Good Vis, Bad Vis

C. Andrews

2014-02-27

70%
63%
60%

How can we evaluate visualizations?

What is the purpose of the visualization?

How well does it perform?

- Do the encodings make sense?
- Can you read the data out of it?
  - Does it highlight the important information?
- Can you see something interesting beyond the information?
- Is there interaction?
  - Is it useful?
- Is there an appropriate amount of information represented?
  - Enough to be useful, not enough to be confusing?
- Is it honest?

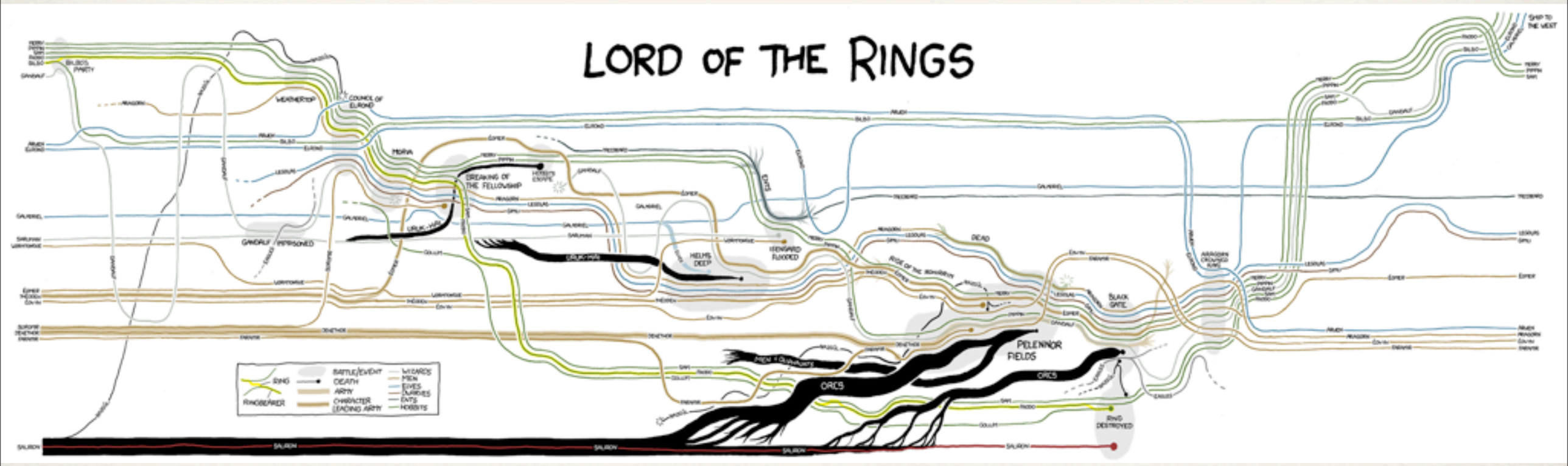
Is it aesthetic?

- Does it invite exploration?

Intuitive mappings

Pick mappings that match expectations

- temperature - color or height
- time - horizontal axis or motion



http://xkcd.com/657

Intuitive mappings

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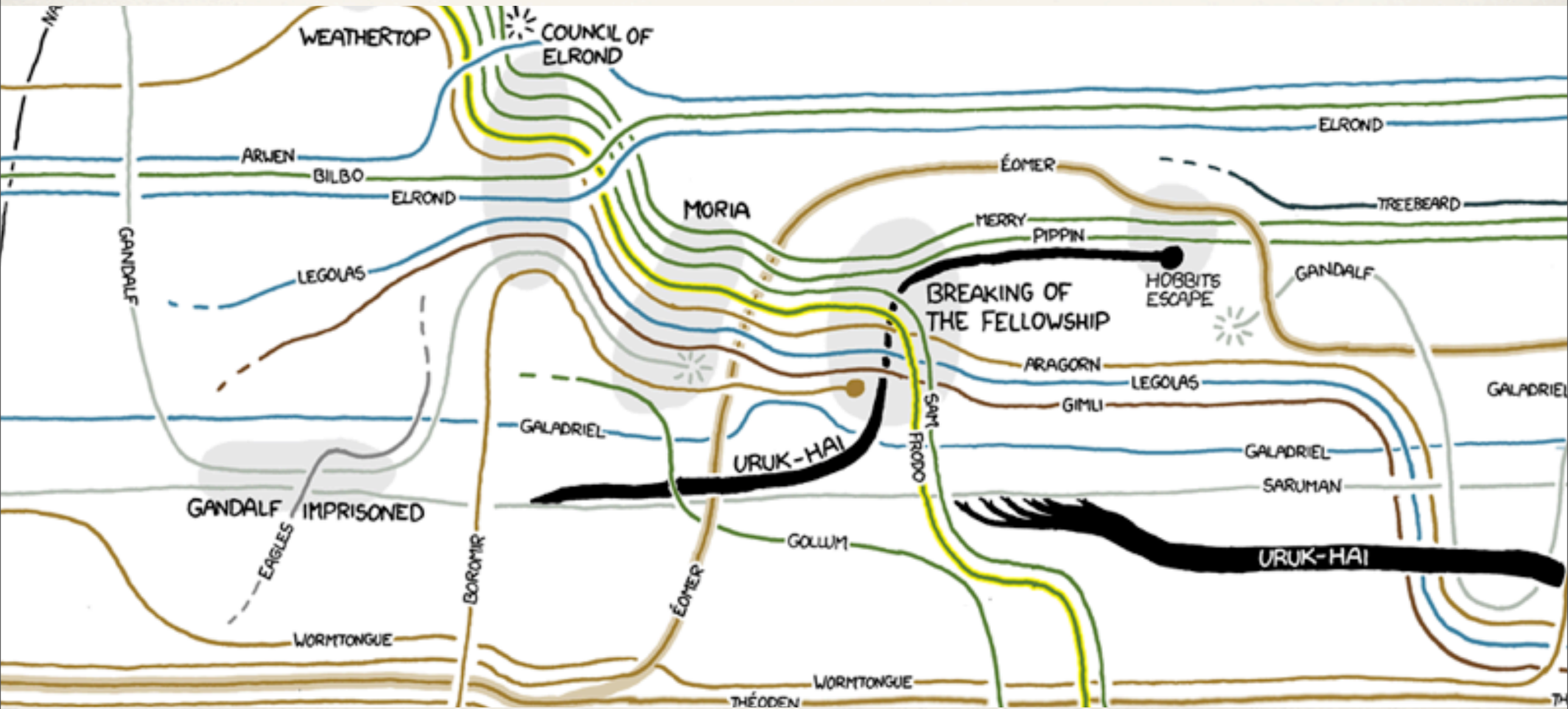
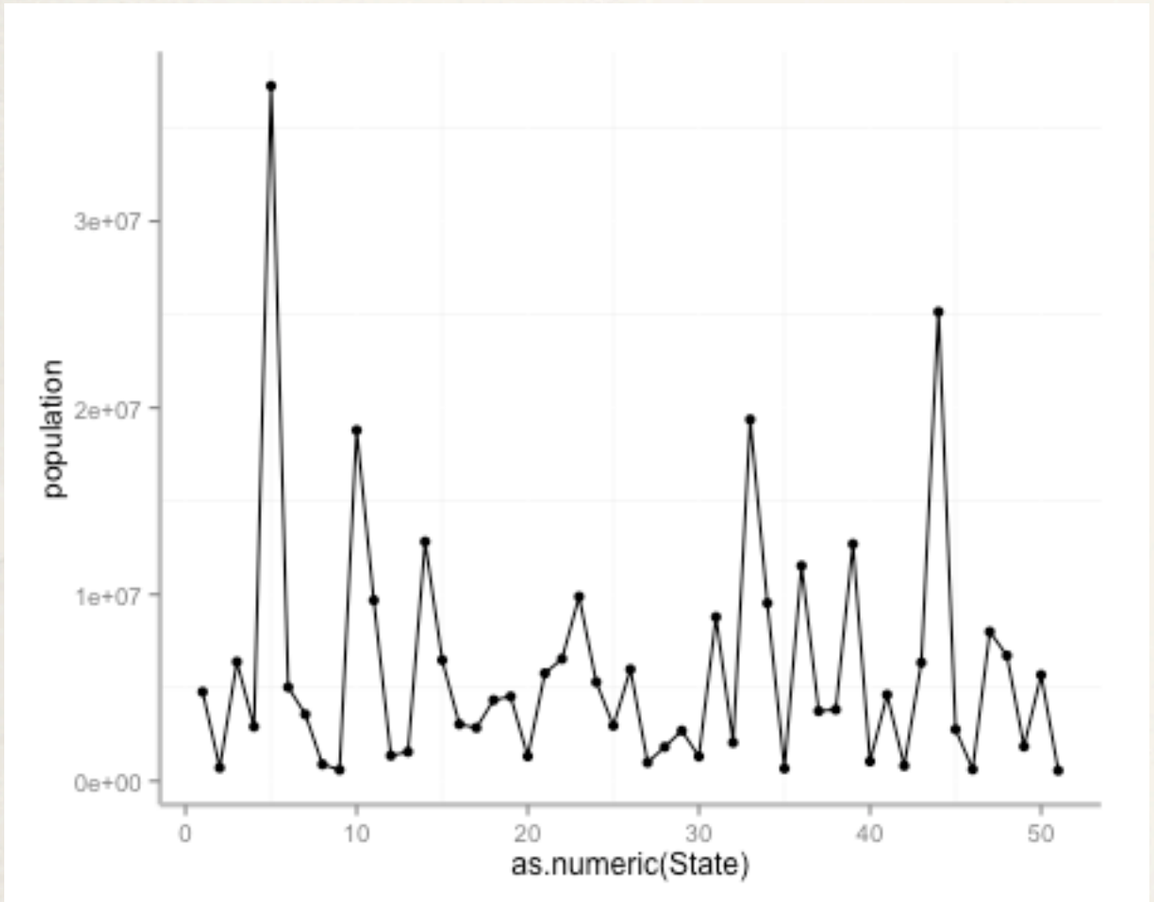
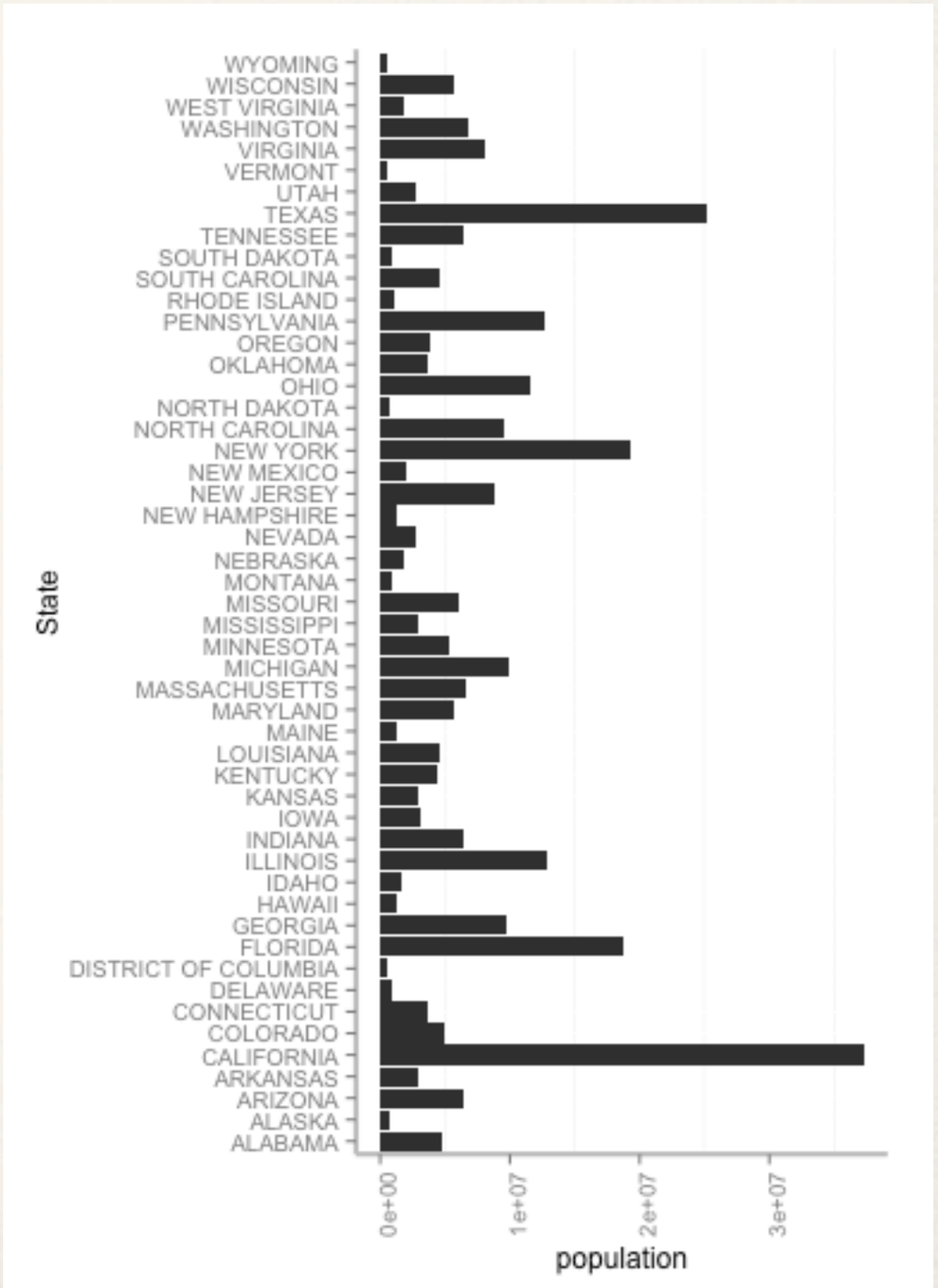


http://xkcd.com/657

Intuitive mappings

Pick mappings that match the kind of data





Intuitive mappings

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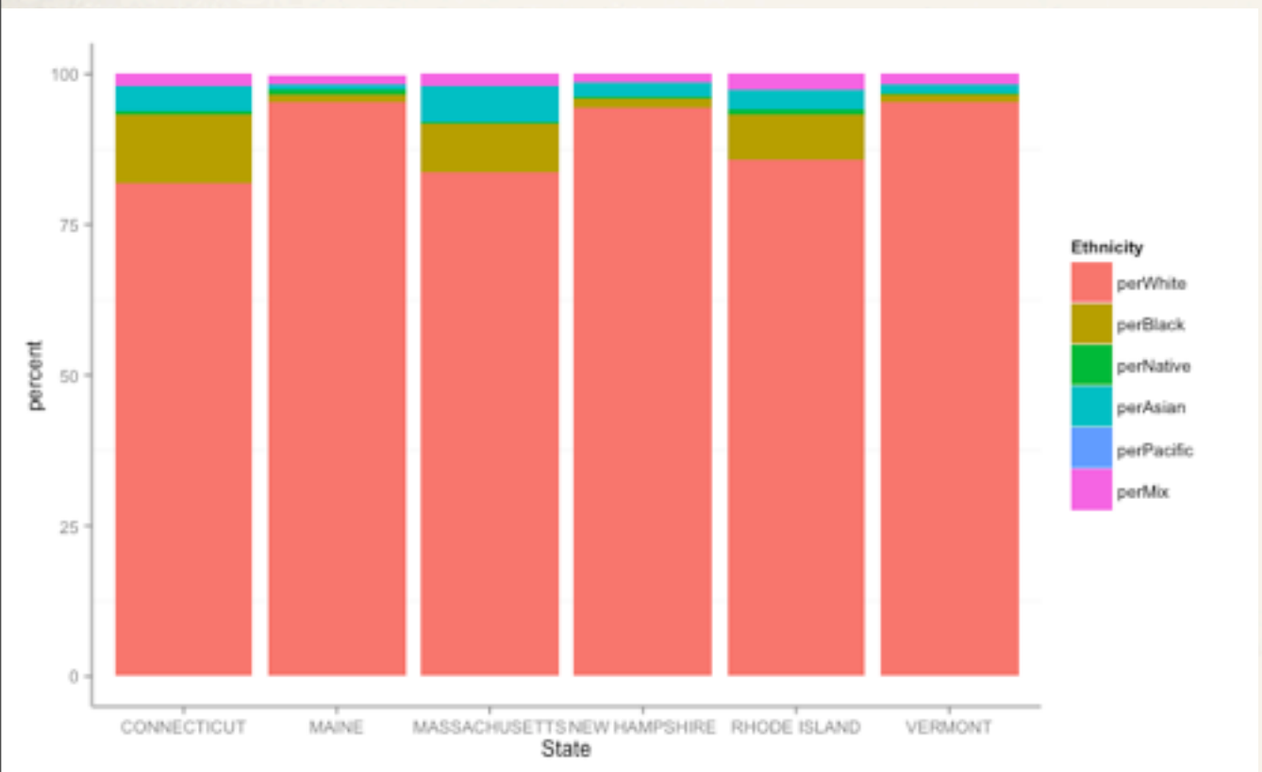

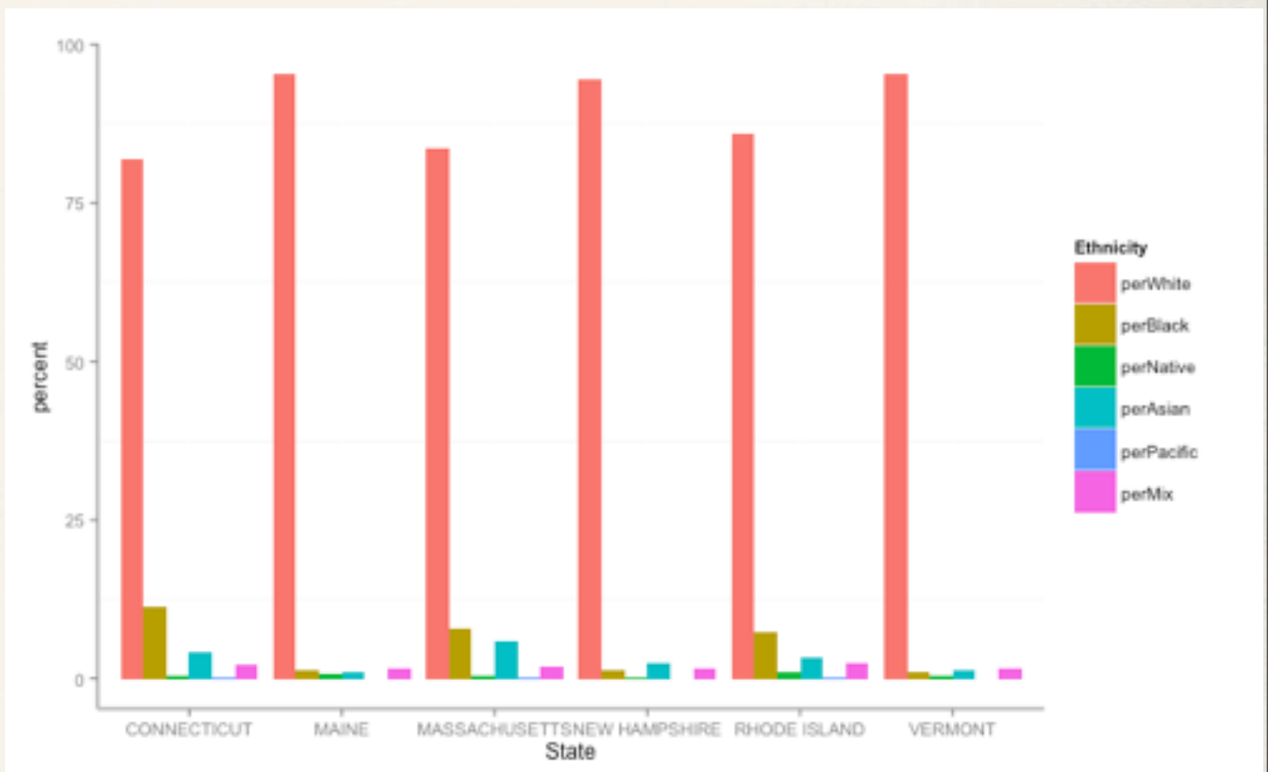

Intuitive mappings

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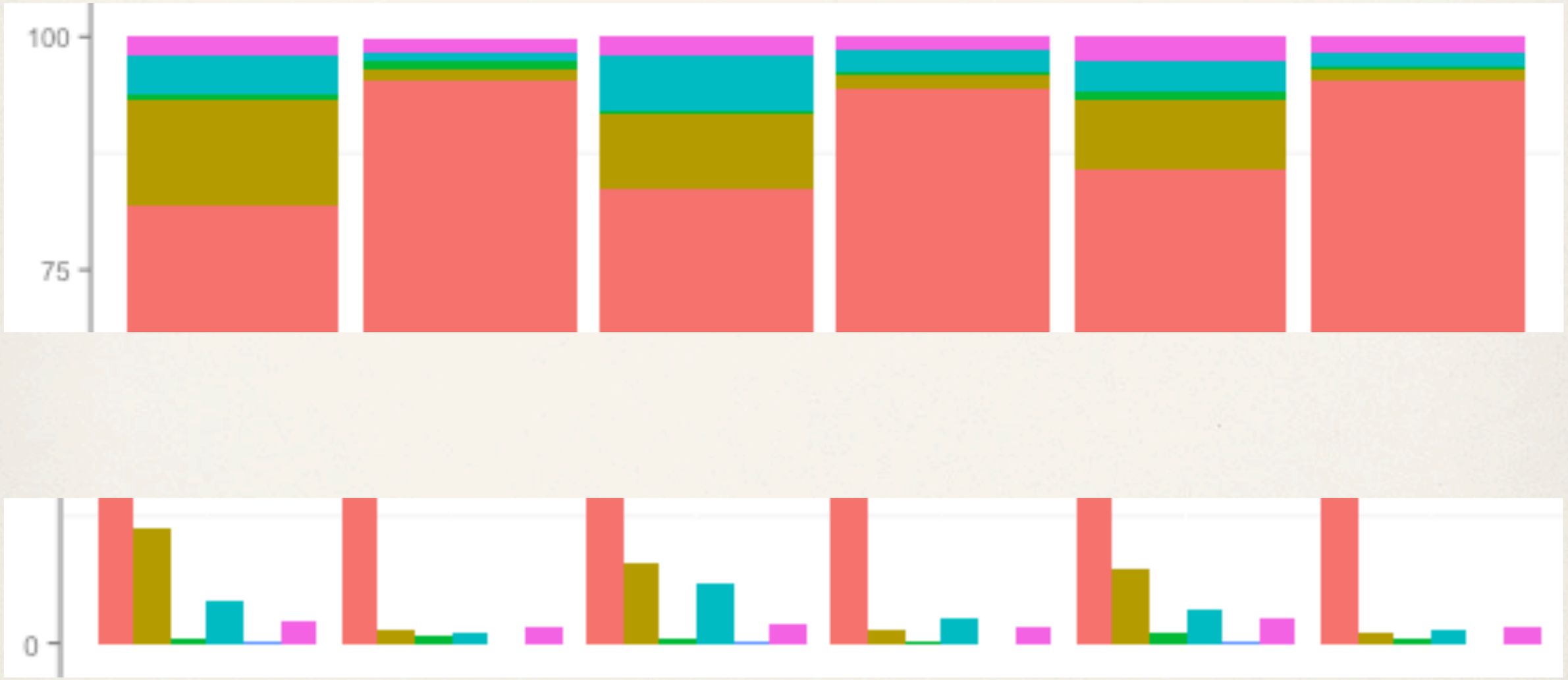
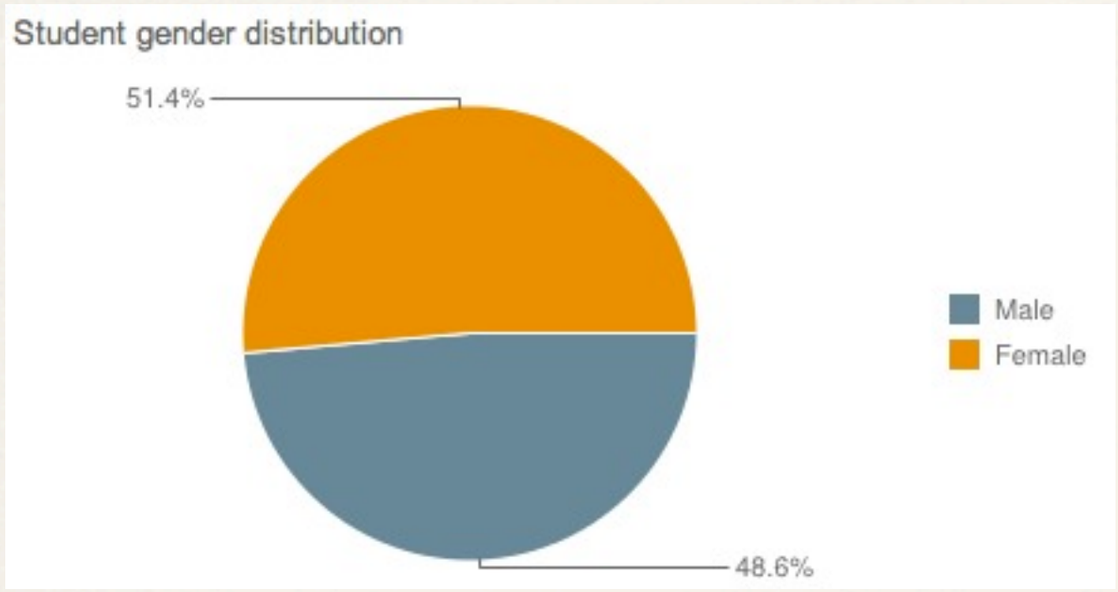
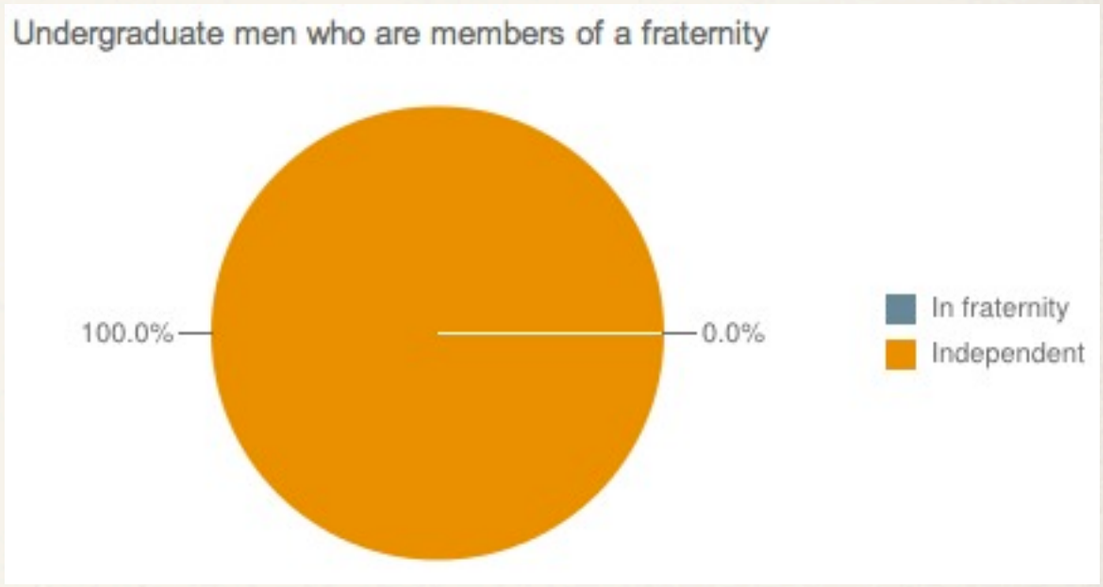
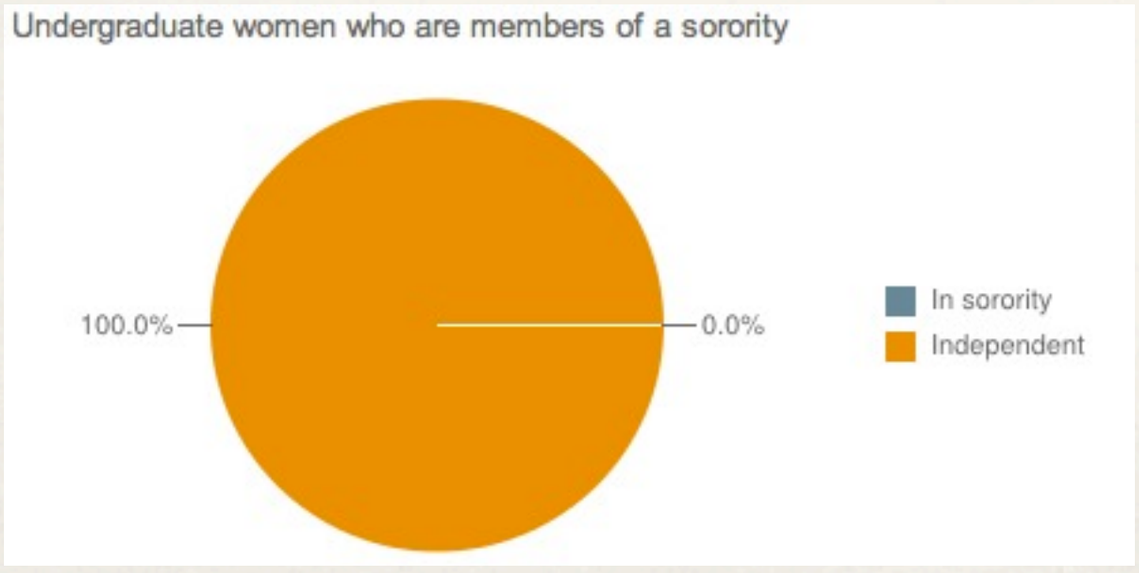


Do you need the visualization?

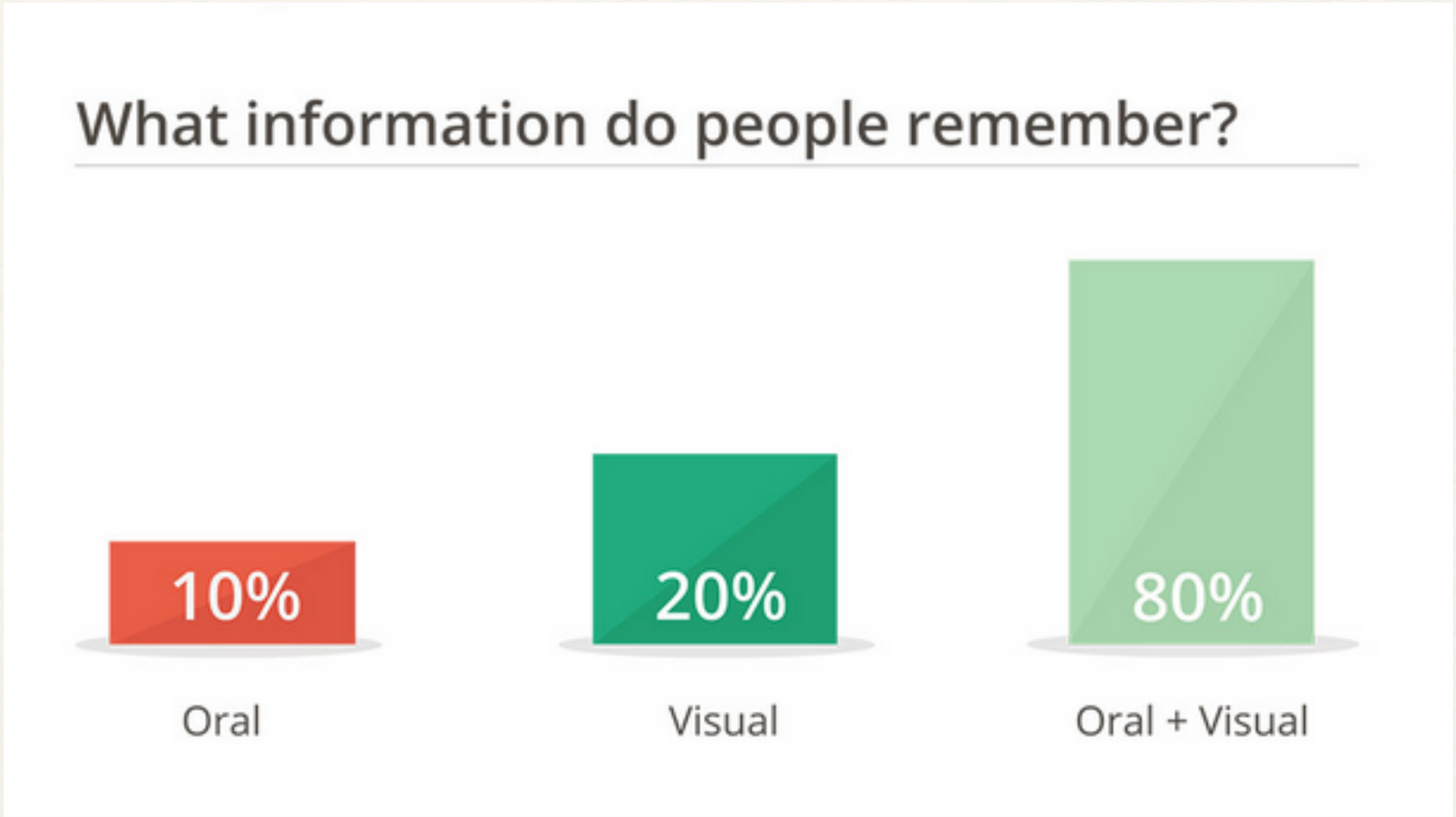






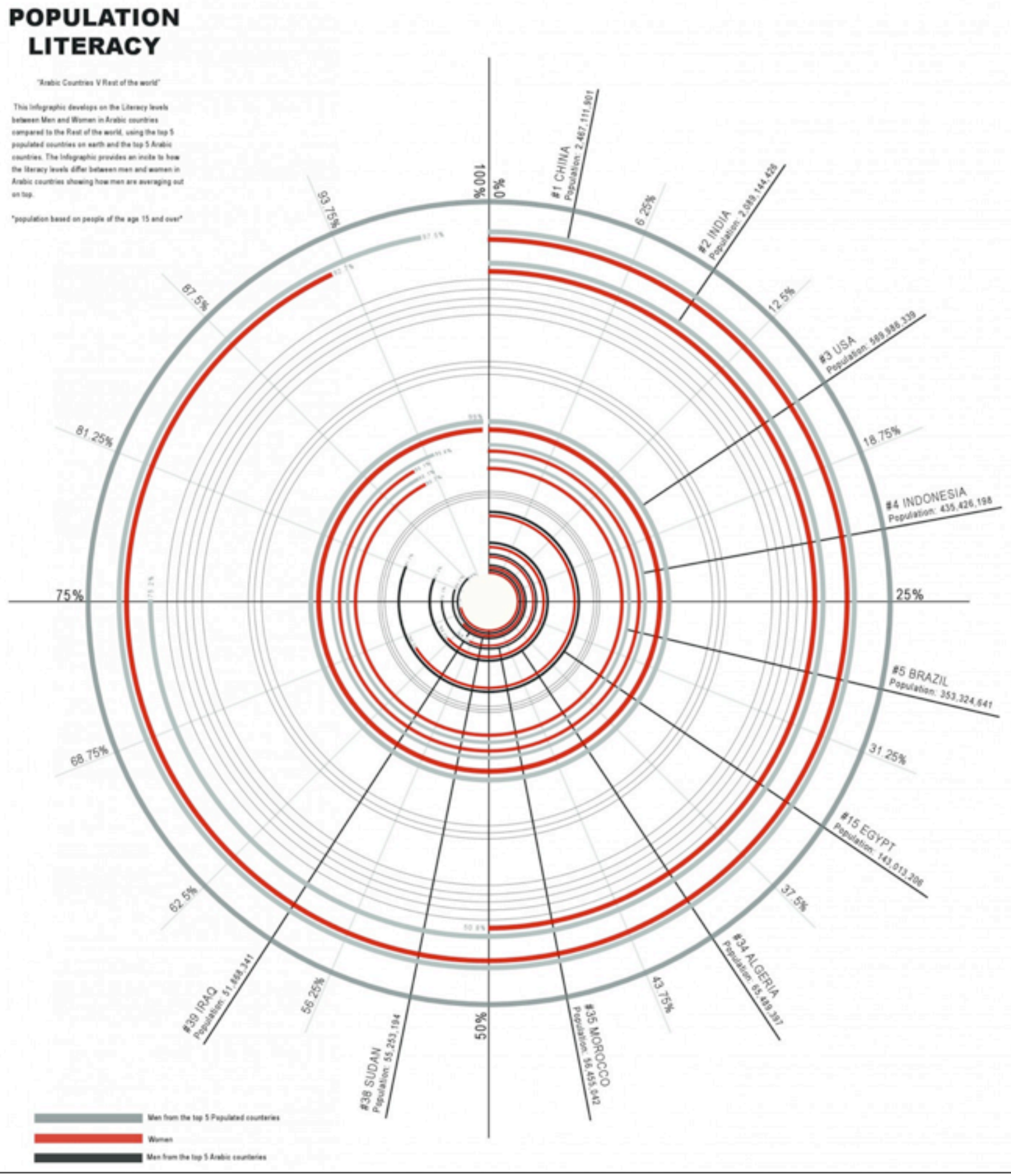
http://colleges.usnews.rankingsandreviews.com/best-colleges/middlebury-college-3691

Do you need the visualization?



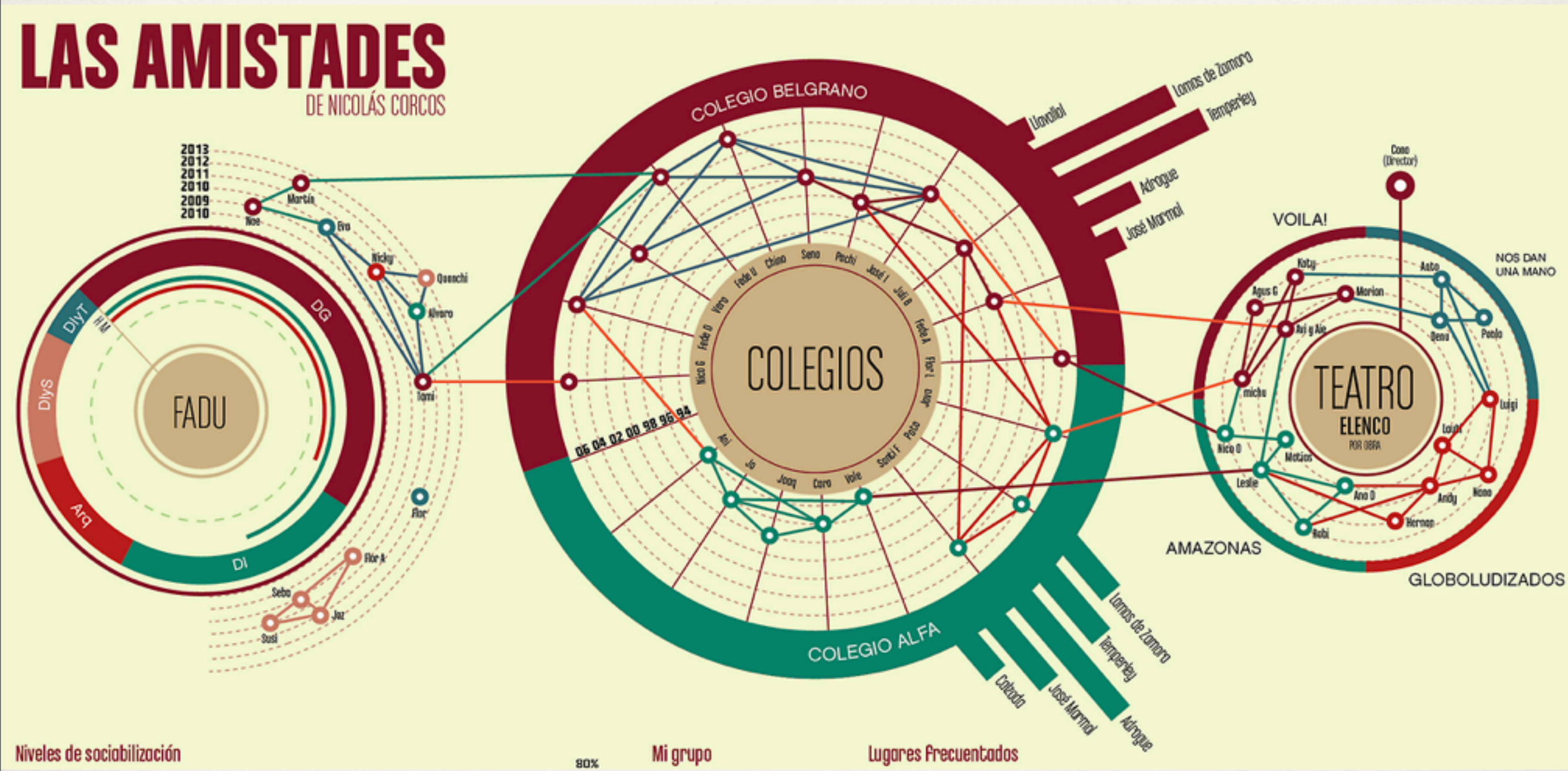
http://wtfviz.net

Trying to say too much?



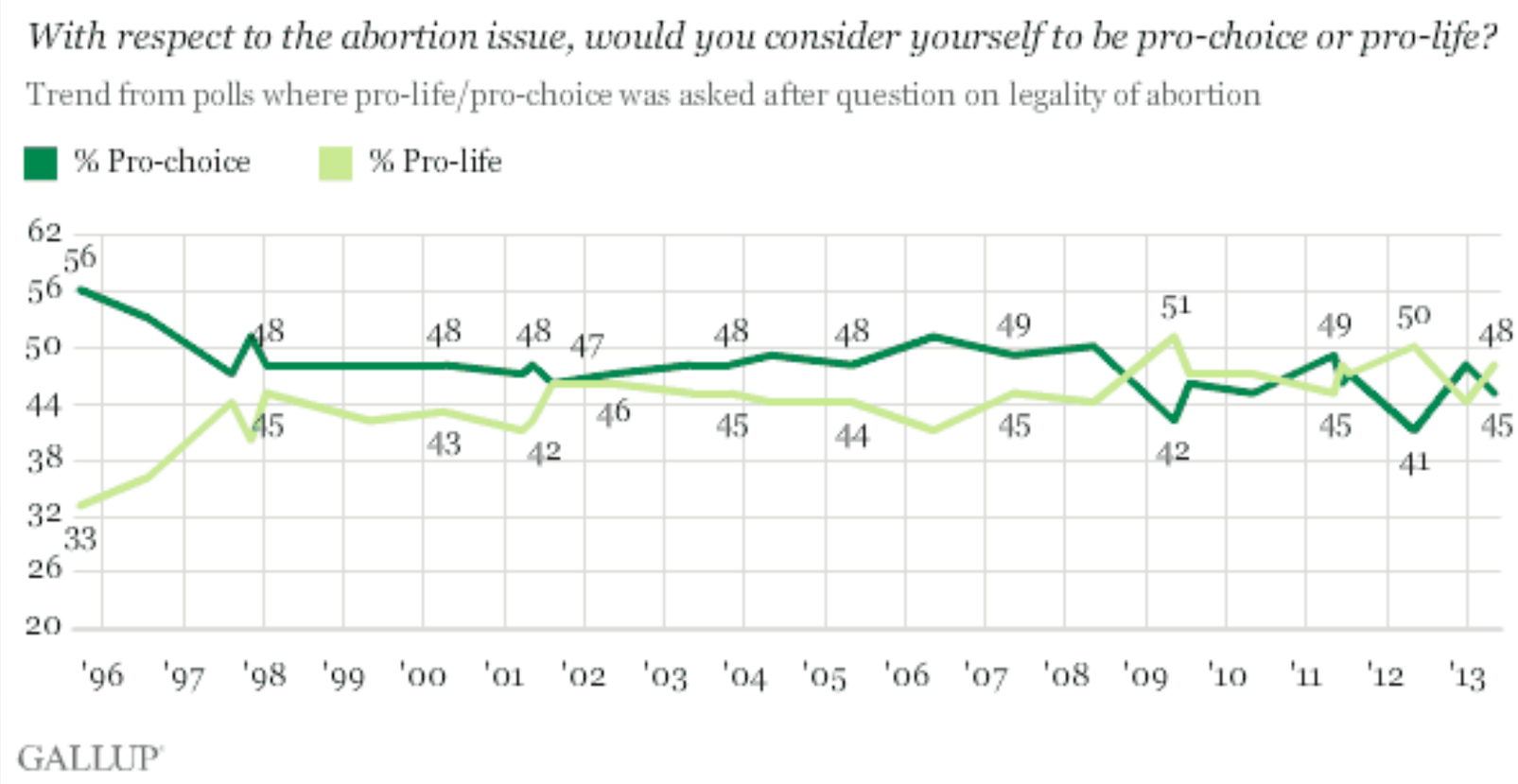
http://visual.ly/population-literacy

Trying to say too much?



http://wtfviz.net

Lie to me



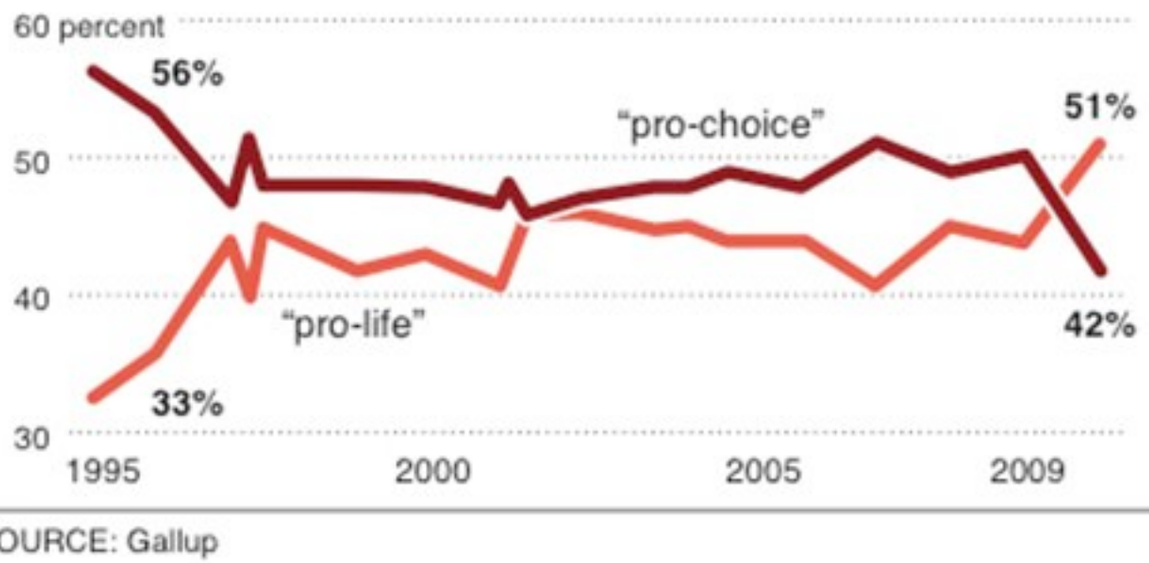
https://visualisingadvocacy.org/blog/disinformation-visualization-how-lie-datavis

Lie to me

Strong shift in opinion on abortion

A new poll found 51 percent of Americans identify themselves as "pro-life" on the issue of abortion and 42 percent as "pro-choice." It's the first time since 1995 that a majority of U.S. adults have identified themselves as pro-life.

Americans calling themselves "pro-life" or "pro-choice"

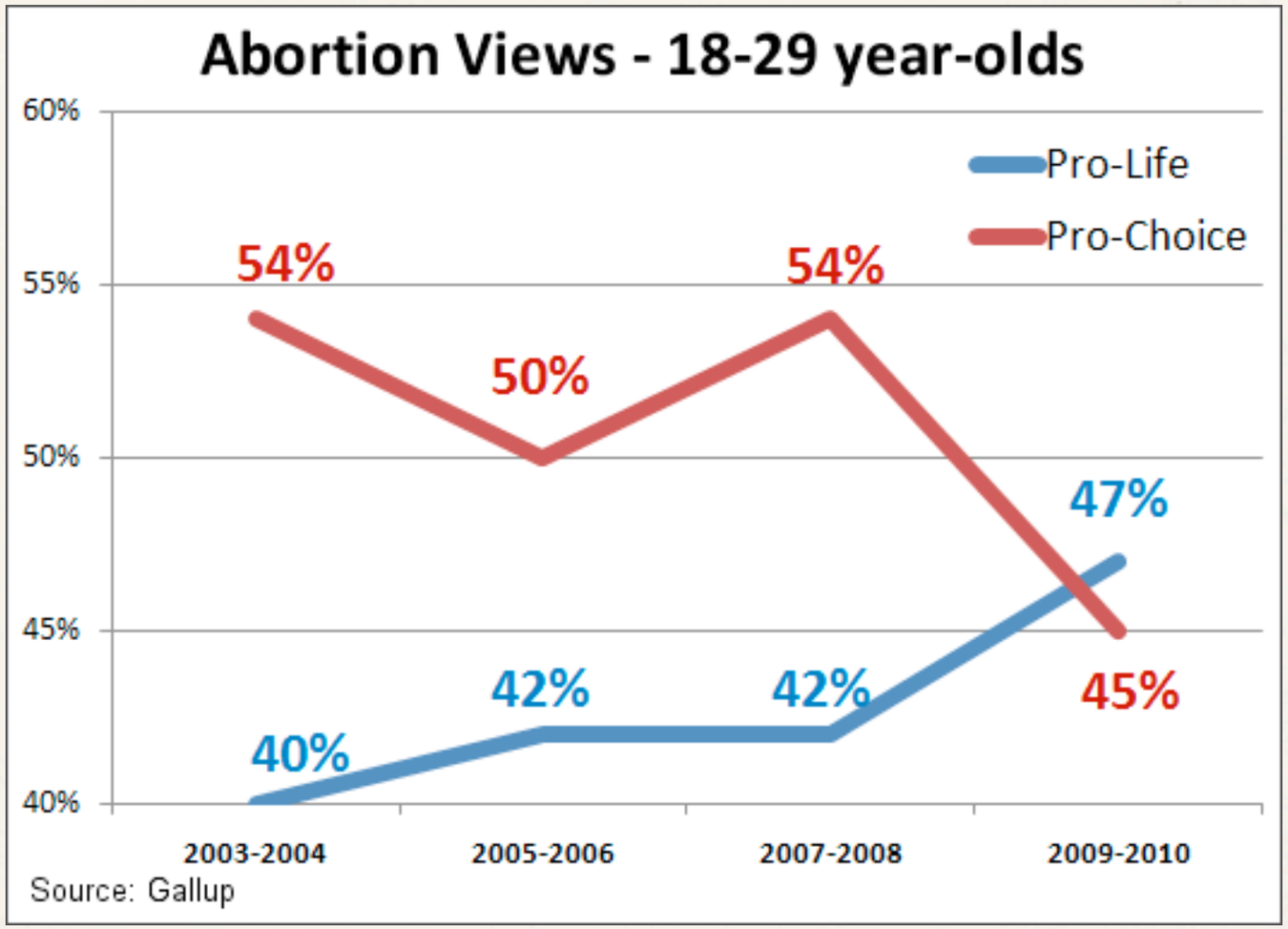


SOURCE: Gallup

AP

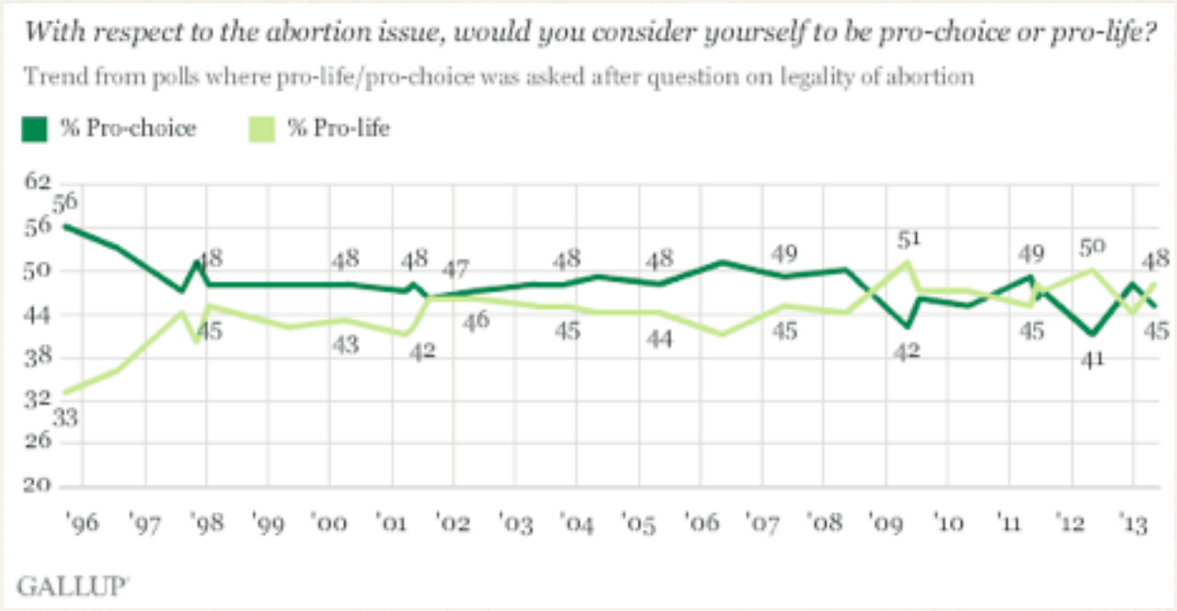
https://visualisingadvocacy.org/blog/disinformation-visualization-how-lie-datavis

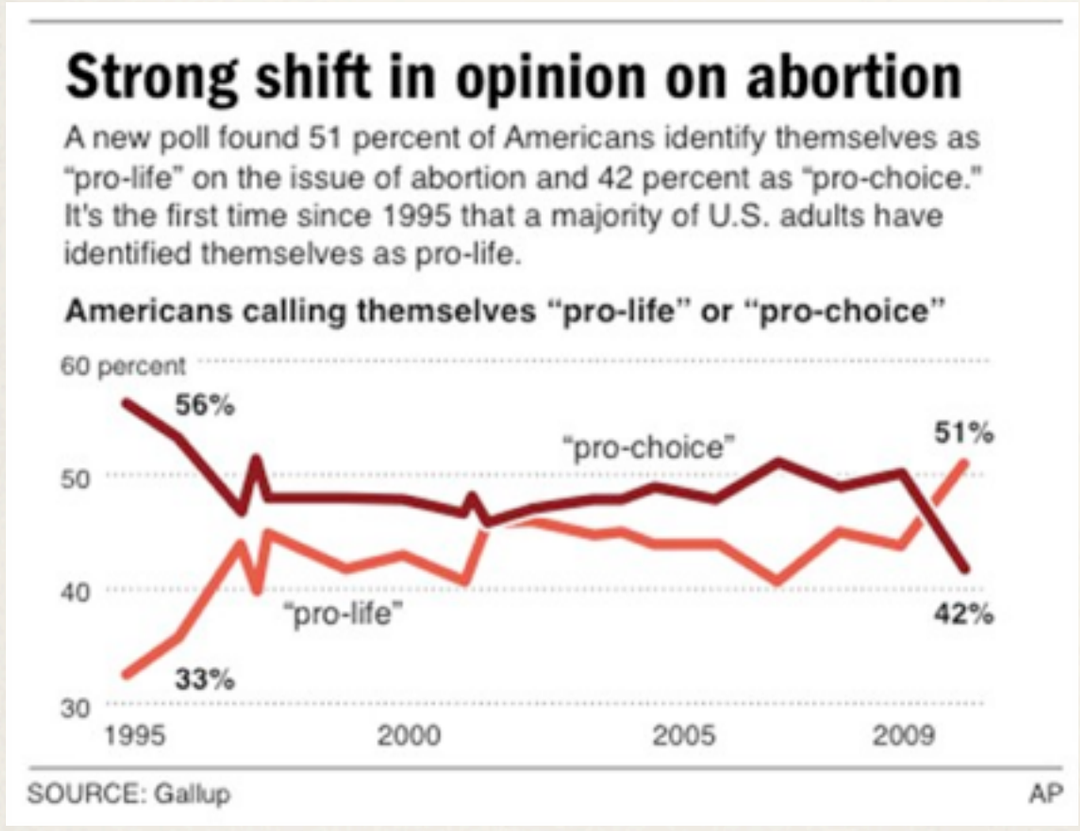
Lie to me

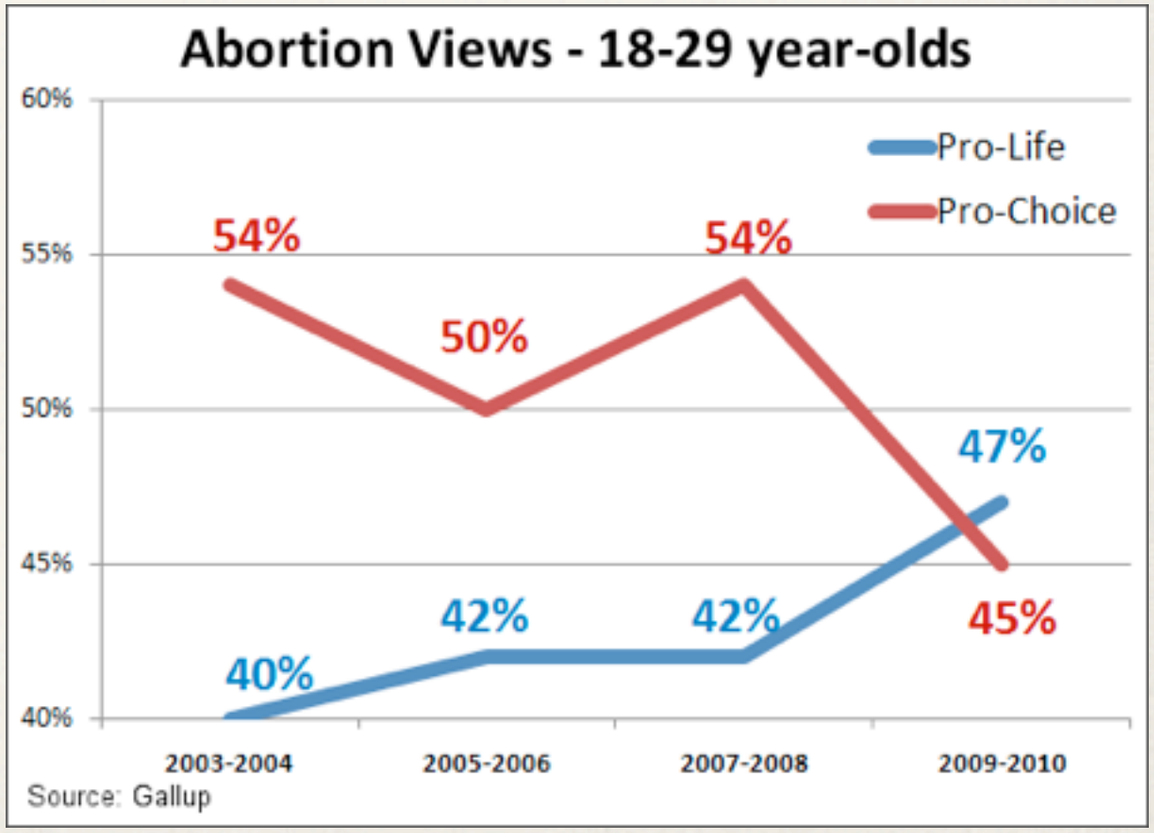


https://visualisingadvocacy.org/blog/disinformation-visualization-how-lie-datavis

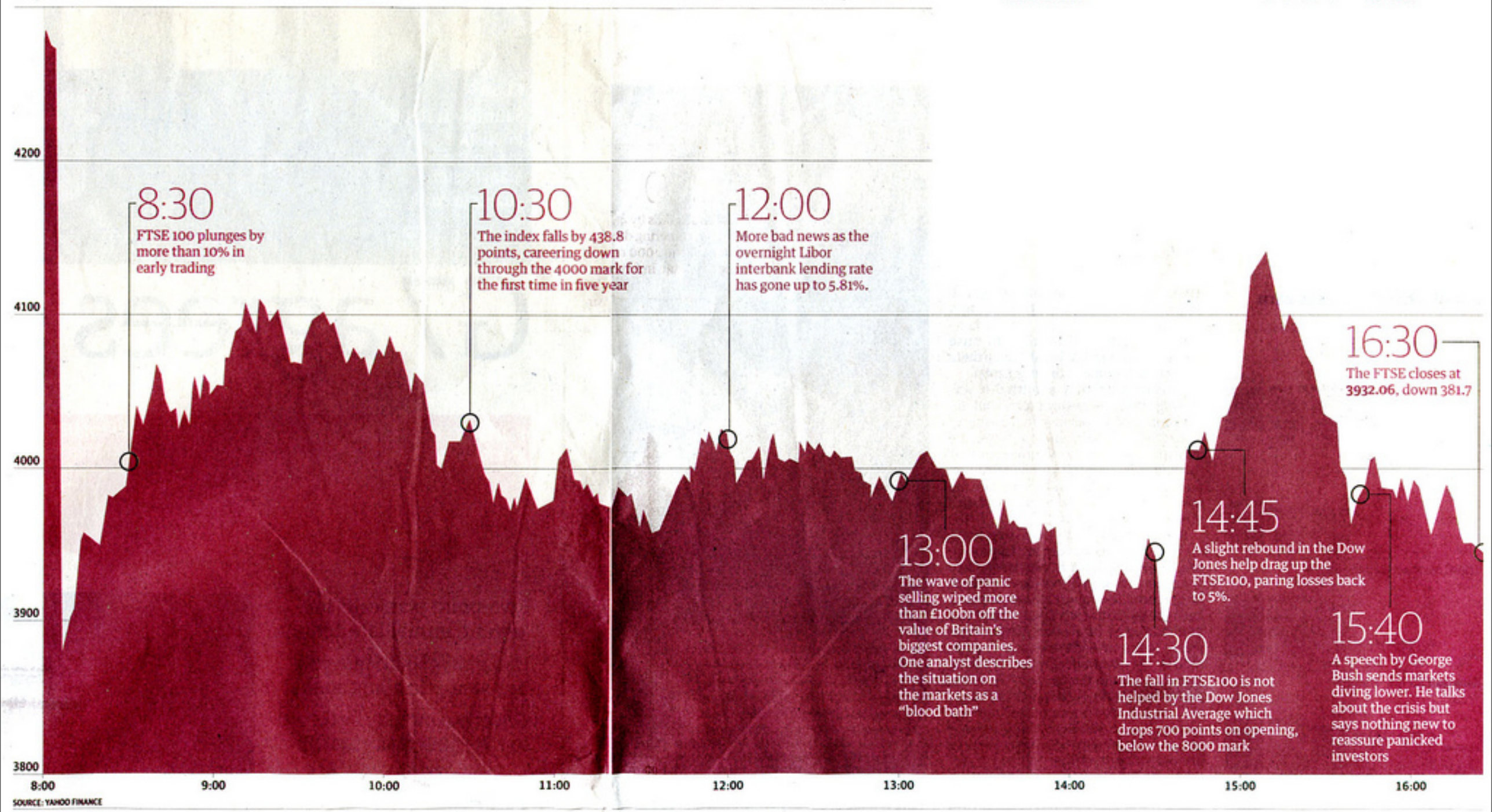
Lie to me



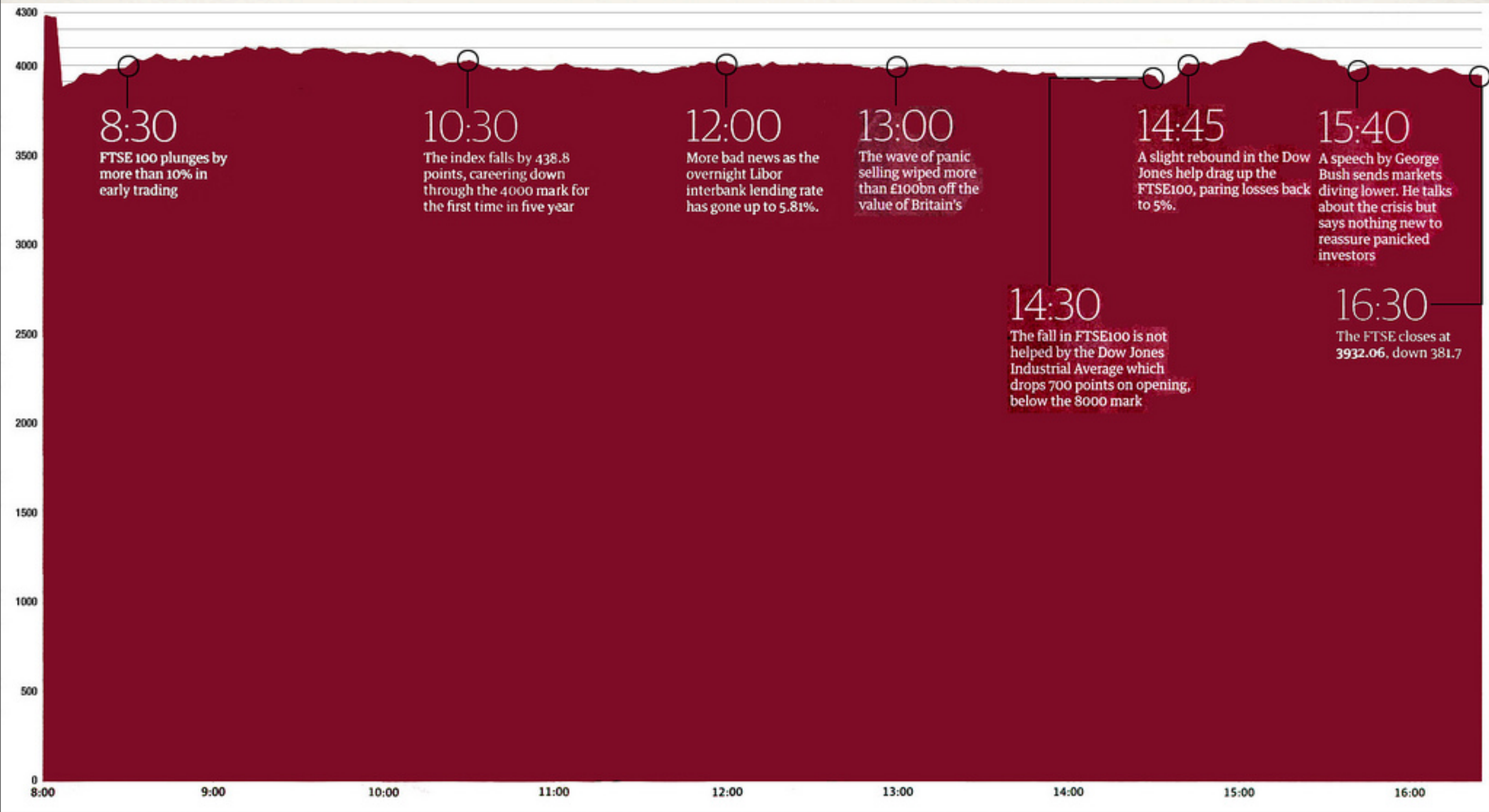




https://visualisingadvocacy.org/blog/disinformation-visualization-how-lie-datavis



Phil Gyford - http://www.flickr.com/photos/philgyford/2932821996/in/photostream/

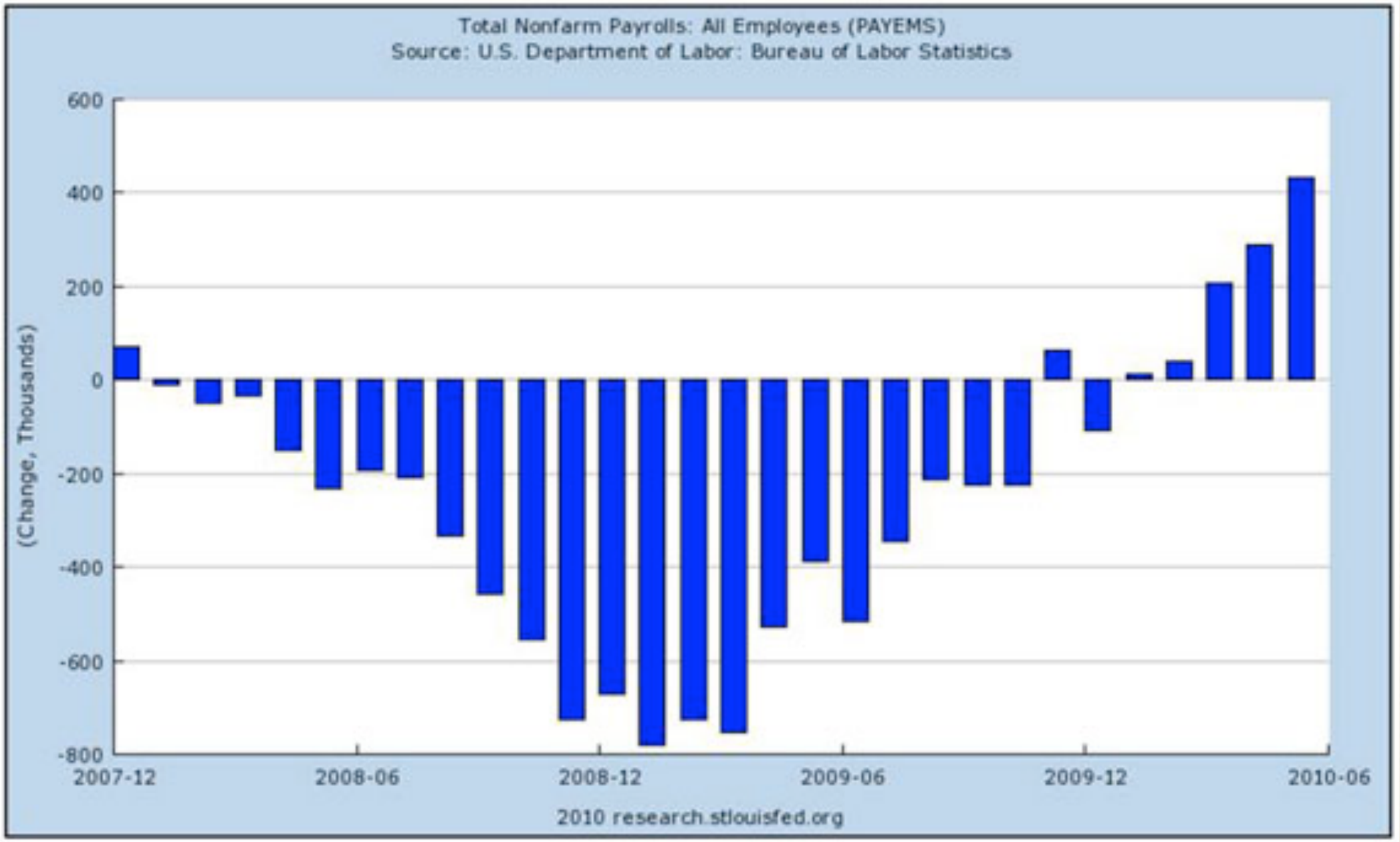


Phil Gyford - http://www.flickr.com/photos/philgyford/2931964129/in/photostream/

Lie to me

http://mediamatters.org/blog/2010/06/28/updated-worst-chart-ive-seen-all-day/166862

Lie to me



http://mediamatters.org/blog/2010/06/28/updated-worst-chart-ive-seen-all-day/166862

Lie to me

Unemployed

http://mediamatters.org/blog/2010/06/28/updated-worst-chart-ive-seen-all-day/166862

Lie to me

Unemployed

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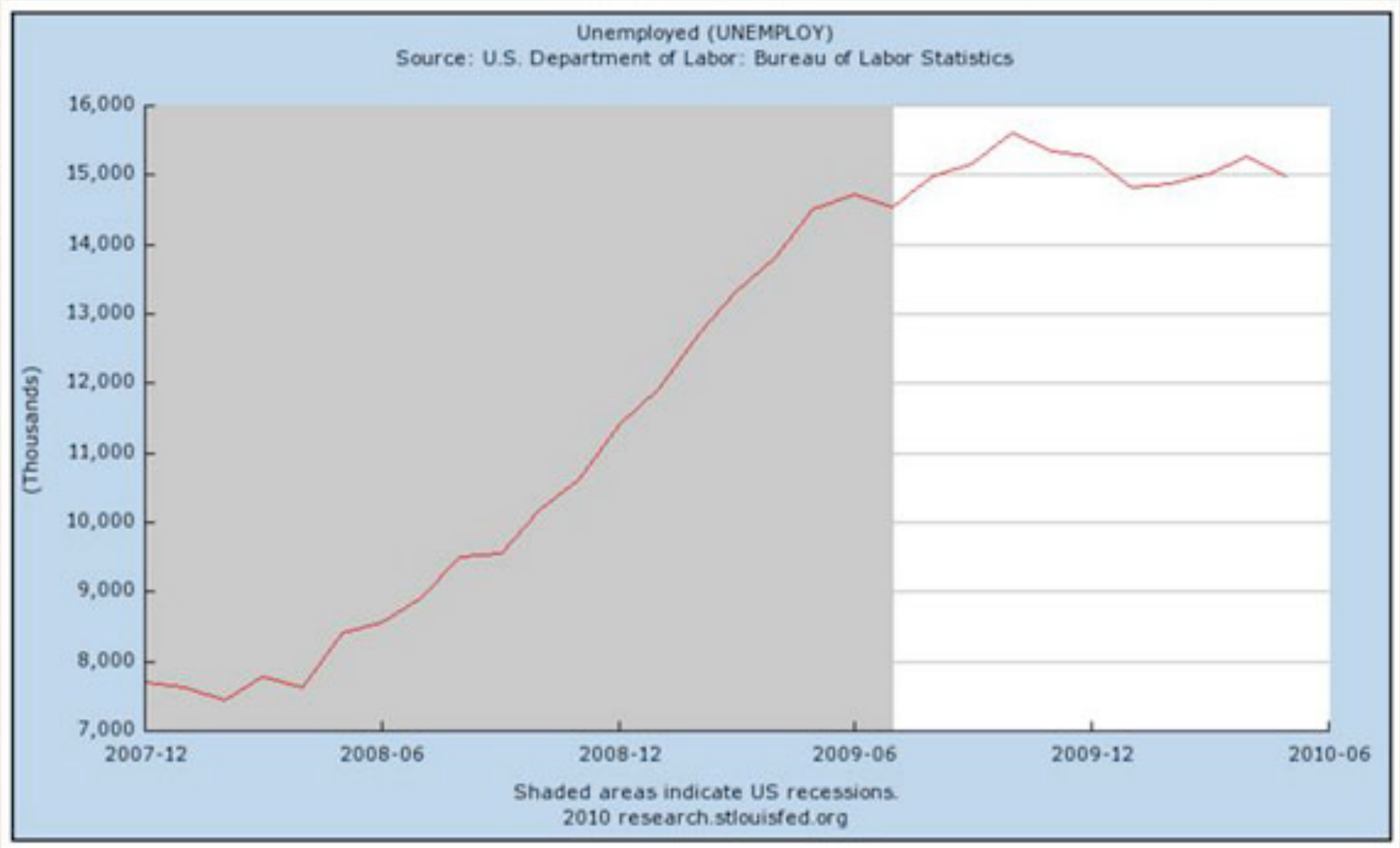
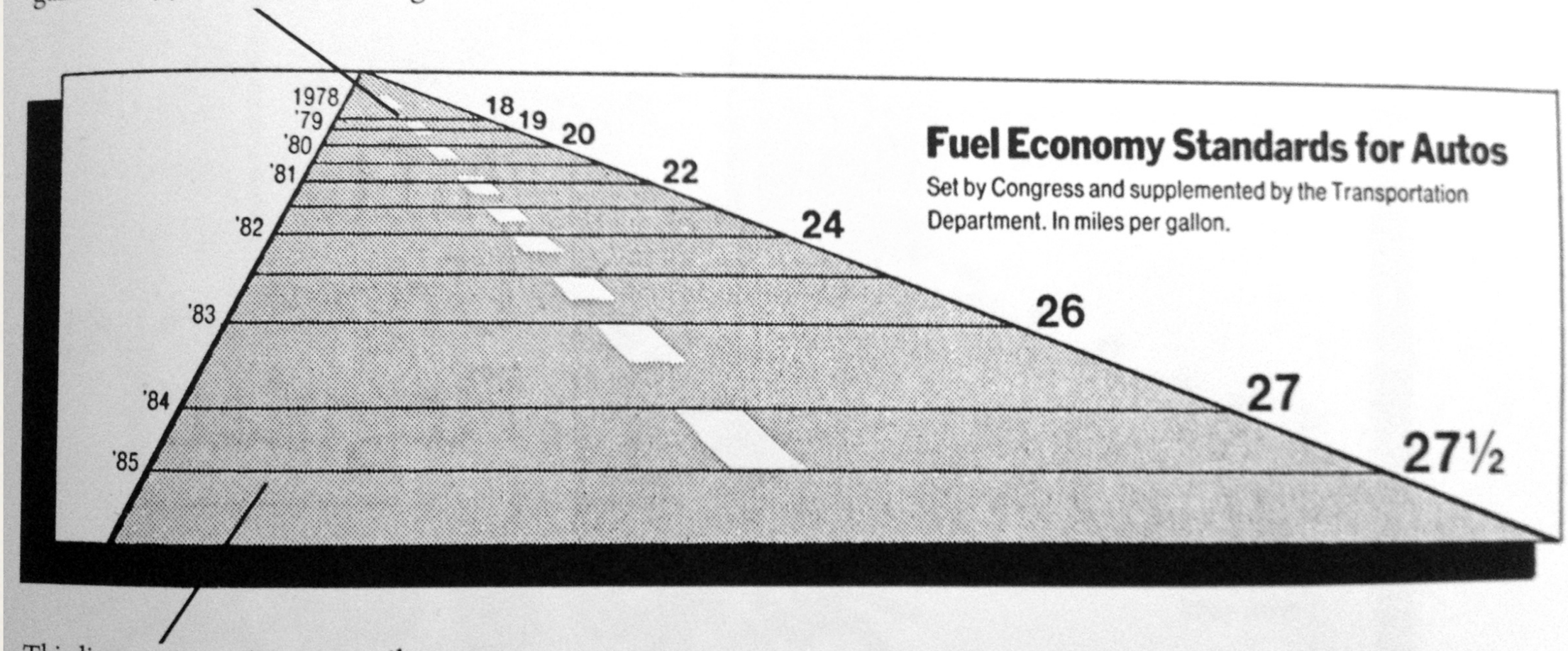
Lie to me


Unemployed (UNEMPLOY)
Source: U.S. Department of Labor: Bureau of Labor Statistics
16,000
15,000
14,000
13,000
12,000
11,000
10,000
9,000
8,000
7,000
(Thousands)
2007-12
2008-06
2008-12
2009-06
2009-12
2010-06
Shaded areas indicate US recessions.
2010 research.stlouisfed.org

Lie factor

This line, representing 18 miles per gallon in 1978, is 0.6 inches long.

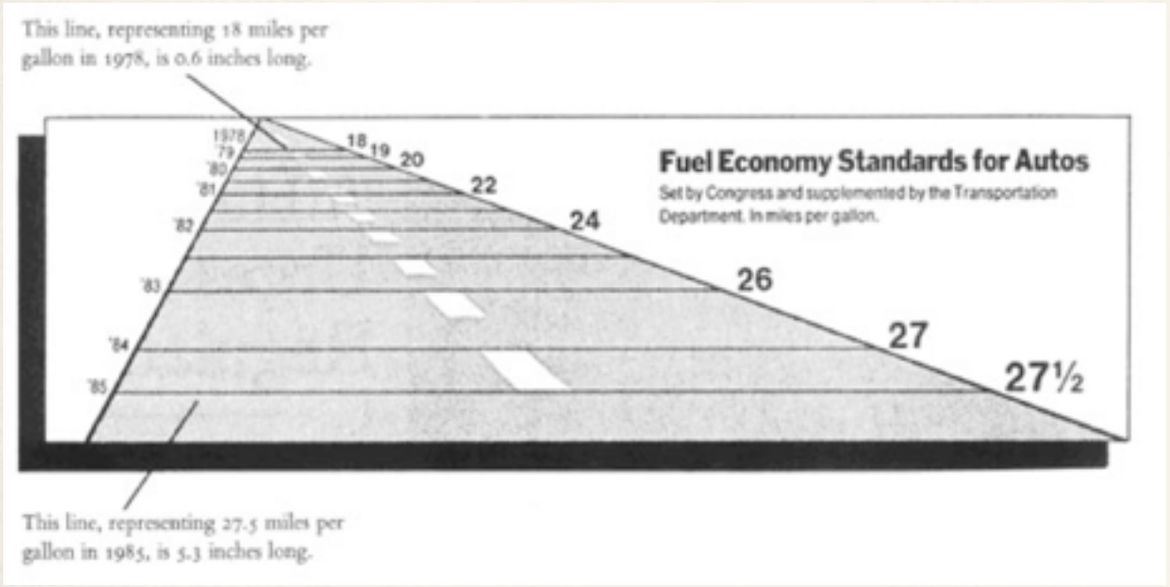


This line, representing 27.5 miles per gallon in 1985, is 5.3 inches long.

New York Times, August 9, 1978, p. D-2.

http://www.infovis-wiki.net/index.php?title=Lie_Factor

Lie factor



$$\text{Lie Factor} = \frac{\text{Size of effect in graphic}}{\text{Size of effect in data}}$$

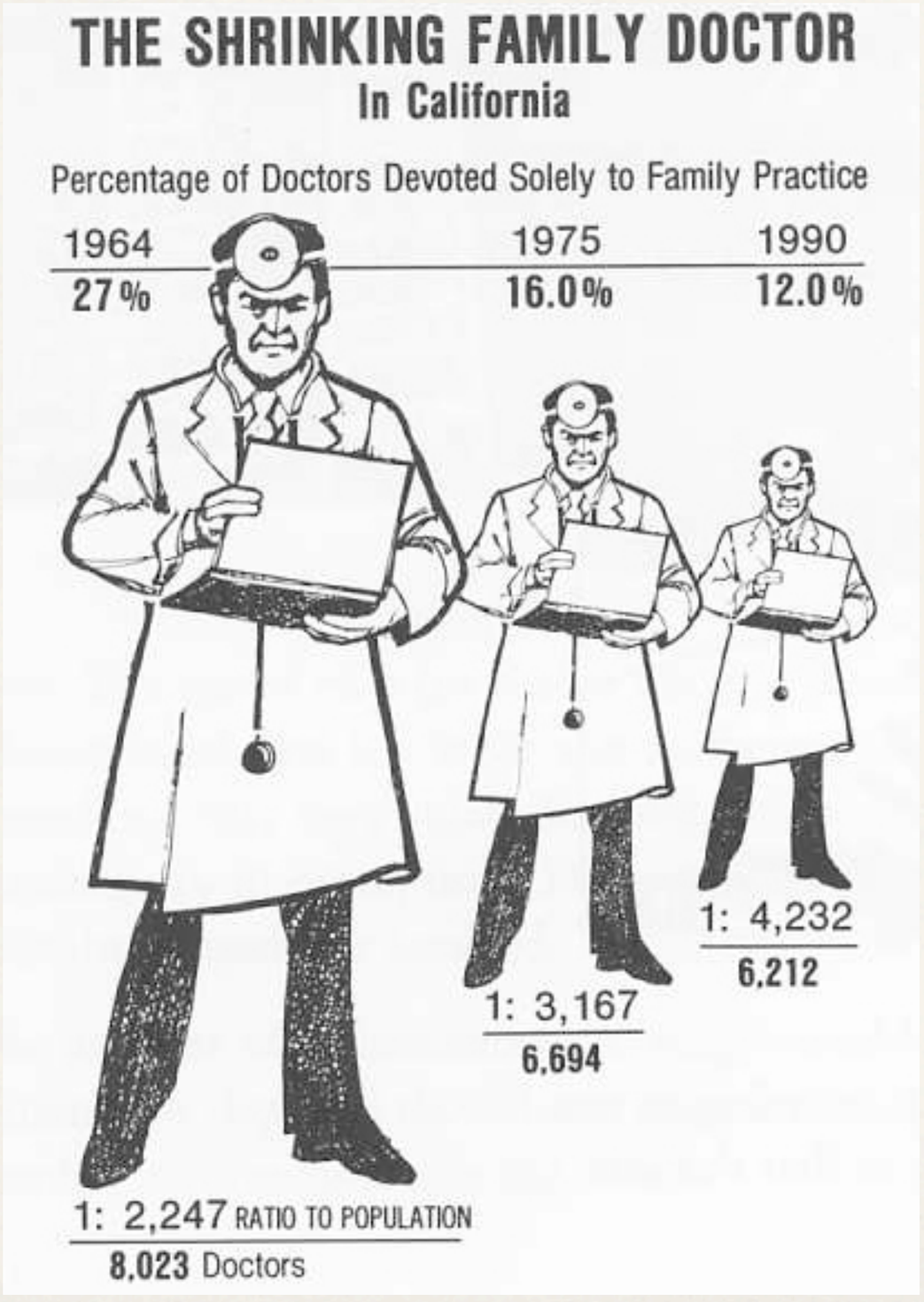
$$\text{Size of effect in graphic} = \frac{5.3in - 0.6in}{0.6in} = 7.83$$

$$\text{Size of effect in data} = \frac{27.5 - 18}{18} = 0.53$$

Lie Factor = 14.8

http://www.infovis-wiki.net/index.php?title=Lie_Factor

Area and one-dimensional data



Los Angeles Times, 1979-08-05

Lie factor: 2.8

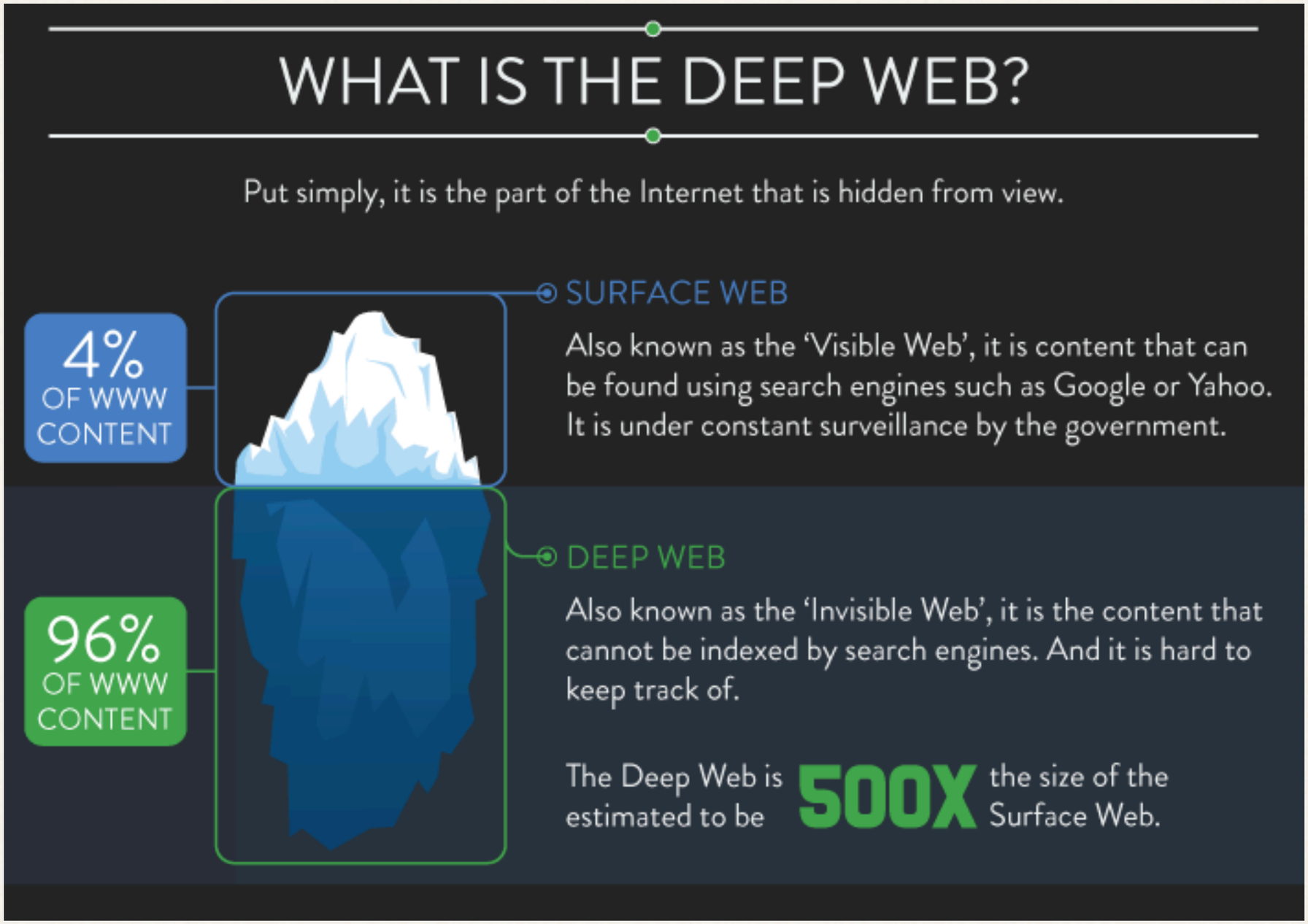
...*and* overlapping to make this look like it has perspective distortion

...*and* misleading horizontal displacement

...*and* one of those is a prediction

Tufte, "The Visual Display of Quantitative Data"

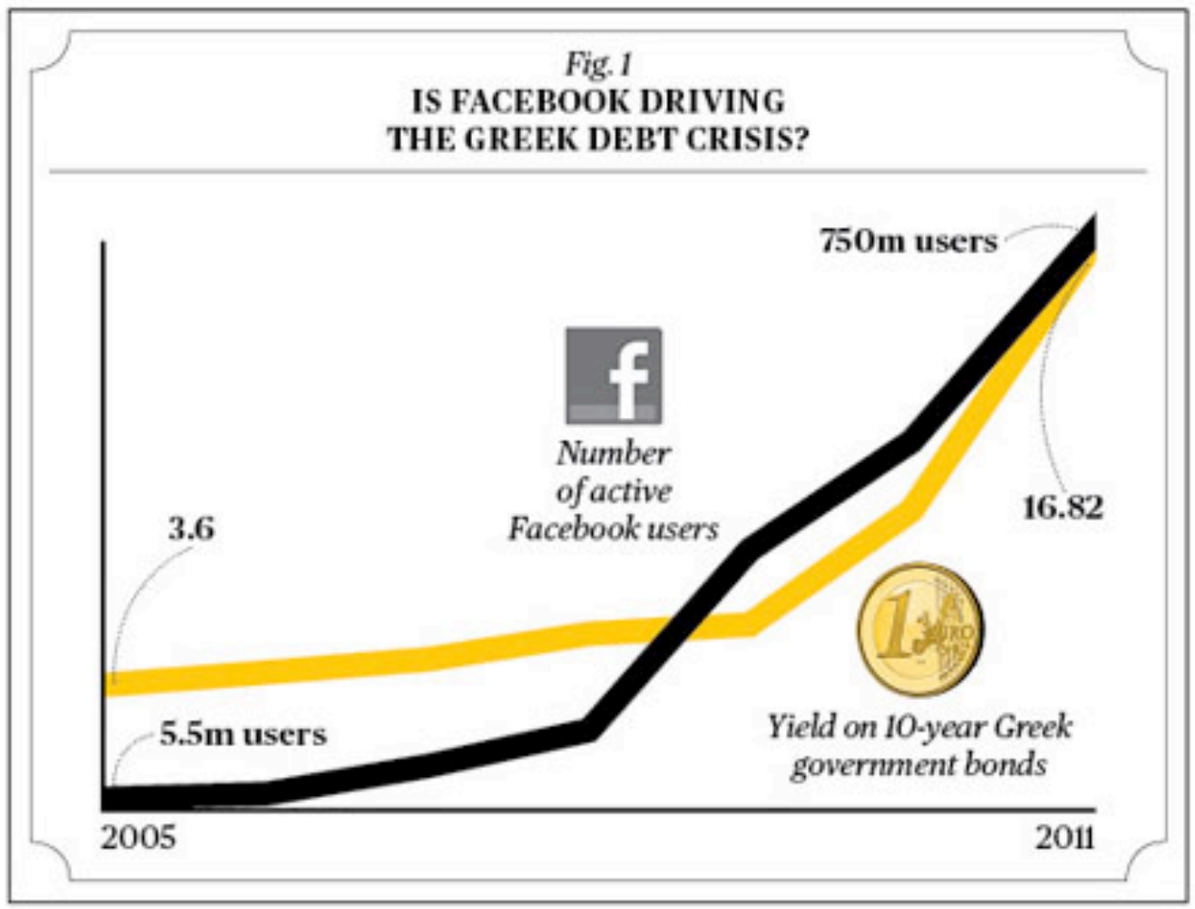
That is a big 4%...

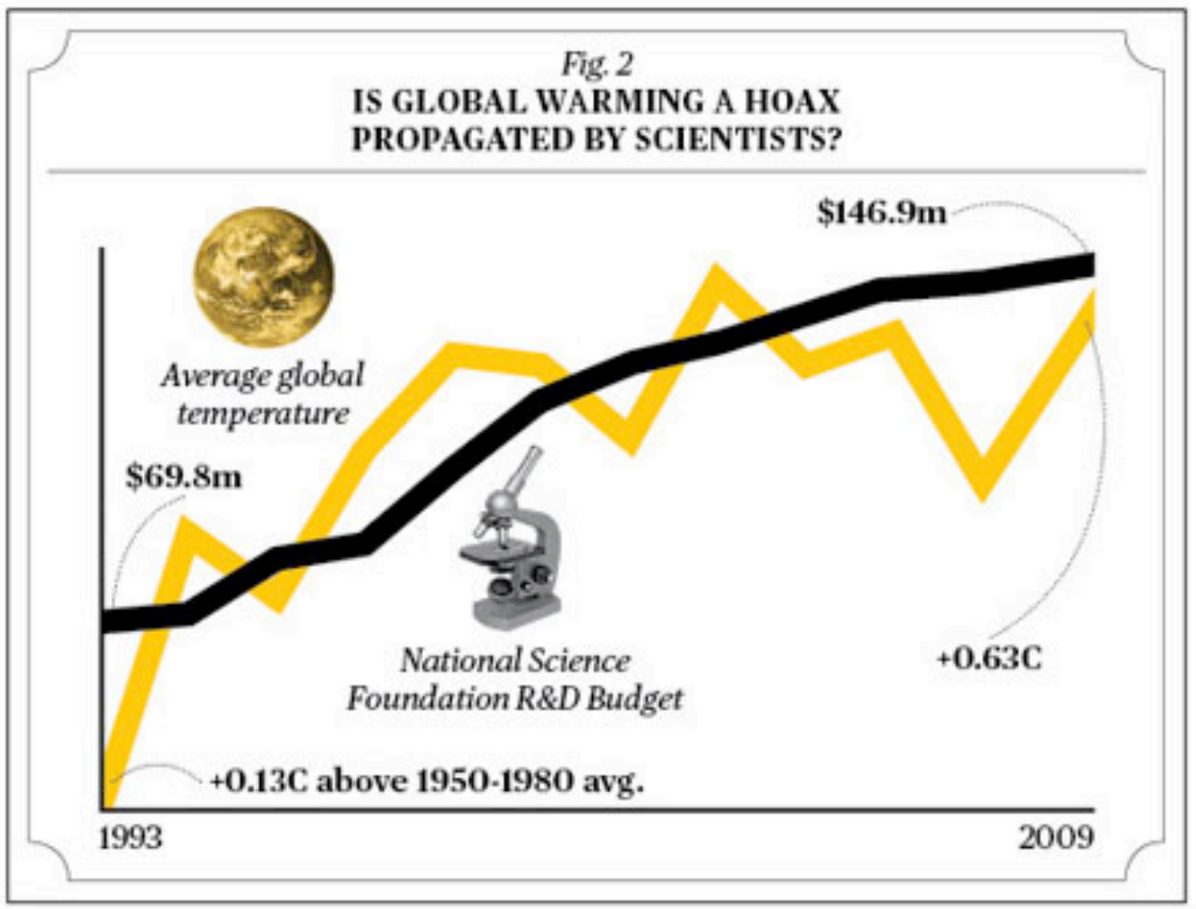


Lie factor: 0.048

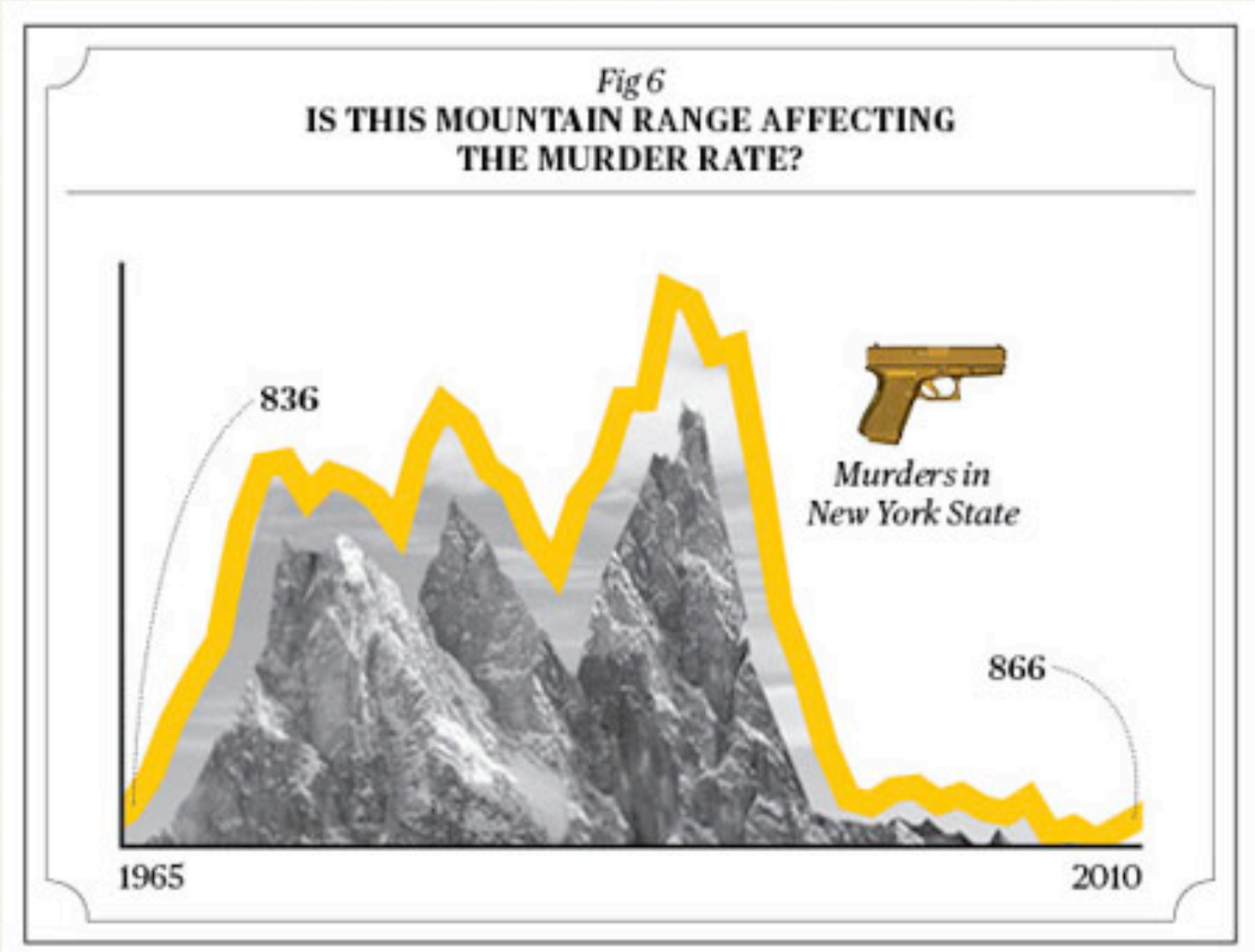
http://wtfviz.net

Correlation or Causation?



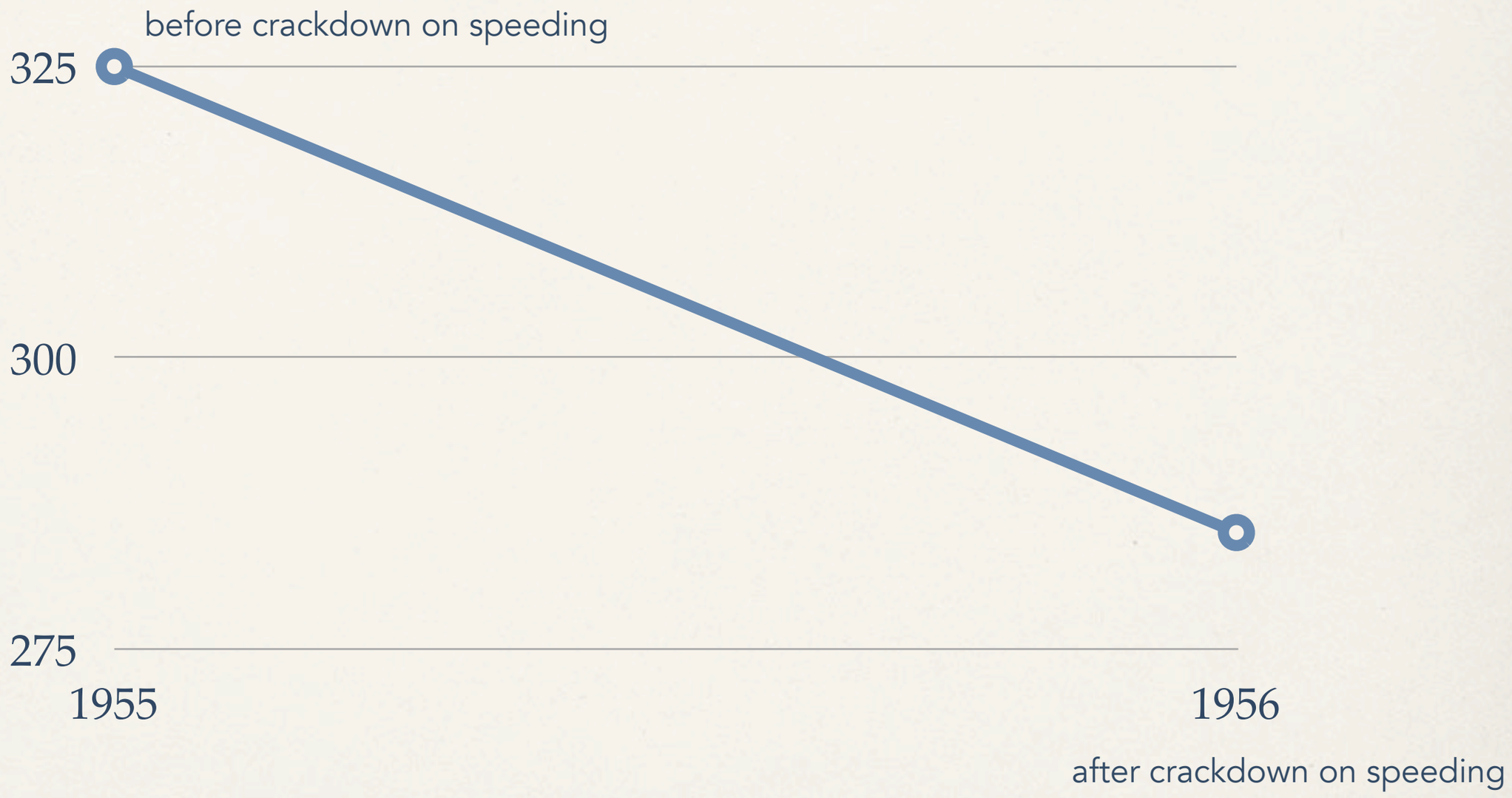


Correlation or Causation?



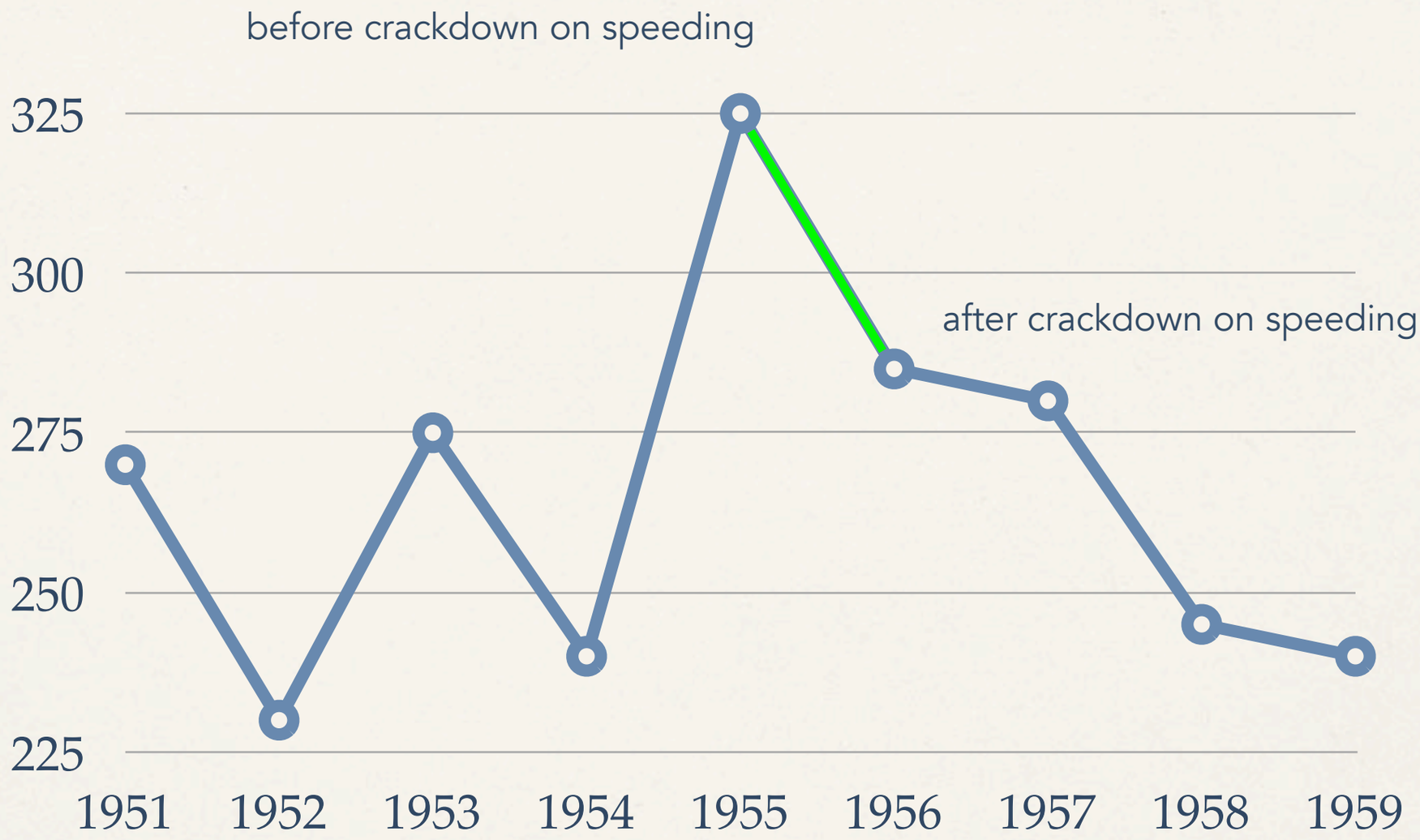
Context is essential

Connecticut Traffic Deaths



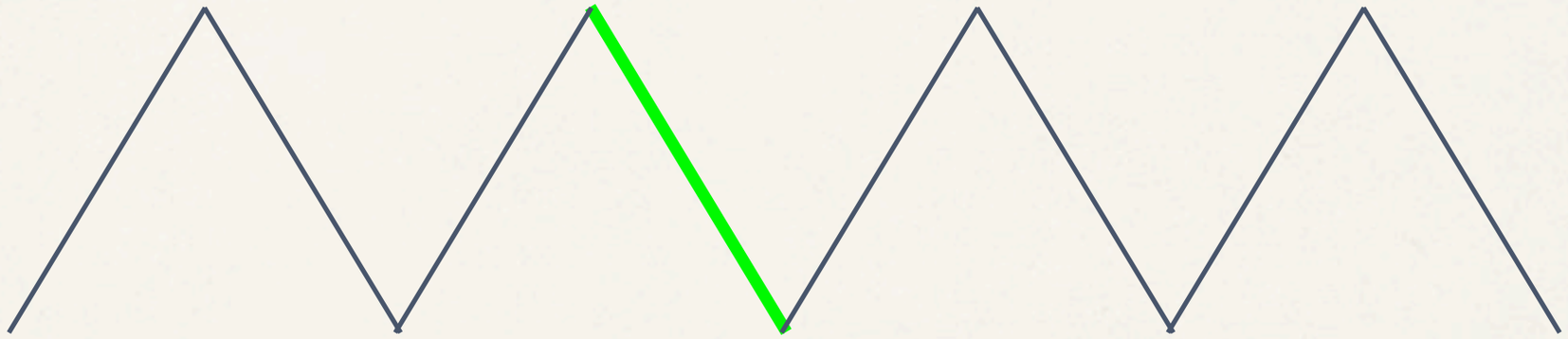
Context is essential

Connecticut Traffic Deaths

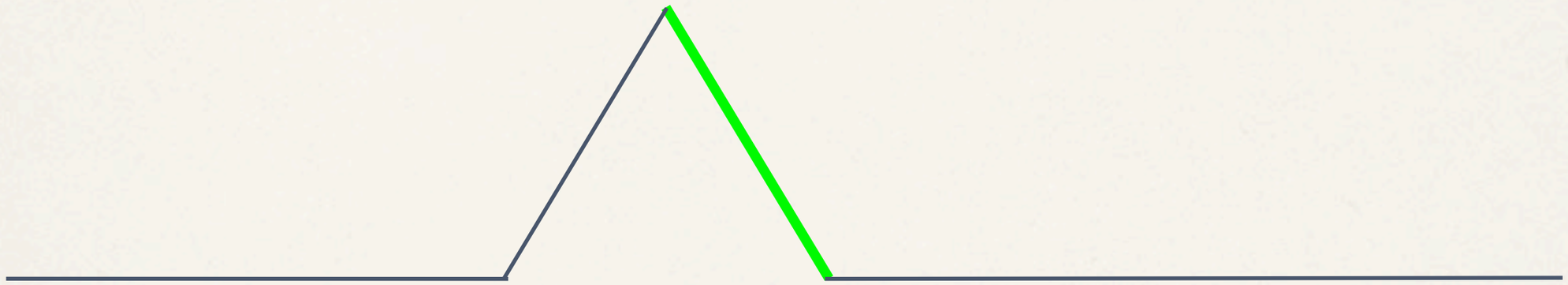


Context is essential

Context is essential



Context is essential



Context is essential

How to lie

Remove outliers until you have visible trends

Find a fitted curve and throw away the original data

Change the scaling to make a trend appear

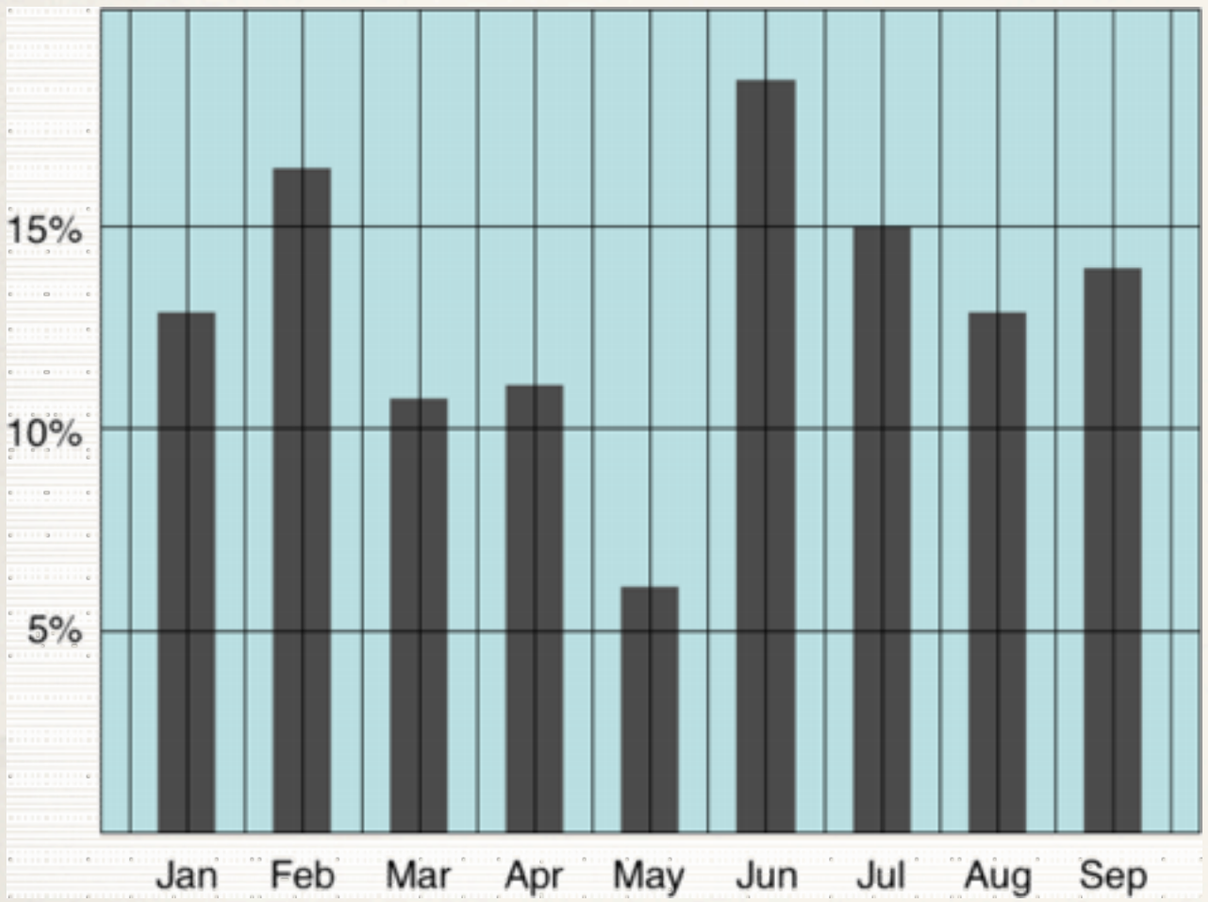
Change the range to only show the effect you want

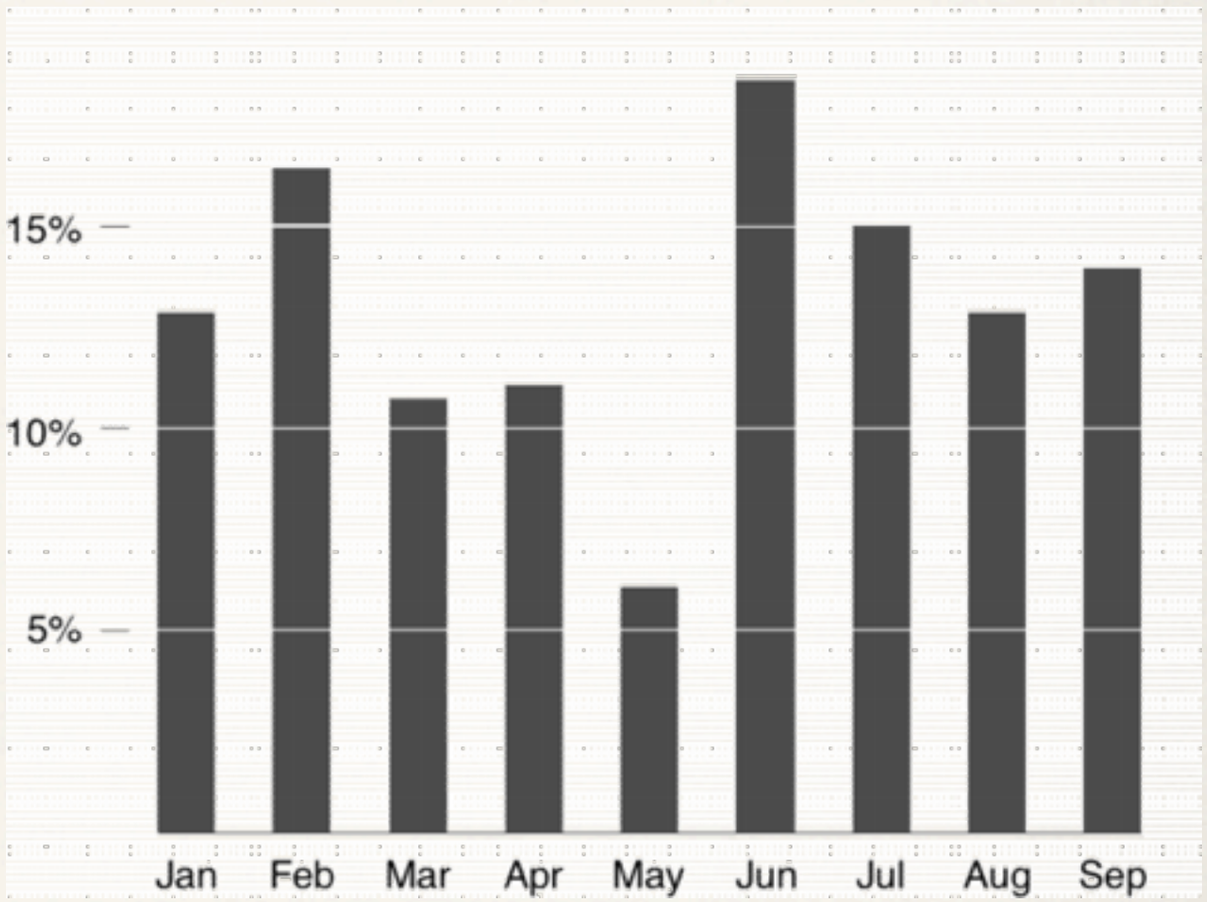
Distort the scale (e.g., move the baseline so the bottom isn't at 0)

Abuse dimensionality -- use volume or area instead of length since we know that they are harder to interpret

Compare apples to oranges, mixing two different kinds of data on the same chart

Data Ink Ratio





$$\text{data-ink ratio} = \frac{\text{data-ink}}{\text{ink used in graphic}}$$

http://www.infovis-wiki.net/index.php/Data-Ink_Ratio

Chart junk

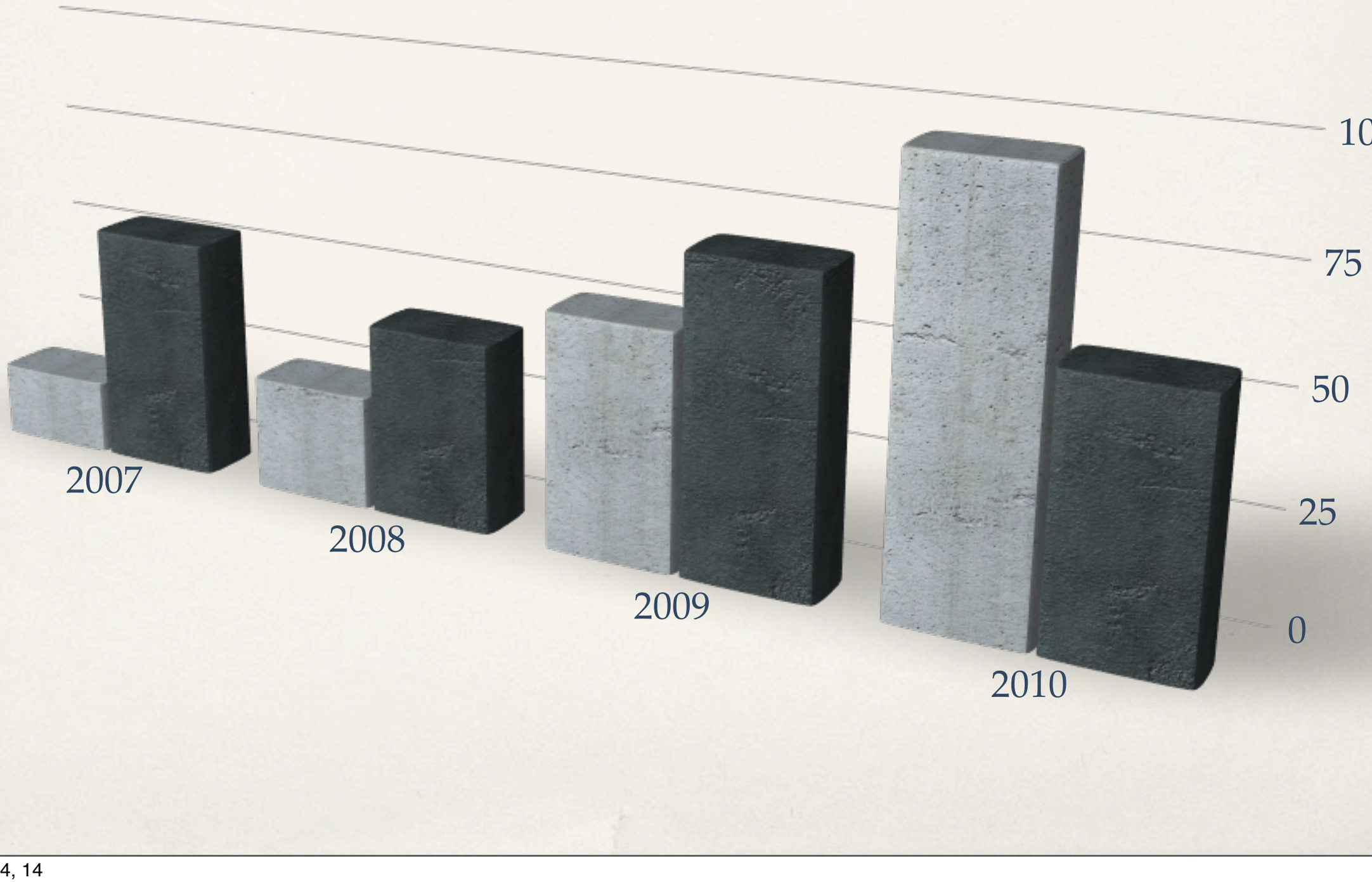
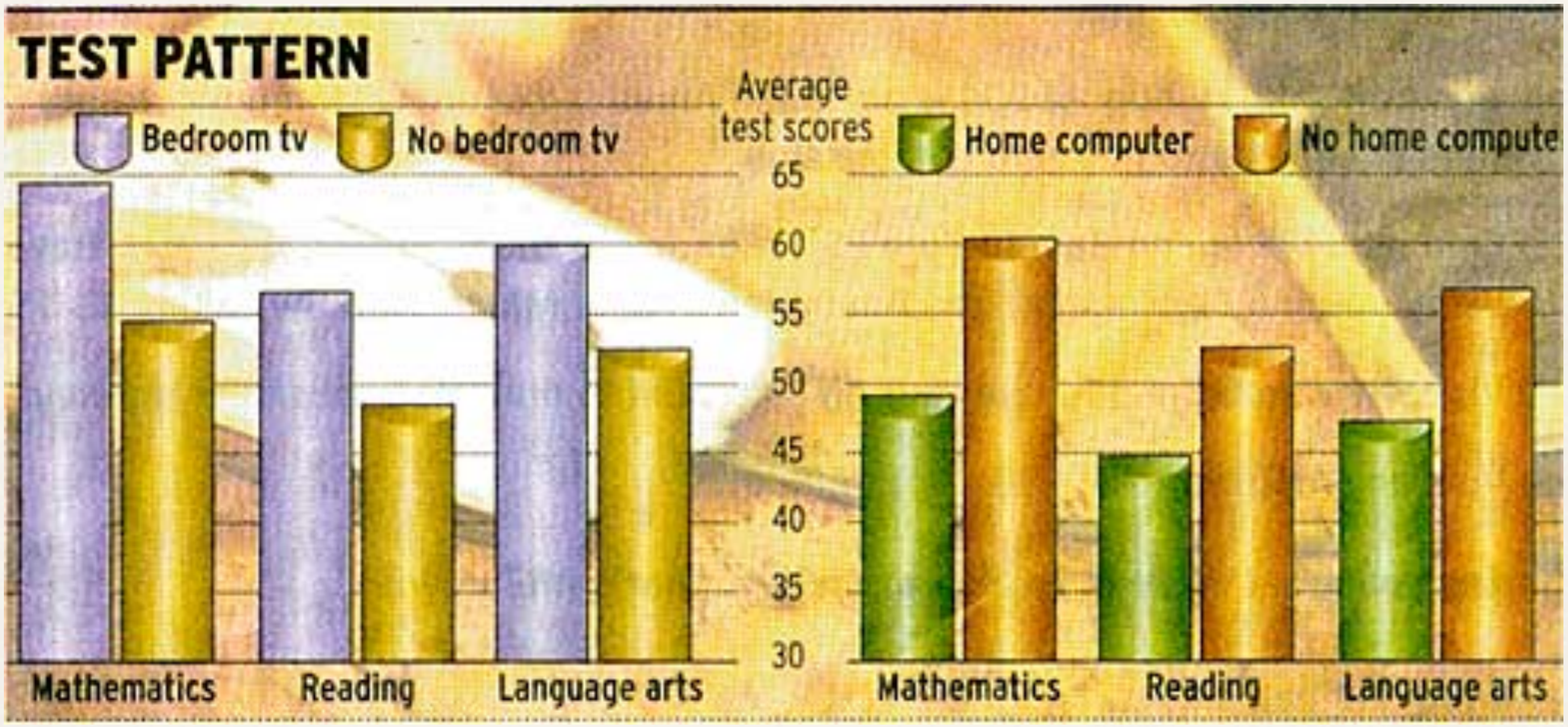


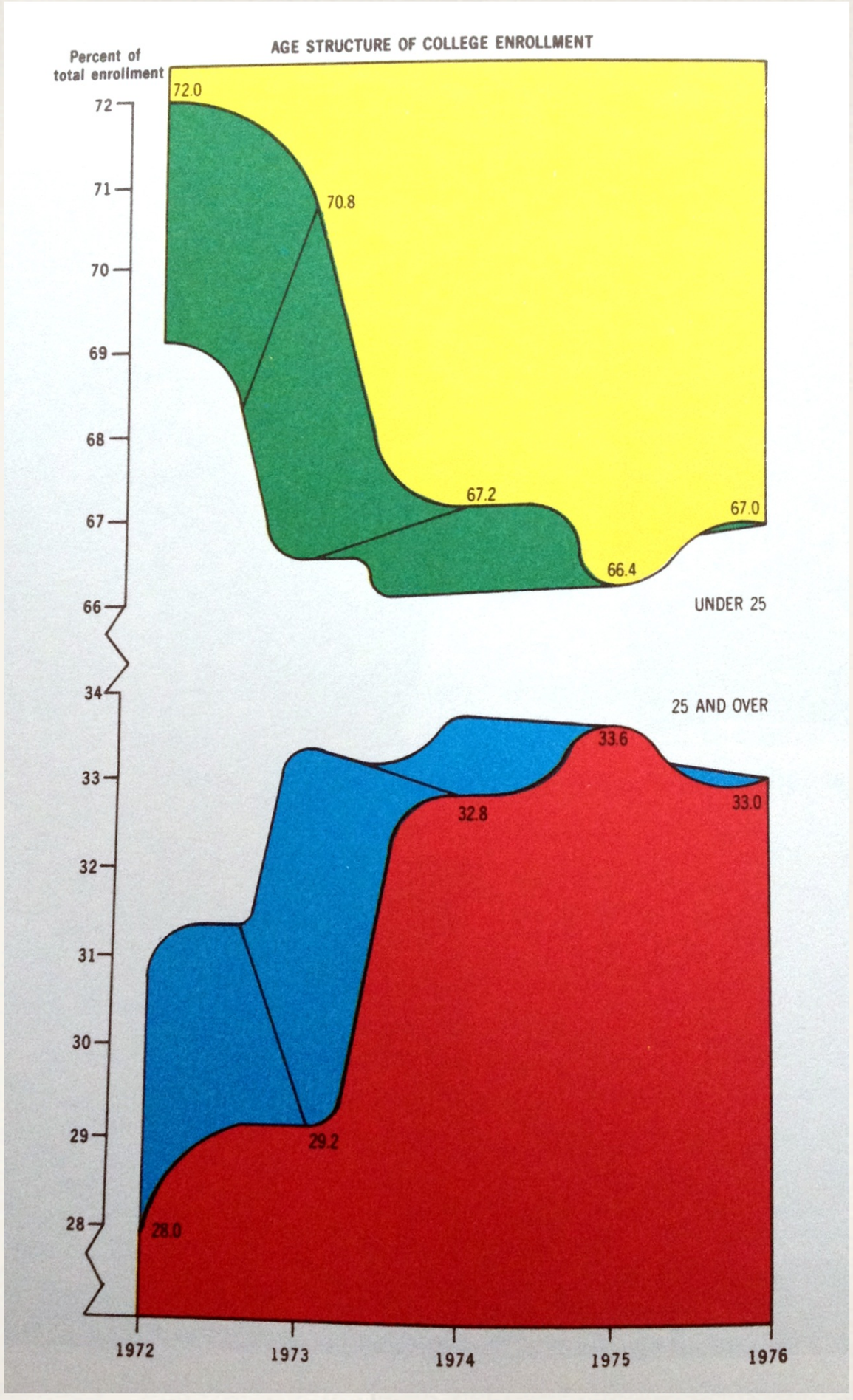
Chart junk



Sunday Morning Herald, 2005-07-06

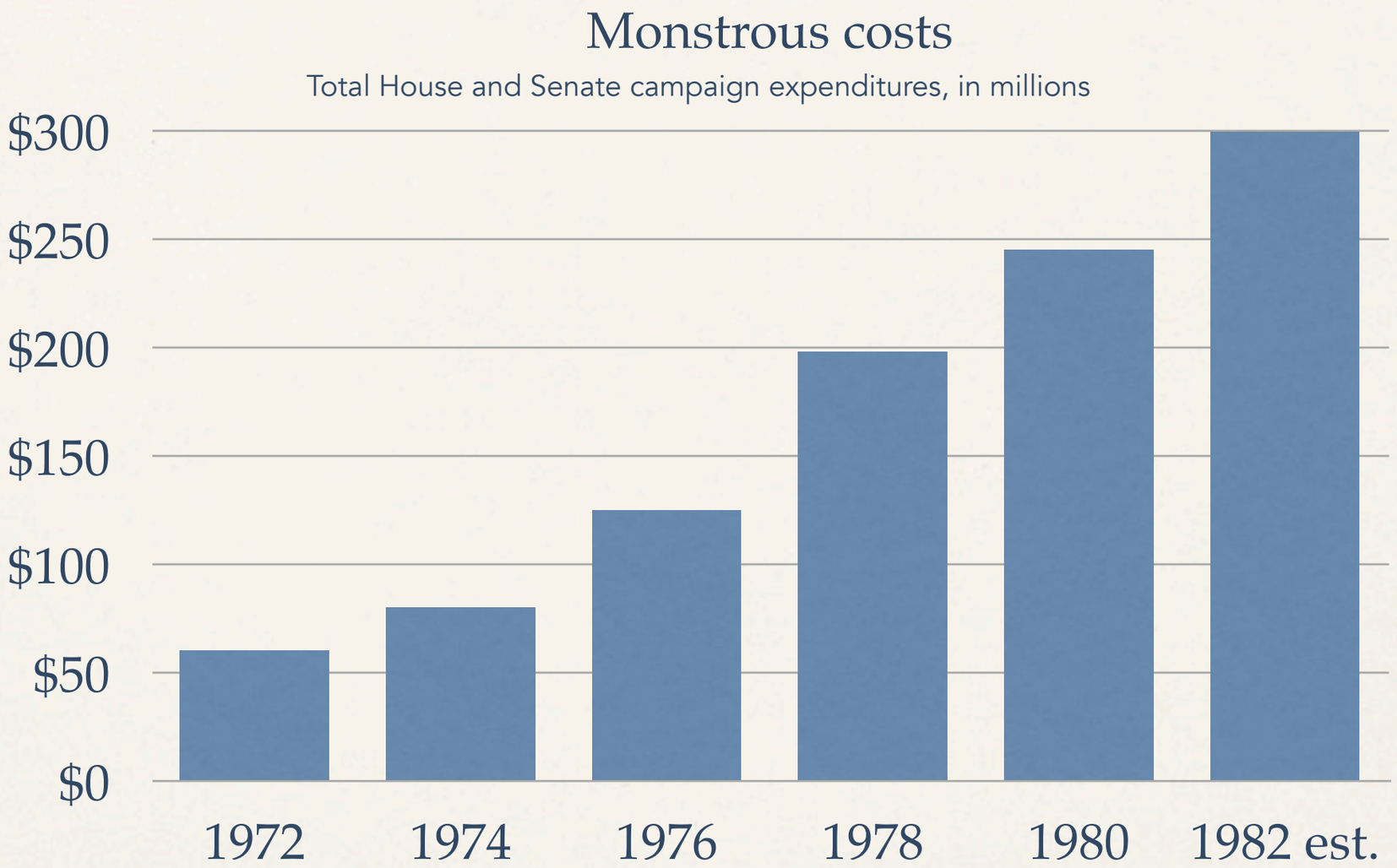
http://chartjunk.karmanaut.com/?p=8

Chart junk



Tufte, "The Visual Display of Quantitative Data"

Useful chart junk?



Useful chart junk?

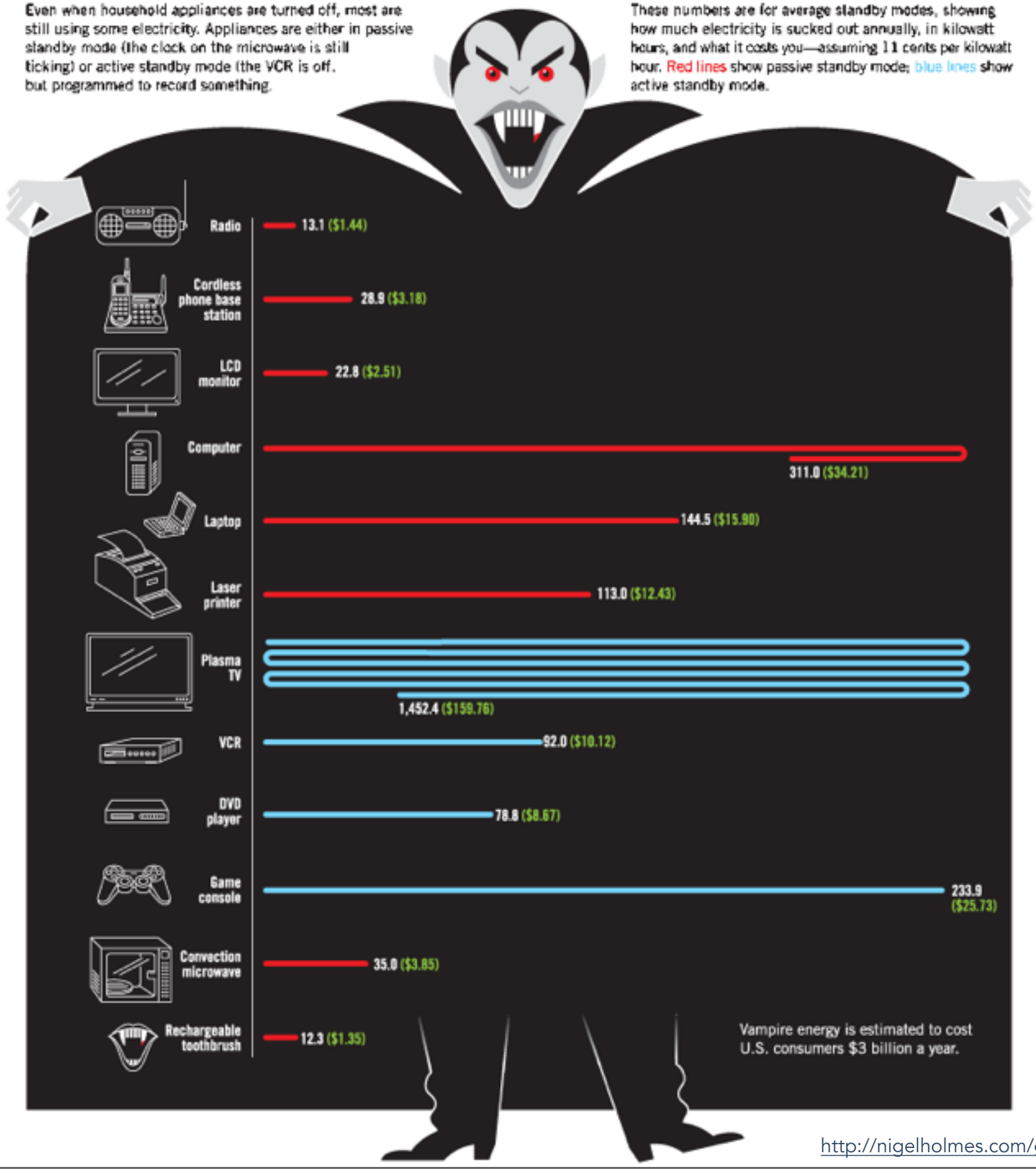
Bateman et a., Useful Junk? The Effects of Visual Embellishment on Comprehension and Memorability of Charts, CHI '05

Useful chart junk?

Vampire Energy

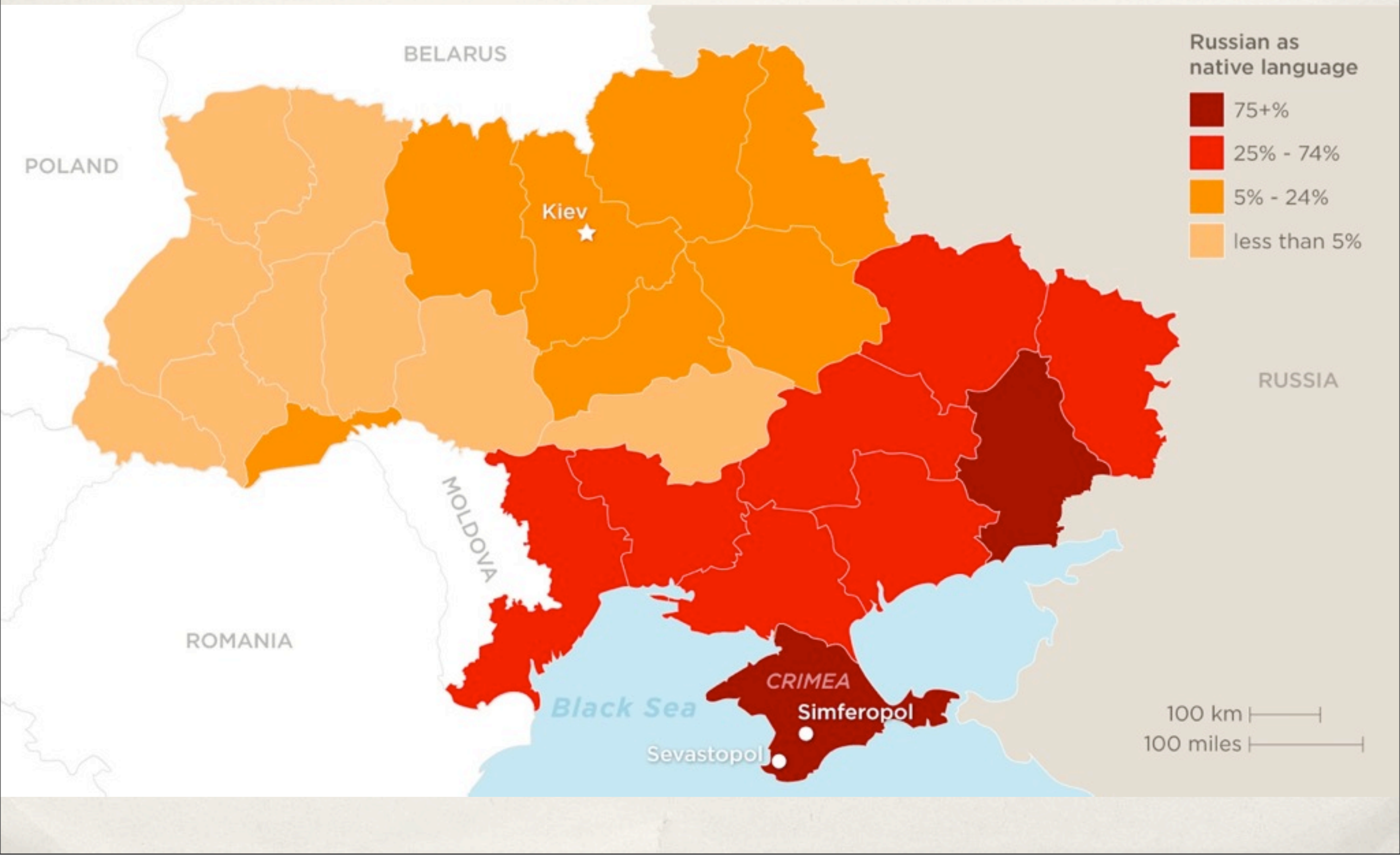
Even when household appliances are turned off, most are still using some electricity. Appliances are either in passive standby mode (the clock on the microwave is still ticking) or active standby mode (the VCR is off, but programmed to record something.

These numbers are for average standby modes, showing how much electricity is sucked out annually, in kilowatt hours, and what it costs you—assuming 11 cents per kilowatt hour. Red lines show passive standby mode; blue lines show active standby mode.



http://nigelholmes.com/graphic/vampire-good-magazine/

Color


BELARUS
POLAND
Kiev
RUSSIA
MOLDOVA
ROMANIA
CRIMEA
Simferopol
Sevastopol
Black Sea
Russian as native language
75+%
25% - 74%
5% - 24%
less than 5%
100 km
100 miles

Rainbow color maps

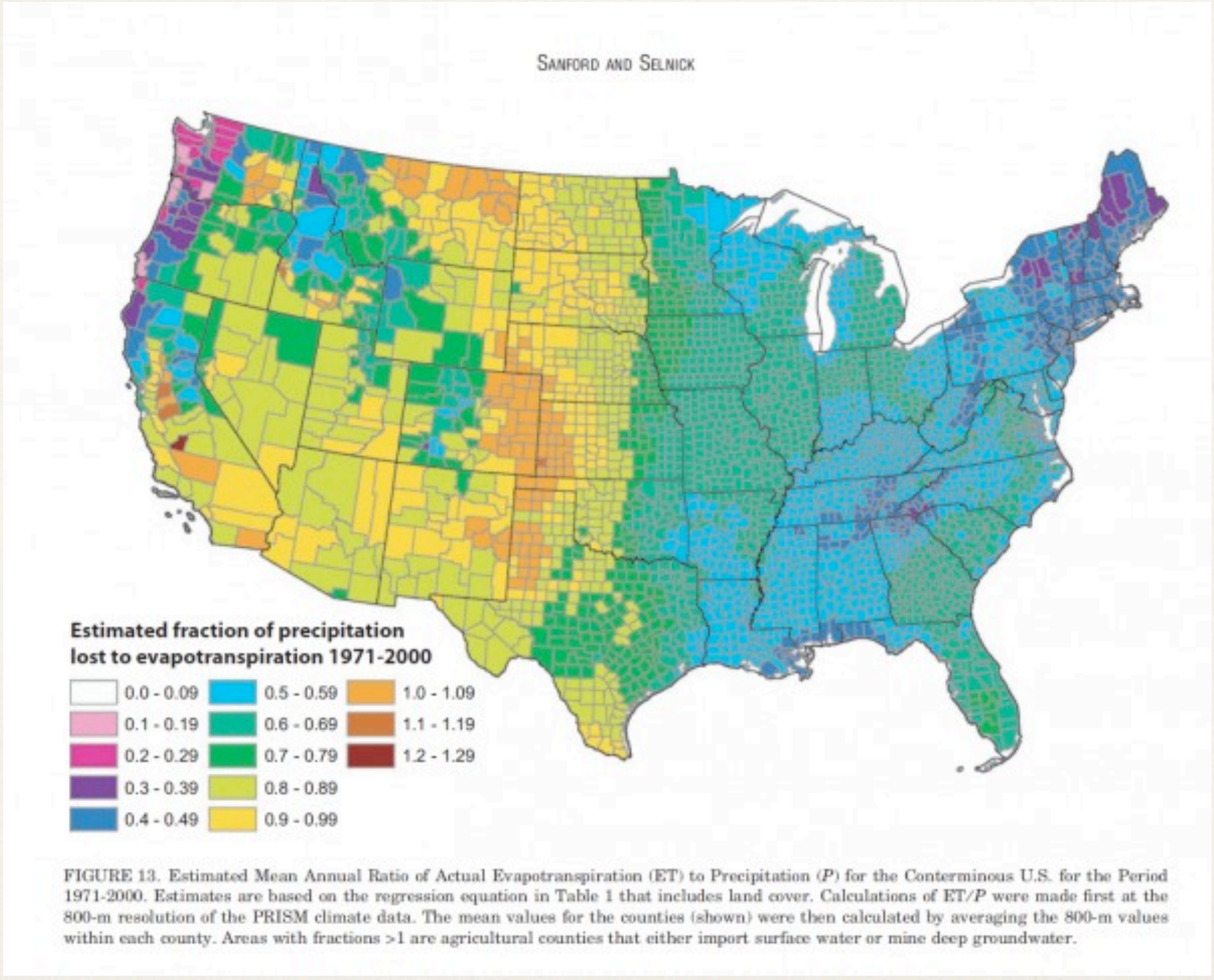


FIGURE 13. Estimated Mean Annual Ratio of Actual Evapotranspiration (ET) to Precipitation (P) for the Conterminous U.S. for the Period 1971-2000. Estimates are based on the regression equation in Table 1 that includes land cover. Calculations of ET/P were made first at the 800-m resolution of the PRISM climate data. The mean values for the counties (shown) were then calculated by averaging the 800-m values within each county. Areas with fractions >1 are agricultural counties that either import surface water or mine deep groundwater.

http://eagereyes.org/basics/rainbow-color-map

Rainbow color maps

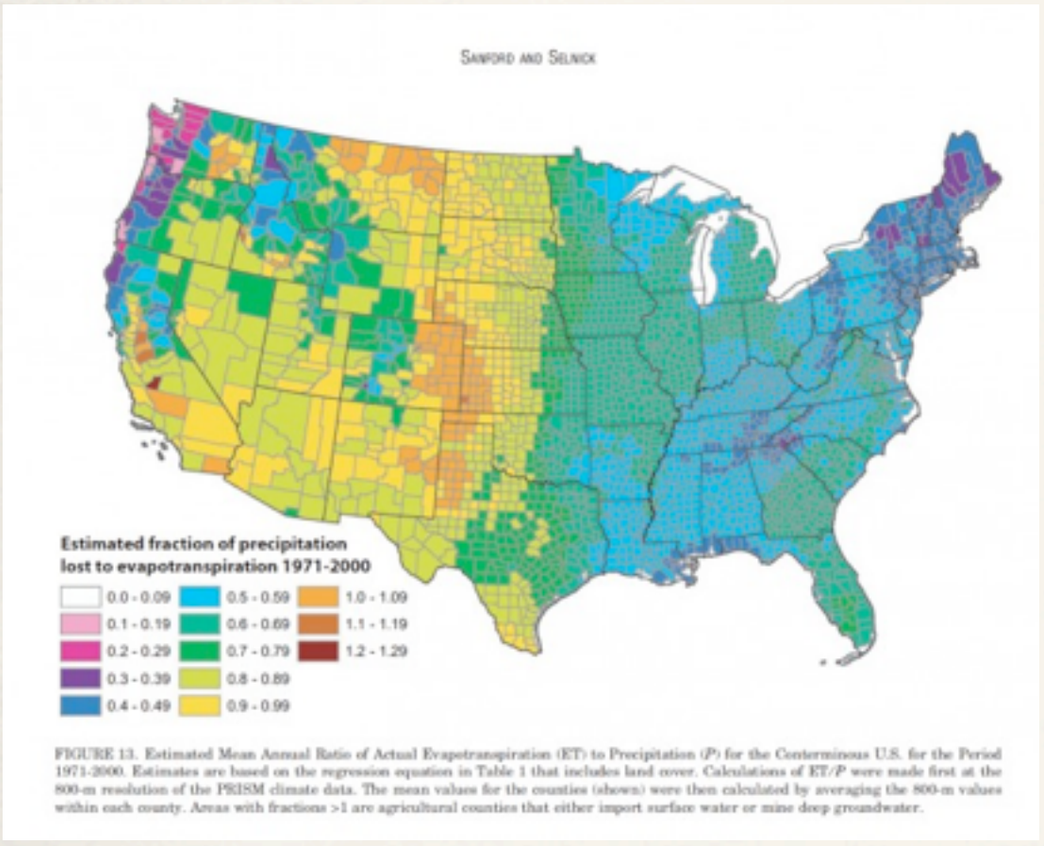
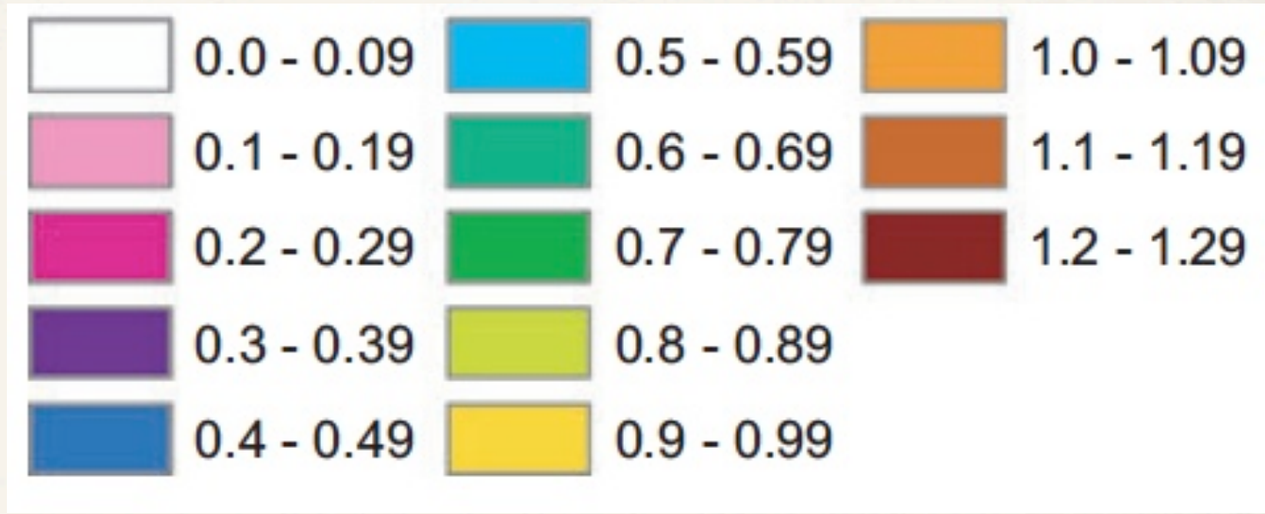
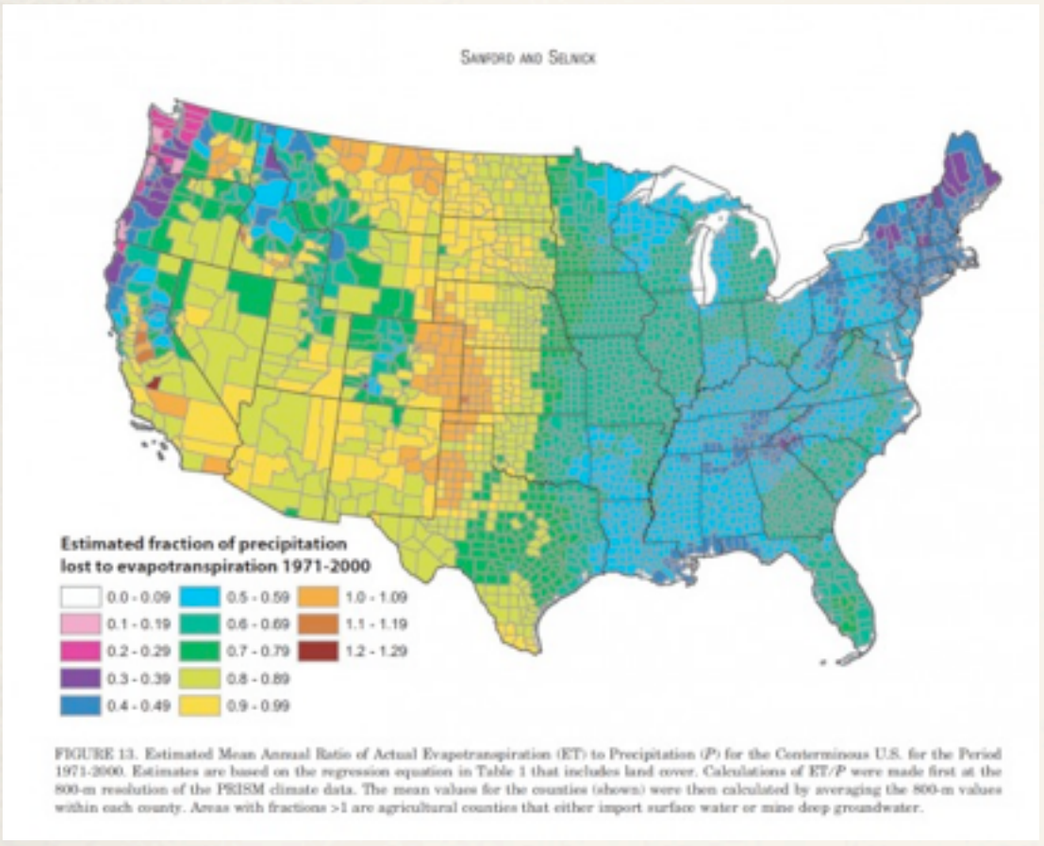


FIGURE 13. Estimated Mean Annual Ratio of Actual Evapotranspiration (ET) to Precipitation (P) for the Conterminous U.S. for the Period 1971-2000. Estimates are based on the regression equation in Table 1 that includes land cover. Calculations of ET/P were made first at the 800-m resolution of the PRISM climate data. The mean values for the counties (shown) were then calculated by averaging the 800-m values within each county. Areas with fractions >1 are agricultural counties that either import surface water or mine deep groundwater.



http://eagereyes.org/basics/rainbow-color-map

Rainbow color maps



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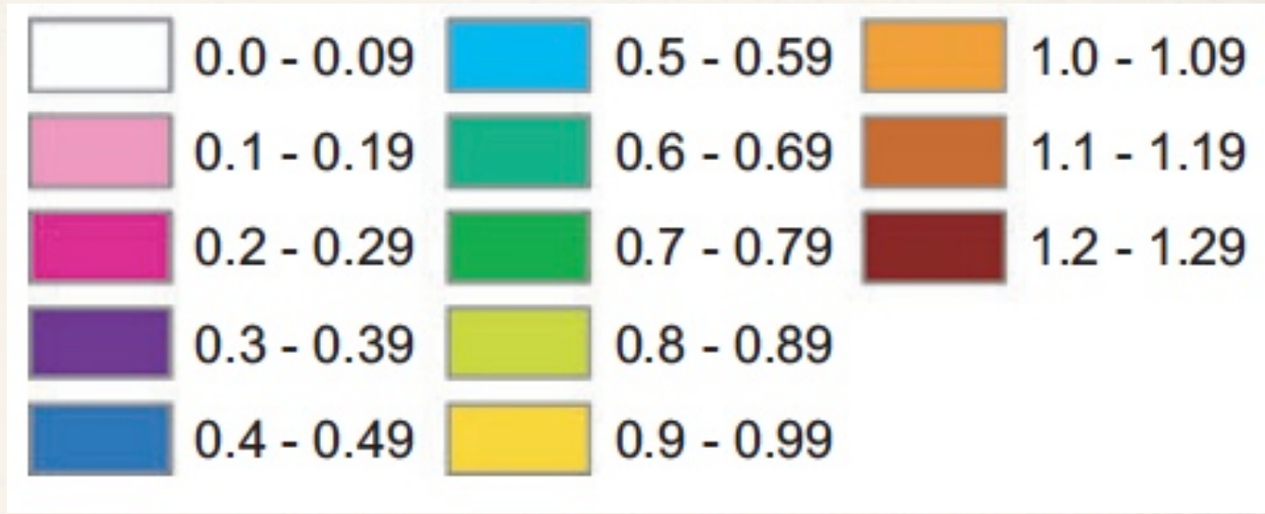
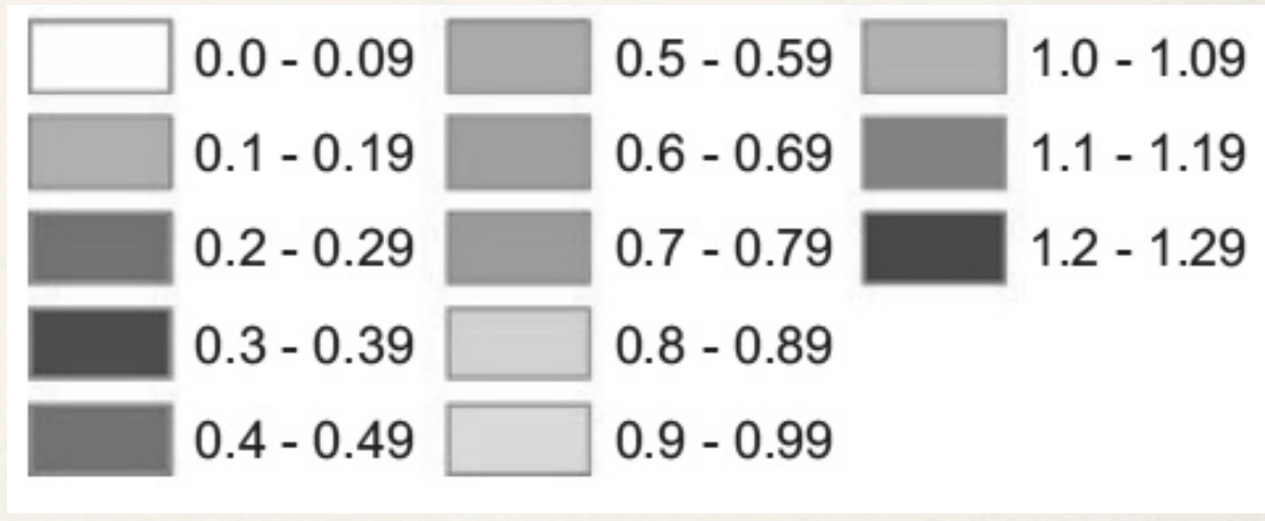
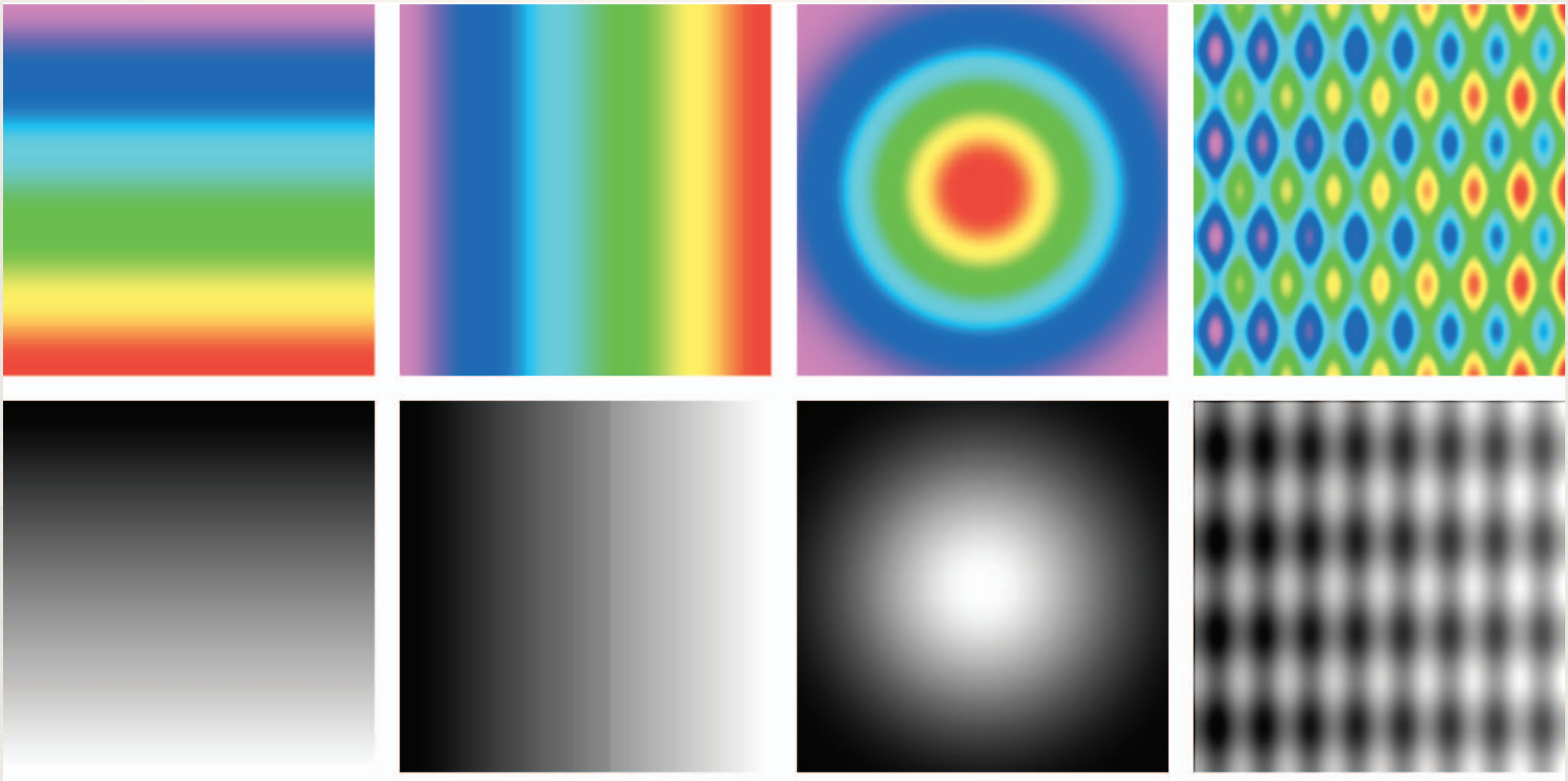




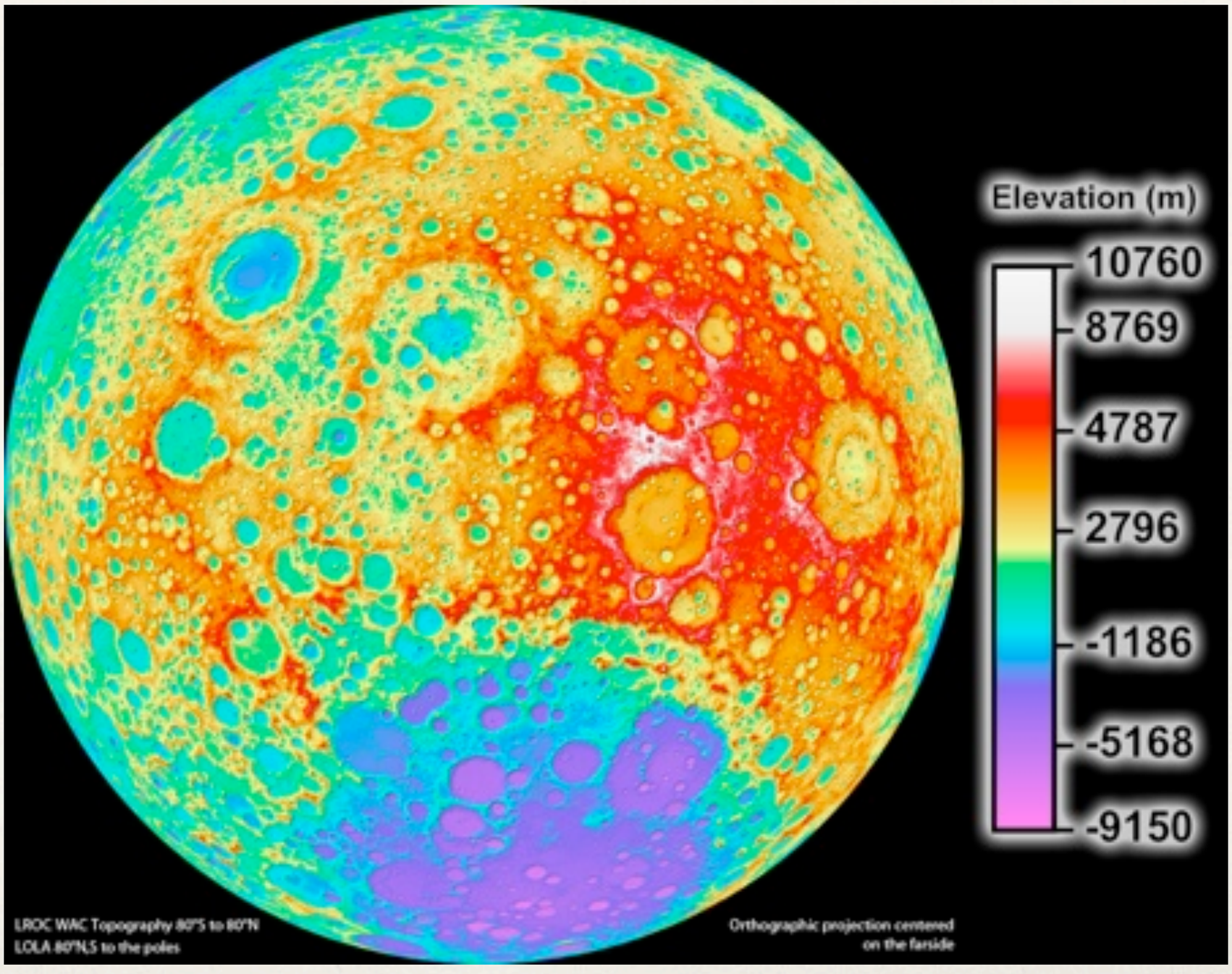
http://eagereyes.org/basics/rainbow-color-map

Rainbow color maps

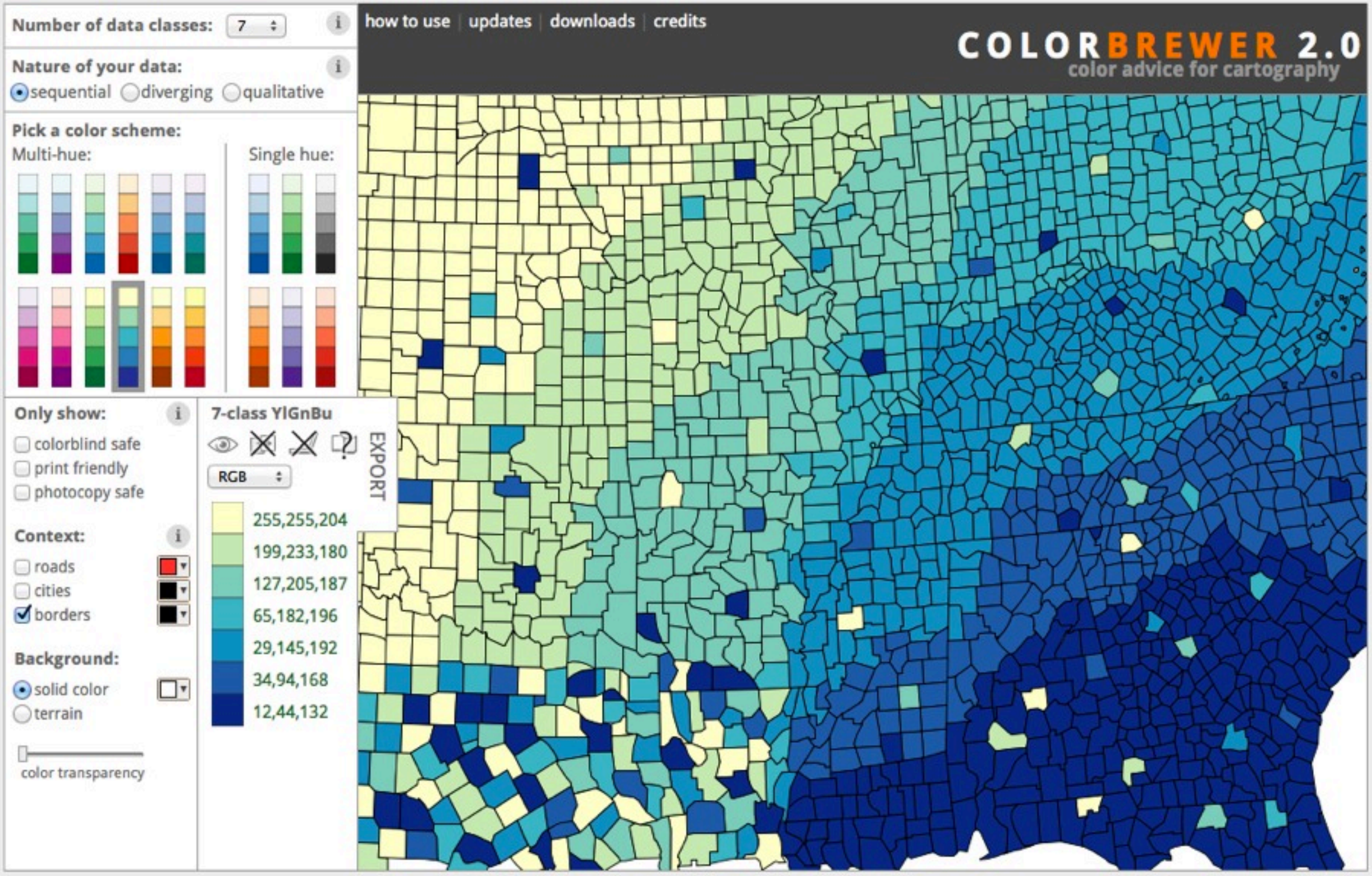


Borland and Russell, “Rainbow Color Map (Still) Considered Harmful”

Rainbow color maps

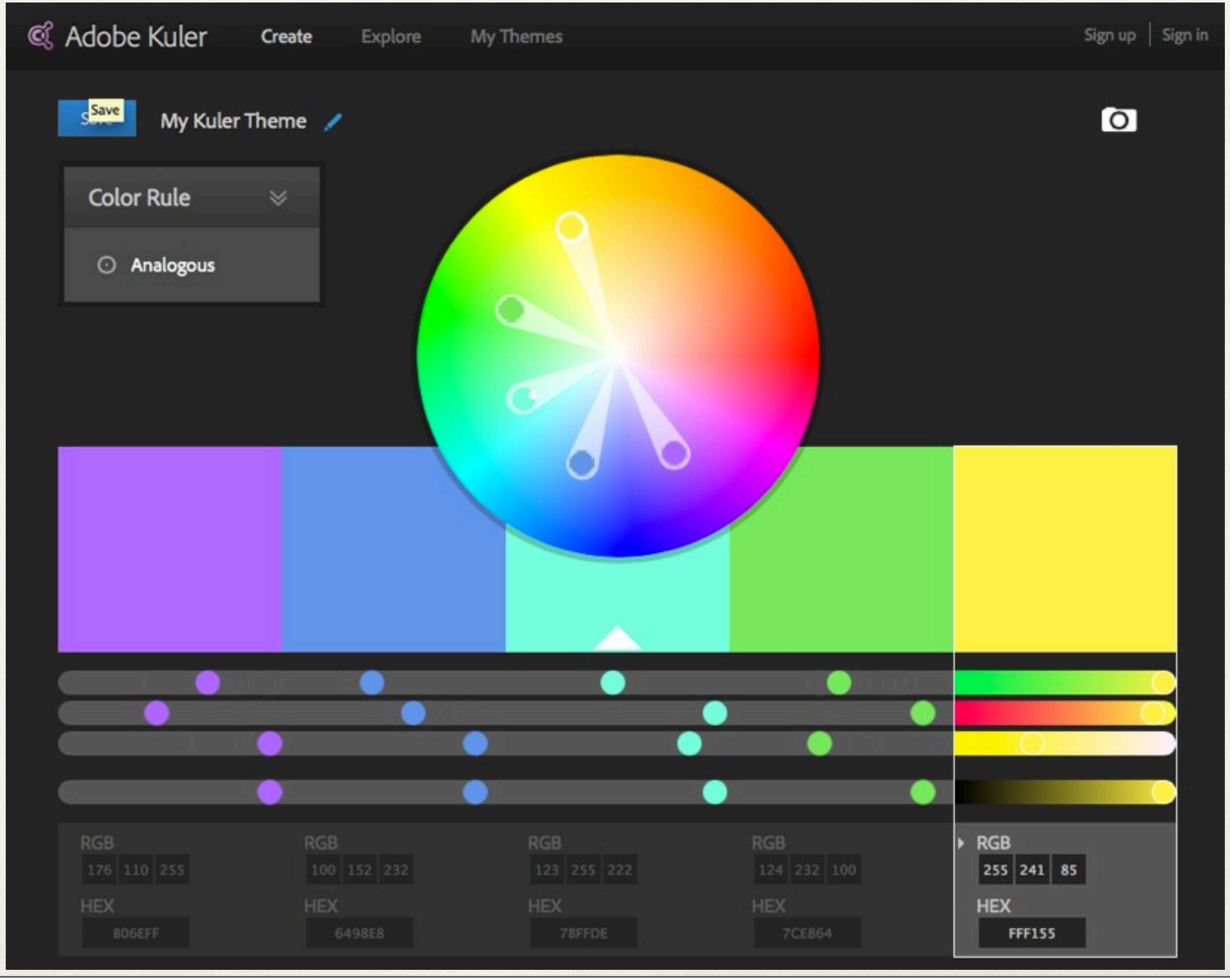


Color Brewer



http://colorbrewer2.org

Adobe Kuler


Adobe Kuler
Create
Explore
My Themes
Sign up
Sign in
Save
My Kuler Theme
Color Rule
Analogous
RGB
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HEX
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RGB
100 152 232
HEX
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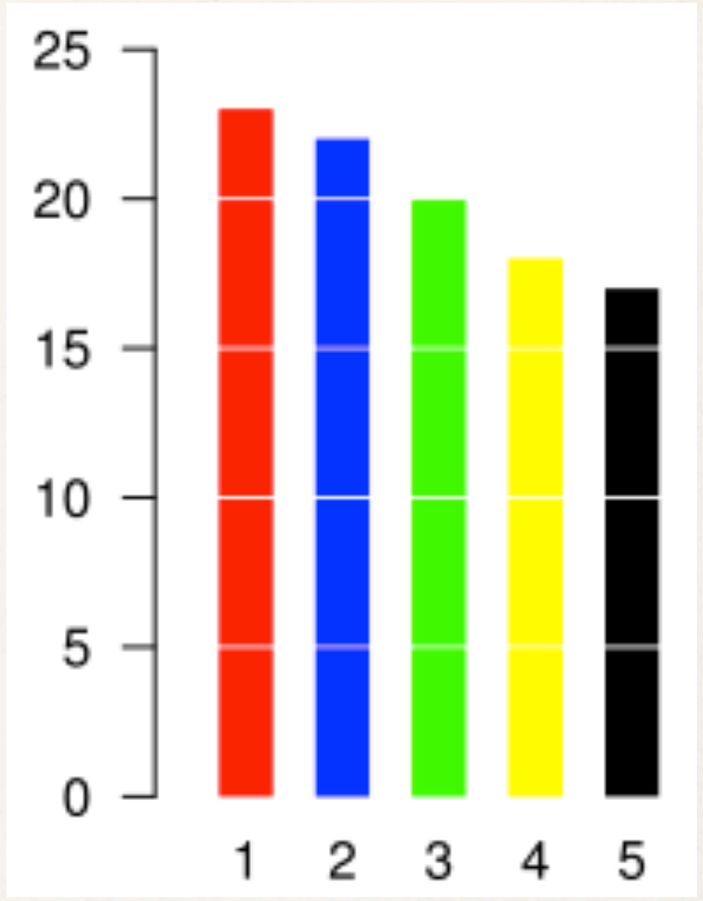
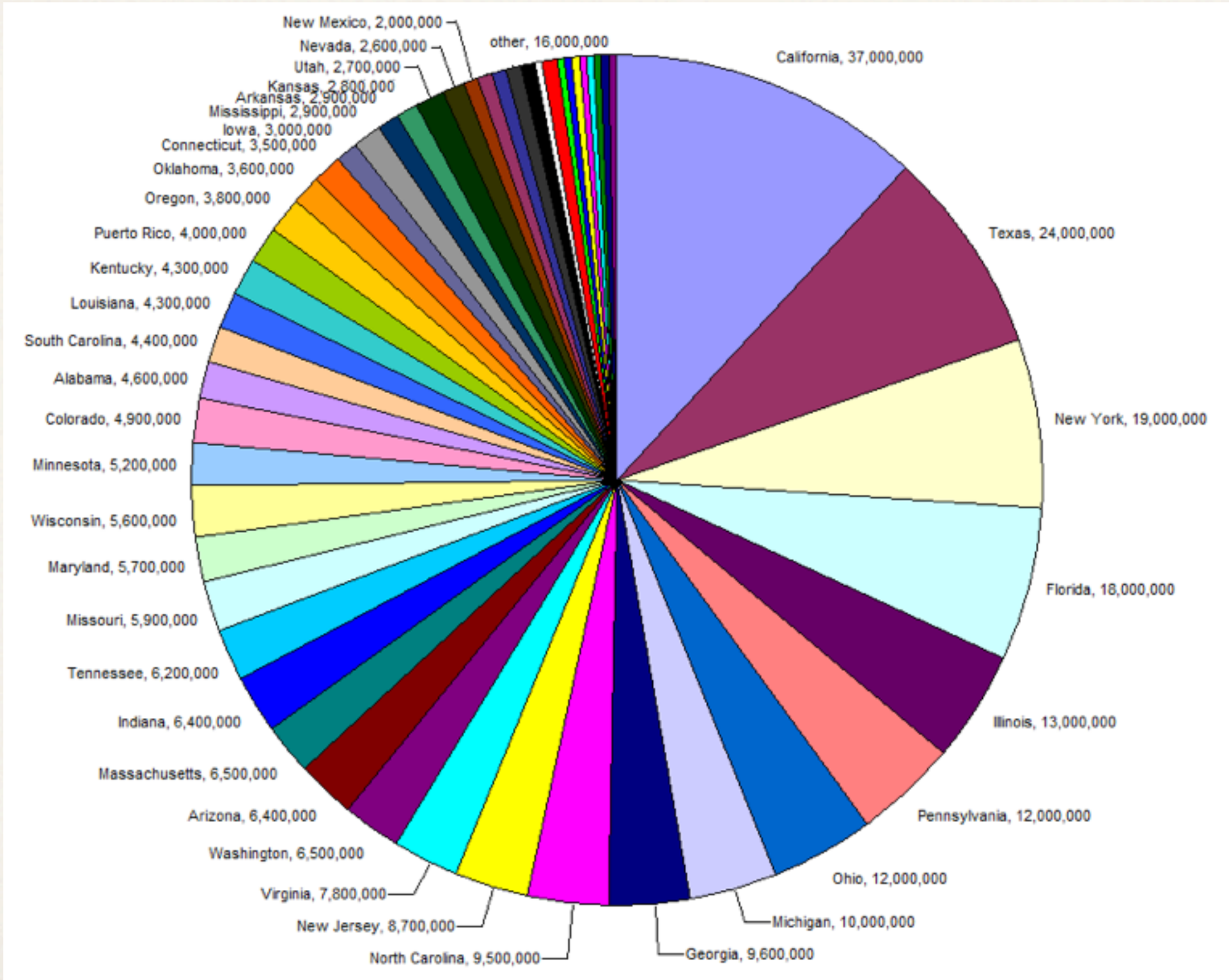
That pie chart...



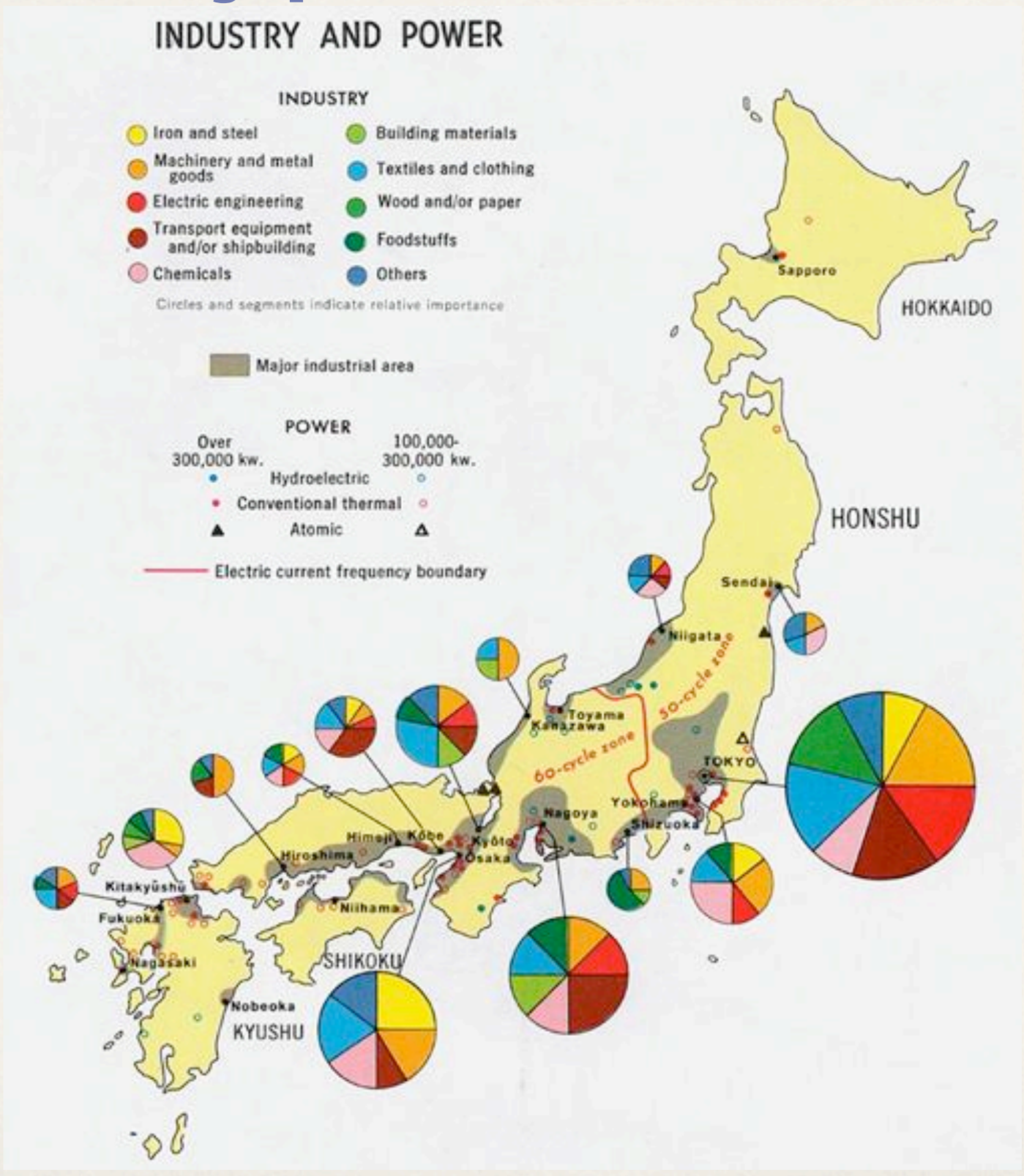
http://eagereyes.org/techniques/pie-charts

Too many slices of pie



http://commons.wikimedia.org/wiki/File:Pie_chart_of_US_population_by_state.png

Too many pies

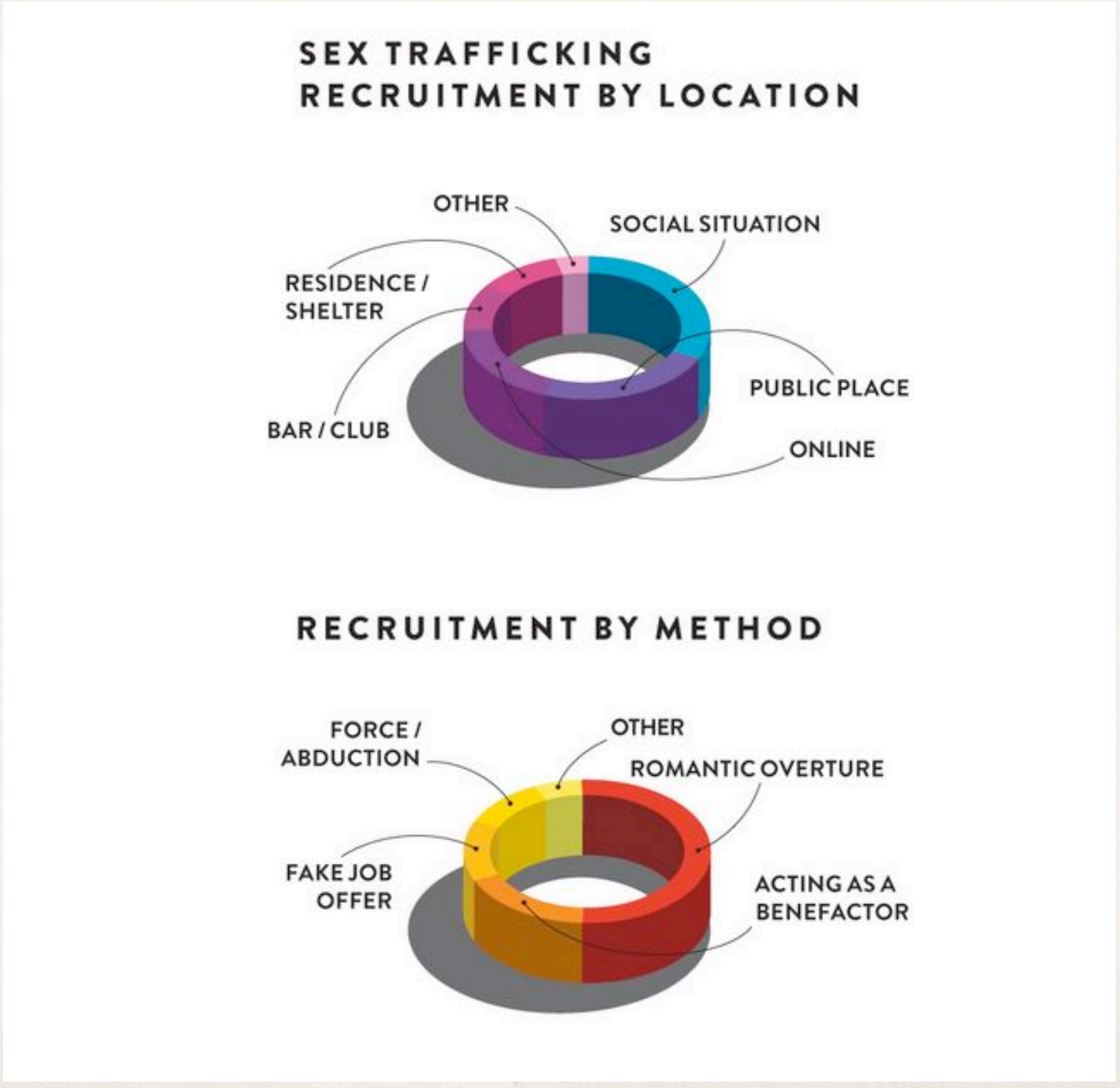


The only worse design than a pie chart is several of them

Tufte, "*The Visual Display of Quantitative Information*"

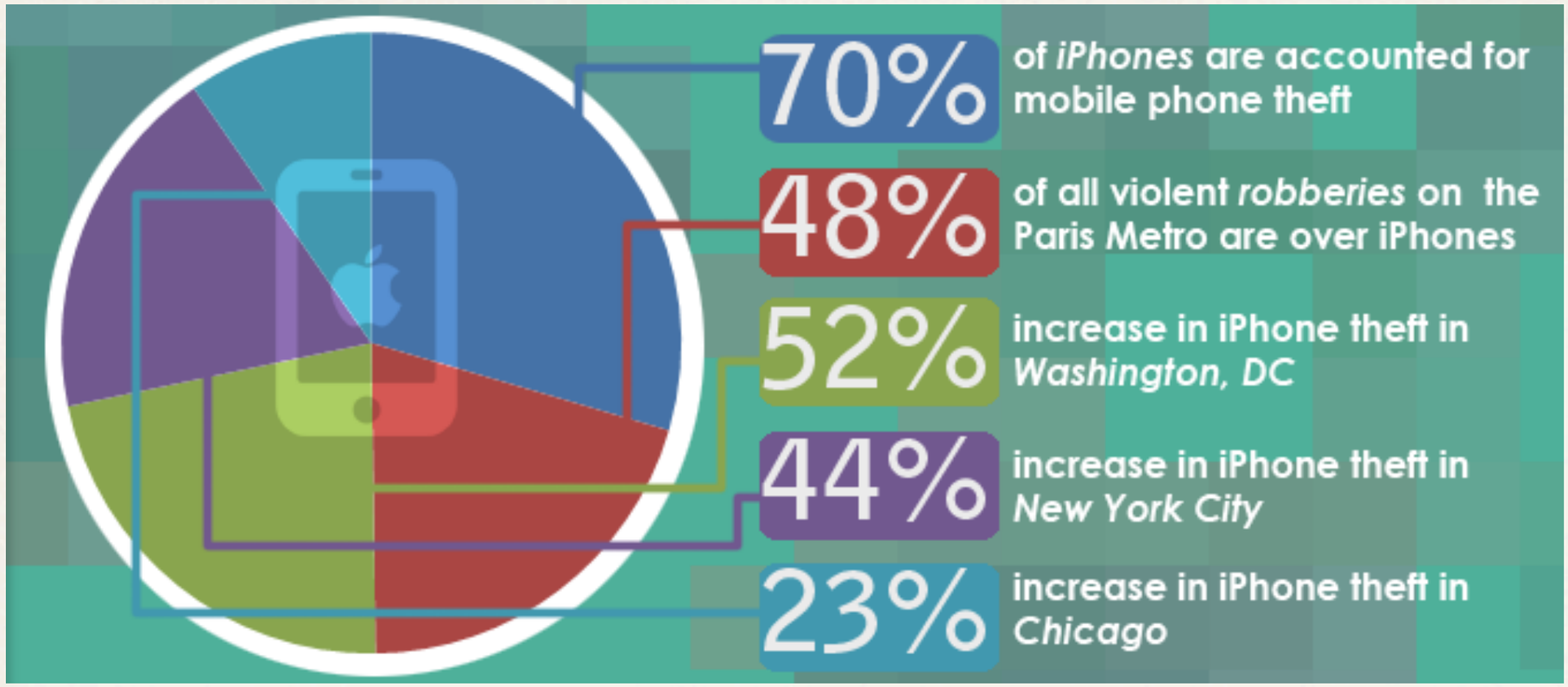
http://maps.unomaha.edu/Peterson/geog1000/MapLinks/Japan.htm

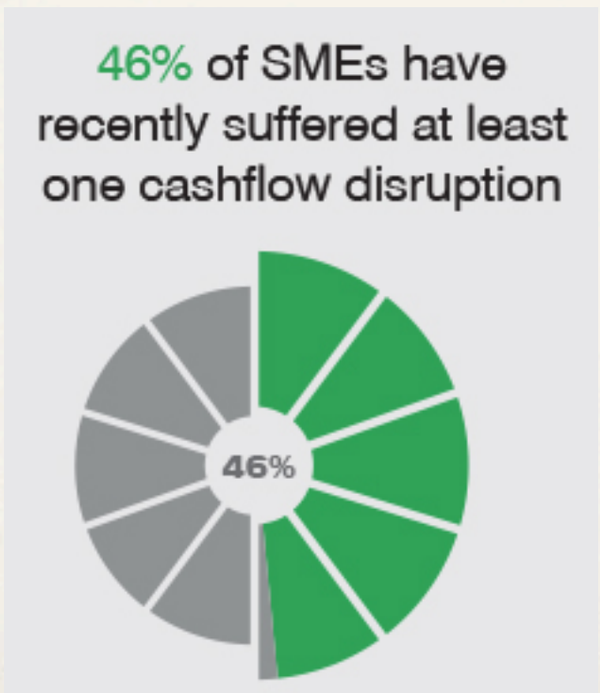
3D Doughnut plots

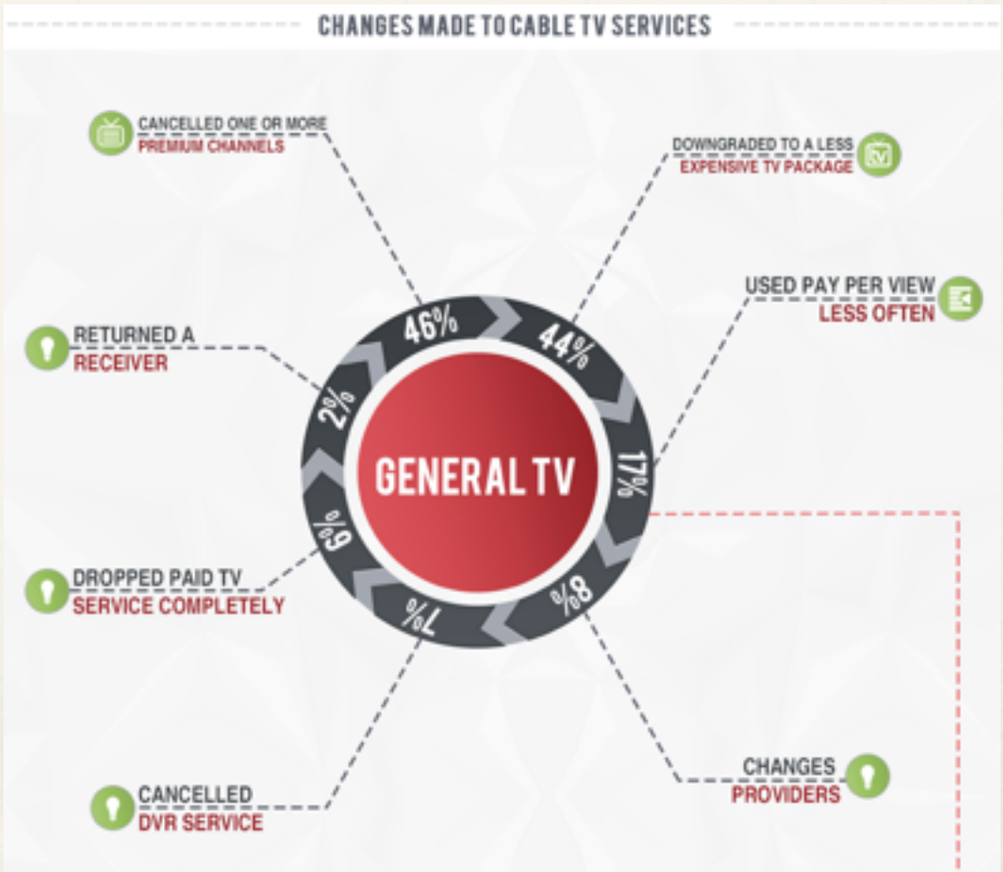


http://wtfviz.net

Wait a minute...







http://wtfviz.net