

Big Data Analytics Virtual Summer School

Perception and Dimensional Mapping



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Effectiveness

A visualization is more effective than another visualization if the information conveyed by one visualization is more readily perceived than the information in the other visualization.



Gestalt Psychology

The human mind considers objects in their entirety before, or in parallel with, perception of their individual parts; suggesting the whole is other than the sum of its parts.

Theory of perception

[Wikipedia](#)

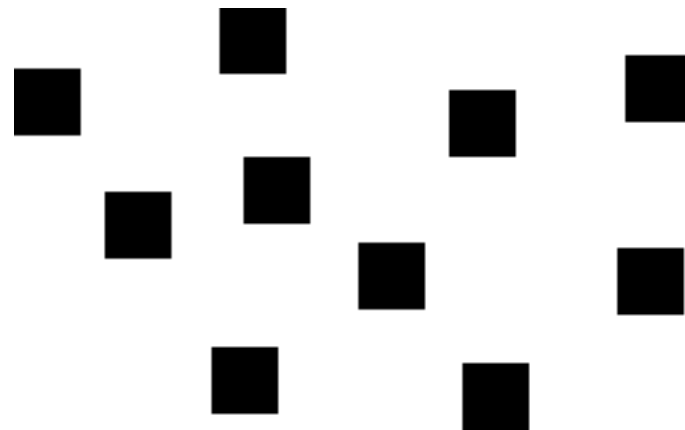


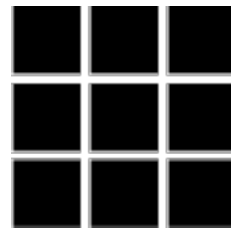








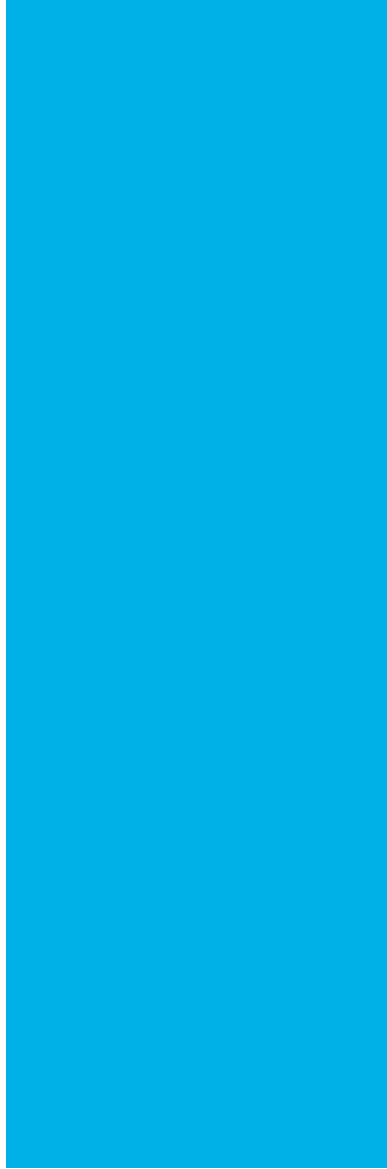


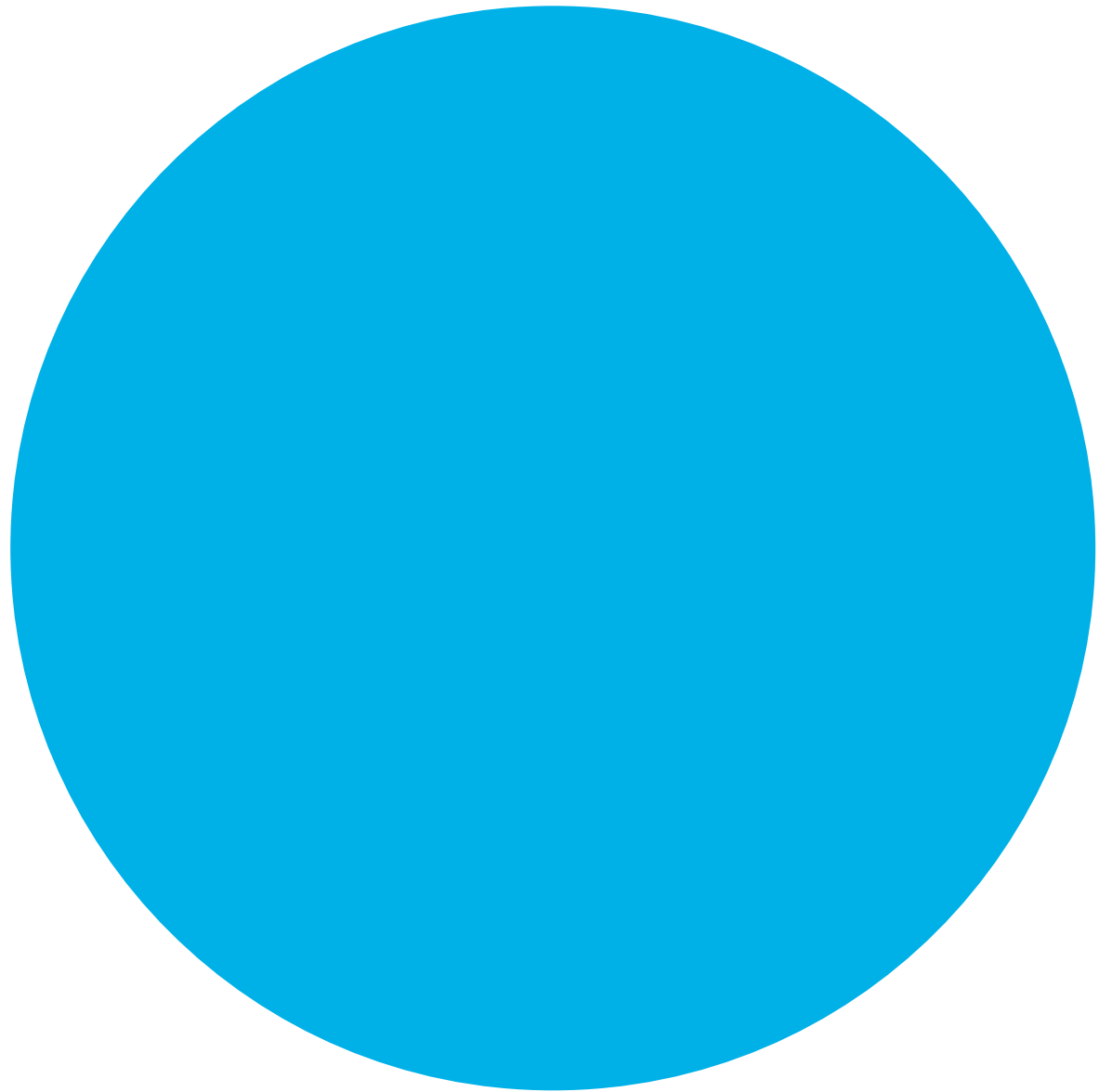
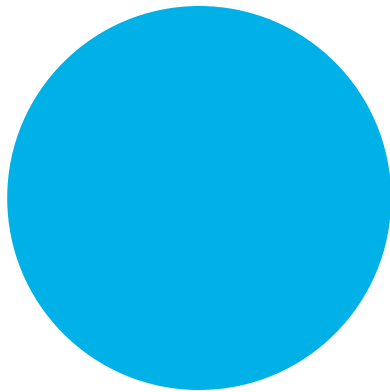


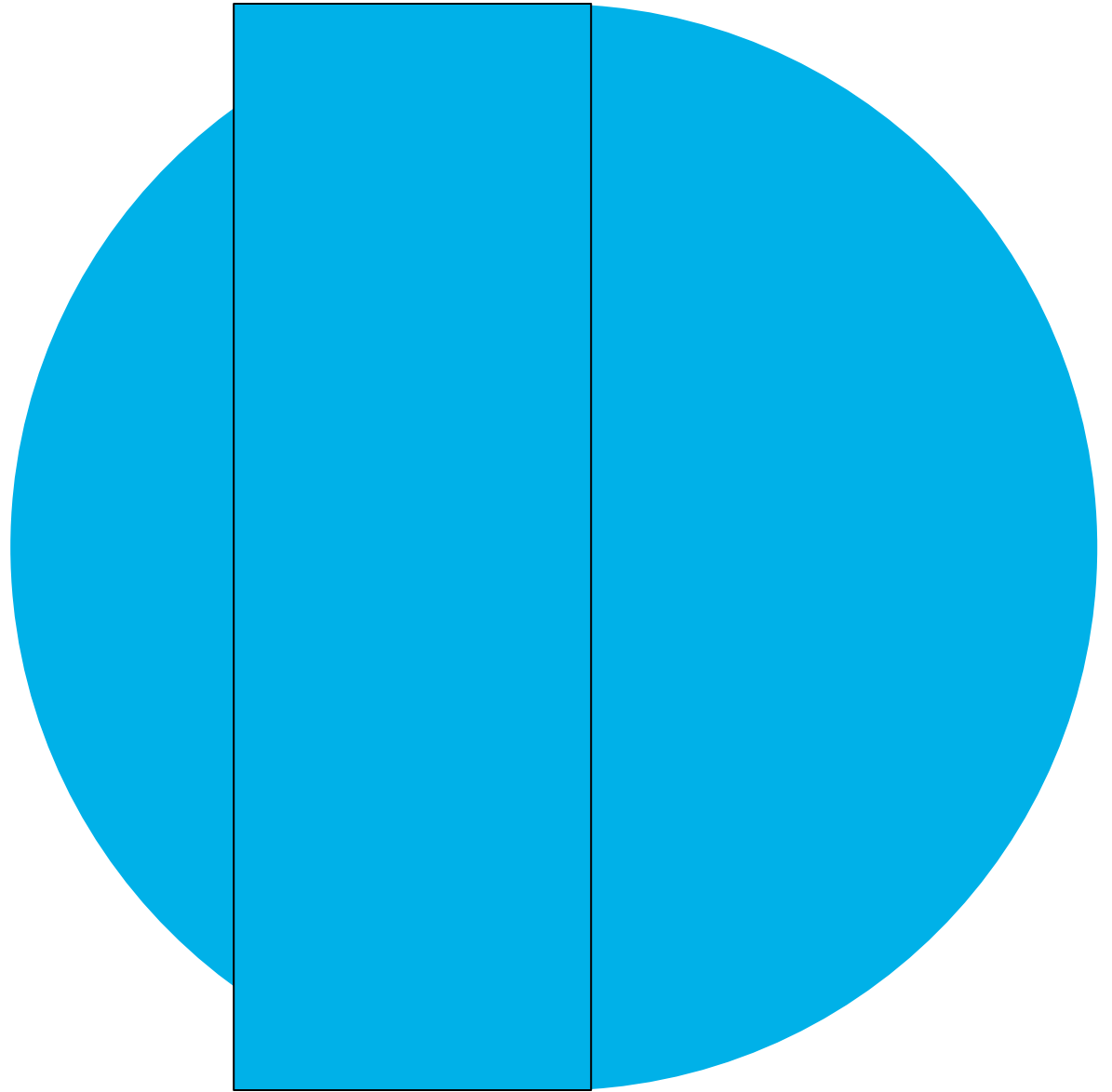
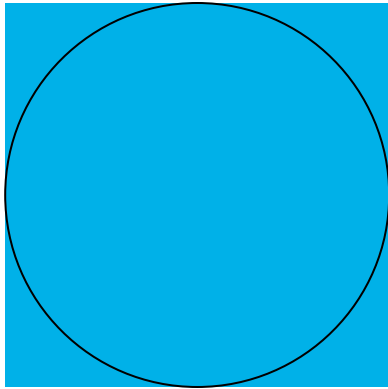


How much bigger?









Which is brighter?





134, 134, 134

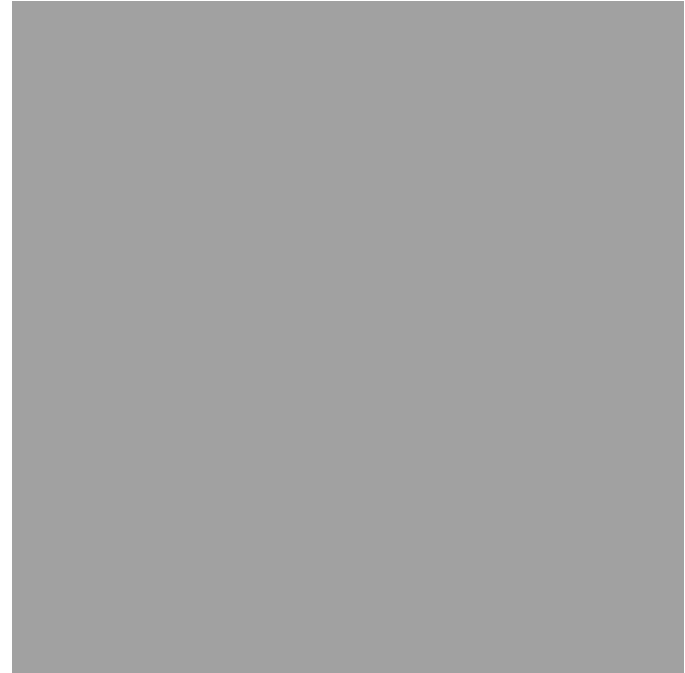


128, 128, 128



Which is brighter?





128, 128, 128



144, 144, 144



Many senses are organized around the “just noticeable difference”

Ratio is more important than magnitude

Most continuous variation in stimuli is perceived in discrete steps



How can we extend what we know about color perception into visualization practices?



Principle of consistency

Properties of the image (visual encoding) should match the properties of the data

Principle of importance ordering

Encode the most important variables in the most effective way



Most accurate



Position



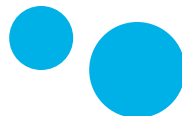
Length



Slope



Angle



Area



Volume

Least accurate



Color

Types of Data

Nominal	Fruits, apples, oranges
Ordinal	Quality of meats A, AA, AAA
Quantitative	Length

On the theory of scales and measurements, 1946

[Stevens](#)



Quantitative

Position
Length
Angle
Slope
Area
Volume
Density
Saturation
Hue
Texture
Connection
Containment
Shape

Ordinal

Position
Density
Saturation
Hue
Texture
Connection
Containment
Length
Angle
Slope
Area
Volume
Shape

Nominal

Position
Hue
Texture
Connection
Containment
Density
Saturation
Shape
Length
Angle
Slope
Area
Volume

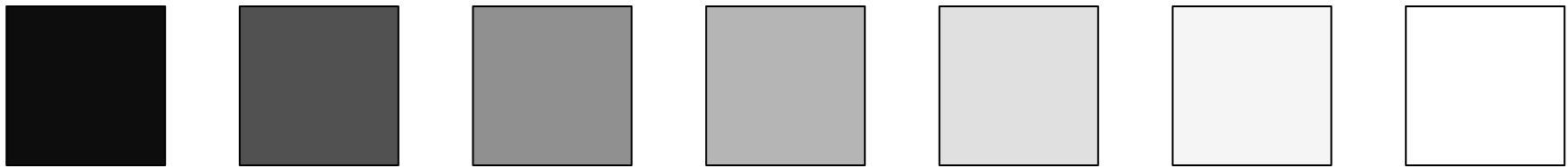
Hypothesized measure of visualization efficacy

[Mackinlay, 1986](#)



Color value is perceived as ordered

Value easily encodes ordinal variables

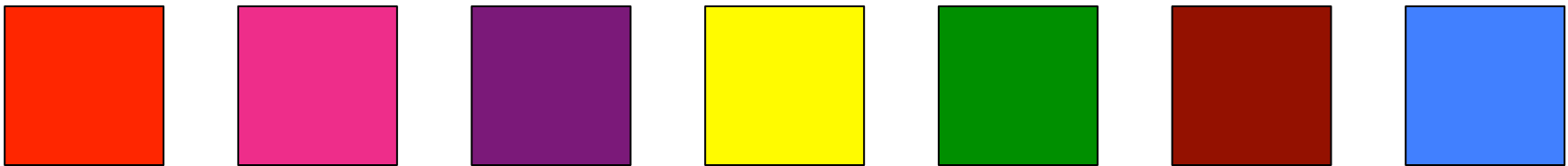


Value encodes continuous variables (less well)



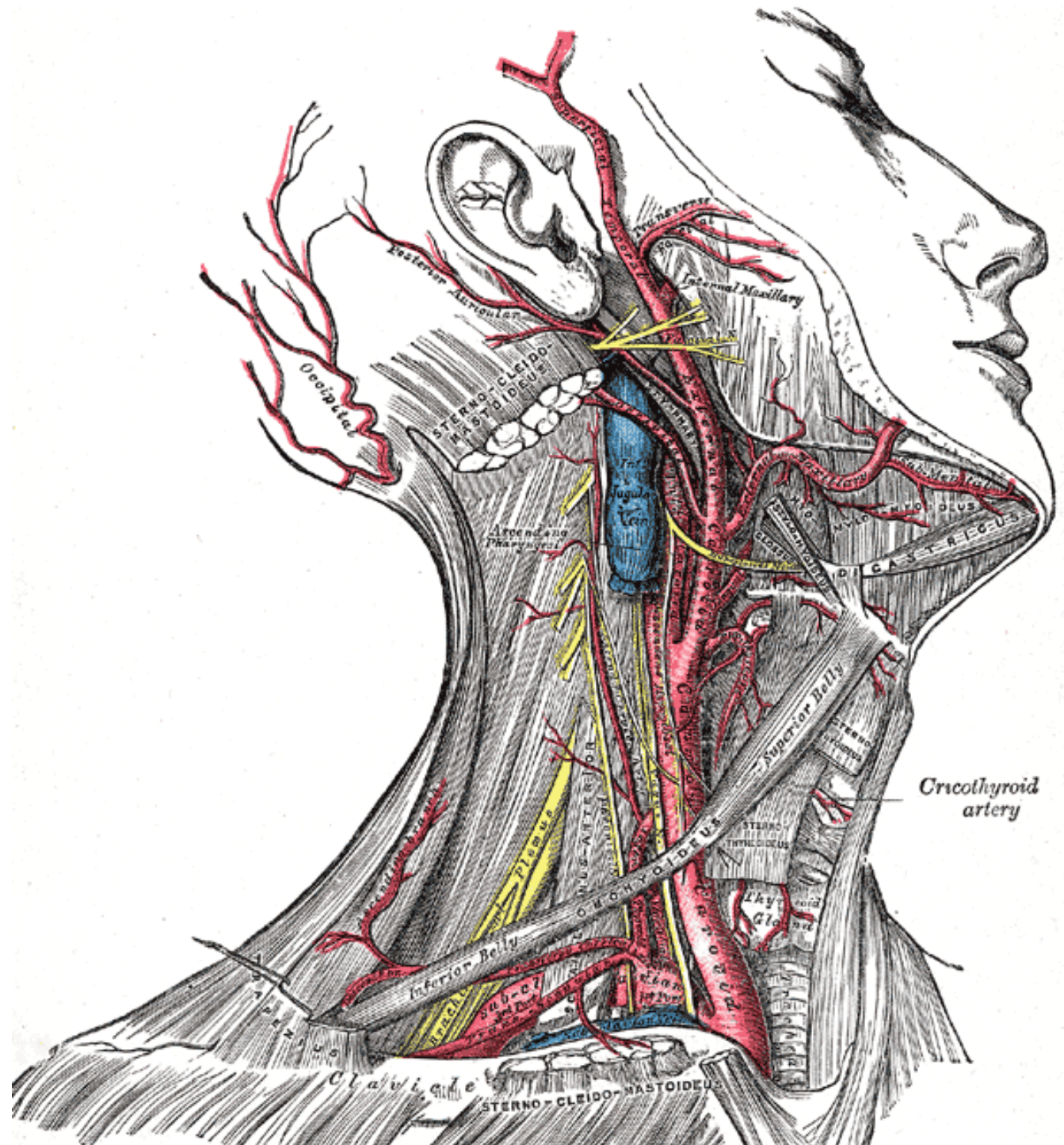
Color hue is normally perceived as unordered

Hue encodes nominal variables



Color applications: Categorical





Arteries of the neck
[Bartleby](#)

Presidential results

✓ projected winner Democrat Republican Third Party Undecided

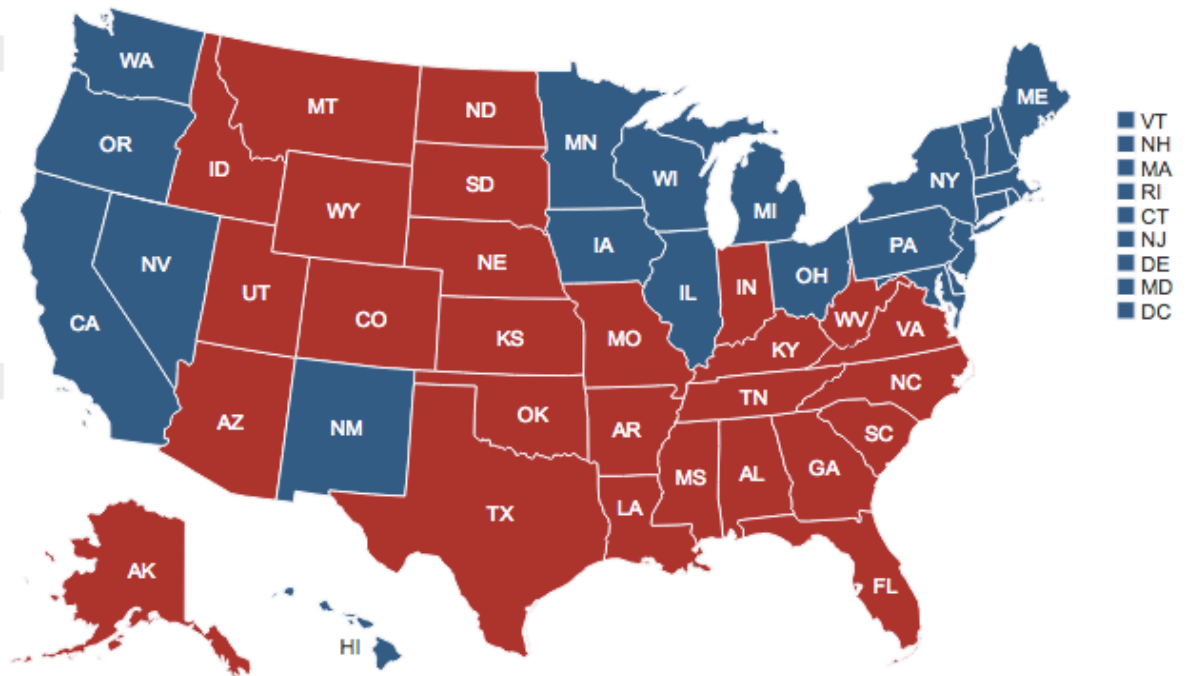
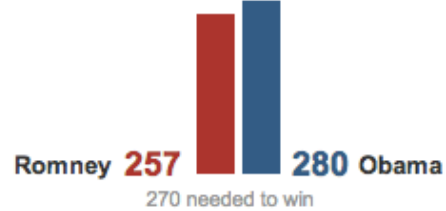
POPULAR VOTE

16% in

Mitt Romney  **55%** 19,699,793

Barack Obama  **43%** 15,594,835

ELECTORAL VOTE

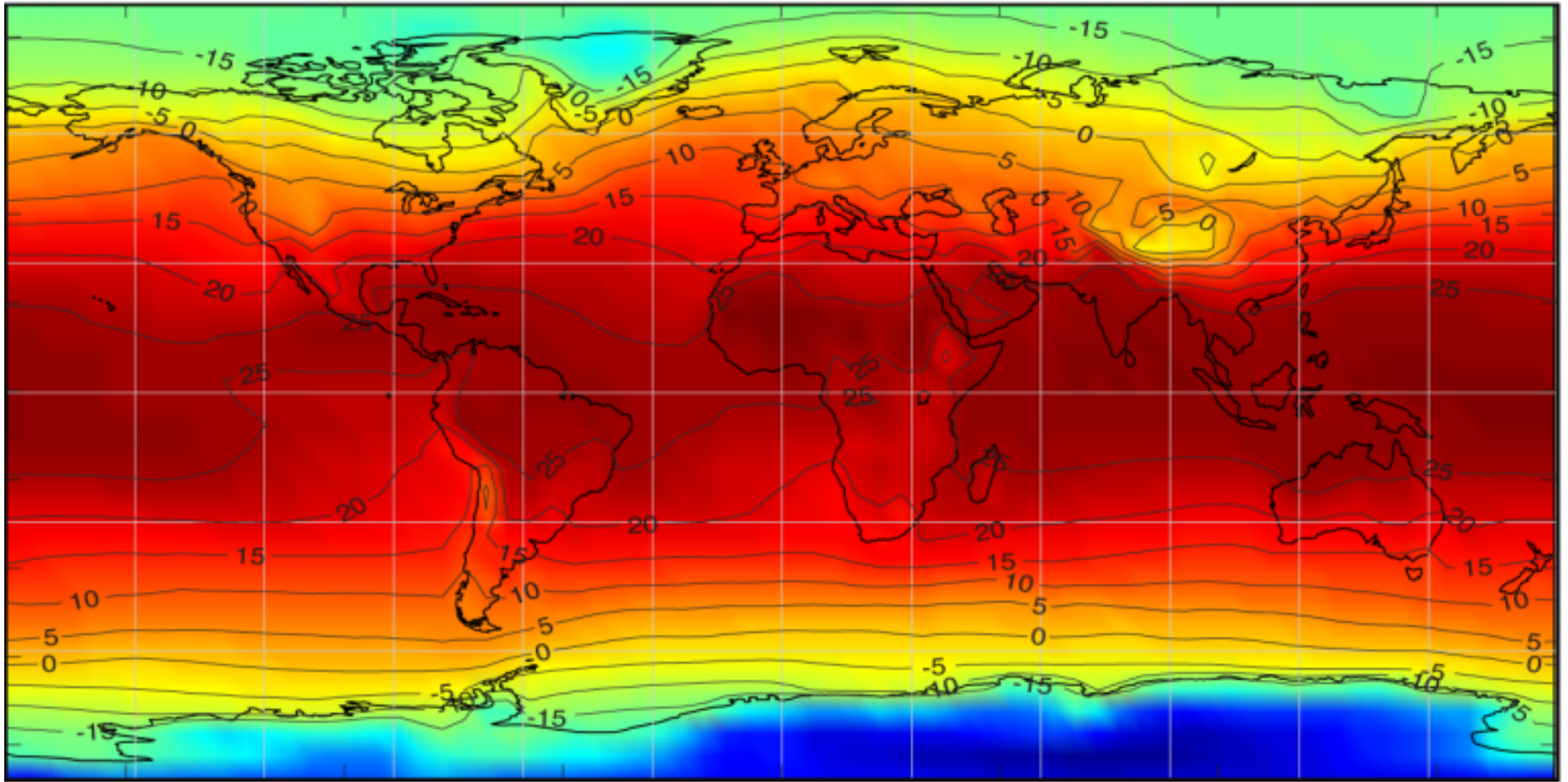


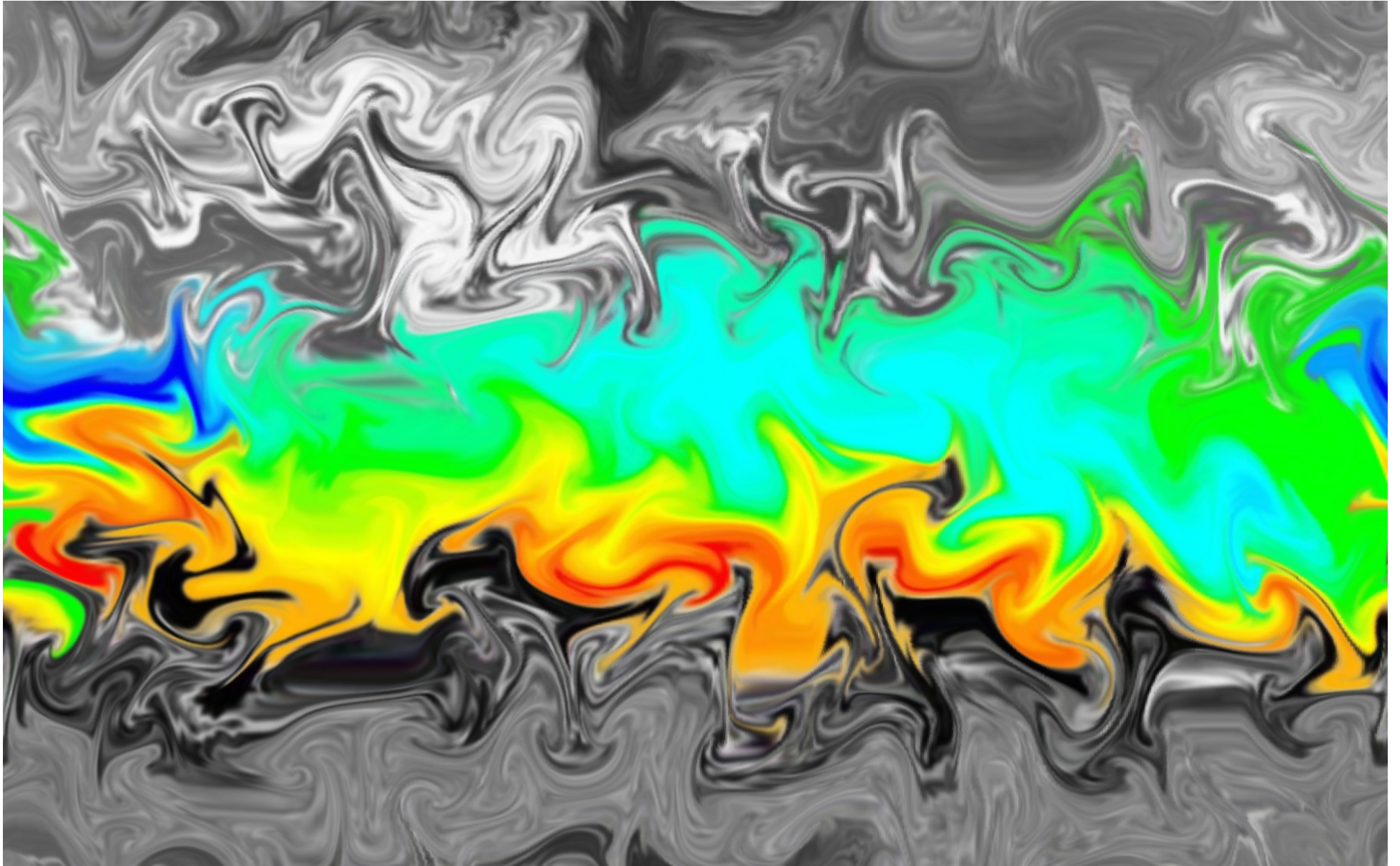
2012 Presidential election results
NBC via Bartleby



Color applications: Quantitative



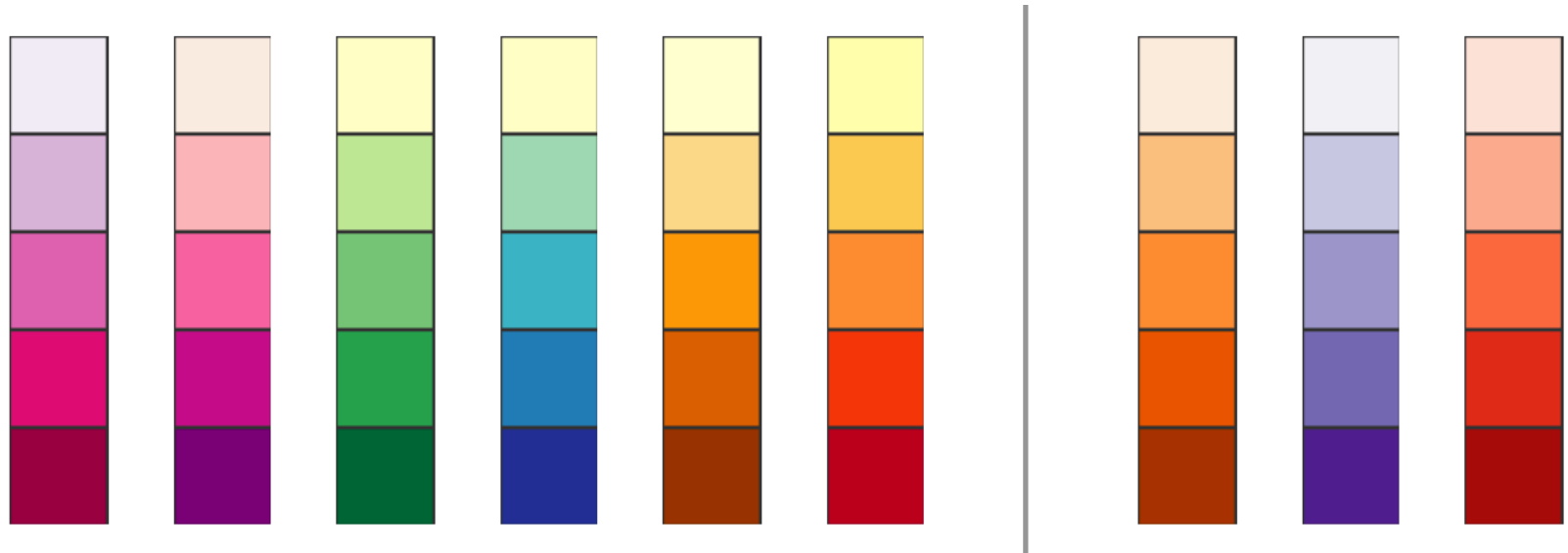




Color applications: Ordinal



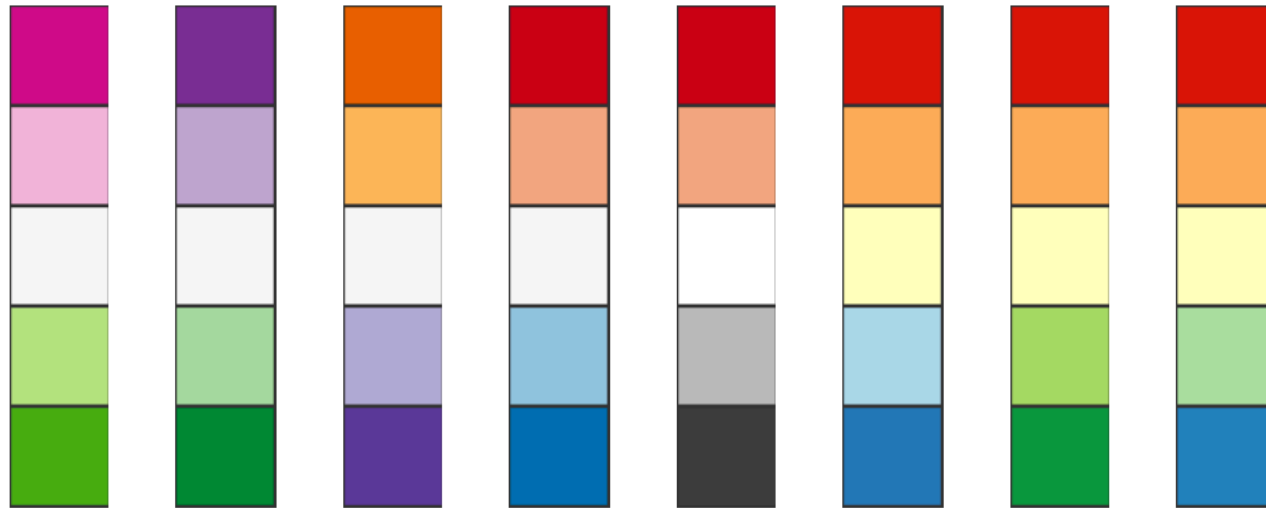
Sequential color



Vary luminance and saturation

Map higher values to darker colors

Diverging color



Data maps to meaningful mid-point

Color midpoint neutral, saturation at endpoints

Guidelines for Color in Data Visualization

Use only a few colors

Colors should be distinctive and named

Strive for color harmony

Be aware of cultural conventions

Beware bad interactions

Get it right in black and white



Quantitative color

Use a very limited palette (6 is ideal, 9 is max)

Beware of bad interactions

Get it right in black and white

Respect the color blind

