Visual Analytics– Color

Dr. Ab Mosca (they/them)

Slides based off slides courtesy of Jordan Crouser (https://jcrouser.github.io/)

Notes

- Nice job on the mid-semester project!

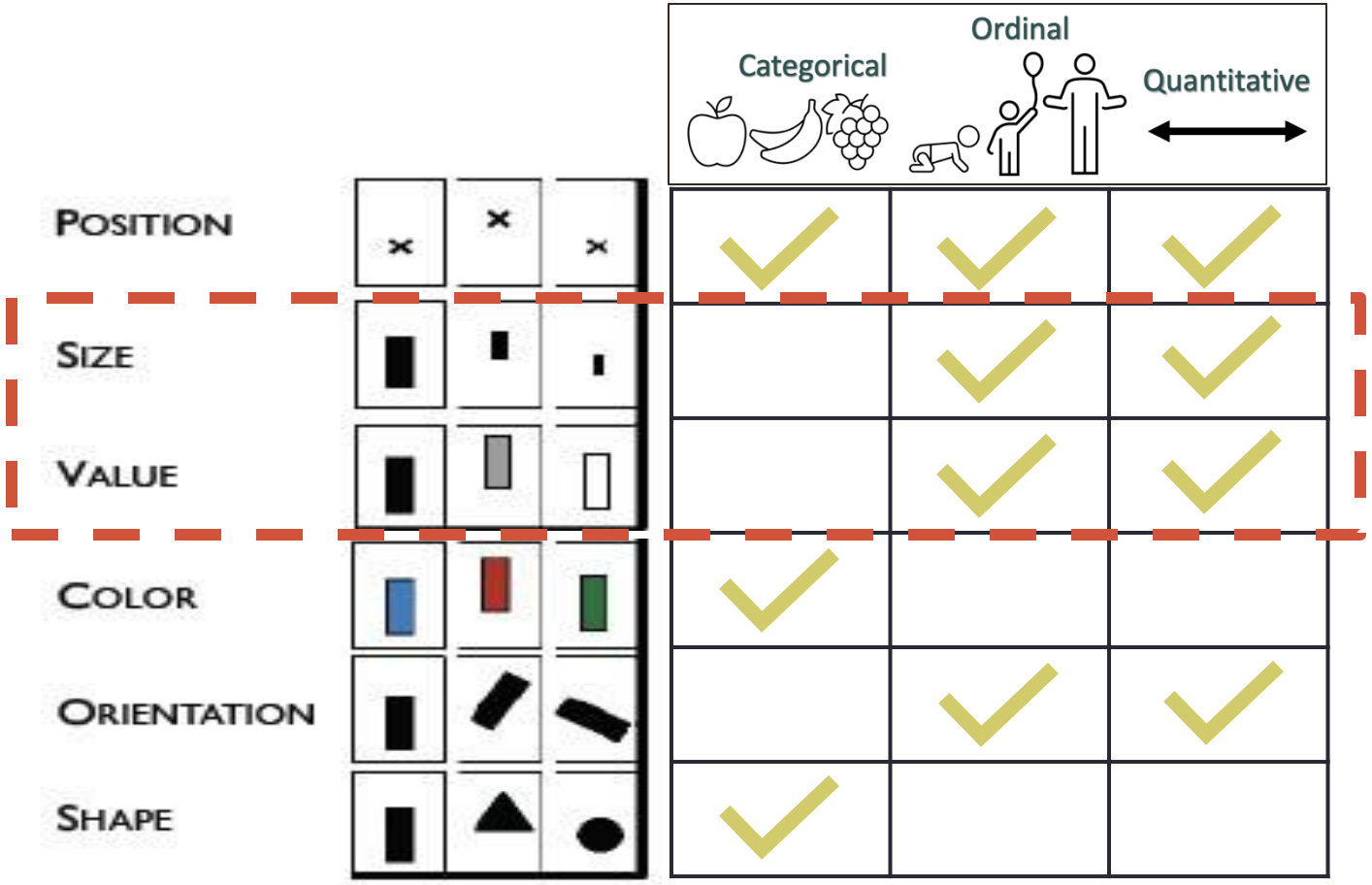
- How was reading an academic paper?
- What did you learn from looking at VA systems?

Plan for Today

- Color
  - How we see it
  - Spaces
  - Phenomenon
  - Pallets
- Lab

Flashback: Mapping to visual dimensions

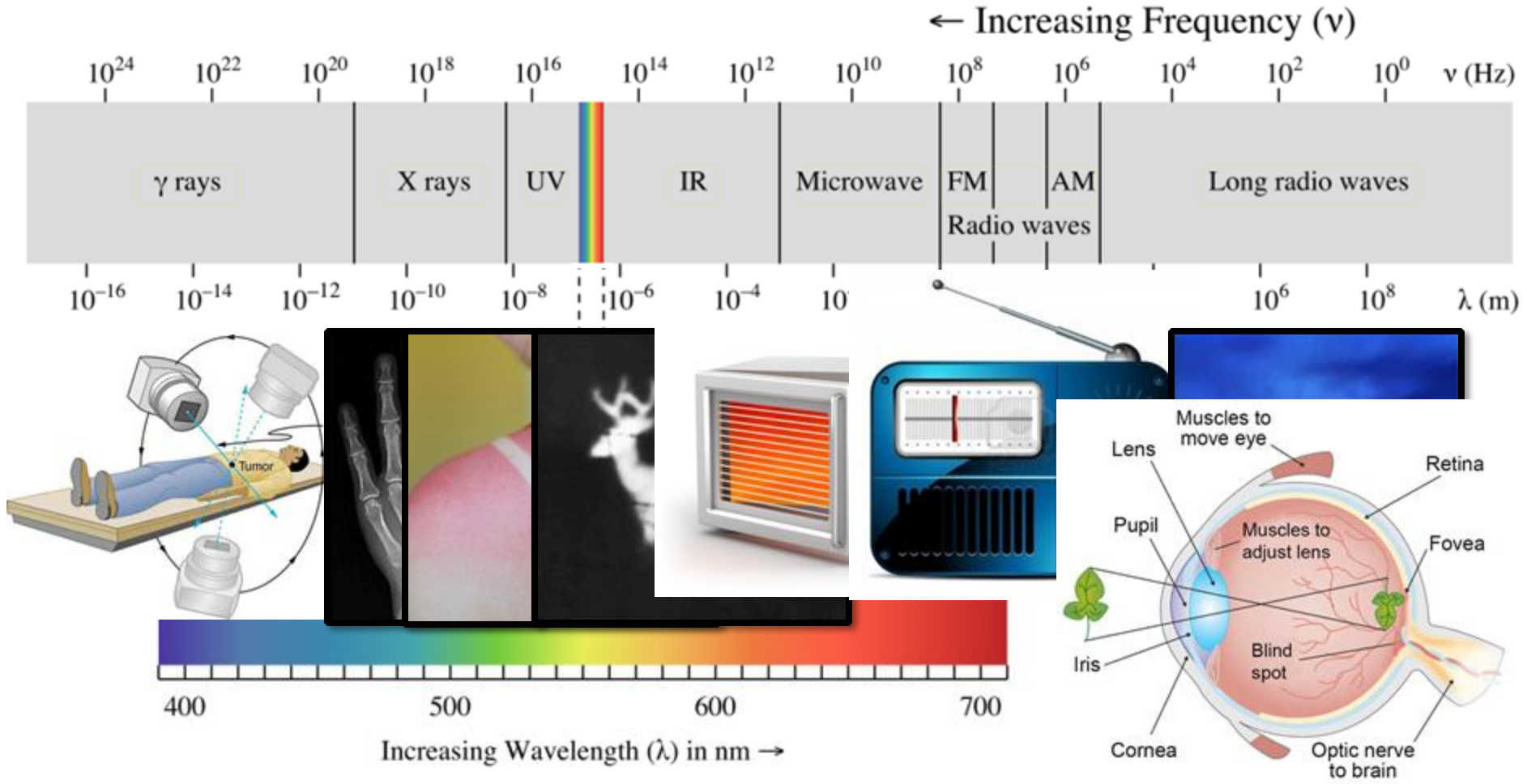
- Remember… **Big idea behind visualization**
  - Map data dimensions to visual dimensions in a principled way
  - Not all visual dimensions can represent all data types



Jacques Bertin, *Semiologie Graphique* (Semiology of Graphics), 1967.

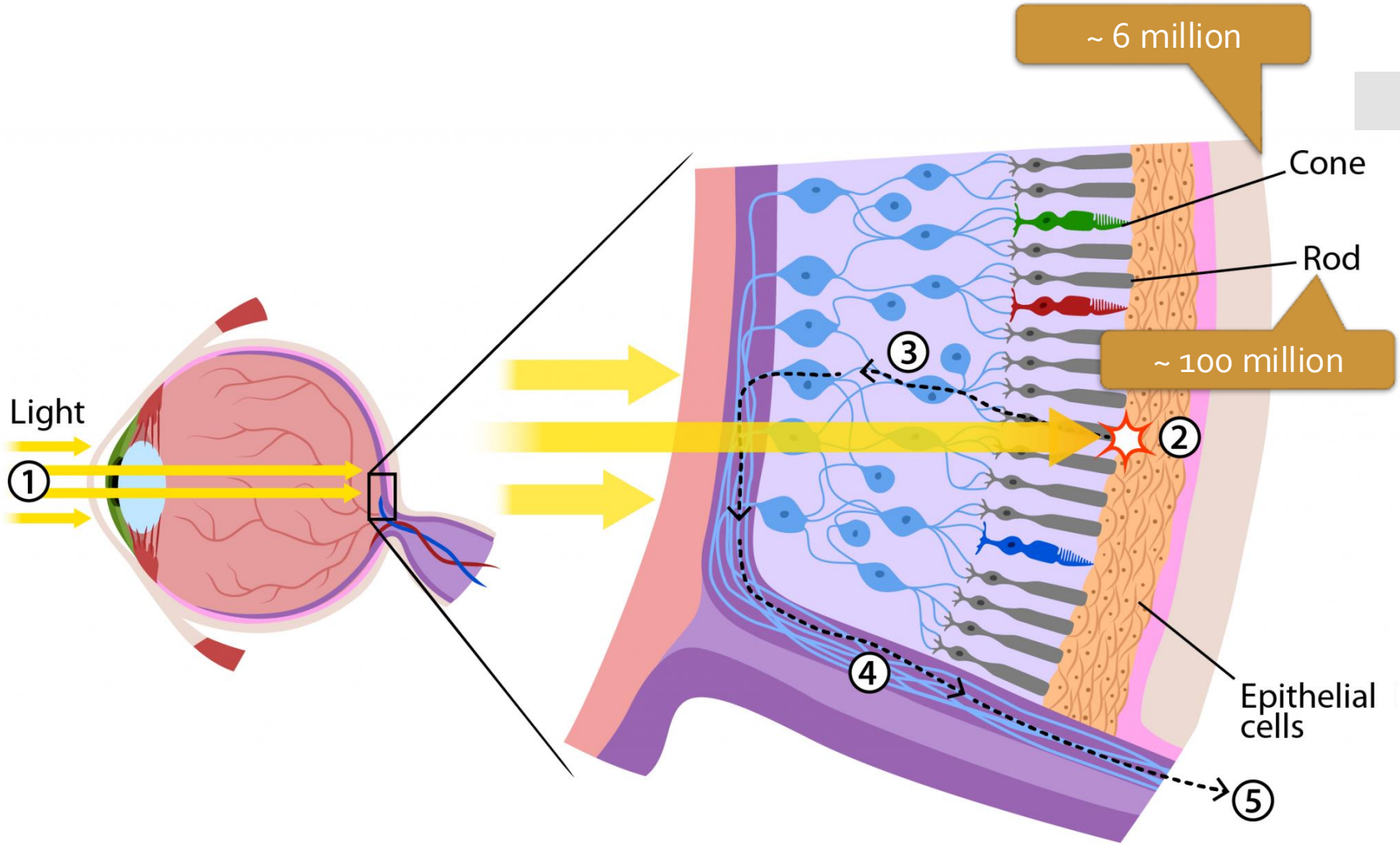
Color 101

Kinds of light



Eye diagram courtesy ASU

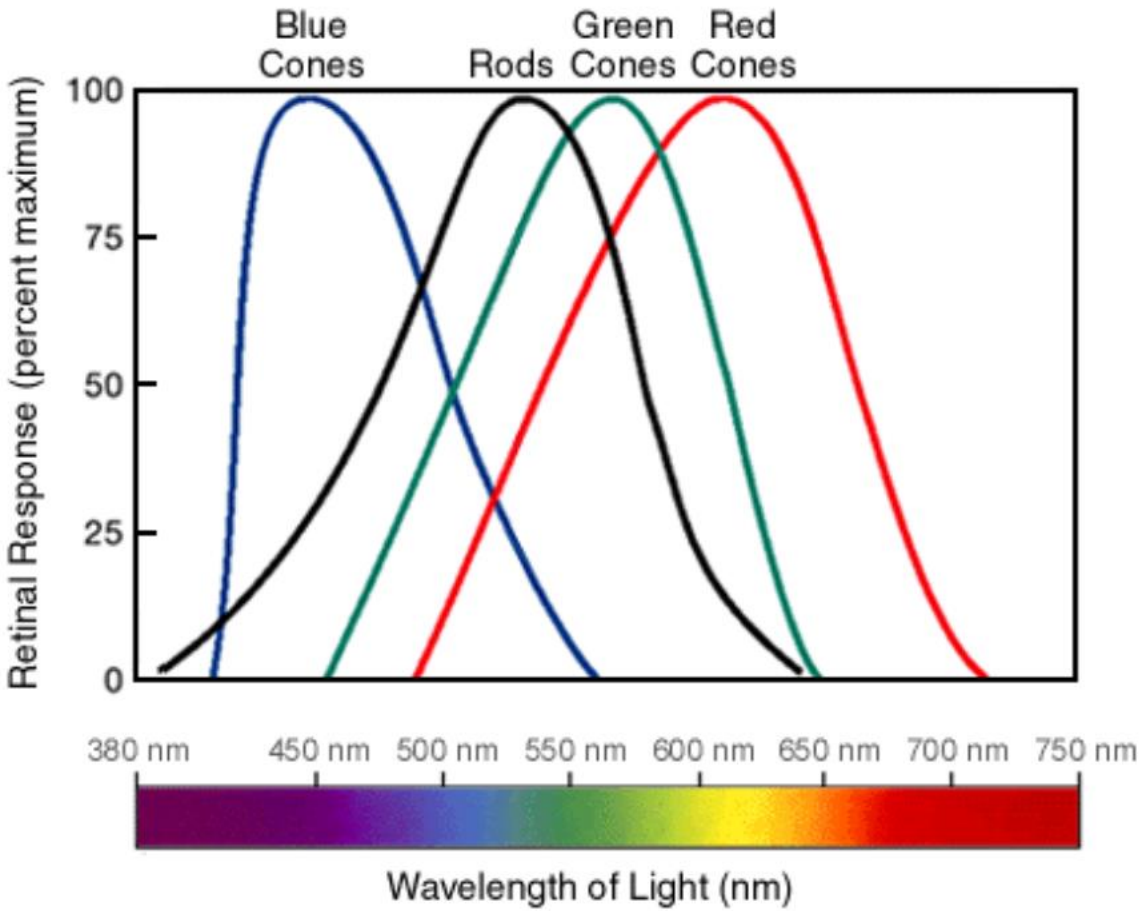
How we see color



https://askabiologist.asu.edu/rods-and-cones

How we see color

What do you notice here?



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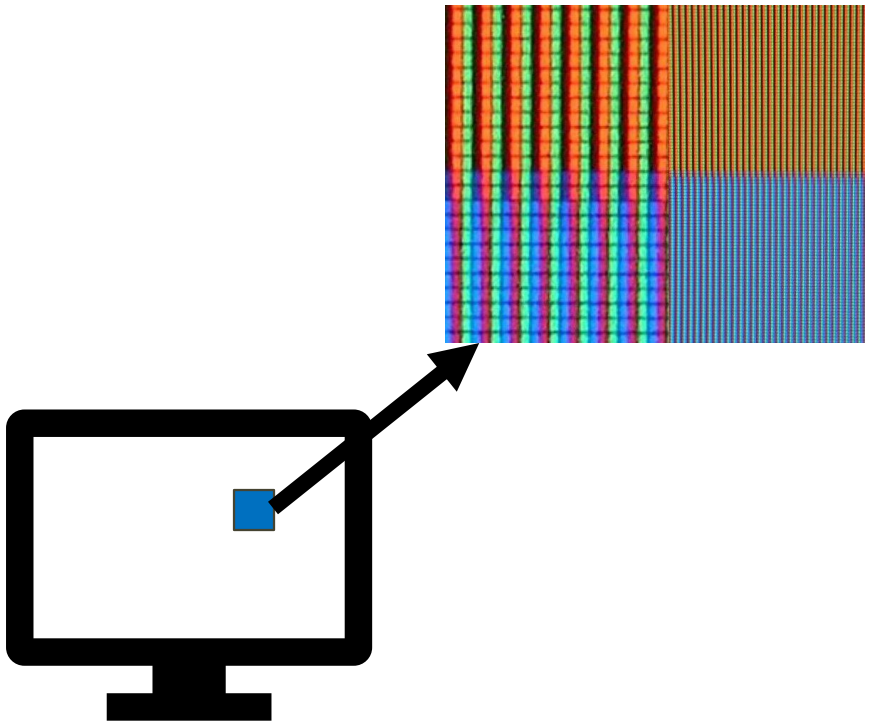
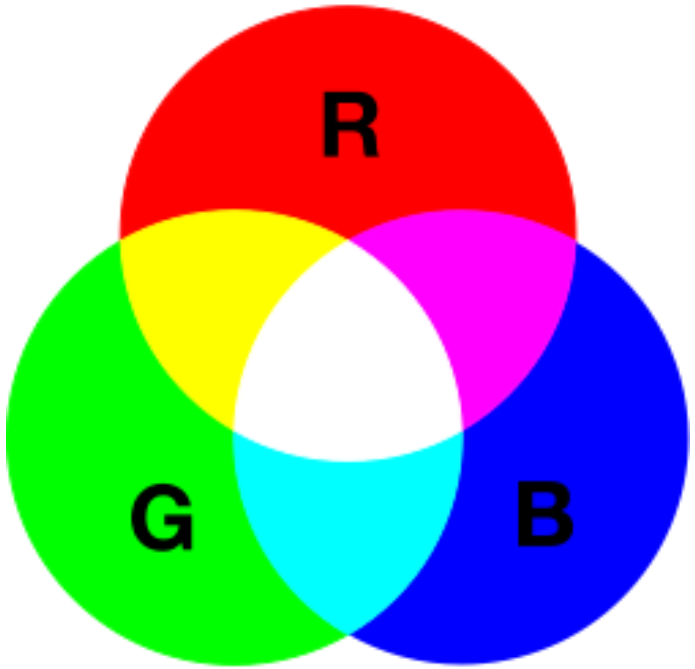
How we represent color

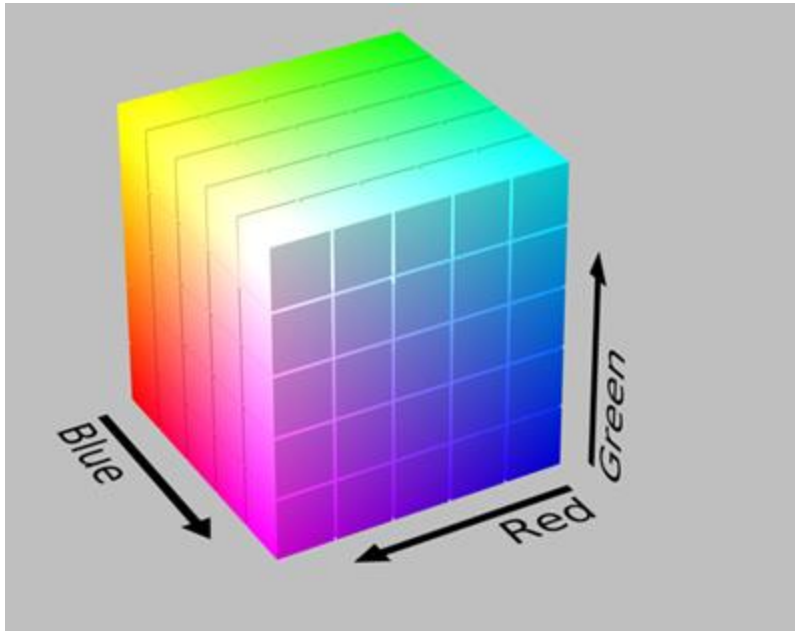
RGB





How we represent color

RGB



Issues

- Distance between colors nowhere near how we perceive differences

A: (5, 7, 15) B: (15, 17, 25)

rgb(0, 128, 0)

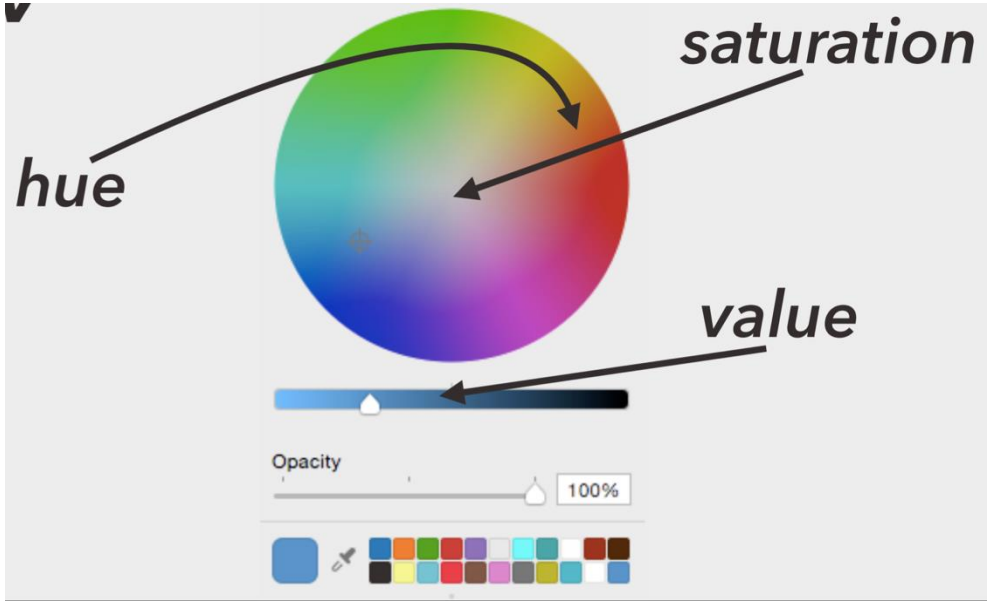
rgb(10, 138, 10)

rgb(128, 0, 0)

rgb(138, 10, 10)

How we represent color

HSV/L



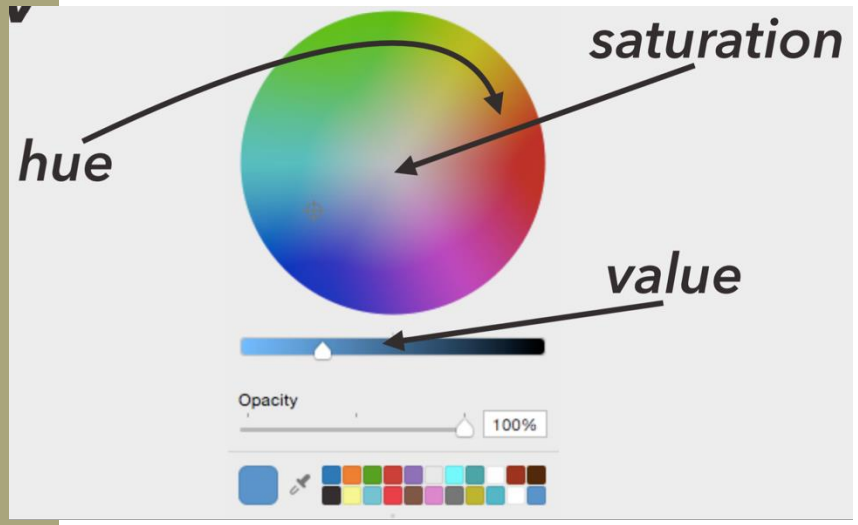
HUE = Pure colors (not mixed with white or black)

SATURATION = Amount of white mixed with pure color

VALUE/LIGHTNESS = Amount of black mixed with pure color

How we represent color

HSV/L



Issues

- Distance between colors is closer, but not identical to how we perceive differences

A: (5, 7, 15)

B: (15, 17, 25)

hsv(120, 100, 50)

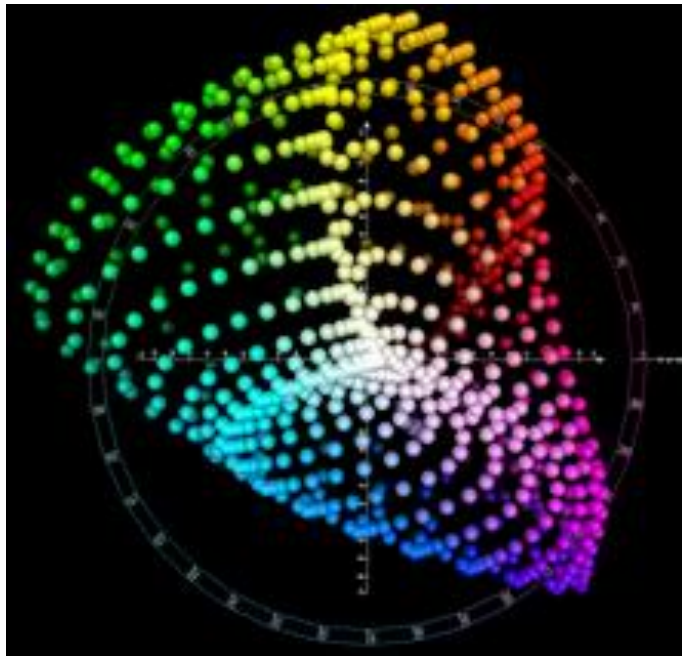
hsv(130, 110, 60)

hsv(0, 100, 50)

hsv(10, 110, 60)

How we represent color

CIELAB



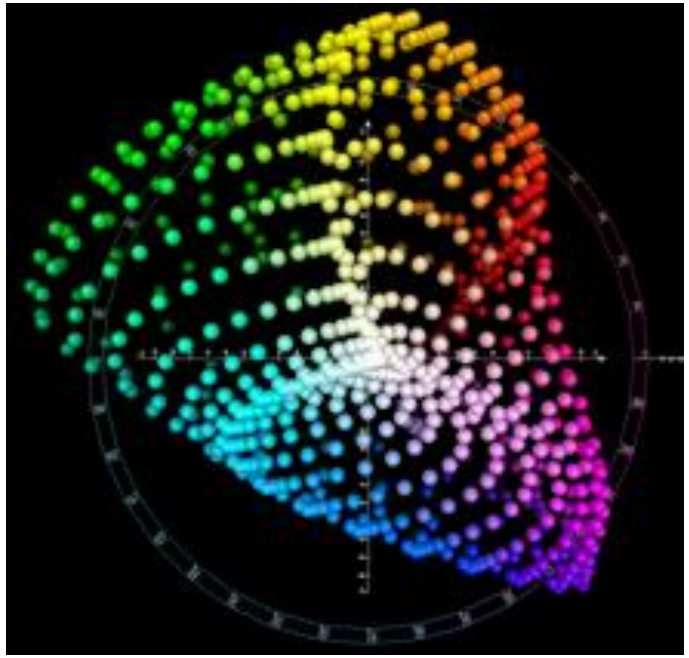
L* = Perceptual lightness

a* = unique color (red – green)

b* = unique color (blue – yellow)

How we represent color

CIELAB



Issues

- Given numerical change corresponds to perceived change in color, but is computationally complex

A: (5, 7, 15)

B: (15, 17, 25)

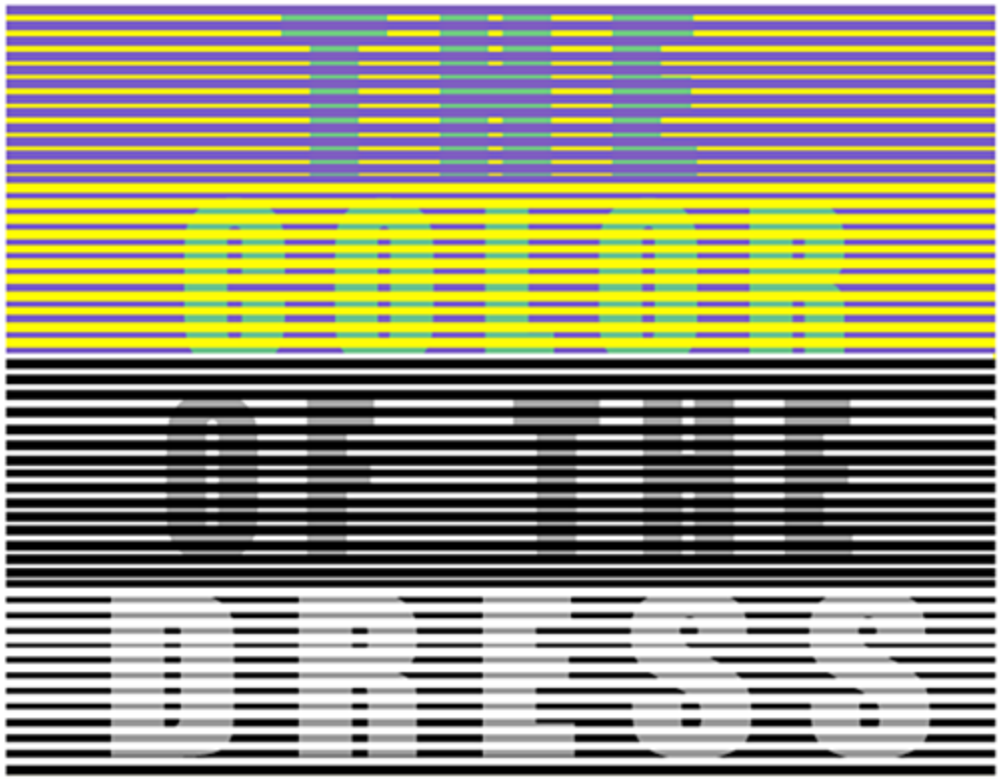
lab(46.05, -51.55, 49.76)

lab(56.05, -41.55, 59.76)

lab(25.42, 47.91, 37.91)

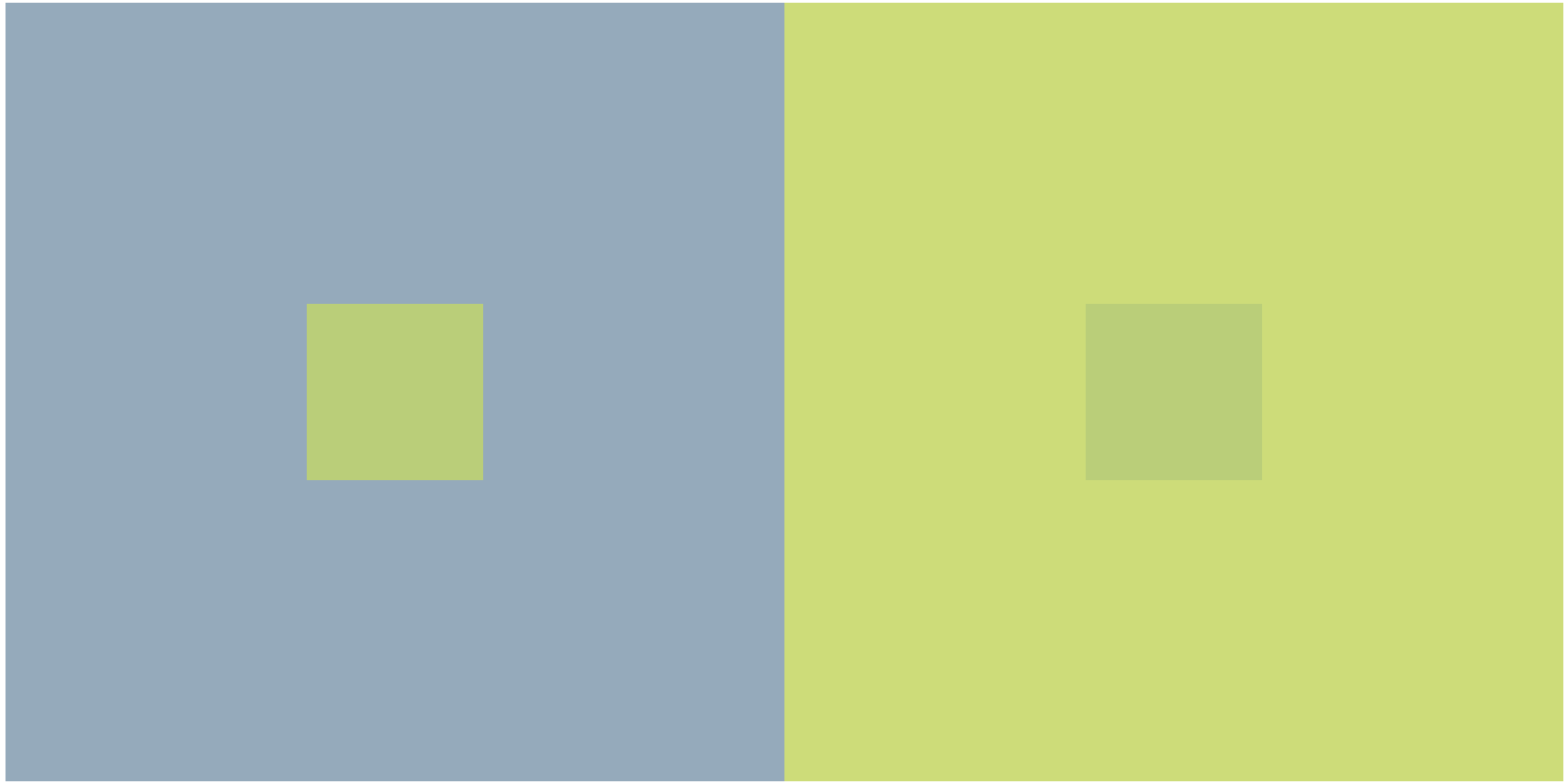
lab(35.42, 57.91, 47.91)

Color phenomena



Color phenomena

Caveat 1: color is perceived in context



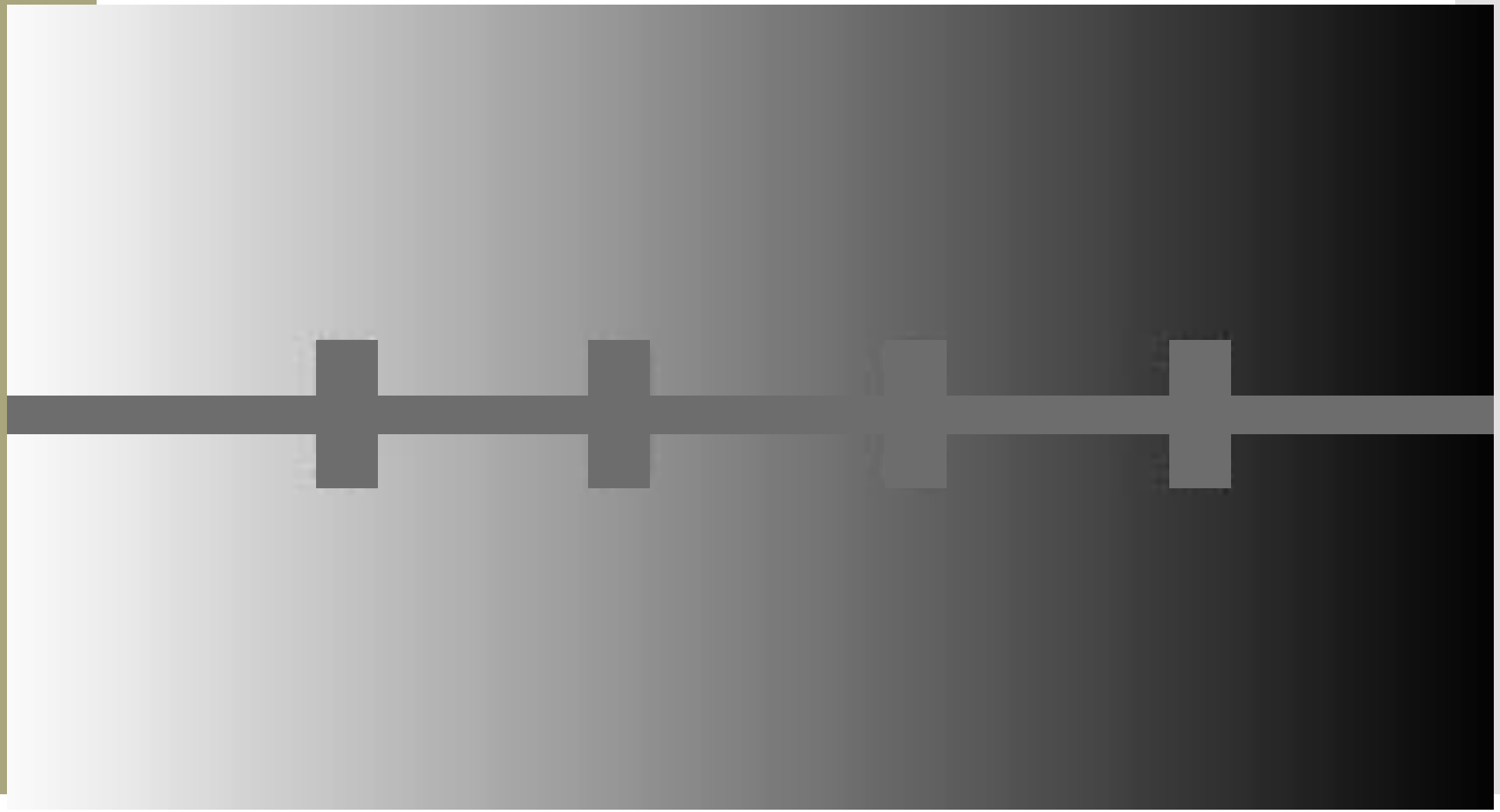
Which small square is **darker green**?

Color phenomena

Caveat 2: difference is relative

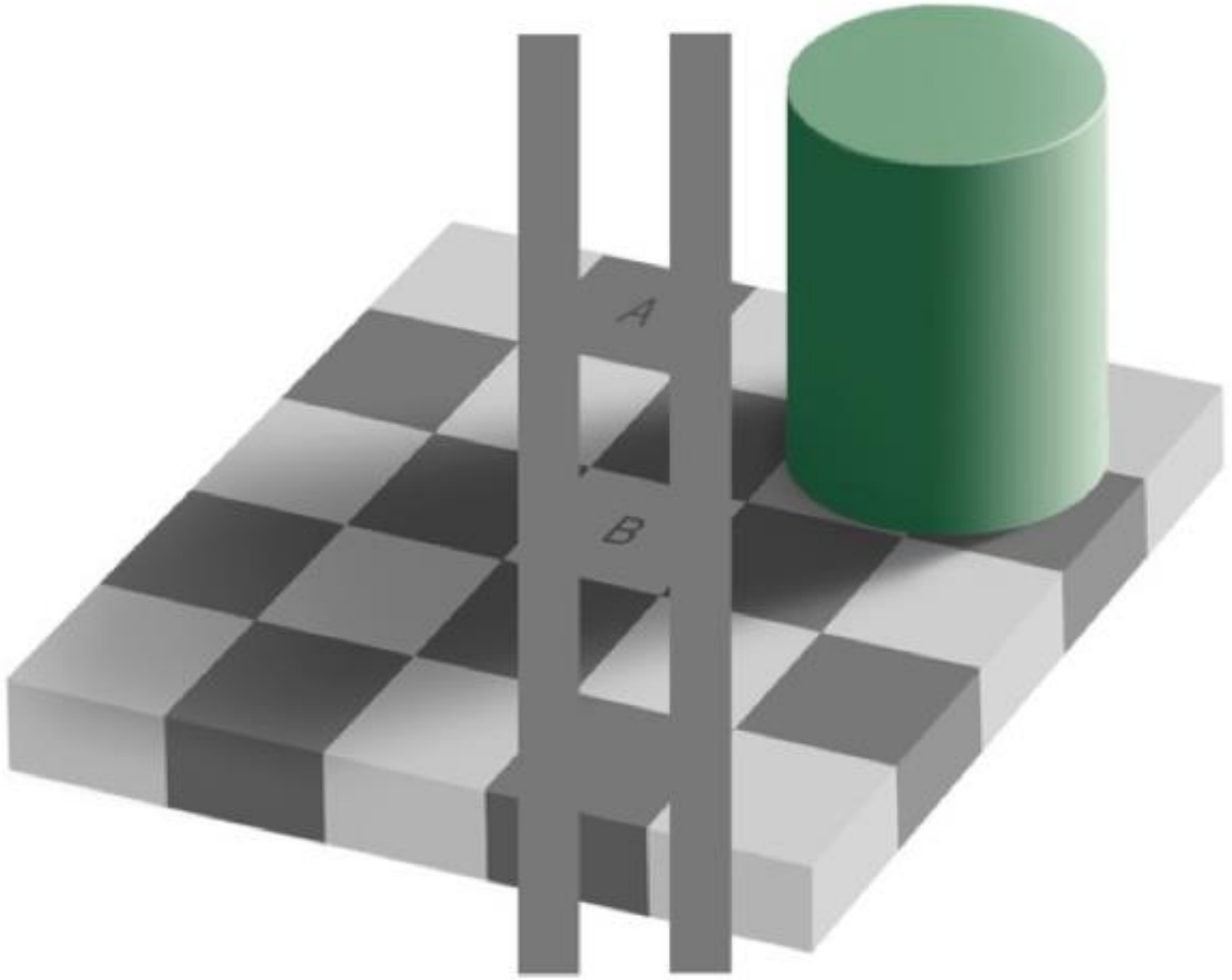
Caveat 2a: so are brightness and contrast

Color phenomena



Color phenomena

Caveat 3: mental models > perception

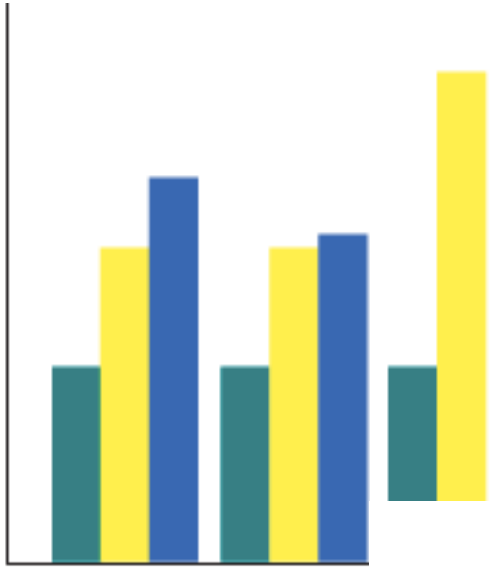


Color palettes

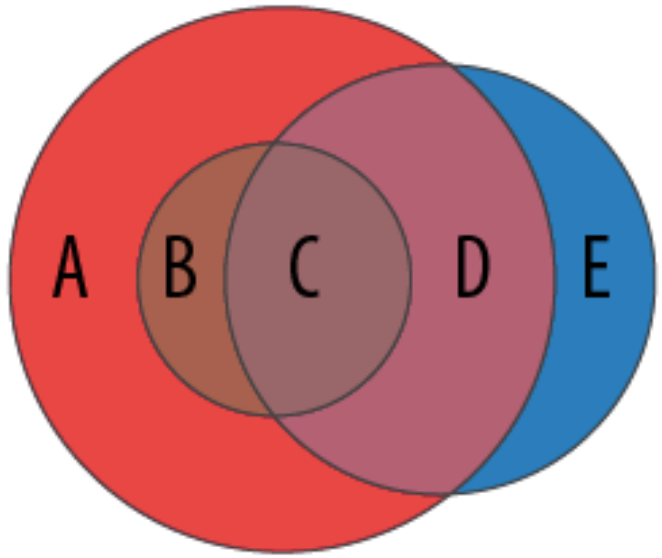
- Using a poor color scheme can also cause issues with your visualization

Color Problems

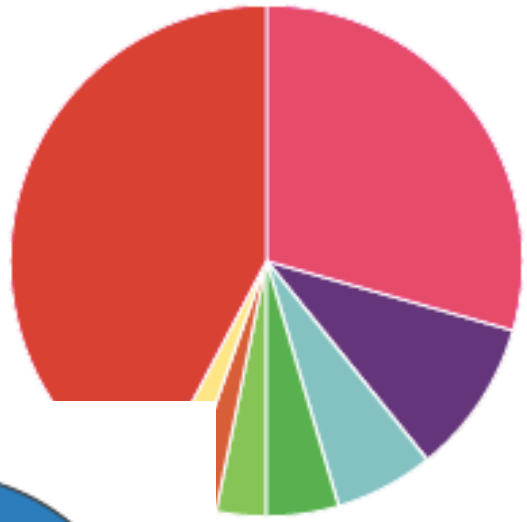
One color dominates



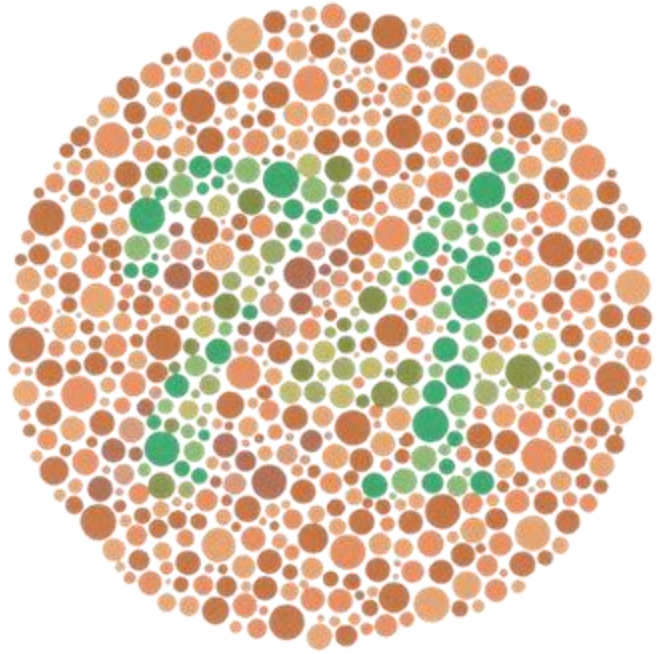
Murky



Difficult to distinguish



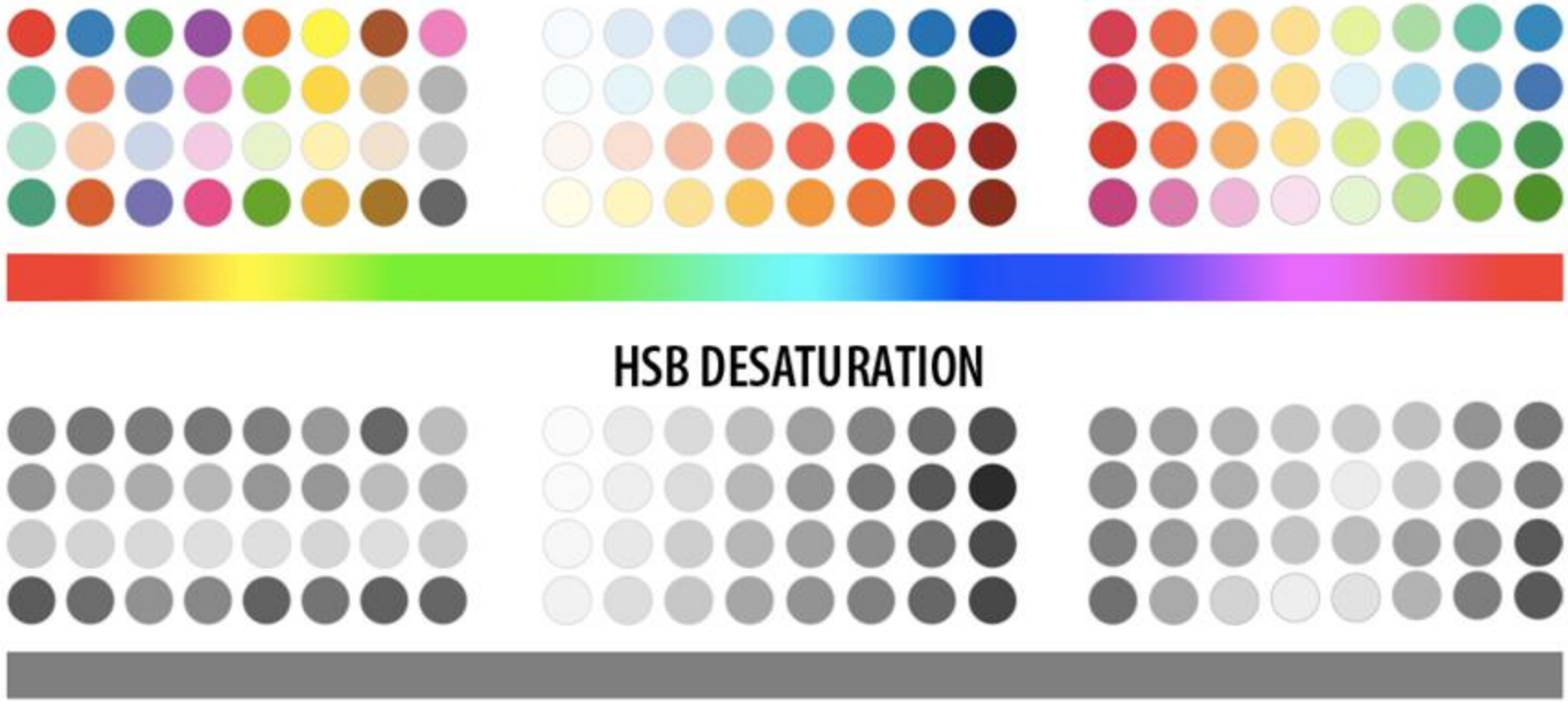
Fun fact: "colorblindness"



1 out of every 8 people has just 2 types of color receptors (rather than 3)

What happens when you print?

- Need color scheme that converts well to grey scale



Colorbrewer palettes

- colorbrewer.org provides a whole bunch of palettes that can help us avoid these issues
- This makes life a lot easier for us!

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When should we use each type of color palette?

Mini-lab: color tricks

- Find a partner
- Open a dataset of your choosing
- Build two visualizations on this dataset
  - One that tells the "real" story in the data (as you understand it), using color to represent at least one variable
  - One that uses color in an intentionally misleading way

Discussion

- What did you try?
- What did you learn about the data?
- Can you imagine a scenario that might incline someone to choose your “bad” visualization instead of a better one?