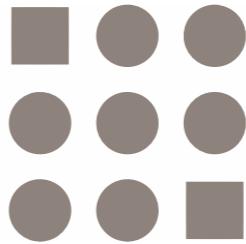
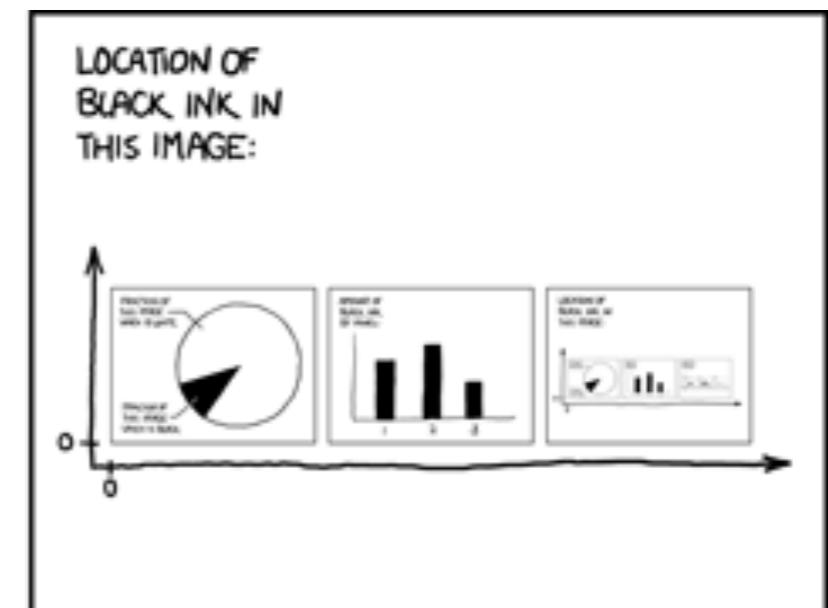
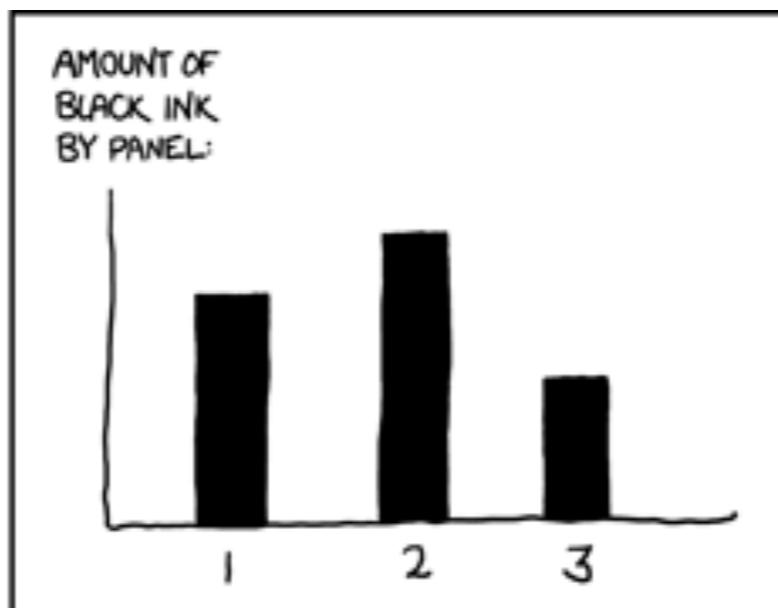
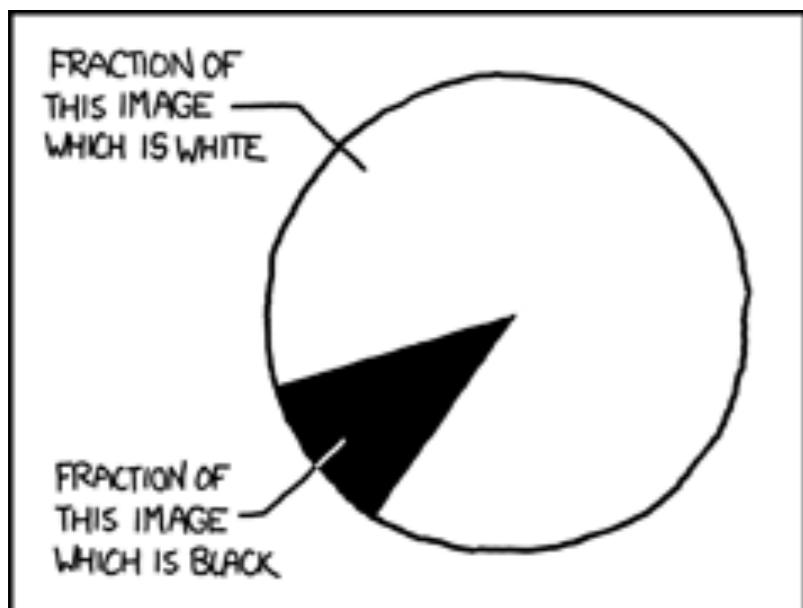


CS 171



Design Principles

Hanspeter Pfister
pfister@seas.harvard.edu



Check In

- Vocareum issues
- Pre-Quiz submitted?
- Get some sheets of paper & sharpies
- Today
 - sketching and idea generation
 - design process
 - design principles

Activity Procedure

- TFs come around and take photos - don't be scared
- Some photos shown after the activity
- You can volunteer to comment on your work but you can also stay anonymous
- Online students - please submit your activity results with your homework!

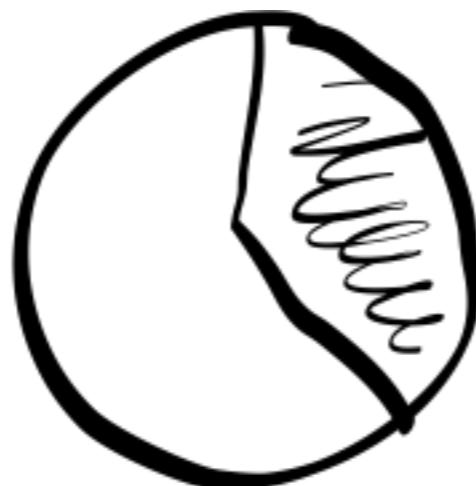
Activity

Create at least three sketches to visualize these two quantities. (1 min)

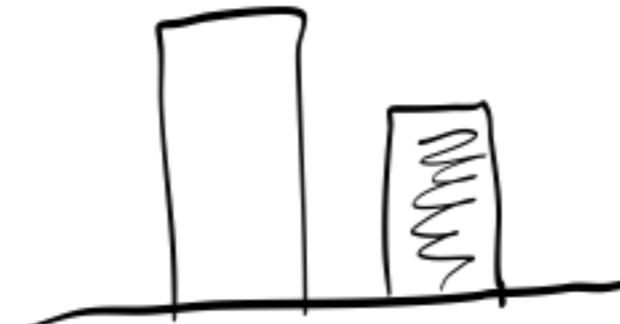


Most likely results

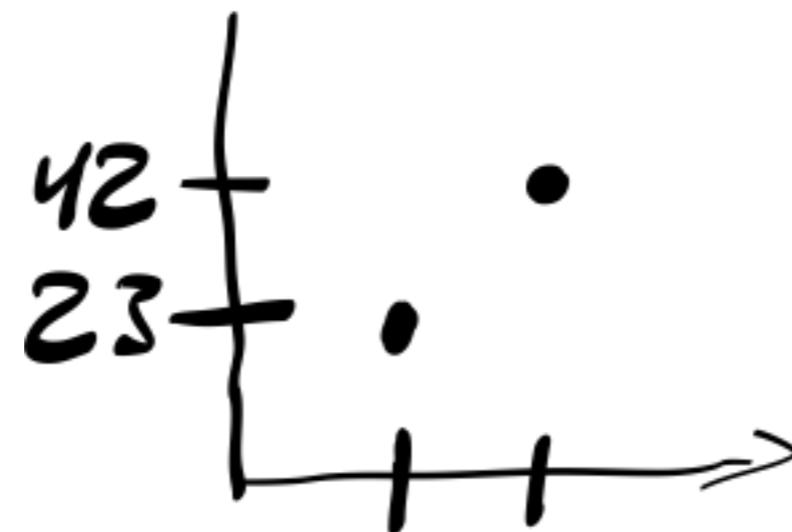
Pie Chart



Bar Chart



Scatterplot

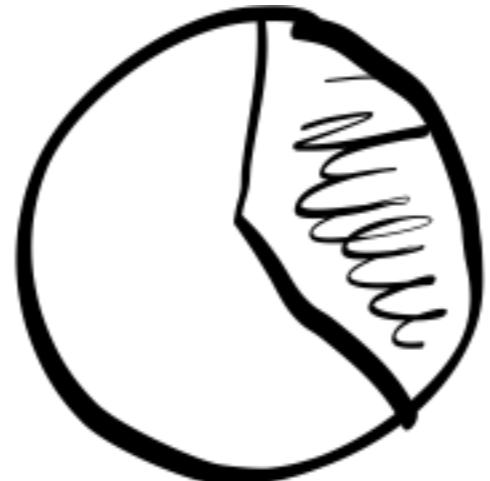


٤٢
٢٣

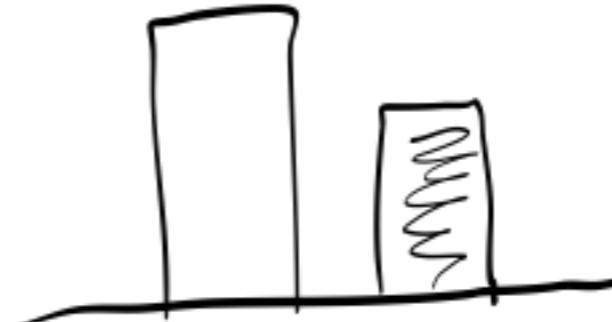
٤٢ Arabic Numbers

Design Fixation: Blind adherence to a set of ideas or concepts

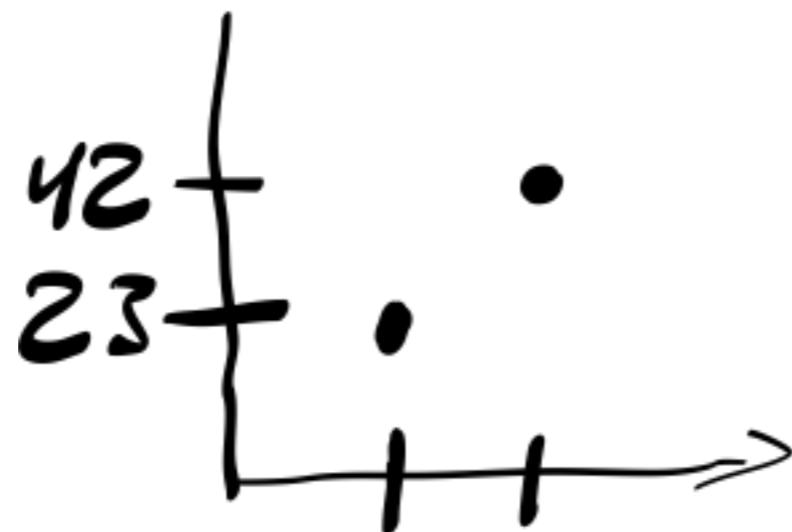
Pie Chart



Bar Chart



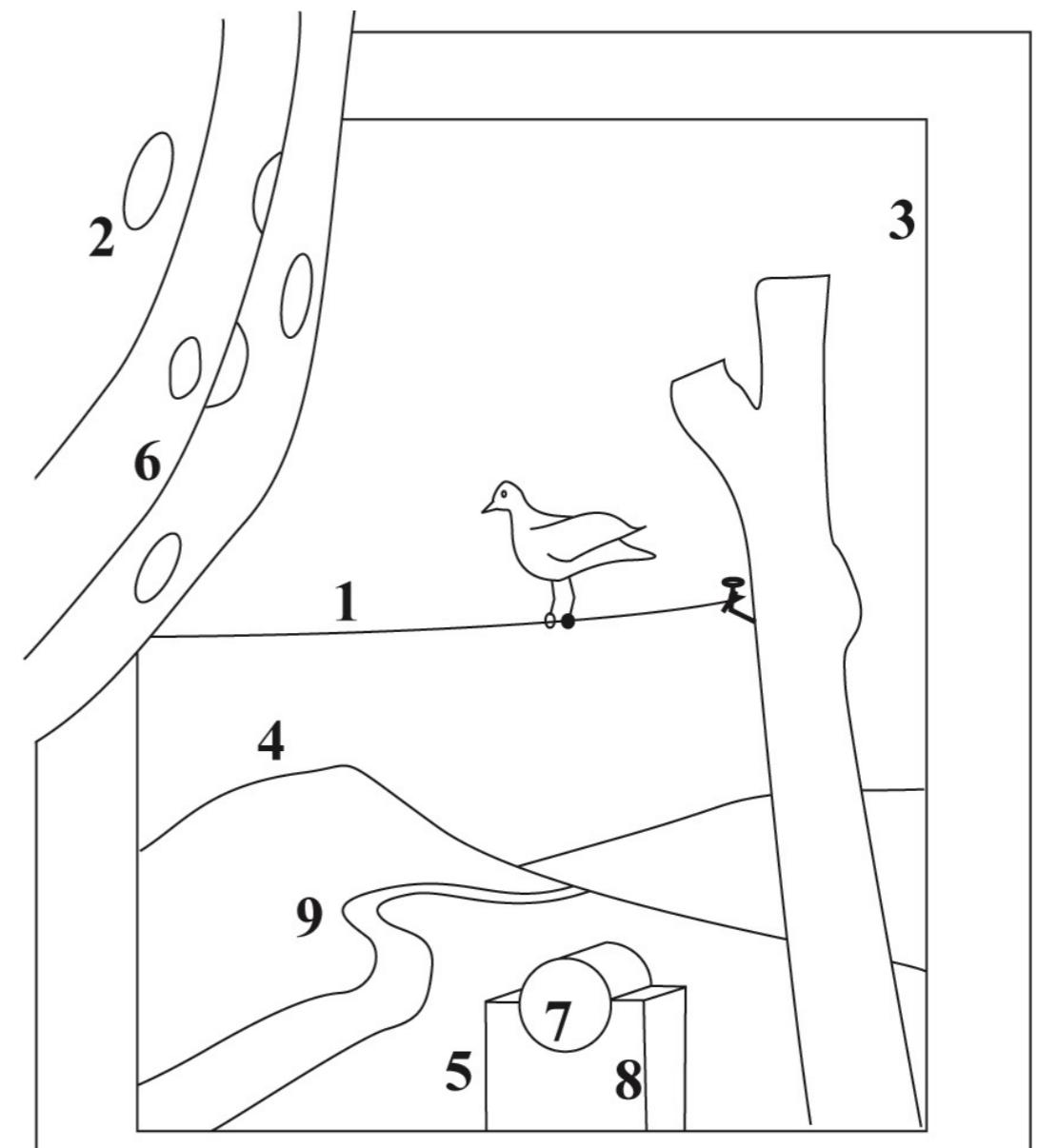
Scatterplot



23
42

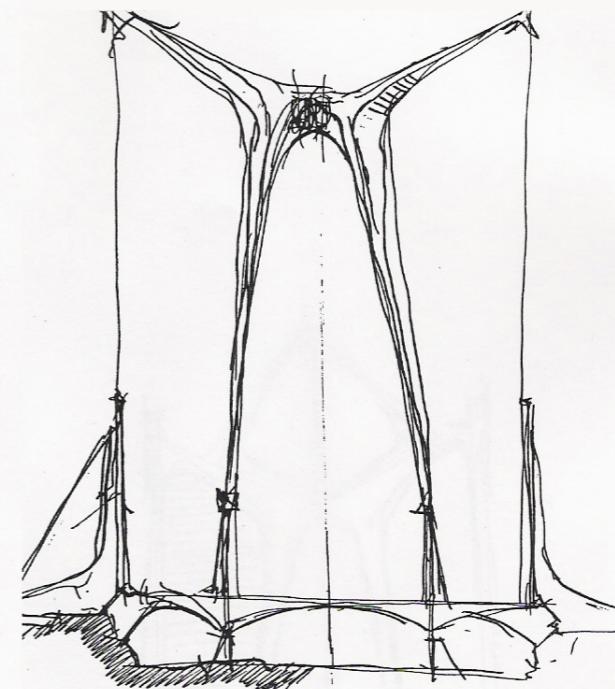
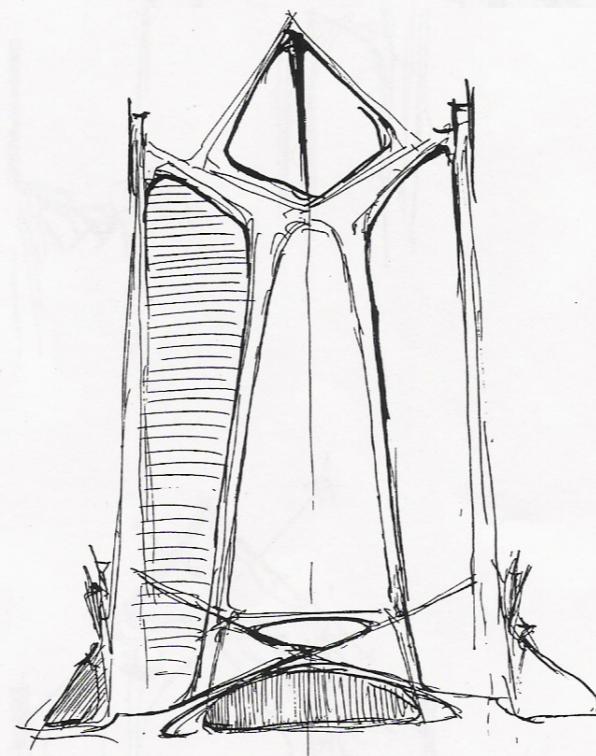
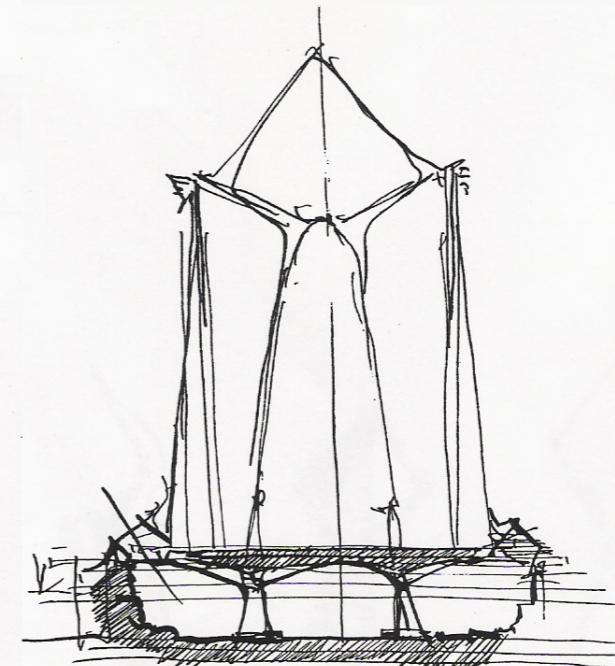
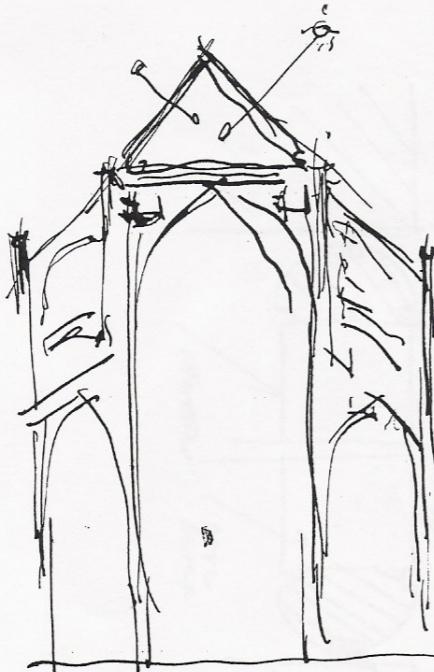
Arabic Numbers

Design and sketching are *constructive* perception



C. Ware, 'Visual Thinking for Design'

Sketches are cheap, fast, and easy to throw away



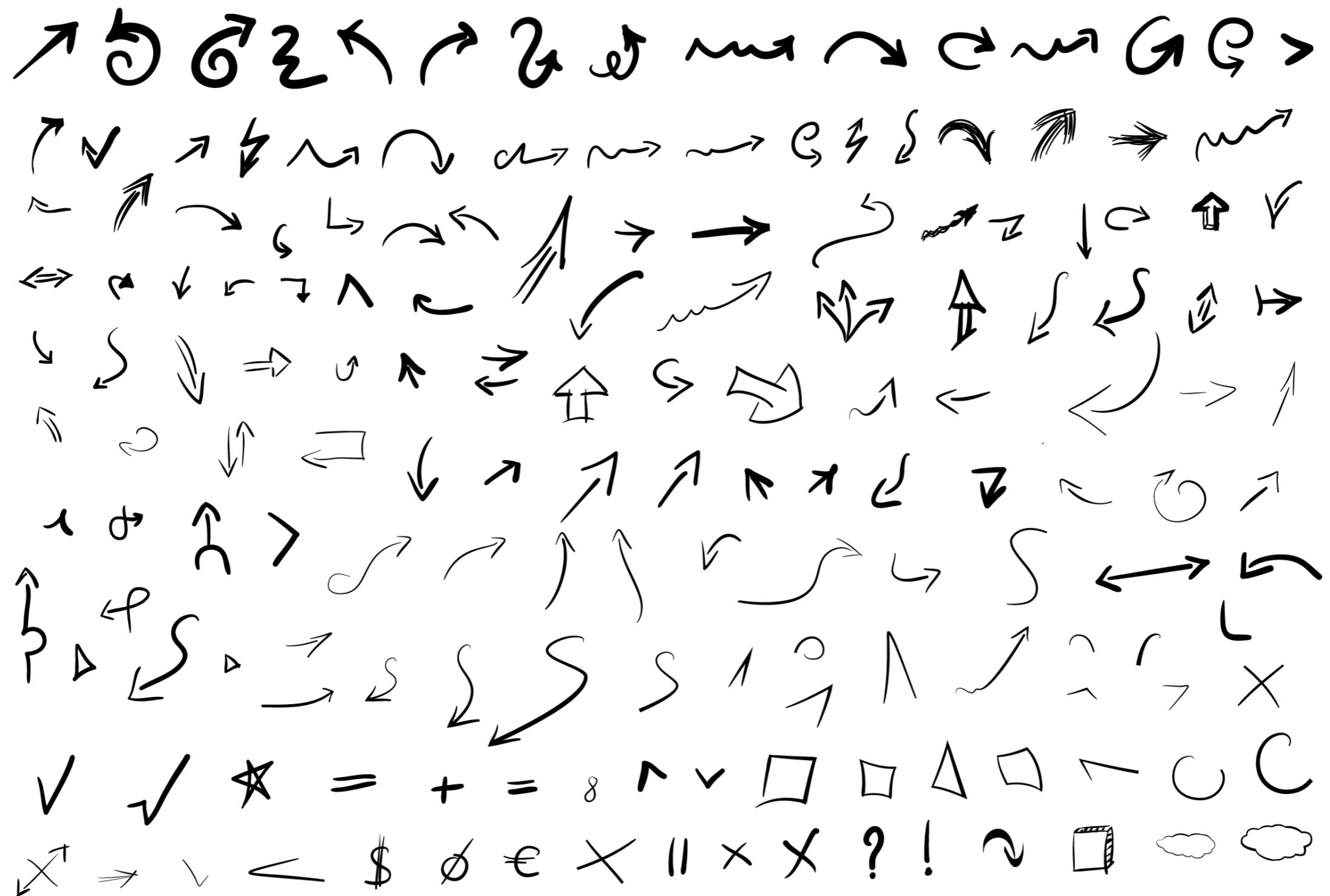
Santiago Calatrava, Architect

Constraints: a set of icons that are based on only **one** line



<http://www.differantly.com/#oneline/>

Symbols



Activity

Create at least three NEW visualizations
that are different from your previous
ideas. (2 mins)



Jacques Bertin

French cartographer
[1918-2010]

Semiology of Graphics
[1967]

Theoretical principles for
visual encodings



Bertin's visual design space

Channels Marks Points Lines Areas

Position

Size

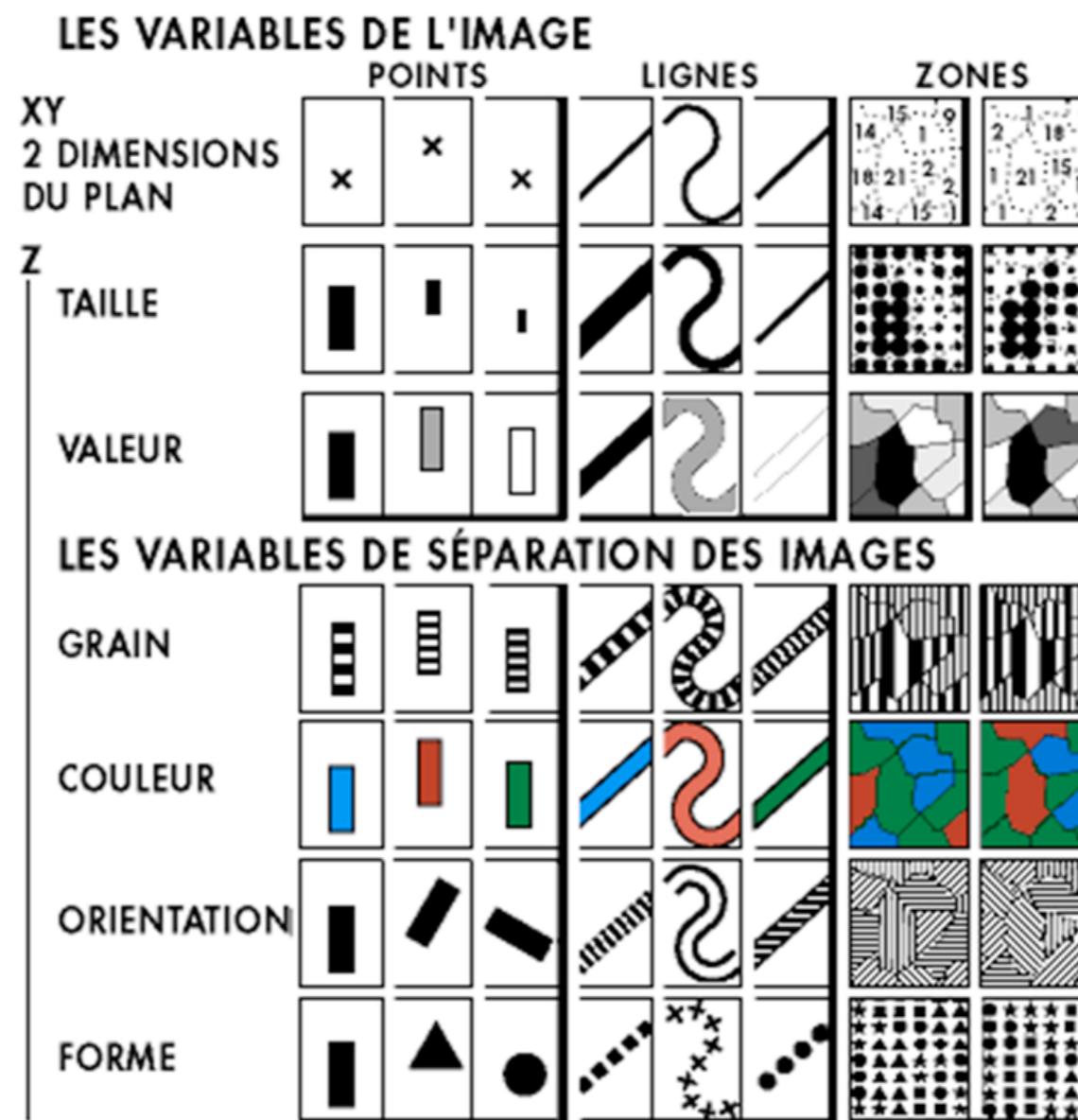
(Grey)Value

Texture

Color

Orientation

Shape



J. Bertin, 'Semiology of Graphics' 1967

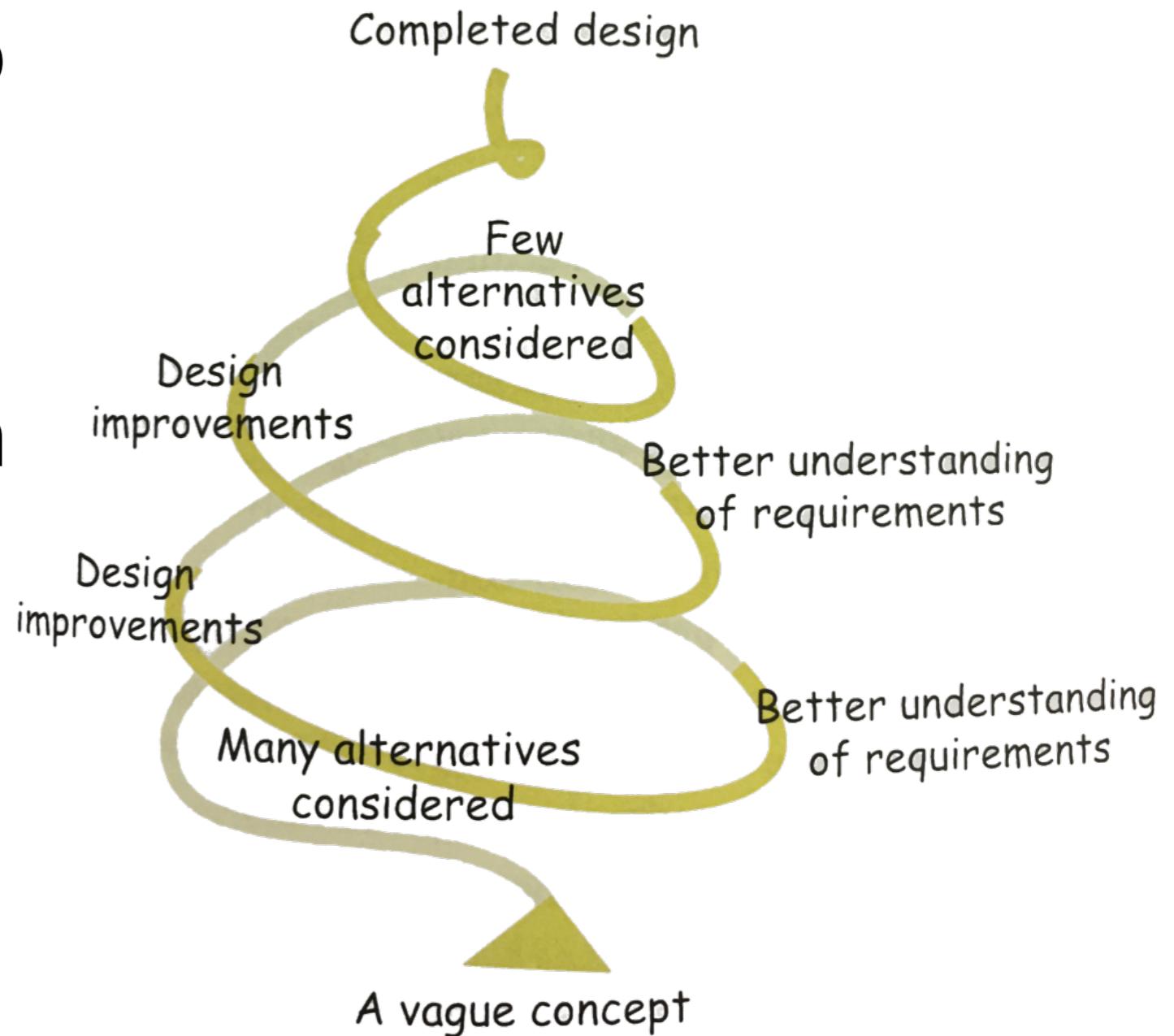
Activity

Explore different dimensions in Bertin's visual design space. Create five NEW sketches to visualize the two quantities.
(3 mins)

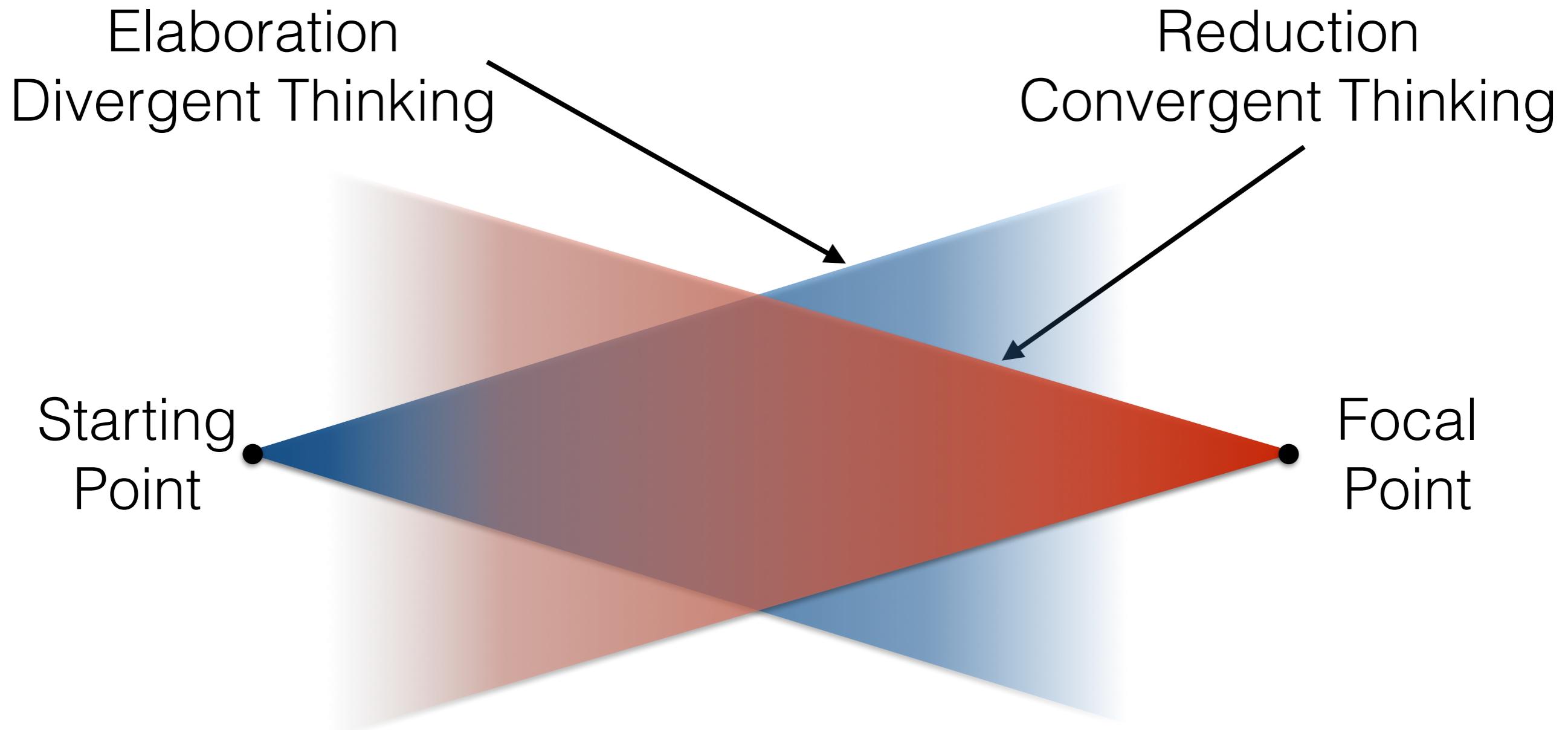


Design Process

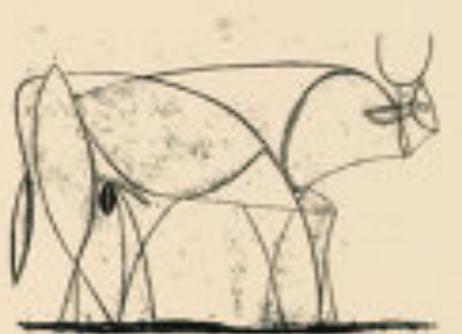
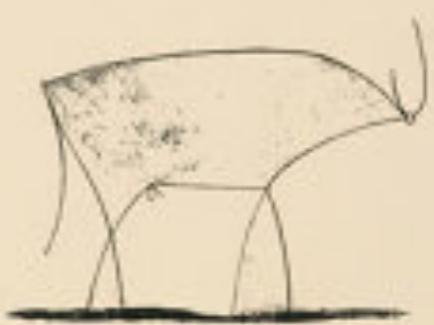
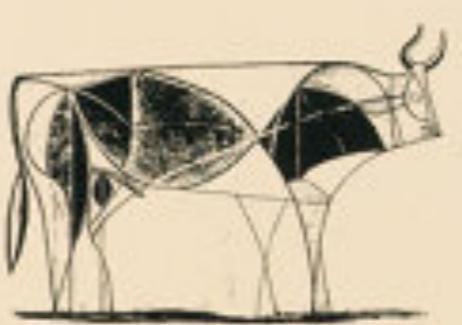
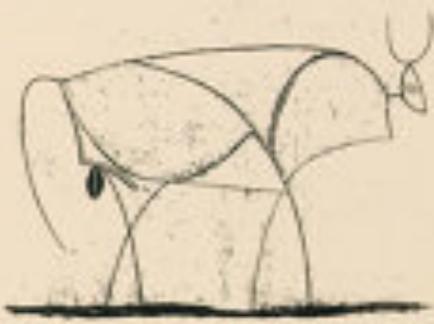
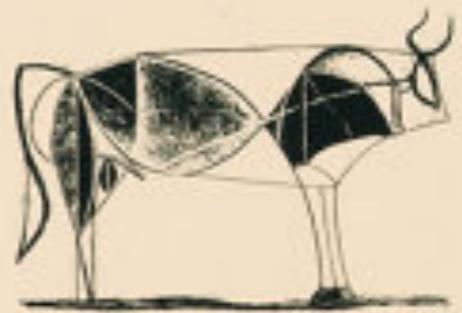
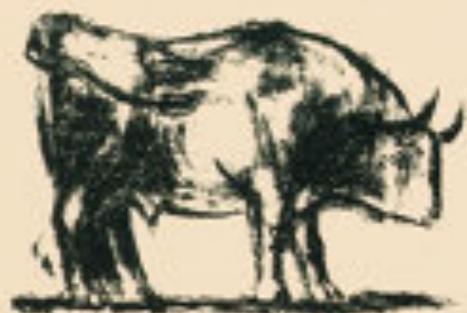
- Creative design loop
= Iteration
- Divergent thinking:
saturate the problem
space
- Visual task analysis



Design Process



"A picture used to be a sum of additions. In my case a picture is a sum of destructions."



Picasso

Activity

In groups of 3-4 students, critique and refine your sketches. Pick your top 3 favorites. (5 mins)



Activity



~45 ways to visualize two quantities

75 and 37

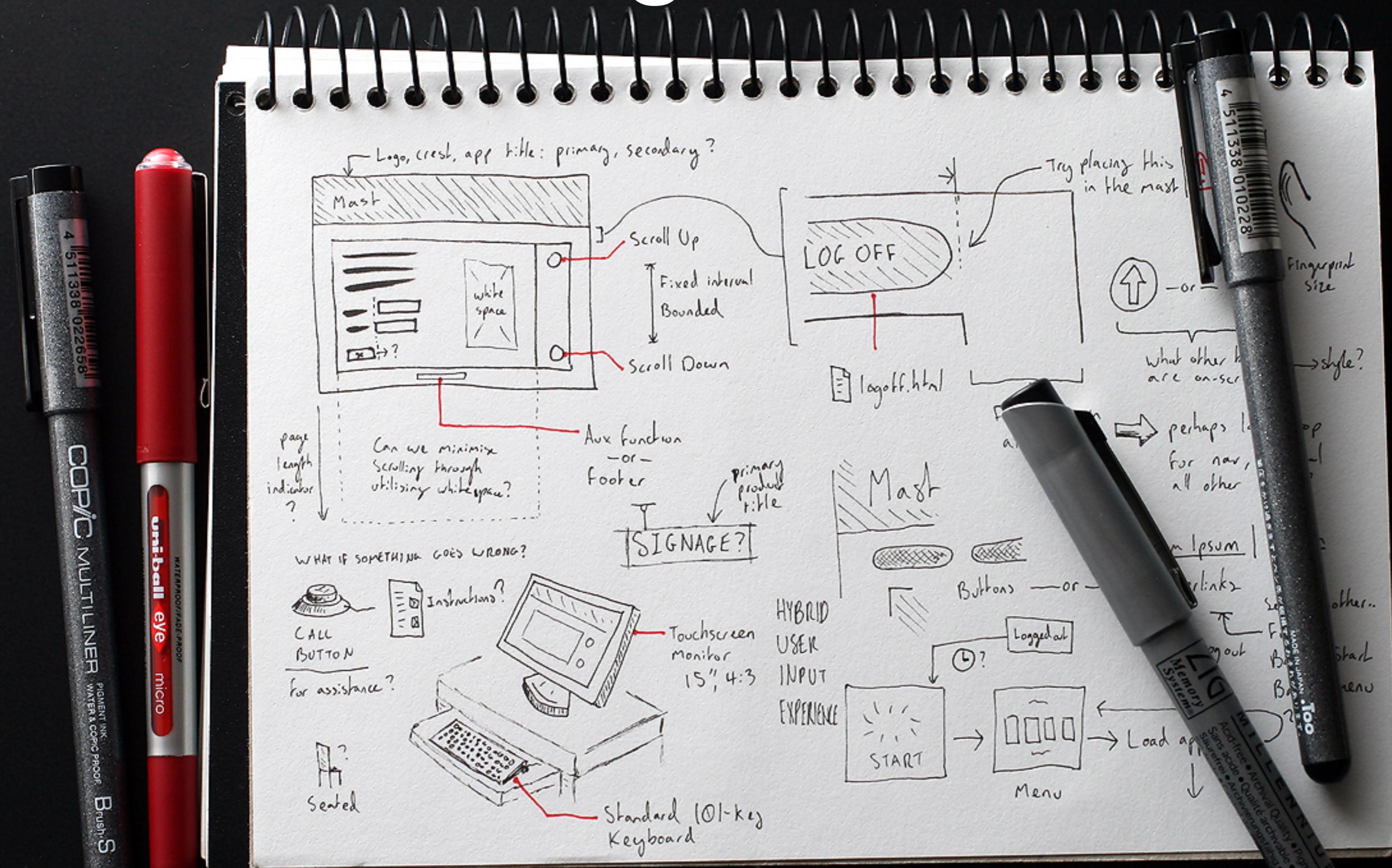
1. writing, number notation

The familiar indo-arabic numerals notation in *a*, and the [babylonian numbers notation](#) in *b*.

2. squares

3. repeated icon

Sketching Interfaces



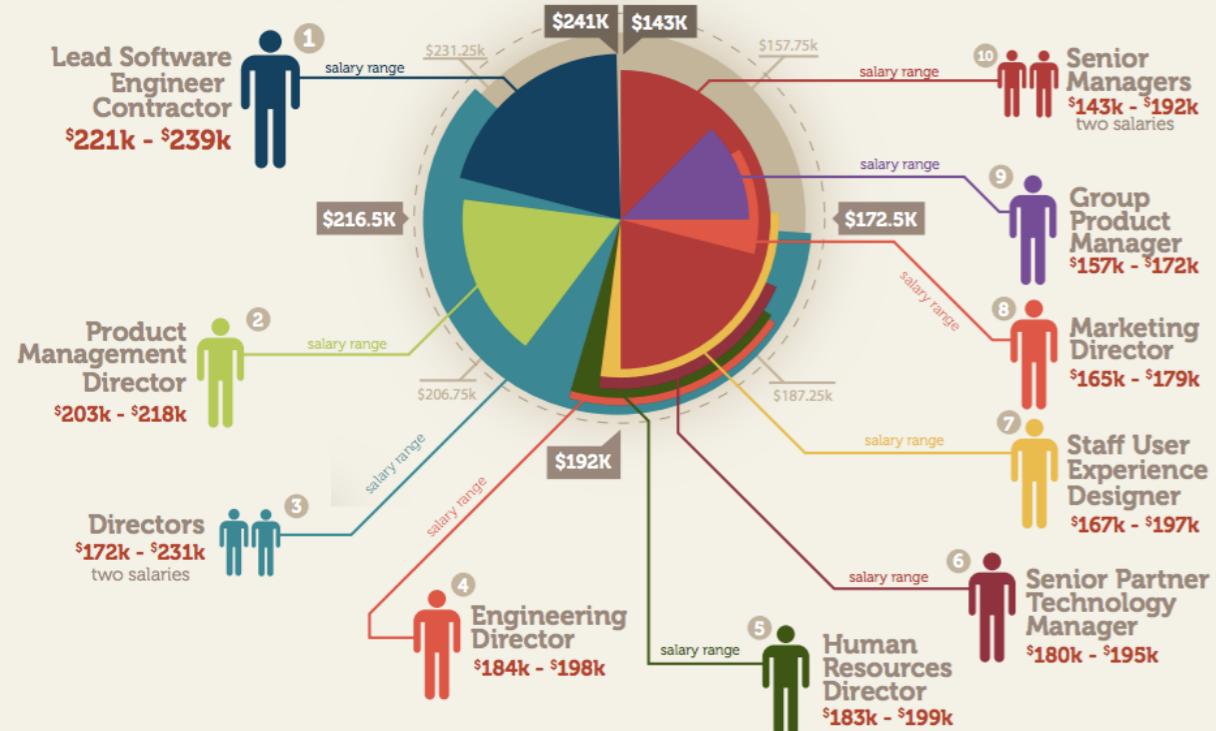
<https://www.flickr.com/photos/purecaffeine/4325067780/>

Activity

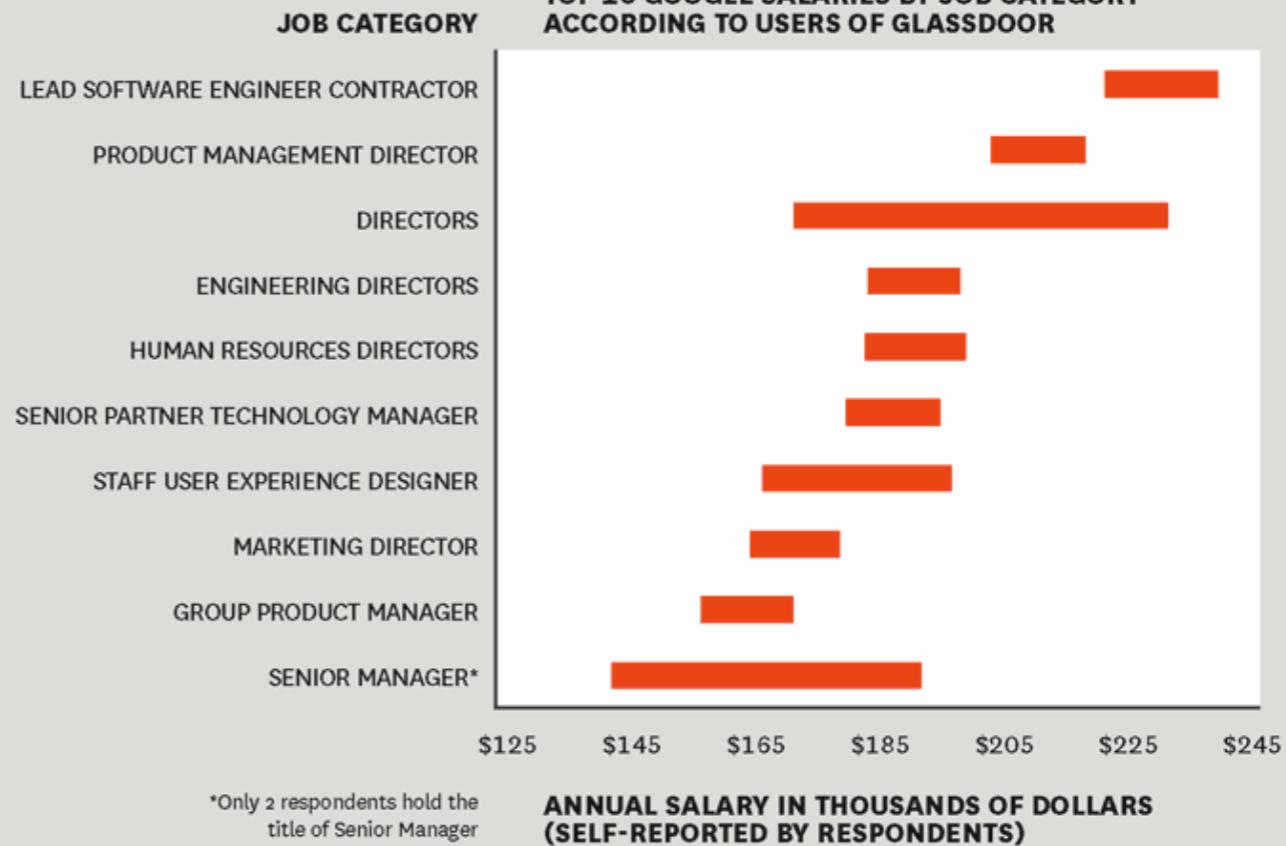
Which visualization do you prefer? Why?

top 10 salaries at Google™

RANGE FROM \$143,000 TO \$241,000 PER YEAR.



TOP 10 GOOGLE SALARIES BY JOB CATEGORY
ACCORDING TO USERS OF GLASSDOOR



bit.ly/top10salariesatgoogle

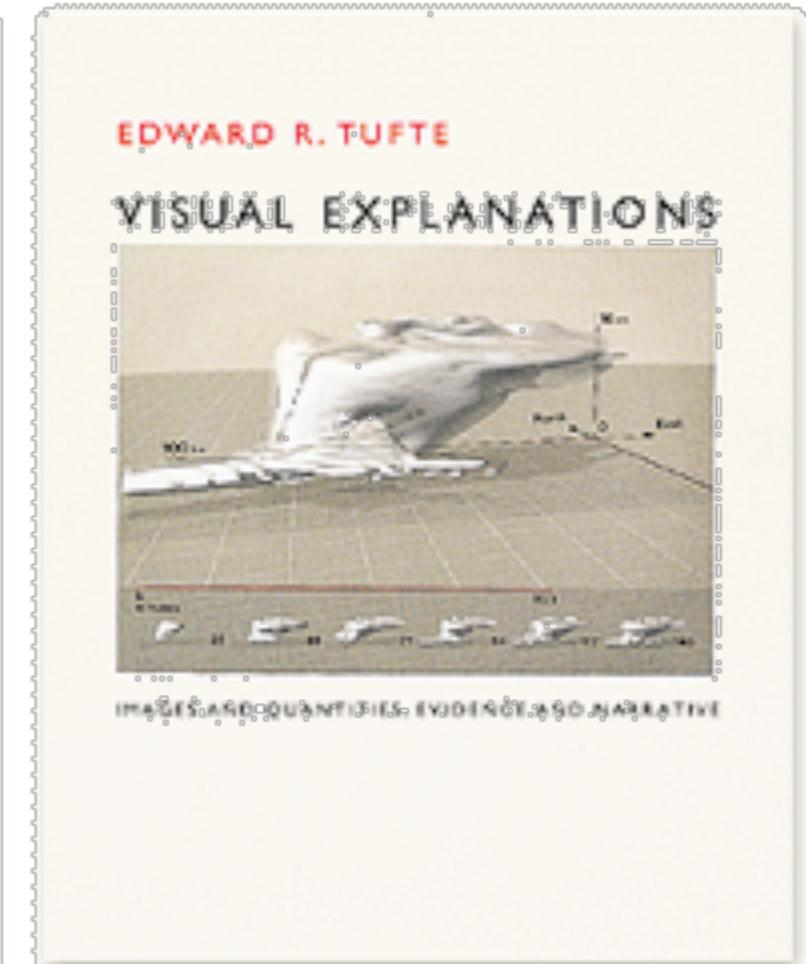
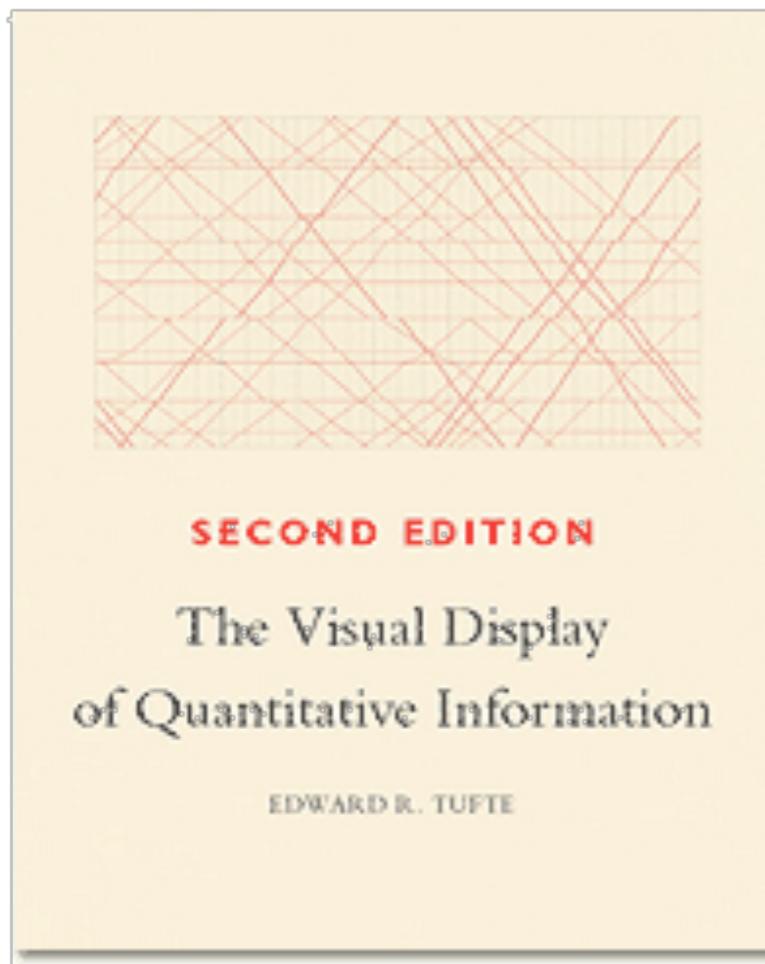
bit.ly/cs171-salaries



“Clutter and confusion are not attributes of information, they are failures of design.”

– Edward Tufte

Edward Tufte



Graphical Integrity

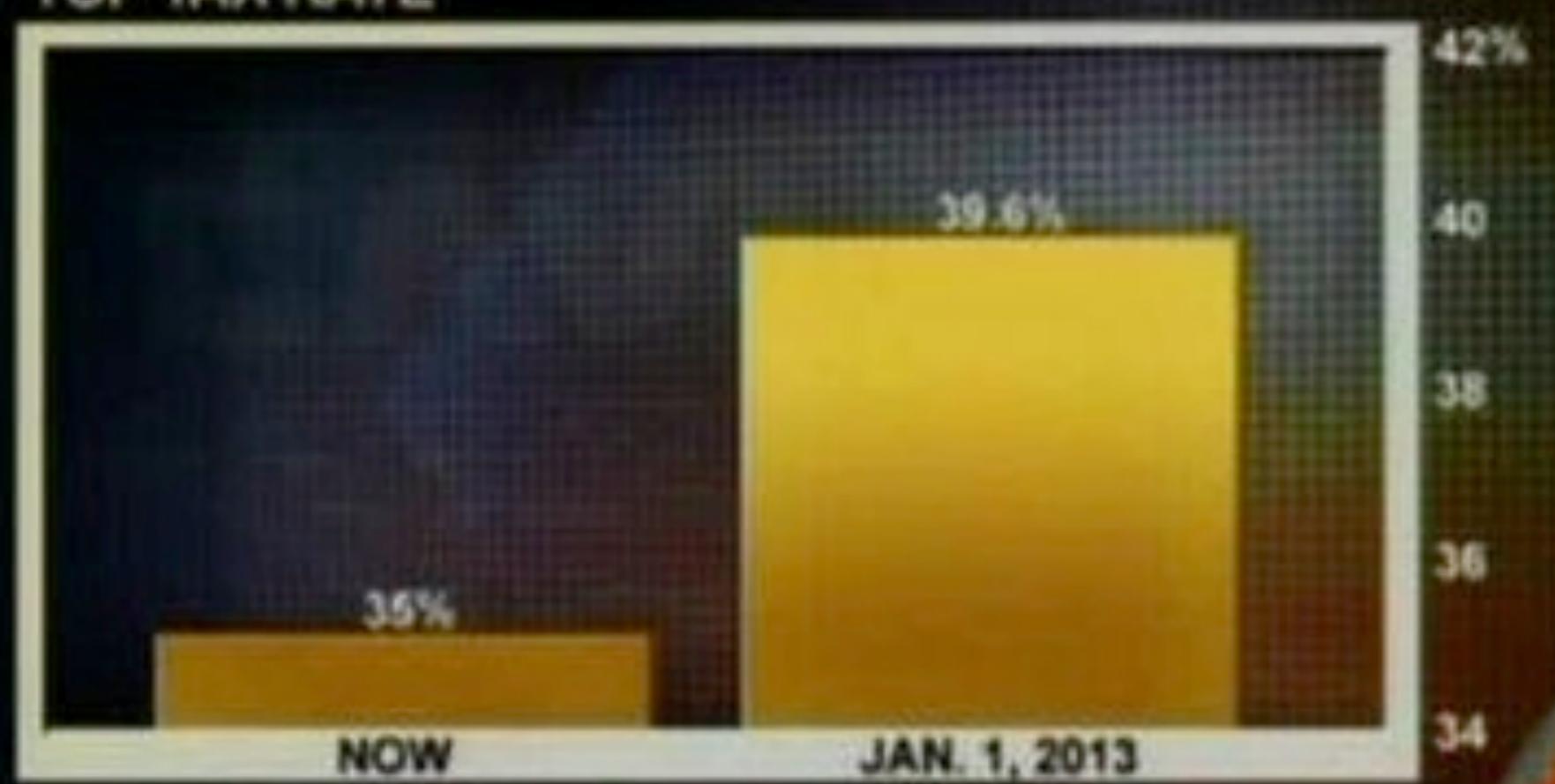
CS

171



IF BUSH TAX CUTS EXPIRE

TOP TAX RATE



8:01 p ET



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

If Bush tax cuts expire...

Top tax rate

40%

39.6%

35.0%

30%

20%

10%

0%

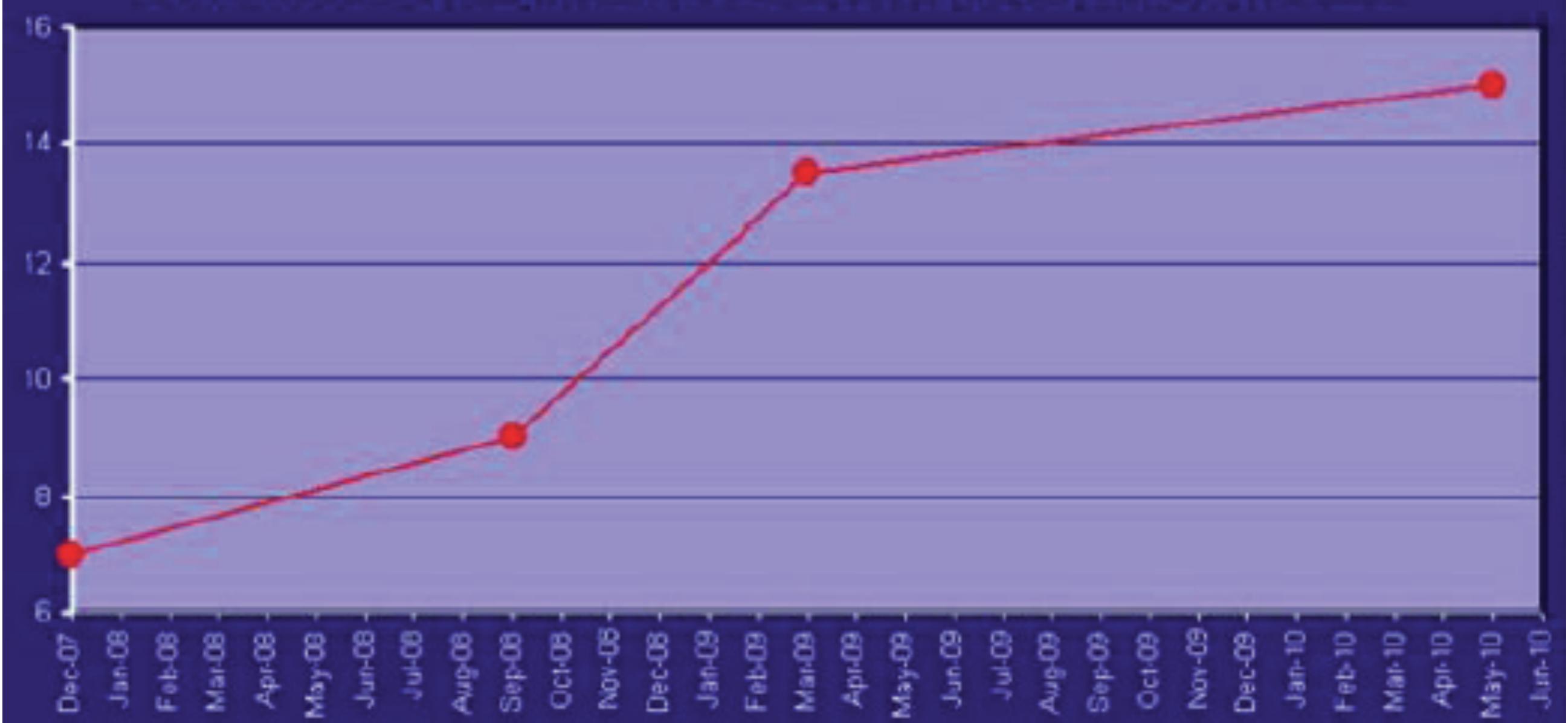
Now

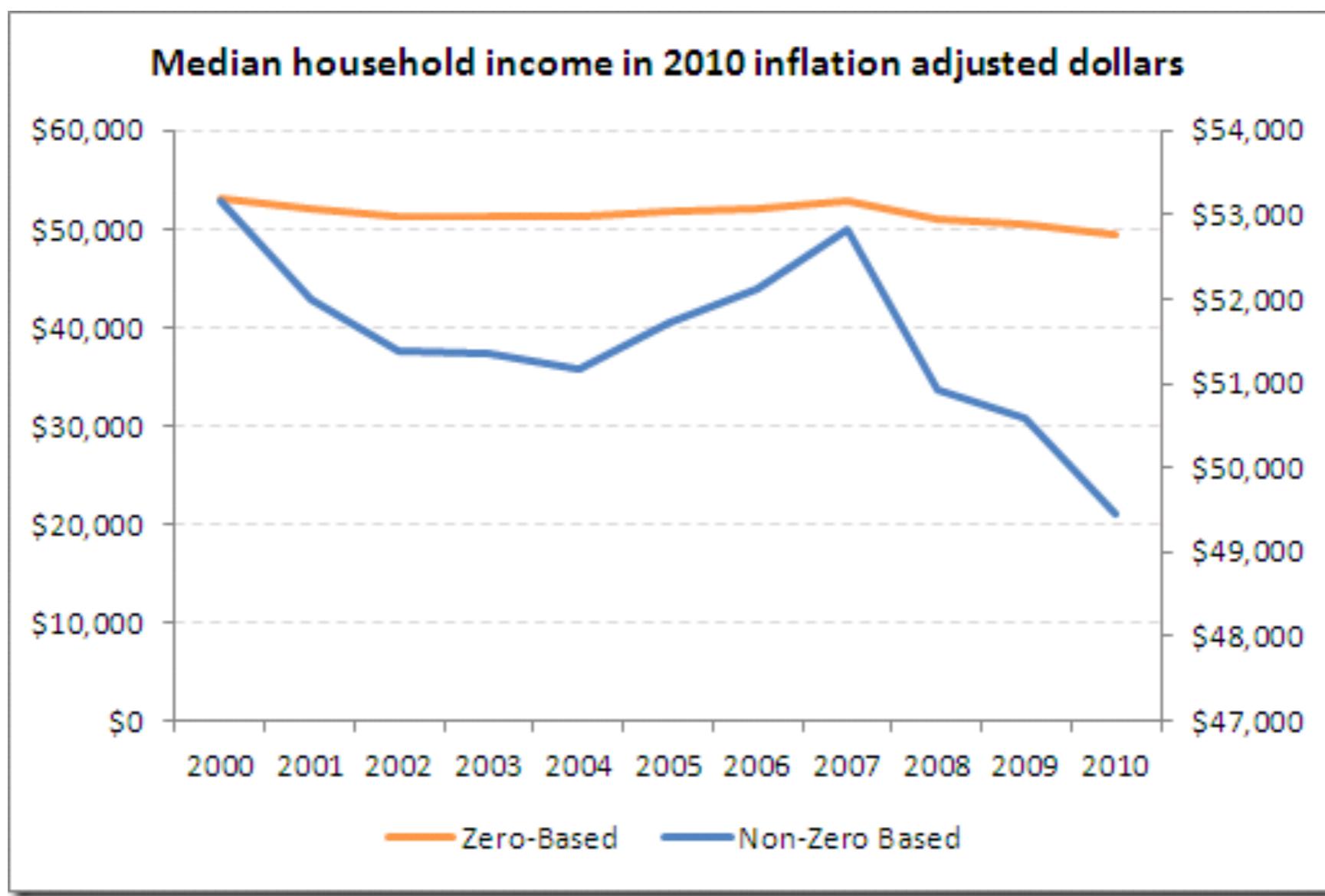
Jan. 1, 2013

JOB LOSS BY QUARTER

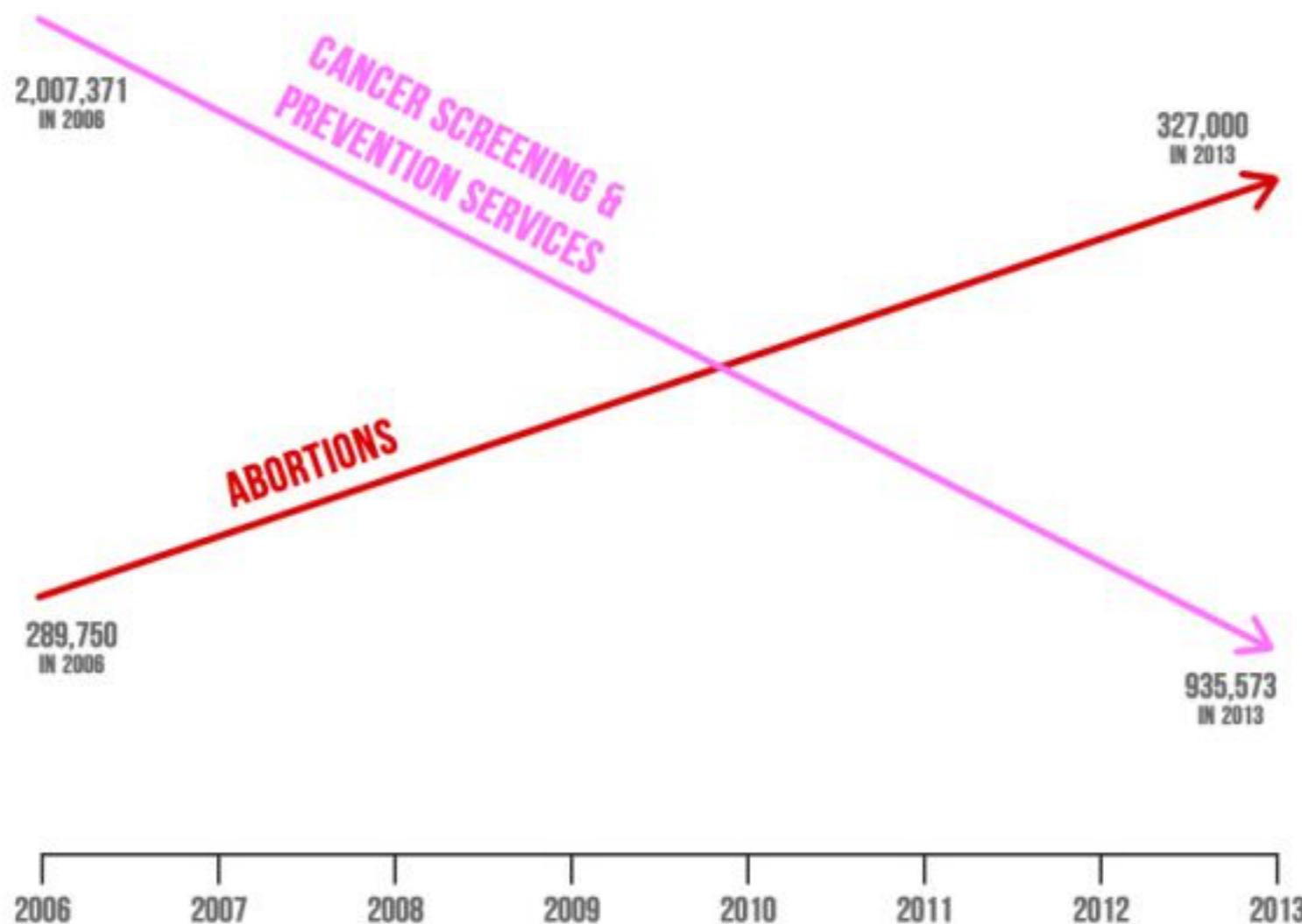


UNEMPLOYMENT LEVEL BY RANDOM QUARTER





PLANNED PARENTHOOD FEDERATION OF AMERICA: ABORTIONS UP – LIFE-SAVING PROCEDURES DOWN

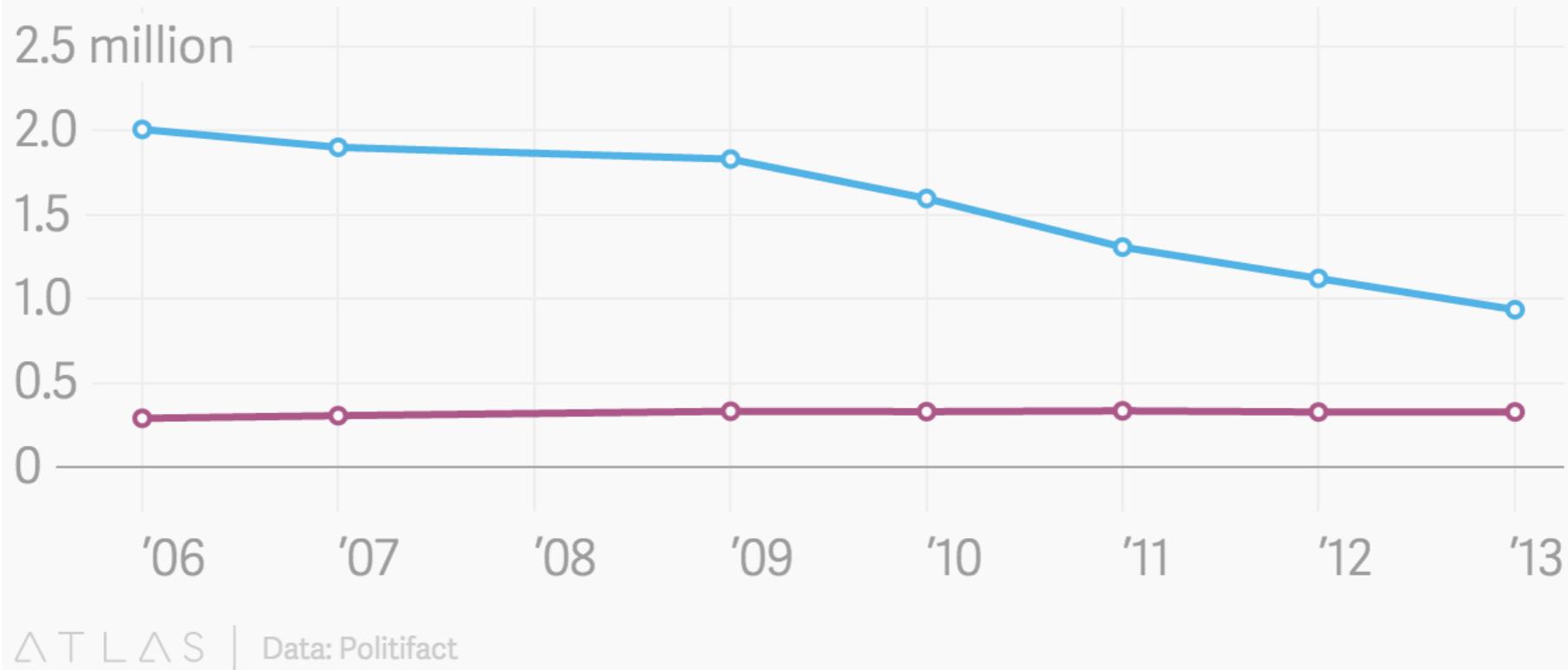


SOURCE: AMERICANS UNITED FOR LIFE

Rep. Jason Chaffetz, Utah, 2015

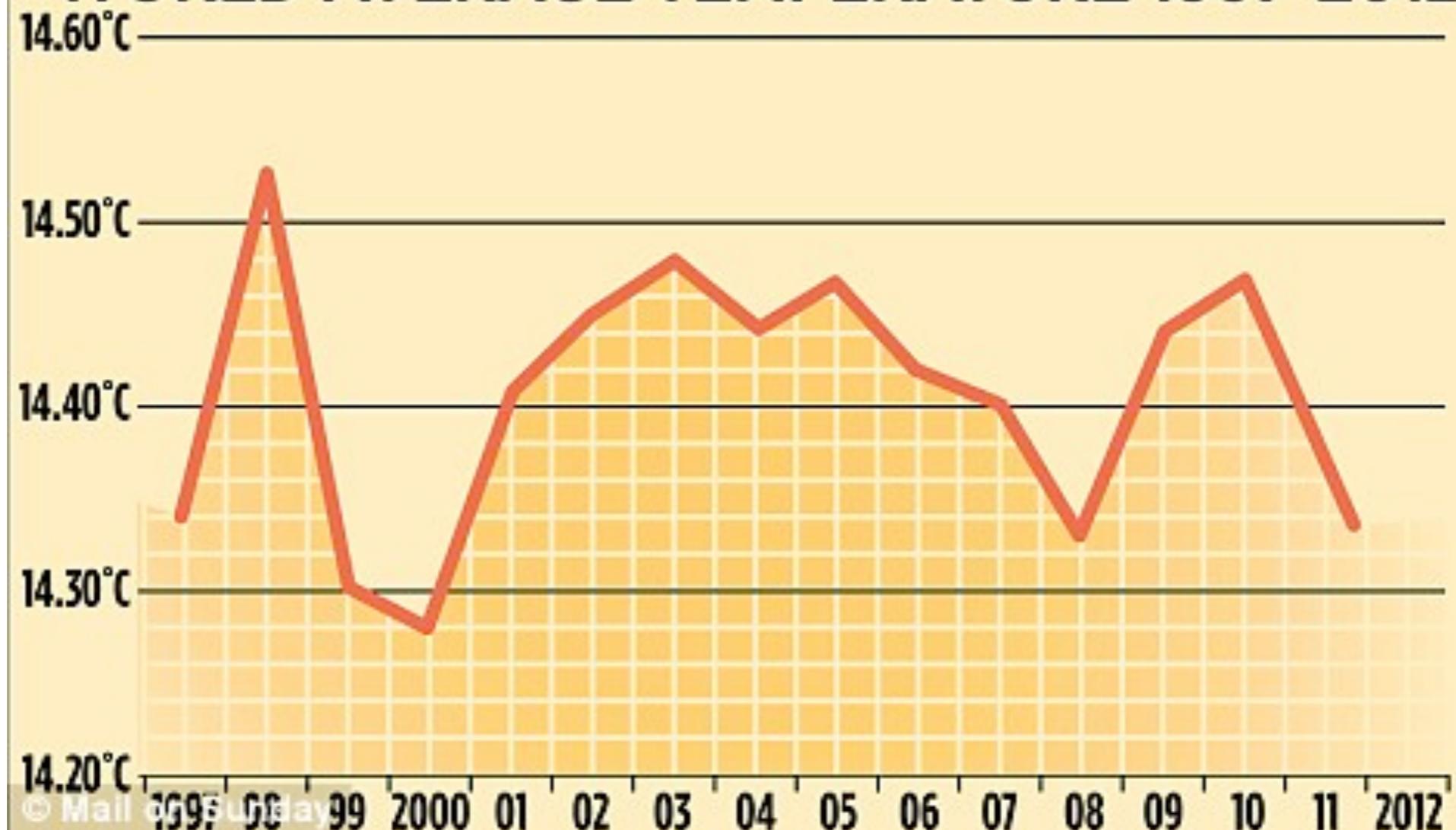
Planned Parenthood services

- Abortion procedures
- Cancer screening / preventative services

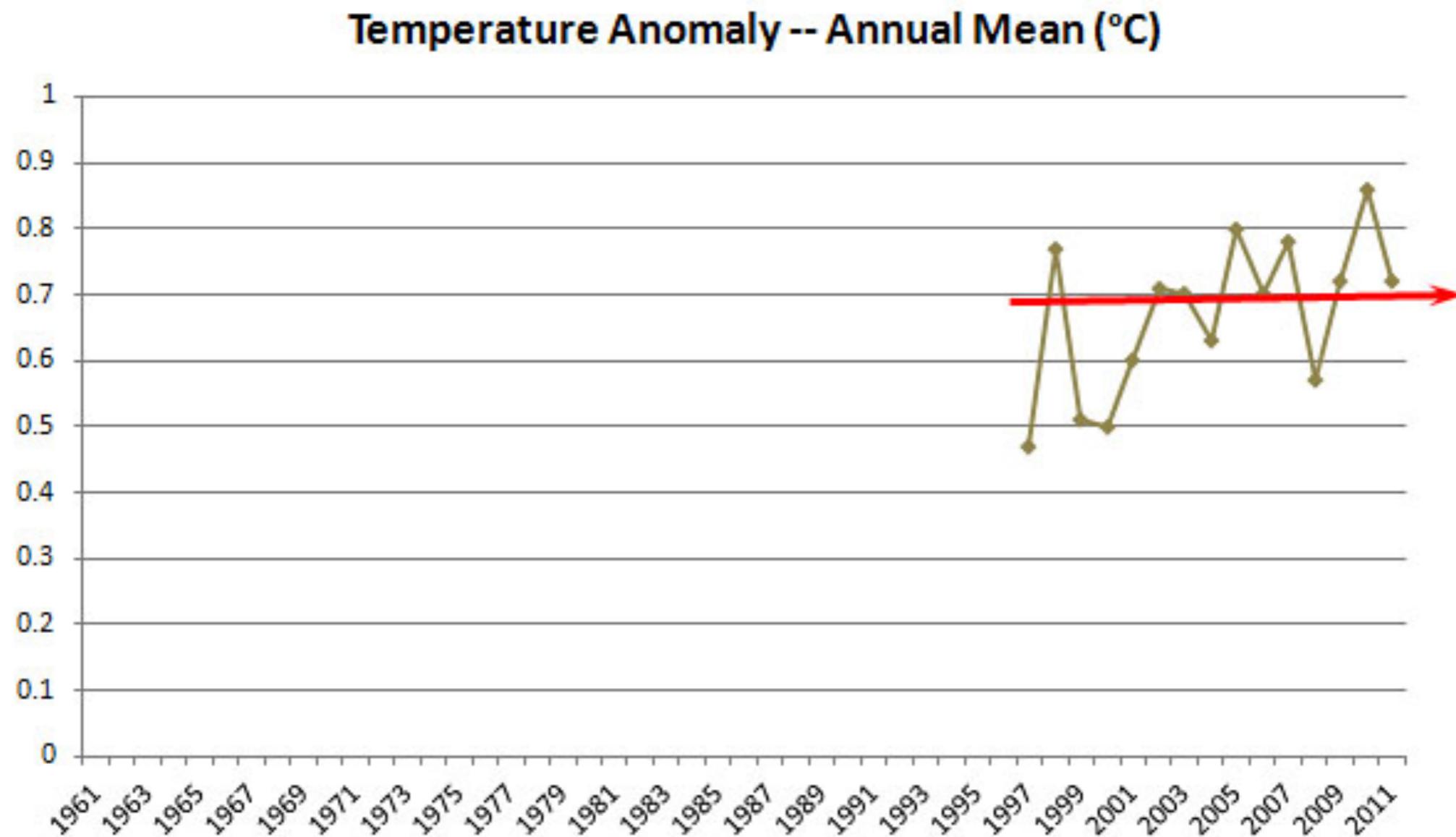


Politifact, 2015

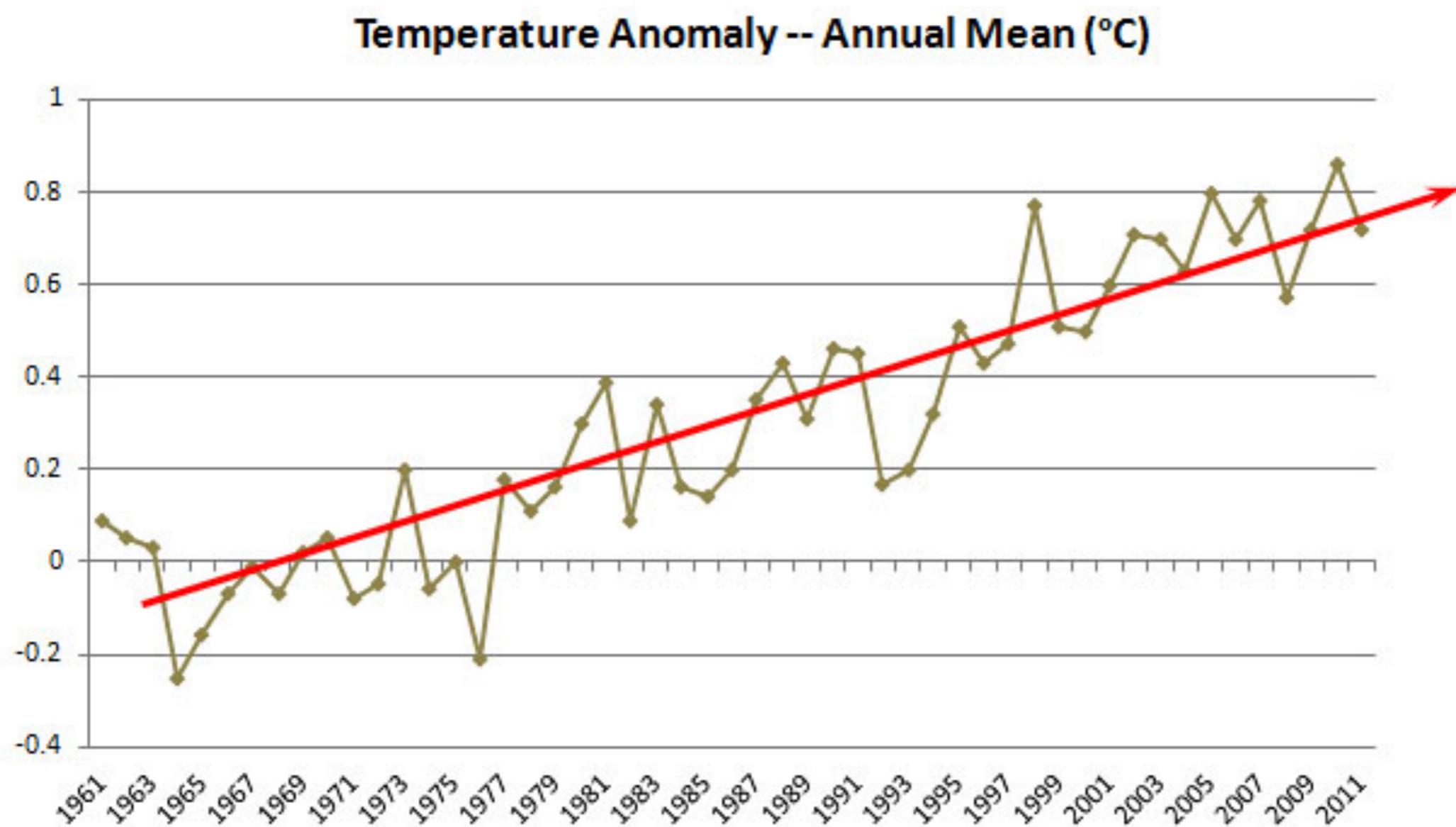
WORLD AVERAGE TEMPERATURE 1997-2012



Global Warming?



Global Warming!



The Lie Factor

CS

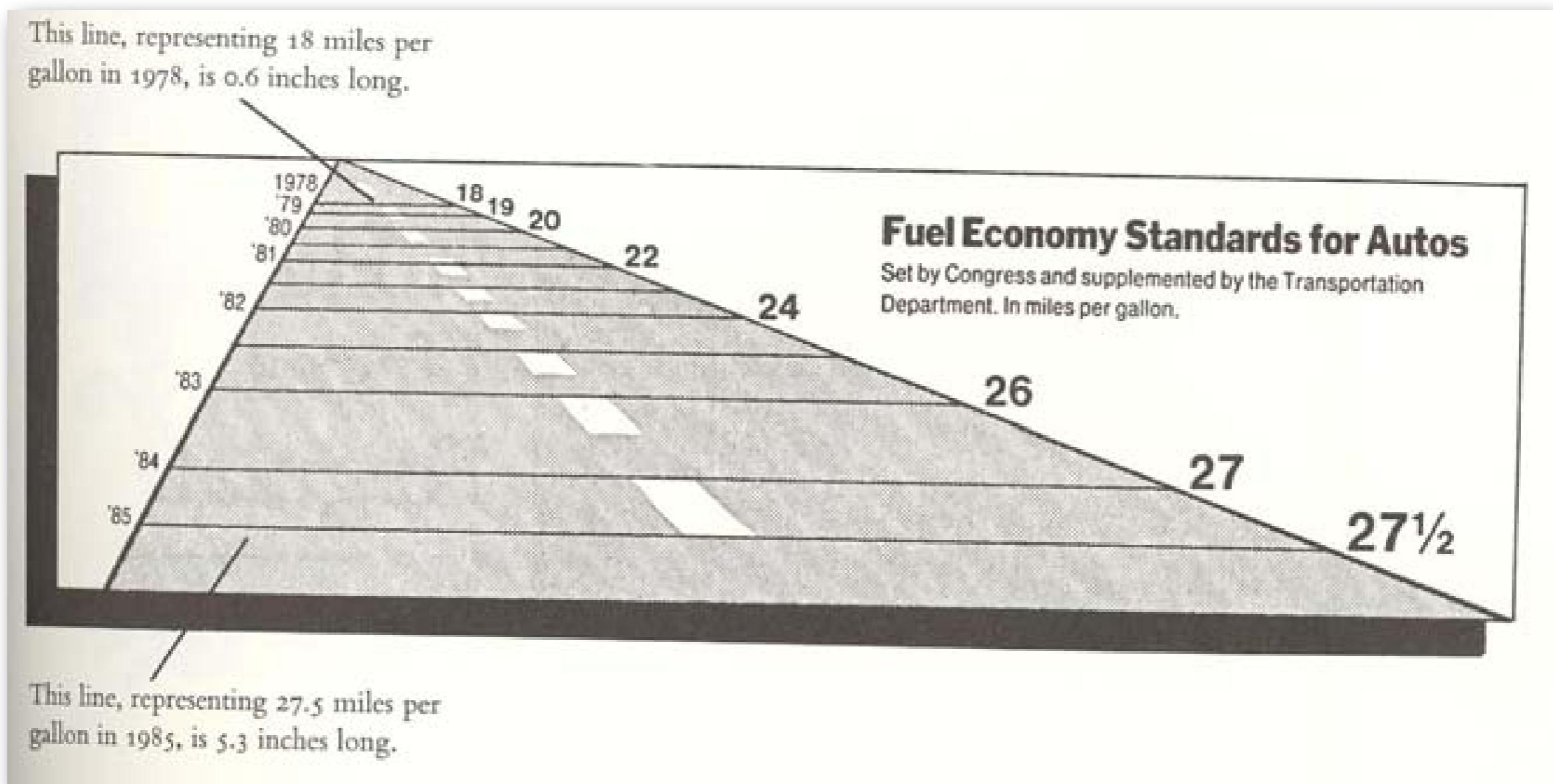
171



The Lie Factor

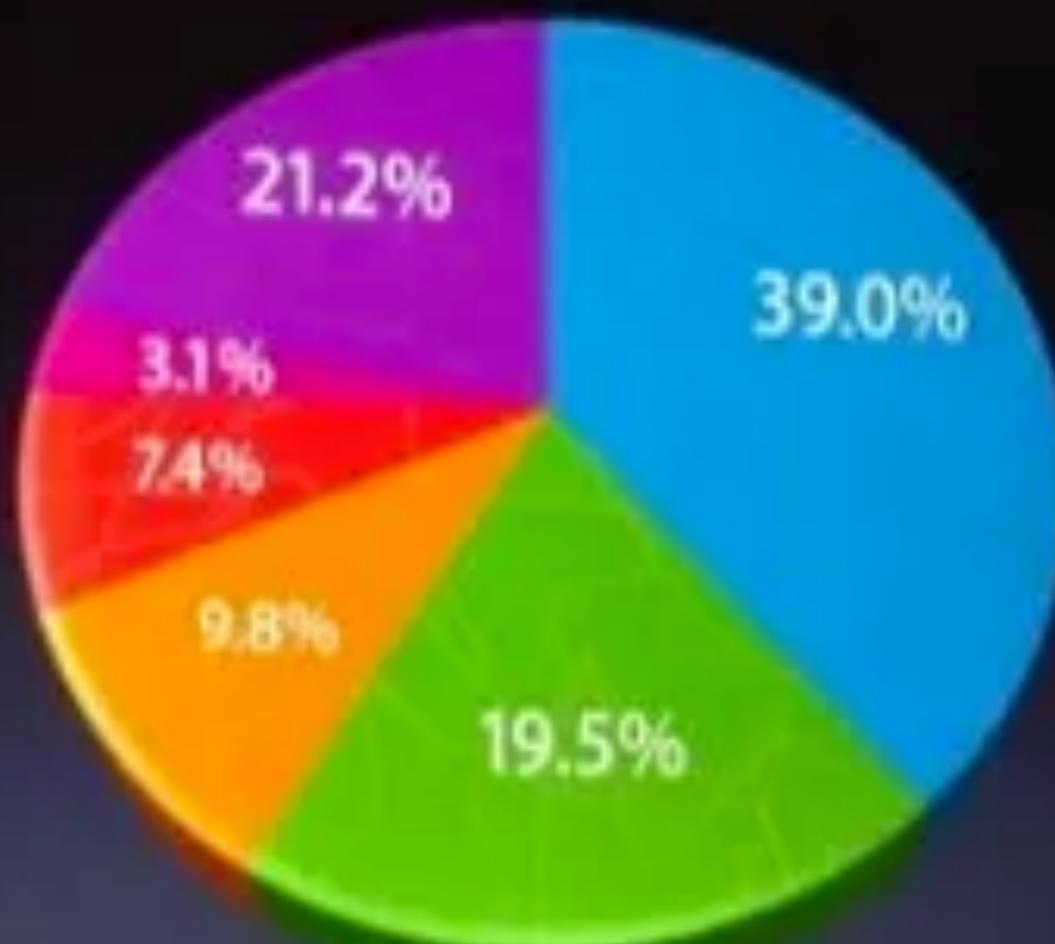
Size of effect shown in graphic

Size of effect in data



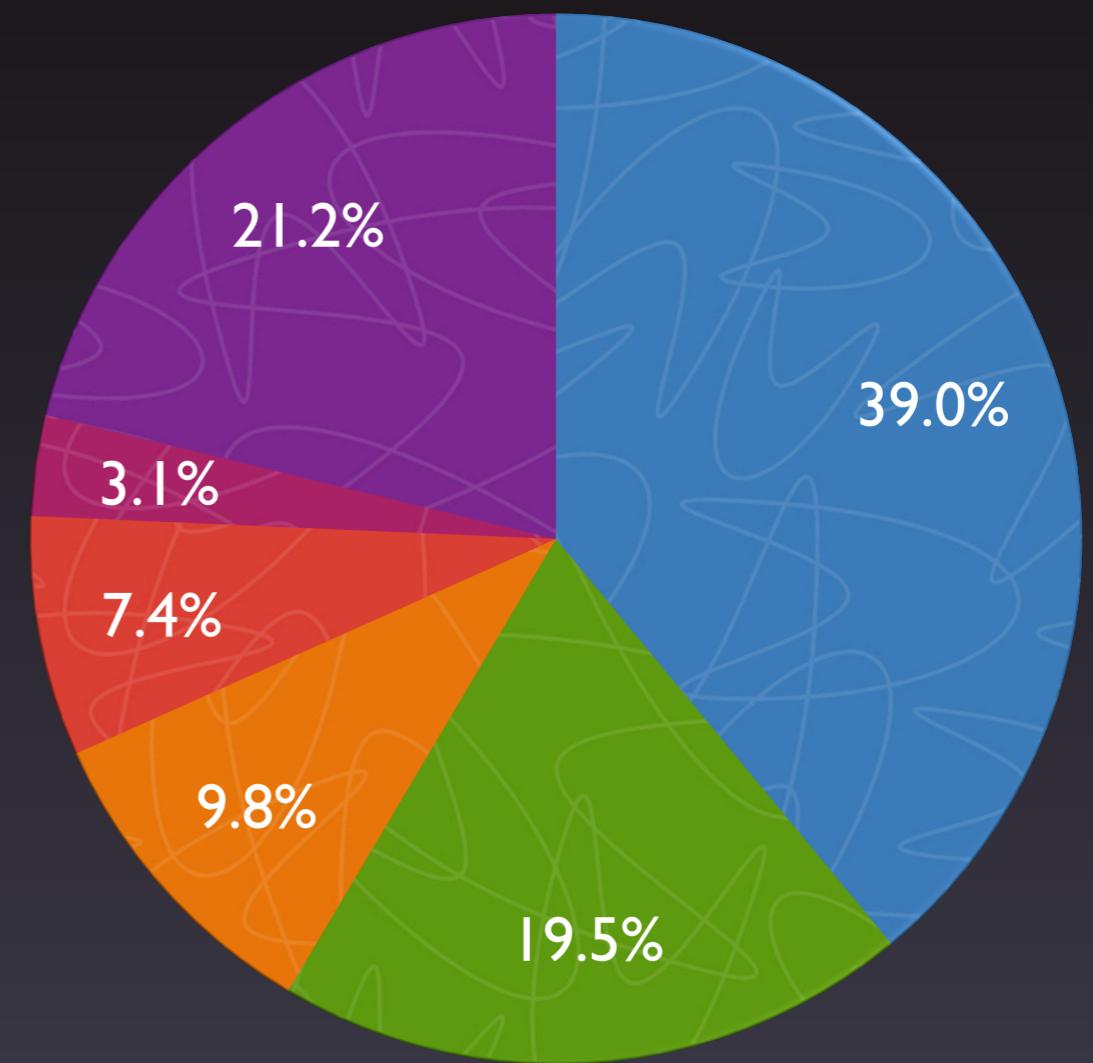
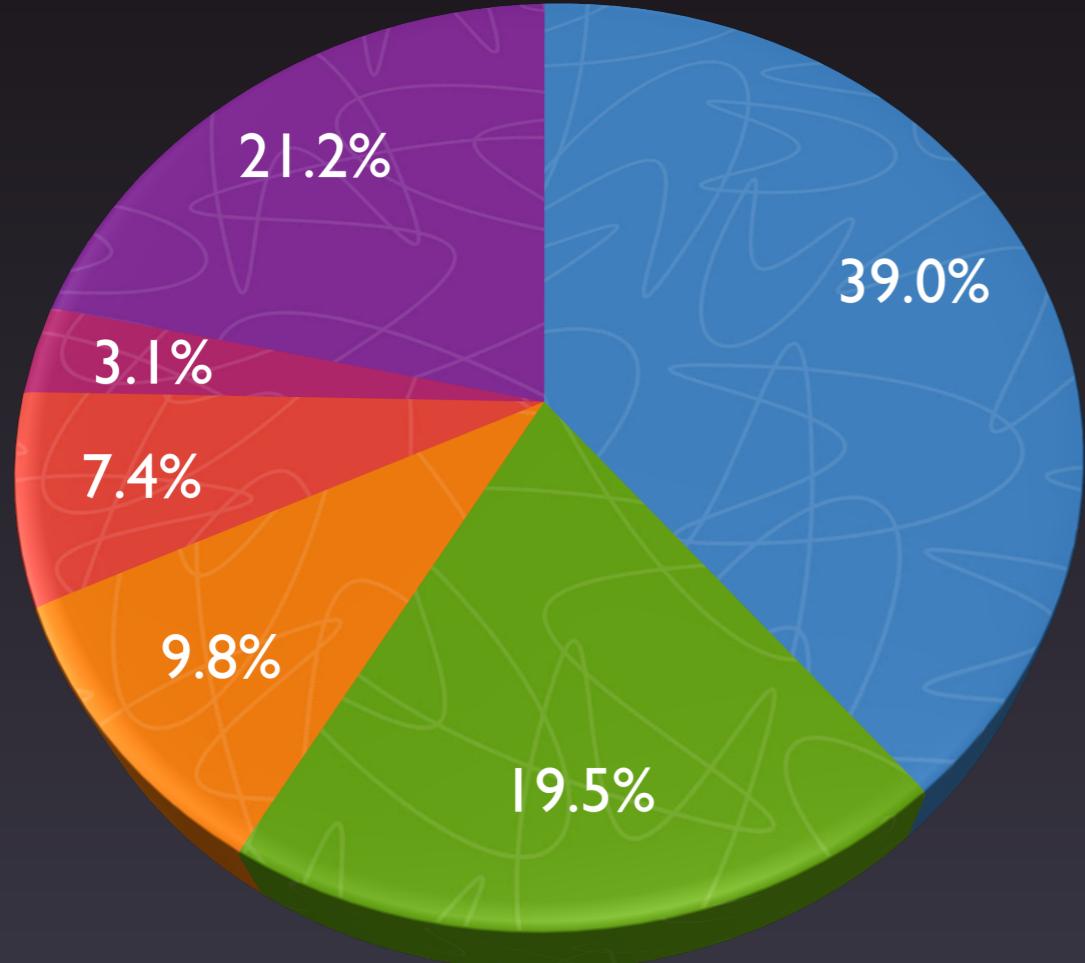
U.S. SmartPhone Marketshare

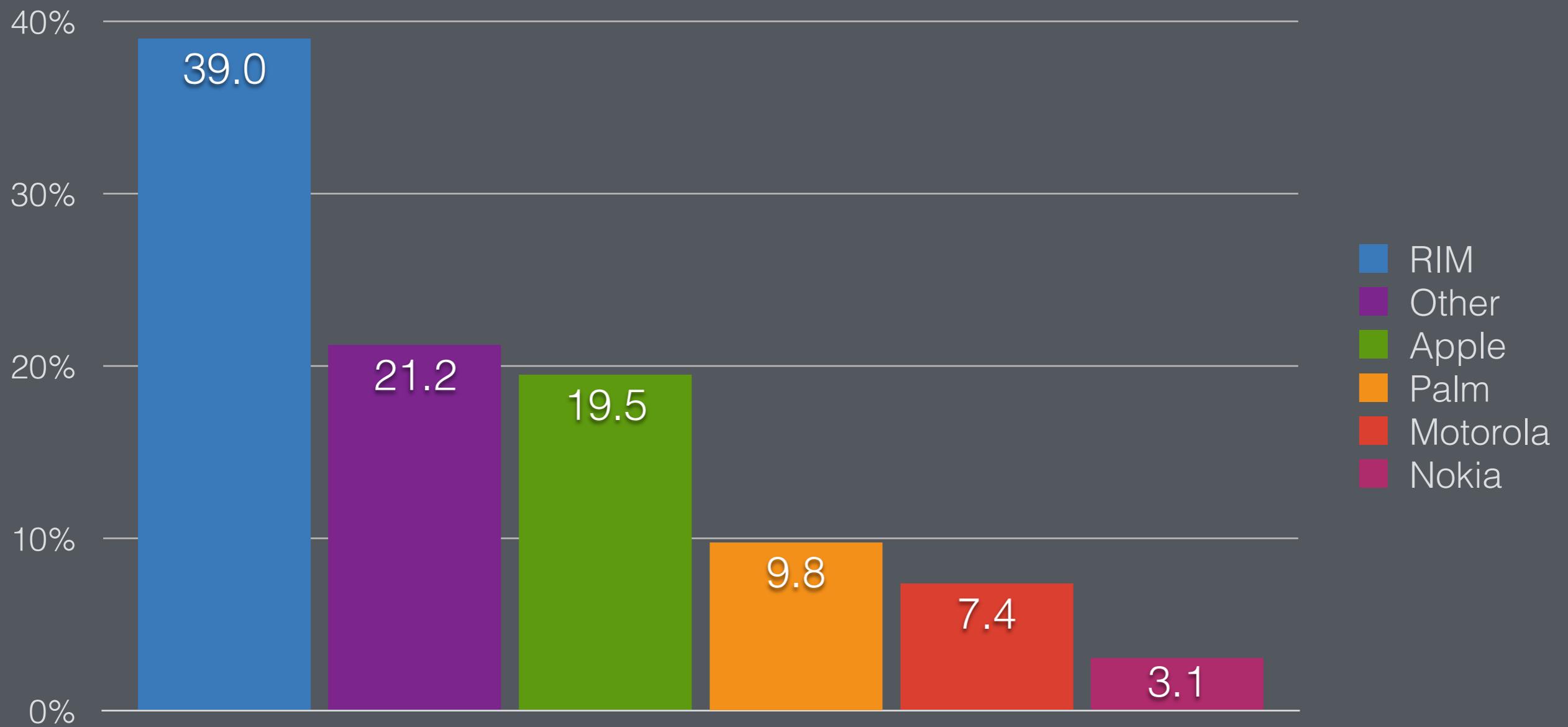
- RIM
- Apple
- Palm
- Motorola
- Nokia
- Other



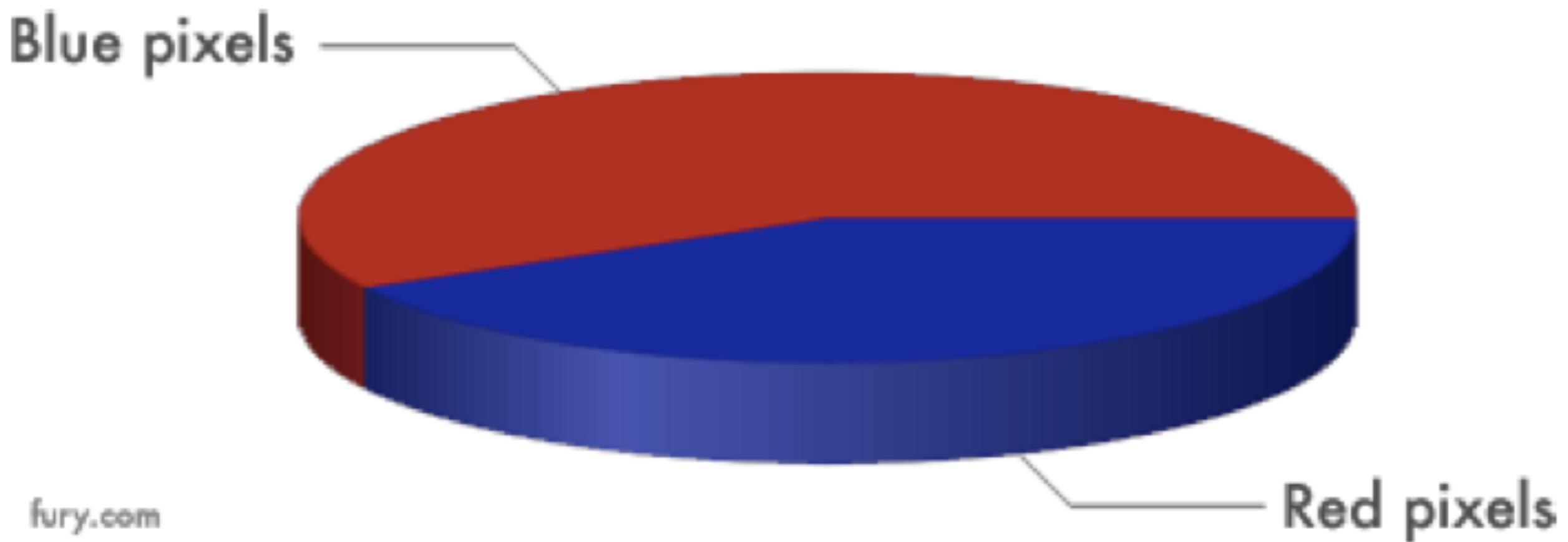
Gartner fo

- RIM
- Apple
- Palm
- Motorola
- Nokia
- Other





Why 3D Pie Charts are Bad



Maximize Data-Ink Ratio

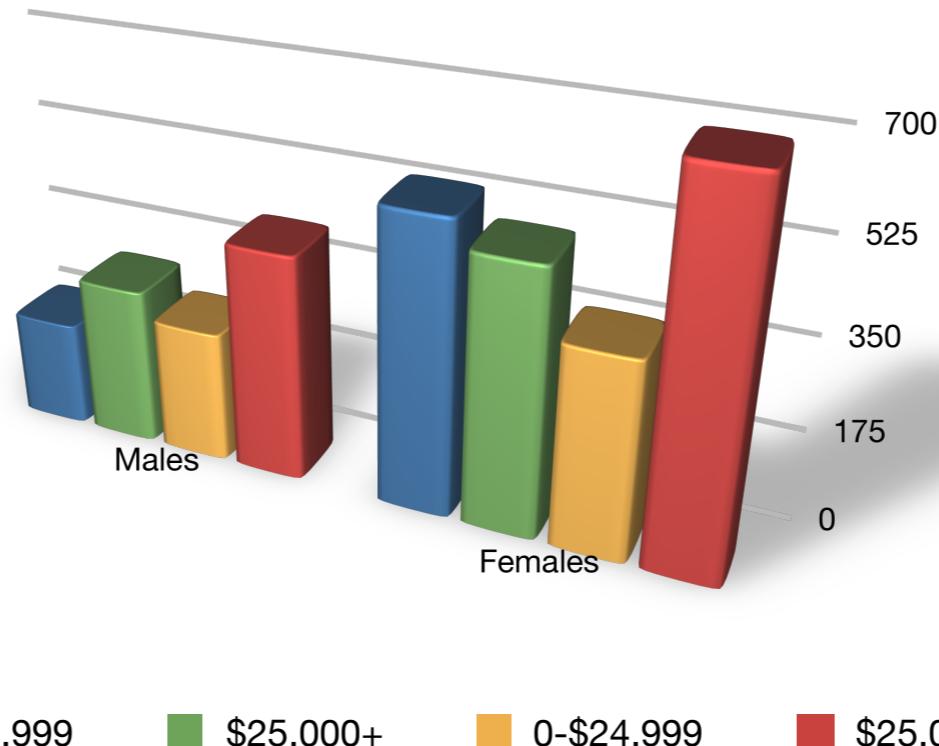
CS

171



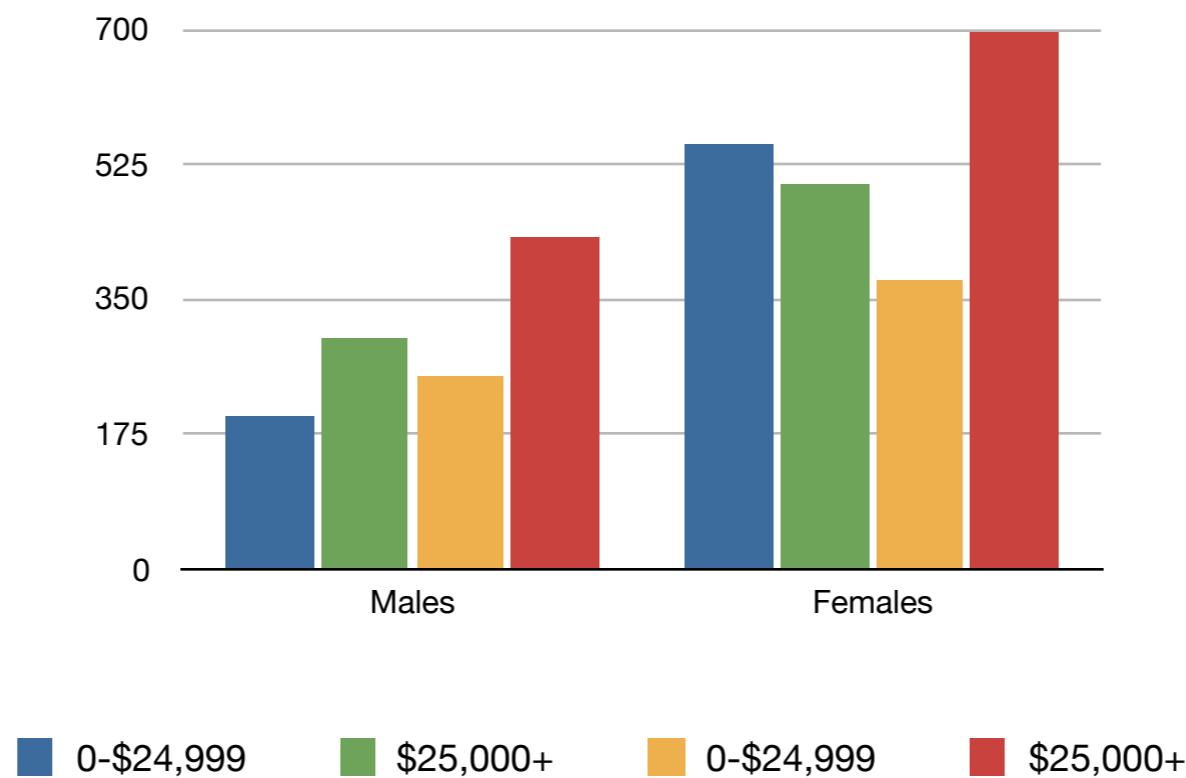
Maximize Data-Ink Ratio

Data-Ink Ratio = $\frac{\text{Data ink}}{\text{Total ink used in graphic}}$



Maximize Data-Ink Ratio

Data-Ink Ratio = $\frac{\text{Data ink}}{\text{Total ink used in graphic}}$



Avoid Chartjunk

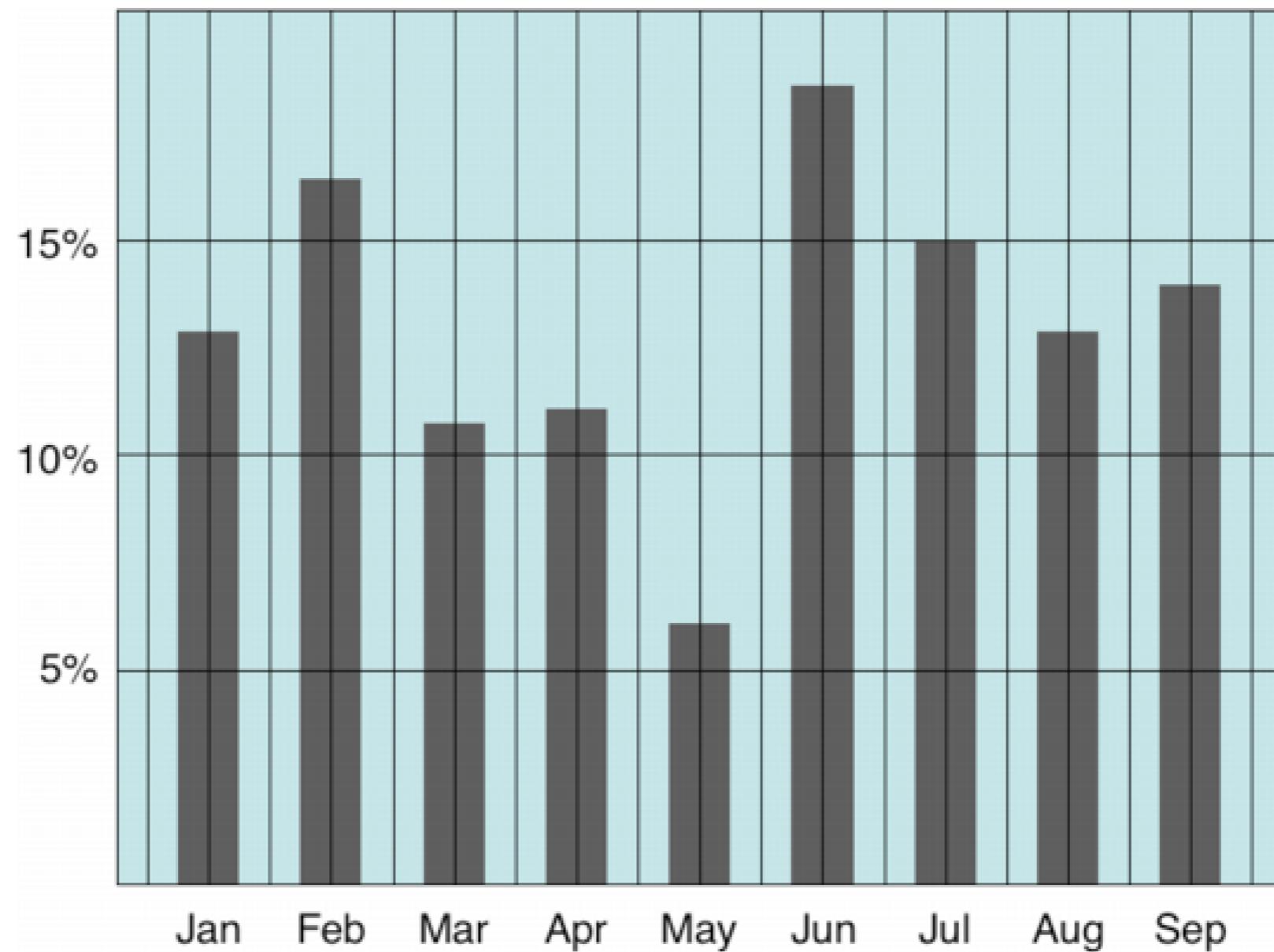
CS

171

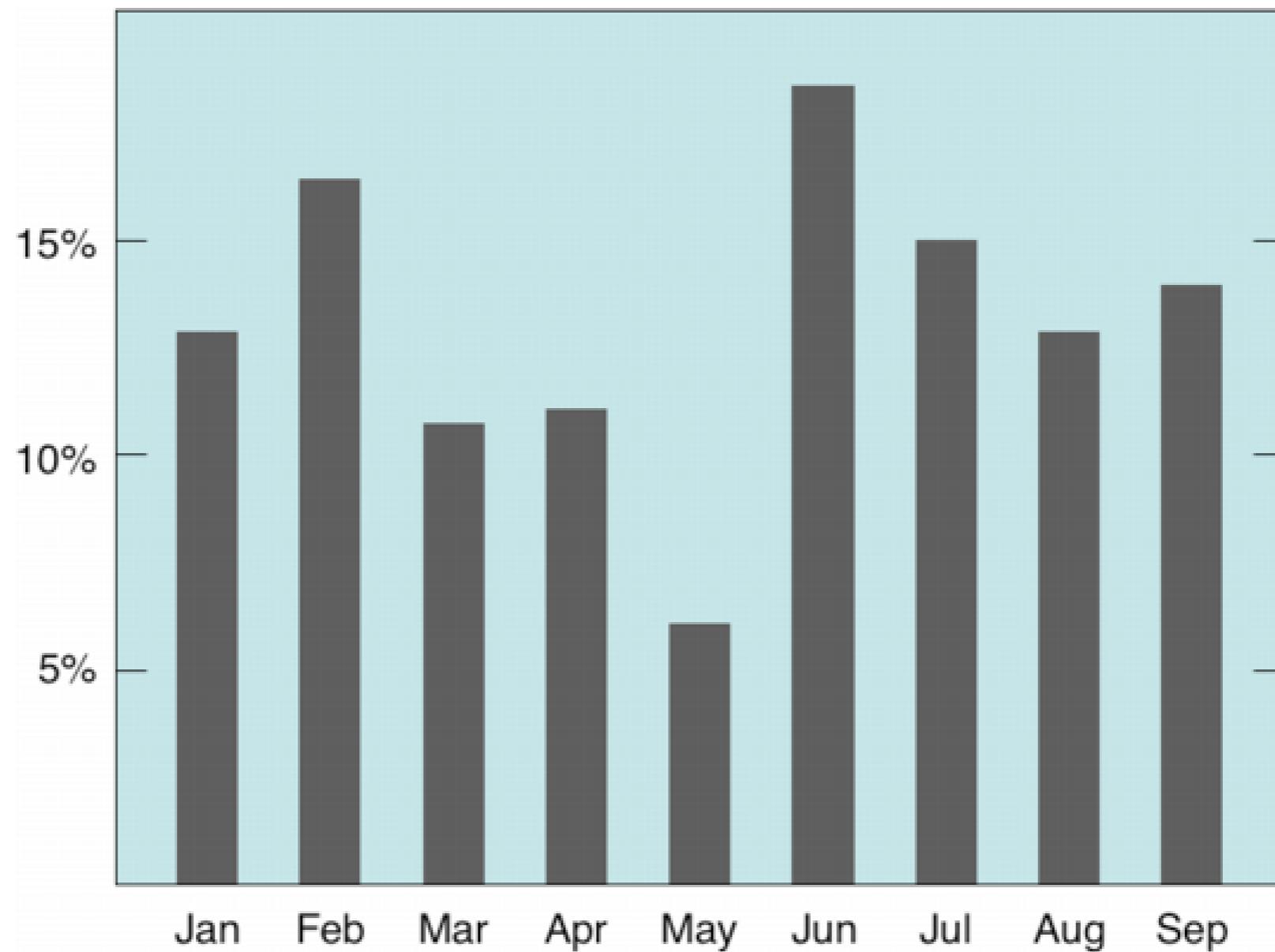


Avoid Chartjunk

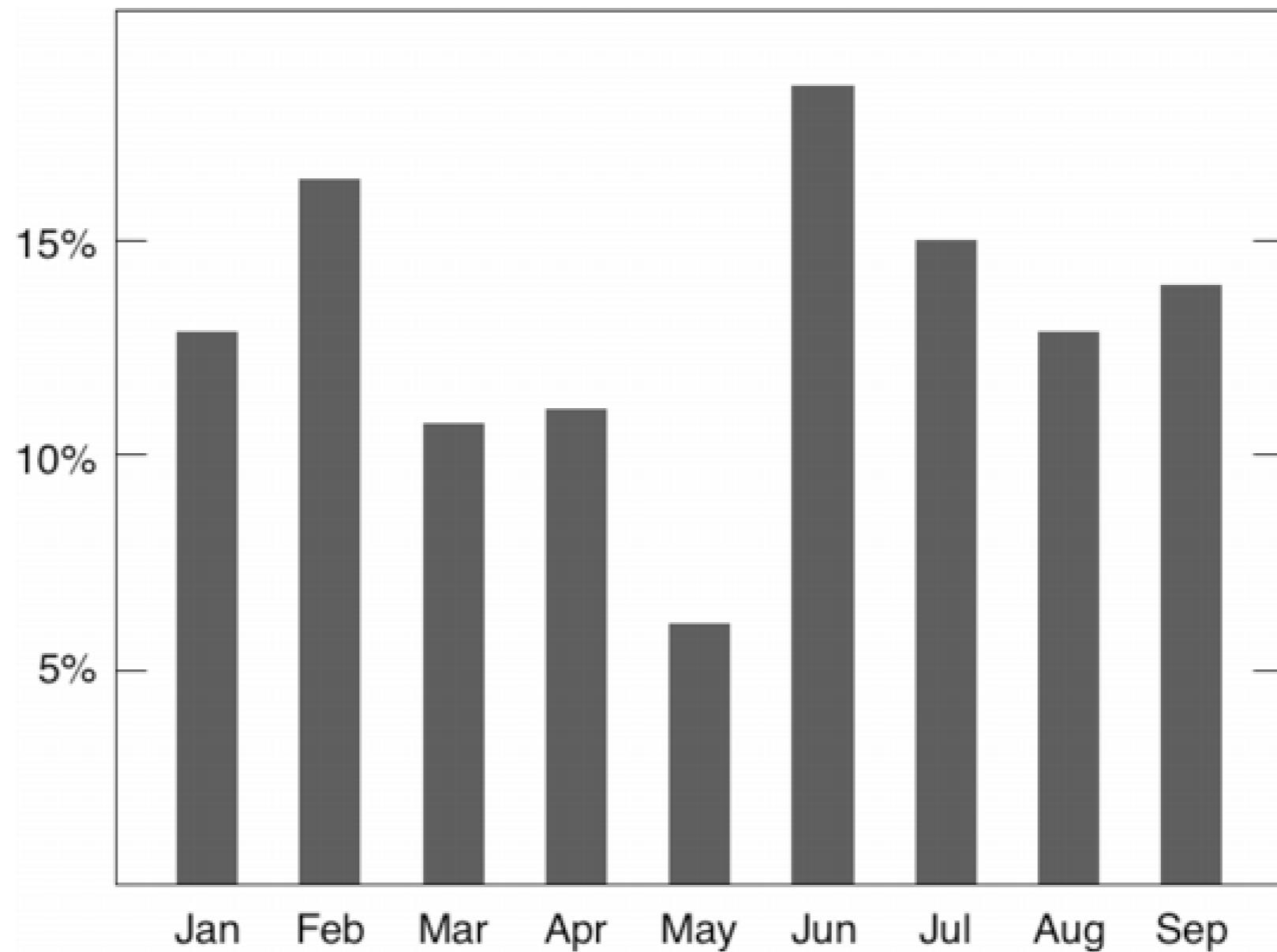
Extraneous visual elements that distract from the message



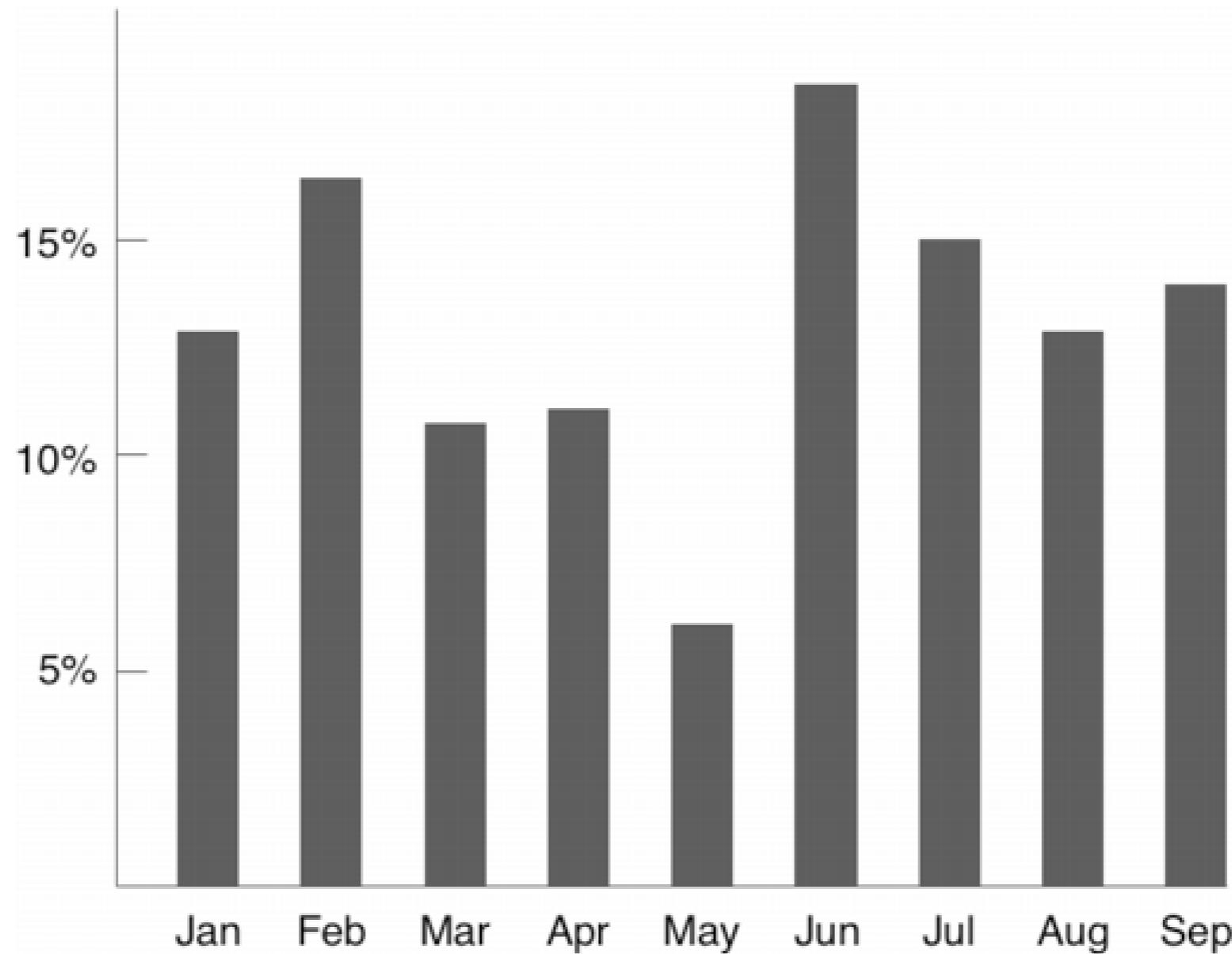
Avoid Chartjunk



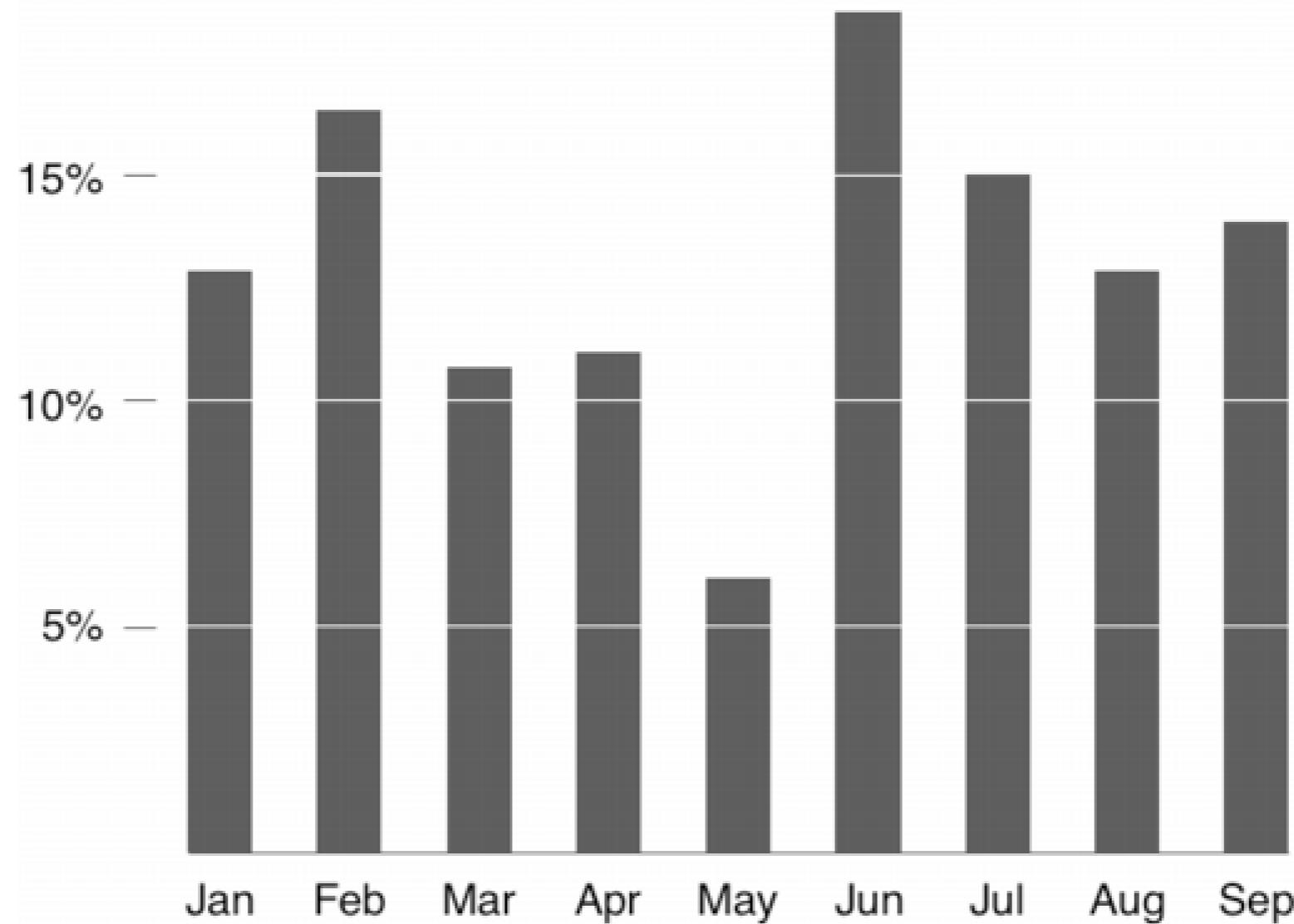
Avoid Chartjunk



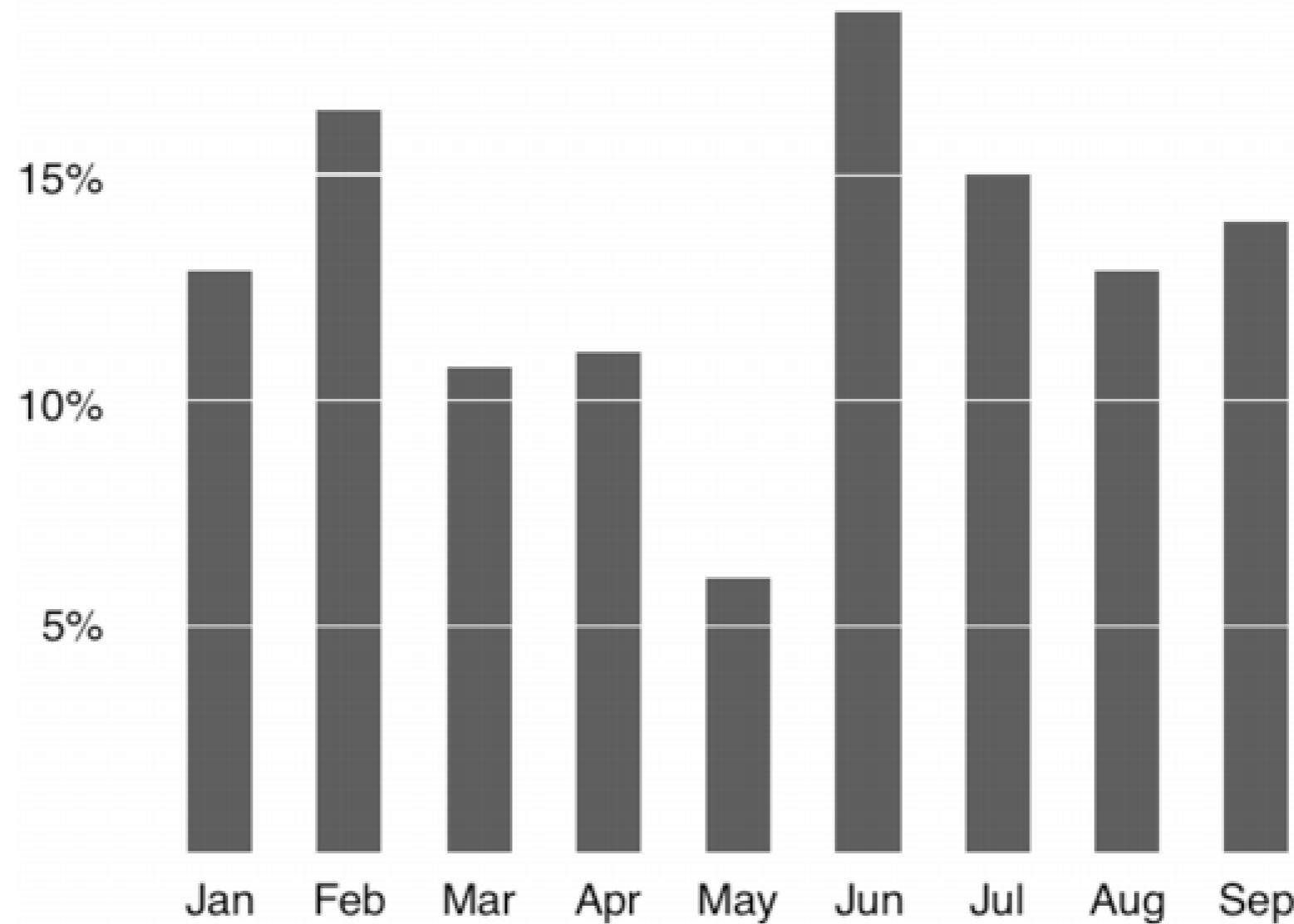
Avoid Chartjunk



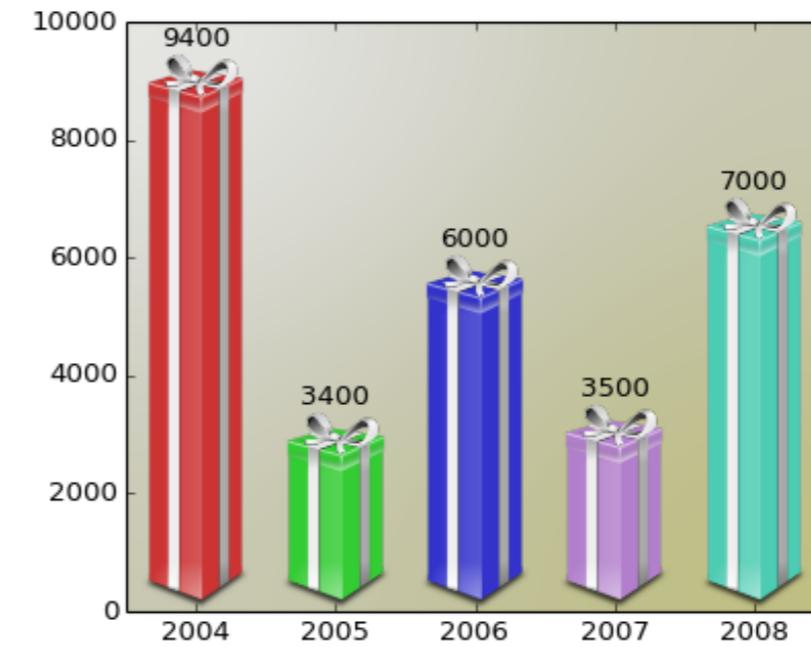
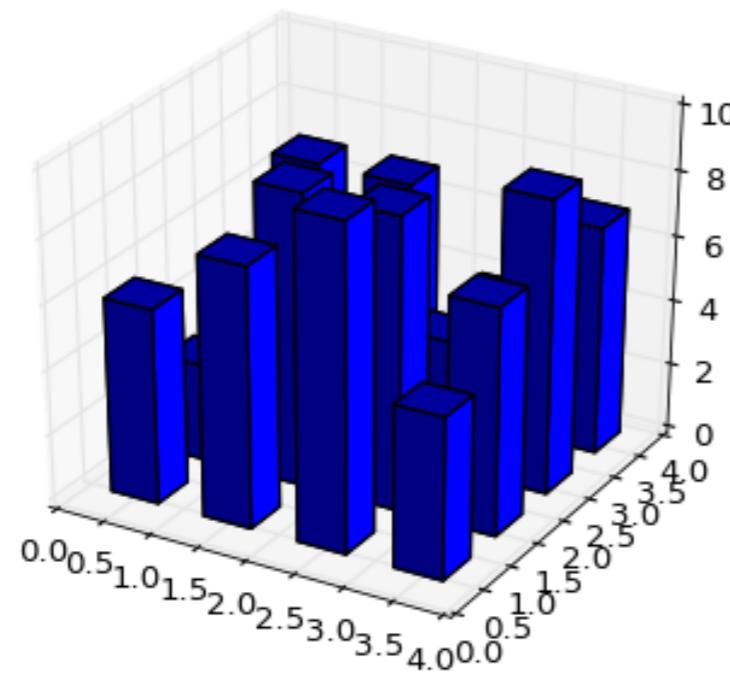
Avoid Chartjunk



Avoid Chartjunk

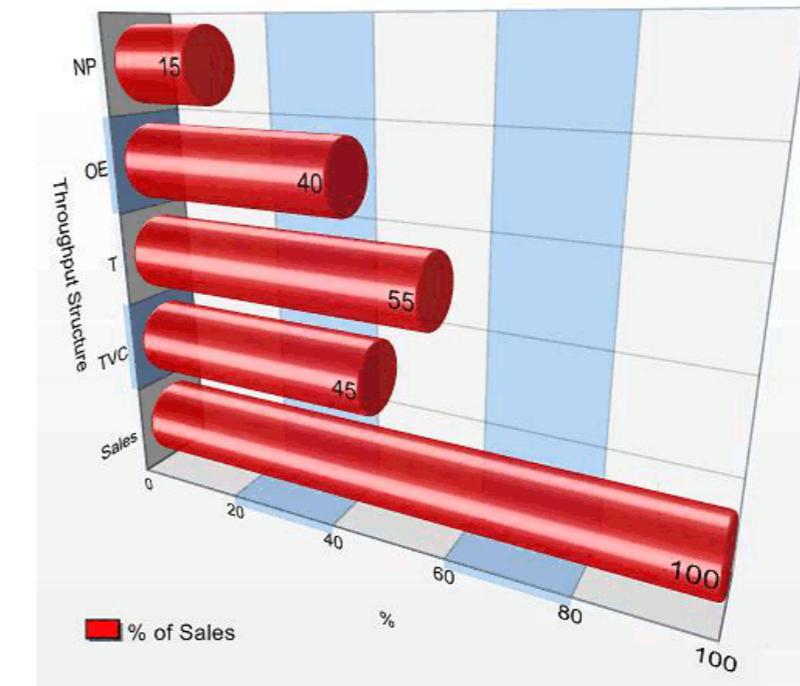
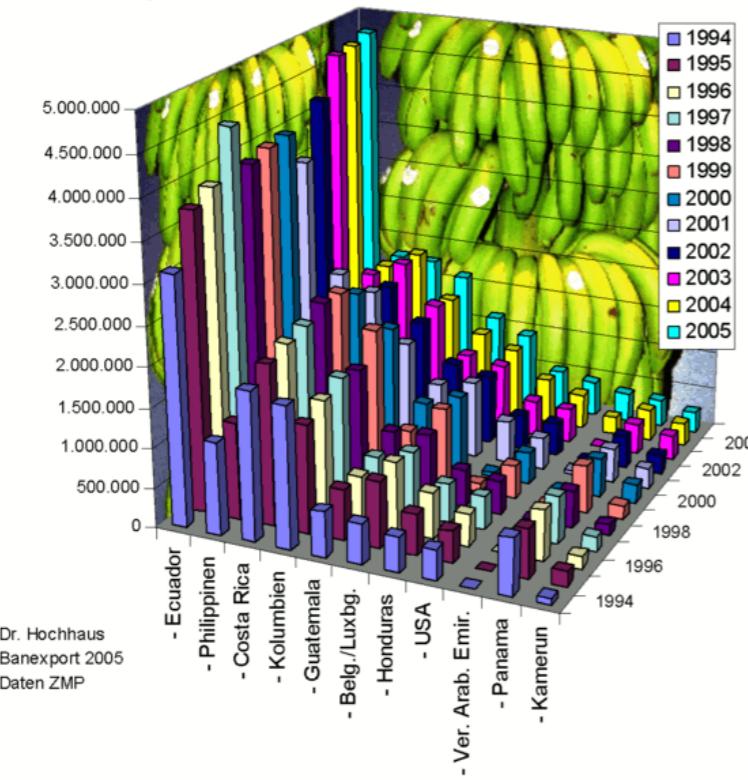


Don't



matplotlib gallery

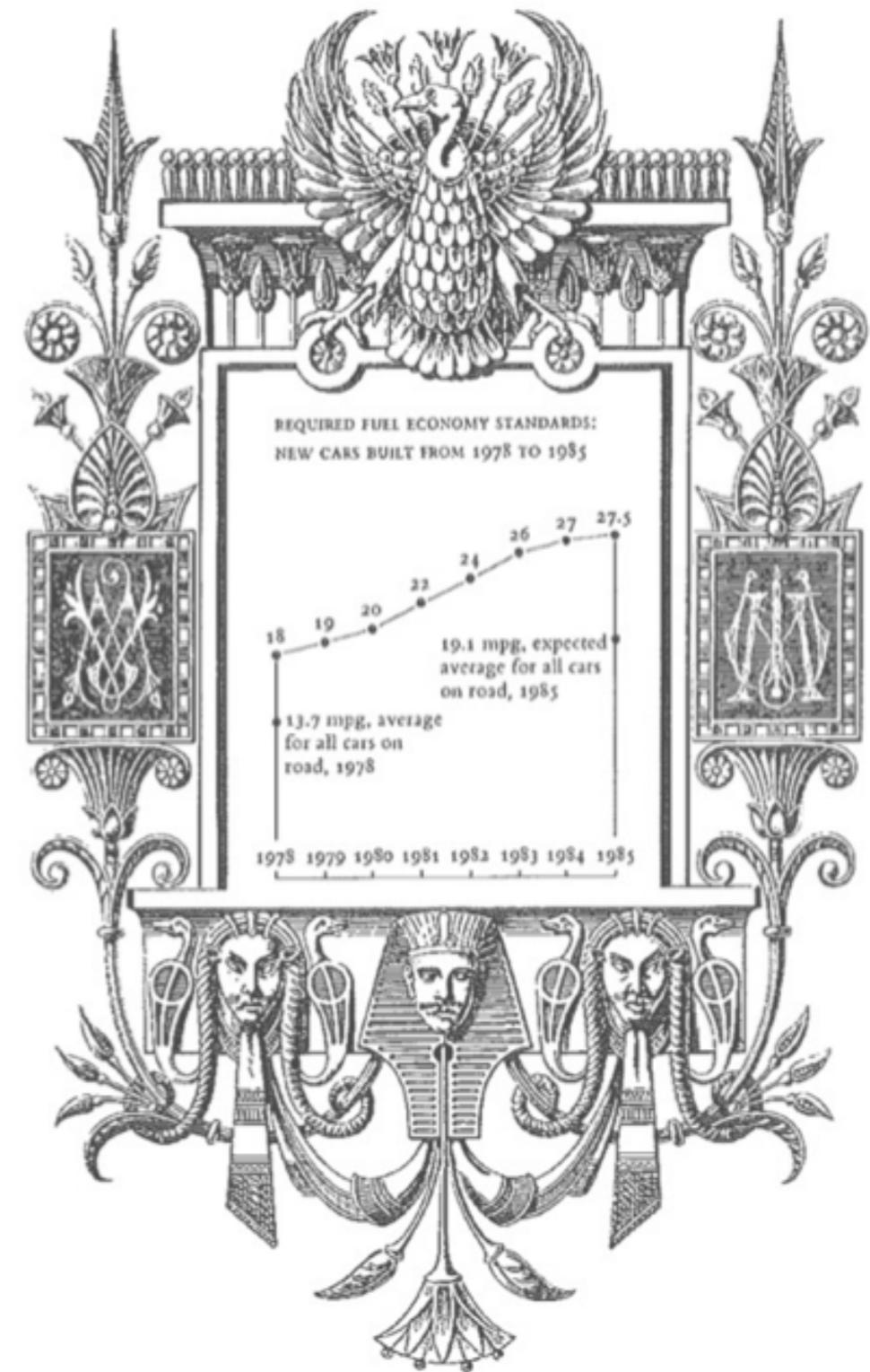
Export von Bananen in Tonnen von 1994-2005



Excel Charts Blog

Tufte's Design Principles

- Graphical integrity
- The Lie Factor
- Maximize data-ink ratio
- Avoid chart junk



REASONS TO GO TO VIZTHINK '08

Does your organization struggle with poor communication? Frustrating design processes? Ineffective learning? Visual Thinking can help. Here are just some of the problems you'll solve and some of the things you'll learn at VizThink '08.

WHAT YOU WILL SOLVE

...slide 127...we're halfway though now!



DEATH BY POWERPOINT



ANALYSIS PARALYSIS



TEAMWORK

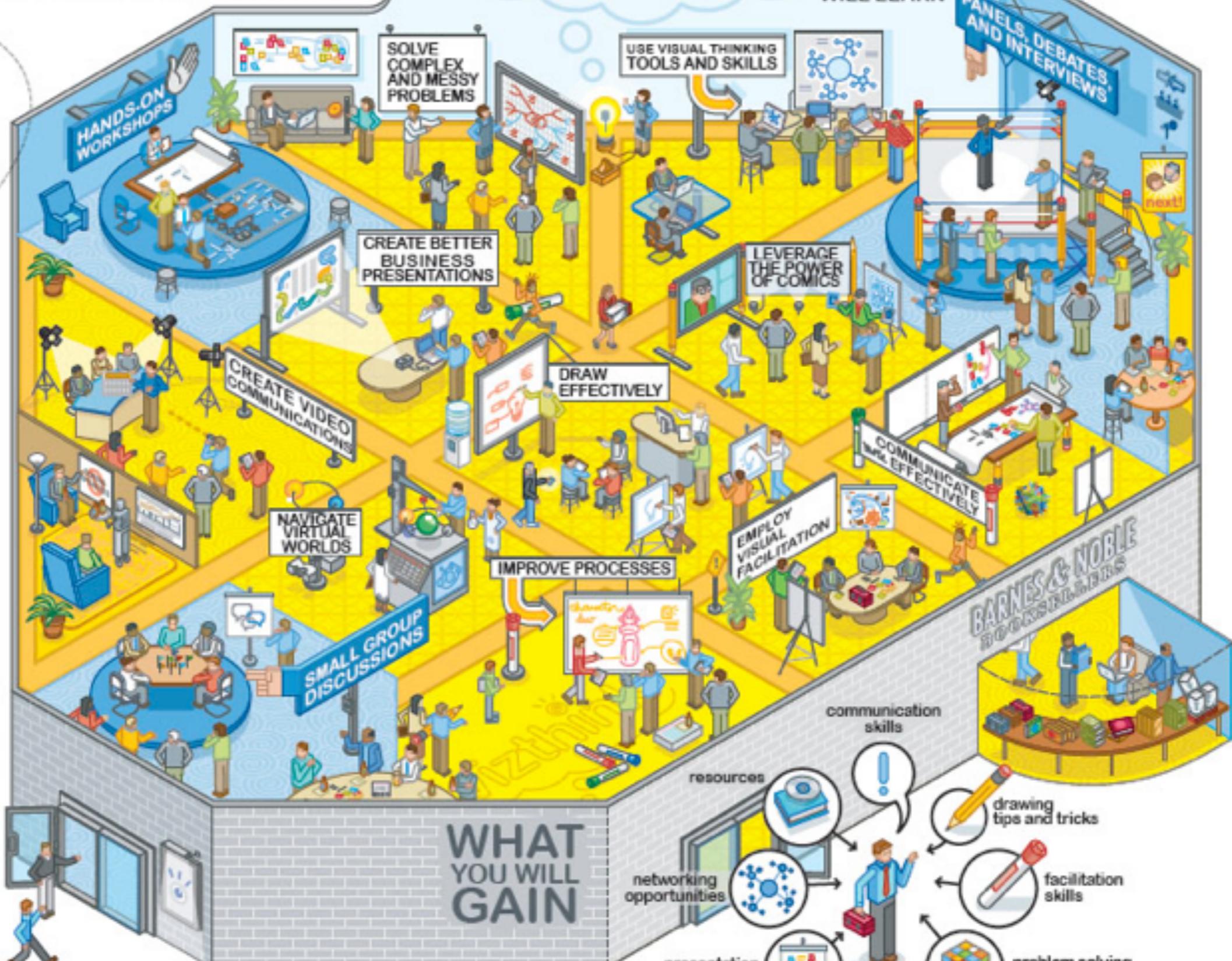
INEFFECTIVE COMMUNICATION



PROCESS HELL

vizthink'08

WHAT YOU WILL LEARN

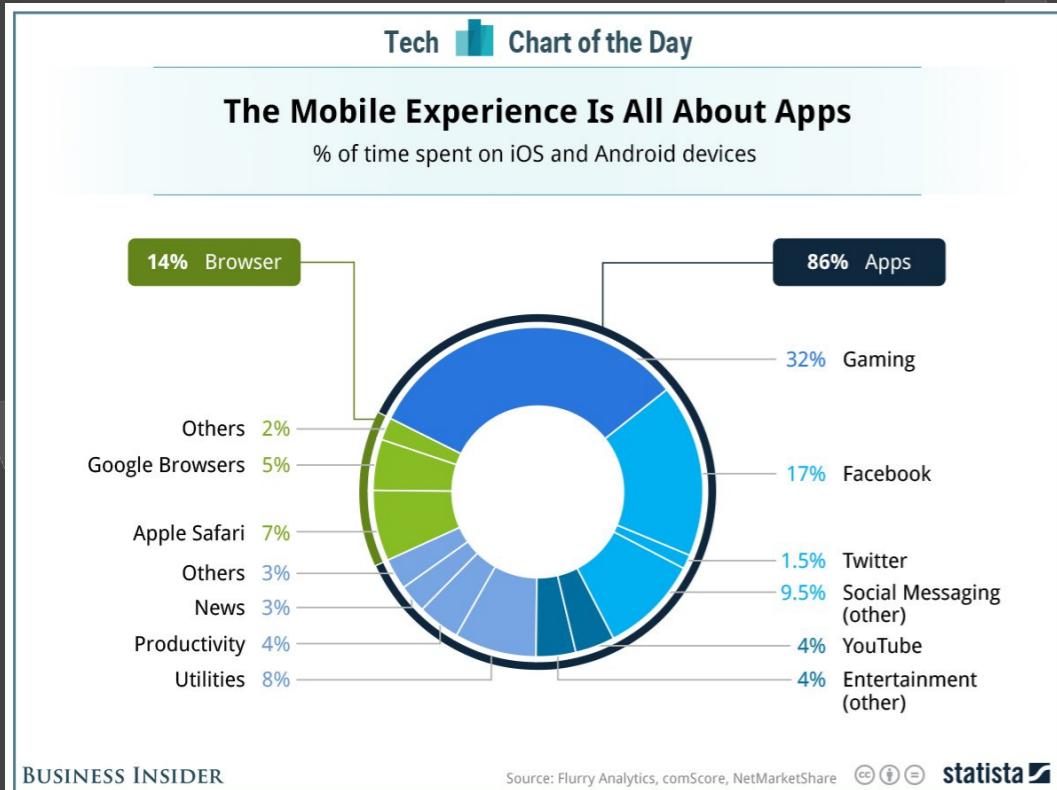


Subjective Dimensions

- **Aesthetics:** Attractive things are perceived as more useful than unattractive ones
- **Style:** Communicates brand, process, who the designer is
- **Playfulness:** Encourages experimentation and exploration
- **Vividness:** Can make a visualization more memorable

Activity

Answer the following questions and redesign this visualization. (2 + 3 min)



bit.ly/visallaboutapps

- What questions does this visualization answer?
- What marks and channels are used?
- Does it violate Tufte's design principles? Which ones?
- Why do you like / dislike this visualization?

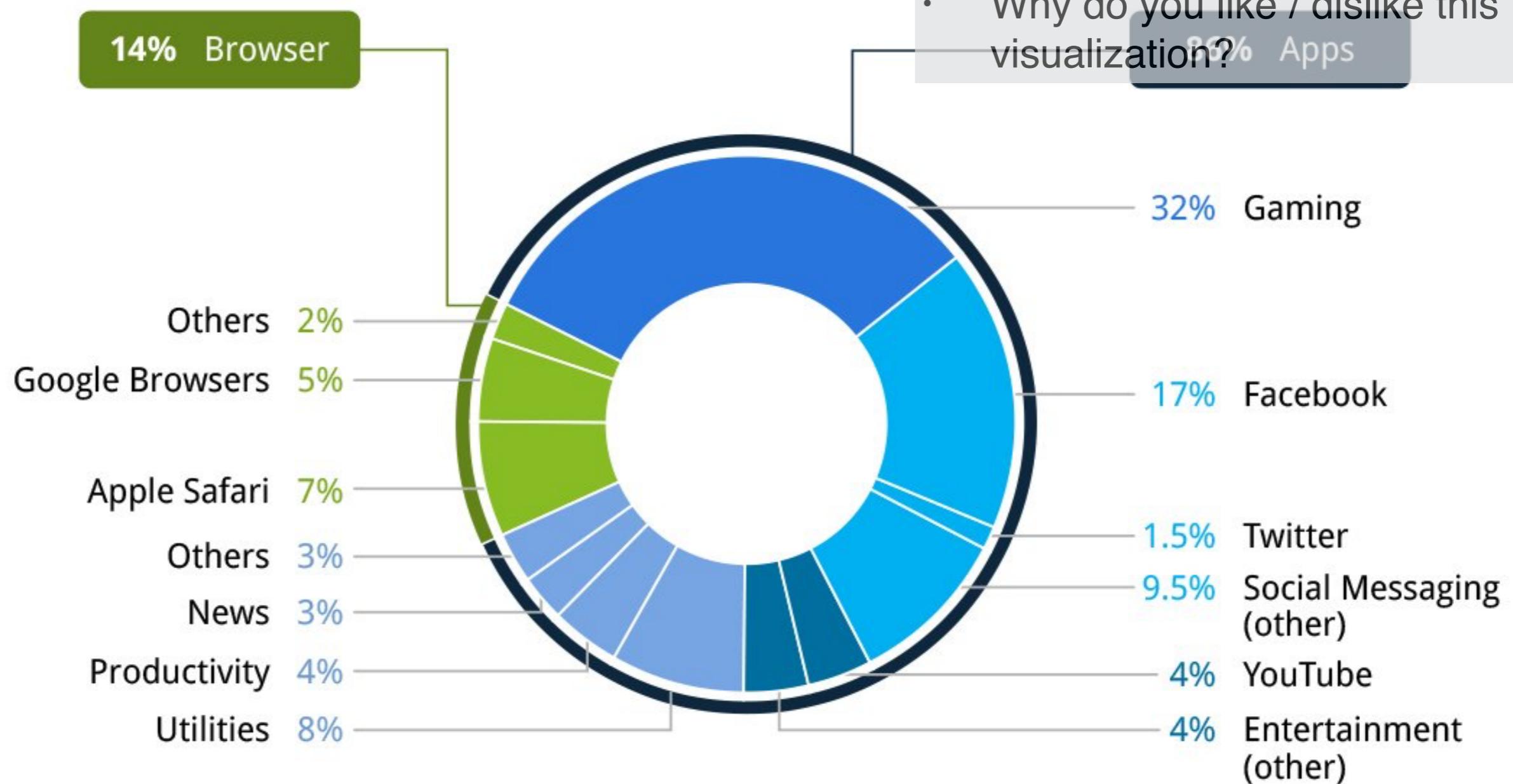


- What questions does this visualization answer?

- What marks and channels are used?

- Does it violate Tufte's design principles? Which ones?

- Why do you like / dislike this visualization?

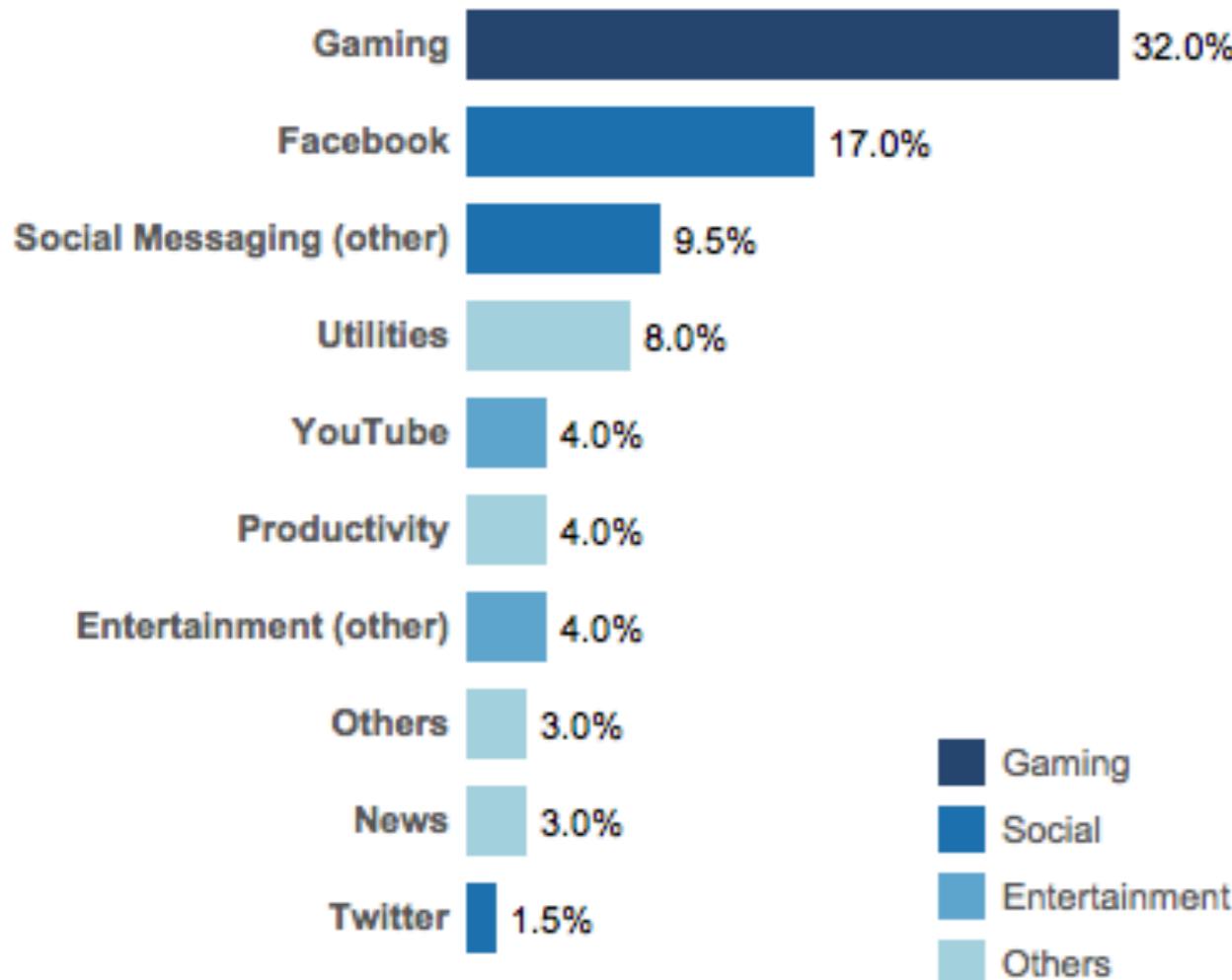


The mobile experience is all about apps!

% of time spent on iOS and Android devices

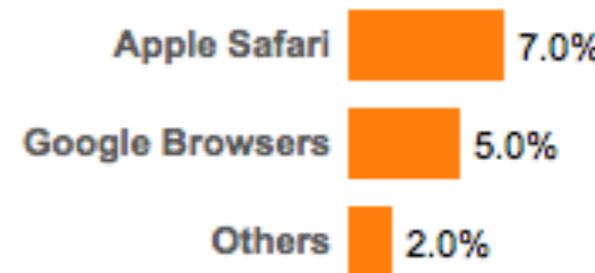
Time spent on Apps

86%



Time spent on Browsers

14%



How?

What are the underlying
human factors and perceptual
principles for effective design?



This Thursday...

- Introduction to JavaScript
- Reading: Murray, Chapter 3 (p. 35-49)



Next Tuesday...

- Perception
- Reading: Ware, Chapter 2 (optional: Chapter 4)



Homework (due Monday)...

- Homework 1

One-Minute Paper