Ch 10: Color

Decomposing color
• first rule of color: do not talk about color!
  – color is confusing if treated as monolithic
• decompose into three channels
  – ordered can show magnitude
  – luminance
  – saturation
categorical can show identity
• hue
• channels have different properties
  – what they convey directly to perceptual system
  – how much they can convey: how many discriminable bins can we use?

Designing for color deficiency: Check with simulator

Color spaces
• RGB: poor for encoding
  – HSL: better, but beware
  – lightness = luminance
  
Designing for color deficiency: Avoid encoding by hue alone

Chroma
Saturation
Luminance
Hue

Spectral sensitivity

Opponent color and color deficiency
• perceptual processing before optic nerve
  – one achromatic luminance channel L
  – intrinsic perceptual ordering
  – need luminance contrast for edge detection
two chroma channels R-G and B-Y axis
“color blind” if one chroma axis has degraded acuity
10% of men are red/green color deficient
1.5% of women are red/green deficient

Color deficiency: Reduces color to 2 dimensions

Bezold Effect: Outlines matter
• color constancy: simultaneous contrast effect

Designing for color deficiency: Blue-Orange is safe

Color/Lightness constancy: Illumination conditions

Color/Lightness constancy: Illumination conditions

Colormaps
• Categorical
  – ordered
  – Sequential
  – Diverging
• Sequential
• Compartmental

Idiom design choices: Encode

Challenges of Color
• what is wrong with this picture!

Opponent color and color deficiency

Color deficiency: Reduces color to 2 dimensions

Bezold Effect: Outlines matter
• color constancy: simultaneous contrast effect

Opponent color and color deficiency
**Colormaps**

- Categorical
- Sequential
- Diverging
- Bivariate

**Ordered color: Rainbow is poor default**

- problems
  - perceptually unordered
  - perceptually nonlinear
- benefits
  - fine-grained structure visible and nameable
- alternatives
  - large-scale structure fewer hues

**ColorBrewer**

- [http://www.colorbrewer2.org](http://www.colorbrewer2.org)
  - saturation and area examples: size affects salience!

**Viridis**

- colorful, perceptually uniform, colorblind-safe, monotonically increasing luminance

**Map other channels**

- size
  - length accurate, 2D area ok, 3D volume poor
- angle
  - nonlinear accuracy
- shape
  - complex combination of lower-level primitives
- motion
  - highly separable against static

**Categorical color: limited number of discriminable bins**

- human perception built on relative comparisons
  - great if color contiguous
  - surprisingly bad for absolute comparisons
- noncontiguous small regions of color
  - fewer bins than you want
  - rule of thumb: 6-12 bins, including background and highlights

**Colormaps**

- Categorical
- Sequential
- Diverging
- Bivariate

**Next Time**

- to read
  - VAD Ch. 11: Manipulate View

**Be Worried About Color? Treinish and Rogowitz 1998.**


viridis/vignettes/intro-to-viridis.html
