



# Good Vis, Bad Vis

C. Andrews

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2015-03-09

# How can we evaluate visualizations?

What is the purpose of the visualization?

What task are we expected to perform?

How well does it perform?

Do the encodings work?

Can you read the data out of it?

Does it highlight the important information?

Is there interaction?

Is it useful?

Is there an appropriate amount of information represented?

Enough to be useful, not enough to be confusing?

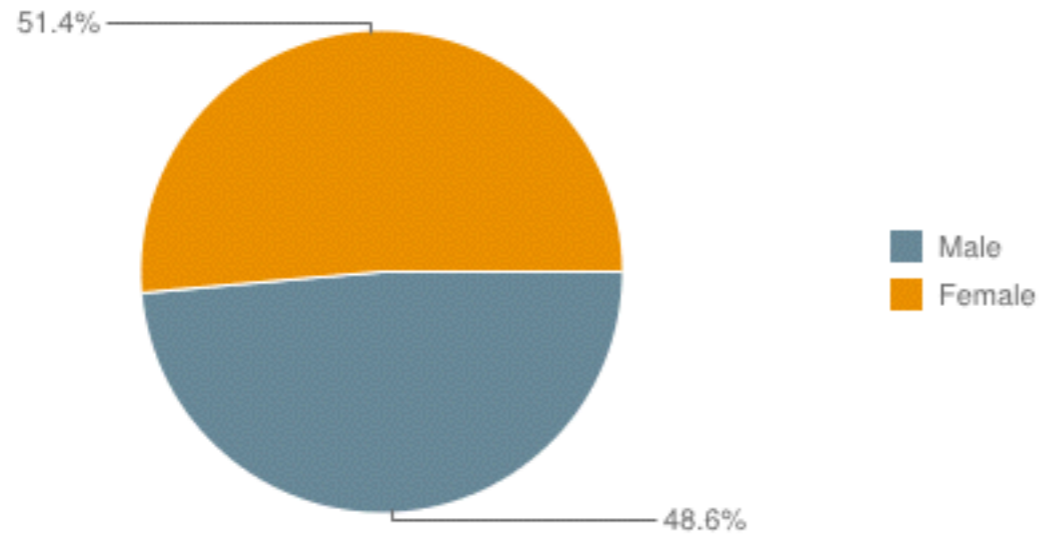
Is it honest?

Is it aesthetic?

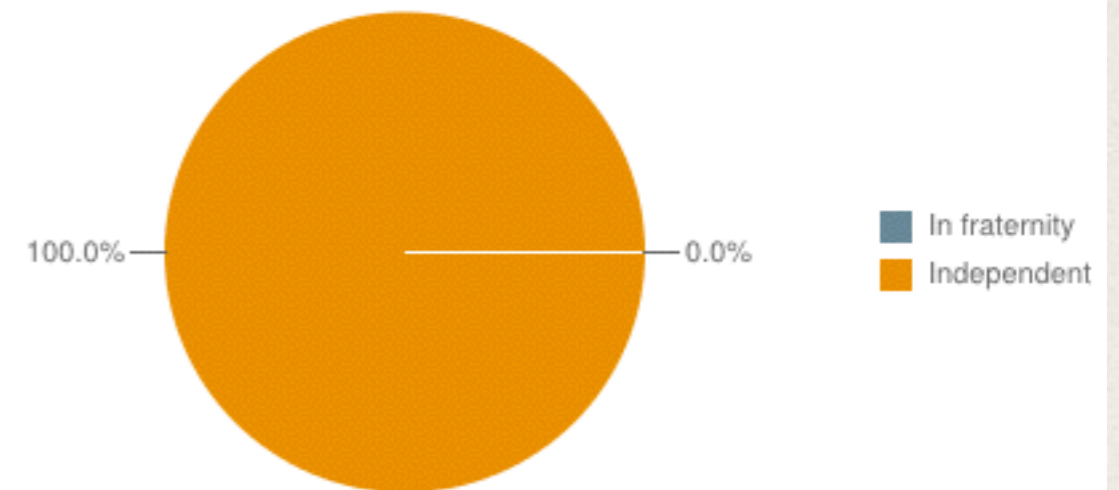
Does it invite exploration?

# Do you need the visualization?

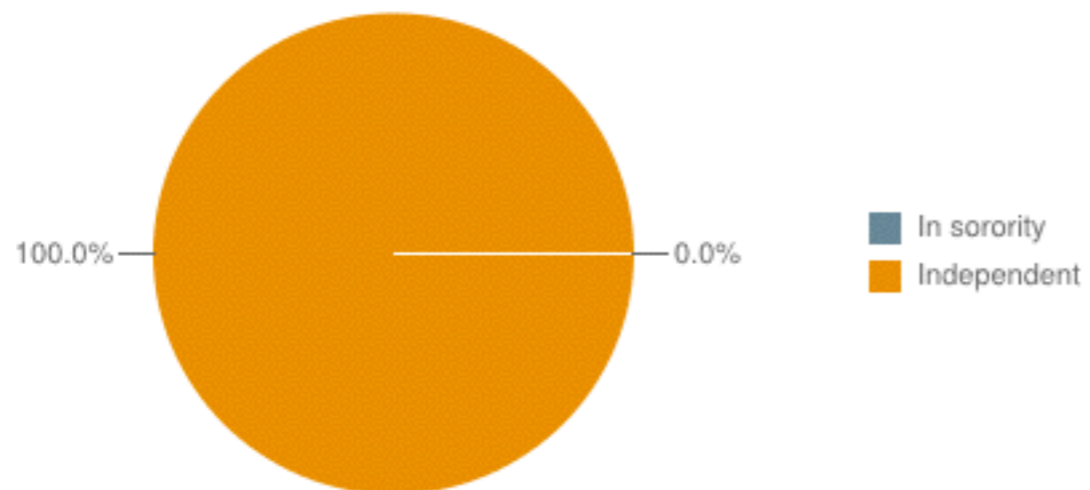
Student gender distribution



Undergraduate men who are members of a fraternity



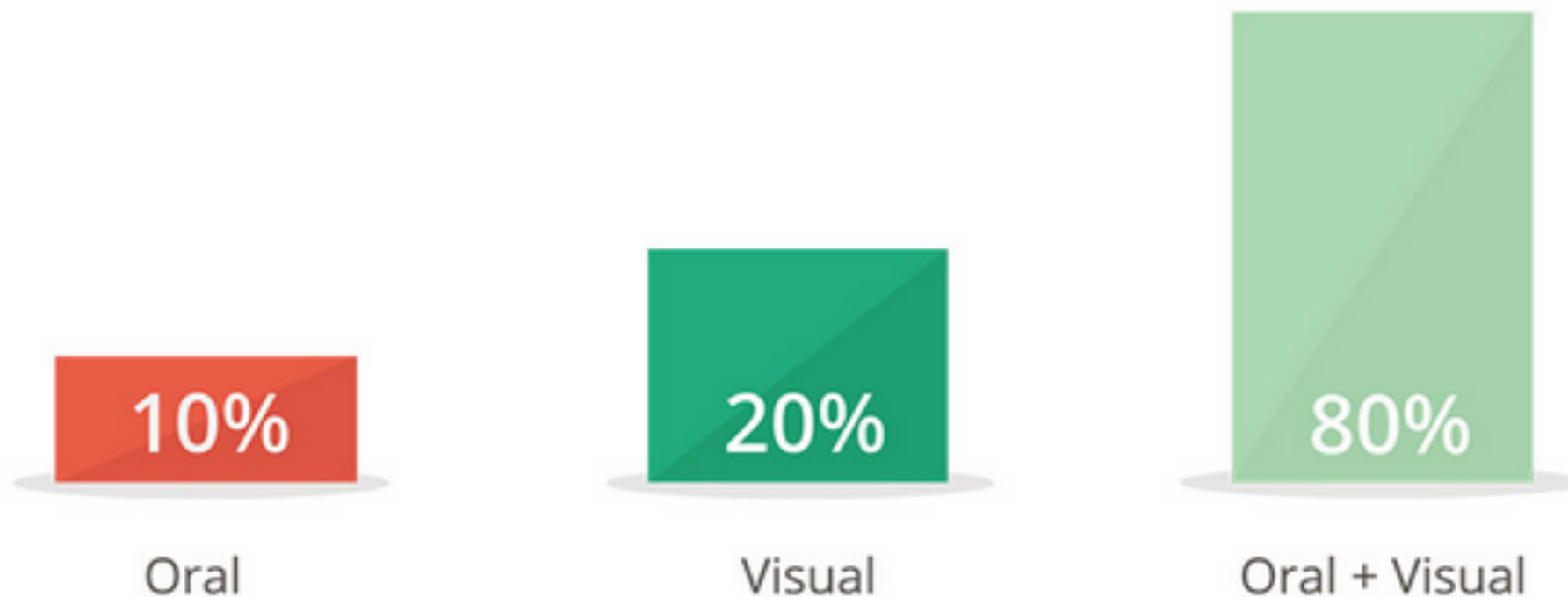
Undergraduate women who are members of a sorority



# Do you need the visualization?

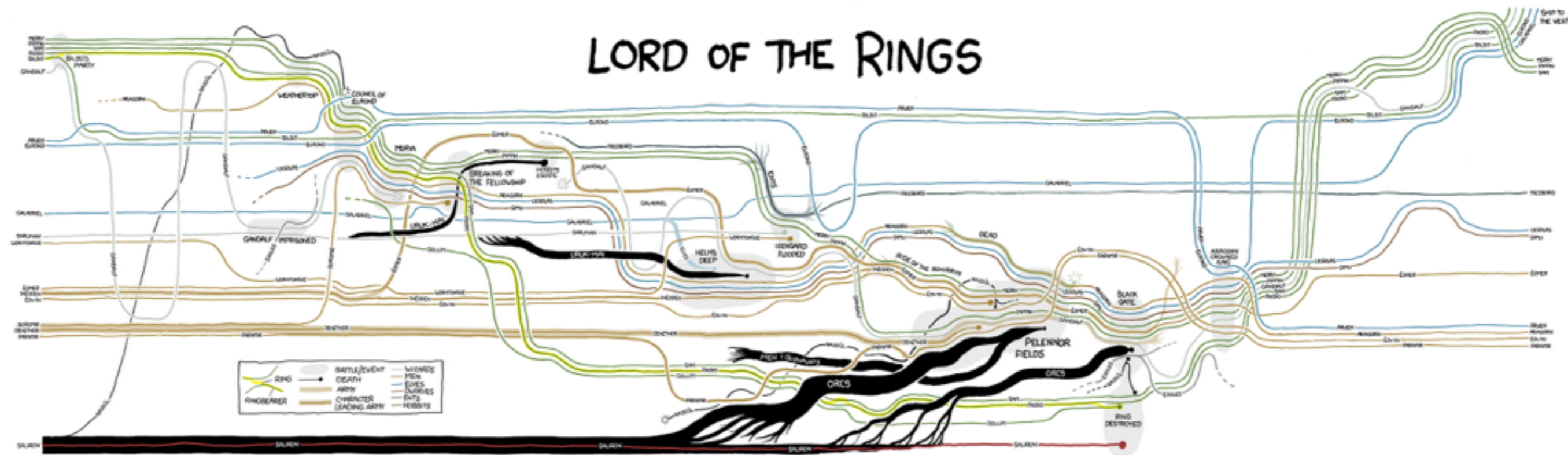
What information do people remember?

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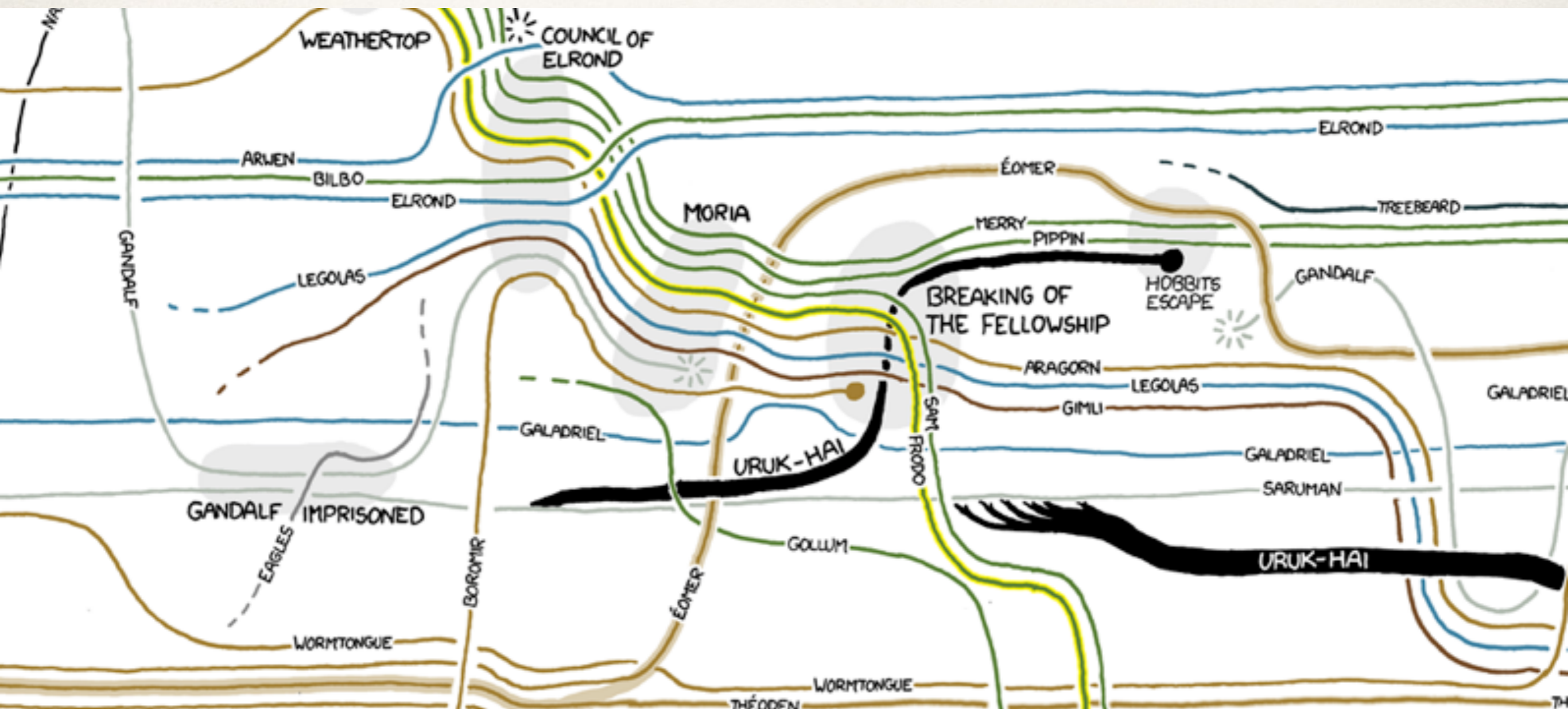
# Intuitive mappings

Pick mappings that match expectations  
temperature - color or height  
time - horizontal axis or motion



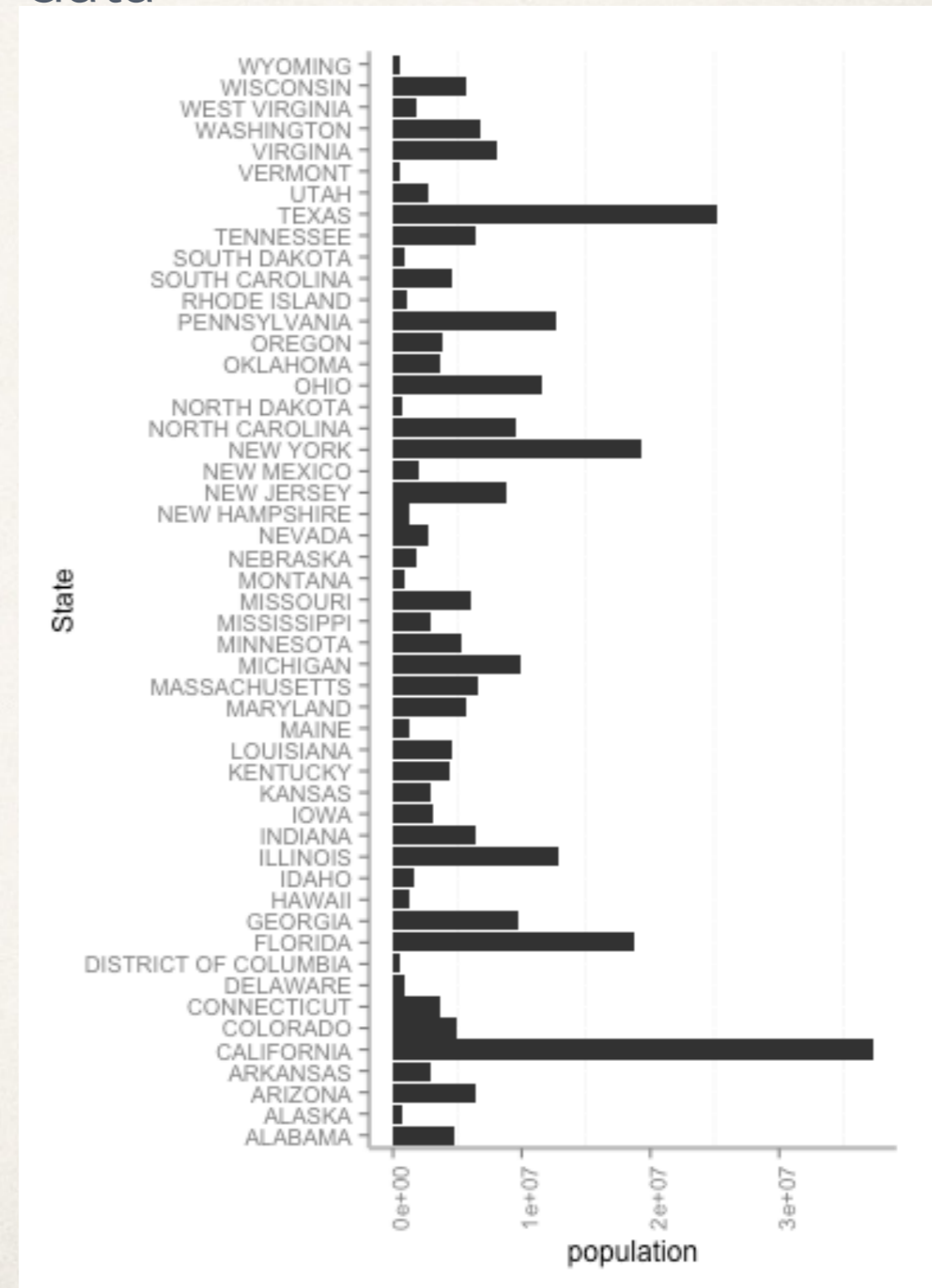
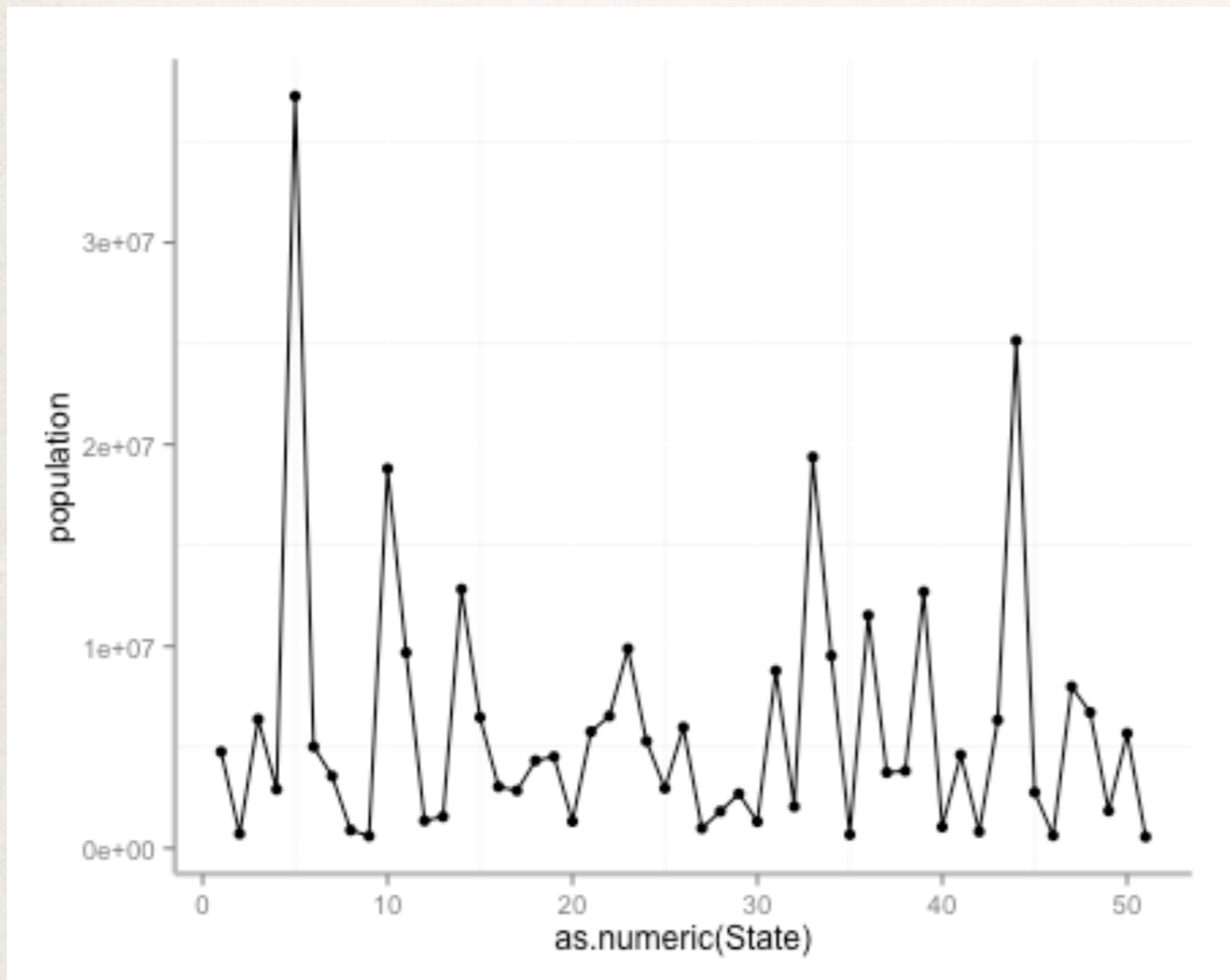
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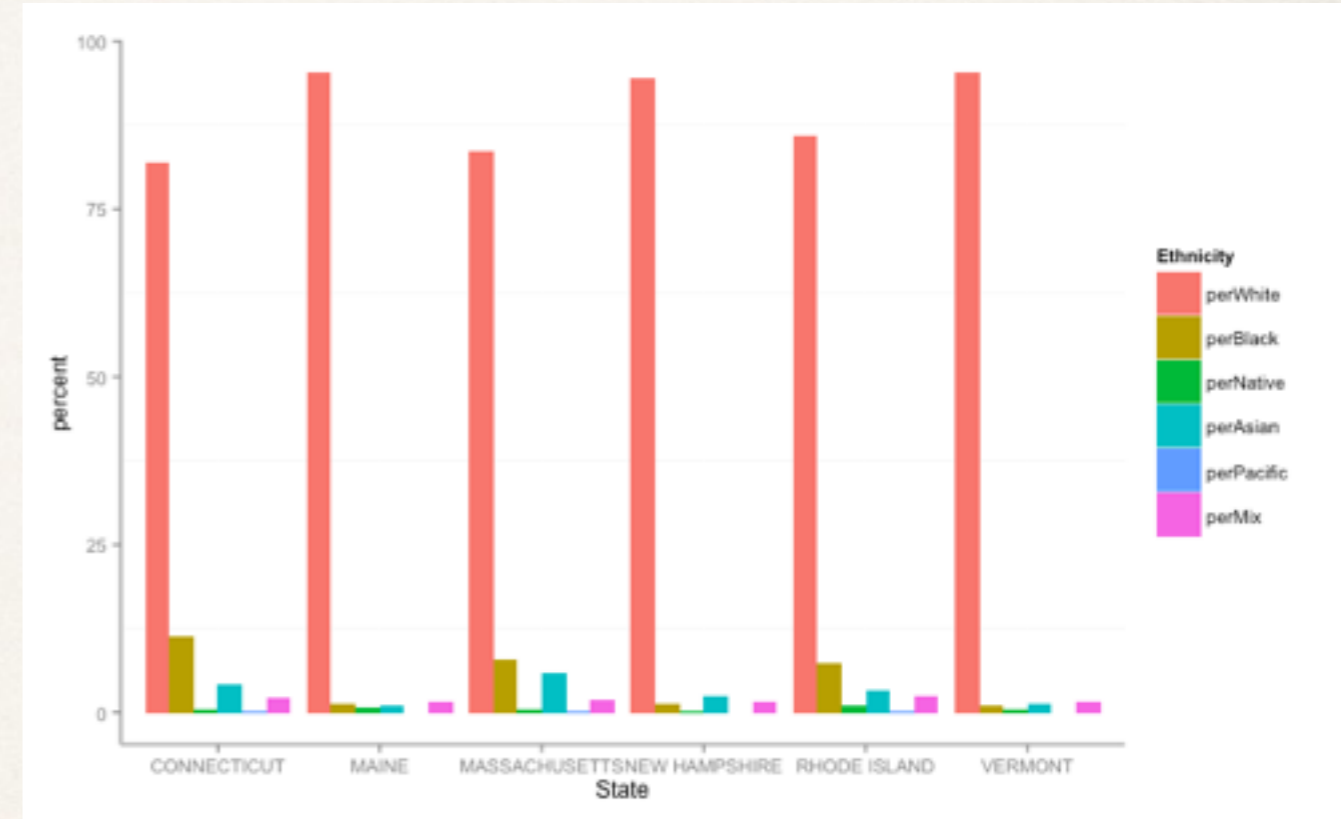
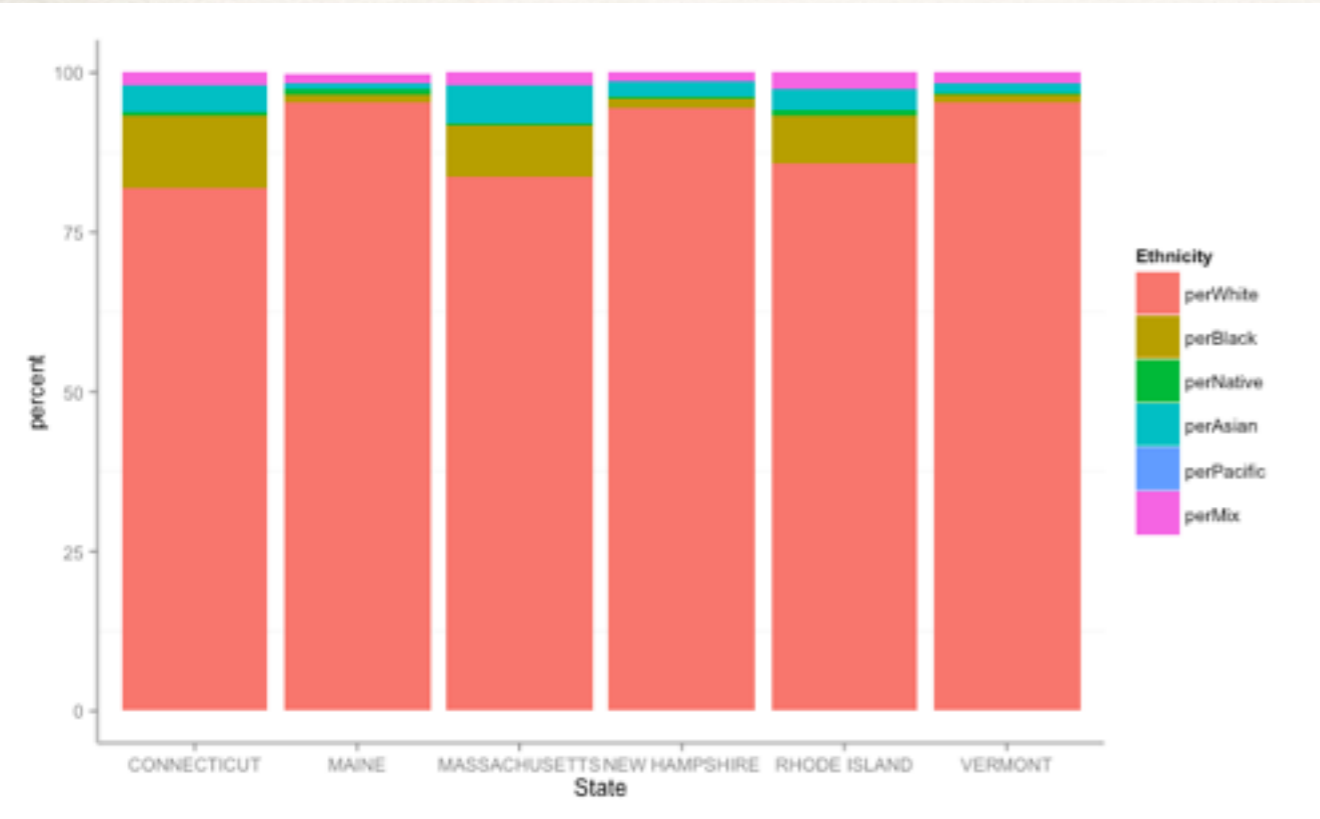
# Intuitive mappings

Pick mappings that match the kind of data



# Intuitive mappings

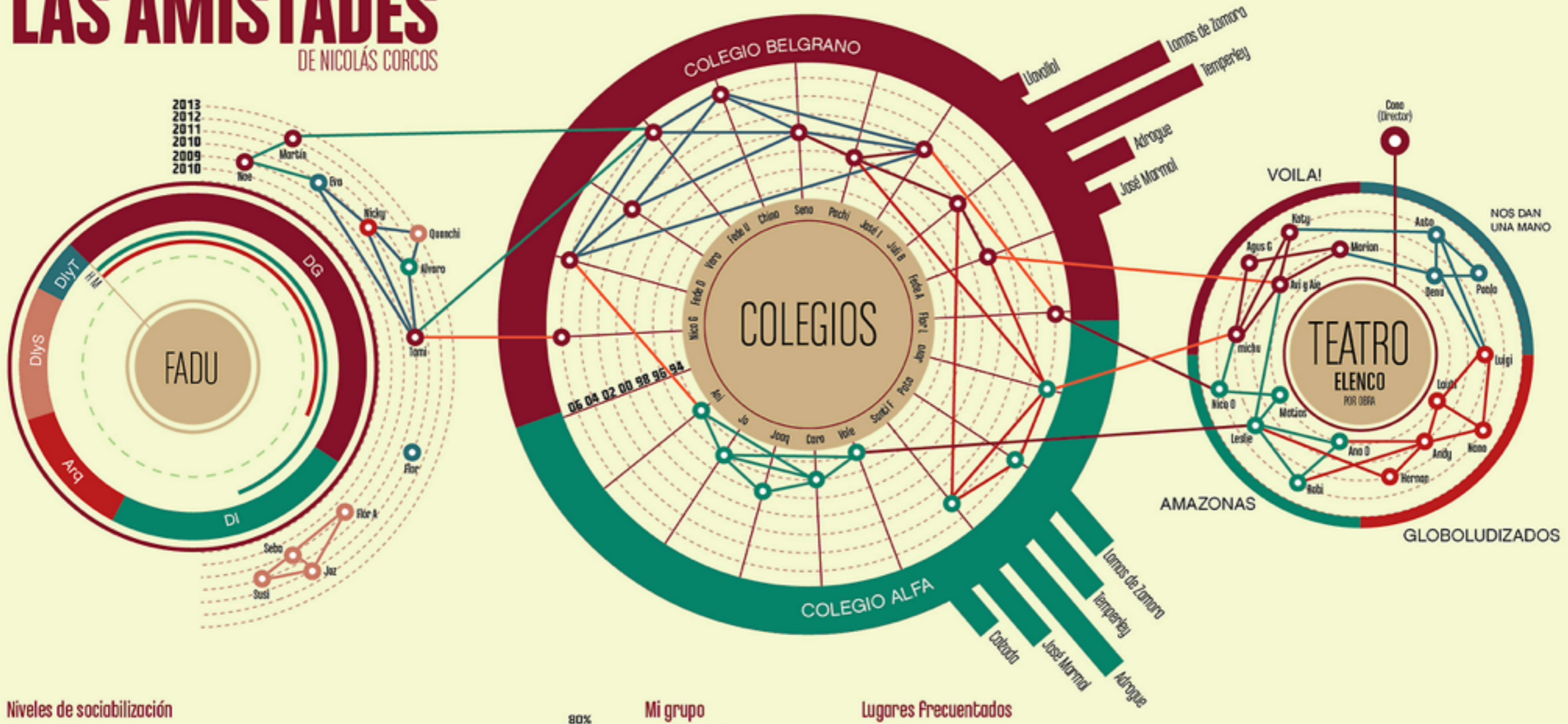
Pick mappings that match the kind of data





# Trying to say too much?

## LAS AMISTADES DE NICOLÁS CORCOS



# Correlation or Causation?

Fig. 1  
IS FACEBOOK DRIVING  
THE GREEK DEBT CRISIS?

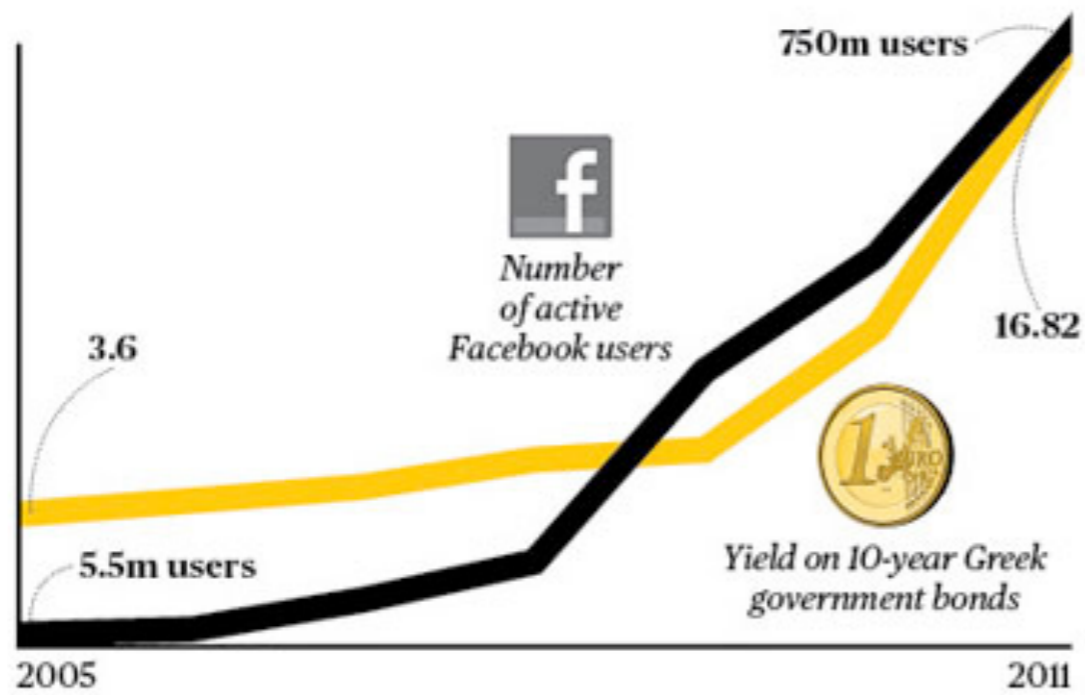
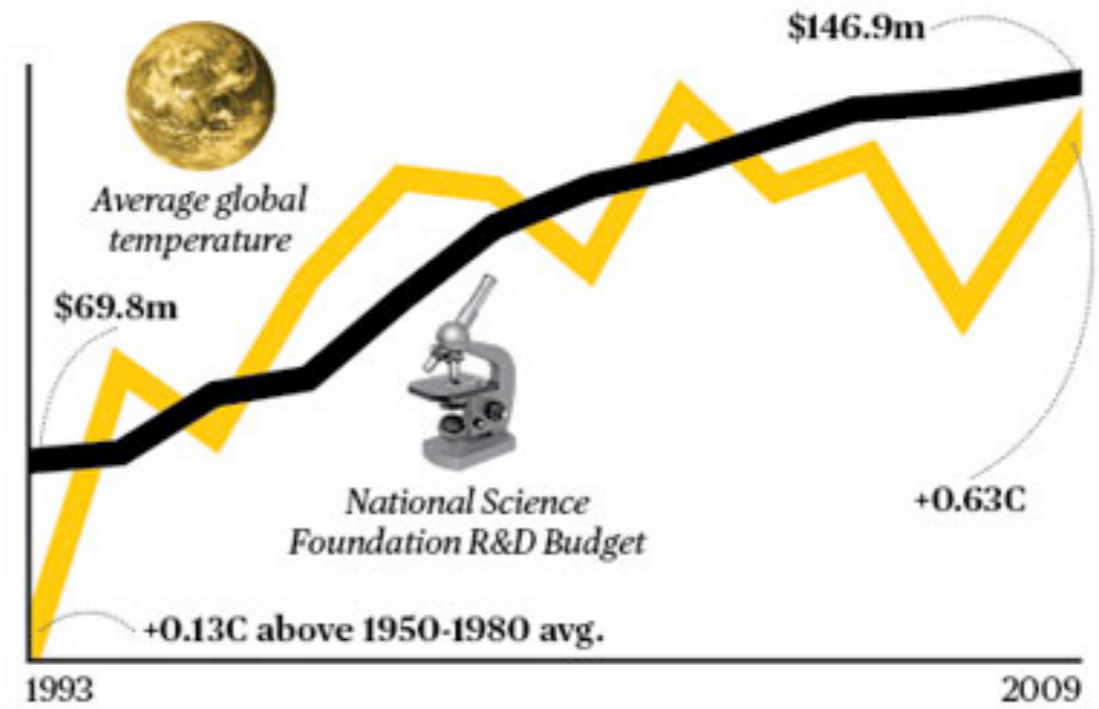
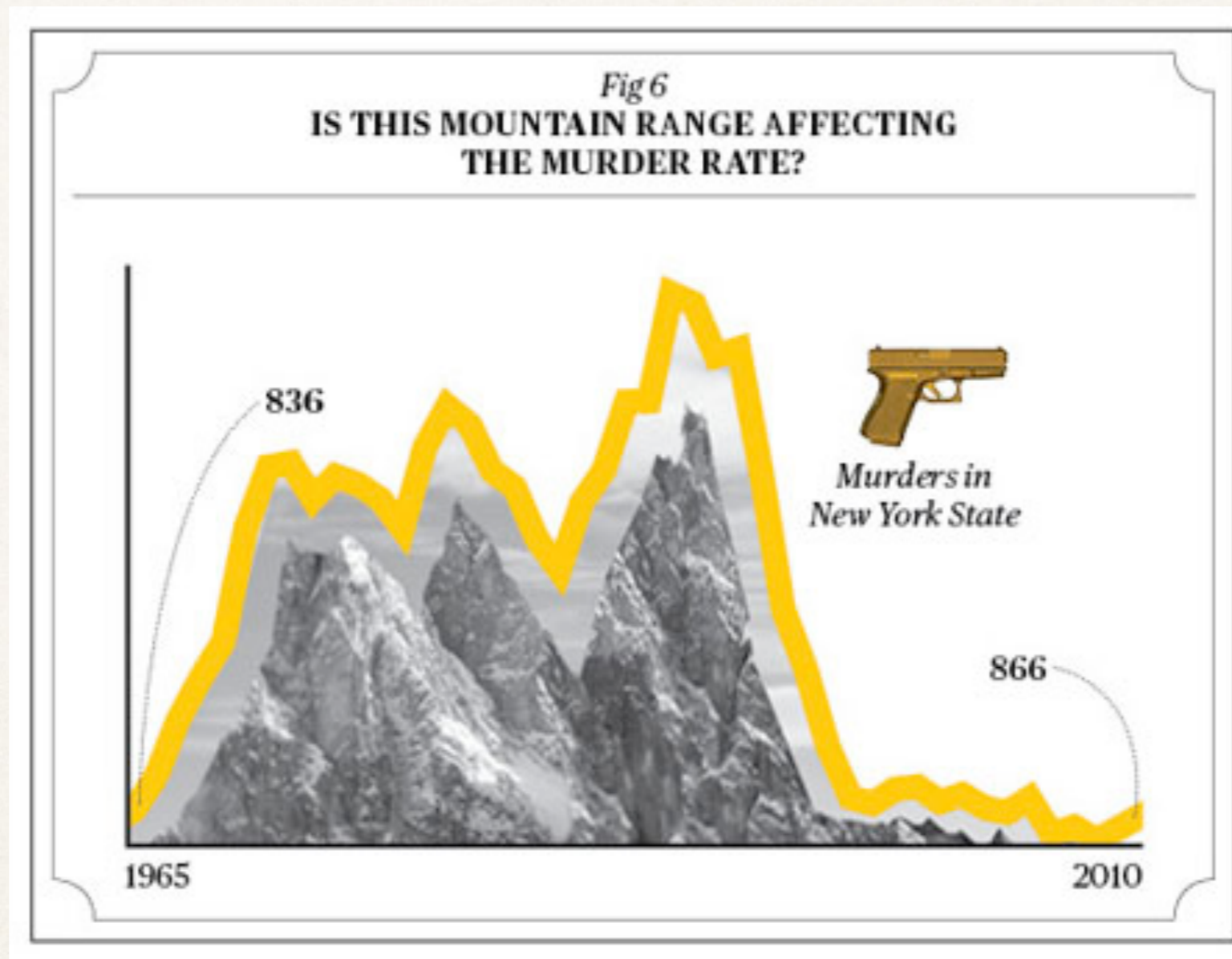


Fig. 2  
IS GLOBAL WARMING A HOAX  
PROPAGATED BY SCIENTISTS?



# Correlation or Causation?

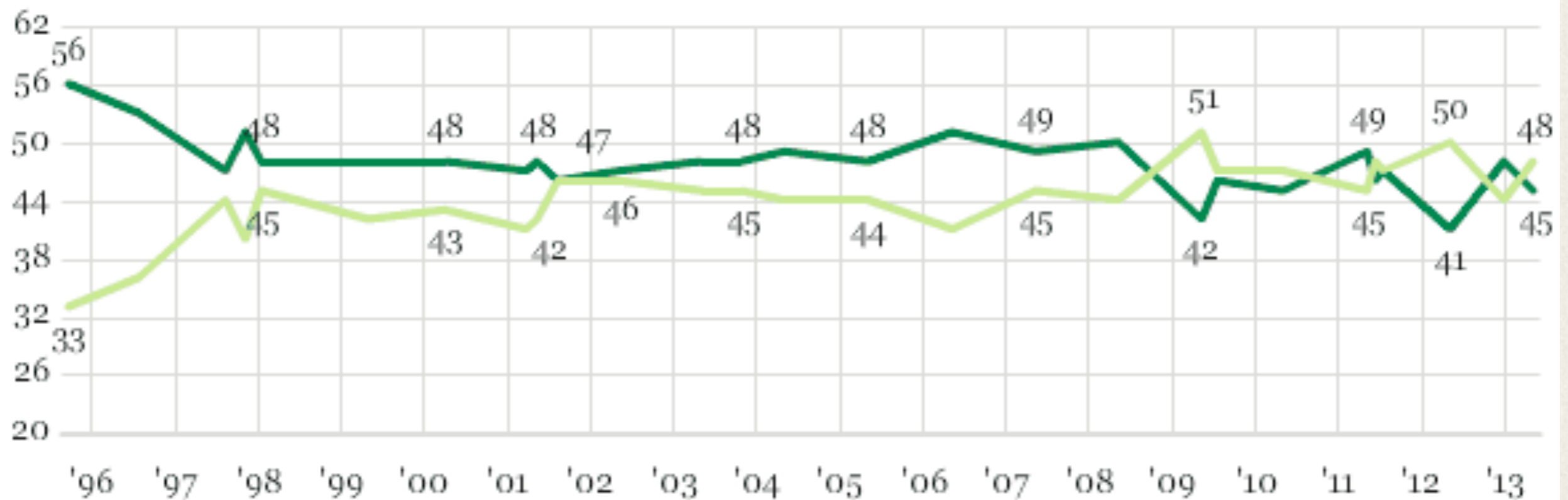


# Lie to me

*With respect to the abortion issue, would you consider yourself to be pro-choice or pro-life?*

Trend from polls where pro-life/pro-choice was asked after question on legality of abortion

■ % Pro-choice    ■ % Pro-life



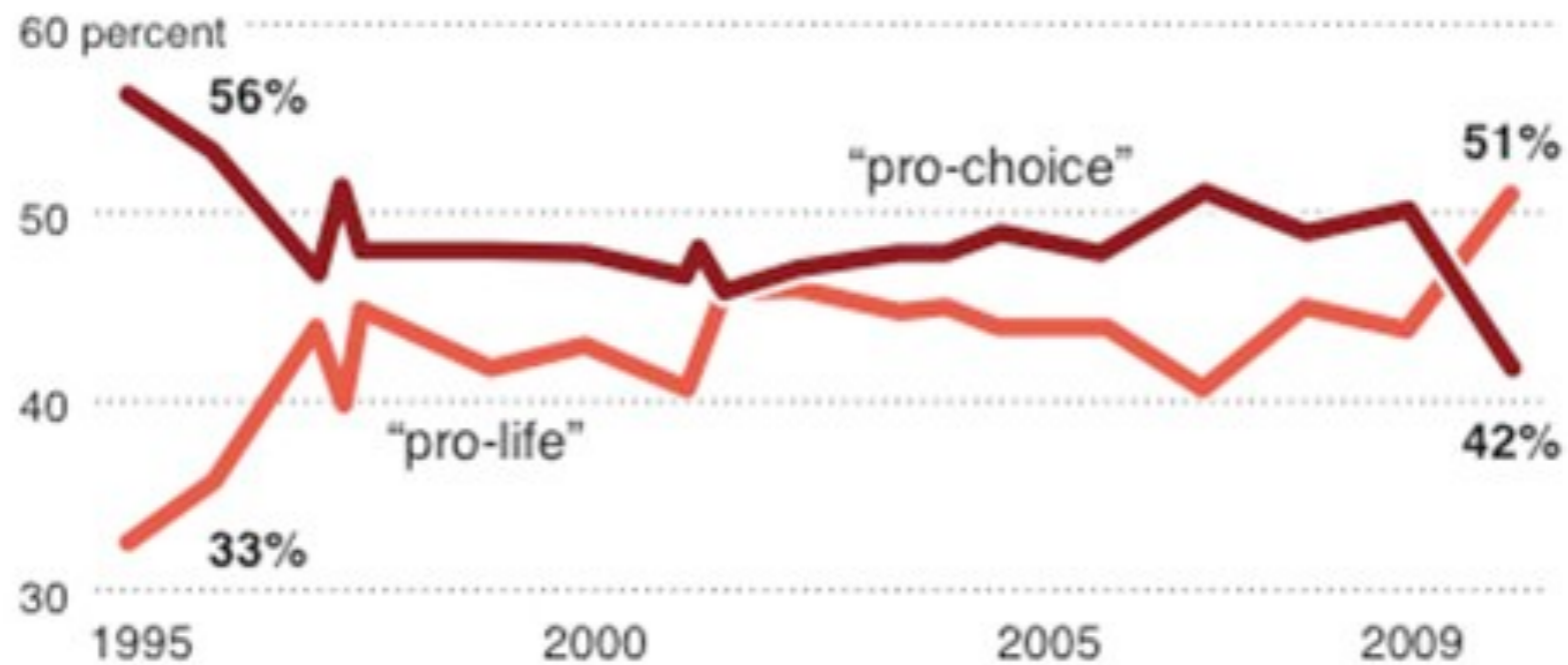
GALLUP®

# 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.

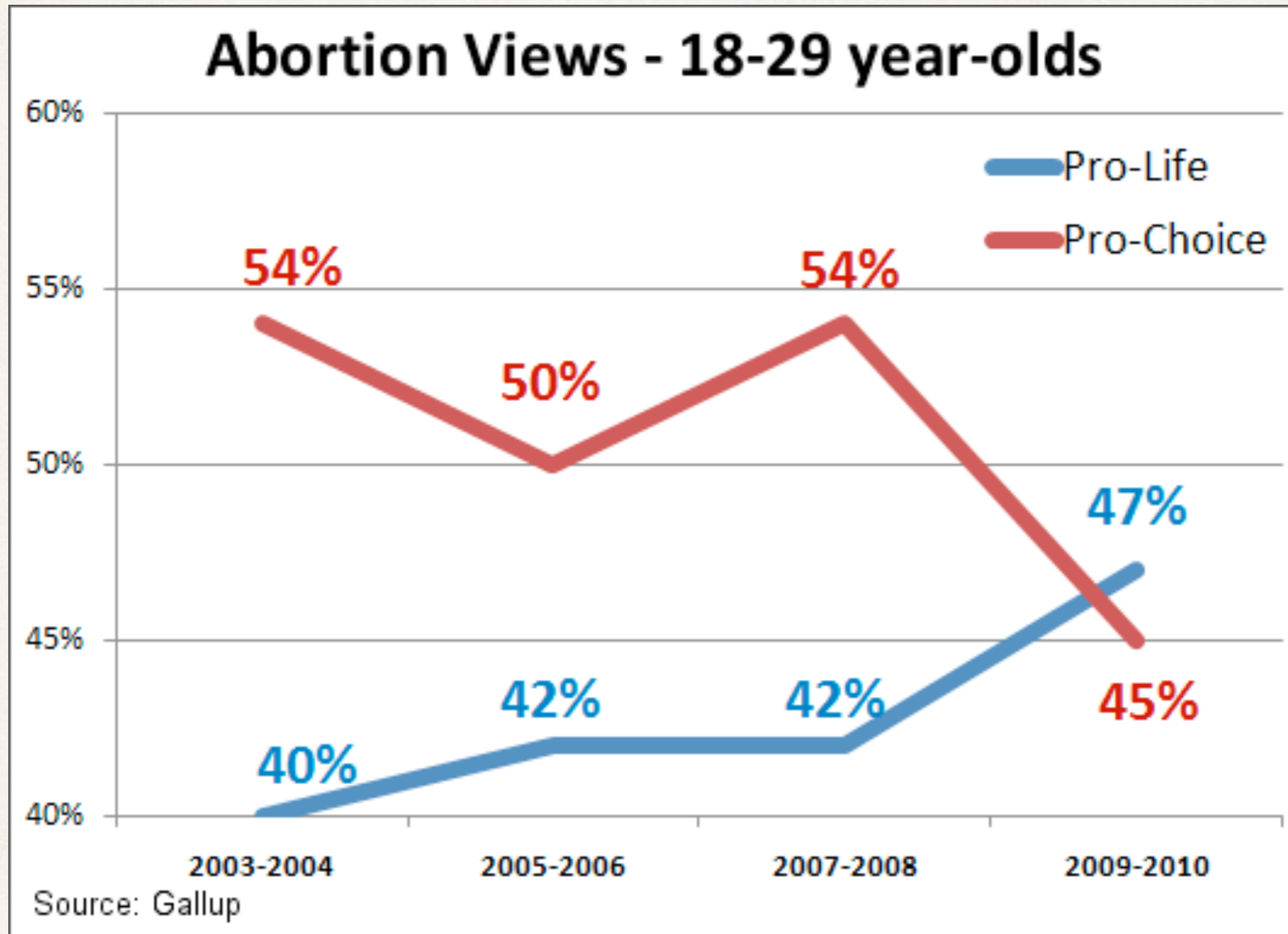
### Americans calling themselves "pro-life" or "pro-choice"



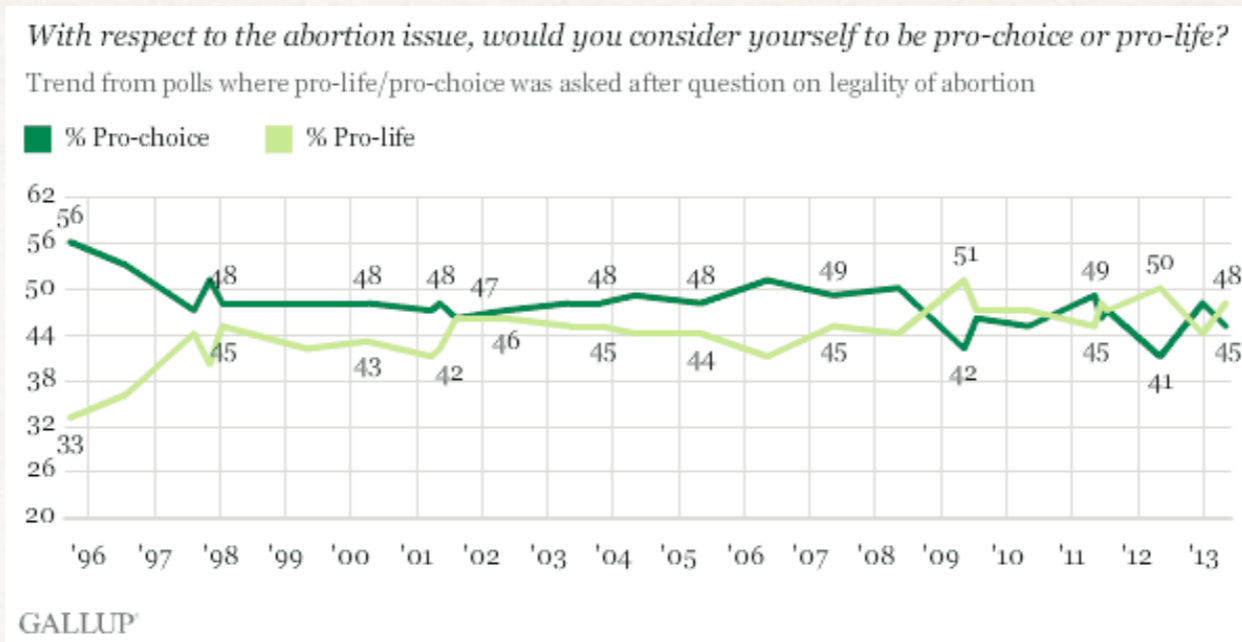
SOURCE: Gallup

AP

# Lie to me



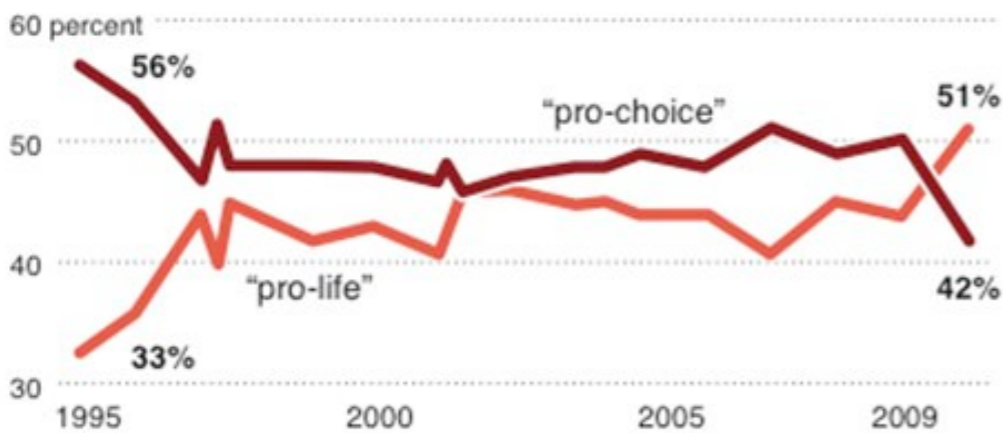
# Lie to me



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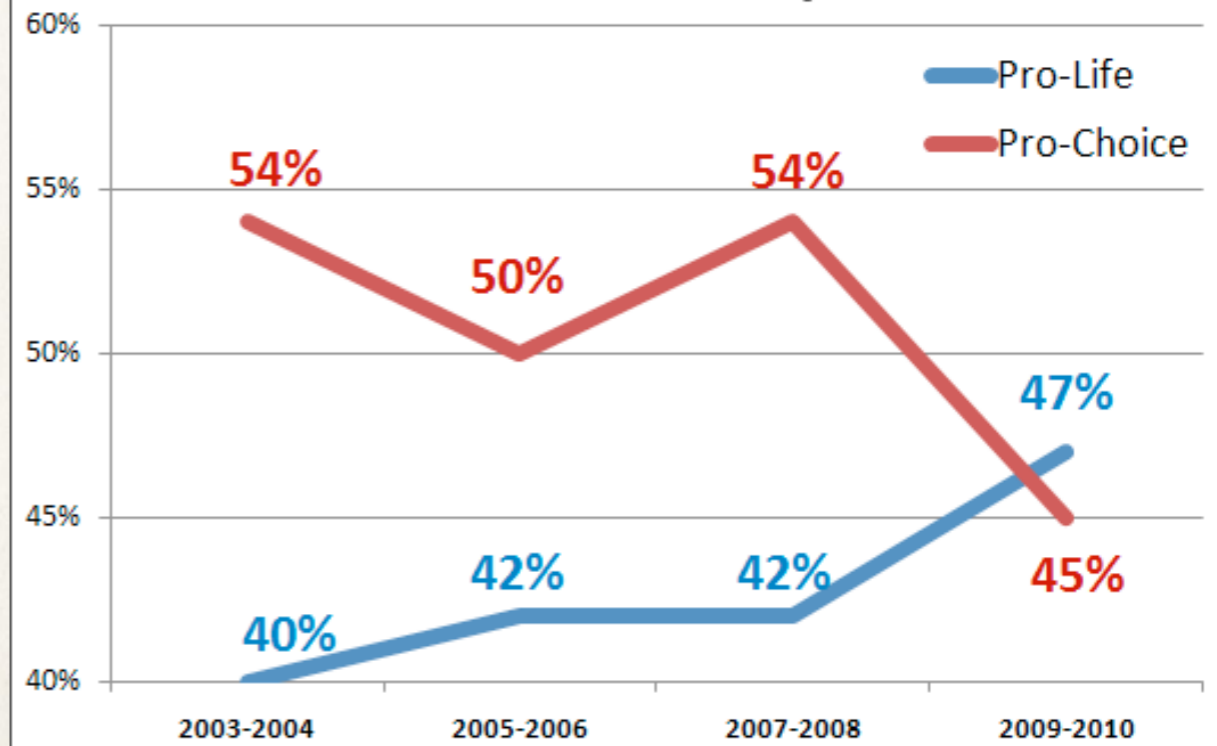
### Americans calling themselves "pro-life" or "pro-choice"



SOURCE: Gallup

AP

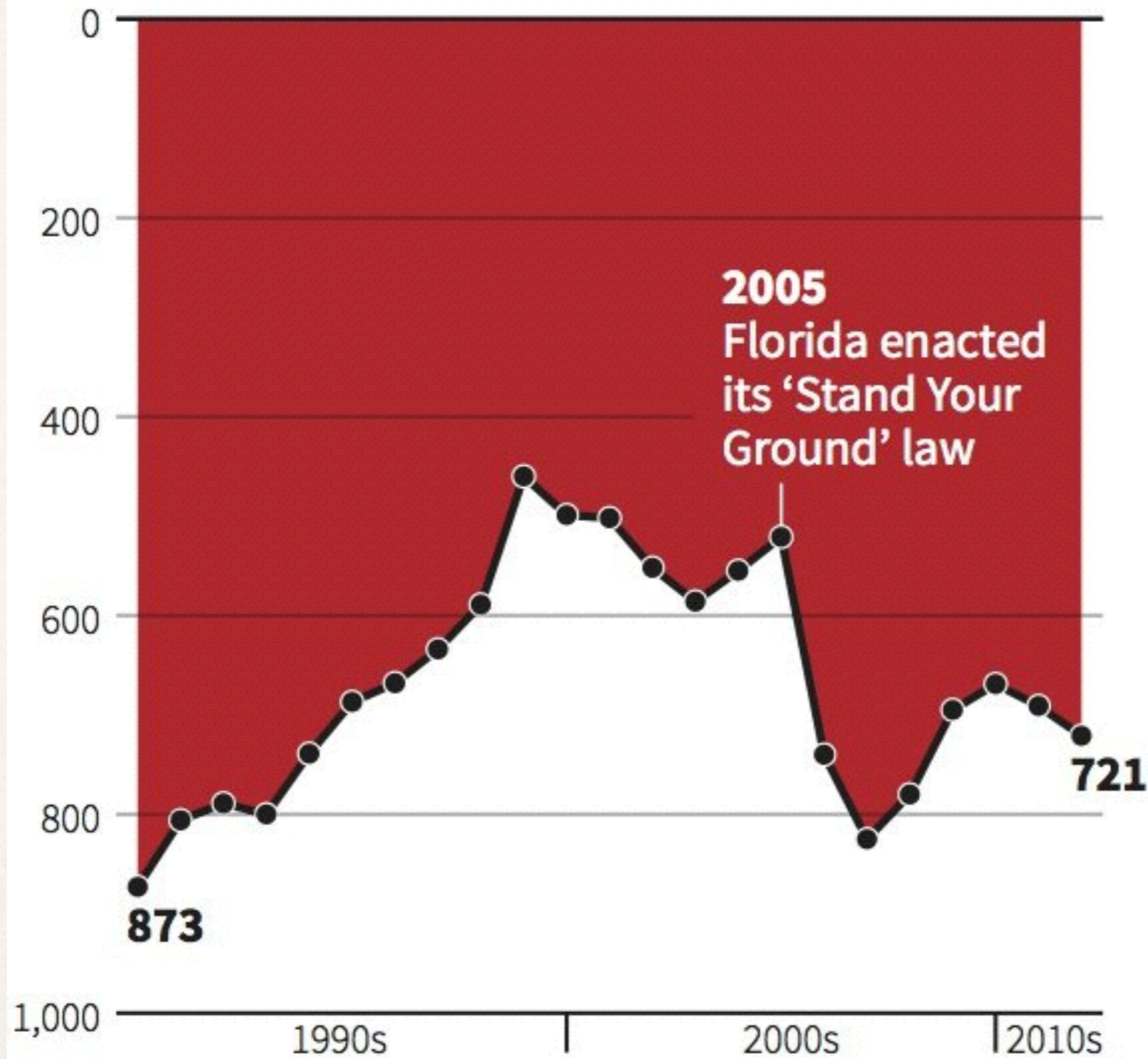
## Abortion Views - 18-29 year-olds



Source: Gallup

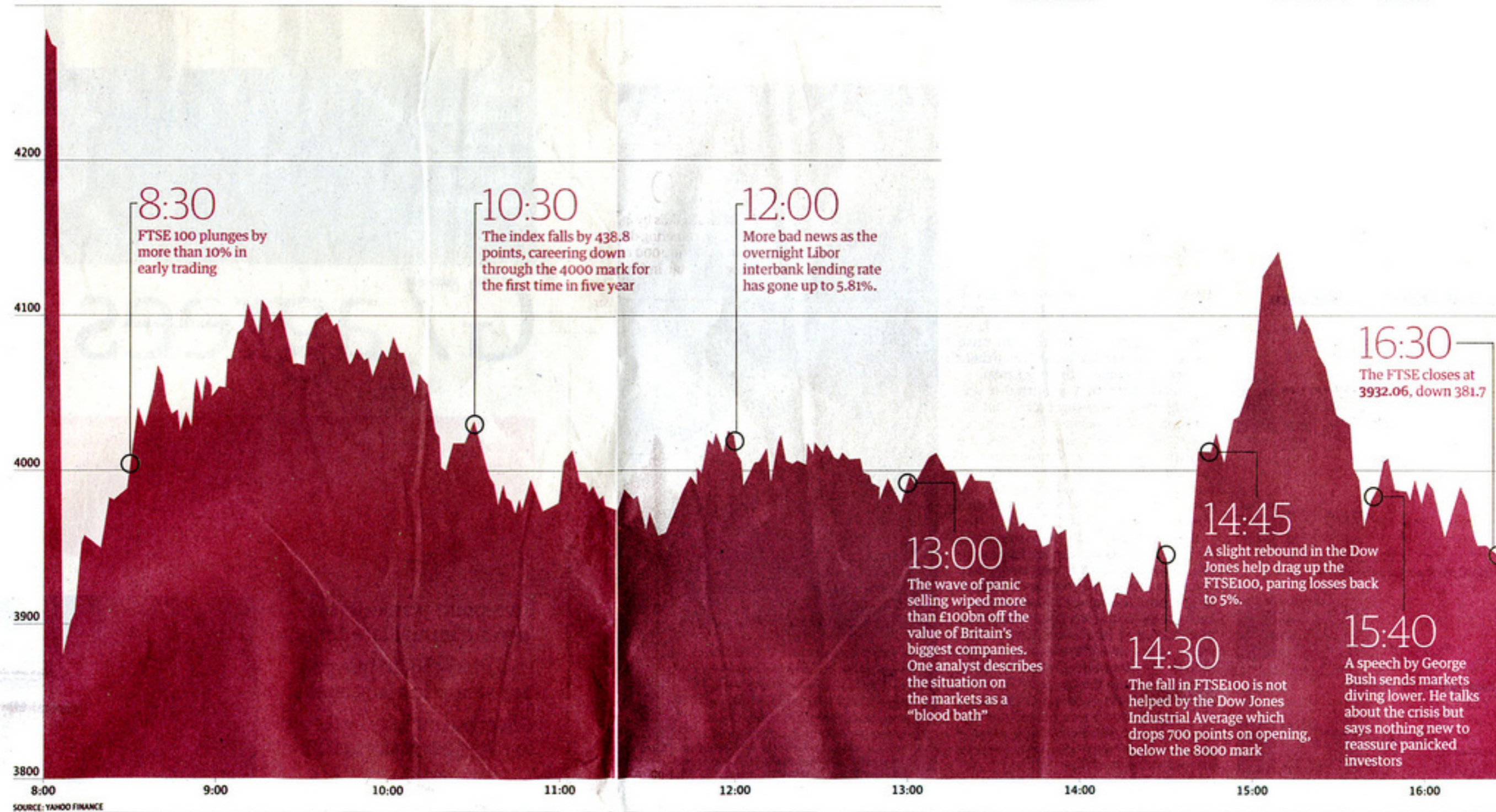
# Gun deaths in Florida

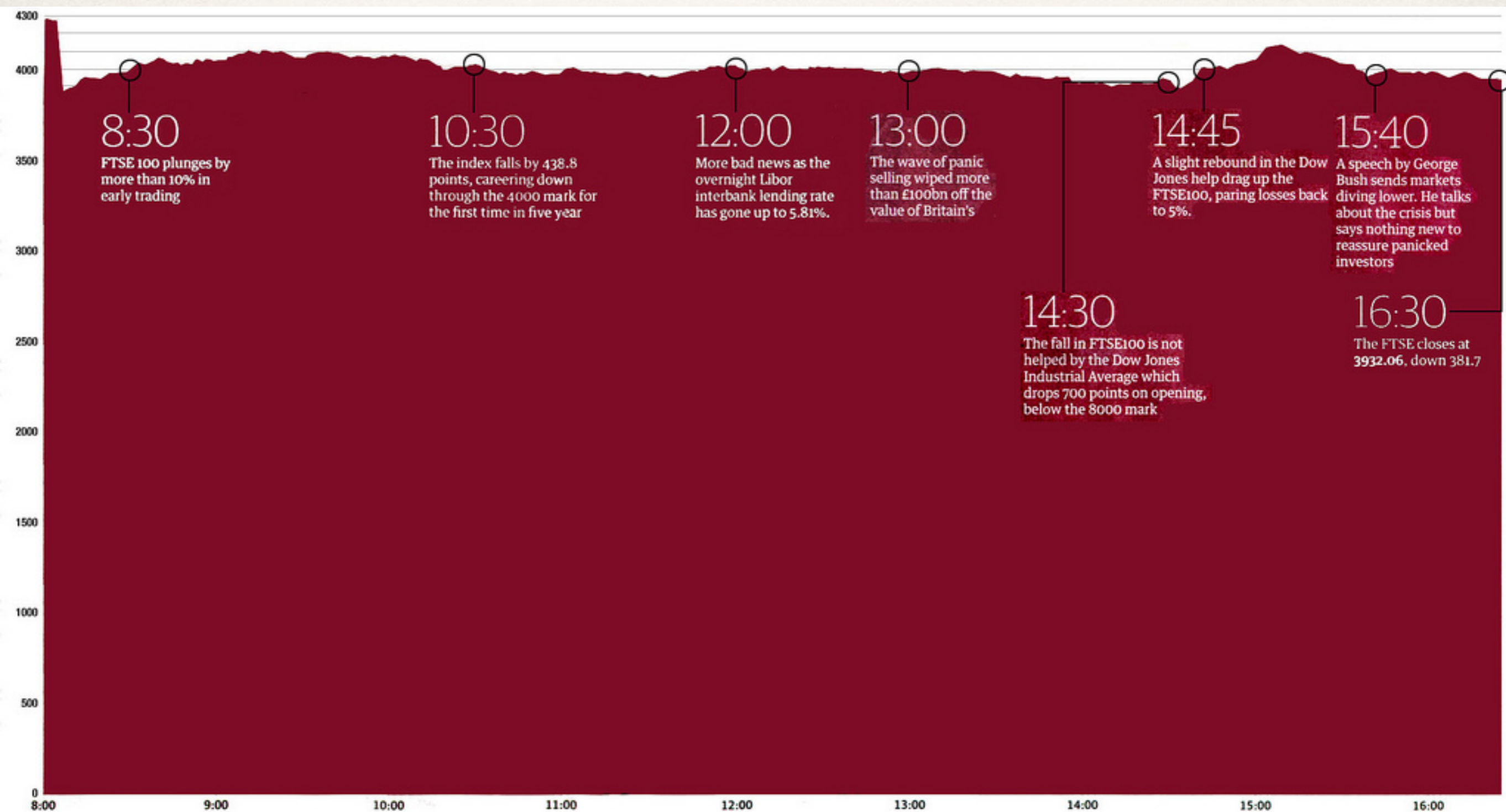
Number of murders committed using firearms



Source: Florida Department of Law Enforcement







Lie to me

# JOB LOSS BY QUARTER



FOX NEWS  
FOX NEWS  
.COM

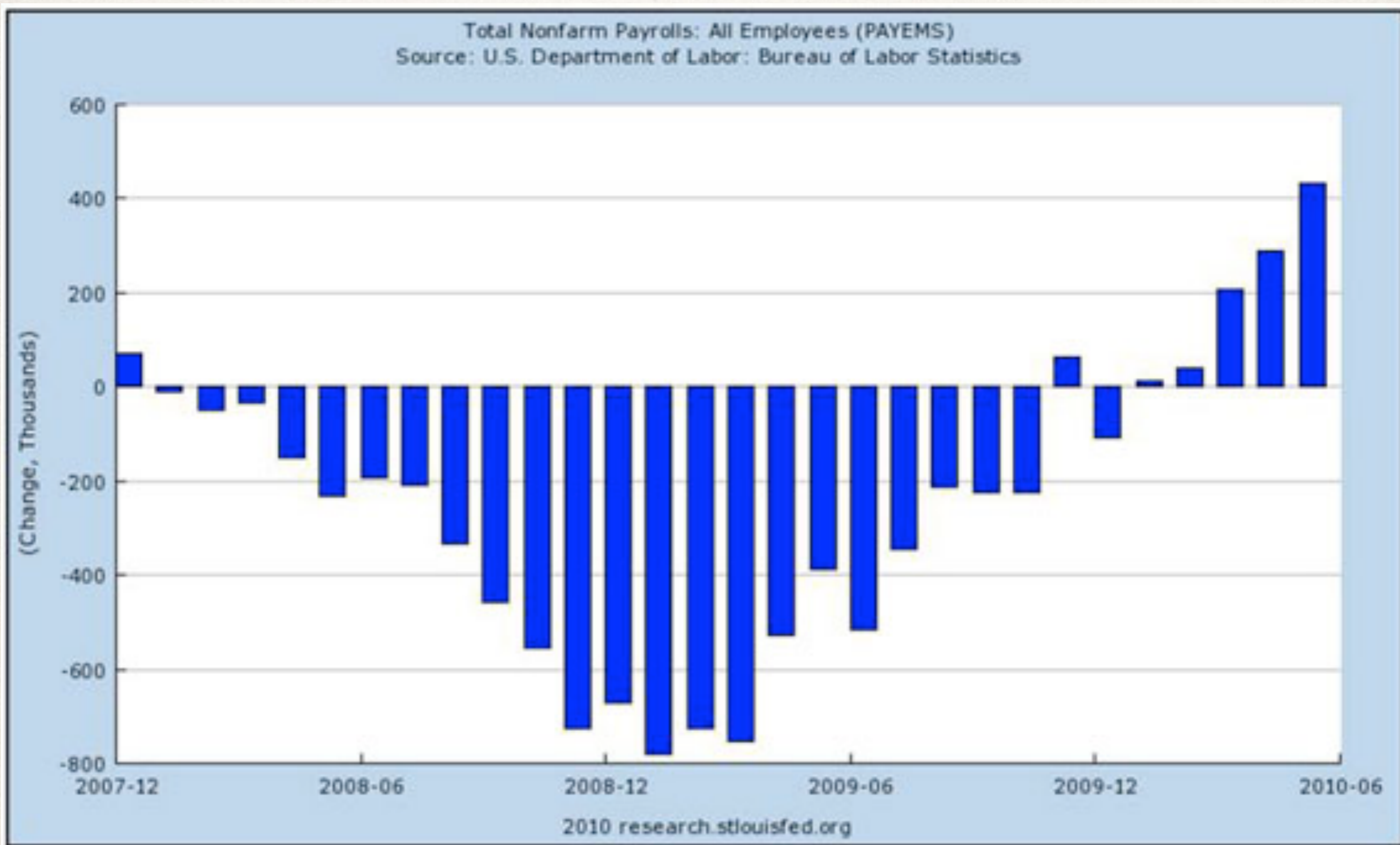
SOURCE: BLS

AMERICA'S  
NEWSROOM

N FAIRFAX, VA... BYRD WAS ADMITTED TO THE HC

S&P ▼ 3.08

# Lie to me



Lie to me

# Unemployed

# JOB LOSS BY QUARTER



FOX NEWS  
FOX NEWS  
.COM

SOURCE: BLS

AMERICA'S  
NEWSROOM

N FAIRFAX, VA... BYRD WAS ADMITTED TO THE HC

S&P ▼ 3.08

# Lie to me

## # Unemployed



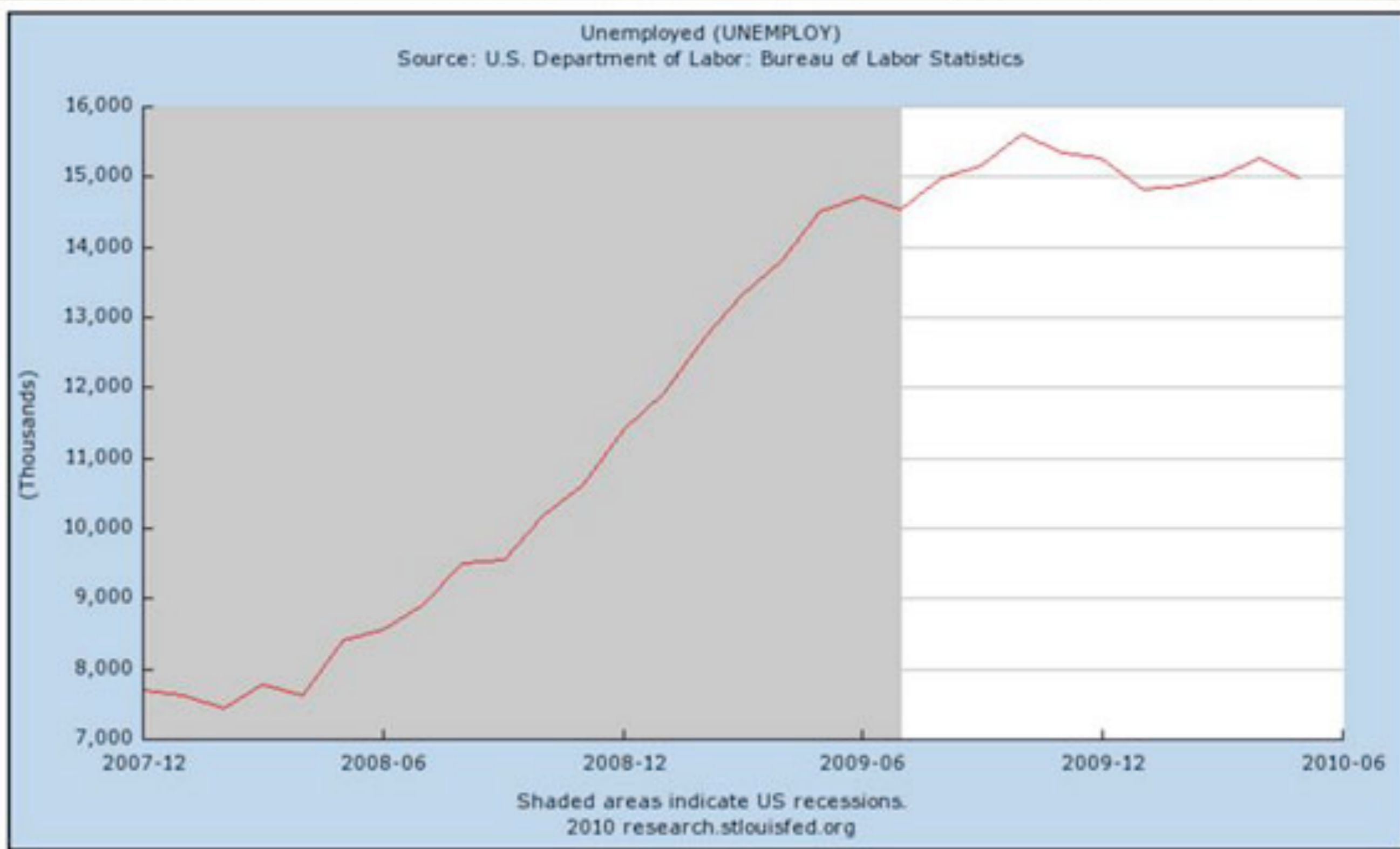
N FAIRFAX, VA... BYRD WAS ADMITTED TO THE HC S&P ▼ 3.08

Lie to me

## UNEMPLOYMENT LEVEL BY RANDOM QUARTER



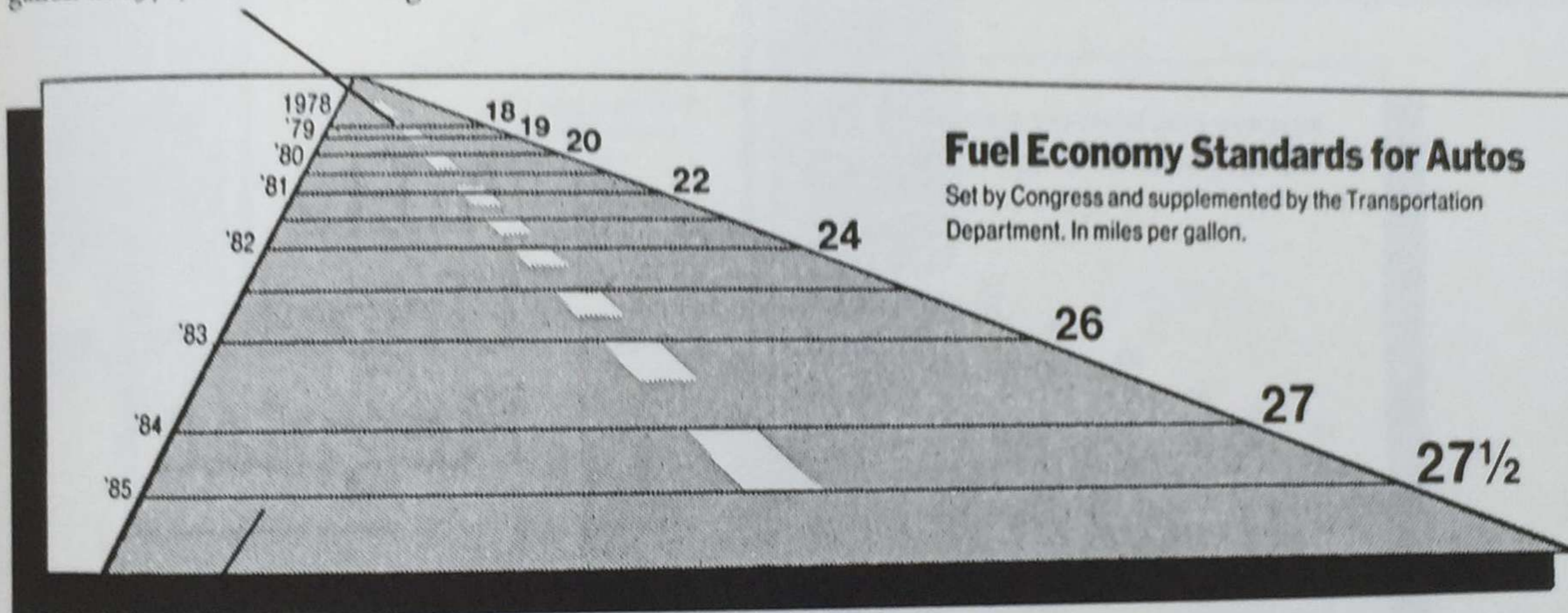
# Lie to me





# Lie factor

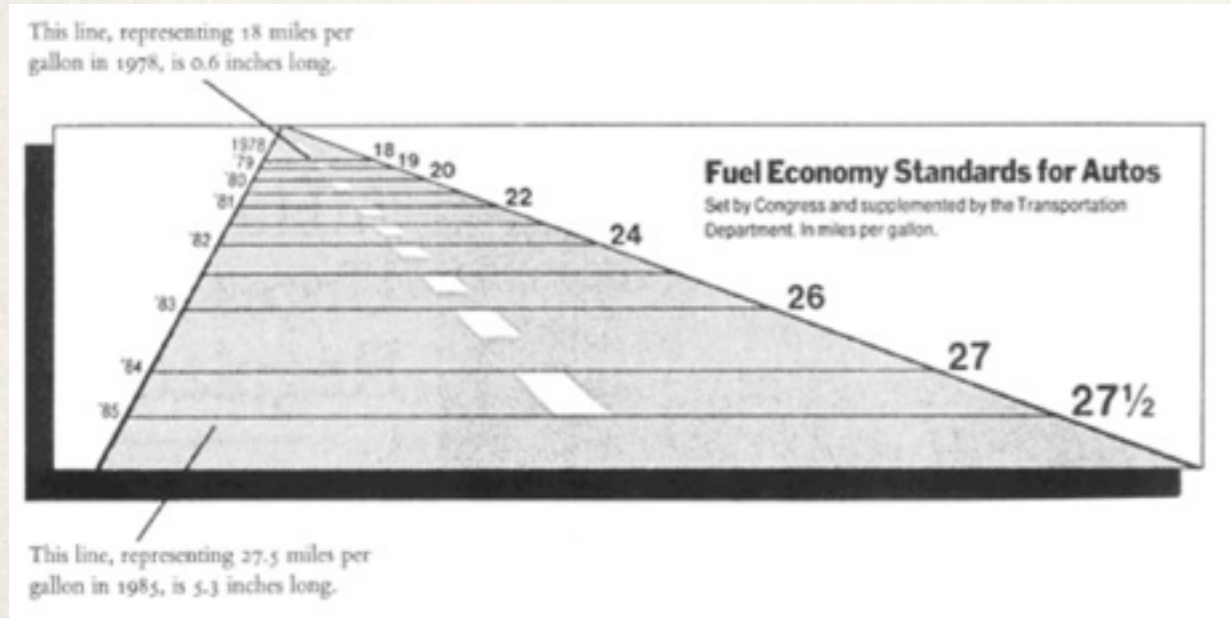
This line, representing 18 miles per gallon in 1978, is 0.6 inches long.



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

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

# Lie factor



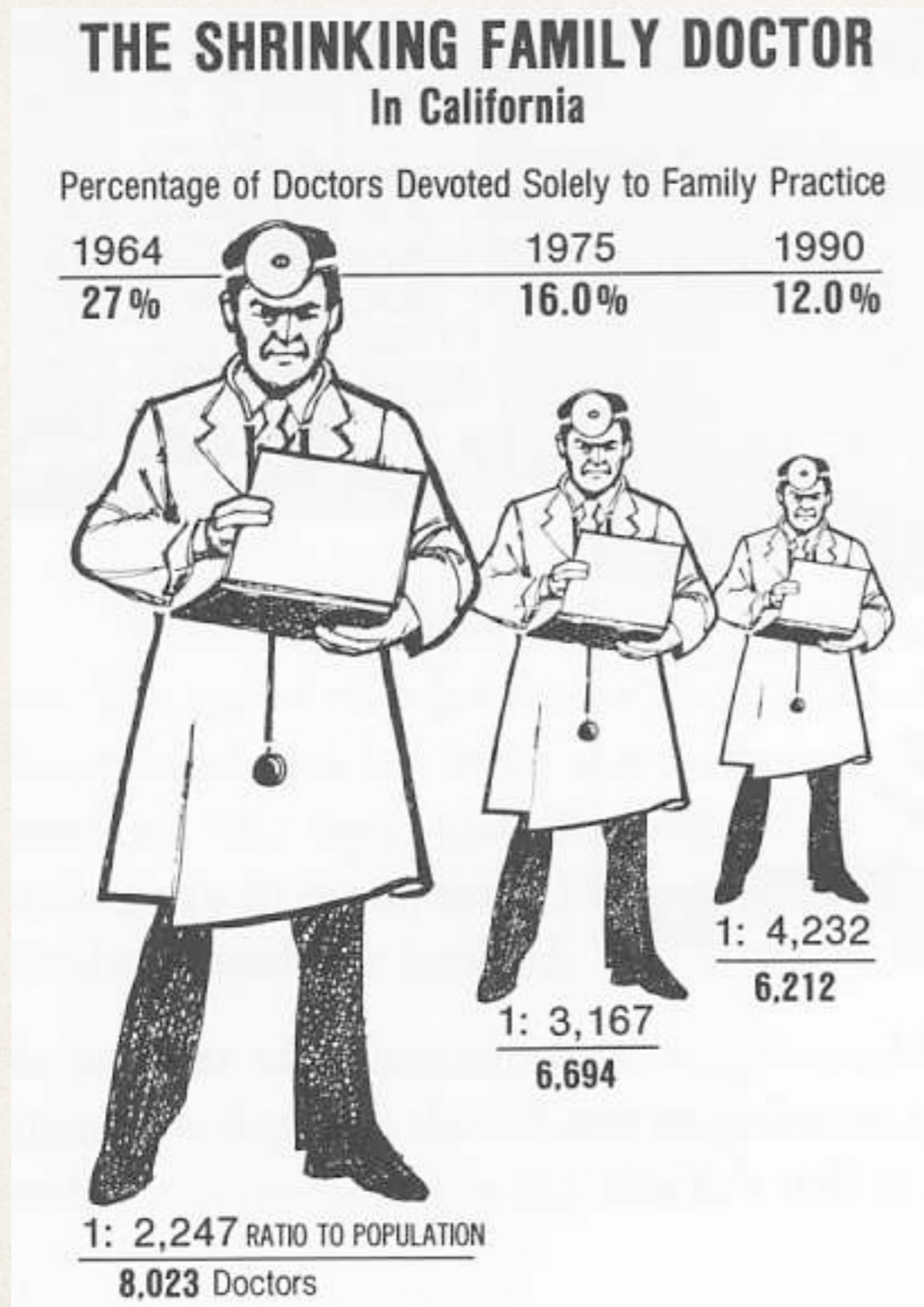
$$\text{Lie Factor} = \frac{\text{Size of effect in graphic}}{\text{Size of effect in data}}$$

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

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

$$\text{Lie Factor} = 14.8$$

# Area and one-dimensional data



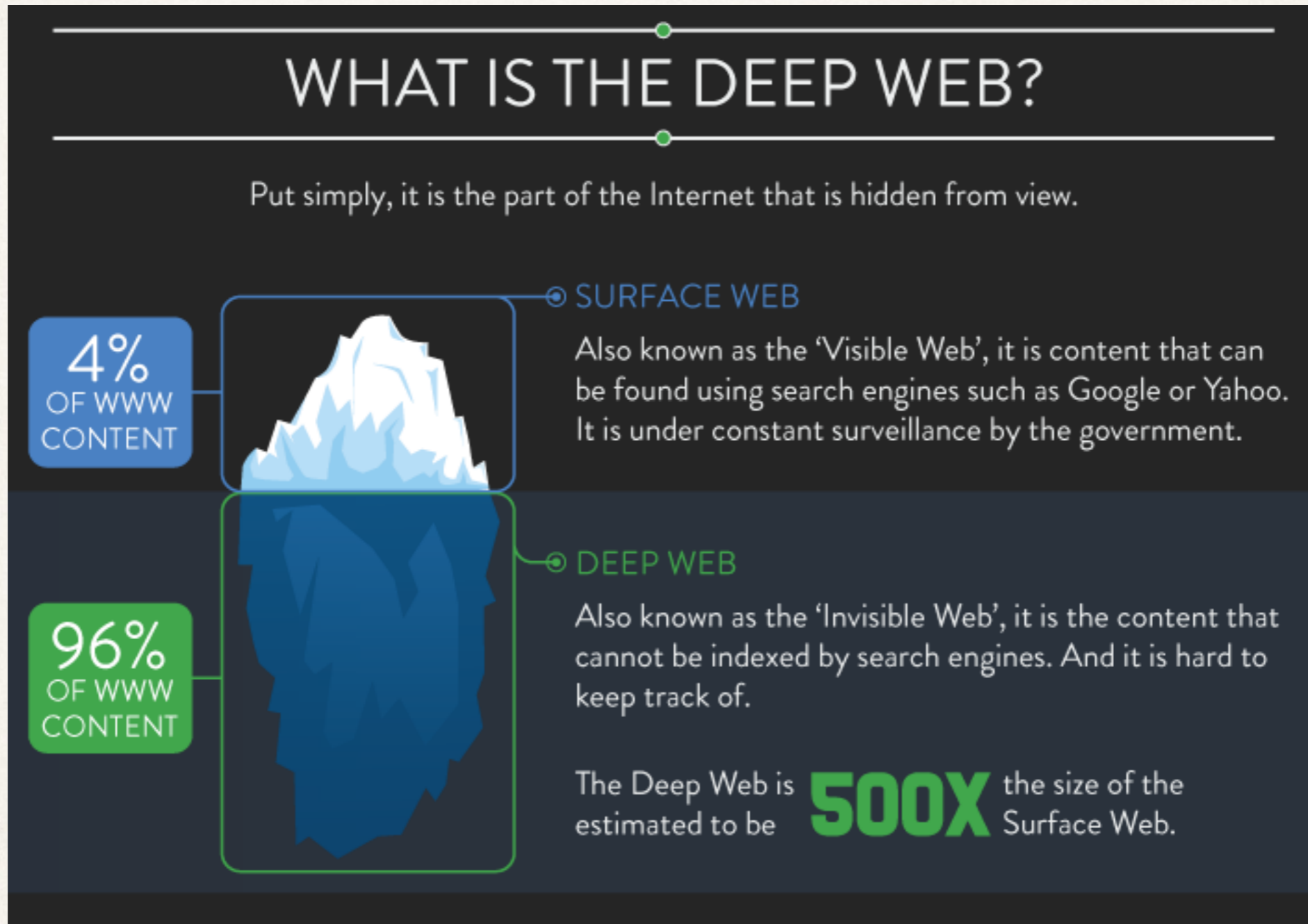
Lie factor: 2.8

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

...and misleading horizontal displacement

...and one of those is a prediction

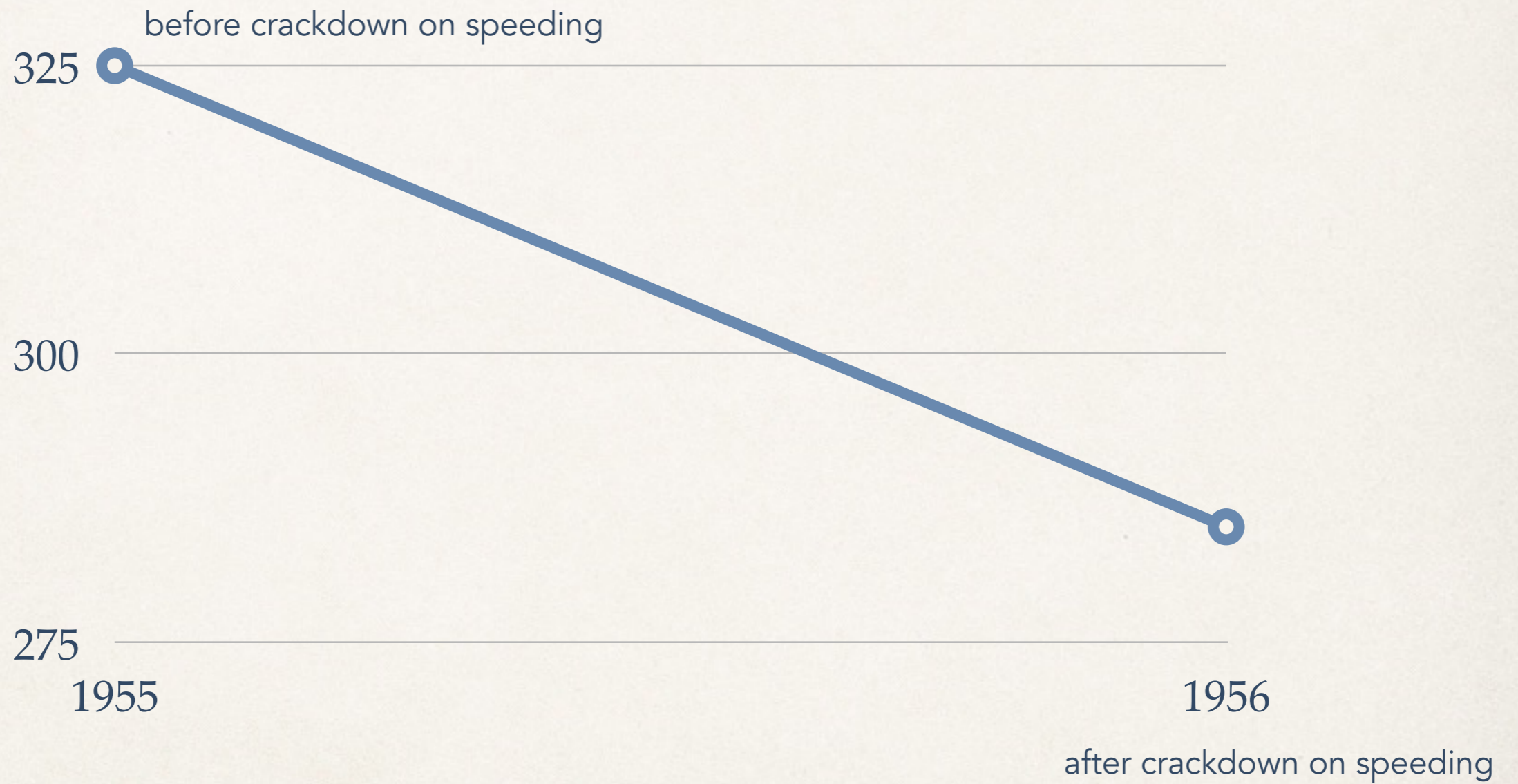
# That is a big 4%...



Lie factor: 0.048

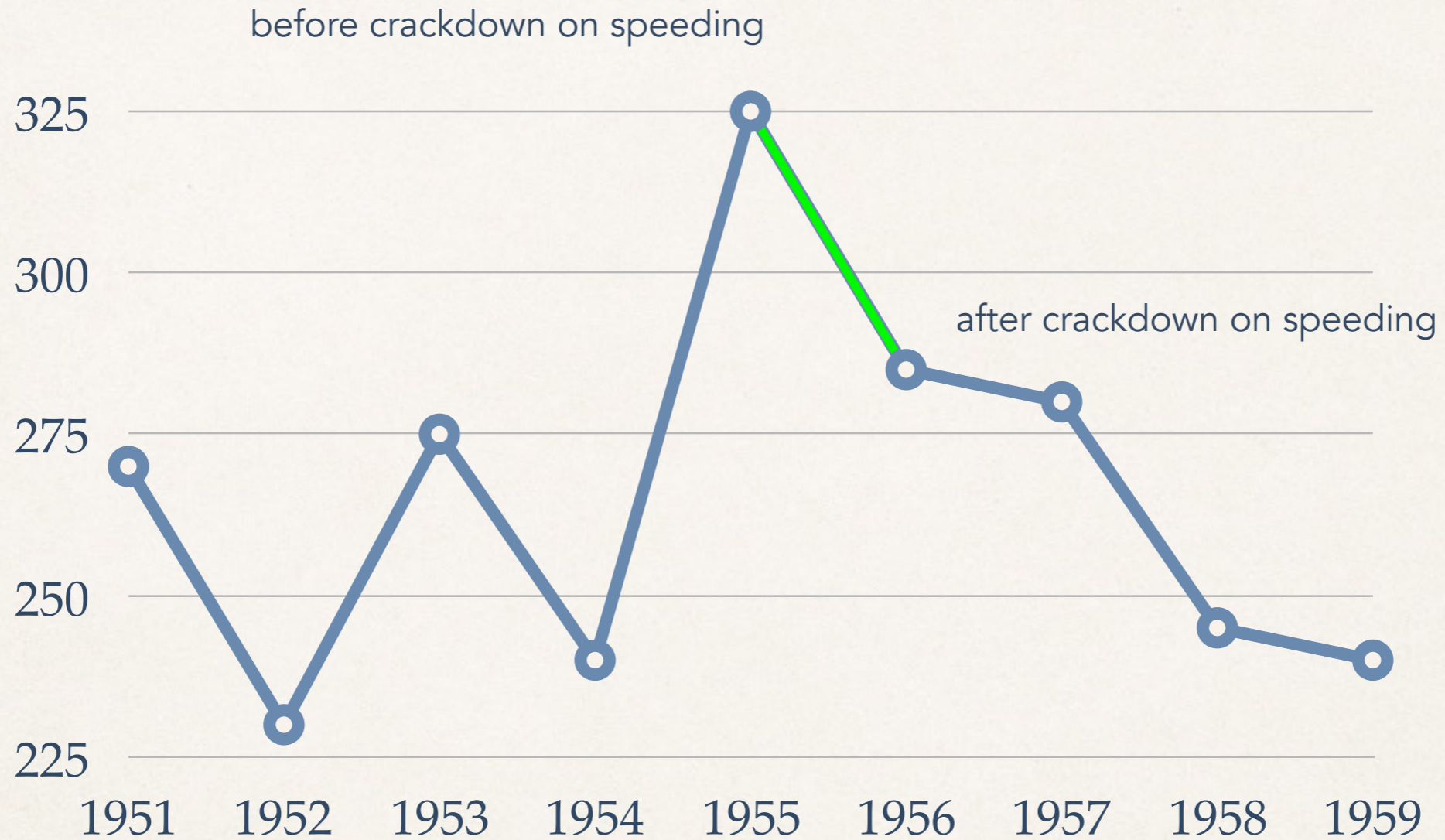
# Context is essential

## Connecticut Traffic Deaths

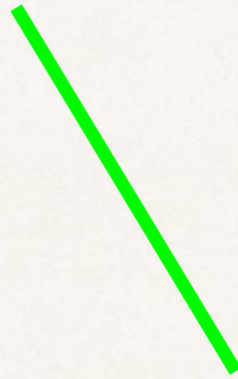


# Context is essential

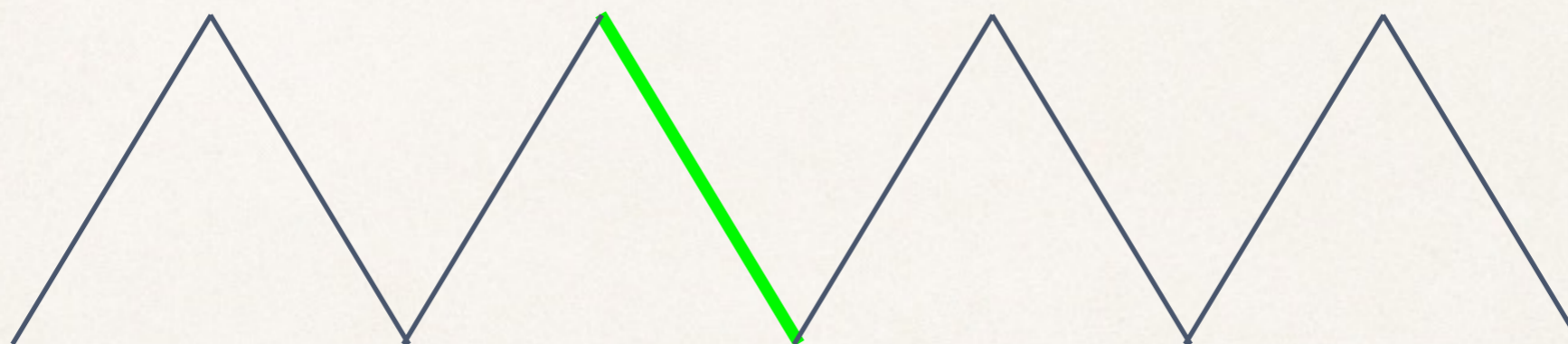
## Connecticut Traffic Deaths



**Context is essential**

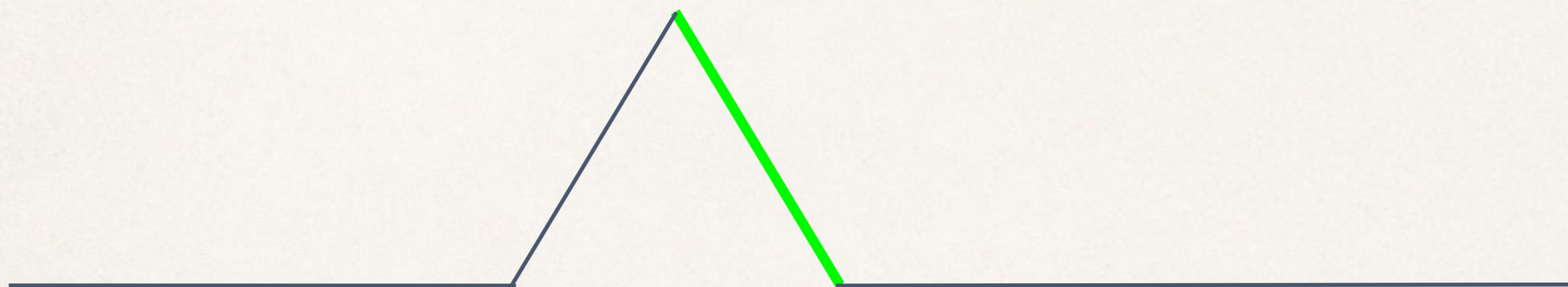


# Context is essential

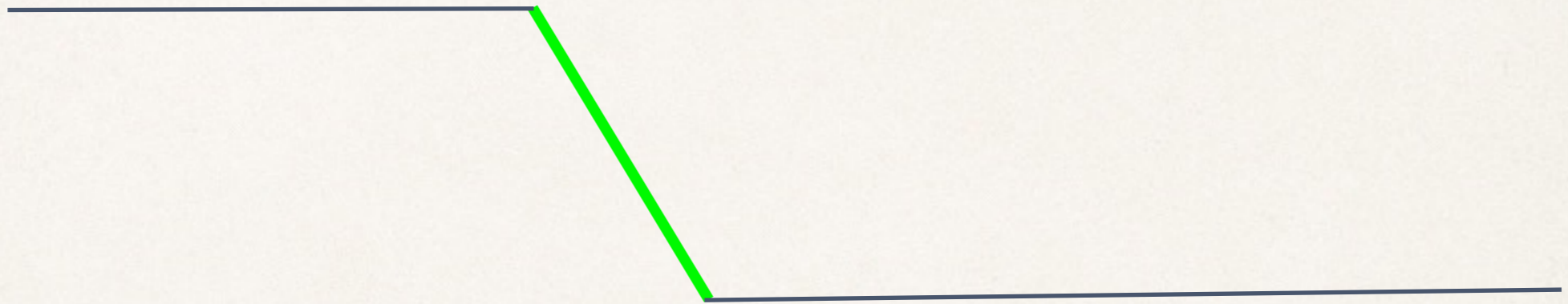




# Context is essential



# Context is essential



# How to lie

Remove outliers and "extra" data until you have visible trends

Find a fitted curve and throw away the original data

Change the scaling to make a trend appear

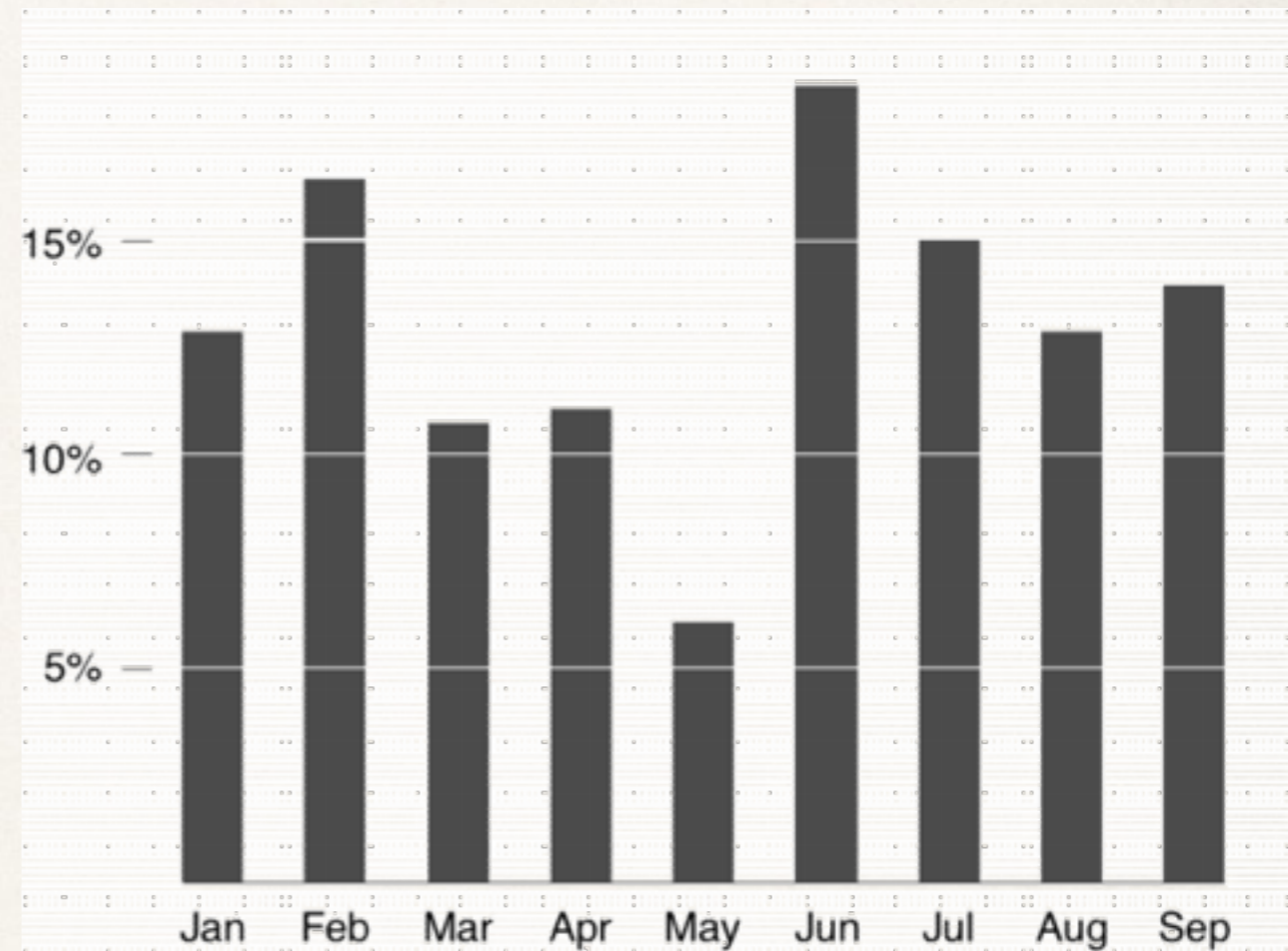
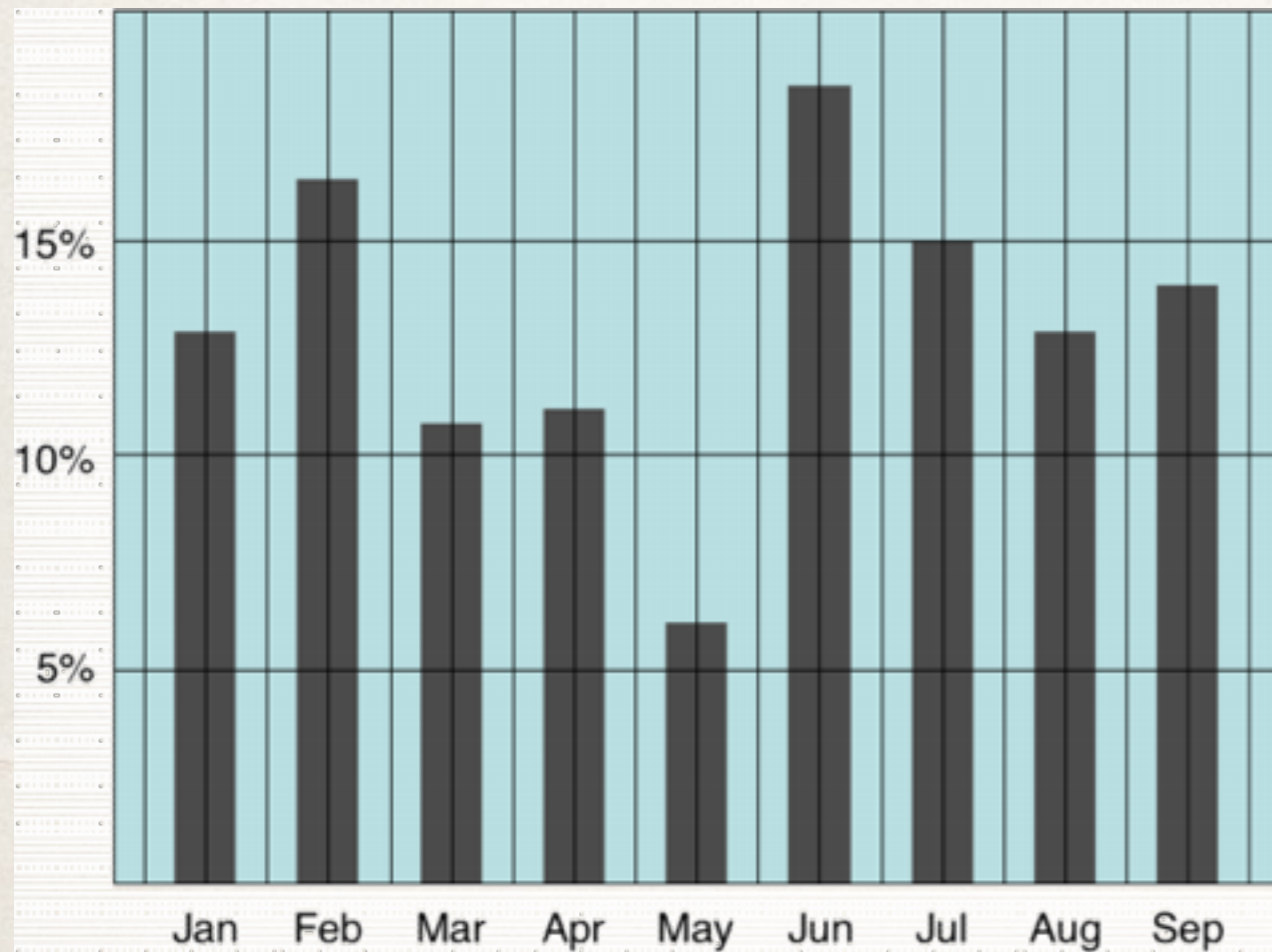
Change the range to only show the effect you want

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

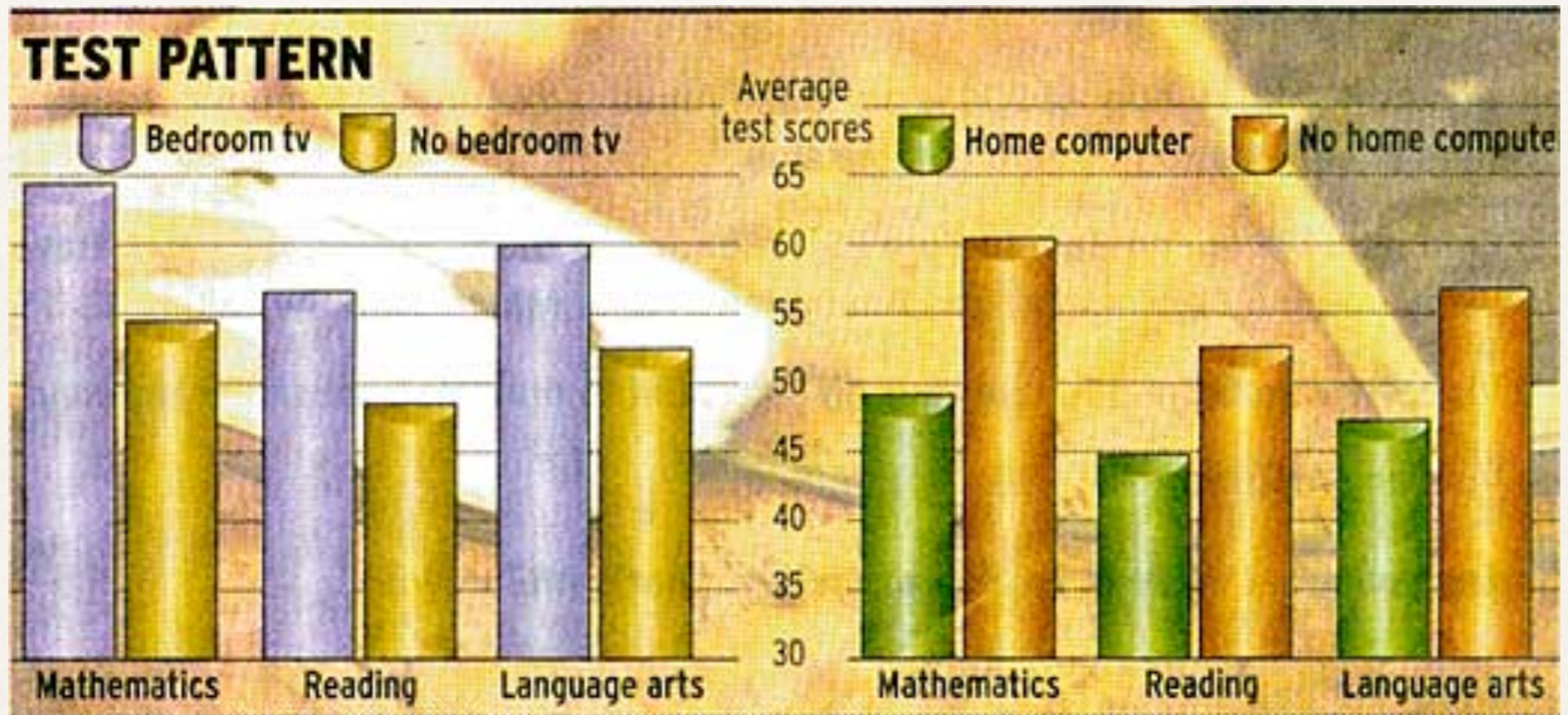
Compare apples to oranges, mixing two different kinds of data on the same chart

# Data Ink Ratio



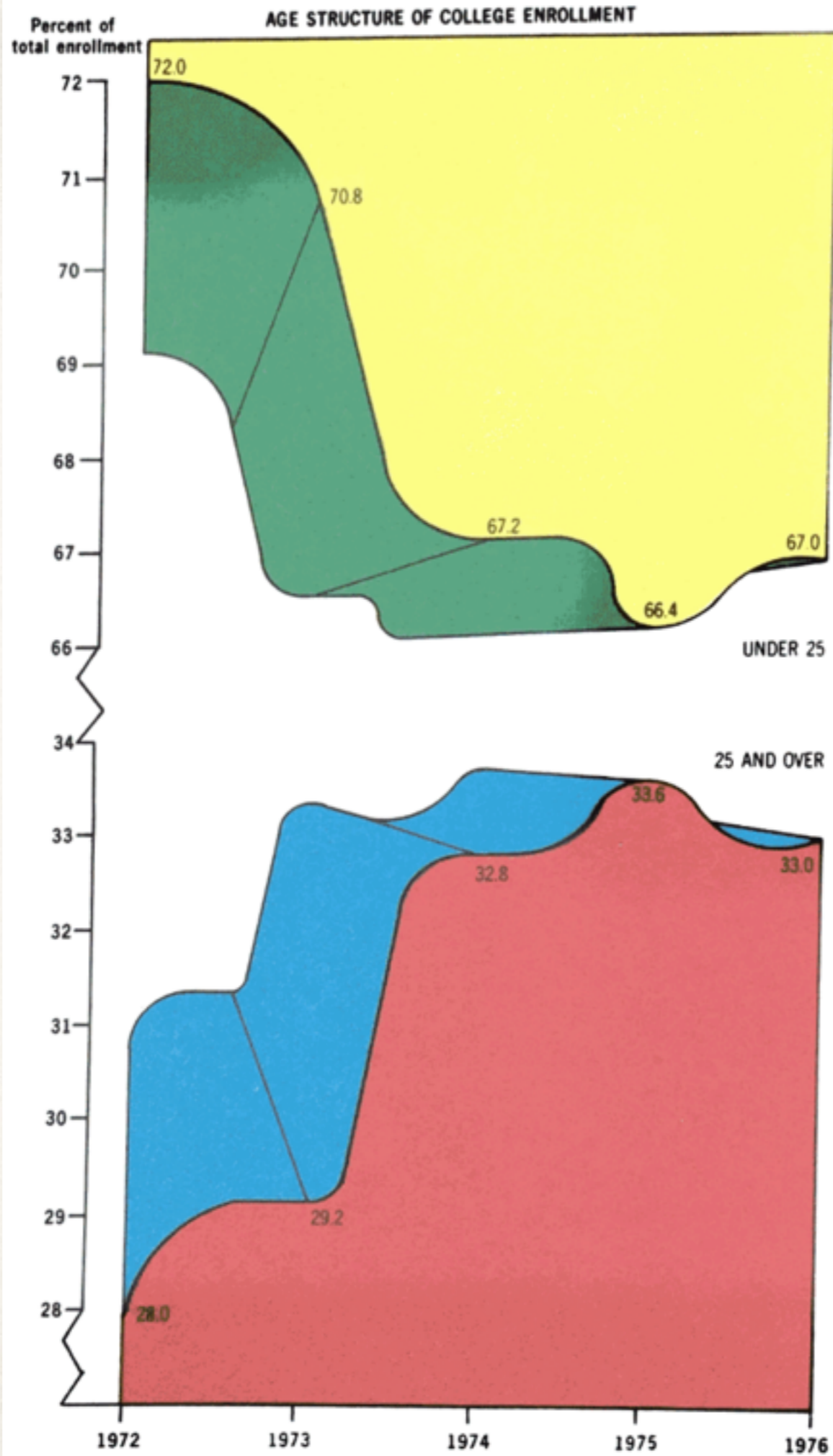
$$\text{data-ink ratio} = \frac{\text{data-ink}}{\text{ink used in graphic}}$$

# Chart junk



Sunday Morning Herald, 2005-07-06

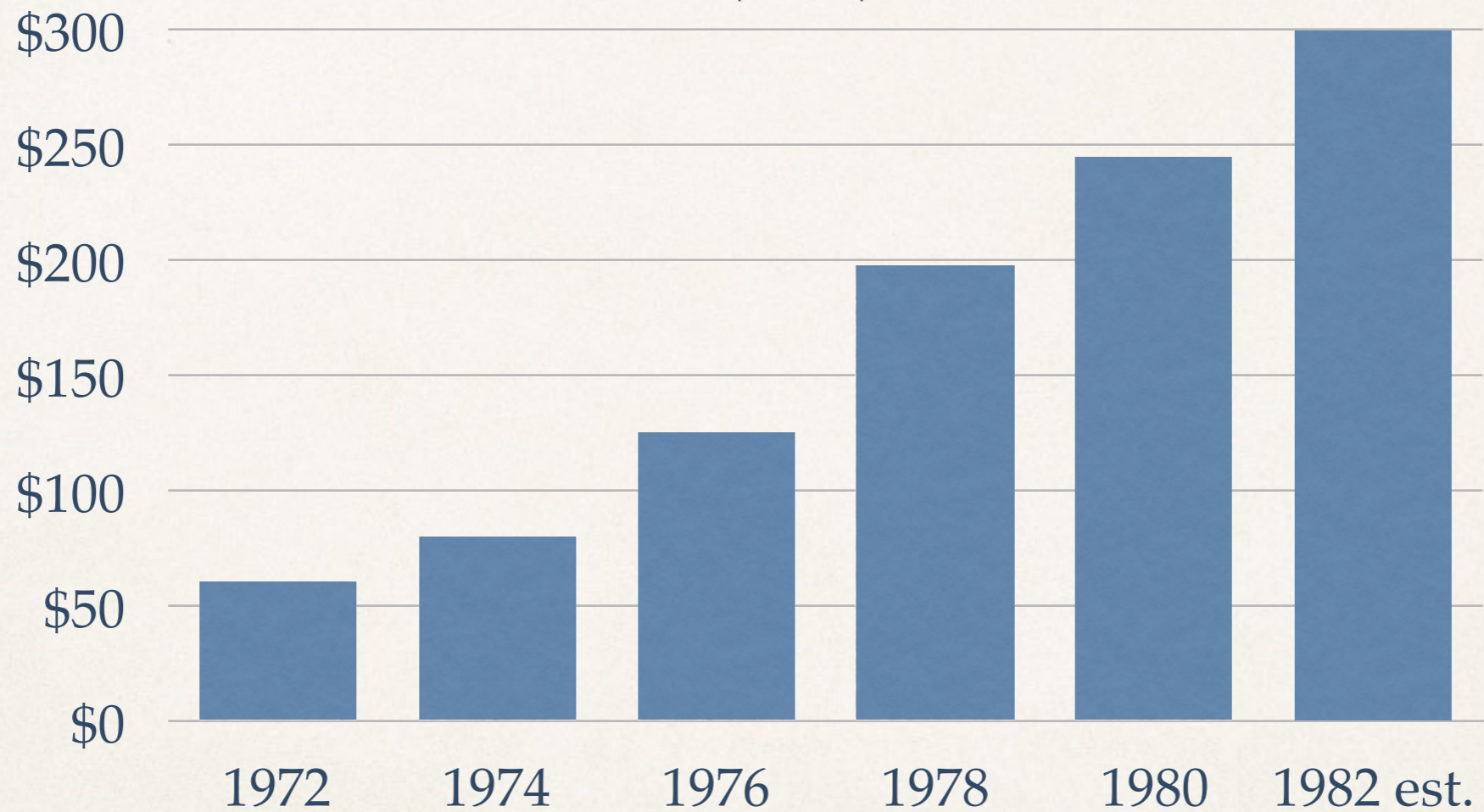
Chart junk



# Useful chart junk?

## Monstrous costs

Total House and Senate campaign expenditures, in millions

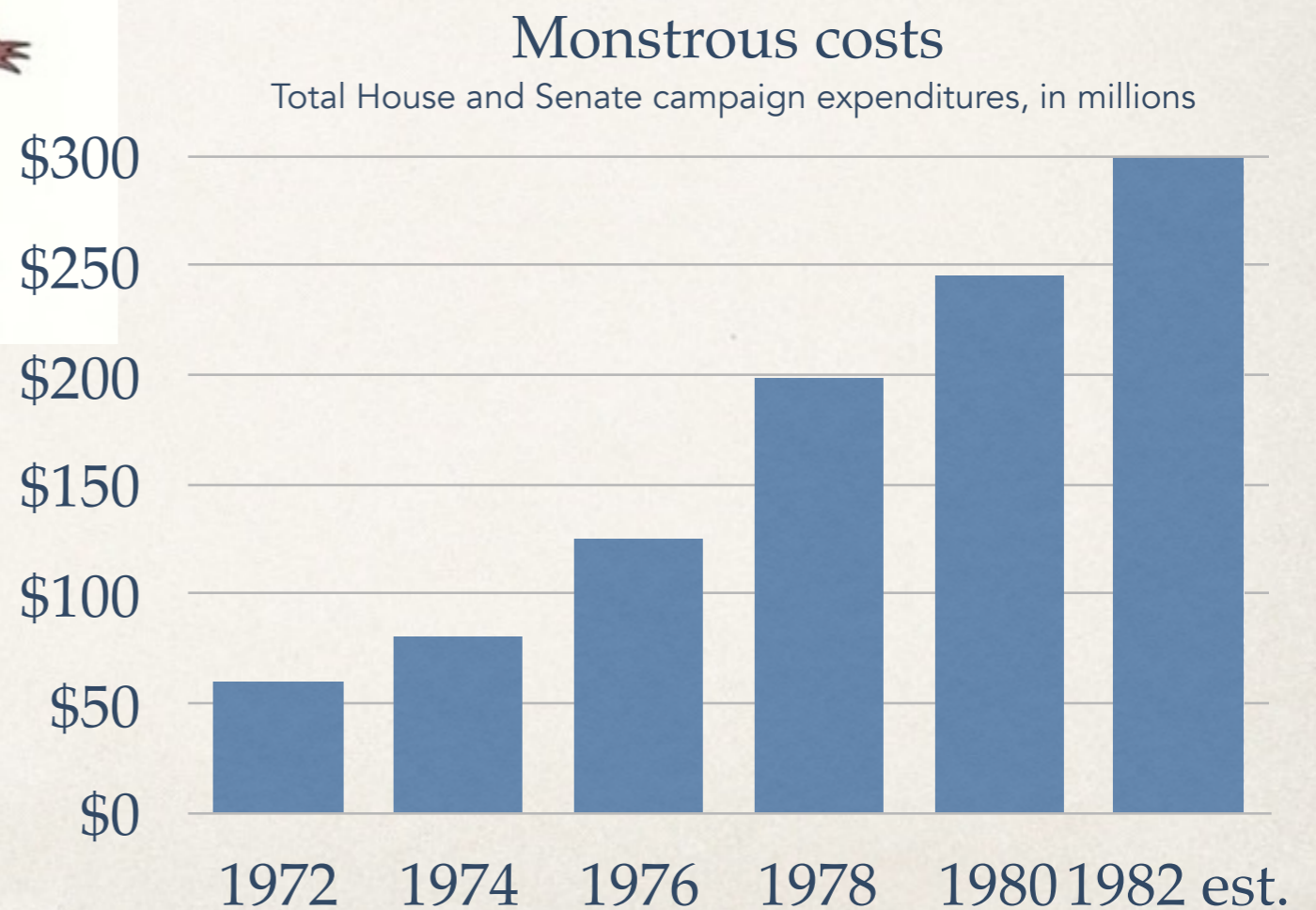


# Useful chart junk?

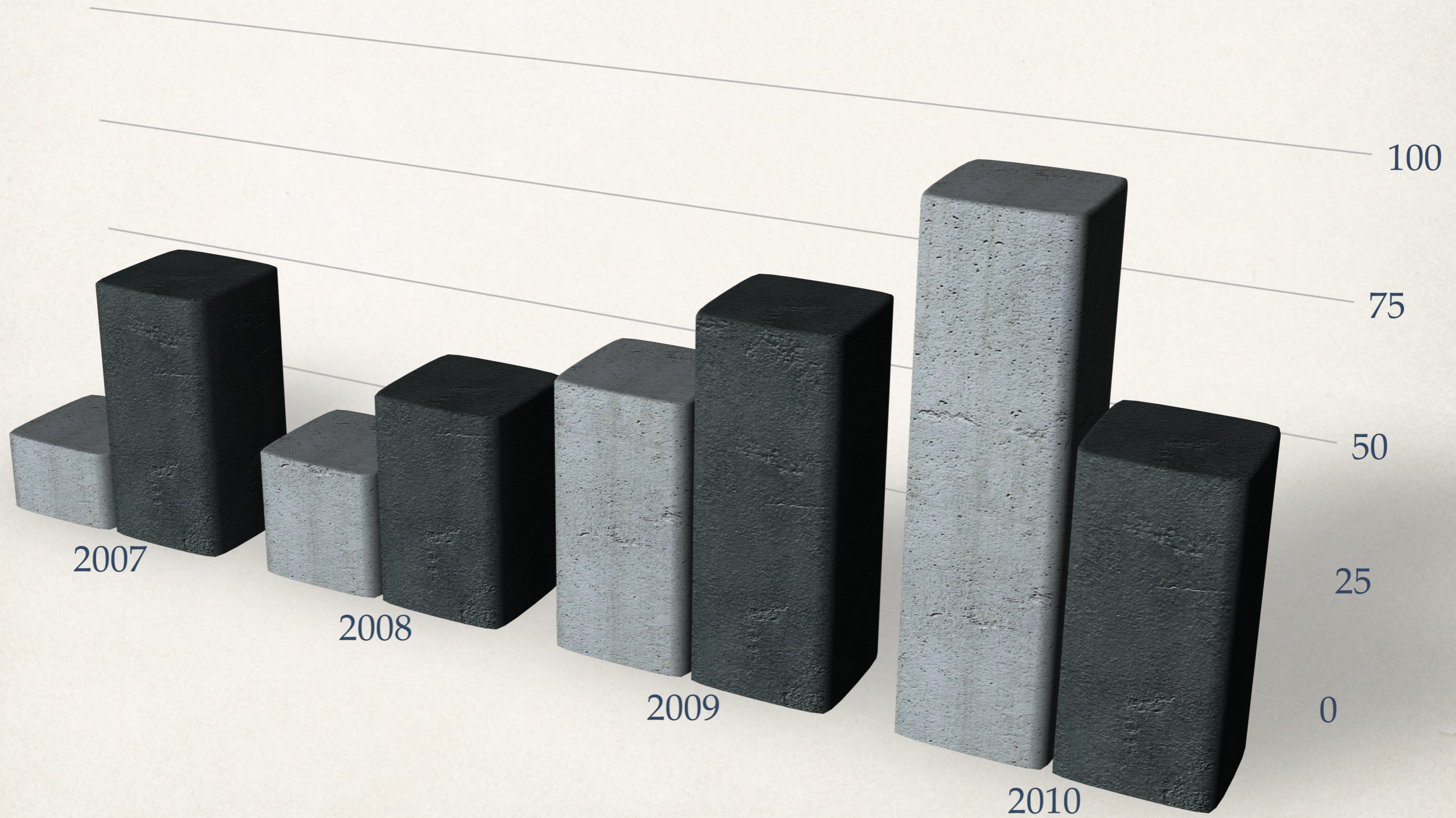




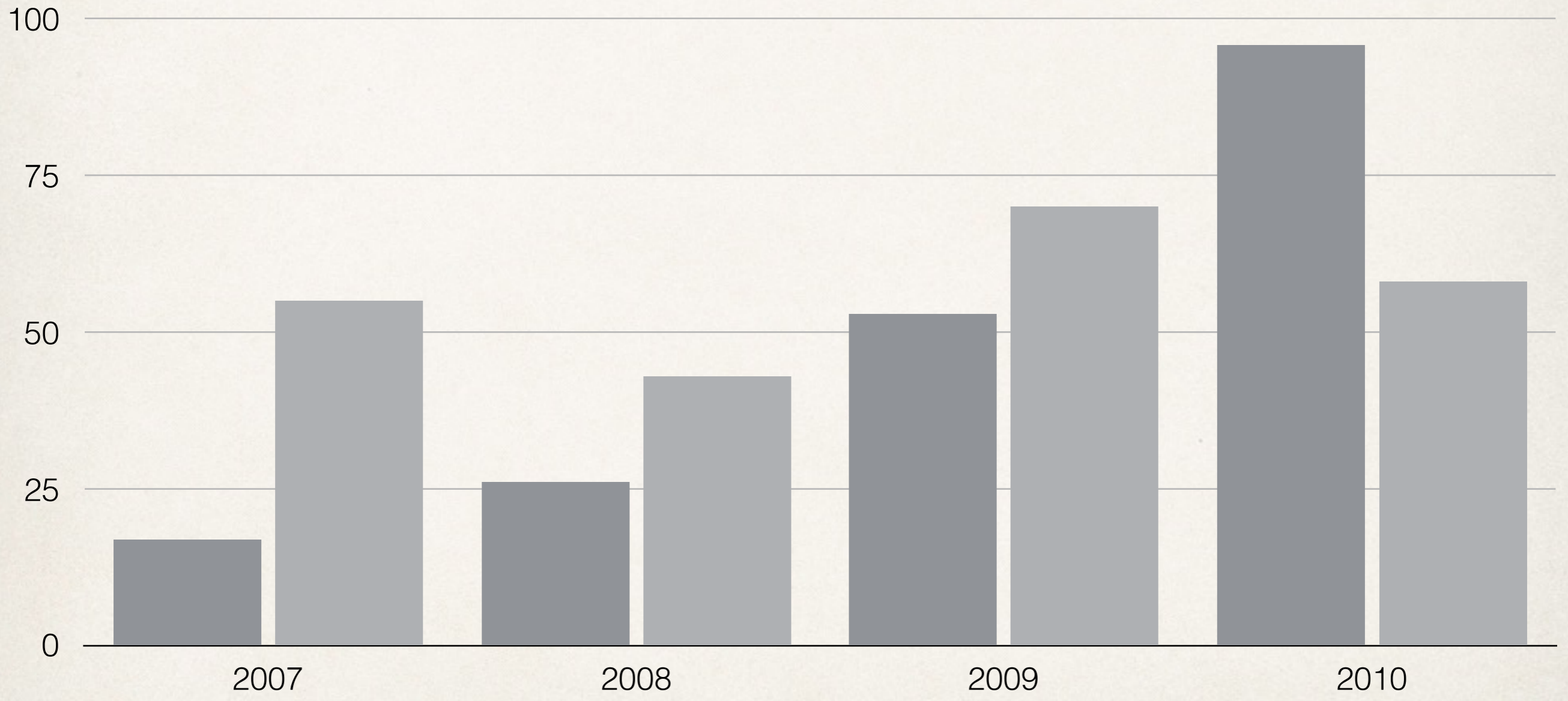
# Useful chart junk?



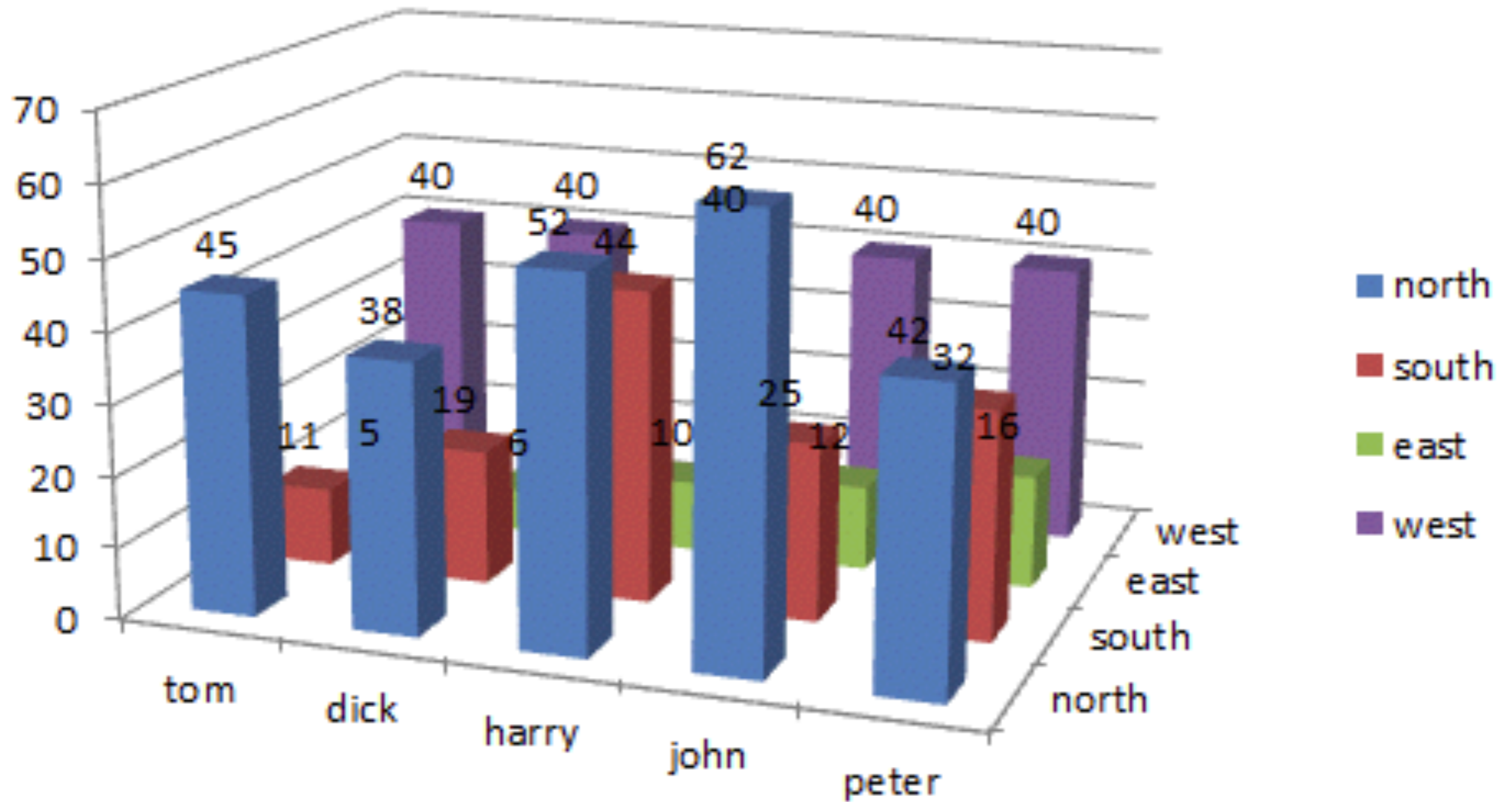
# Now in 3D!



# Now in 3D!

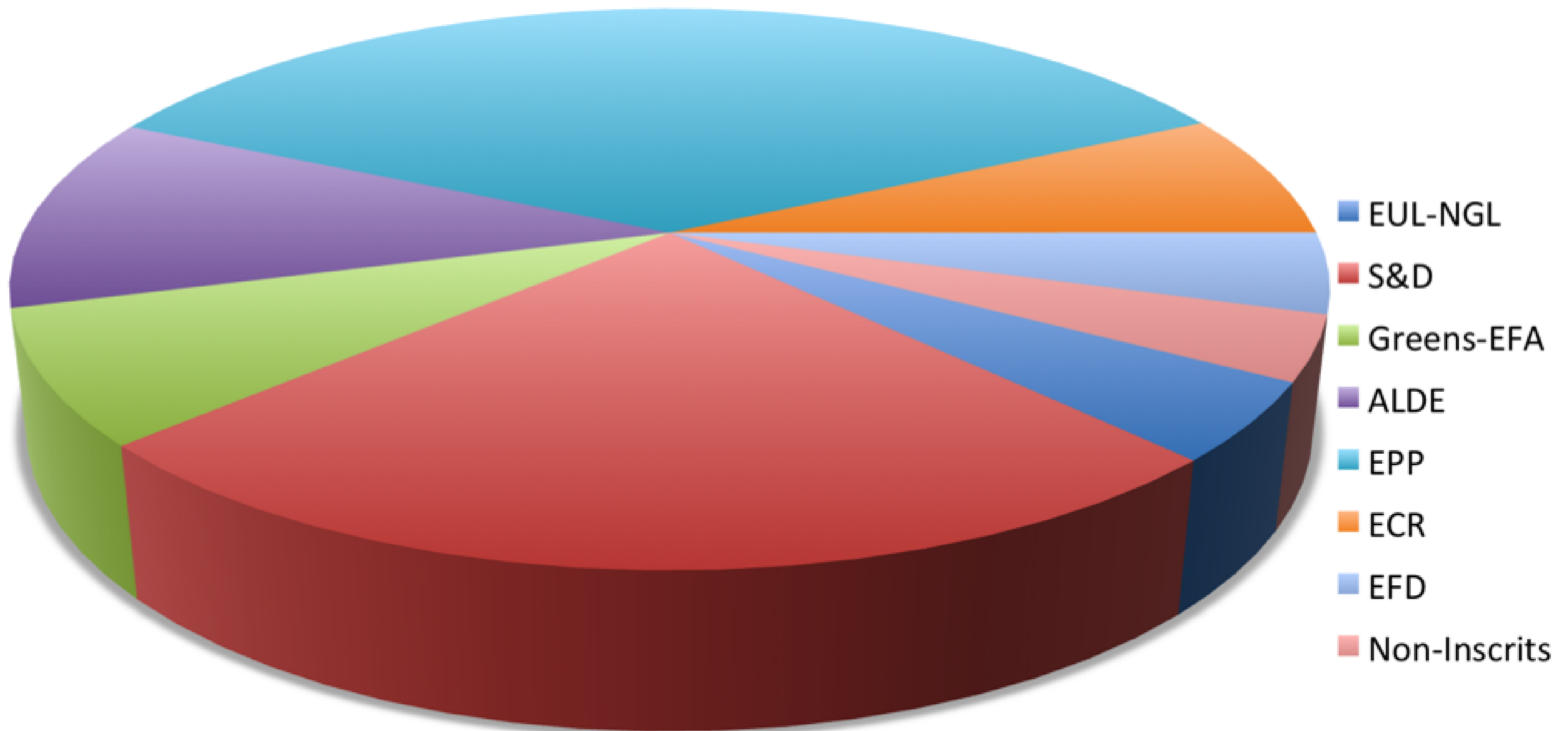


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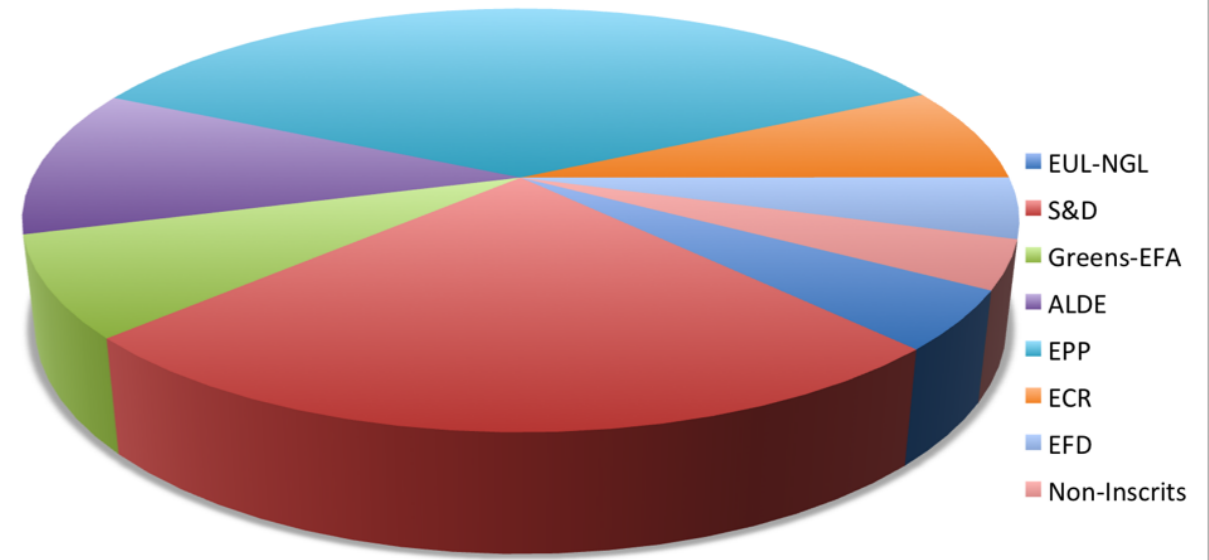
# Now in 3D!

## European Parliament Party Breakdown

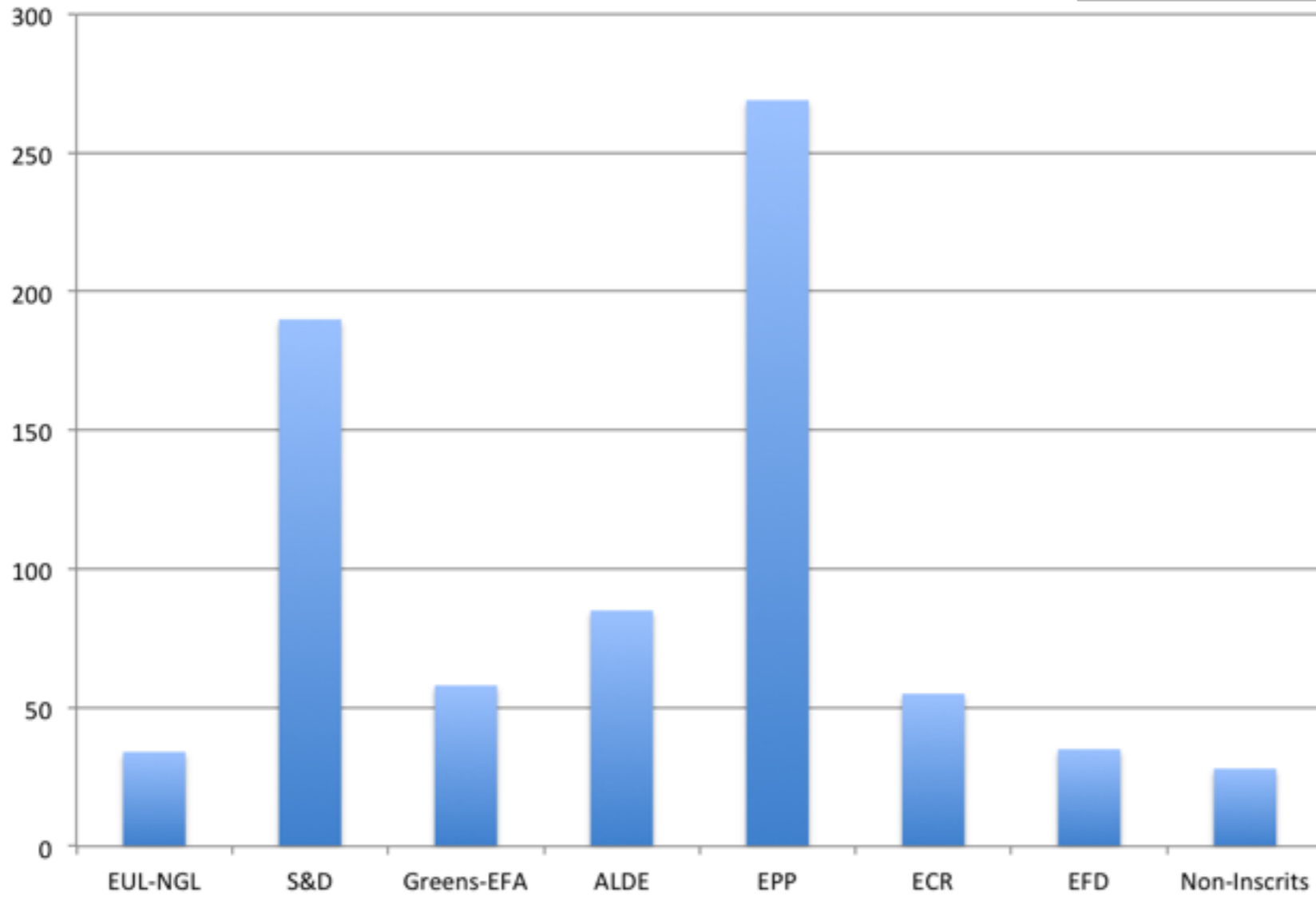


# Now in 3D!

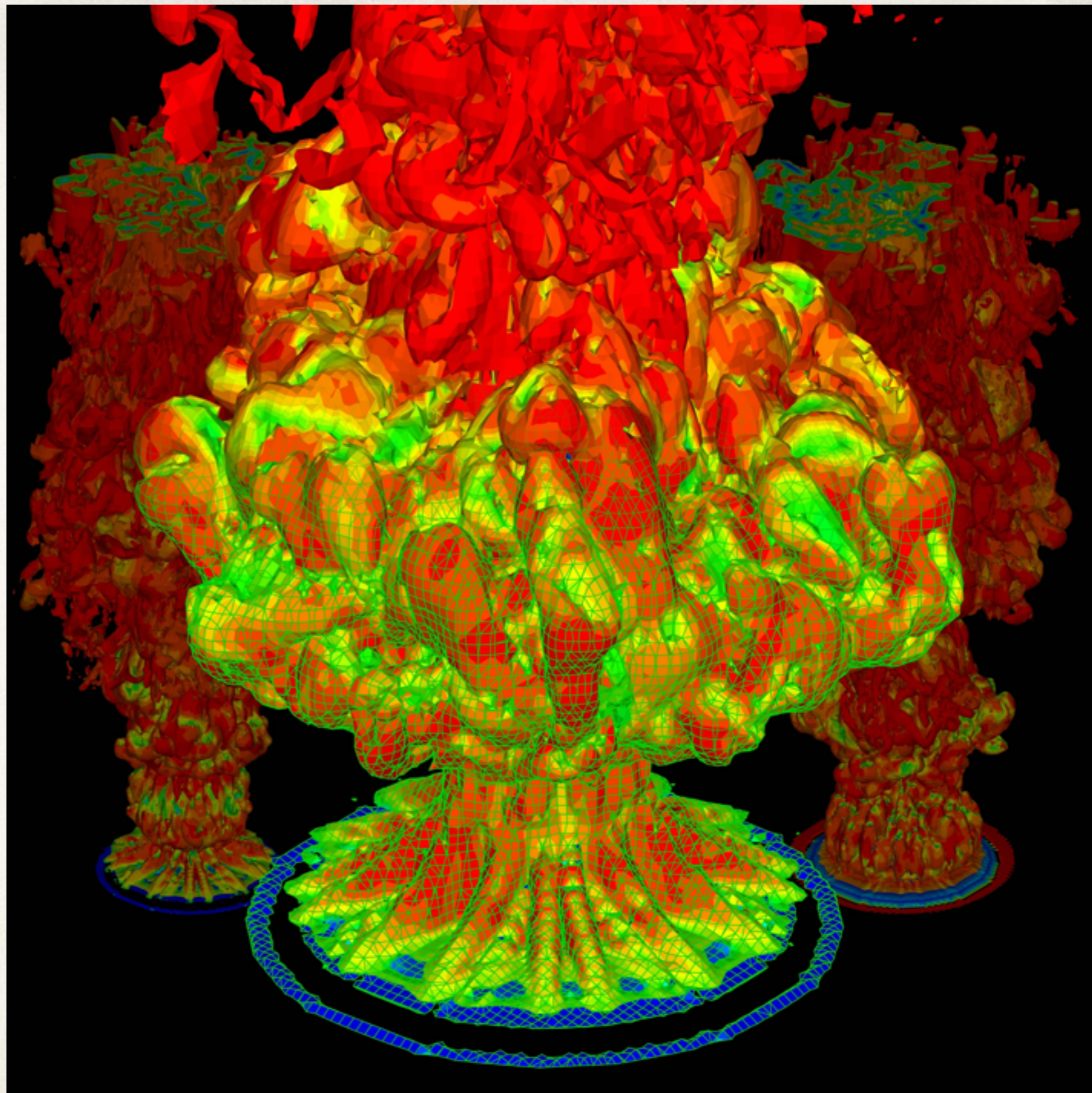
### European Parliament Party Breakdown



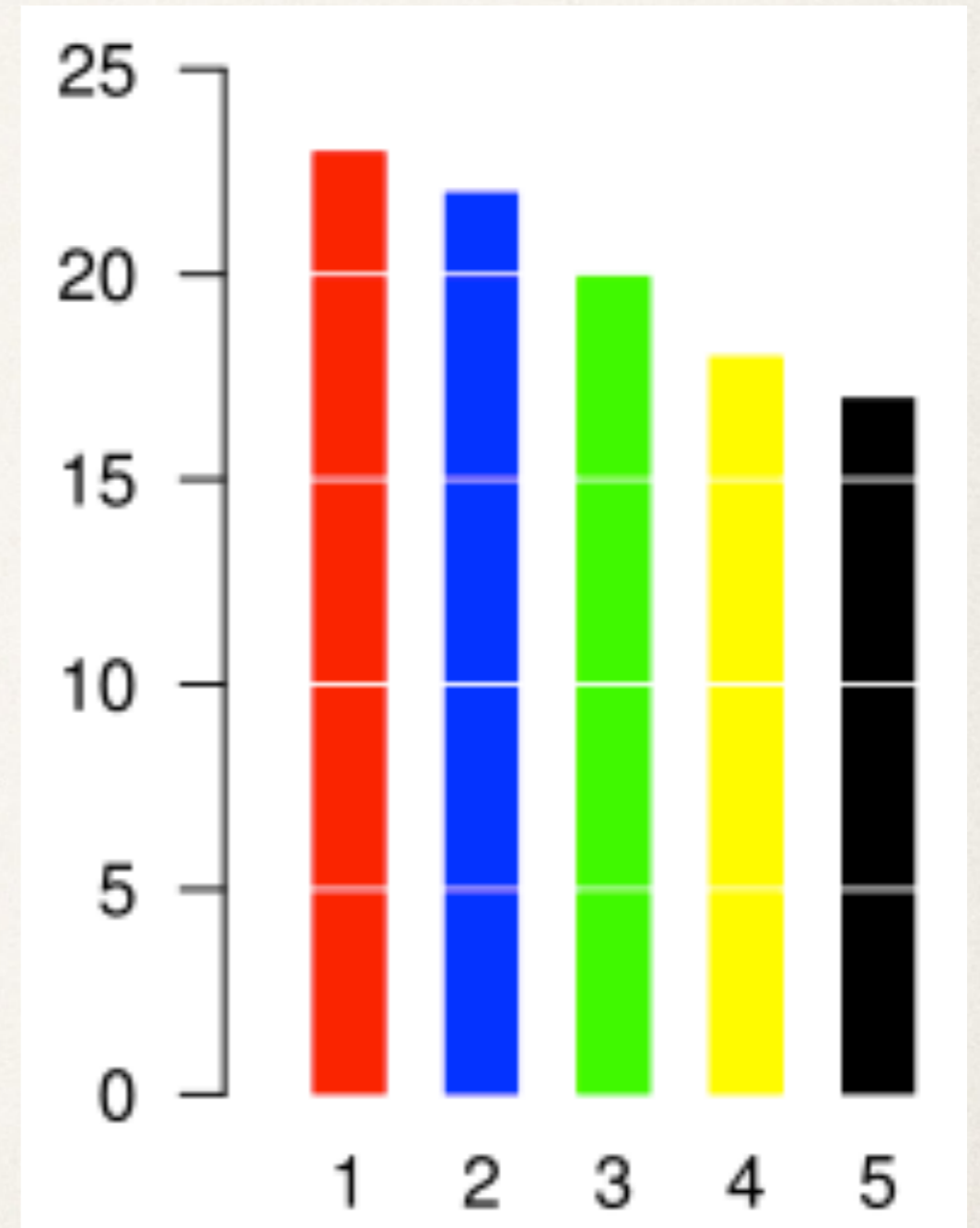
### European Parliament Party Breakdown



Now in 3D!

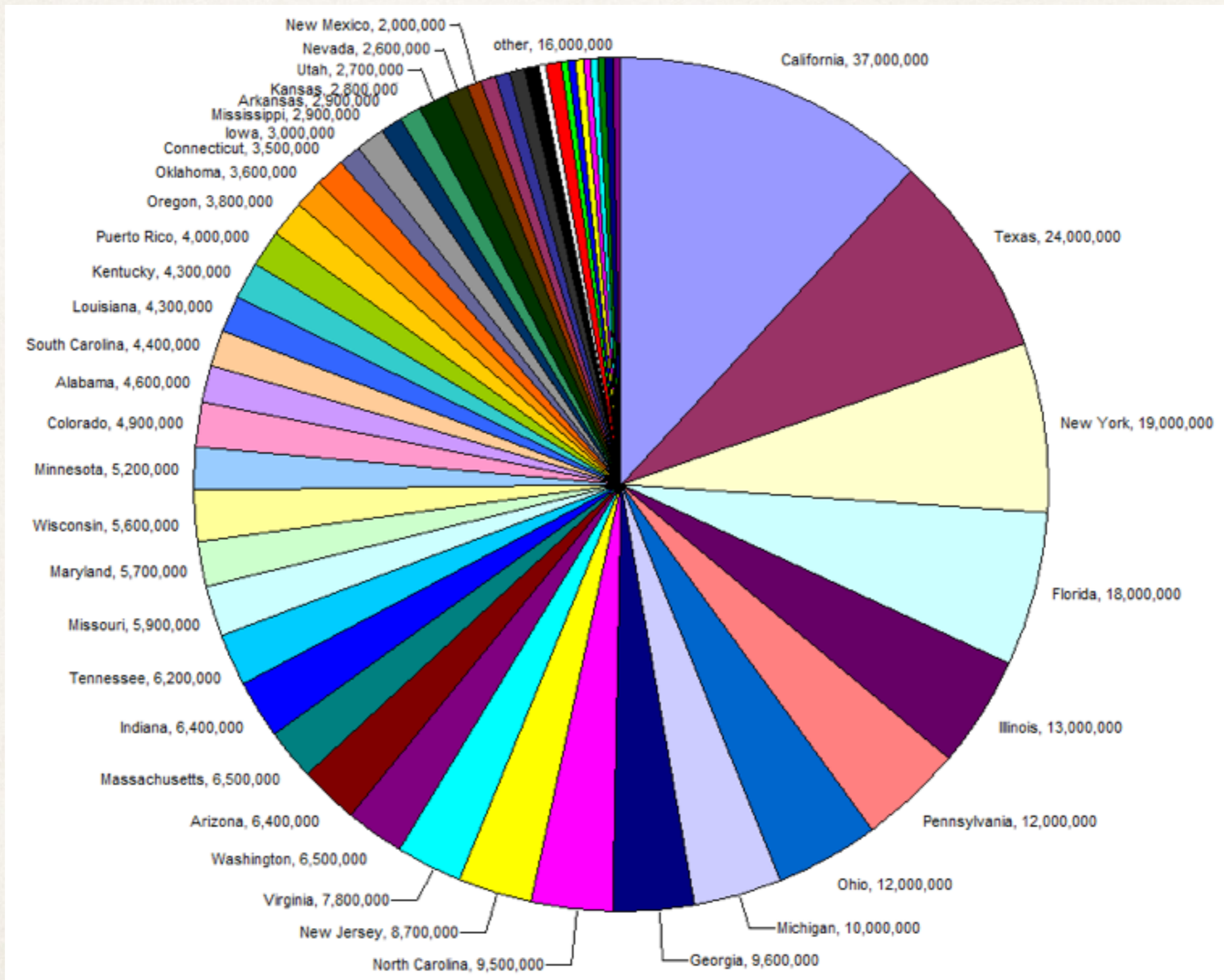


# That pie chart...



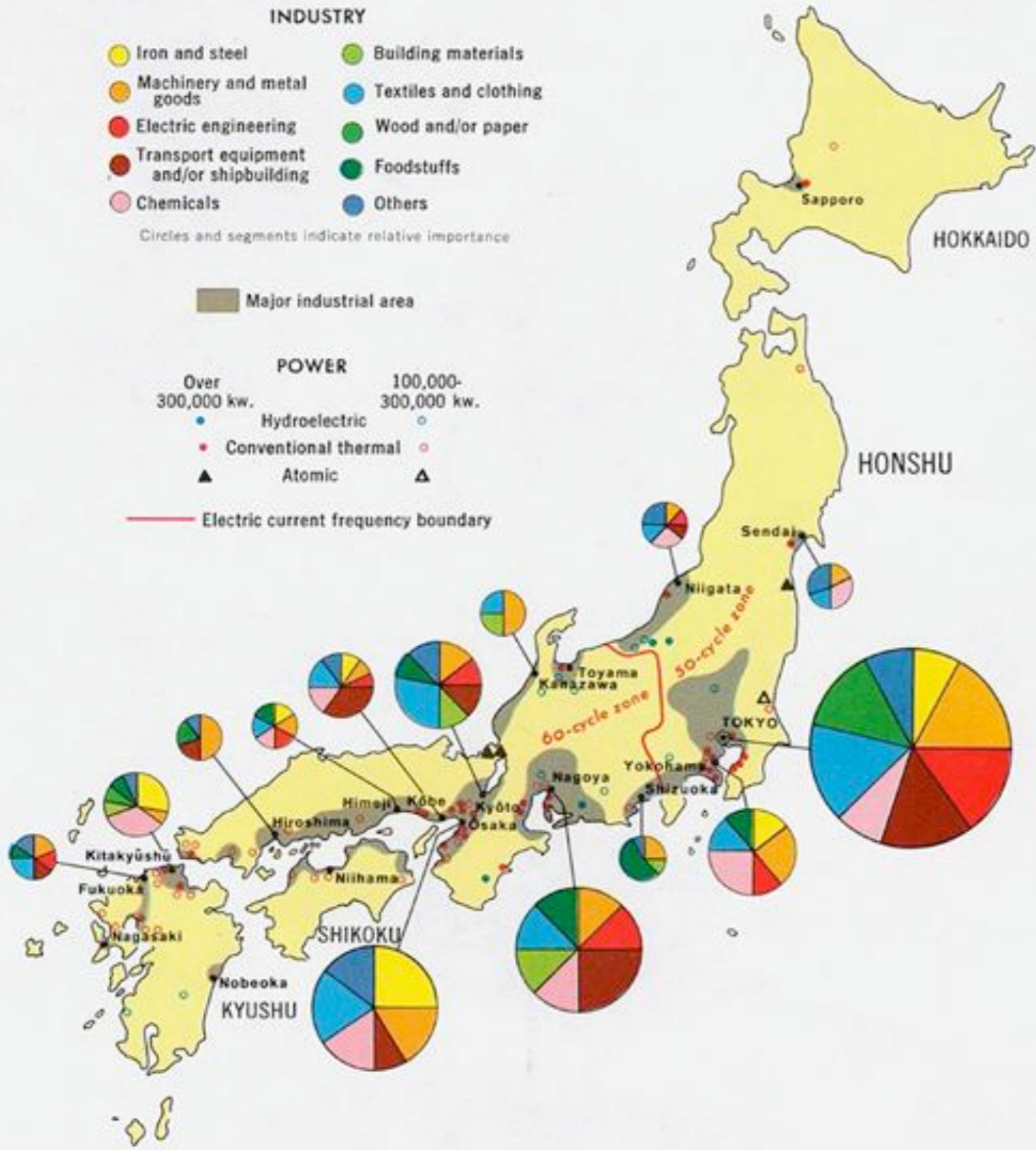


# Too many slices of pie



# Too many pies

## INDUSTRY AND POWER

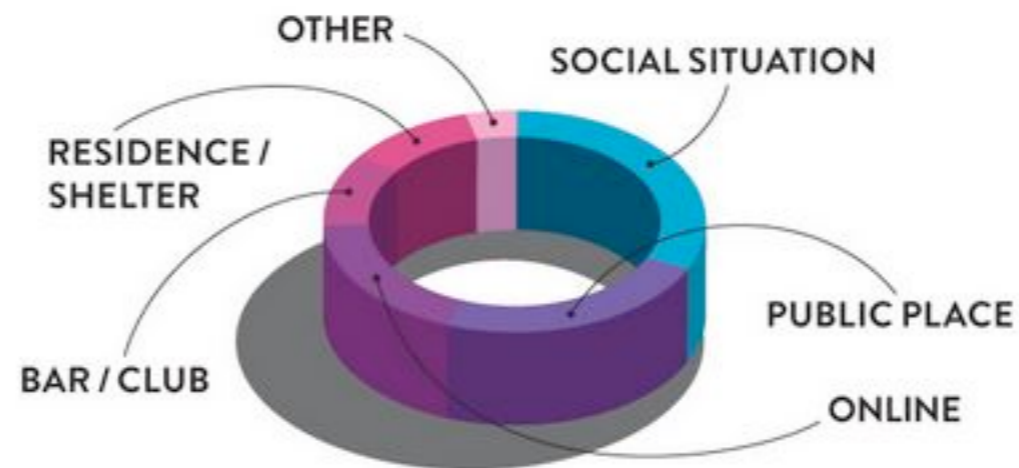


The only worse design than a pie chart is several of them

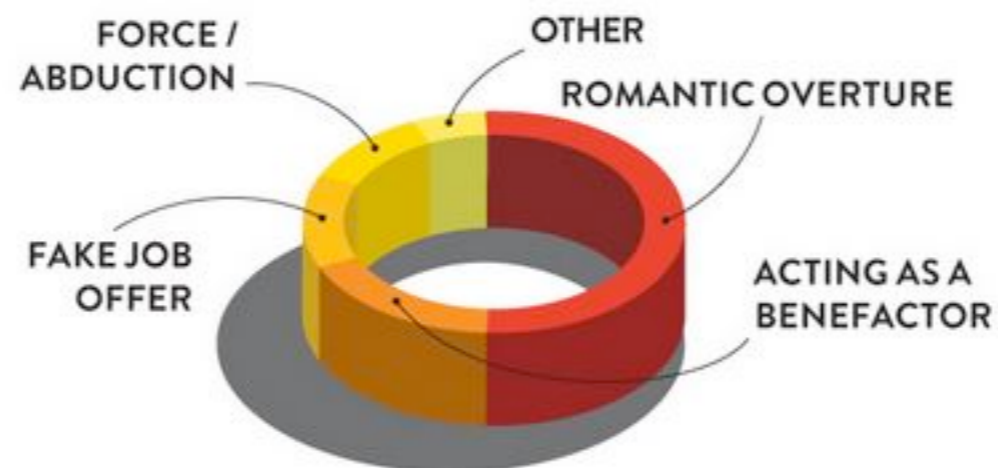
Tufte, "The Visual Display of Quantitative Information"

# 3D Doughnut plots

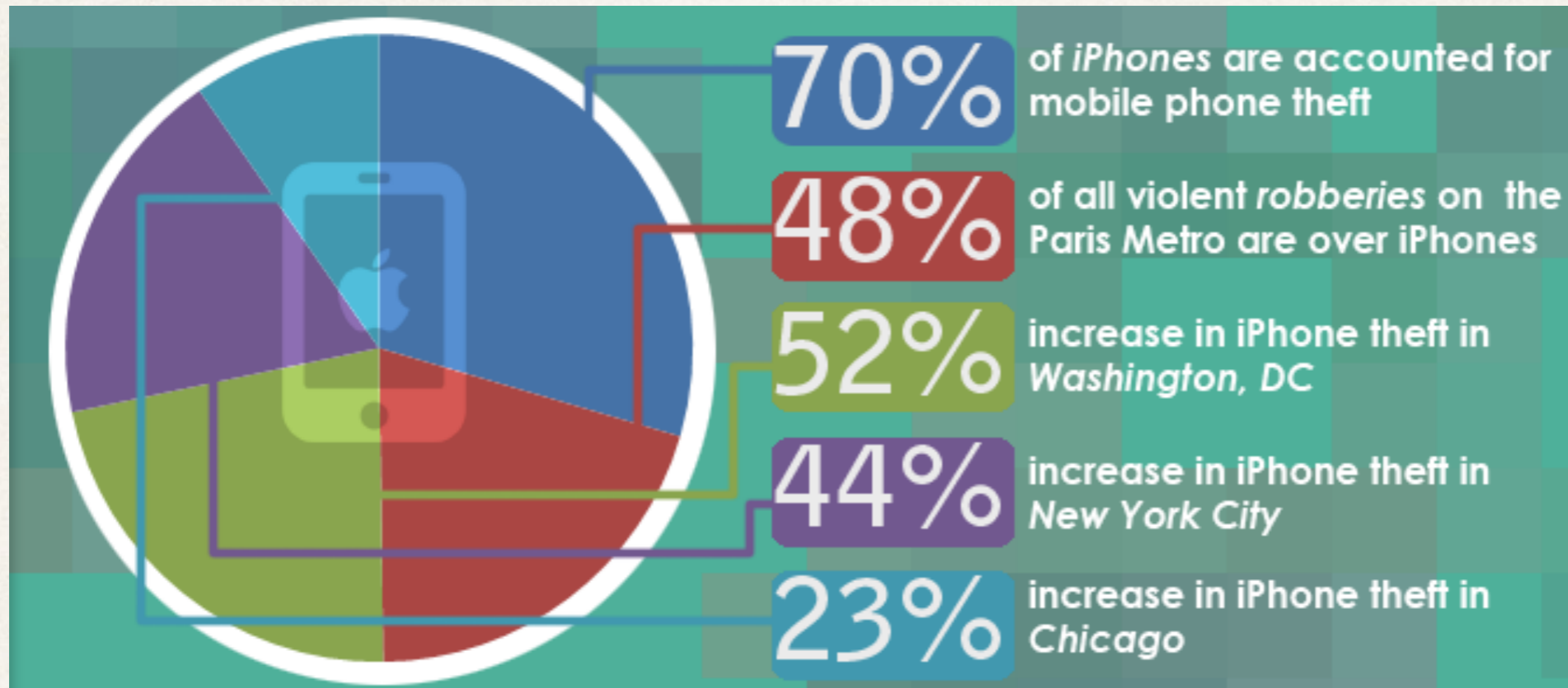
## SEX TRAFFICKING RECRUITMENT BY LOCATION



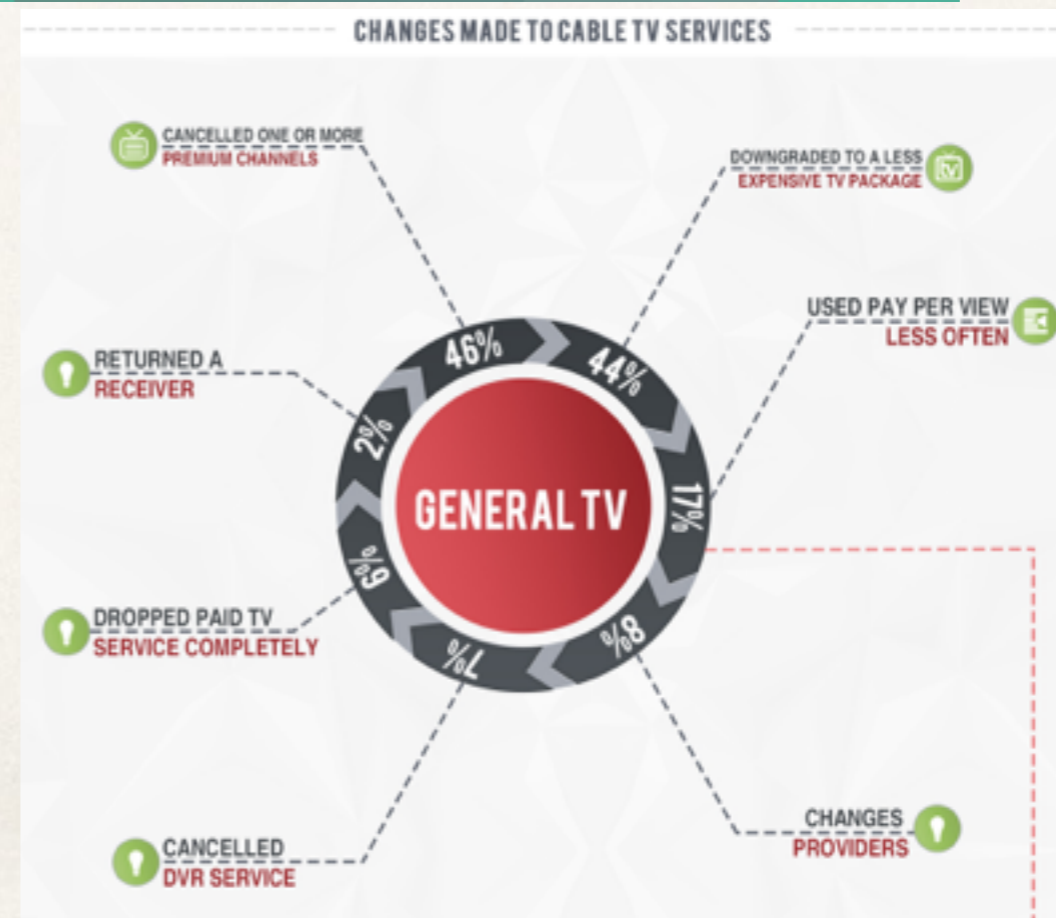
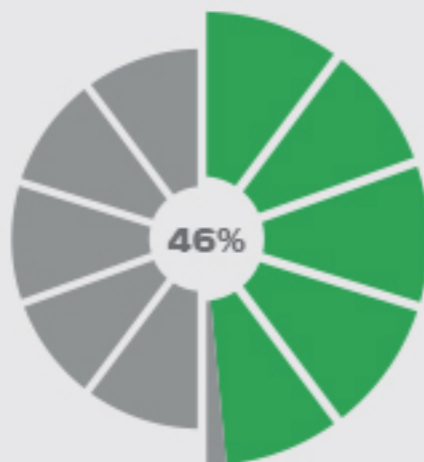
## RECRUITMENT BY METHOD



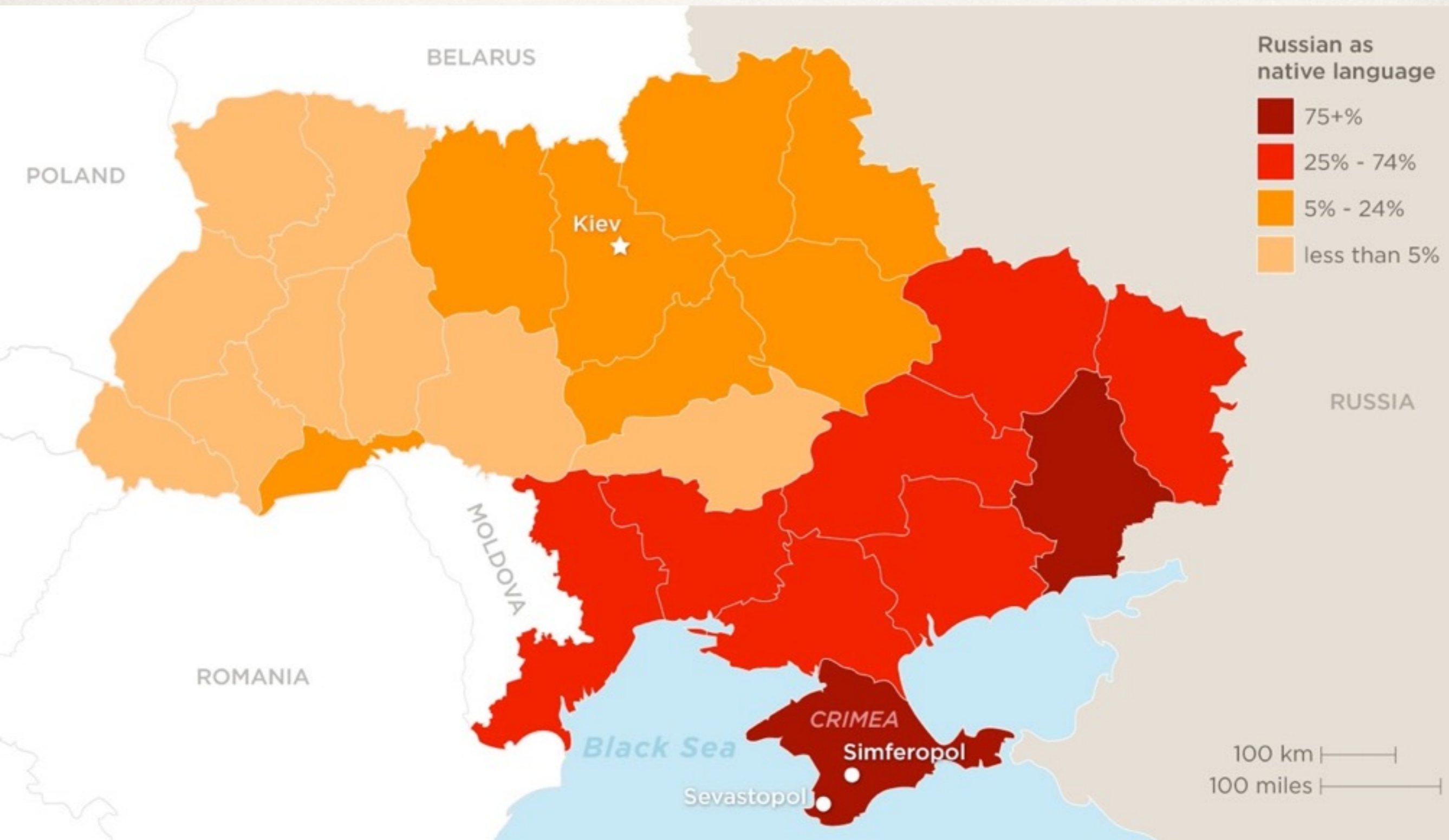
# Wait a minute...



**46%** of SMEs have recently suffered at least one cashflow disruption



# Color



# Rainbow color maps

SANFORD AND SELNICK

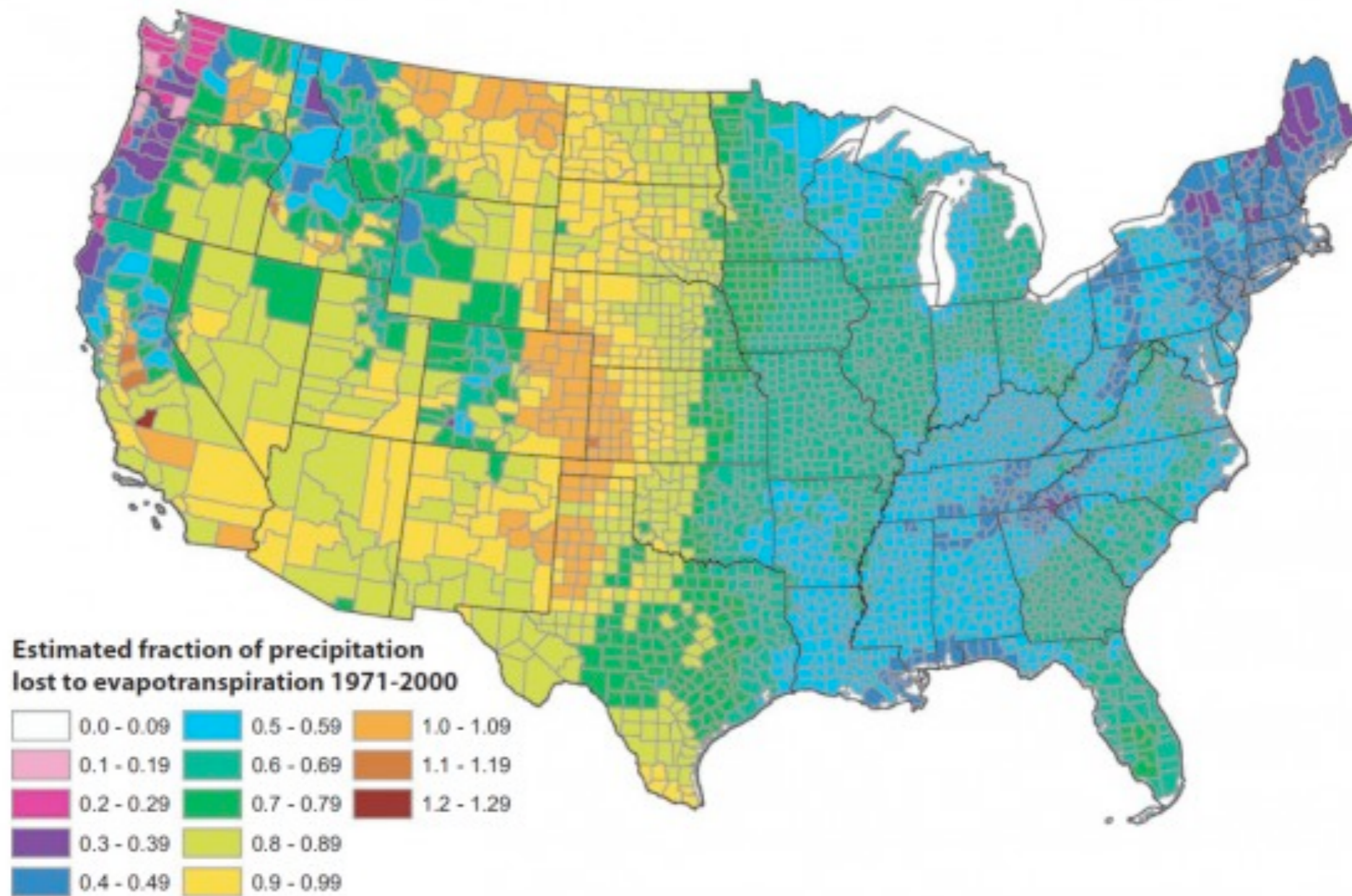
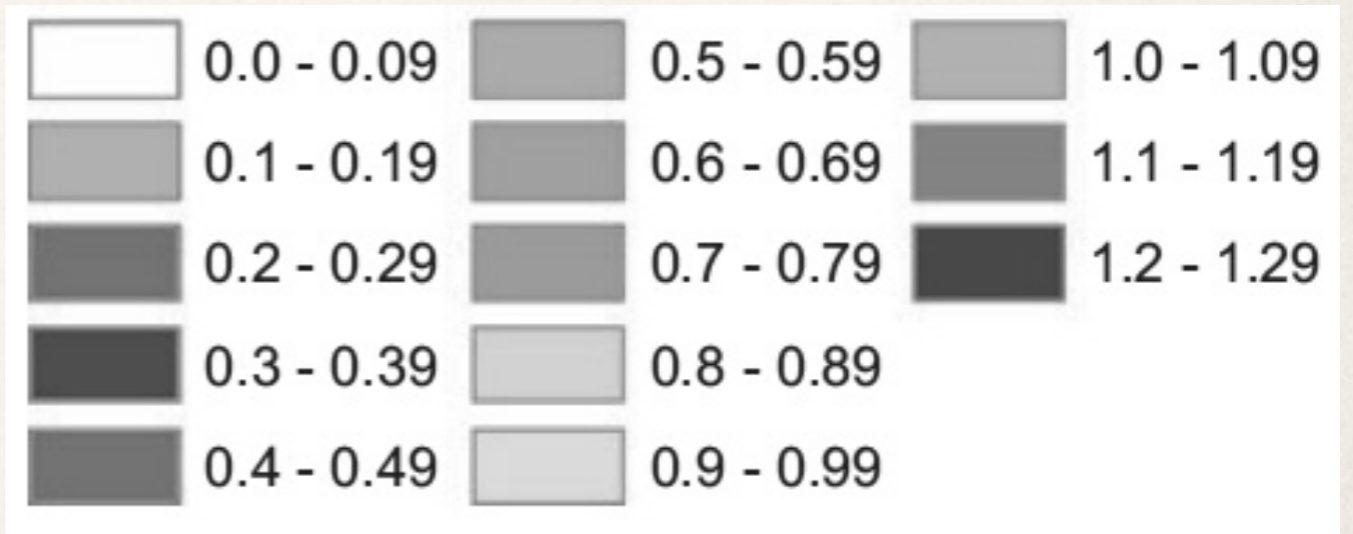
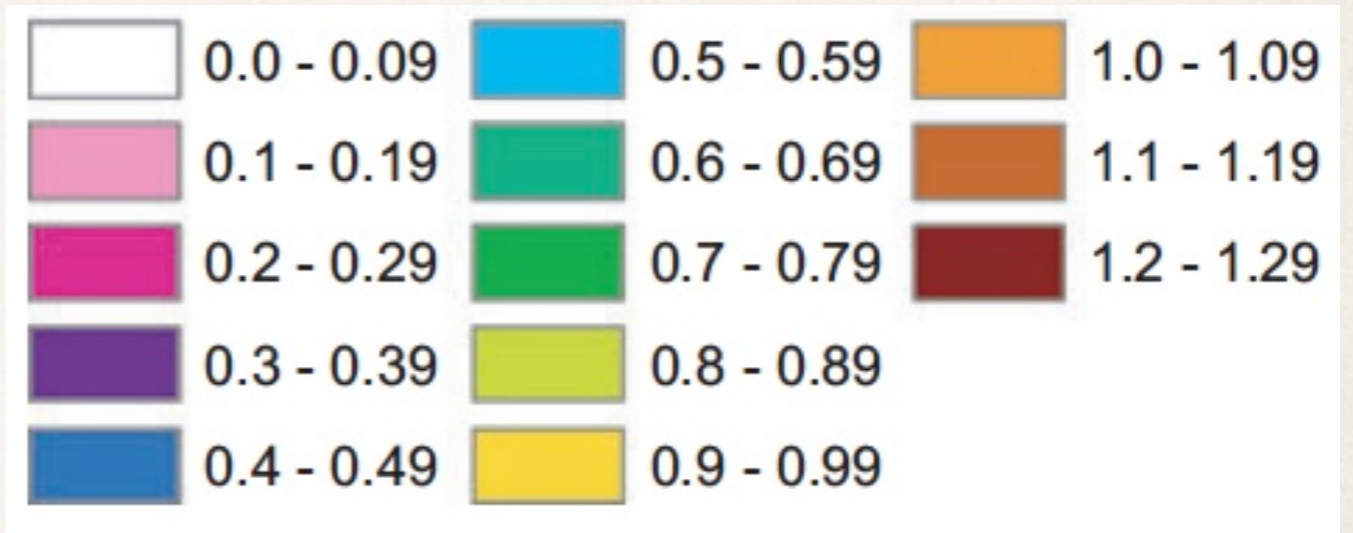
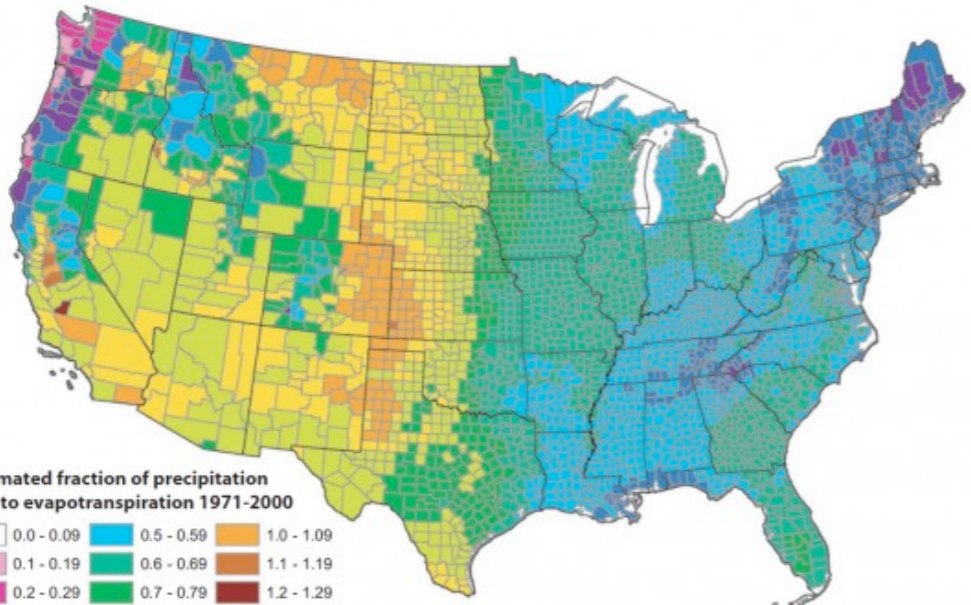


FIGURE 13. Estimated Mean Annual Ratio of Actual Evapotranspiration (ET) to Precipitation ( $P$ ) for the Conterminous U.S. for the Period 1971-2000. Estimates are based on the regression equation in Table 1 that includes land cover. Calculations of  $ET/P$  were made first at the 800-m resolution of 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.

# Rainbow color maps



SANFORD AND SELNICK

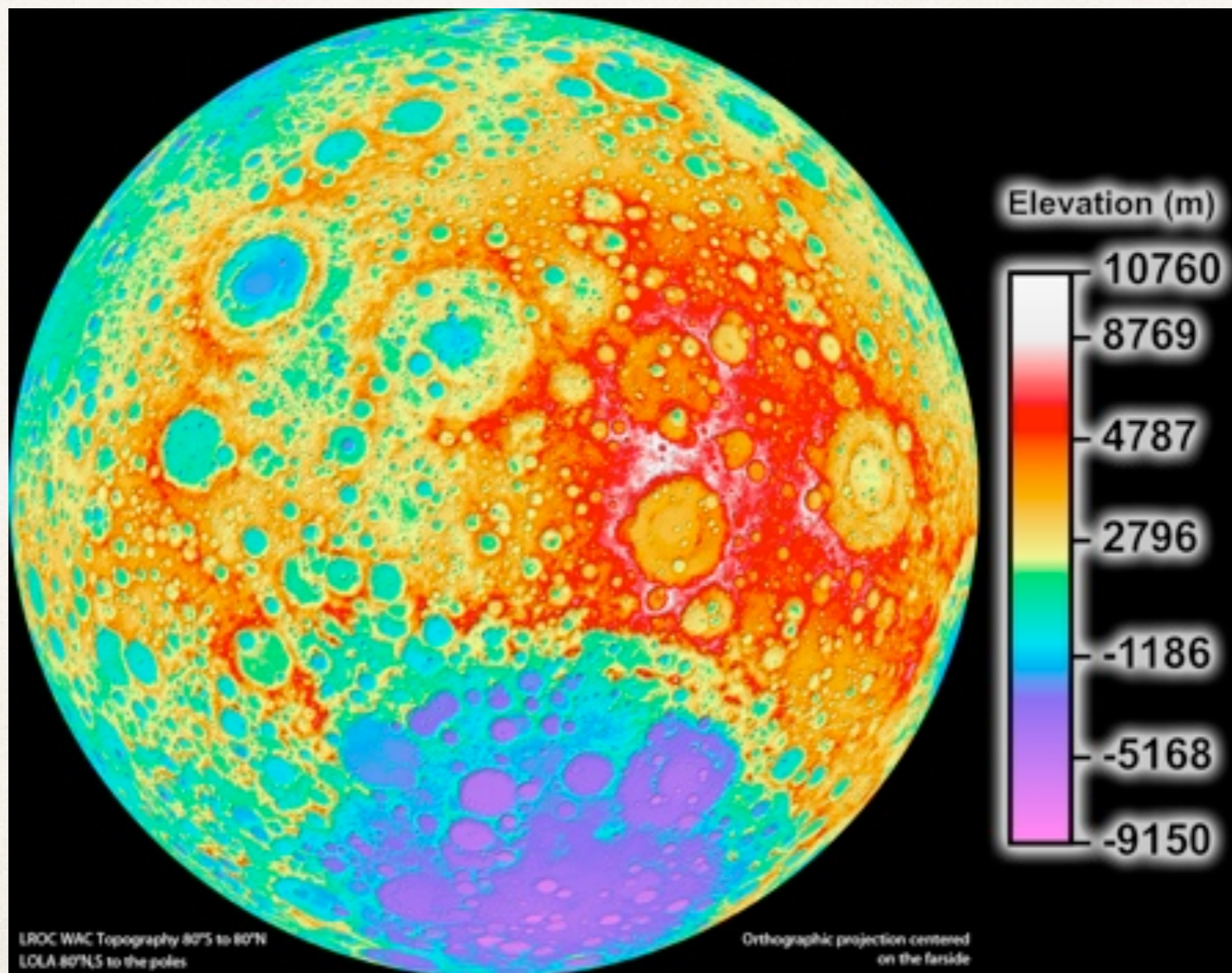


**Estimated fraction of precipitation lost to evapotranspiration 1971-2000**

0.0 - 0.09	0.5 - 0.59	1.0 - 1.09
0.1 - 0.19	0.6 - 0.69	1.1 - 1.19
0.2 - 0.29	0.7 - 0.79	1.2 - 1.29
0.3 - 0.39	0.8 - 0.89	
0.4 - 0.49	0.9 - 0.99	

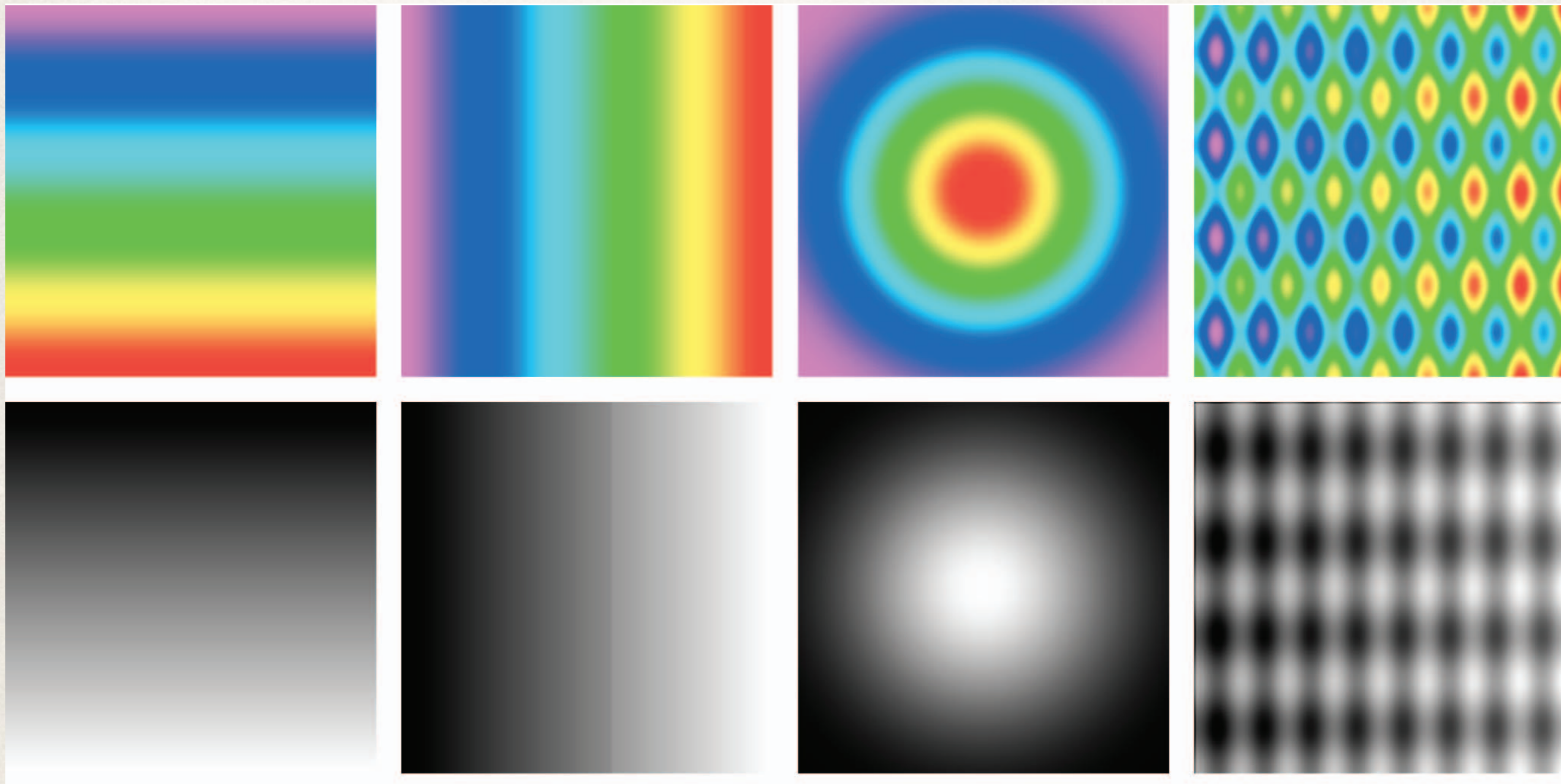
FIGURE 13. Estimated Mean Annual Ratio of Actual Evapotranspiration (ET) to Precipitation (P) for the Conterminous U.S. for the Period 1971-2000. Estimates are based on the regression equation in Table 1 that includes land cover. Calculations of ET/P were made first at the 800-m resolution of the PRISM 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.

# Rainbow color maps

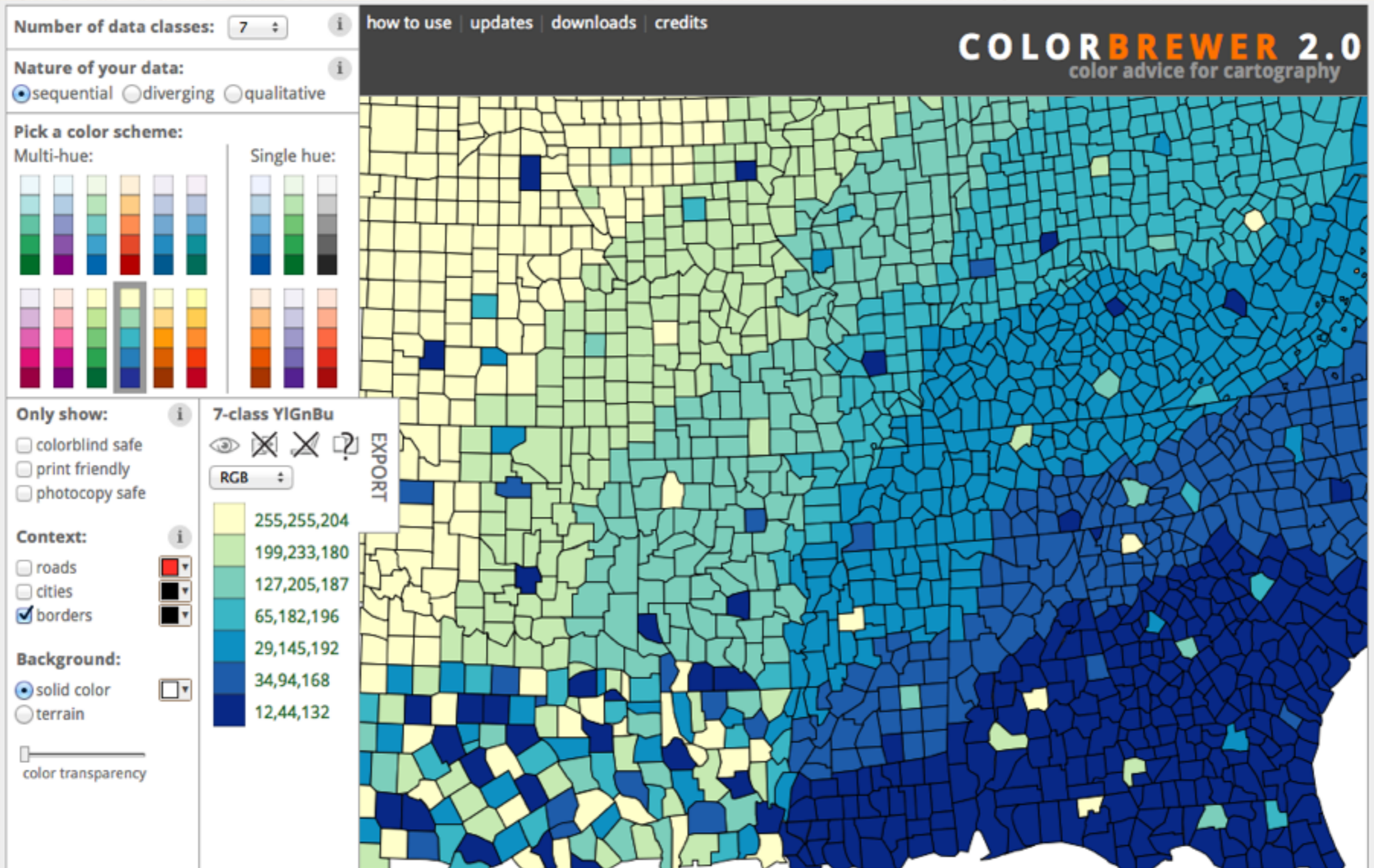




# Rainbow color maps



# Color Brewer



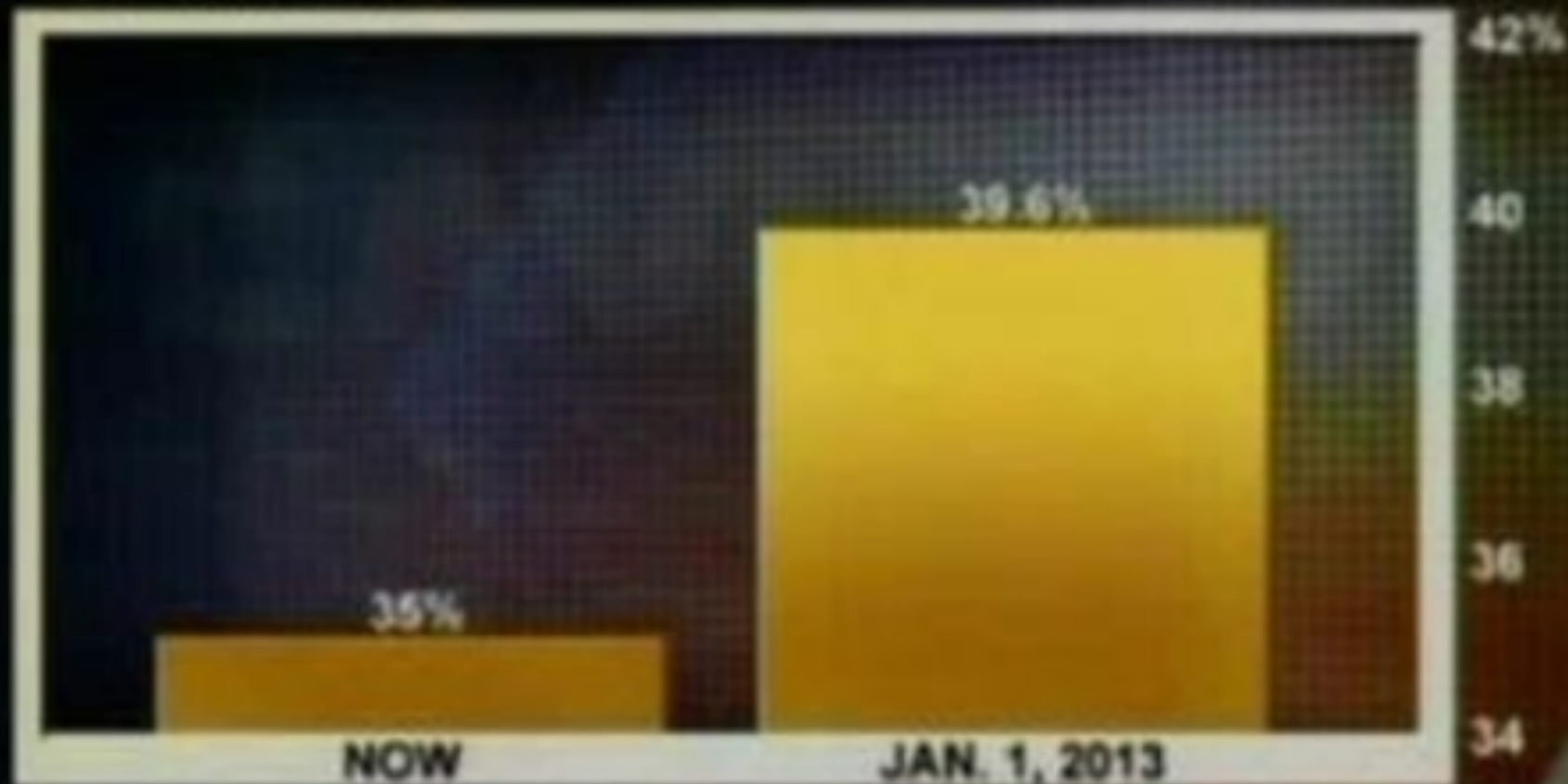
# Adobe Kuler

The screenshot displays the Adobe Kuler web interface. At the top, the navigation bar includes the Adobe Kuler logo, 'Create', 'Explore', and 'My Themes' links, along with 'Sign up' and 'Sign in' options. Below the navigation, there is a 'Save' button and the text 'My Kuler Theme' with an edit icon. A 'Color Rule' dropdown menu is set to 'Analogous'. The central feature is a large, vibrant color wheel with five white handles. Below the wheel, a horizontal bar shows five color swatches: purple, blue, cyan, green, and yellow. Underneath these swatches are four horizontal sliders with colored dots, representing a color gradient. At the bottom, there are five color information panels, each showing RGB and HEX values for a specific color.

Color	RGB	HEX
Purple	176, 110, 255	B06EFF
Blue	100, 152, 232	6498E8
Cyan	123, 255, 222	78FFDE
Green	124, 232, 100	7CE864
Yellow	255, 241, 85	FFF155

# IF BUSH TAX CUTS EXPIRE

## TOP TAX RATE



8:01 p ET

**FOX**  
BUSINESS

TOP STORIES

TECHNOLOGY

CONSUMER

WITH THE JUSTICE DEPARTMENT AND ACQUIRES FULL T

DOW 13008.68 ▼ 64.33

S&P 1379.32 ▼ 5.98

NASDAQ 2939.52 ▼ 6.32

Lie factor: 25.21!

# 2005

Click the chart to advance, or click on a year

2005

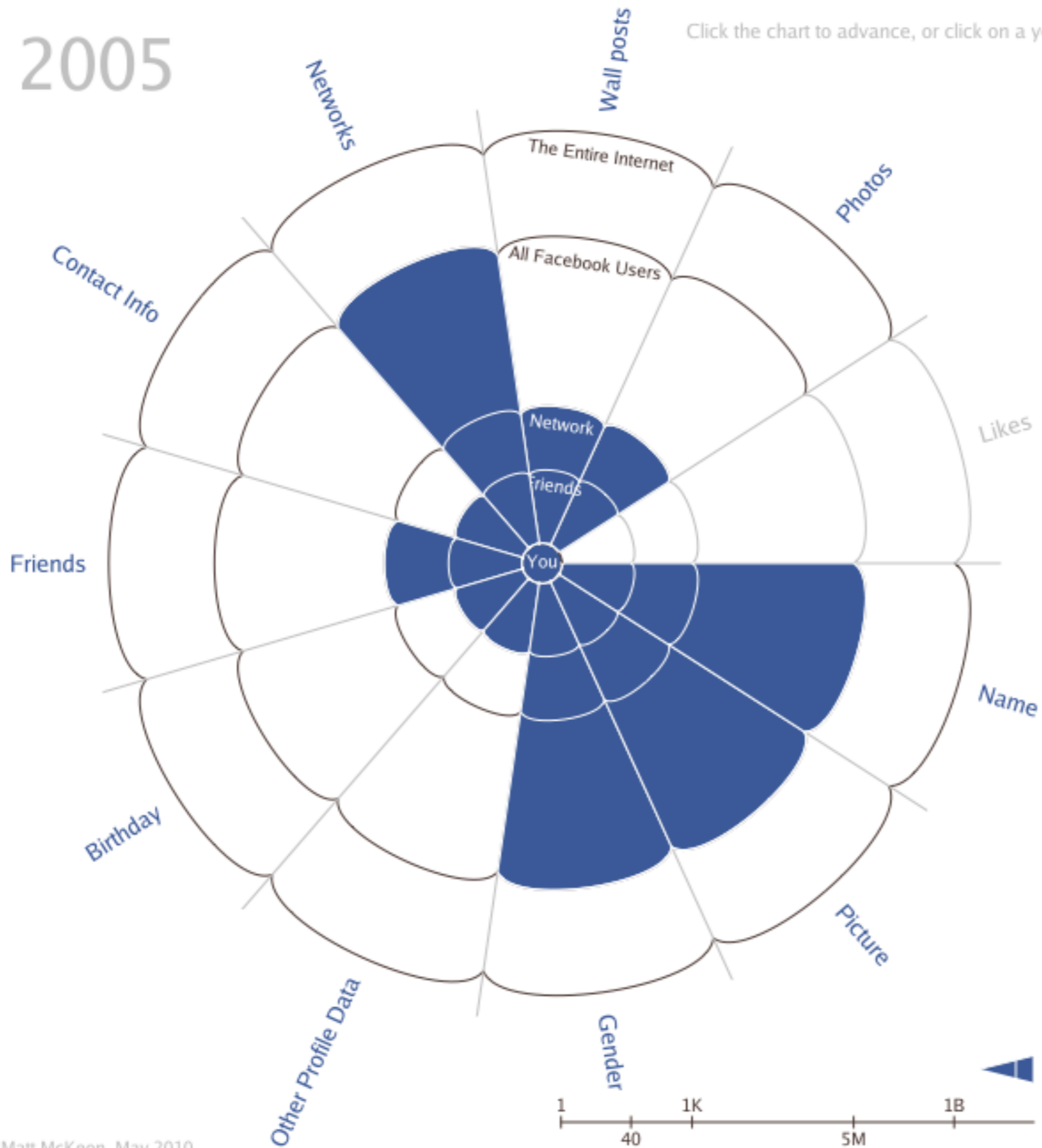
2006

2007

2009 (Nov)

2009 (Dec)

2010 (Apr)



Availability of your personal data on Facebook (default settings)

Number of People



# UNEMPLOYMENT RATE

## UNDER PRESIDENT OBAMA



2011

SOURCE: BUREAU OF LABOR STATISTICS

WAR AND A TROOP WITHDRAWAL AT THE E NAS FUT 2,292.50