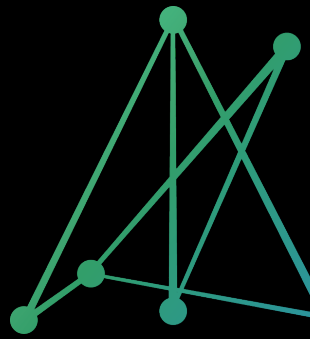


DATA SCIENCE
& ANALYTICS

University of Missouri

Data Visualization

Color

Visual Perception

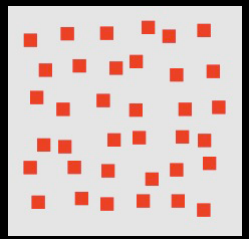
- Design visual information to be efficiently perceivable – quick, unambiguous.
- Need to understand how human visual perception and information processing works.

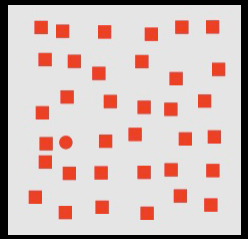
- Preattentive Processing
- Small set of basic visual properties are processed preattentively.
- Information that “pops out”.
- Parallel processing by the low-level visual system.

- Important for designing effective visualizations
- What features can be perceived rapidly?
- Which properties are good discriminators?
- What can mislead viewers?
- How to design information such that it pops out?

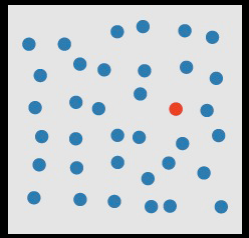
Preattentive Processing

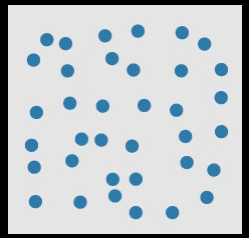
Color is preattentively processed. So is shape.





DF**V**HDYJDWYSEPSBCWNQWZNCXETRBX
QECMRTHJPC**V**ORCGMXNXZEZFKYJH**V**CT
XECRF**V**PTOJNBK**V**CMXNRXW**V**MYBMACQ
RTRPFEOFG**V**MCNSZXNCEHOCYJHOB**V**CM



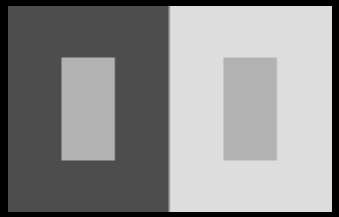


Perceptual Distortions in Color

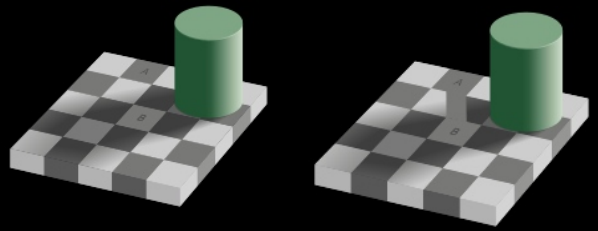
- Simultaneous contrast
- Interactions between color components
  - Brightness/hue
  - Saturation/brightness
- Effect of color on perceived size
- Color deficiencies (color blindness)

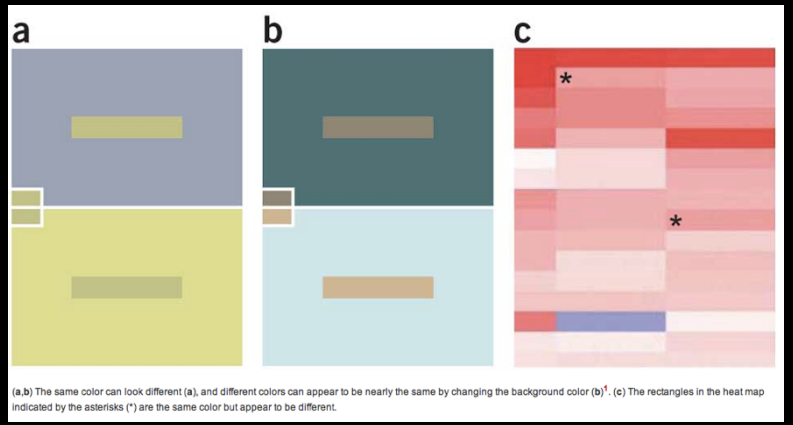
Color Considerations

- Simultaneous contrast



Same color different perception

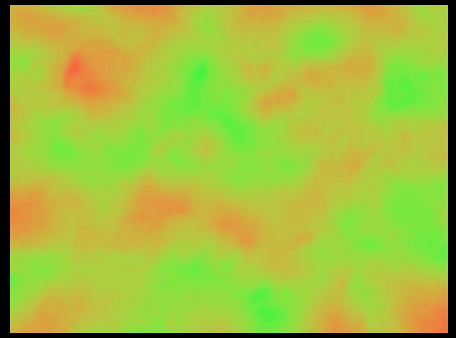




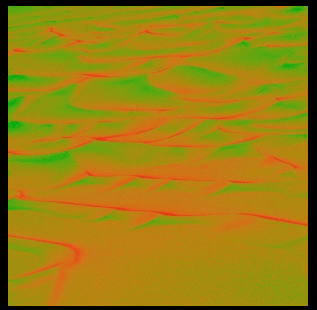
(a,b) The same color can look different (a), and different colors can appear to be nearly the same by changing the background color (b)[1]. (c) The rectangles in the heat map indicated by the asterisks (*) are the same color but appear to be different.

Color Considerations

- Contrast Sensitivity



Human visual perception is more sensitive to changes in luminance.



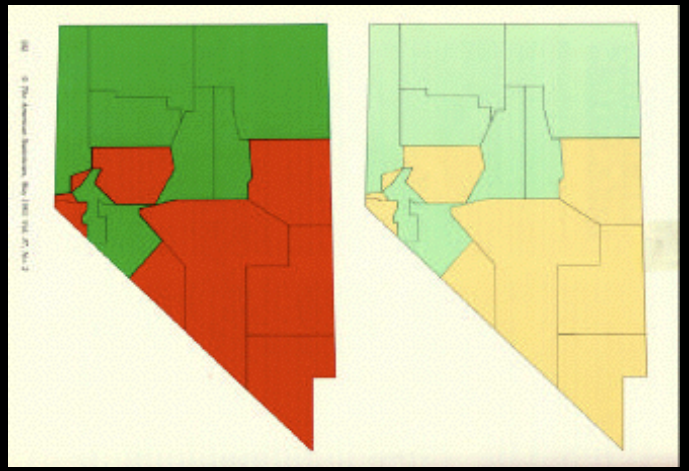
Color Considerations

- “Get it right in black and white.”

Color Considerations

- Color size illusion

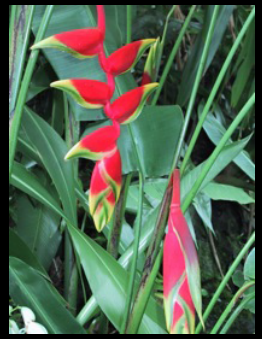
Red has the highest visual weight; yellow has the least visual weight.

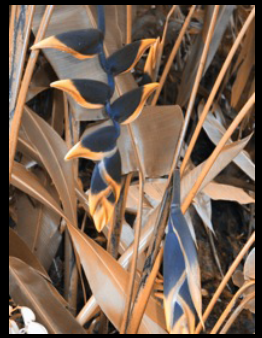


Color Blindness

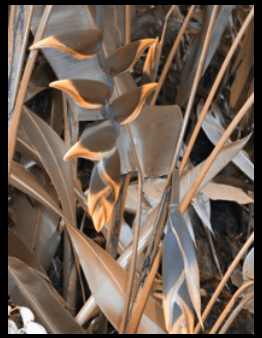
Red / Green deficiencies

Blue / Yellow deficiency

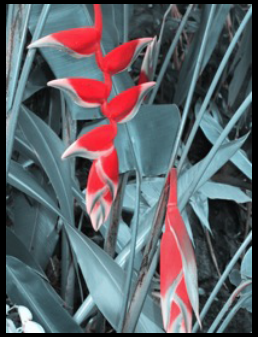




Protanope



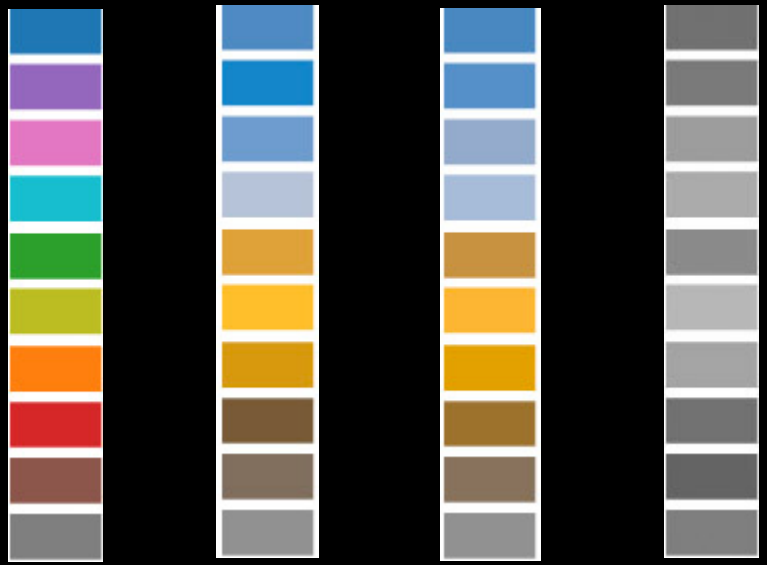
Deuteranope



Tritanope

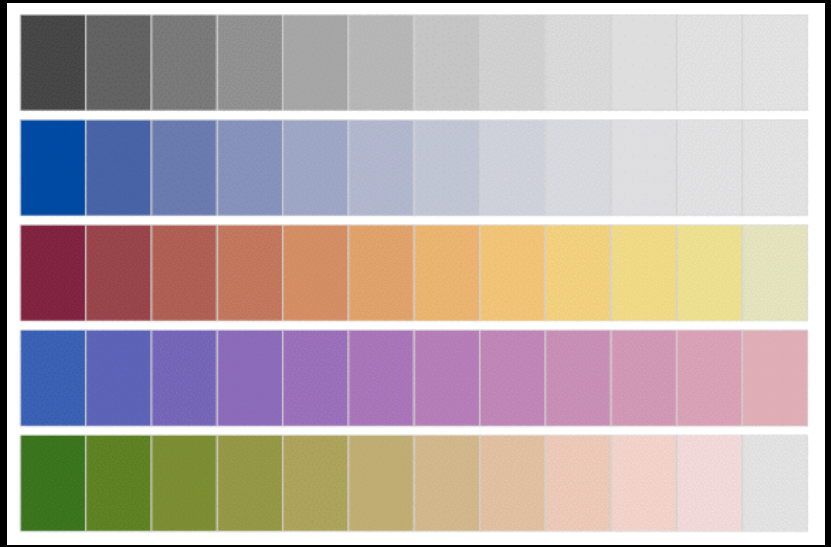
Color Blindness

About 7-10% of the male population is red-green color blind.

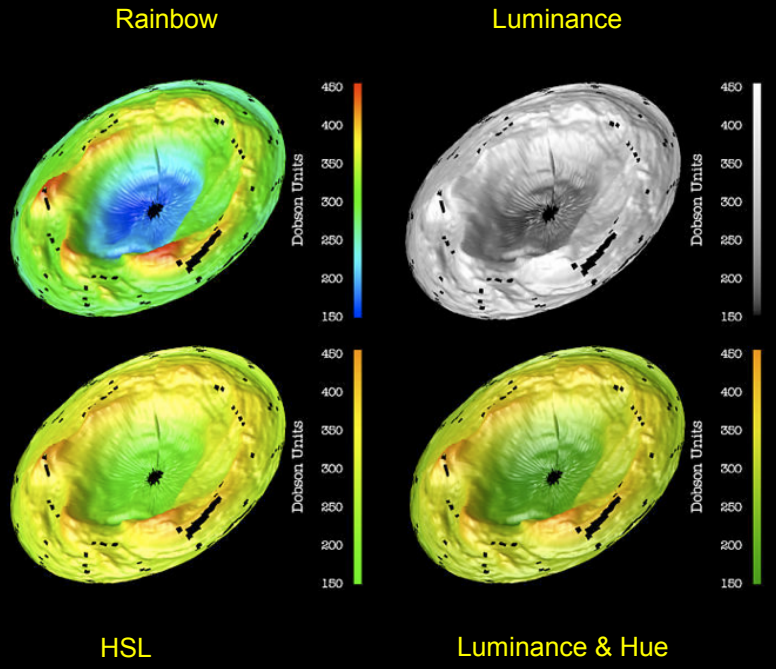


Using Sequential Colors

Vary luminance and saturation.
Hue can also increase contrast.



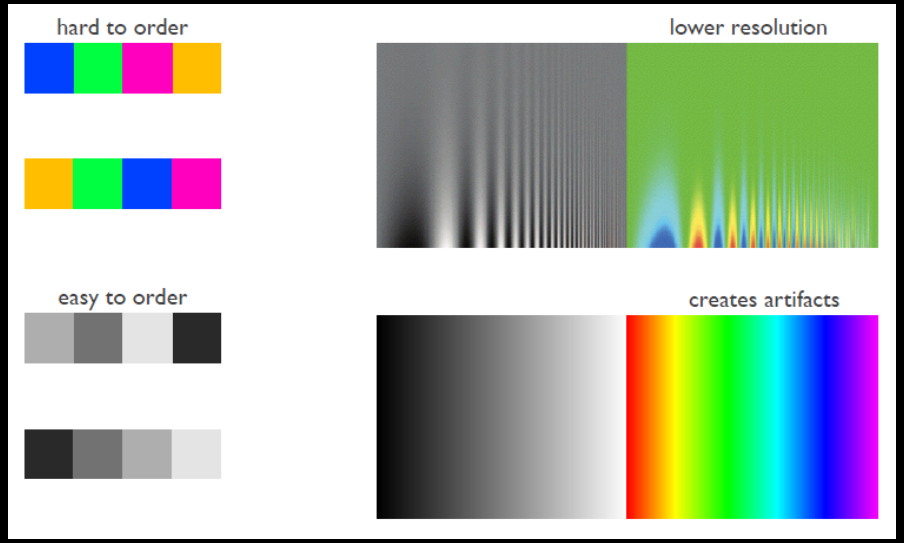
Color Maps


Rainbow
Luminance
HSL
Luminance & Hue
Dobson Units
450
400
350
300
250
200
150
better
Rainbow
Luminance
HSL
Luminance & Hue

Rainbow Colormap

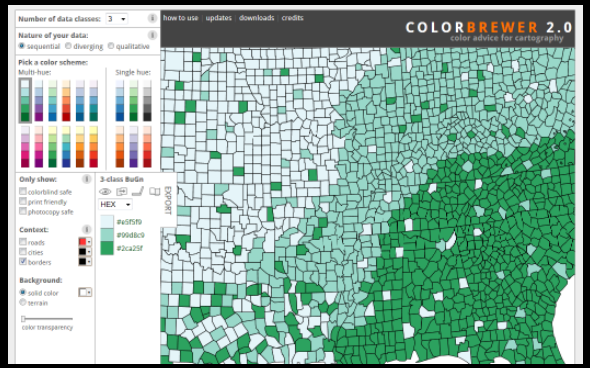
Rainbow colormap has several problems and should be avoided.

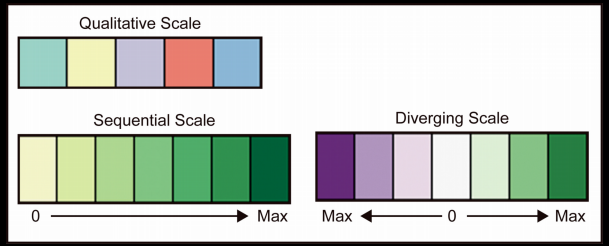
- hard to order colors
- has lower visual resolution
- creates artificial gradients



ColorBrewer

For color advice, visit colorbrewer2.org and play with the choices.





END OF SLIDES