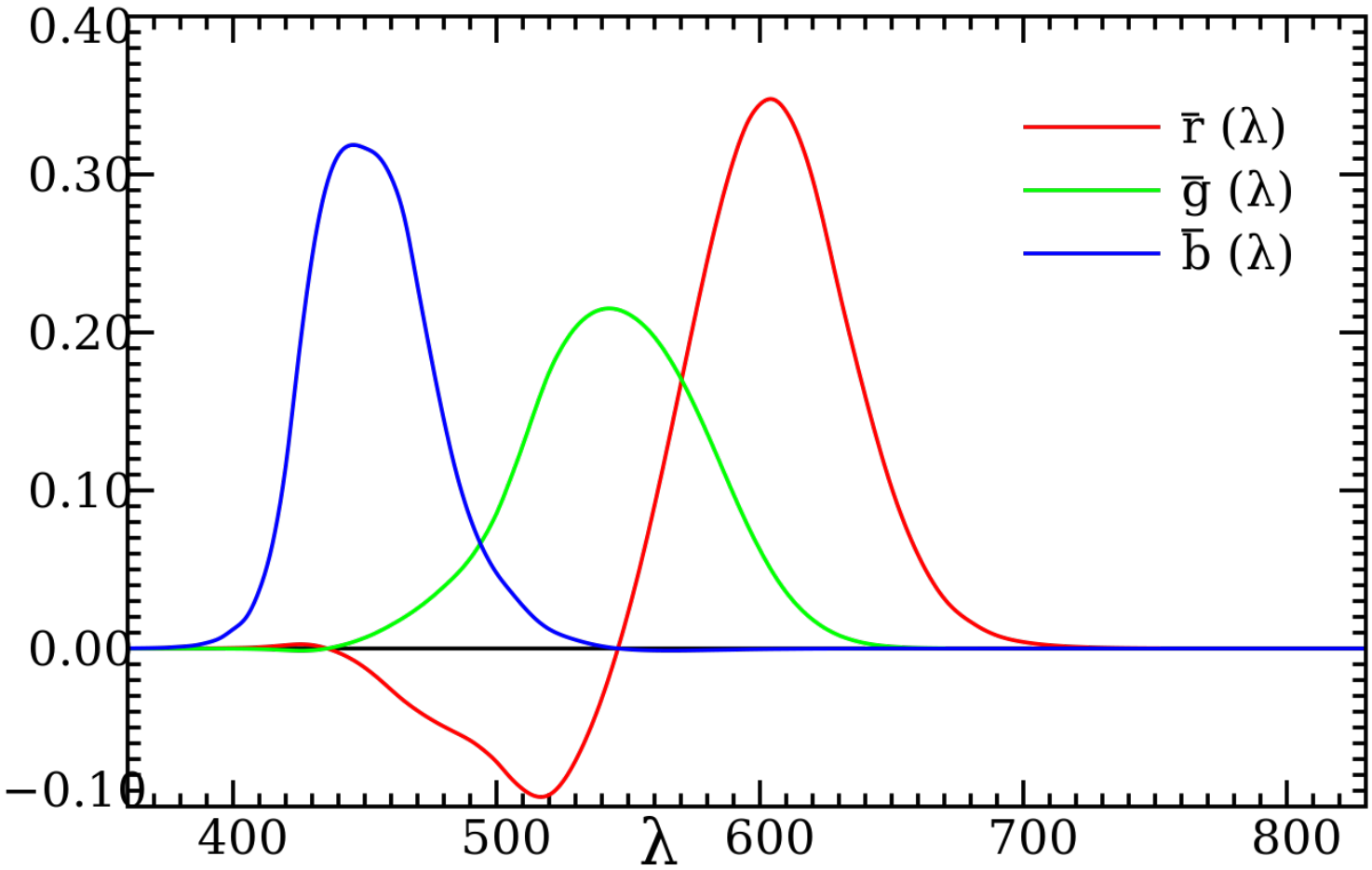
CIE Standard Observer

- CIE: International Commission on Illumination
- Definition of an objective color-mapping function:
  - Standard colorimetric observer
- Experiment
  - An observer is positioned in front of a bipartite screen
  - Observer can manipulate intensities of three primary color beams
  - Task:match the reference color

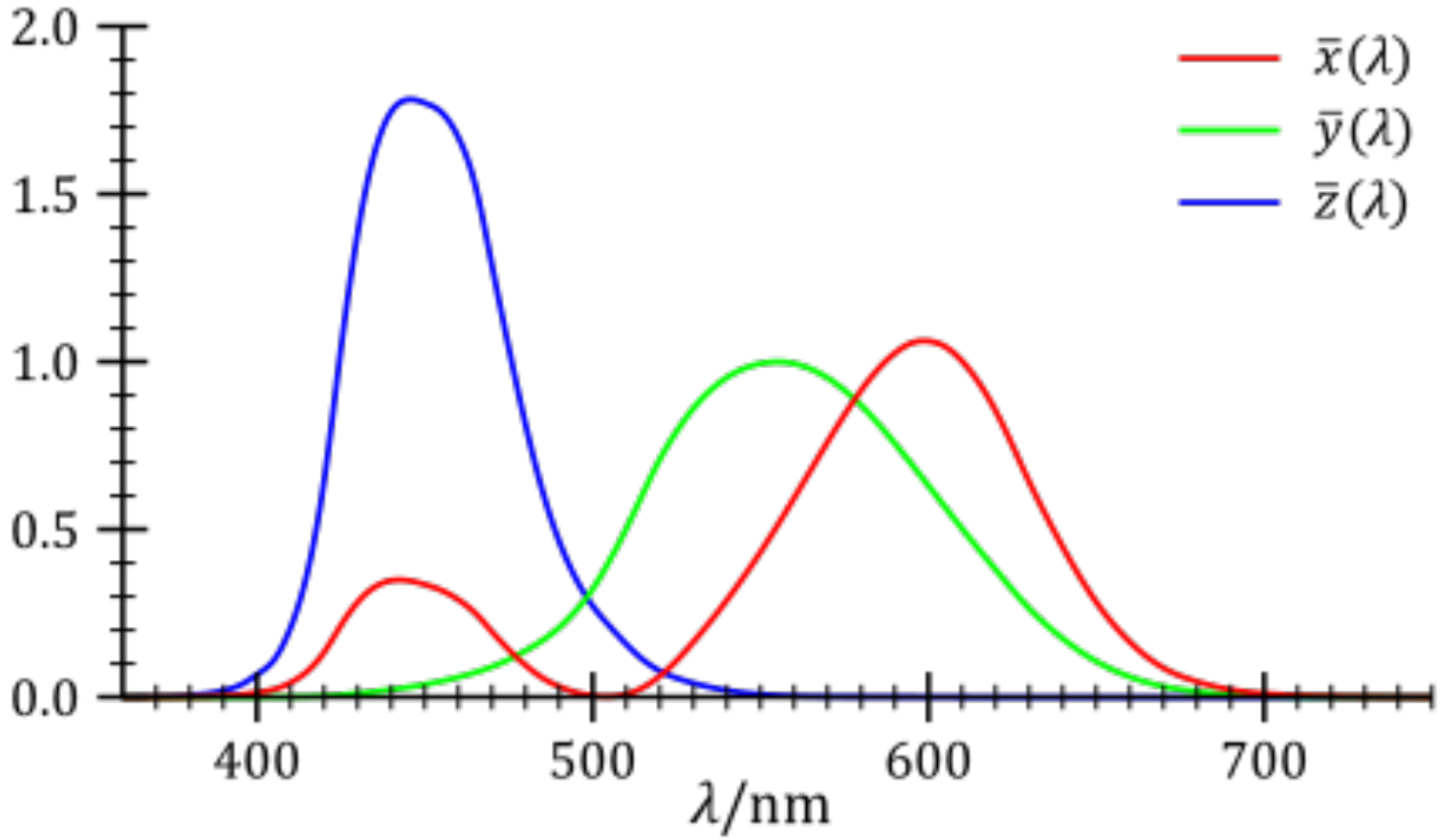
Standard Observer Experiment



Standard Observer Results



Color Matching Functions: imaginary primary colors



Tristimulus Values

- A color if defined by its spectral function S(λ)
- According to the matching function , we have:

$$X = \int \bar{x}(\lambda) S(\lambda) d\lambda$$

$$Y = \int \bar{y}(\lambda) S(\lambda) d\lambda$$

$$Z = \int \bar{z}(\lambda) S(\lambda) d\lambda$$

Chromaticities

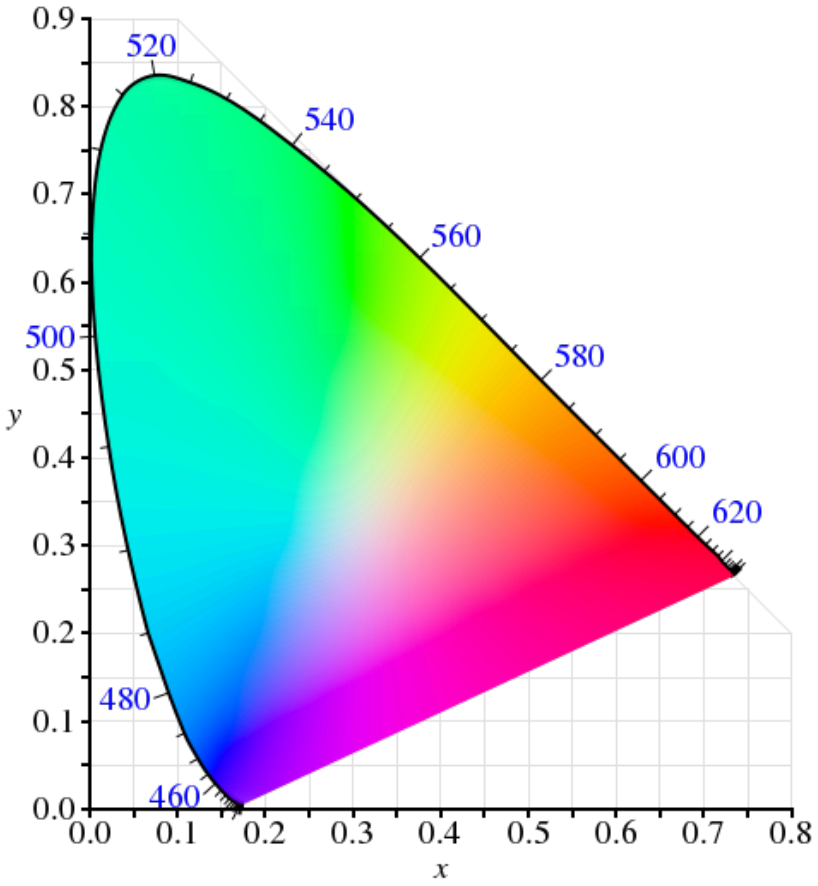
- Tristimulus values comprehend effects of hue, saturation and brightness
- We can filter out brightness with chromaticitied:

$$x = \frac{X}{X+Y+Z}$$

$$y = \frac{Y}{X+Y+Z}$$

$$z = \frac{Z}{X+Y+Z}$$

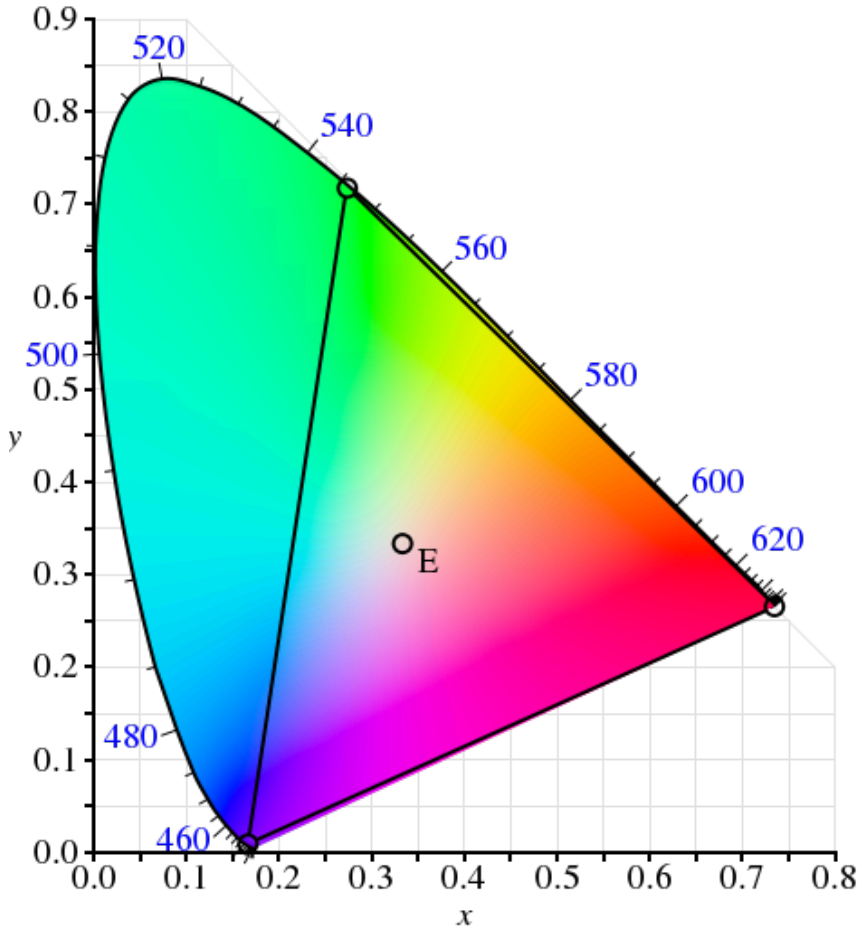
Chromaticity Diagram



- A mixture of two colors lies on the line connecting the two colors
- Chromaticity Diagram (gamut) is convex
- All visible colors are non-negative combination of x, y, and z
- An equal combination of two colors does not lie in the mid-point

Color Mixing

- Given three primary colors, the corresponding triangle cannot cover the whole gamut



"CIE1931xy CIERGB" by BenRG - Own work, inspired by File:CIExy1931.png. Licensed under Public Domain via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:CIE1931xy_CIERGB.svg#/media/File:CIE1931xy_CIERGB.svg