DASHBOARDS & VISUAL COMMUNICATION

UNIVERSITY OF CALGARY

PRESENTATION AND VISUAL COMMUNICATION

Effectively communicating your analysis findings to other people

DASHBOARD DESIGN

Creating tools that allow others to use, explore, and maintain awareness of data.

USEFUL WHEN PRESENTING YOUR OWN WORK AND WHEN CRITIQUING OTHERS'

A FEW MISTAKES THAT WE ALL MAKE

Making meaningful comparisons

Inferring trends and differences from noise

Assumptions about the meaning of correlations

Claims of “significance”

MAKING MEANINGFUL COMPARISONS

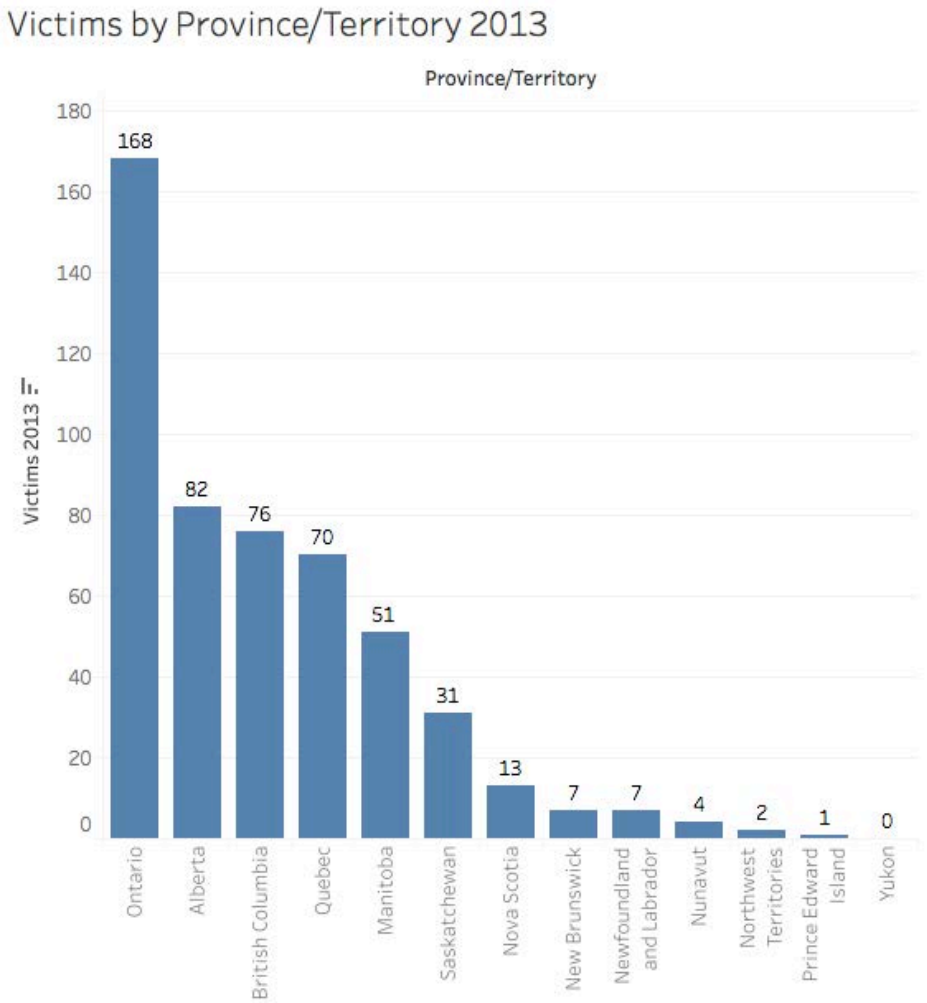
Normalized vs. **Non-normalized** Counts

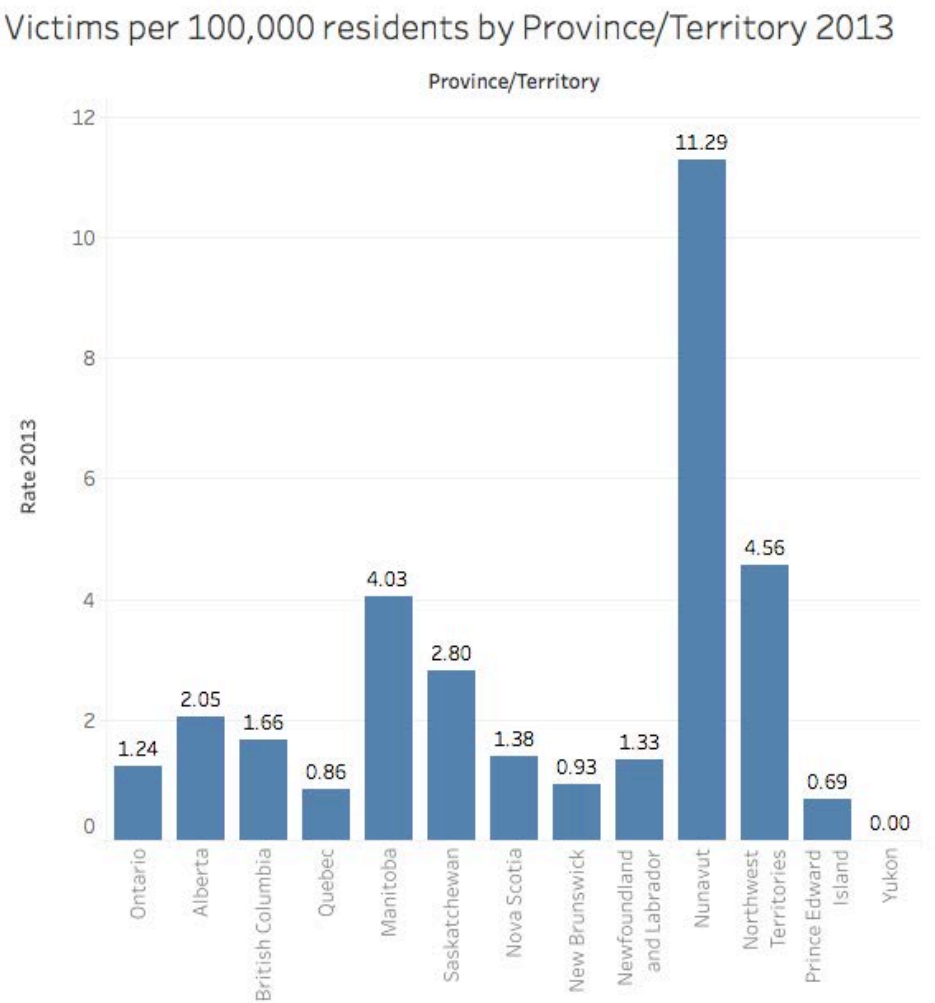
- Murders / Capita
- Failing grades / 100 Students
- Etc.

Counts vs. **Distinct Counts**

- # visits vs. # of customers

WHAT IS THE MOST DANGEROUS PROVINCE?



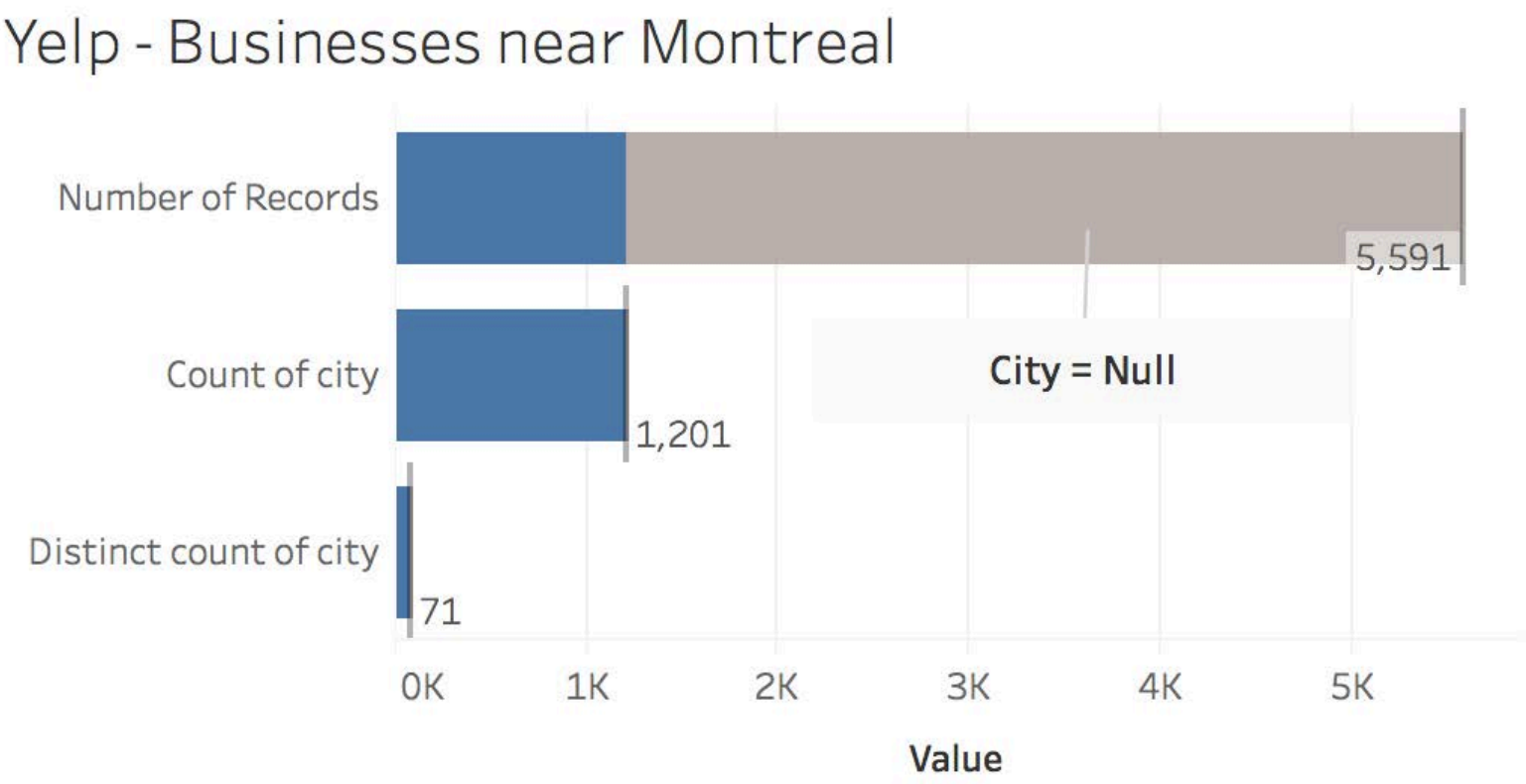


COUNT vs COUNT DISTINCT

Number of Records =
How many individual rows are there?

Count =
How many rows have a value for this column?

Count Distinct =
How many distinct values are there in this column?



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WE ALMOST ALWAYS KNOW LESS THAN WE THINK WE DO

(Even after we've looked at the data.)

LOOKING FOR PATTERNS IN STATIC

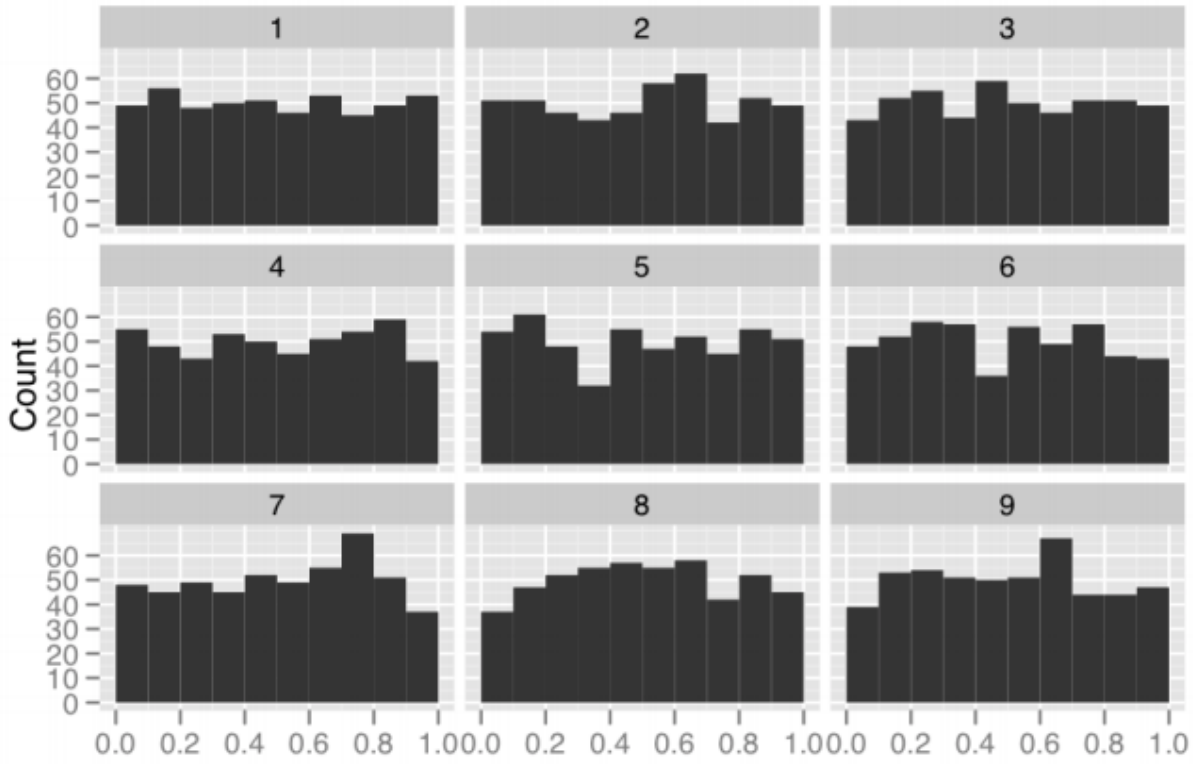
Almost all data has noise, errors, and variability.

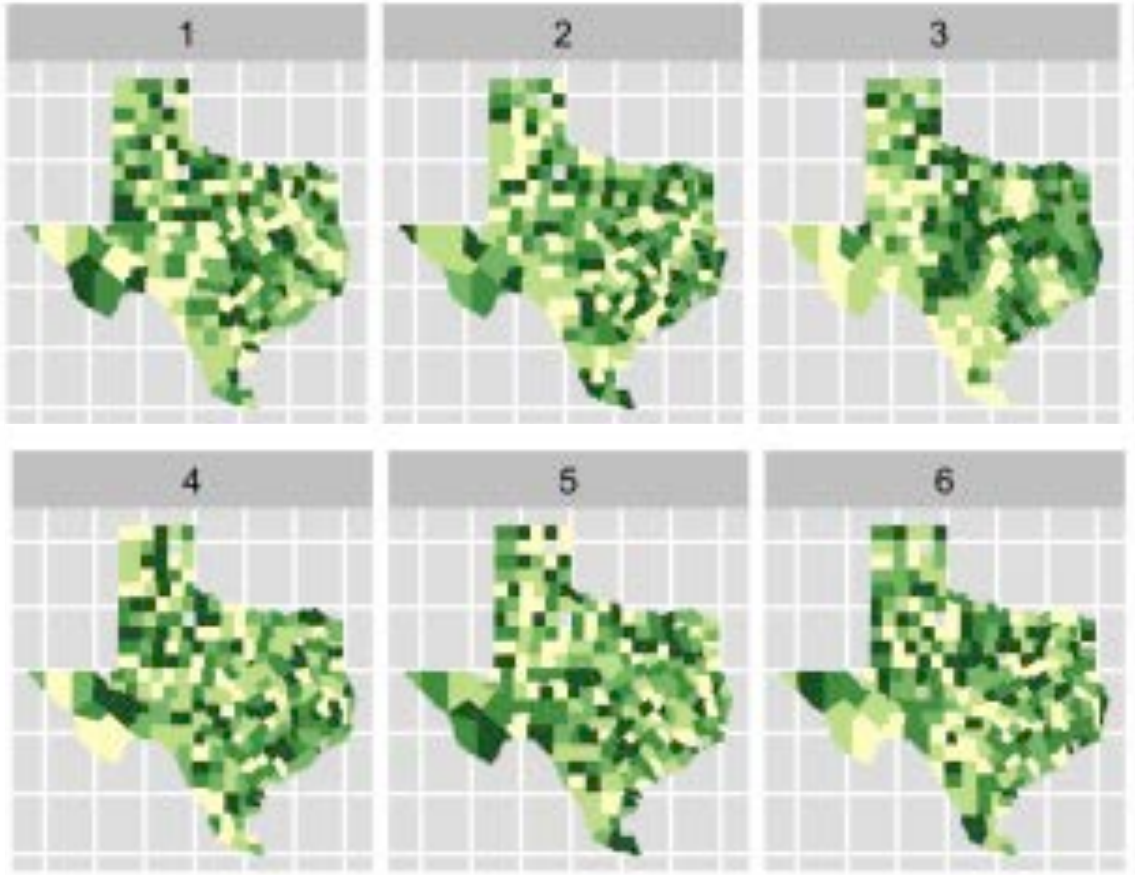
We are great at seeing patterns – **even when we shouldn't.**

IT'S VERY EASY TO TELL STORIES AROUND DATA

...but it's harder to show that those stories are robust!

RANDOM DATA vs REAL DATA





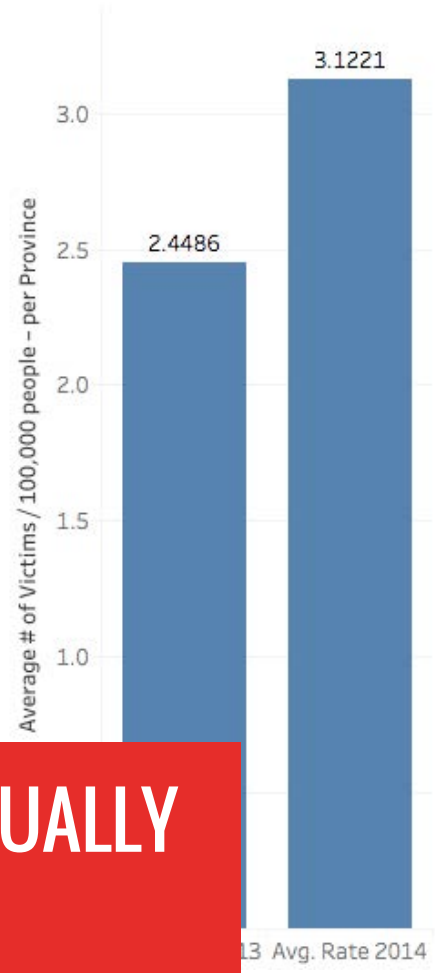
[Wickham et al. 2010]

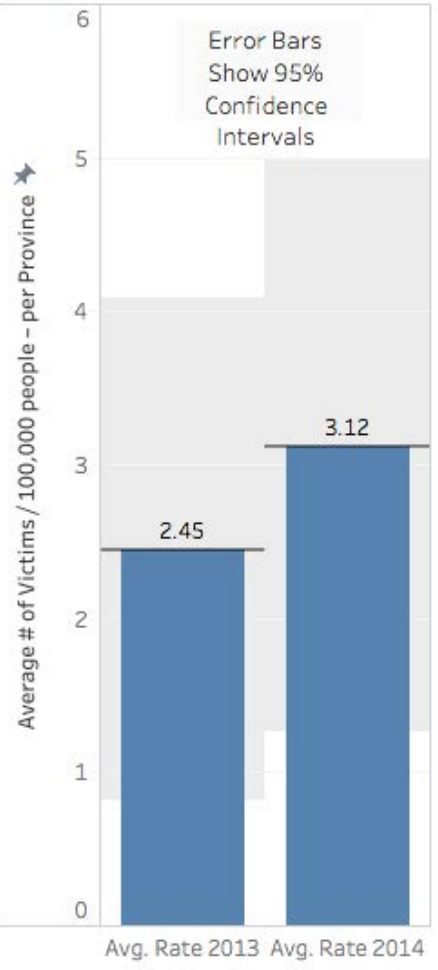
A "RORSCHACH" PROTOCOL

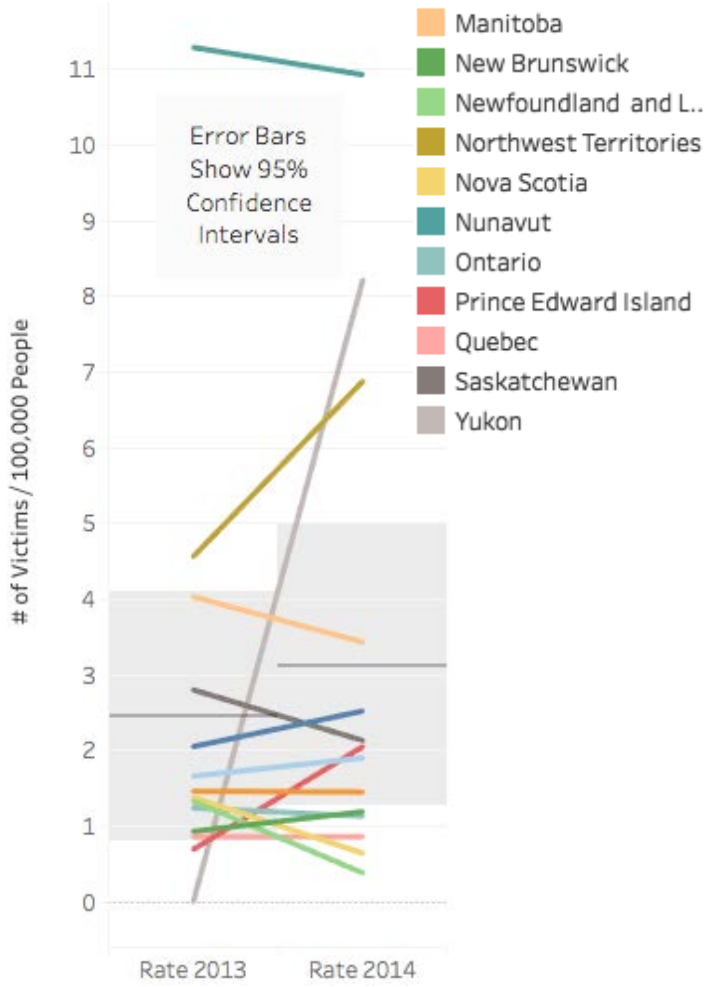
IGNORING EFFECT SIZE AND VARIABILITY

Victims by Province Territory Table

Province/Territory	Rate 2013	Rate 2014
Alberta	2.05	2.52
British Columbia	1.66	1.90
Manitoba	4.03	3.43
New Brunswick	0.93	1.19
Newfoundland and Labra..	1.33	0.38
Northwest Territories	4.56	6.88
Nova Scotia	1.38	0.64
Nunavut	11.29	10.93
Ontario	1.24	1.13
Prince Edward Island	0.69	2.05
Quebe		
Saska		
Yukon		







ALTHOUGH, THIS IS ACTUALLY A REALLY BAD EXAMPLE!

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Assumptions about the meaning of correlations

Claims of “significance”

CORRELATIONS

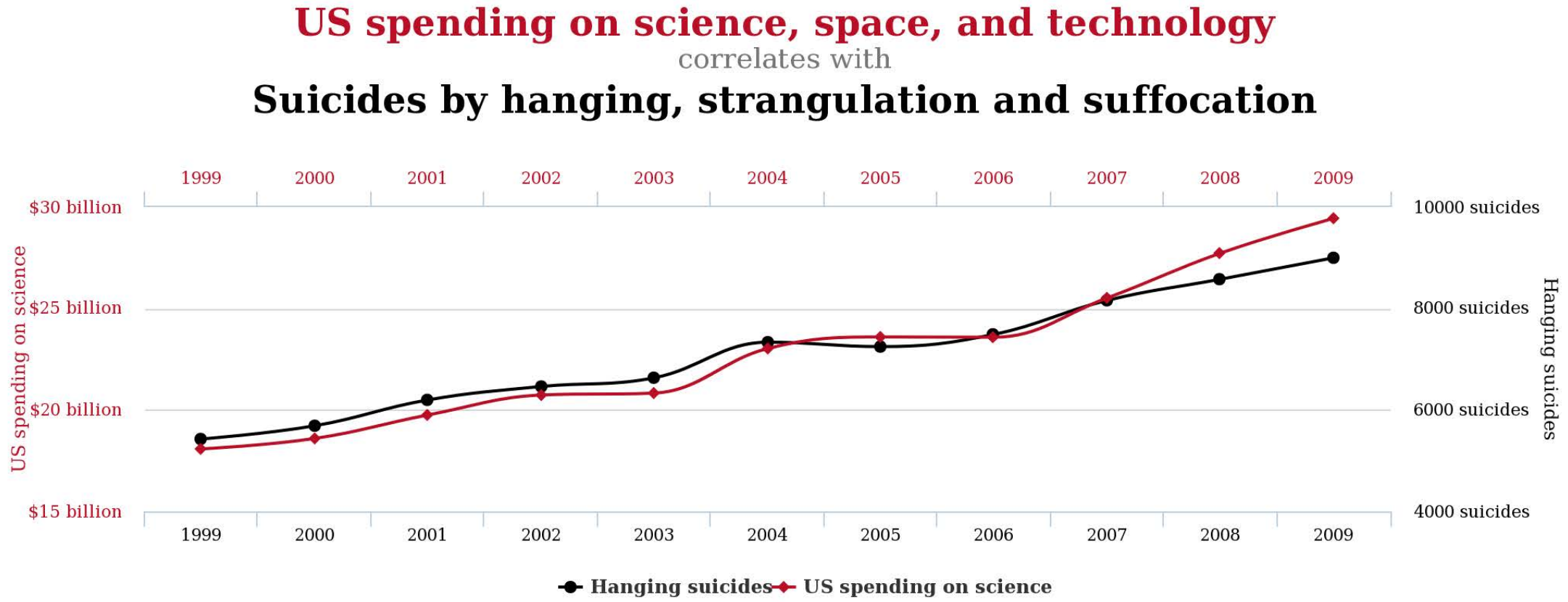
Is there **really** a correlation?

How **strong** is it?

Is it **corroborated** by other data?

Does it **make sense**?

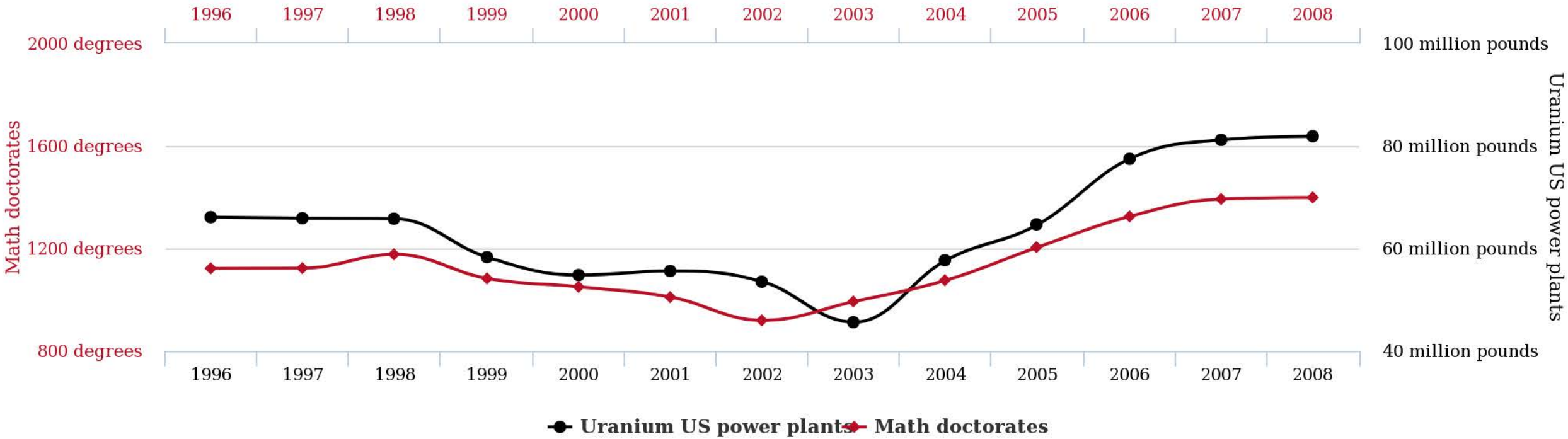
EVEN STRONG CORRELATIONS MIGHT NOT MEAN ANYTHING!



Math doctorates awarded

correlates with

Uranium stored at US nuclear power plants



tylervigen.com

A FEW MISTAKES THAT WE ALL MAKE

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Inferring trends and differences from noise

Assumptions about the meaning of correlations

Claims of “significance”

THE "LITERALLY" OF DATA ANALYSIS

“SIGNIFICANTLY...

NEVER SAY THIS ...

UNLESS YOU’RE SURE THAT YOU HAVE PERFORMED THE CORRECT **STATISTICAL SIGNIFICANCE TEST** AND CAN REPORT **P-VALUES, EFFECT SIZES**, ETC.

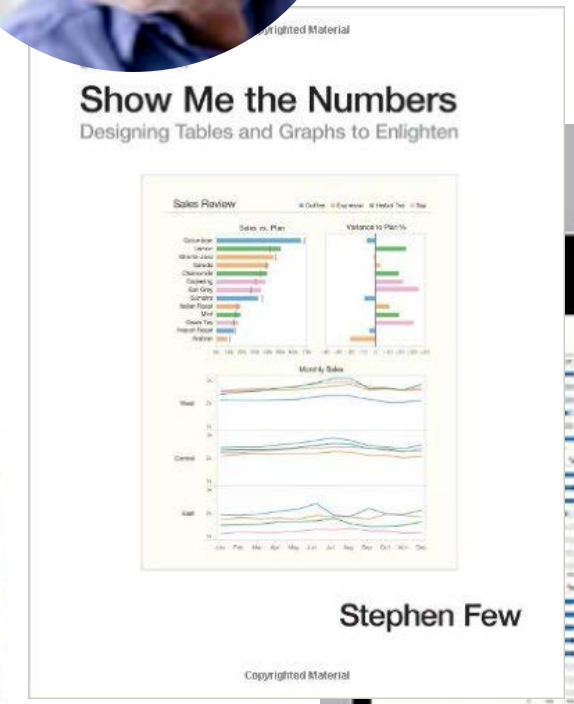
DIFFERENT
HIGHER/LOWER
BIGGER/SMALLER
MORE/LESS
MORE IMPORTANT
ETC...

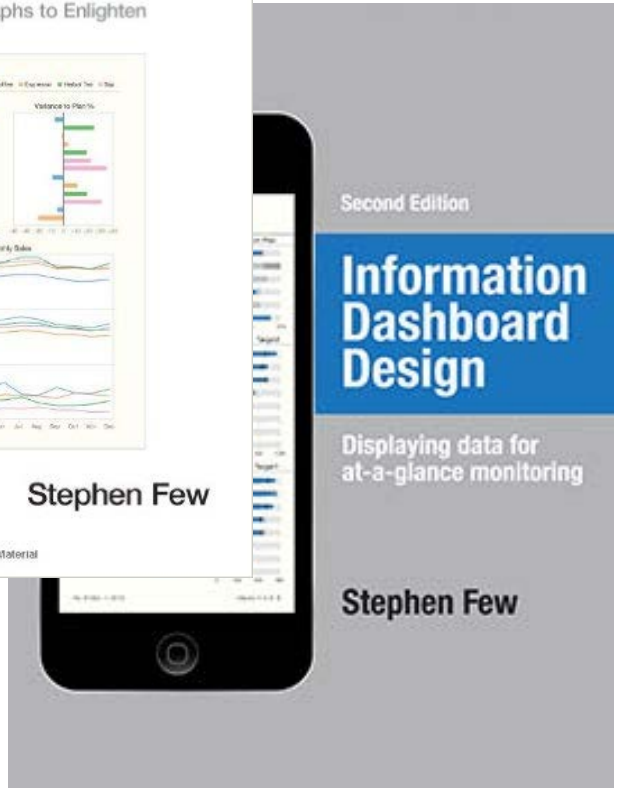
COMMUNICATING ASSUMPTIONS AND LIMITATIONS

A good analysis must avoid overstating claims, and be honest about what you don't or can't know!

Edward Tufte

Stephen Few





GRAPHICAL INTEGRITY

Well-designed presentation of **interesting data**

Substance, statistics, and design

Complex ideas communicated with **clarity**, **precision** and **efficiency**

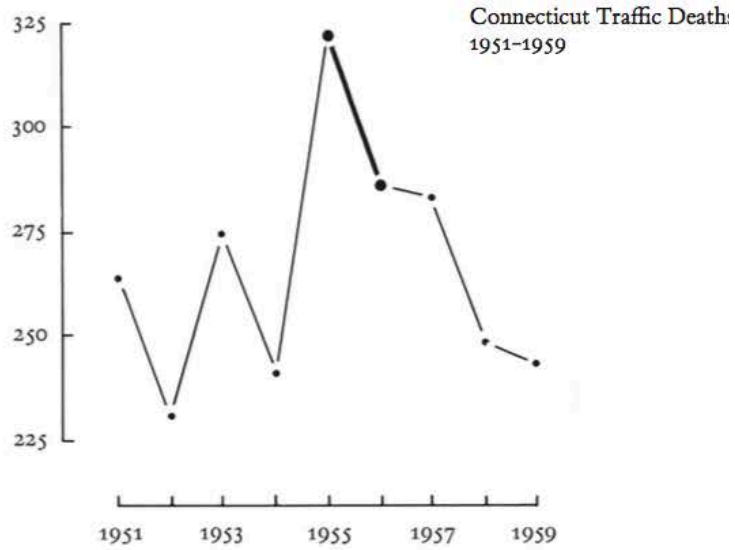
Gives the viewer **greatest number of ideas** in the **shortest amount of time**, with the **least ink** and **smallest space**

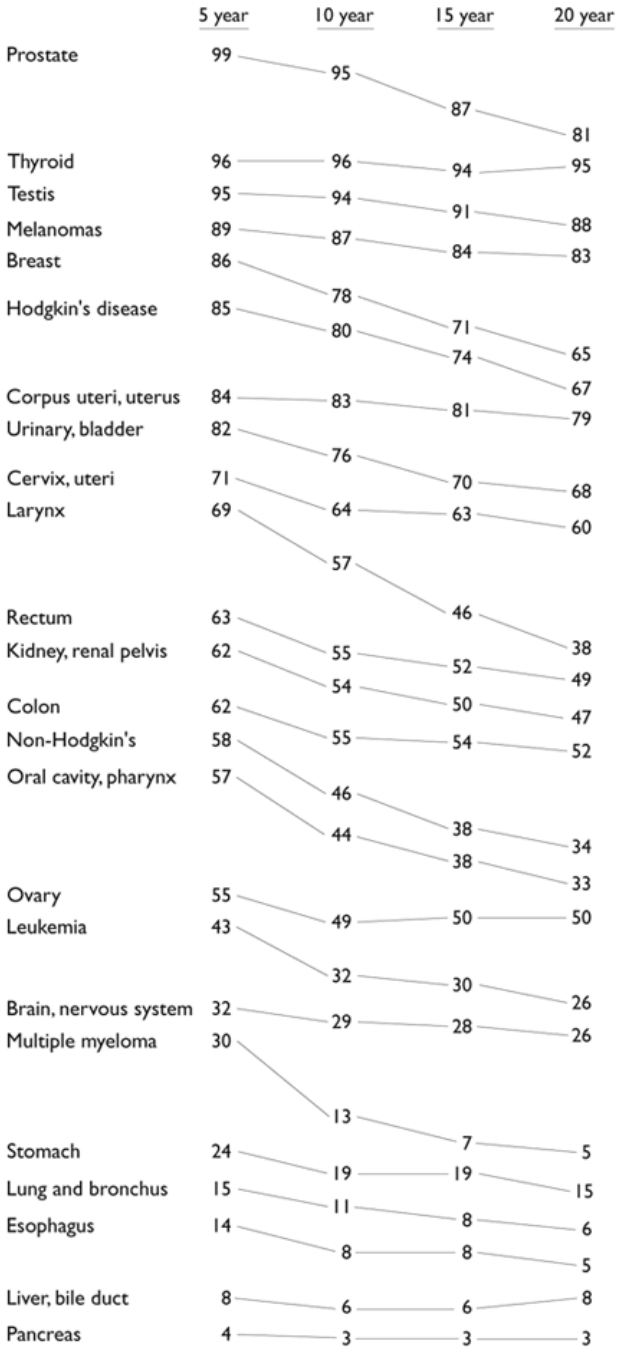
Nearly always **multivariate**

Requires **telling the truth**

Edward Tufte

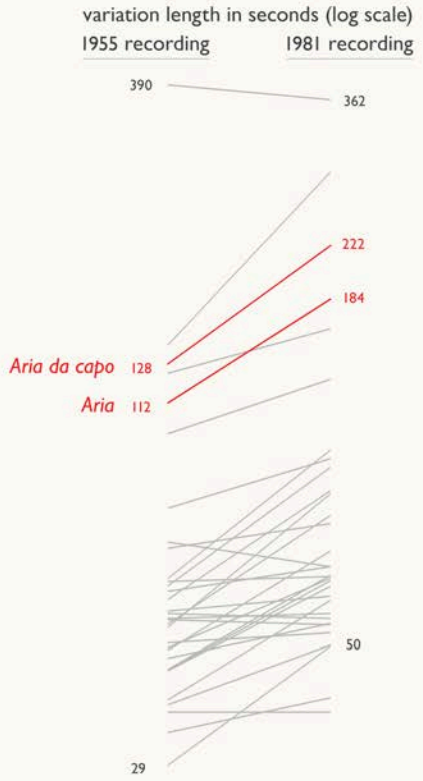
A few more data points add immensely to the account:

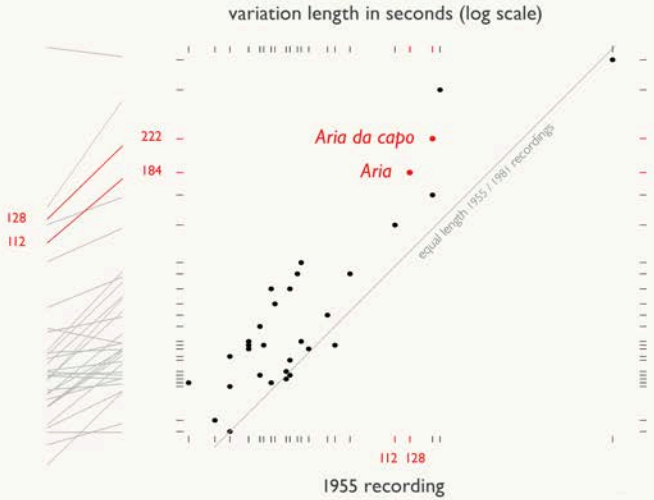




GLENN GOULD, *GOLDBERG VARIATIONS* 1955 AND 1981 RECORDINGS

J. S. Bach's *Goldberg Variations* has 32 parts: an opening *Aria*, 30 variations, and finally an *Aria da capo*, a repeat playing of the opening *Aria*. Two major recordings are Glenn Gould's piano version, recorded in 1955 and 1981. Gould plays 4 versions of the beautiful aria, each differing greatly in pace. The 1981 *Aria da capo* is very very slow – so slow that if it were any slower, the notes would fall apart.





Data from Gould, *Goldberg Variations*. Dotdashplot and slopegraph initially constructed with Lukasz Piwek's *Tufte in R*.

What if I told you:

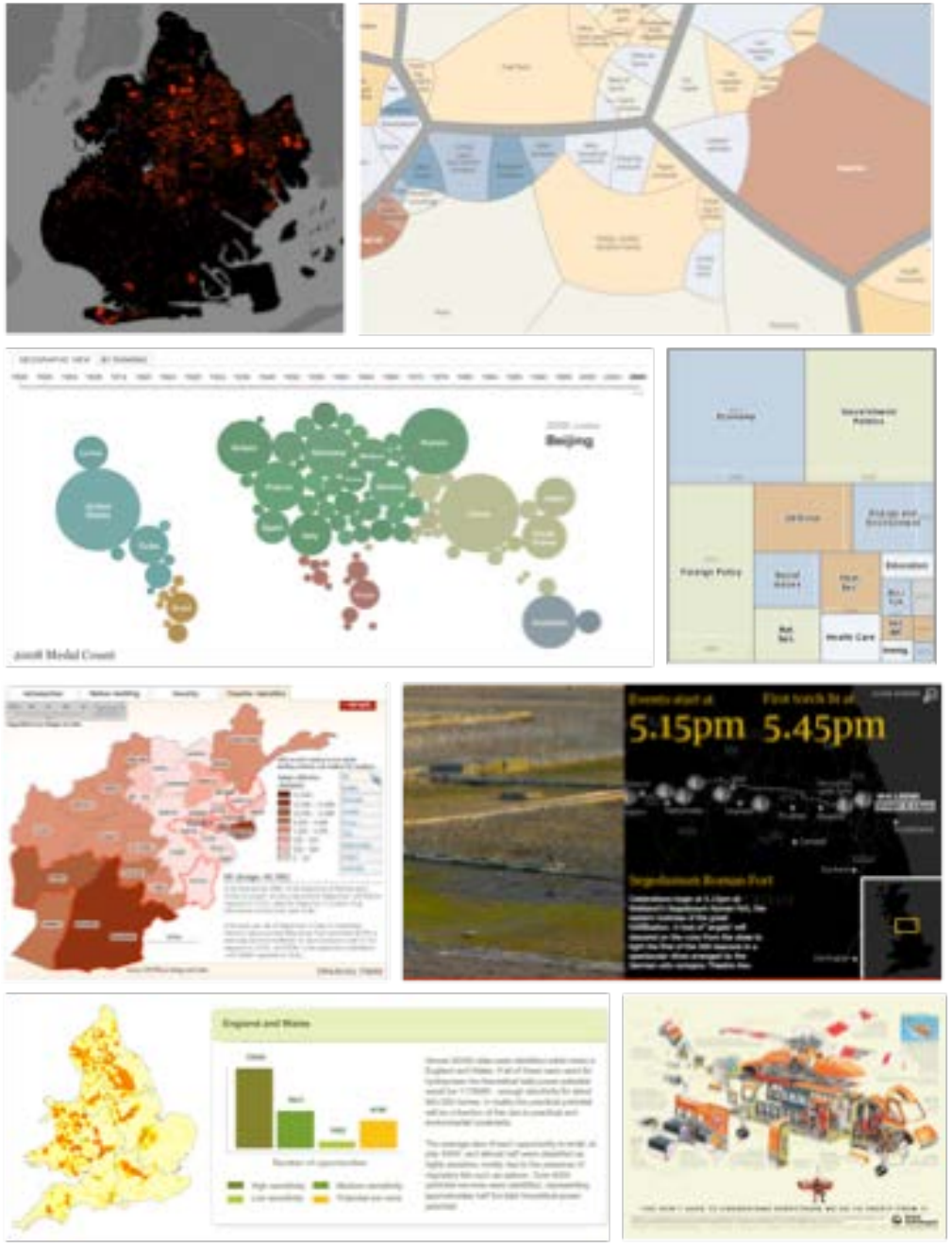
you eat 3496 litres of water

HOW TO COMMUNICATE DATA HONESTLY TO AN AUDIENCE

(my version)

1. **Be clear**
2. **Emphasize** the important parts
3. **Acknowledge assumptions** and **ambiguity**
4. **Avoid overstating results**

USEFUL PATTERNS FOR DATA STORYTELLING

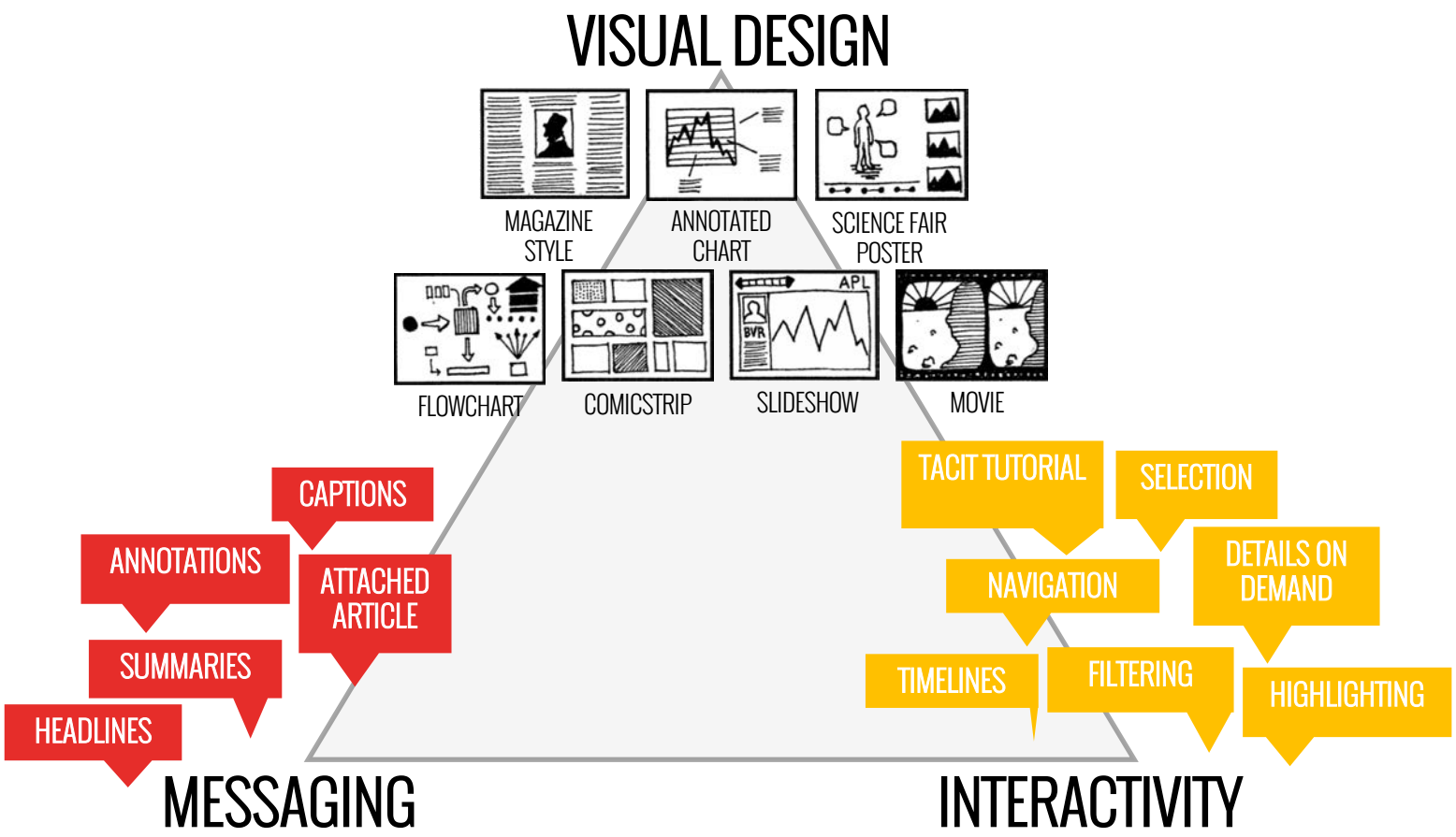


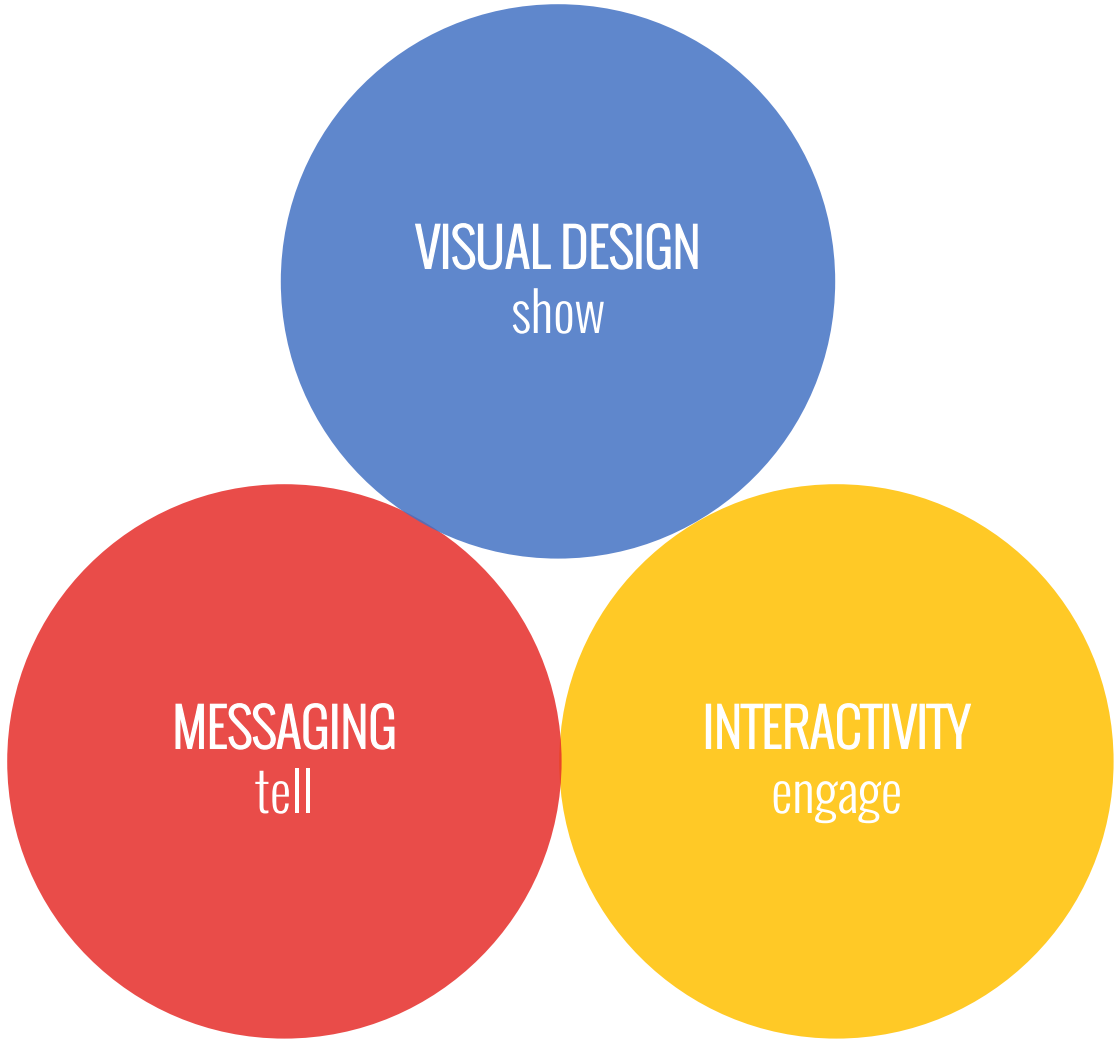
58

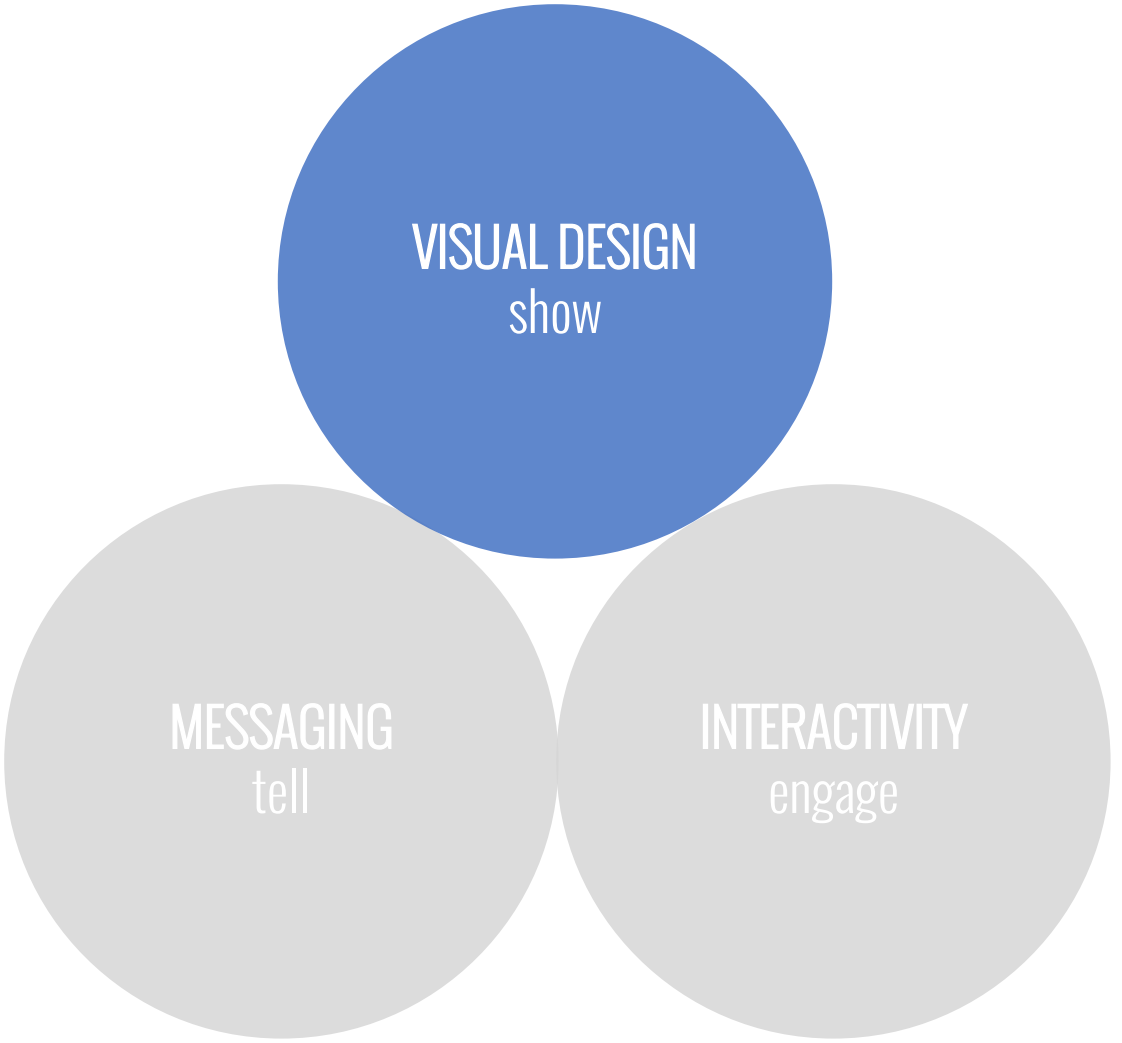
CASE STUDIES

70% JOURNALISM
20% BUSINESS
10% RESEARCH

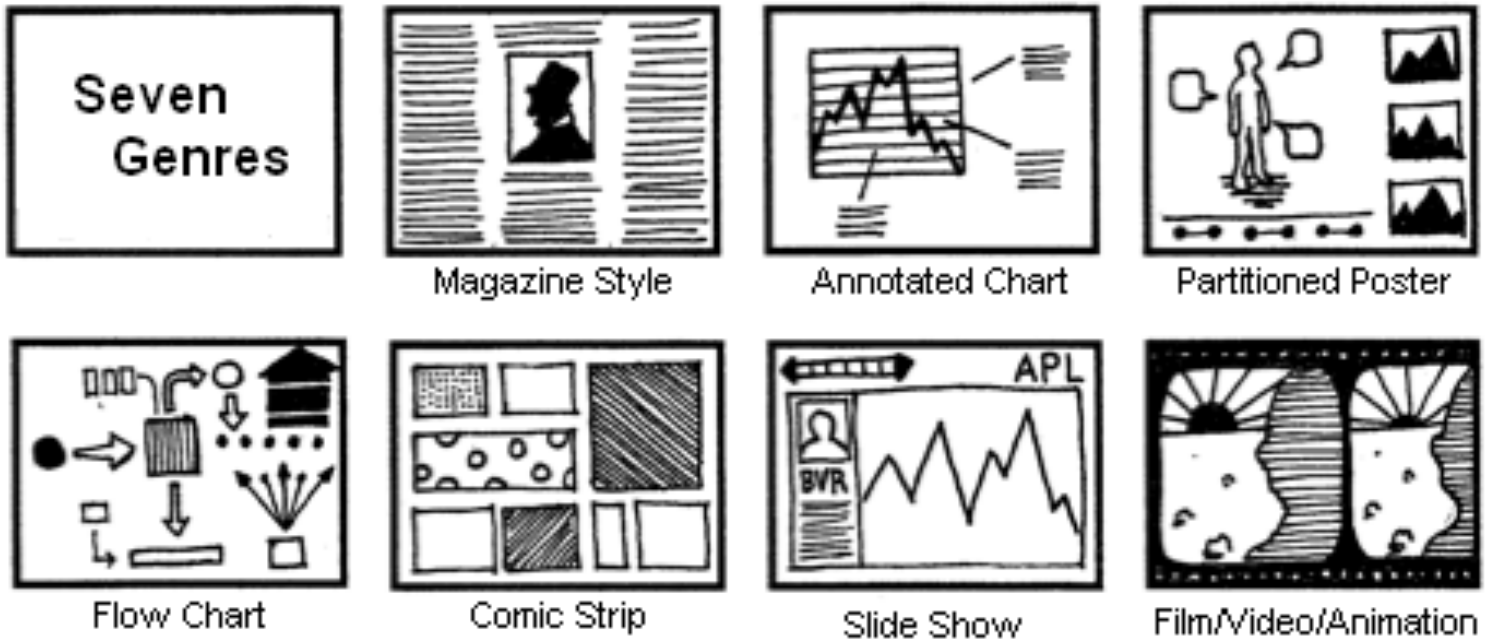
EDWARD SEGEL &
JEFFREY HEER **2010**


VISUAL DESIGN
MAGAZINE STYLE
ANNOTATED CHART
SCIENCE FAIR POSTER
FLOWCHART
COMICSTRIP
SLIDESHOW
MOVIE
CAPTIONS
ANNOTATIONS
ATTACHED ARTICLE
SUMMARIES
HEADLINES
TACIT TUTORIAL
SELECTION
NAVIGATION
DETAILS ON DEMAND
TIMELINES
FILTERING
HIGHLIGHTING
MESSAGING
INTERACTIVITY


VISUAL DESIGN
show
MESSAGING
tell
INTERACTIVITY
engage

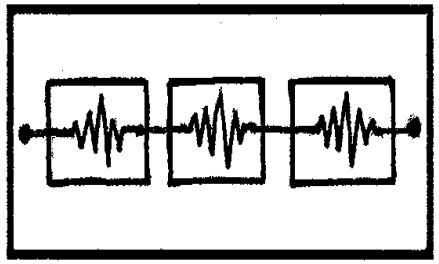

VISUAL DESIGN
show
MESSAGING
tell
INTERACTIVITY
engage

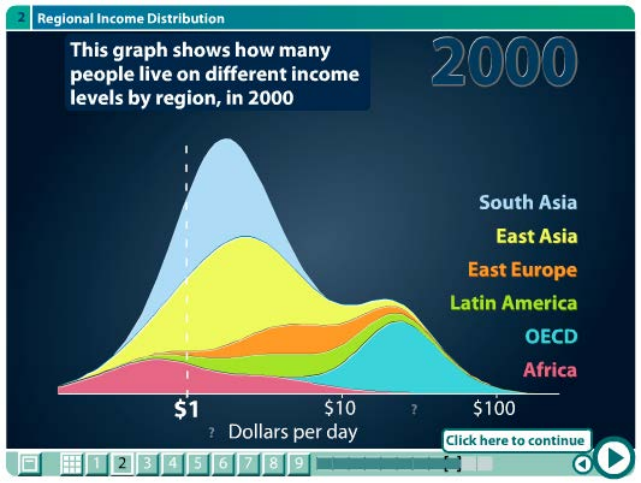
GENRES OF NARRATIVE VISUALIZATION



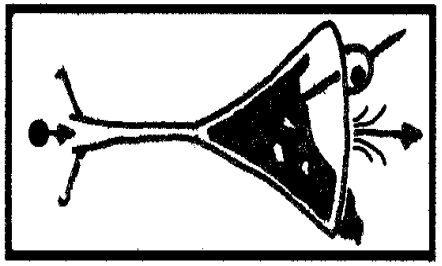
BALANCING AUTHOR- & READER-DRIVEN STORIES

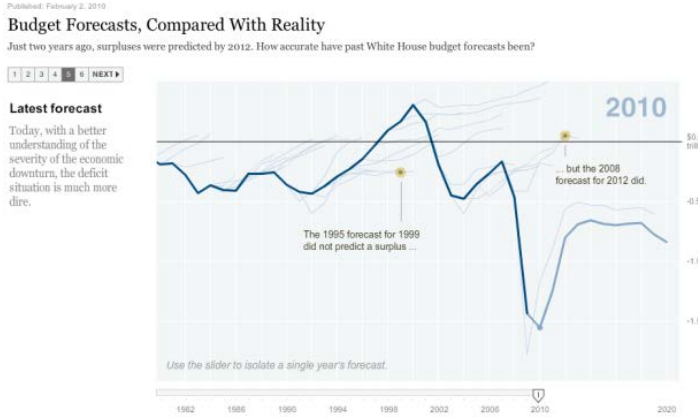
Interactive Slide Show



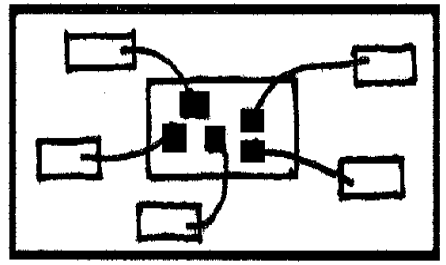


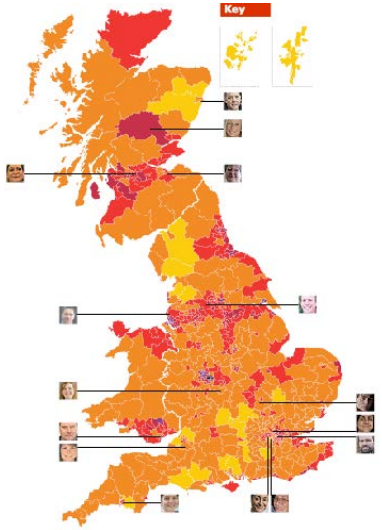
Martini Glass

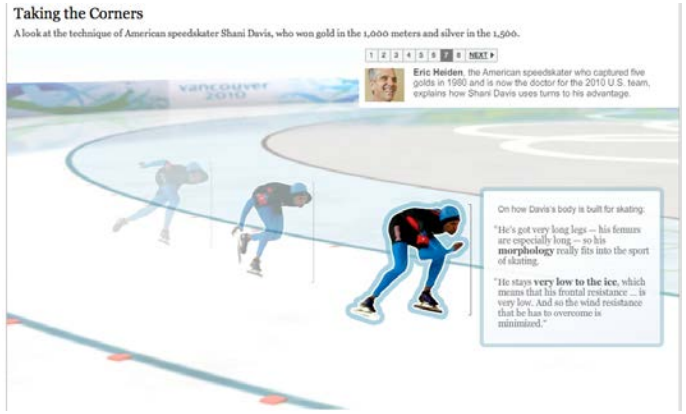




Drill-Down Story

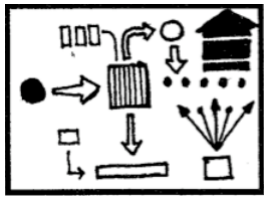




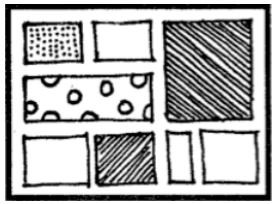


THE MORE LINEAR, THE MORE LIKE A STORY.

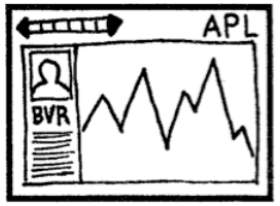
STORIES HAVE A BEGINNING, MIDDLE, AND END.



FLOWCHART



COMICSTRIP

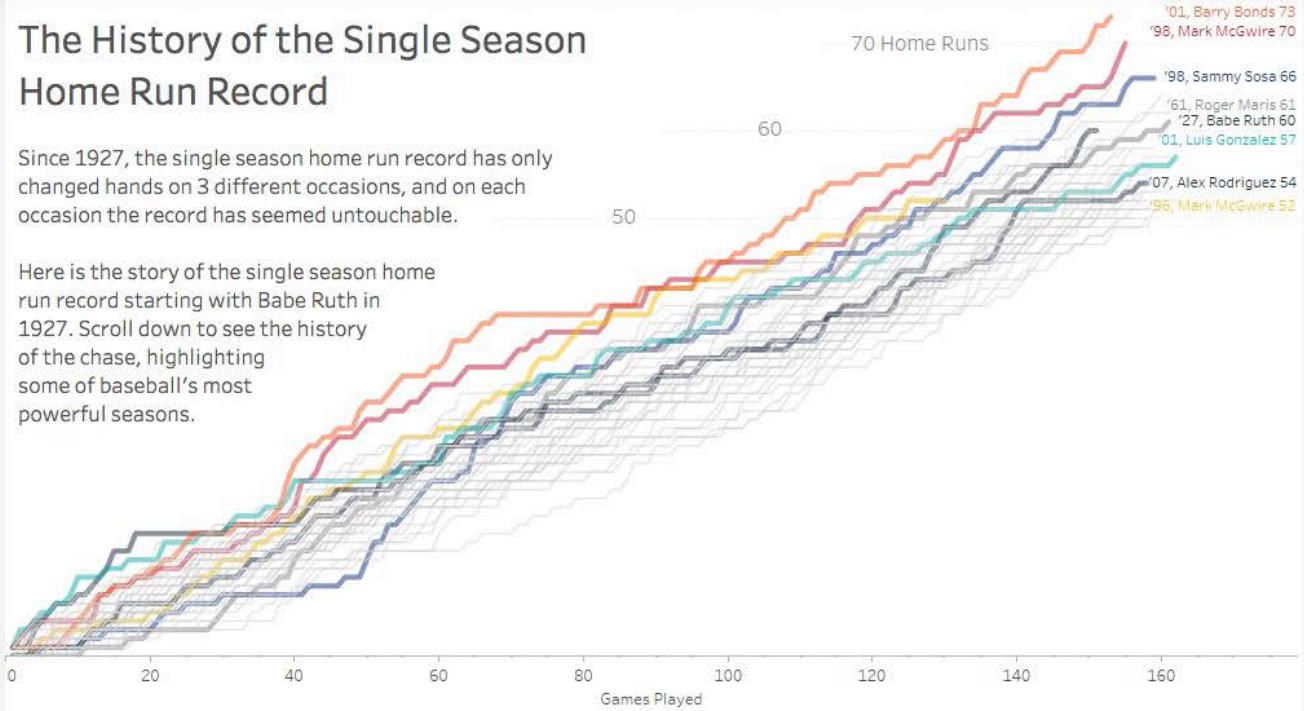


SLIDESHOW

The History of the Single Season Home Run Record

Since 1927, the single season home run record has only changed hands on 3 different occasions, and on each occasion the record has seemed untouchable.

Here is the story of the single season home run record starting with Babe Ruth in 1927. Scroll down to see the history of the chase, highlighting some of baseball's most powerful seasons.

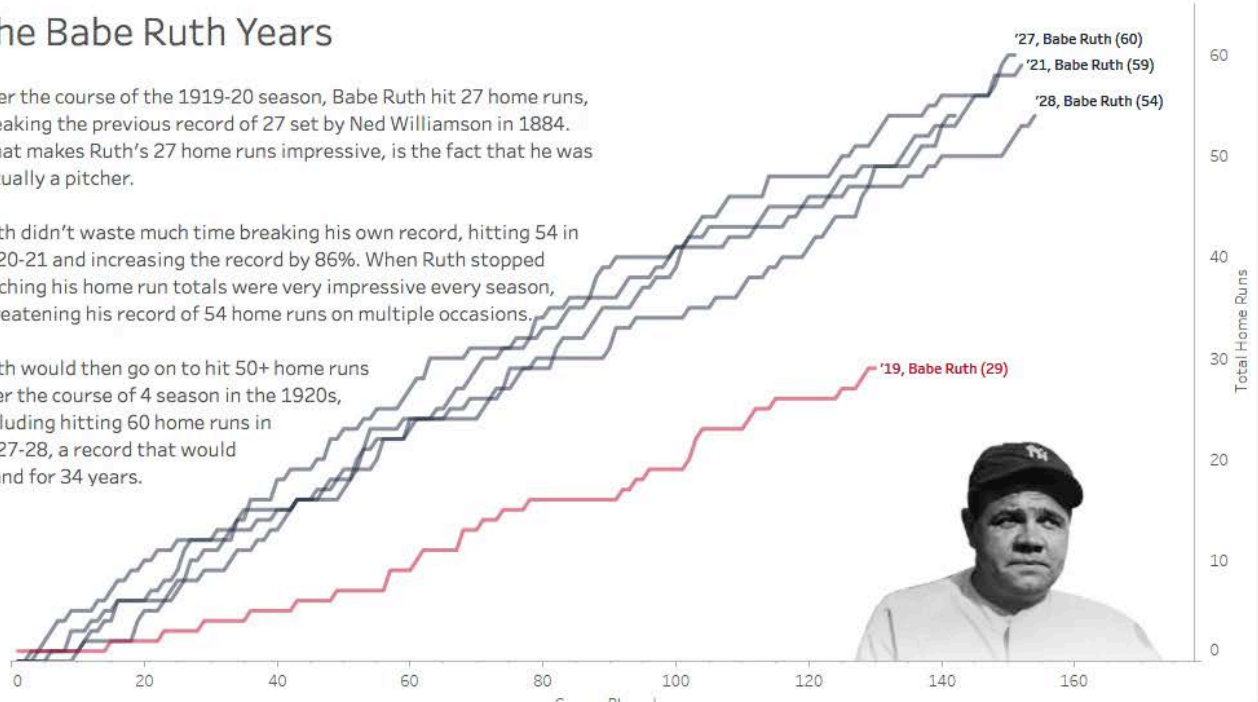


The Babe Ruth Years

Over the course of the 1919-20 season, Babe Ruth hit 27 home runs, breaking the previous record of 27 set by Ned Williamson in 1884. What makes Ruth's 27 home runs impressive, is the fact that he was actually a pitcher.

Ruth didn't waste much time breaking his own record, hitting 54 in 1920-21 and increasing the record by 86%. When Ruth stopped pitching his home run totals were very impressive every season, threatening his record of 54 home runs on multiple occasions.

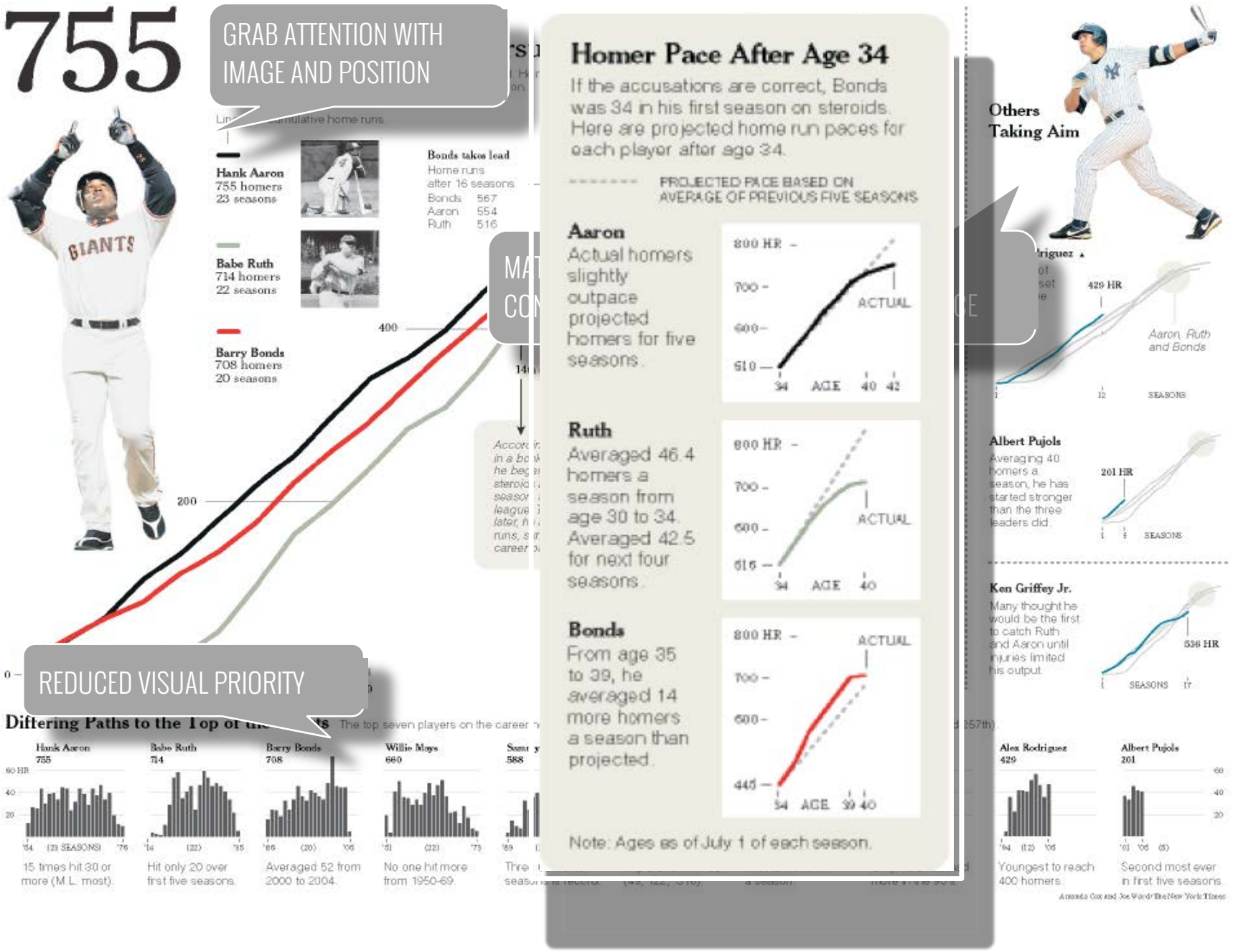
Ruth would then go on to hit 50+ home runs over the course of 4 season in the 1920s, including hitting 60 home runs in 1927-28, a record that would stand for 34 years.



Curtis Harris

USE ESTABLISHING SHOTS

SITUATE THE VIEWER BEFORE DIVING IN.


755
GRAB ATTENTION WITH IMAGE AND POSITION
Hank Aaron
755 homers
23 seasons
Babe Ruth
714 homers
22 seasons
Barry Bonds
708 homers
20 seasons
Bonds takes lead
Home runs after 16 seasons
Bonds 567
Aaron 554
Ruth 516
400
200
0
REDUCED VISUAL PRIORITY
Homer Pace After Age 34
If the accusations are correct, Bonds was 34 in his first season on steroids. Here are projected home run paces for each player after age 34.
PROJECTED PACE BASED ON AVERAGE OF PREVIOUS FIVE SEASONS
Aaron
Actual homers slightly outpace projected homers for five seasons.
Ruth
Averaged 46.4 homers a season from age 30 to 34. Averaged 42.5 for next four seasons.
Bonds
From age 35 to 39, he averaged 14 more homers a season than projected.
800 HR
700
600
510
445
ACTUAL
AGE
34
40
42
39
Note: Ages as of July 1 of each season.
Others Taking Aim
429 HR
Aaron, Ruth and Bonds
SEASONS
Albert Pujols
Averaging 40 homers a season, he has started stronger than the three leaders did.
201 HR
Ken Griffey Jr.
Many thought he would be the first to catch Ruth and Aaron until injuries limited his output.
536 HR
Differing Paths to the Top of the Charts
The top seven players on the career
Hank Aaron 755
Babe Ruth 714
Barry Bonds 708
Willie Mays 660
Alex Rodriguez 429
Albert Pujols 201
15 times hit 30 or more (M.L. most).
Hit only 20 over first five seasons.
Averaged 52 from 2000 to 2004.
No one hit more from 1950-69.
Youngest to reach 400 homers.
Second most ever in first five seasons.

BEGINNING

Lines are cumulative home runs

Hank Aaron
755 homers
23 seasons

Babe Ruth
714 homers
22 seasons

Barry Bonds
708 homers
20 seasons

Bonds takes lead
Home runs after 16 seasons
567
554
516

755
714
23 seasons
22 seasons
20 seasons

Bonds was injured last season. He played 14 games and hit 6 homers

600
400
200
0
14th
5 seasons
10
15

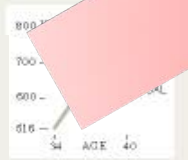
Homer Pace After Age 34

If the accusations are correct, Bonds was 34 in his first season on steroids. Here are projected home run paces for each player after age 34.

PROJECTED PACE BASED ON AVERAGE OF PREVIOUS FIVE SEASONS

Aaron
Actual homers slightly outpace projected homers for five seasons.

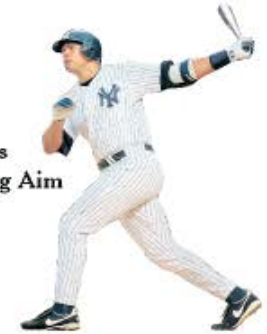
Ruth
Averaged 46.4



to 39, he averaged 14 more homers a season than projected.

Note: Ages as of July 1 of each season.

MIDDLE



Others Taking Aim

Alex Rodriguez ▲
Is ahead of

END

Albert Pujols
Averaging 40 homers a season, he has started strong than the three leaders did.

SEASONS

Ken Griffey Jr.
Many thought would be the to catch Ruth and Aaron un injuries limite his output.

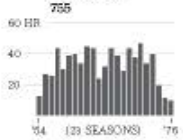
536 HR

17

Differing Paths to the Top of the Charts

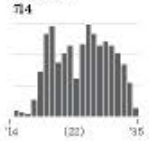
The top seven players on the career home run list, along with a look at Griffey (12th), Rodriguez (37th) and Pujols (tied 257th).

Hank Aaron 755



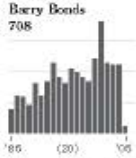
15 times hit 30 or more (M.L. most).

Babe Ruth 714



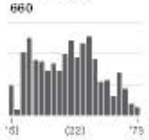
Hit only 20 over first five seasons.

Barry Bonds 708



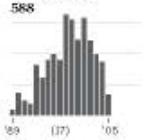
Averaged 52 from 2000 to 2004.

Willie Mays 660



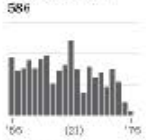
No one hit more from 1950-69.

Sammy Sosa 588



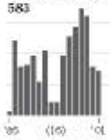
Three 60-homer seasons is record.

Frank Robinson 586



Triple Crown in '66 (49, 122, .316).

Mark McGwire 583



First to hit 70 in a season.

Ken Griffey Jr. 536

Alex Rodriguez 429

Albert Pujols 201

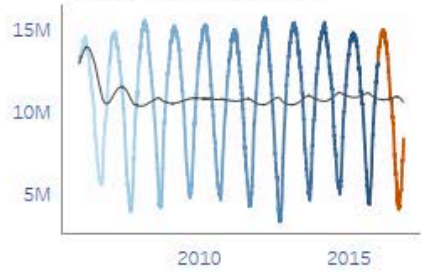
EPILOGUE

Amanda Cox and Joe Ward/The New York Times

The ice is melting.

Pick a region:

Daily Ice Volume (Km^2):



November 7, 2016
8,424,918 km^2

Same day, year on year:

-89,650 km^2 per year, on average.

Northern Hemisphere

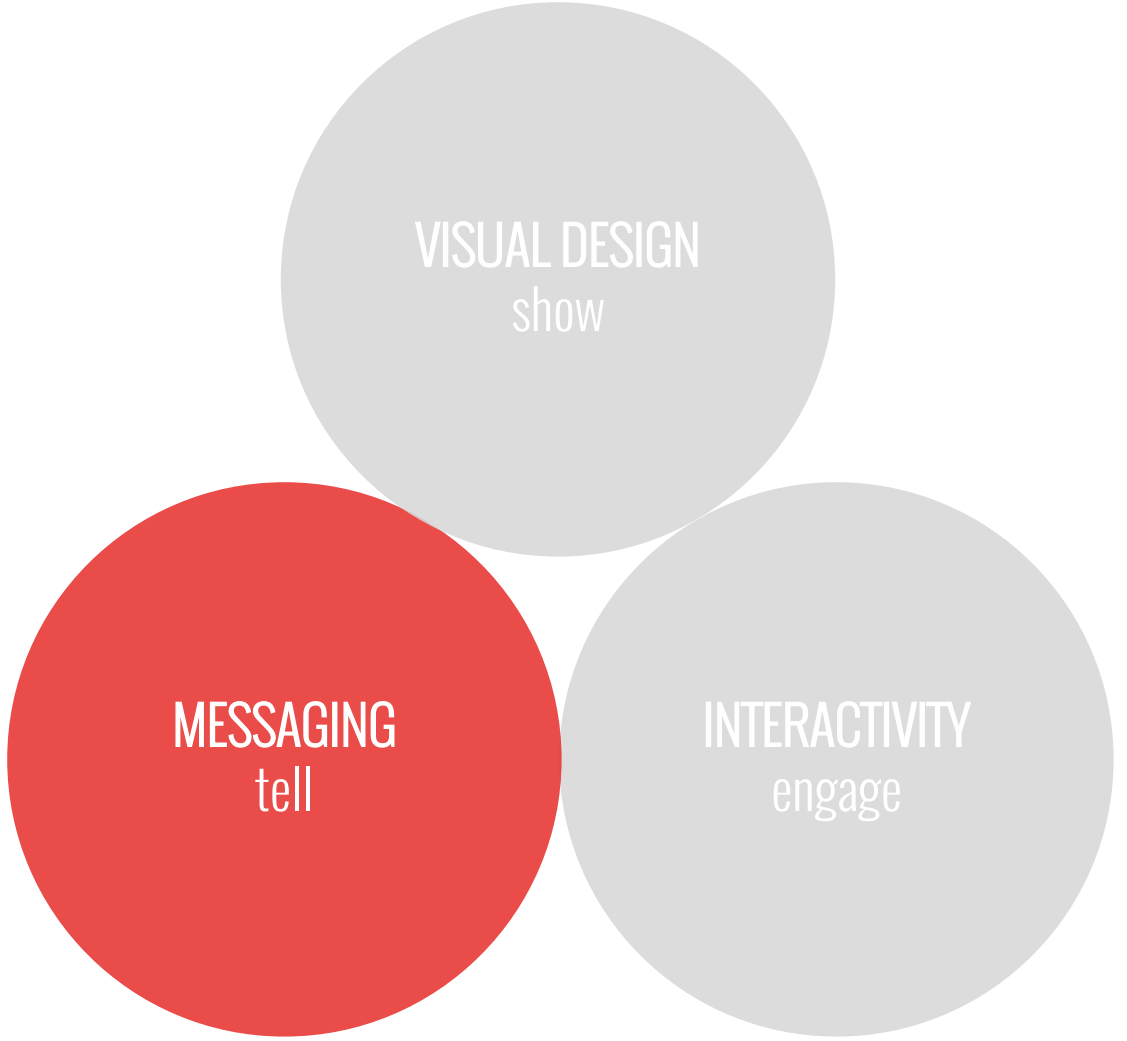
Years:
(All)

2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016

Source: sidads.colorado.edu

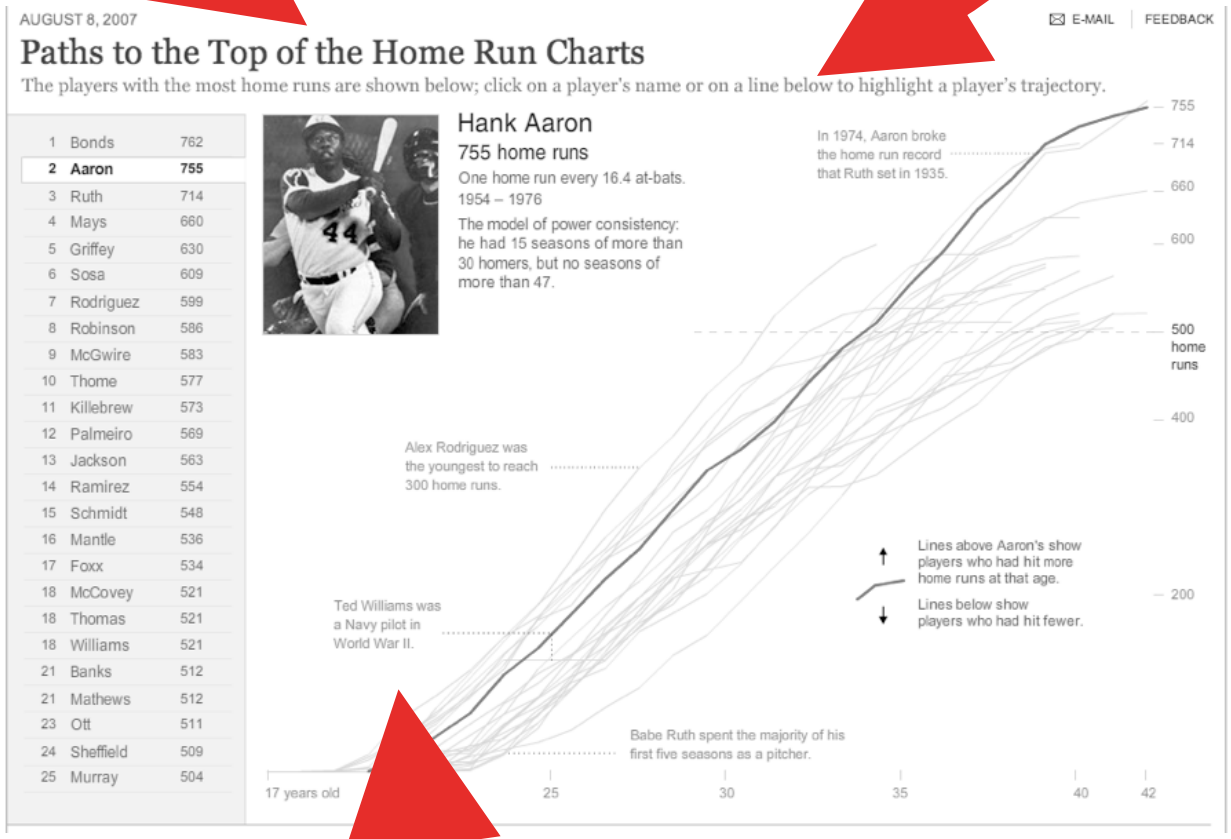
Viz: @Nicco_Cirone

Nicco Cirone


VISUAL DESIGN
show
MESSAGING
tell
INTERACTIVITY
engage

HEADLINE

CAPTION

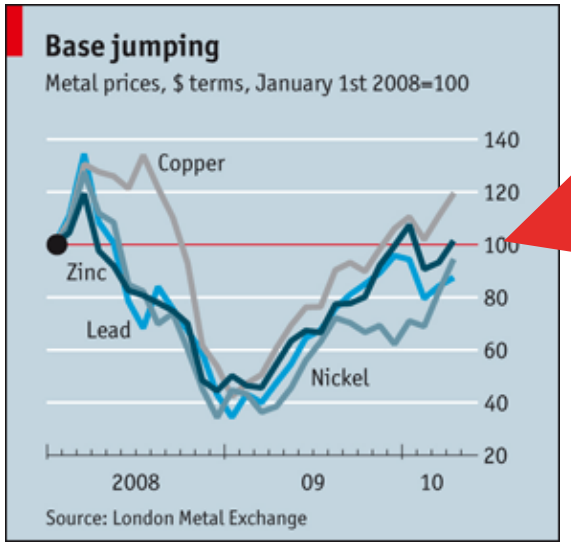


ANNOTATION

USE HEADLINES, CAPTIONS, & ANNOTATIONS

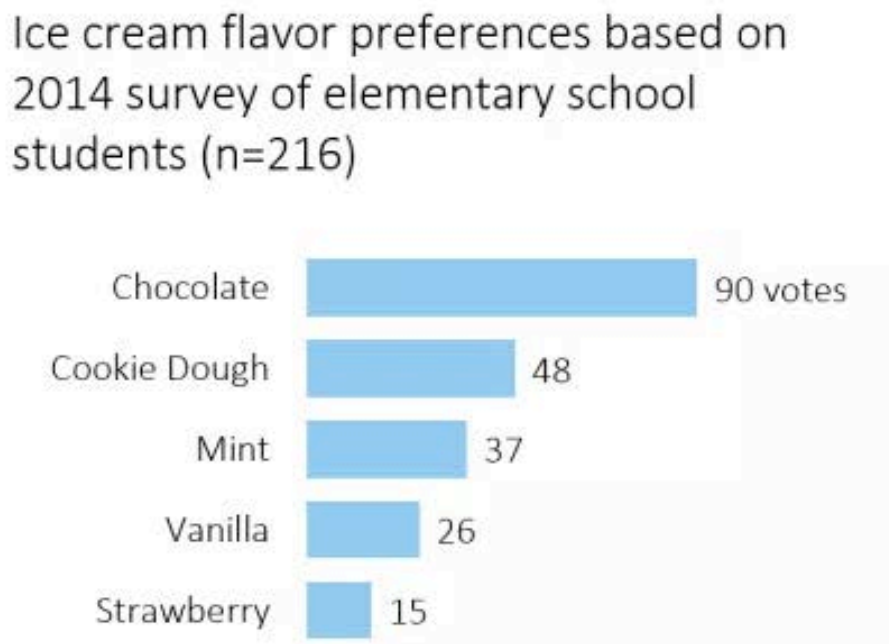
QUICKLY DRAW ATTENTION TO WHAT'S IMPORTANT.

MARK FOR EMPHASIS

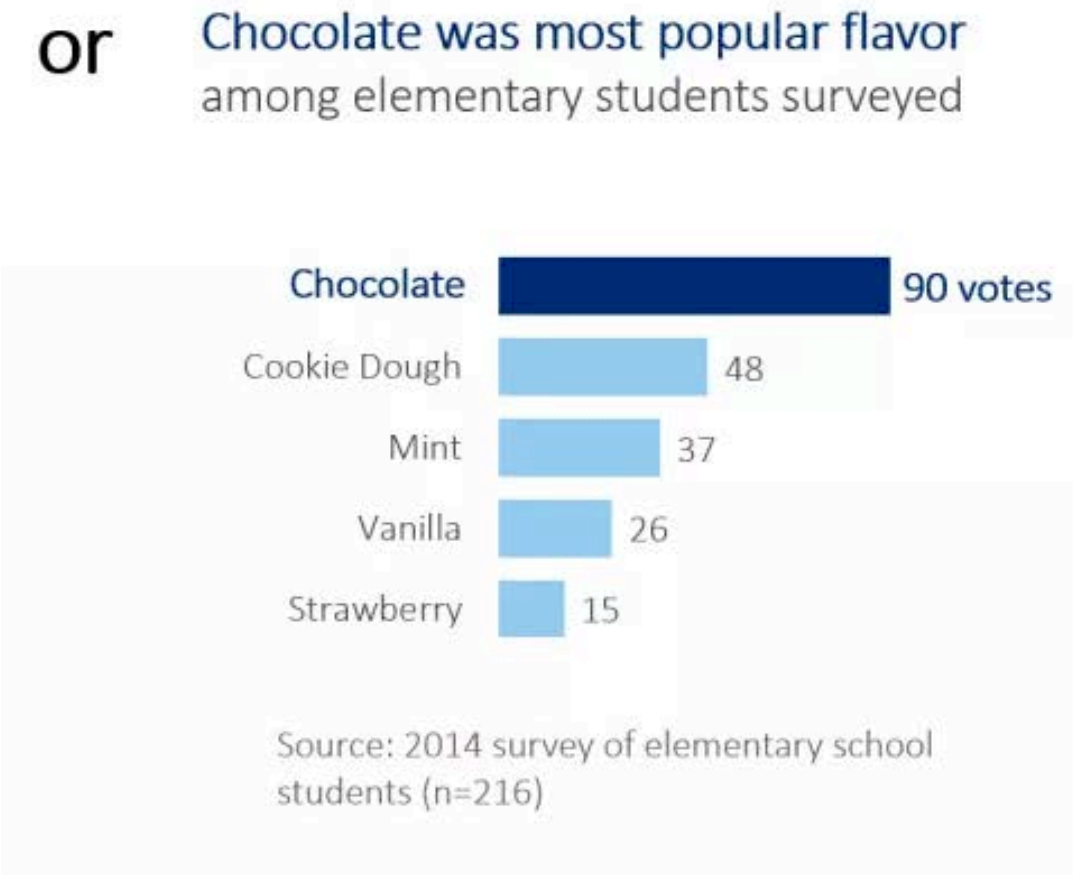


DESCRIPTIVE TITLES AND ANNOTATIONS

Can be the difference between a chart and a story.



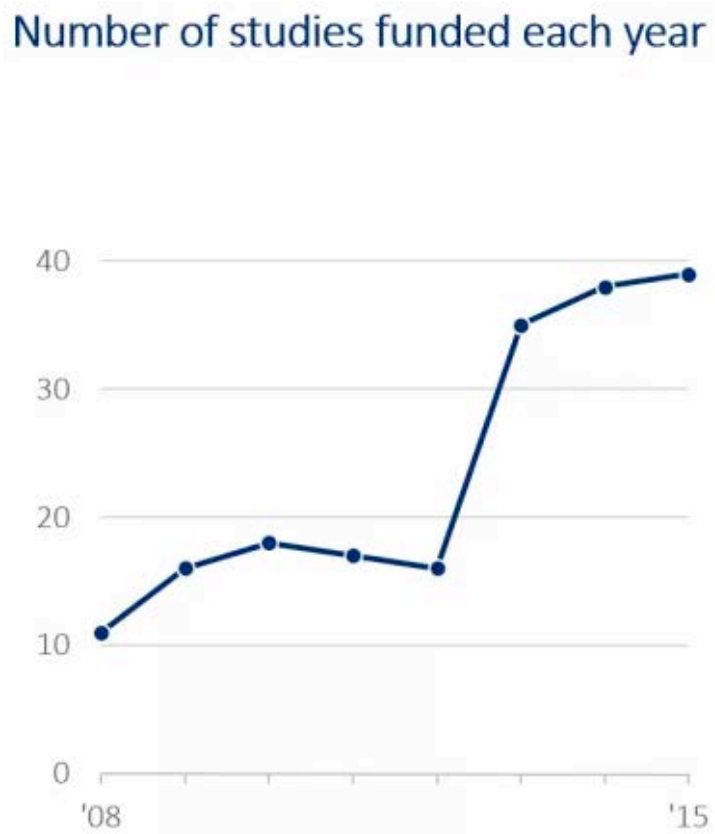
or



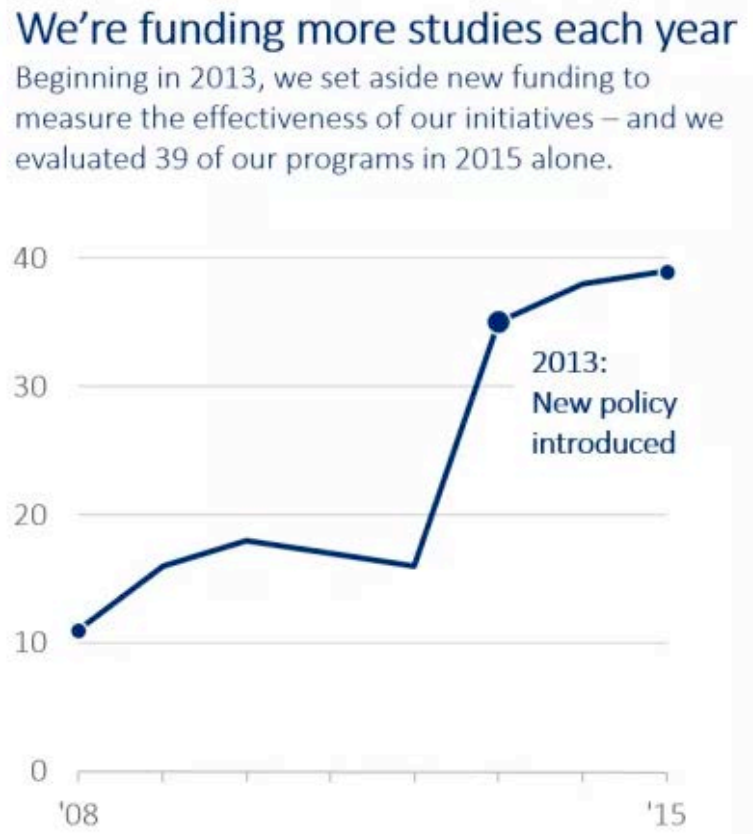
ANN K. EMERY 2016

DESCRIPTIVE TITLES AND ANNOTATIONS

Can be the difference between a chart and a story.



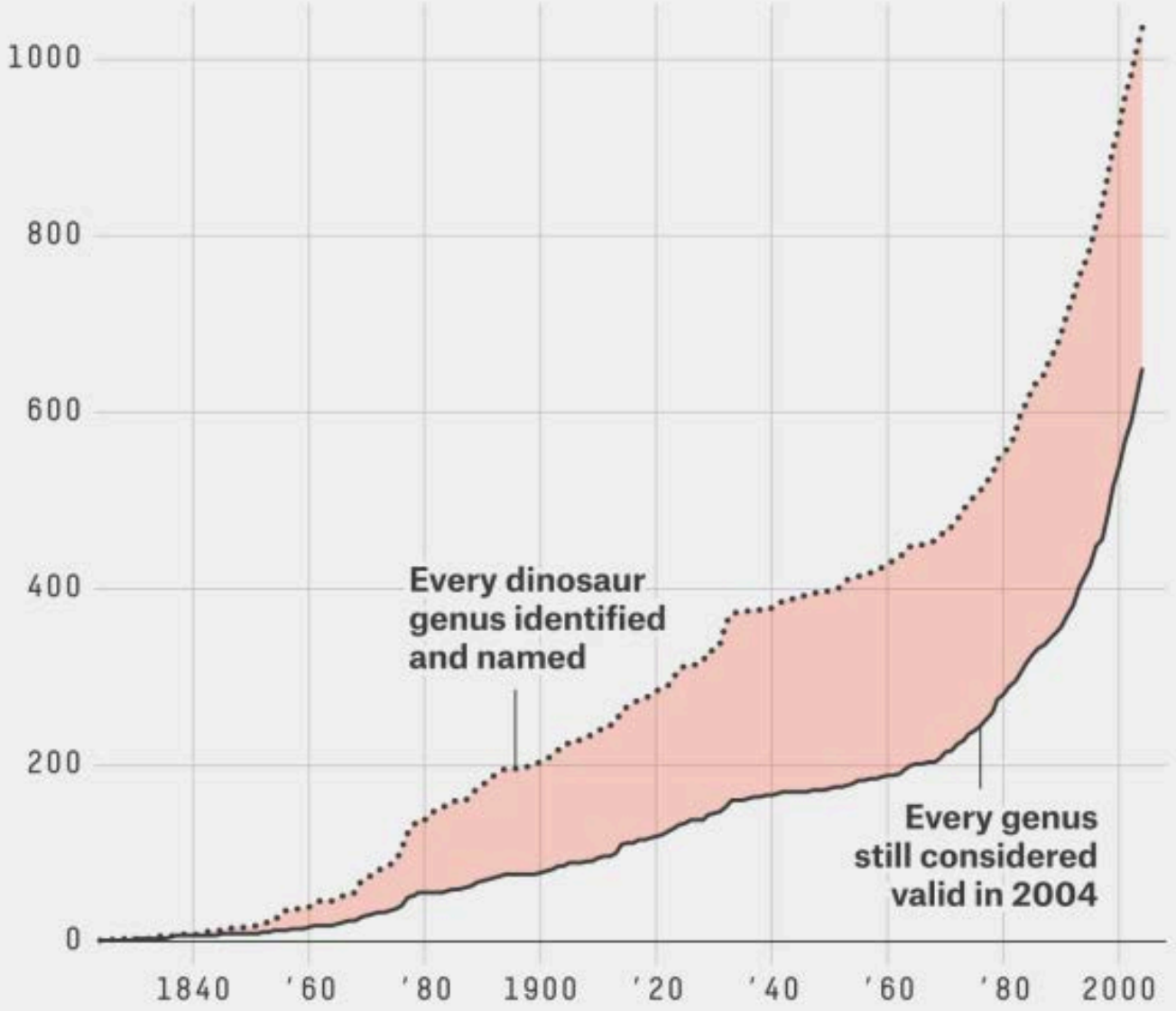
or



ANN K. EMERY 2016

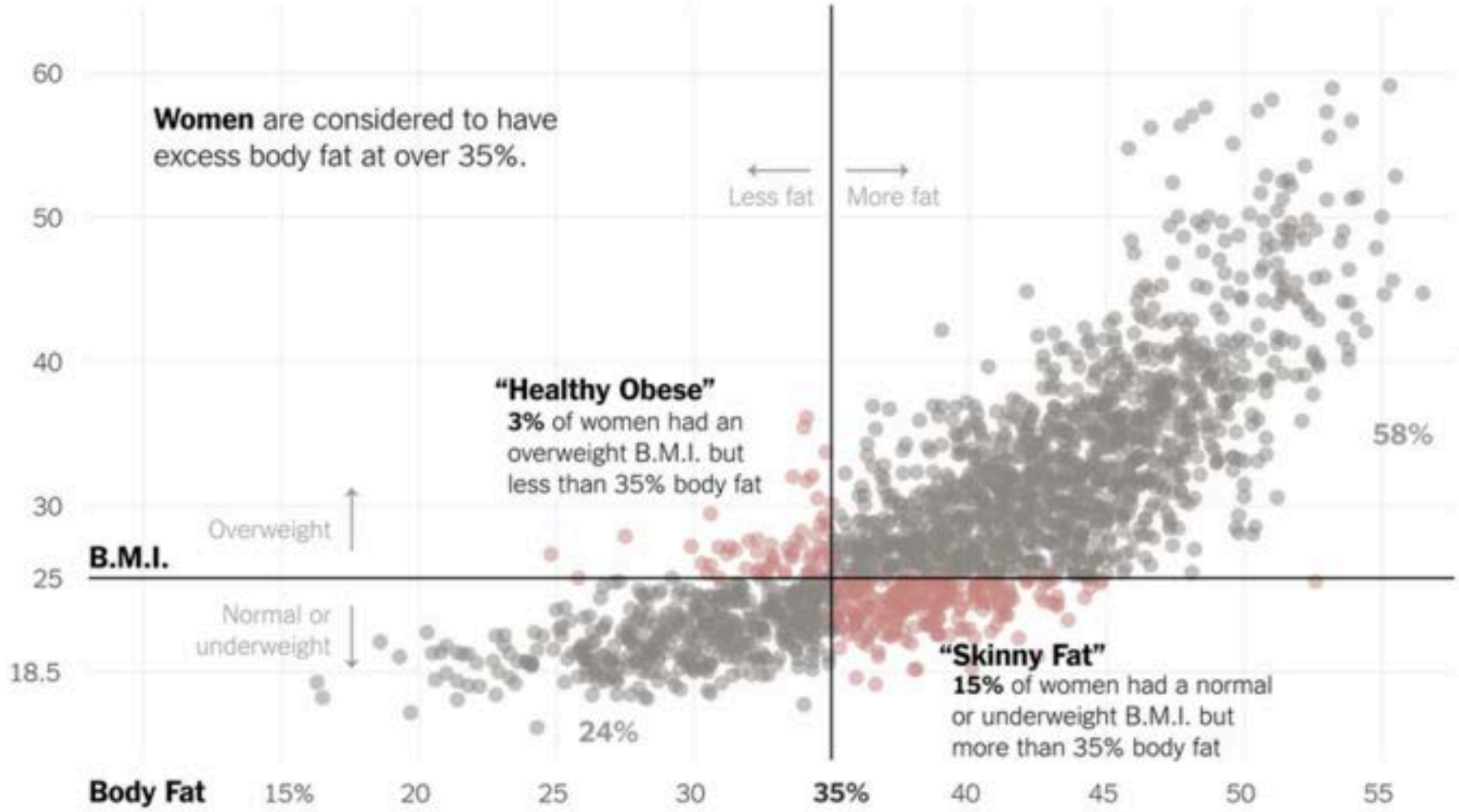
Dinosaurs named, then unnamed

By 2004, about 37 percent of every dinosaur genus ever identified and named had had its genus status revoked



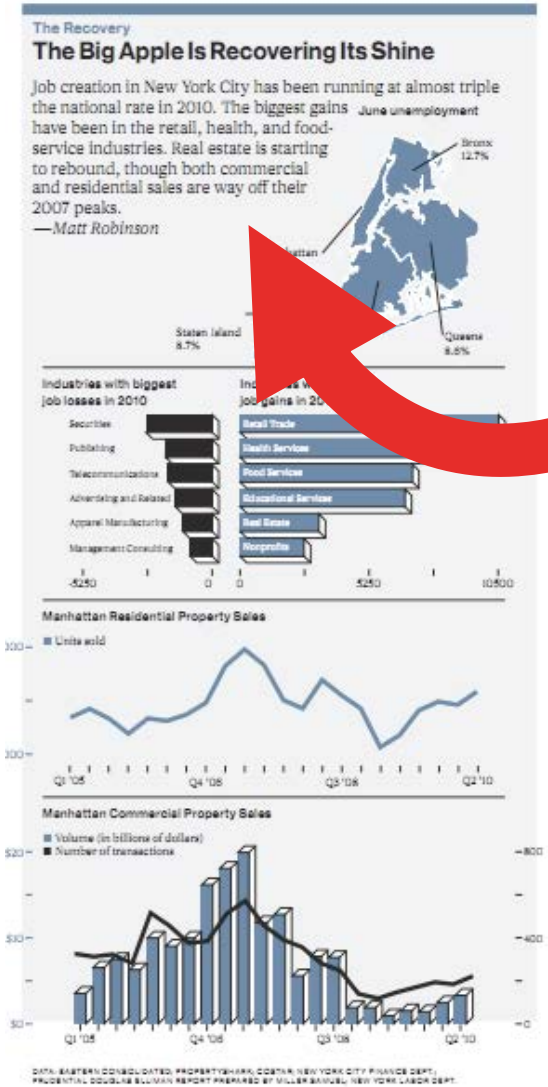
FIVETHIRTYEIGHT

SOURCE: PALEOBIOLOGY



Data backs up the notion that many Americans are "skinny fat" and "healthy obese" — their body fat percentage tells a different story than their B.M.I.

Source: National Health and Nutrition Examination Survey, 2005–2006



ISOLATED

WEAVE TEXT INTO THE GRAPHIC, NOT JUST AT THE BEGINNING.

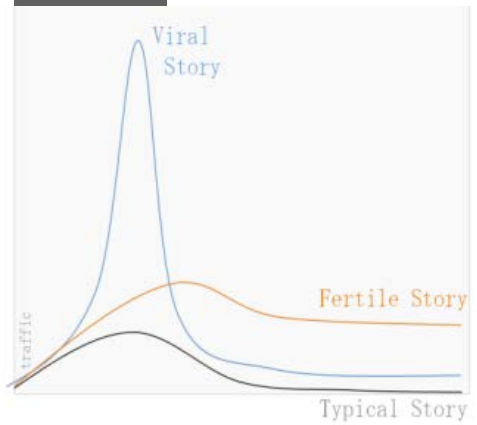
Text and graphics work better together than apart.

CONNECT THE TEXT TO RELEVANT GRAPHICS

"See fig. 5"

...this work economical, visualizations ...at are either *persistent* or *viral* in order ...g traffic. Persistent stories cover ..." that maintain relevance over time ...conomics, the housing market). ...sistent themes "fattens and elongates" ...s (which are already fatter and longer ...g this slow-burn, these visualizations ...of stories over several months and ...l stories achieve heavy traffic ...ikes of popularity. These stories tend ...alities, or sensational news. To get the ...e visualizations for editorial content

Fig. 5



“SPARKLINES” & WORD-SCALE VIS

Sparklines: Intense, Simple, Word-Sized Graphics

Edward Tufte

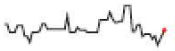
THE most common data display is a noun accompanied by a number. For example, a medical patient's current level of glucose is reported in a clinical record as a word and number:

glucose 6.6

Placed in the relevant context, a single number gains meaning. Thus the most recent measurement of glucose should be compared with earlier measurements for the patient. This data-line shows the path of the last 80 readings of glucose:

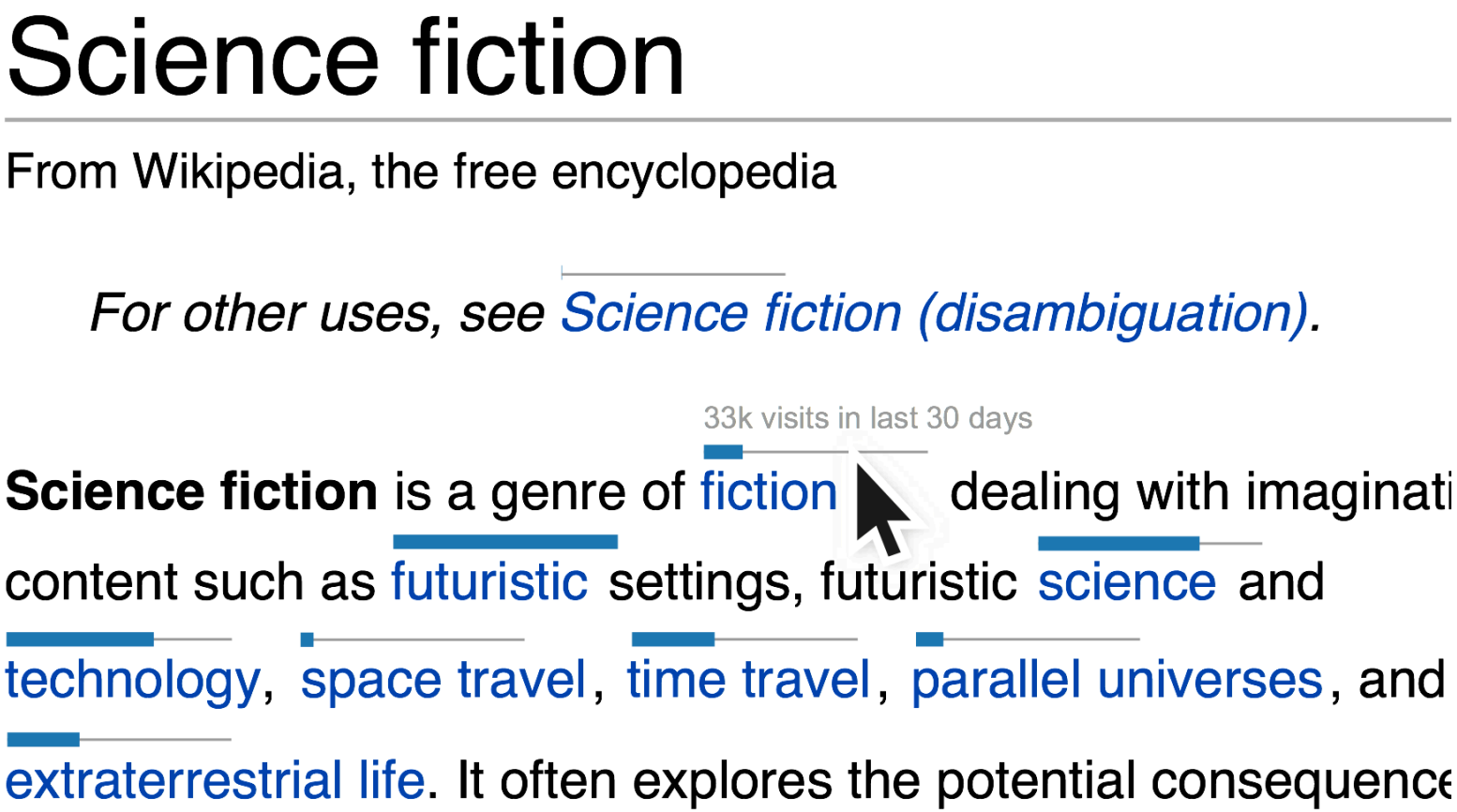
 glucose 6.6

Lacking a scale of measurement, this free-floating line is dequantified. At least we do know the value of the line's right-most data point, which corresponds to the most recent value of glucose, the number recorded at far right. Both representations of the most recent reading are tied together with a color accent:

 glucose 6.6

Some useful context is provided by showing the *normal range* of glucose, here as a gray band. Compared to normal limits, readings above the band horizon are elevated, those below reduced:

“SPARKLINES” & WORD-SCALE VIS



Goffin et al. 2014

“SPARKLINES” & WORD-SCALE VIS

EASTERN EUROPE

Soviet cult and pragmatism in Transnistria

Experts worry that the next "Crimea"  could be the breakaway region of Transnistria  Many locals there don't share that f[illegible]r, and if the last referendum holds, a large majority would welcome a Russian  annexation.

Goffin et al. 2014

“SPARKLINES” & WORD-SCALE VIS

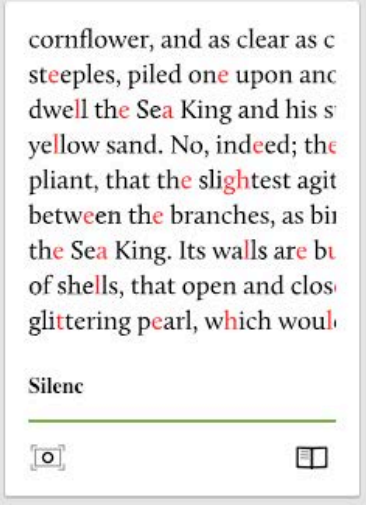
Gonzalo Higuaín slides a cross in from the right  and Ronaldo, at the front post, shoots off target.

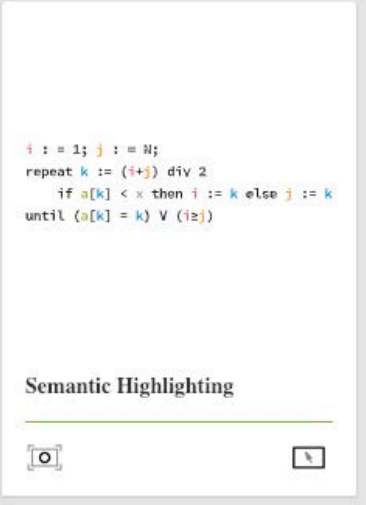
Perin et al. 2013

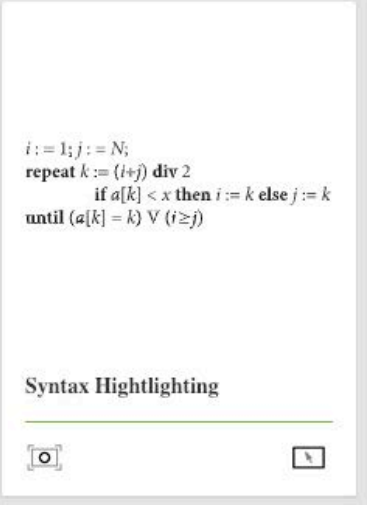

Future climate change and associated impacts will vary from region to region around the globe.[13][14] The effects of an increase in global temperature include a rise in sea levels and a change in the amount and pattern of precipitation, as well as a probable expansion of subtropical deserts.[15] Warming is expected to be strongest in the Arctic, with the continuing retreat of glaciers, permafrost and sea ice. Other likely effects of the warming include more frequent extreme weather events including heat waves, droughts, heavy rainfall, and heavy snowfall;[16] ocean acidification; and species extinctions due to shifting temperature regimes. Effects significant to humans include the threat to food security from decreasing crop yields and the loss of habitat from inundation.[17][18]
Contropedia


Today are 8°C in Berlin.
Sparkline

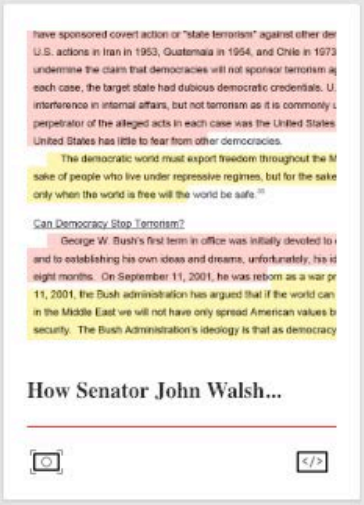

Typo-graph

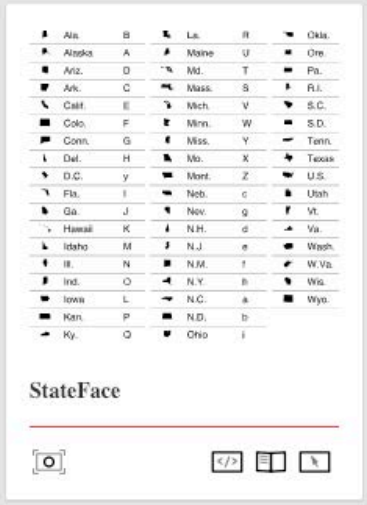

cornflower, and as clear as c
steeples, piled one upon anc
dwell the Sea King and his s
yellow sand. No, indeed; the
pliant, that the slightest agit
between the branches, as bi
the Sea King. Its walls are b
of shells, that open and clos
glittering pearl, which woul
Silenc


i : = 1; j : = N;
repeat k := (i+j) div 2
if a[k] < x then i := k else j := k
until (a[k] = k) V (i≥j)
Semantic Highlighting


i : = 1; j : = N;
repeat k := (i+j) div 2
if a[k] < x then i := k else j := k
until (a[k] = k) V (i≥j)
Syntax Hightlighting

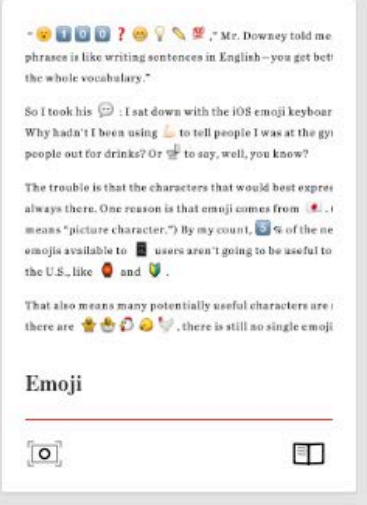

[...] Generation, dass neben der numerische und grafischen Darstellung der Messwerte e automatische Regelung des Durchmessers oder der Wanddicke übernimmt. sikora
[...] sehen: Moderne Steuerungen mit benutzerfreundlicher Visualisierung und Anbindung an das Prozessleitsystem sowie moderne, [...] bma-de.
[...] Flussprofilen für jede einzelne Spritzenpumpe und die grafische Visualisierung des Gerätezustandes jeder einzelnen Achse. cetor.
Linguee


have sponsored covert action or "state terrorism" against other de
U.S. actions in Iran in 1953, Guatemala in 1954, and Chile in 1973
undermine the claim that democracies will not sponsor terrorism a
each case, the target state had dubious democratic credentials. U.
interference in internal affairs, but not terrorism as it is commonly
perpetrator of the alleged acts in each case was the United States
United States has little to fear from other democracies.
The democratic world must export freedom throughout the M
sake of people who live under repressive regimes, but for the sake
only when the world is free will the world be safe.
Can Democracy Stop Terrorism?
George W. Bush's first term in office was initially devoted to
and to establishing his own ideas and dreams, unfortunately, his id
eight months. On September 11, 2001, he was reborn as a war p
11, 2001, the Bush administration has argued that if the world can
in the Middle East we will not have only spread American values b
security. The Bush Administration's ideology is that as democracy
How Senator John Walsh...


Ala. B
Alaska A
Ariz. D
Ark. C
Calif. E
Colo. F
Conn. G
Del. H
D.C. y
Fla. I
Ga. J
Hawaii K
Idaho M
Ill. N
Ind. O
Iowa L
Kan. P
Ky. Q
La. R
Maine U
Md. T
Mass. S
Mich. V
Minn. W
Miss. Y
Mo. X
Mont. Z
Neb. c
Nev. g
N.H. d
N.J. e
N.M. f
N.Y. h
N.C. a
N.D. b
Ohio i
Okla.
Ore.
Pa.
R.I.
S.C.
S.D.
Tenn.
Texas
U.S.
Utah
Vt.
Va.
Wash.
W.Va.
Wis.
Wyo.
StateFace


having their proper fo
whilst the marine mer
of the same two great
pass through consider
and often great change
their development. Sp
again, barely undergo
metamorphosis. The l
On The Origin of Species


FatFonts


Mr. Downey told me
phrases is like writing sentences in English – you get bet
the whole vocabulary."
So I took his : I sat down with the iOS emoji keyboar
Why hadn't I been using to tell people I was at the gy
people out for drinks? Or to say, well, you know?
The trouble is that the characters that would best expres
always there. One reason is that emoji comes from
means "picture character.") By my count, % of the ne
emojis available to users aren't going to be useful to
the U.S., like and .
That also means many potentially useful characters are
there are , there is still no single emoji
Emoji

MIND YOUR PRECISION.

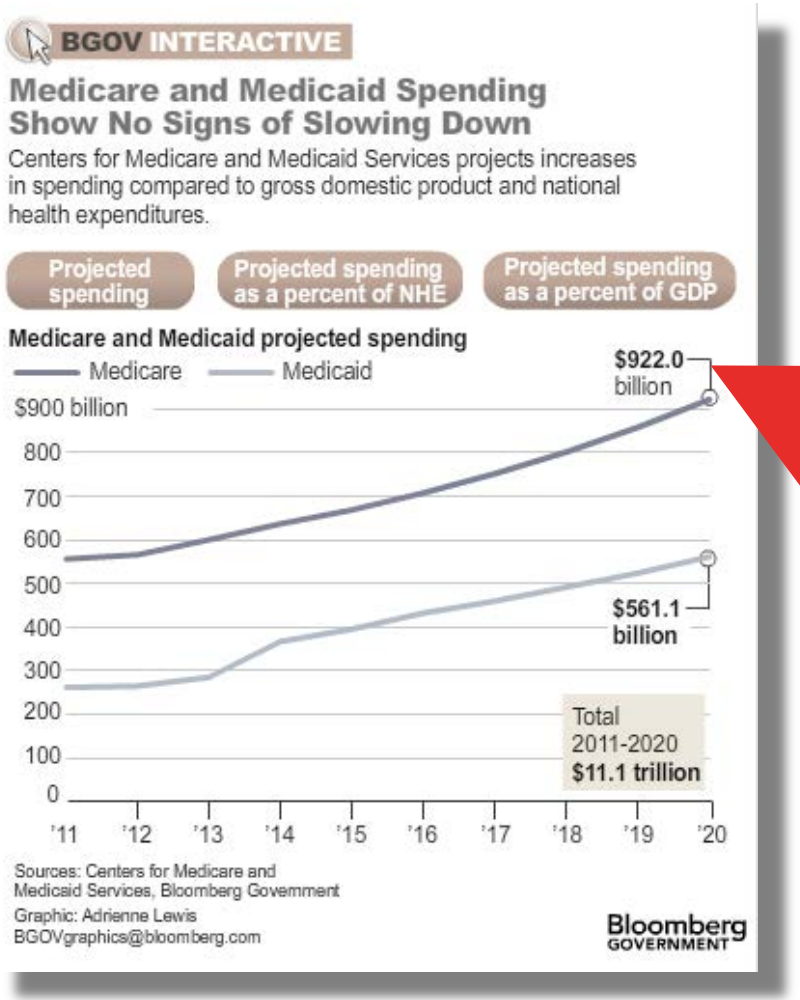
Significant digits, tick marks, and labels suggest what deserves attention.

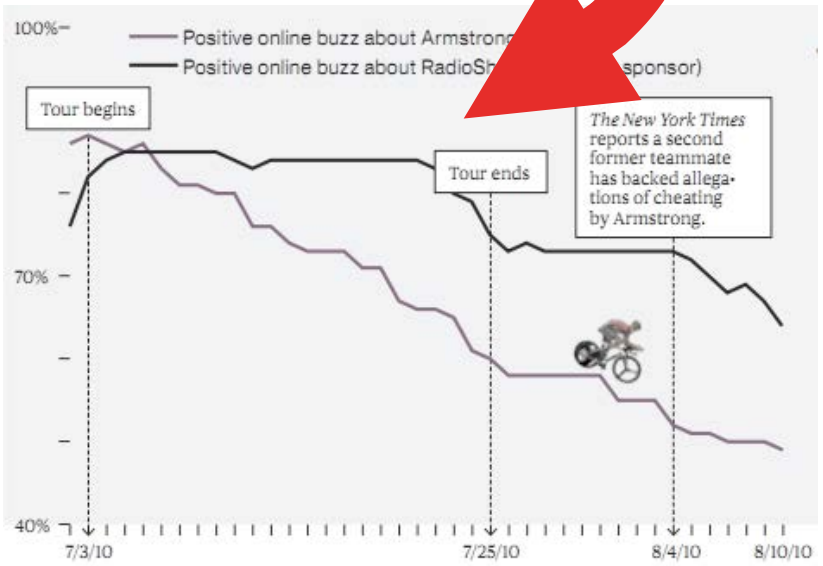
Representative	District	Fiscal 2010 contract spending
Mike Coffman	Colo. 6	$3.26 billion
Doug Lamborn	Colo. 5	2.98 billion
Rob Bishop	Utah 1	2.76 billion
Kenny Marchant	Texas 24	2.58 billion
Jeff Duncan	S.C. 3	2.40 billion
Sandy Adams	Fla. 24	2.36 billion
Lamar Smith	Texas 21	1.65 billion
Steve Scalise	La. 1	1.49 billion
Jeff Landry	La. 3	1.47 billion
Roscoe Bartlett	Md. 6	1.44 billion
John Carter	Texas 31	1.42 billion

FINE

TOO PRECISE

THOUGHTFUL





Published: January 8, 2010

A Peek Into Netflix Queues

Examine Netflix rental patterns, neighborhood by neighborhood, in a dozen cities. Some titles with distinct patterns are Mad Men, Obsessed and Last Chance Harvey. Comments (135)

100 titles that were frequently rented from Netflix in 2009

◄ Previous | Next ► | Most rented — Least rented

Change how movies are sorted: Most rented | Alphabetical | By metascore

Mad Men: Season 1: Disc 1

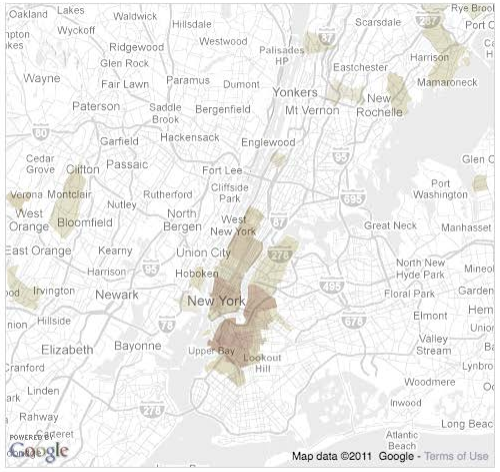
77

Metacritic score
100=loved by critics, 0=hated

There were seven deadly sins practiced at the dawn of the 1960s: smoking, drinking, adultery, sexism, homophobia, anti-Semitism and racism. The magic of "Mad Men" is that it softly spoofs those cruel, antiquated mores without draining away the romance of that era: the amber-lit bars and indigo nightclubs, soaring skyscrapers, and the brash confidence that comes with winning a war and owning the world.

Read Rest of NYT Review »

The ZIP codes are shaded according to each movie's rank. Ranked No. 1 — No. 50



Sources: Netflix provided data on the top 50 rentals in 2009 in each ZIP code. Titles are listed in the approximate order of popularity across selected metropolitan areas. Metascores are from metacritic.com.

START WITH AN INTERESTING VIEW.

Curate the experience
from the beginning.

MAKE DATA RELATABLE & PUT NUMBERS AND FACTS IN CONTEXT.

250 thousand square miles?
"It's the size of alberta!"

Wetlands Destruction

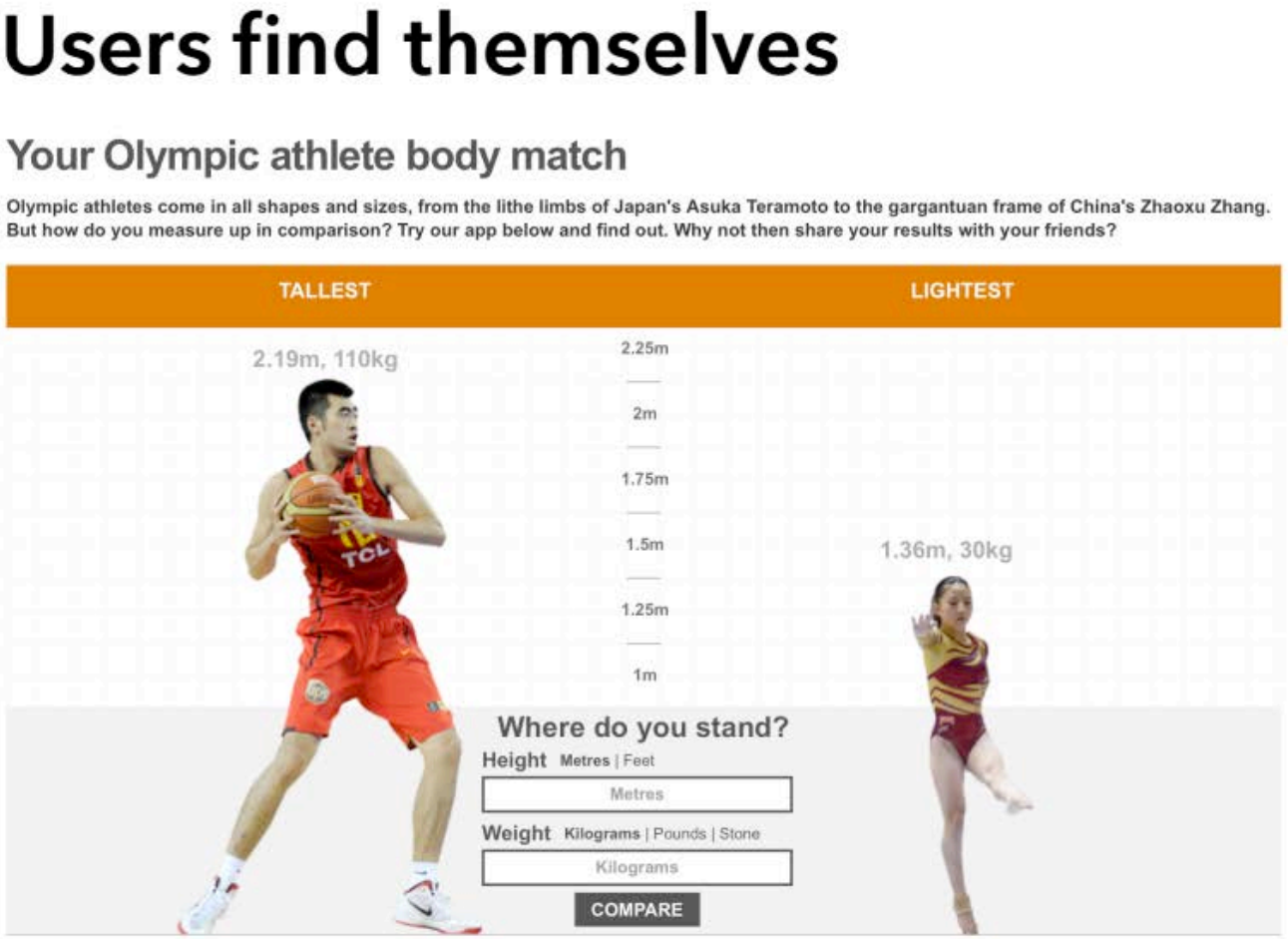
Coastal marshes absorb fertilizer runoff from farms and buffer civilization from Gulf storms.

Losses in coastal watersheds, 1998 to 2004

Great Lakes	**20,000**	acres
Atlantic	**110,000**	acres

Aug 16, 2010

MORE NARRATIVE PATTERNS



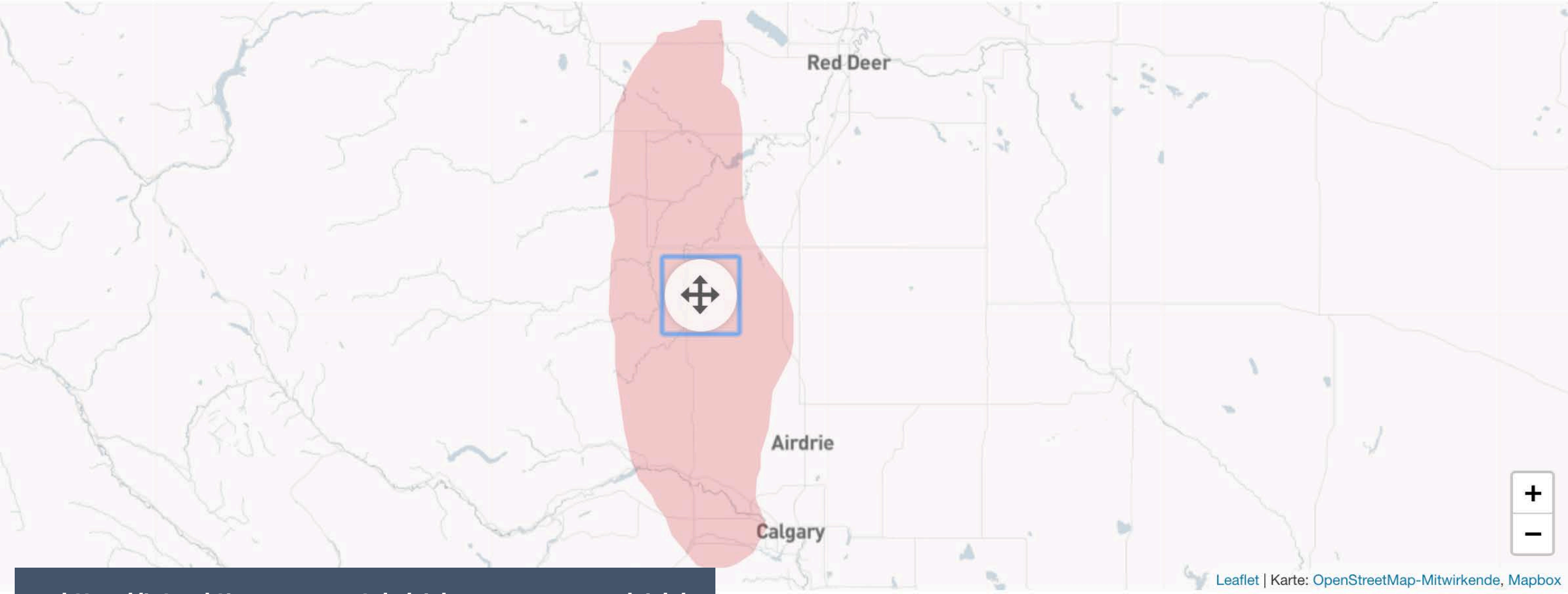
HELPS ANCHOR VIEWER IN THE PIECE.
MAKES DATA MORE PERSONALLY RELEVANT.

2016 LYN BARTRAM, BENJAMIN BACH, JEREMY BOY, PAULO CIUCCARELLI, STEVEN DRUCKER, YURI ENGELHARDT, ULRIKE KOEPPEN, MORITZ STEFANER, BARBARA TVERSKY, & JO WOOD.

Larsen C

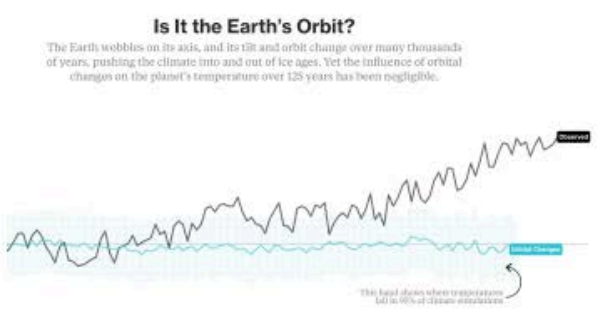
So groß ist der Eisberg im Vergleich zu Ihrer Stadt

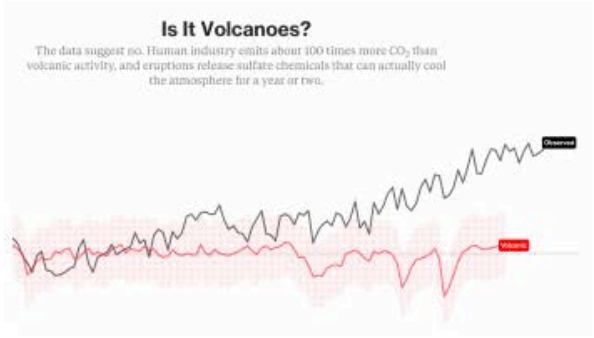
In der Westantarktis hat sich ein gigantischer Eisberg von der knapp siebenfachen Größe Berlins vom Schelfeis gelöst. Verschieben Sie ihn auf der Karte und übertragen Sie die Dimensionen auf Ihre Gegend.

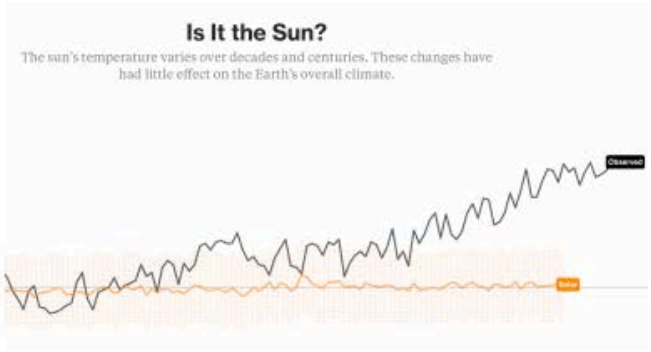


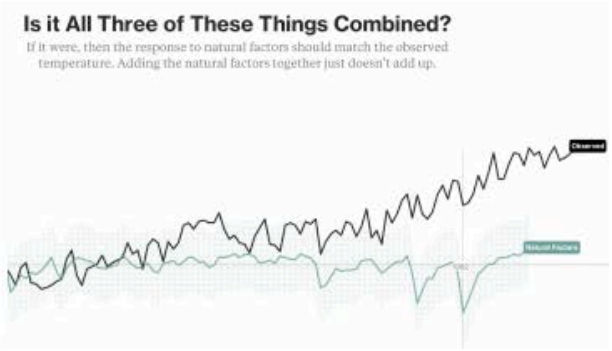
https://interaktiv.morgenpost.de/eisberg-groessenvergleich/

Again, and again…









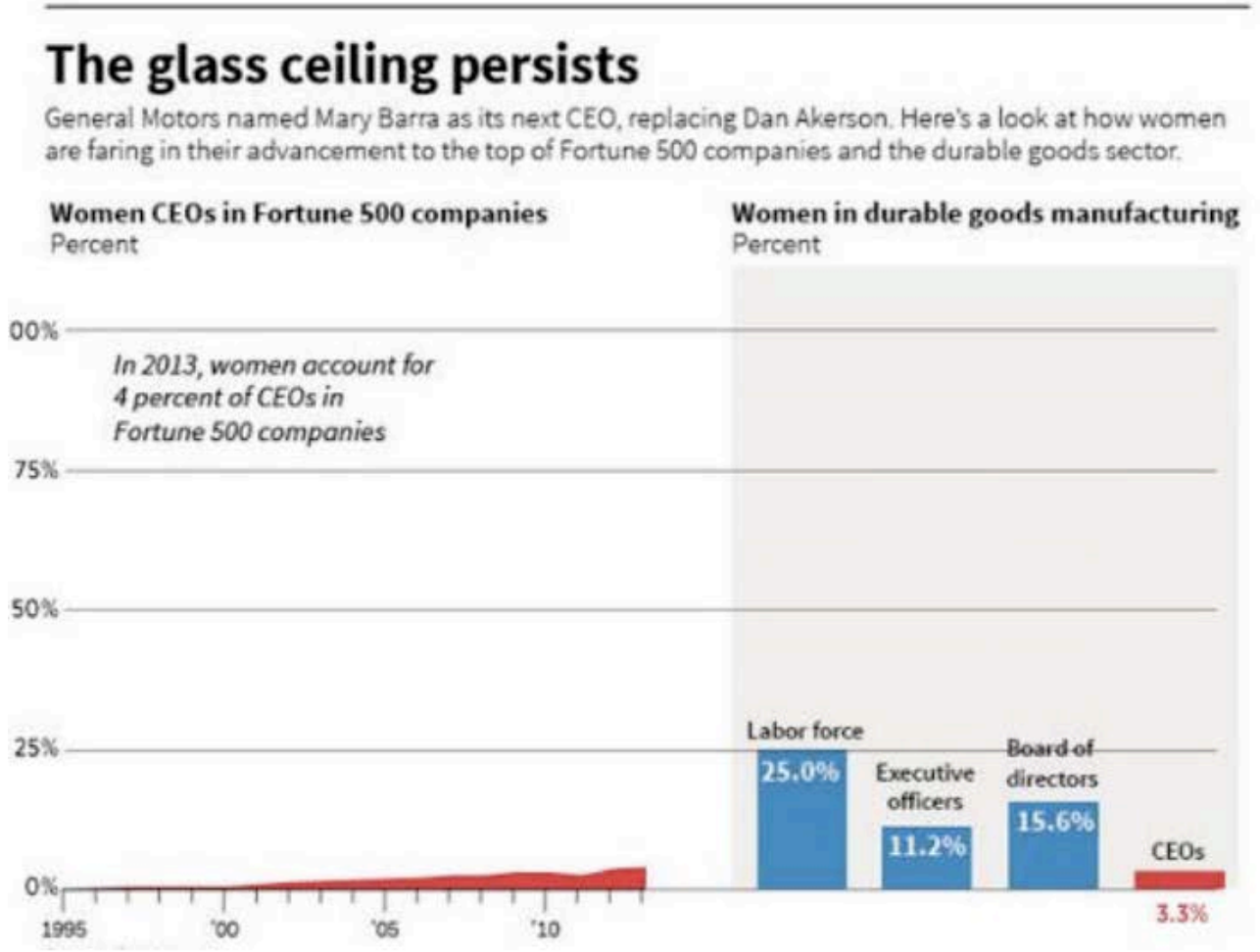
SHOW SAME PHENOMENON OVER AND OVER, CHANGING ONLY ONE VARIABLE.

RHYTHM STRENGTHENS THE NARRATIVE.

REPEATED DISAPPOINTMENT SETS UP THE FINAL REVEAL.

2016 LYN BARTRAM, BENJAMIN BACH, JEREMY BOY, PAULO CIUCCARELLI, STEVEN DRUCKER, YURI ENGELHARDT, ULRIKE KOEPPEN, MORITZ STEFANER, BARBARA TVERSKY, & JO WOOD.

Break conventions



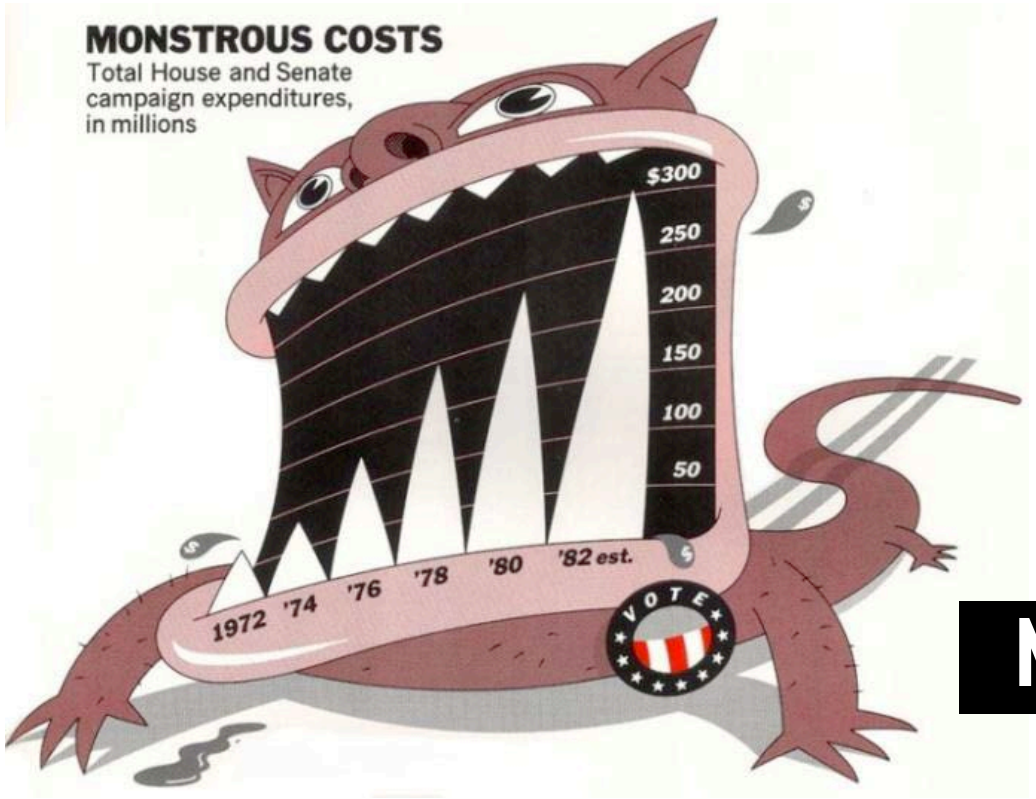
PURPOSEFULLY BREAK CONVENTIONS OF CHART DESIGN.

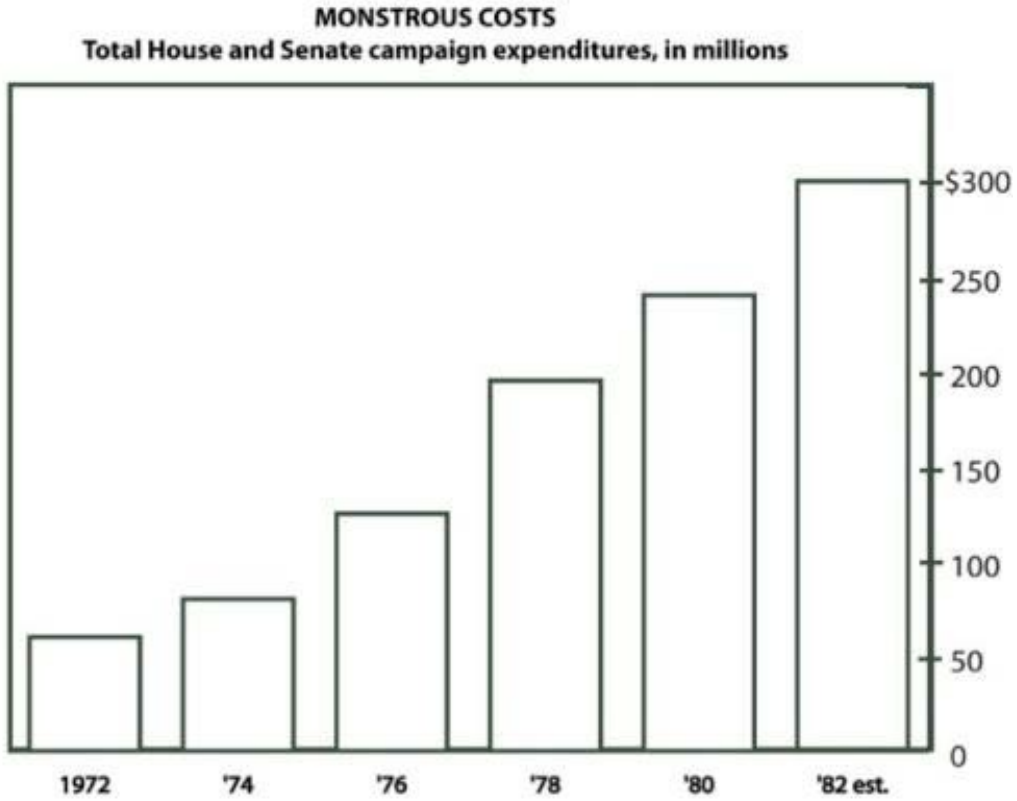
Breaking expectations can be used to underline particular interpretations.

2016 LYN BARTRAM, BENJAMIN BACH, JEREMY BOY, PAULO CIUCCARELLI, STEVEN DRUCKER, YURI ENGELHARDT, ULRIKE KOEPPEN, MORITZ STEFANER, BARBARA TVERSKY, & JO WOOD.

USE EMBELLISHMENTS SPARINGLY & CAREFULLY.

Stylised visuals can be engaging but are hard to get right.

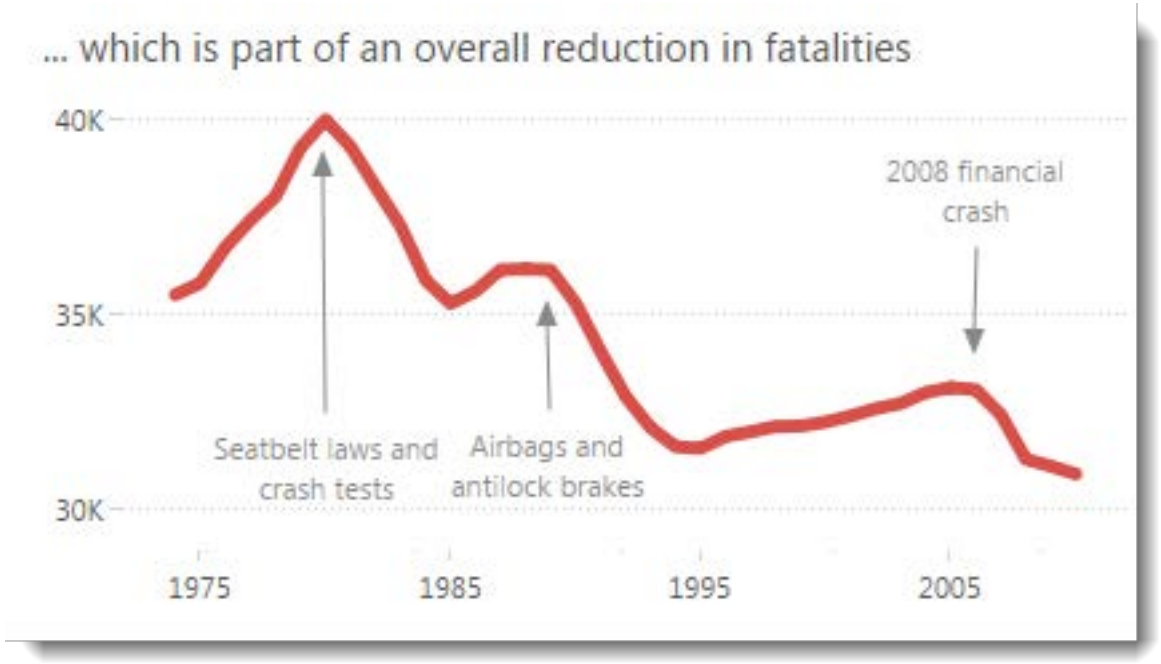




NIGEL HOLMES

IT'S IMPORTANT TO REALLY UNDERSTAND THE RULES OF GOOD VISUAL COMMUNICATION BEFORE YOU TRY TO BREAK THEM.

ALMOST ALL OF THIS IS FAIRLY STRAIGHTFORWARD TO DO IN TOOLS LIKE TABLEAU

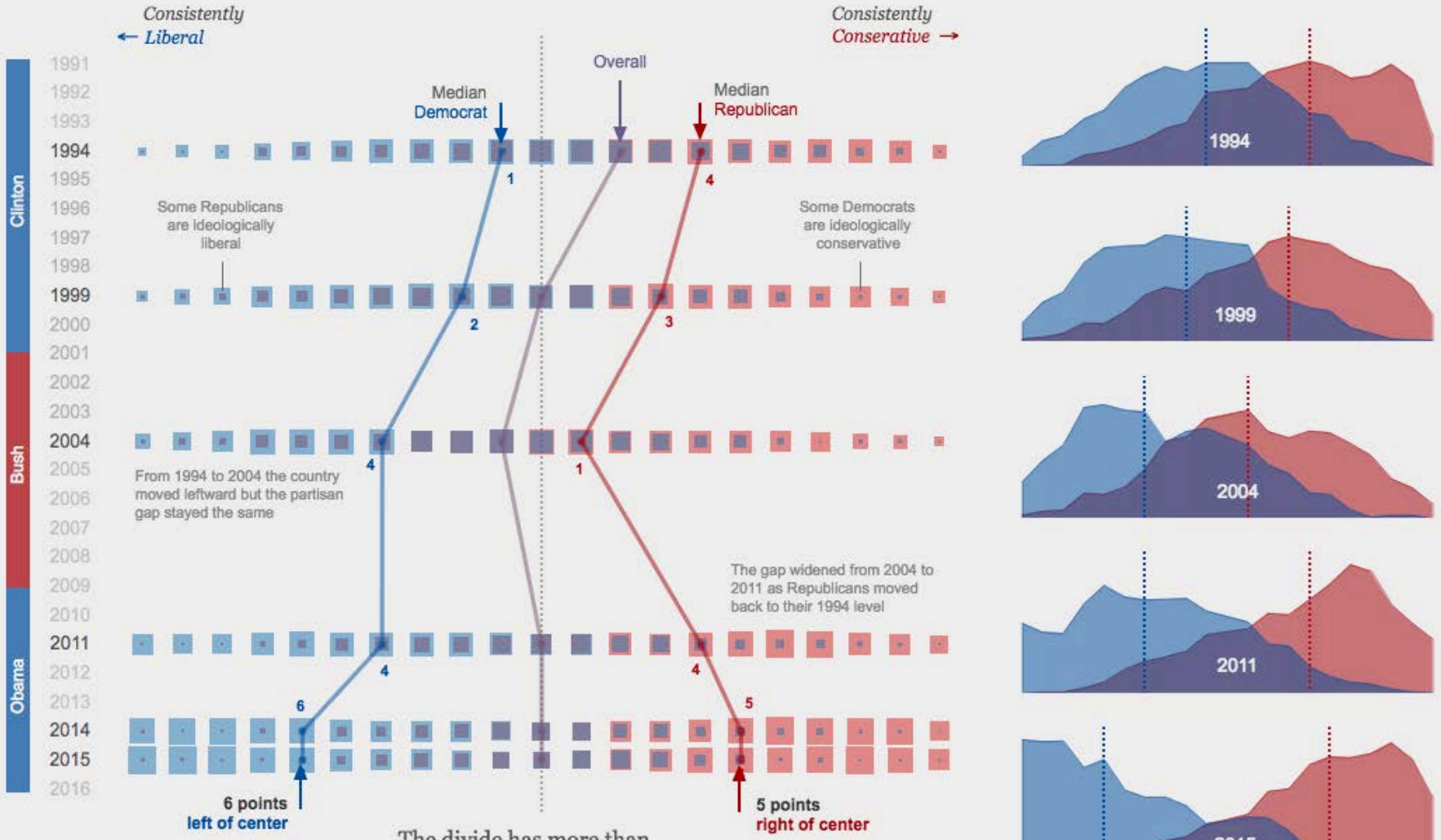


...and you can create some really elaborate presentations if you push the tool to its limit.

US vs. THEM

From 1994 to 2015, Pew Research Center scored survey respondents on a 10-point ideological scale. In the past decade, members of both parties moved further away from the center.

Choose a Segment
- ○ General Population
- ◉ Politically Engaged



By Robert Rouse. Source: Pew Research Center

A COUPLE OF THINGS TO WATCH OUT FOR

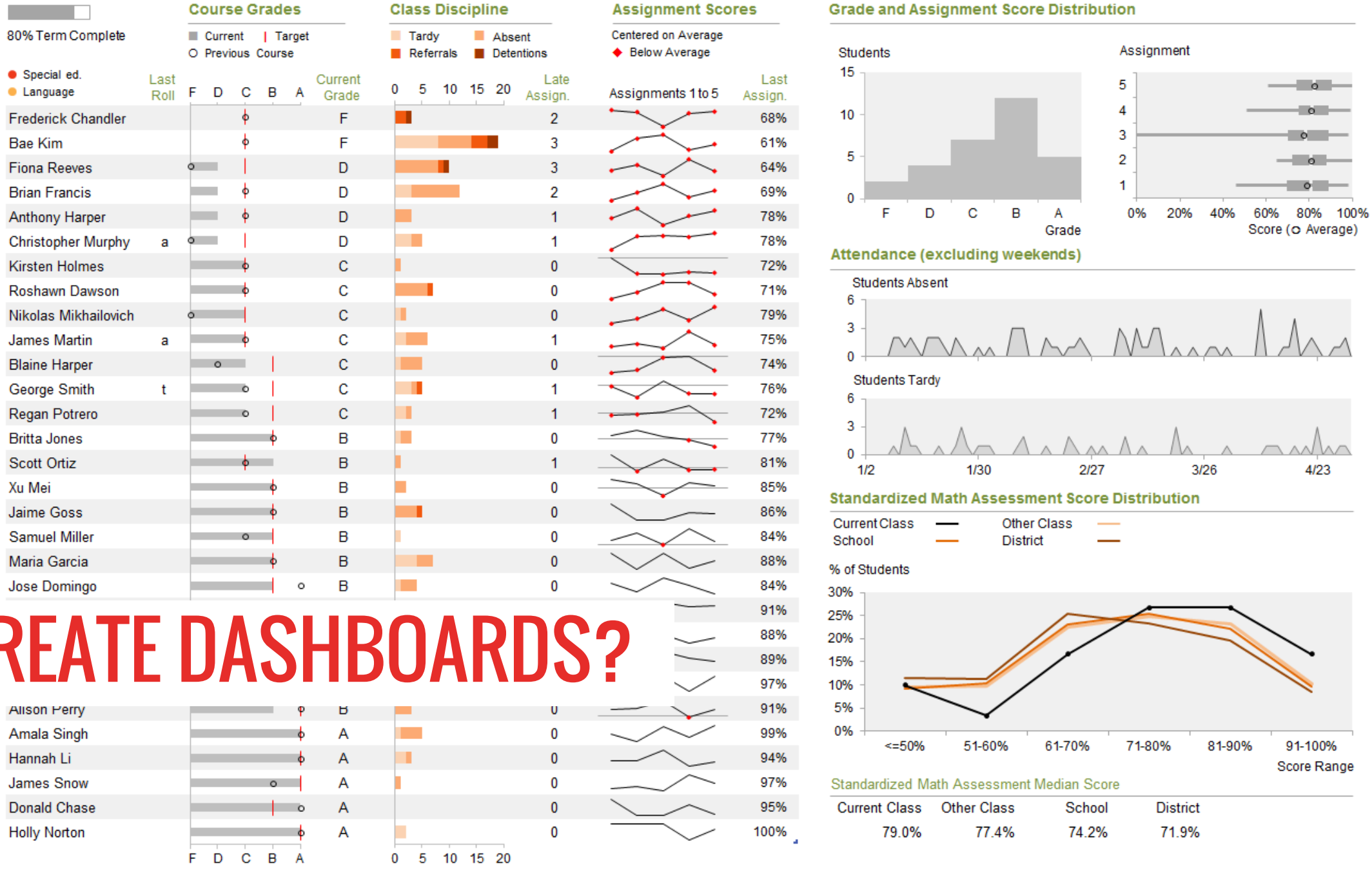
Make sure your charts are legible!

- Increase font sizes
- Use clear **axis labels** and **titles**
- Explain how to read the chart.
  (What data does it show, what are the axes, etc.)

DASHBOARDS

Visualization views designed to support common, repeated tasks...

WHY CREATE DASHBOARDS?



DIFFERENT CONSUMERS OR USERS OF DATA

Analysts

Managers

Readers

Etc..

DIFFERENT TASKS AND GOALS

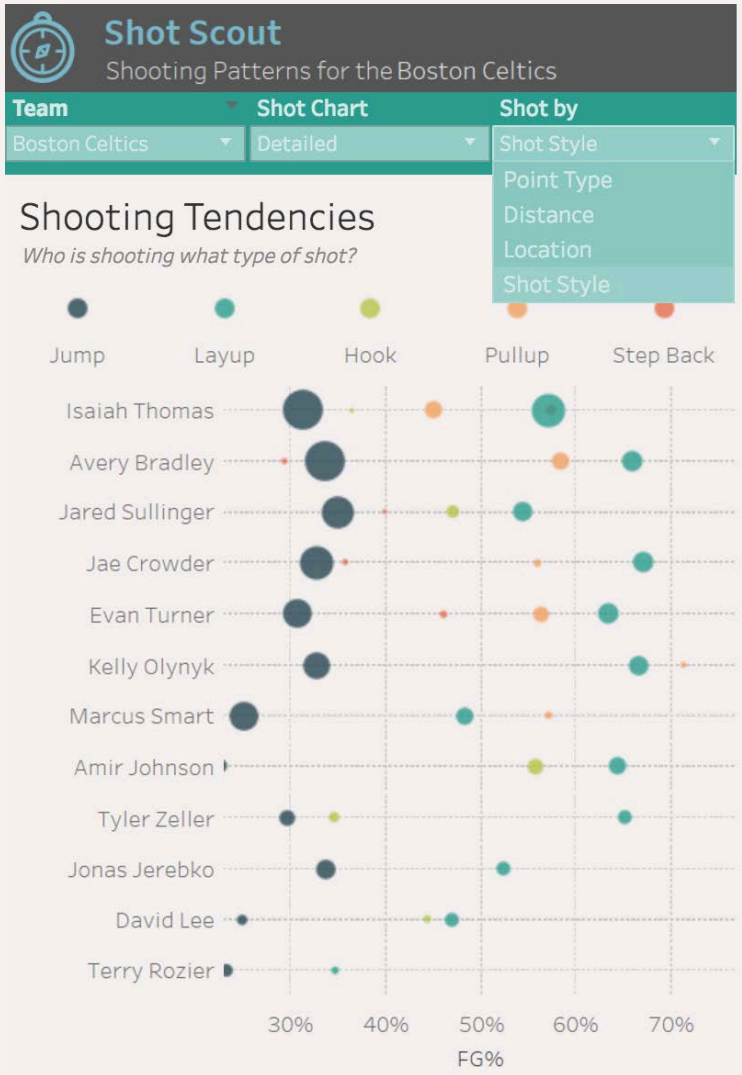
Problem-solving

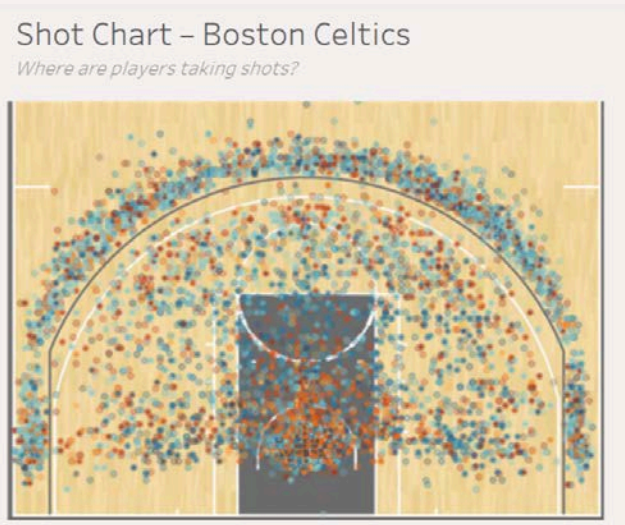
Decision-making

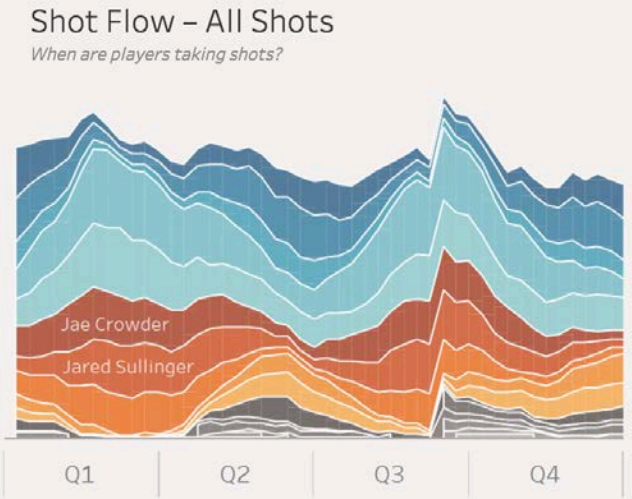
Monitoring/Awareness

Prompting Discussion

TASKS - PROBLEM SOLVING, DECISION MAKING, & SANDBOXED EXPLORATION







Luke Stanke

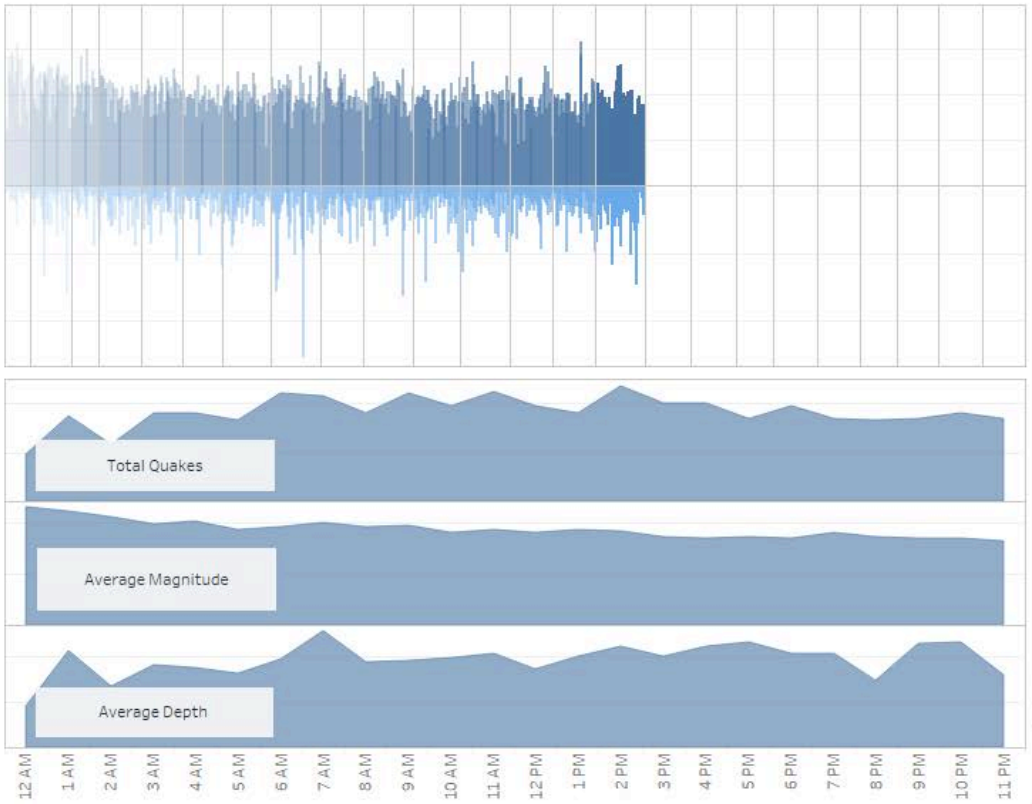
New Zealand rocked by 7.5 Quake: Close to 900 aftershocks in the first 24 hours

Total Quakes Felt	Max. Magnitude	Average Quakes per Hour	Average Mins between Quakes
879	**7.5**	**36.6**	**1.6**
47	5.31	47.00	1.28

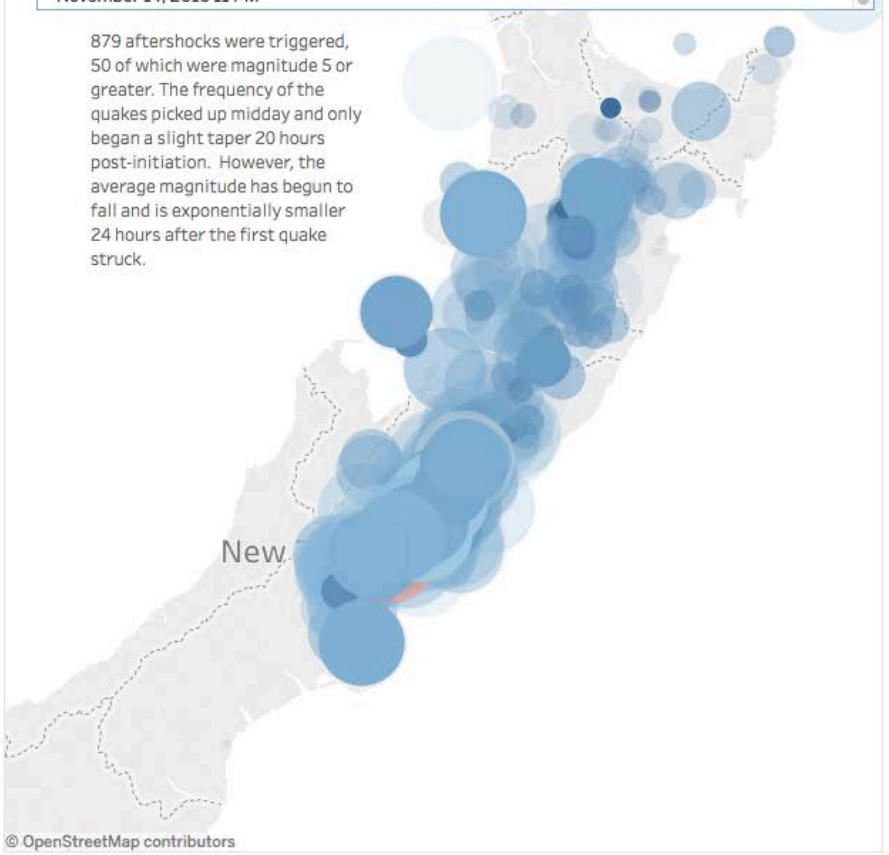
November 14, 2016 2 PM

November 14, 2016 8 AM
November 14, 2016 9 AM
November 14, 2016 10 AM
November 14, 2016 11 AM
November 14, 2016 12 PM
November 14, 2016 1 PM
November 14, 2016 2 PM
November 14, 2016 3 PM
November 14, 2016 4 PM
November 14, 2016 5 PM
November 14, 2016 6 PM
November 14, 2016 7 PM
November 14, 2016 8 PM
November 14, 2016 9 PM
November 14, 2016 10 PM
November 14, 2016 11 PM

Magnitude and Depth per Quake



879 aftershocks were triggered, 50 of which were magnitude 5 or greater. The frequency of the quakes picked up midday and only began a slight taper 20 hours post-initiation. However, the average magnitude has begun to fall and is exponentially smaller 24 hours after the first quake struck.



Kali

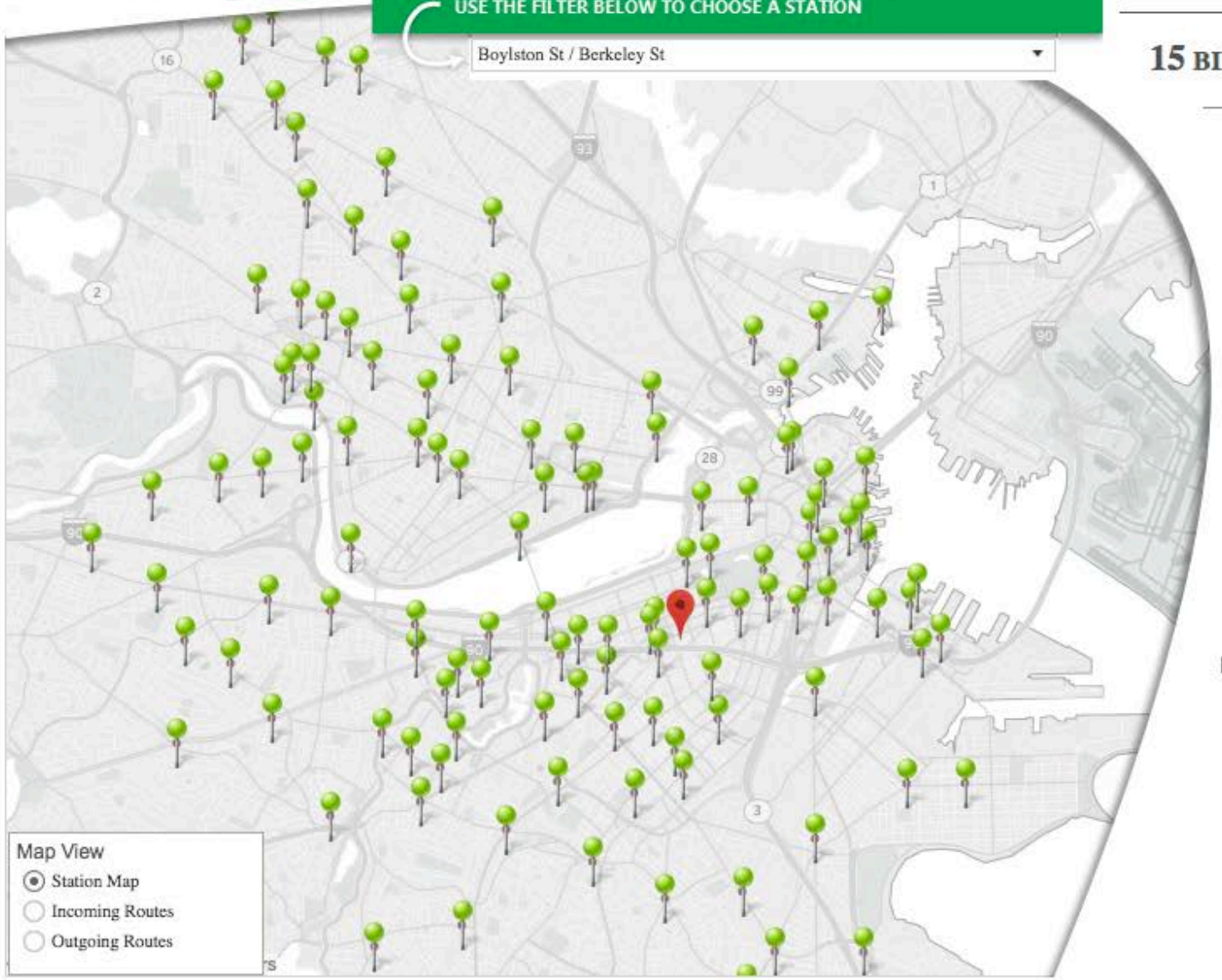
Hubway - Station to Station | USER GUIDE

Hubway

a closer look from STATION to STATION

USE THE FILTER BELOW TO CHOOSE A STATION

Boylston St / Berkeley St



BOYLSTON ST / BERKELEY ST

STATION

15 BIKES | 1ST RIDE | **JULY, 2011** | LAT 42.35 LNG -71.07 | MUNICIPAL BOSTON

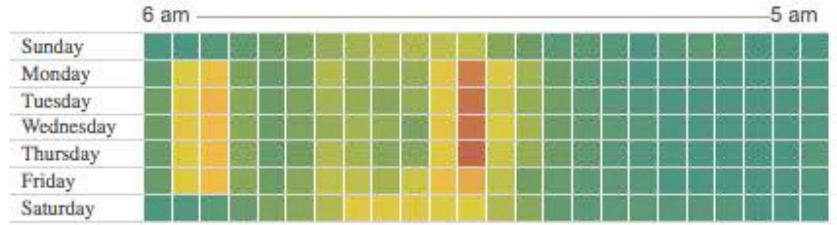
TIMELINE

START Jun-2011 END Dec-2013

TRIP

DAILY TRIPS **38.68** ARRIVALS **37.44** | ALL TRIPS **21,777** ARRIVALS **21,076**

TRIP ACTIVITY BY HOUR / DAY OF



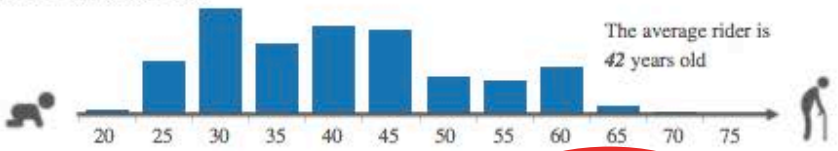
5 PM on **Thursday** is the busiest time of the week (**967** Total Rides)

RIDER

MEMBERSHIP

GENDER

AGE DISTRIBUTION



Brian Halloran

+ableau

44,937 views | more by this author

Share | Download | Full Screen

TASKS - MONITORING / AWARENESS

- Are we doing well or poorly?
- How well? How poorly?
- What has led to what's happening today?

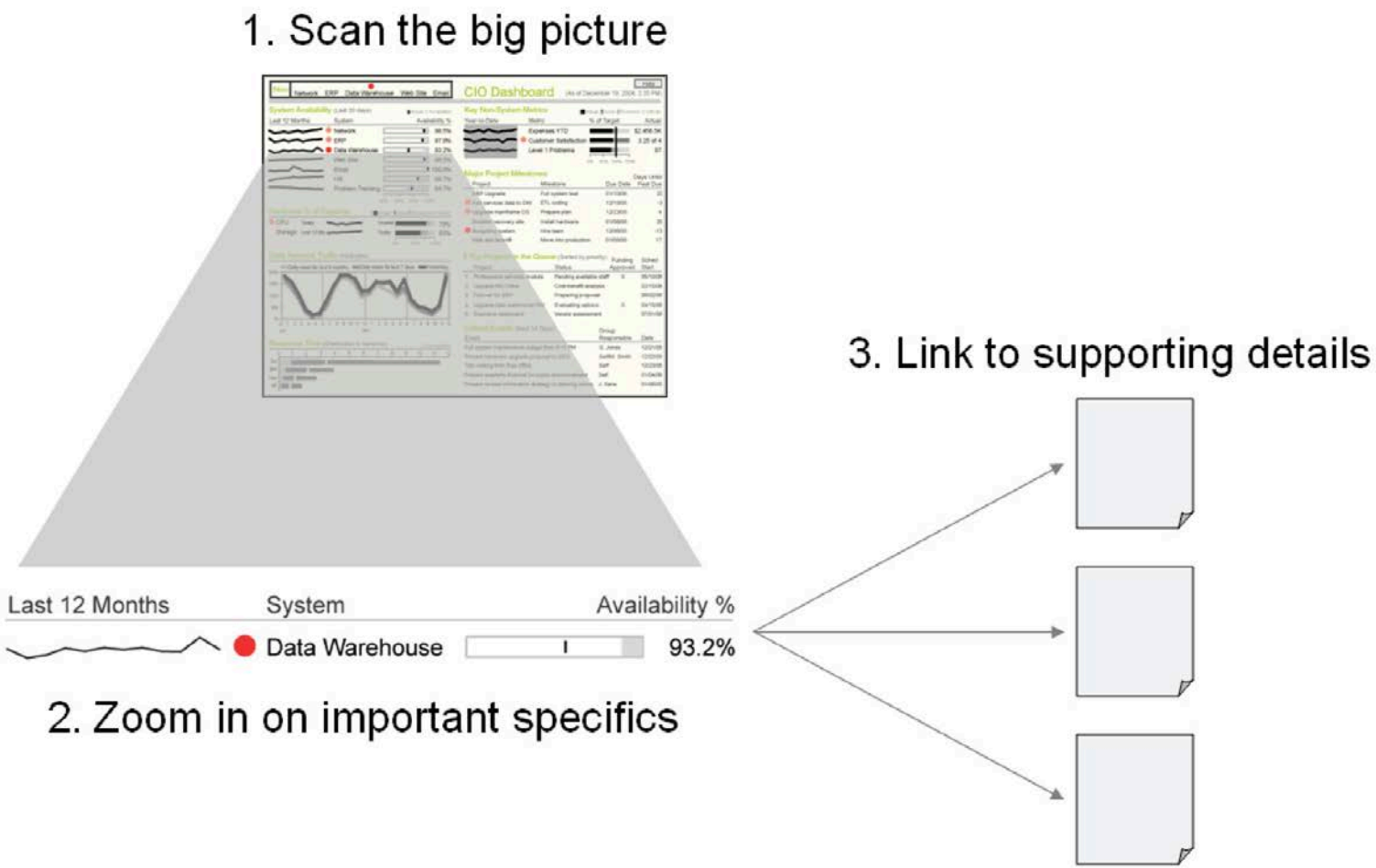
Stephen Few

Compare data against **targets**, **benchmarks**, **historical data**, etc.

BENCHMARKS

Compared to	Example
Plan (or budget)	Actual expenses compared to the expense budget
Forecast	Actual sales compared to the sales forecast
Standard	Number of manufacturing defects compared to a defined standard
Norm	Number of abandoned calls compared to the average number of abandoned calls
The past	Headcount today compared to headcount a month ago or a year ago
Other members of the same category	Average time to ship orders from warehouse A compared to warehouse B
Competitors	Your company's share of the market compared to your competitors' shares
Consecutive intervals of time in the past	Last month's profits compared to profits in each of the preceding 12 months

STAGES OF DASHBOARD MONITORING



STRATEGIES

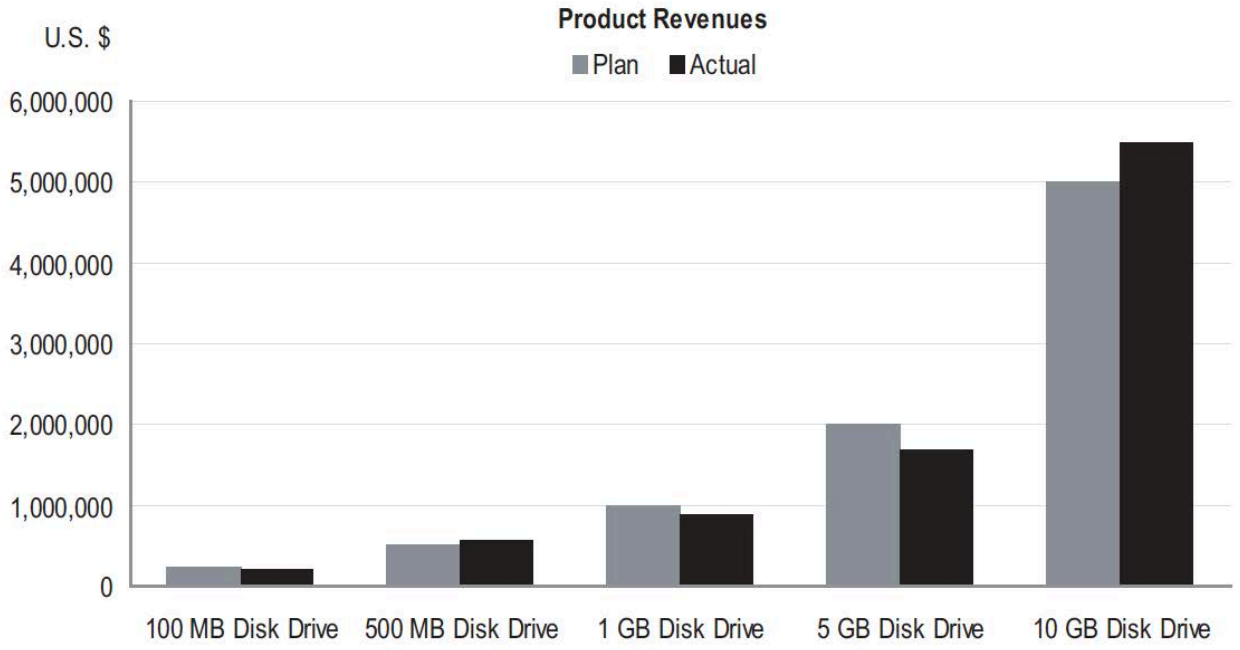
Overview + Detail
Graphics + Tables

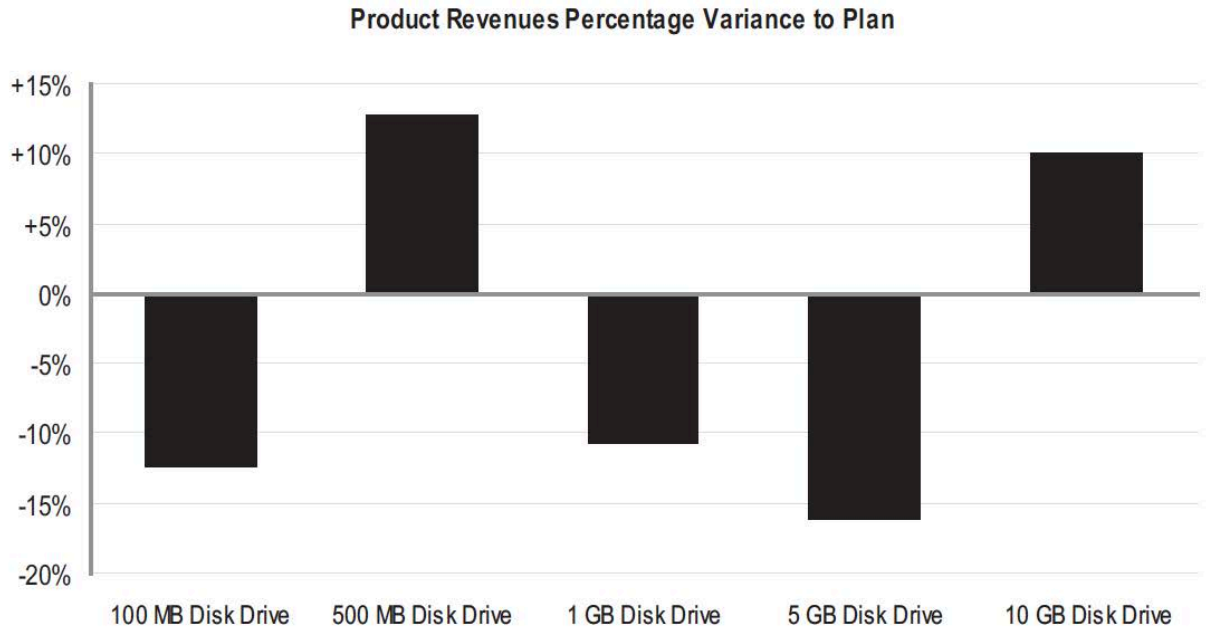
TECHNIQUES

Brushing and linking
Filtering
Details-on-demand

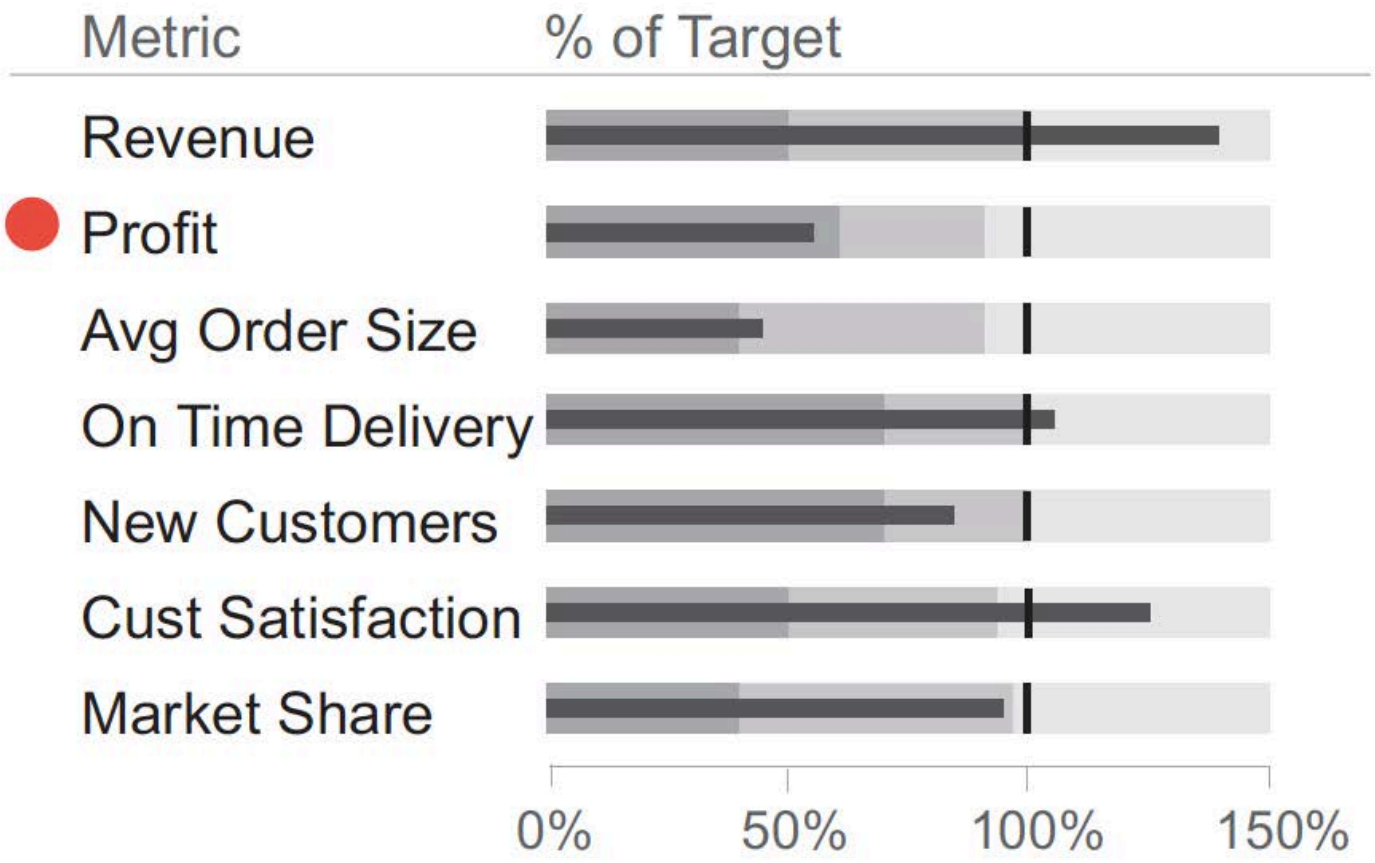
MAKING COMPARISONS MORE VISIBLE

Showing differences rather than the original values



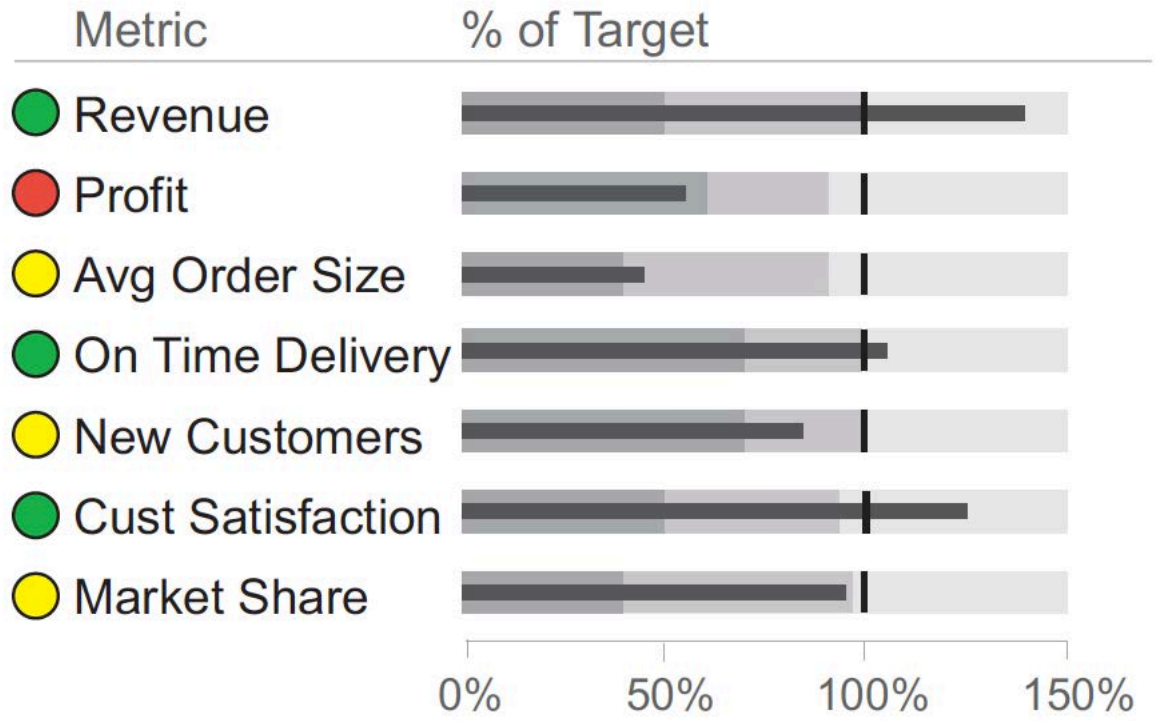


ADDING EMPHASIS



ADDING EMPHASIS

But not too much...



These encodings might actually make it **harder** to extract values.

Metric	Actual	Target	Variance	Variance %
Revenue	$8,938,884	$9,000,000	-$61,116	-0.68%
Profit	$2,873,646	$3,500,000	-$626,354	-17.90%
Avg Order Size	$3,764	$4,000	-$236	-5.90%
On Time Delivery	87%	85%	2%	2.35%
New Customers	15,838	10,000	5,838	58.38%
Cust Satisfaction	79%	90%	-11%	-12.22%
Market Share	13%	15%	-2%	-13.33%

BONUS READING (SARIKAYA ET AL. 2019)

What Do We Talk About When We Talk About Dashboards?

Alper Sarikaya, Michael Correll, Lyn Bartram, Melanie Tory, and Danyel Fisher

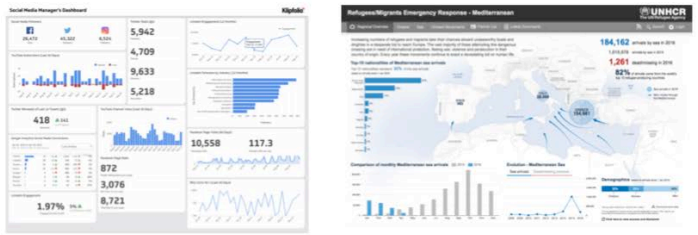


Fig. 1: Klipfolio's Social Media Manager Dashboard (DB065 from our example corpus, left) is a traditional dashboard, with large numbers representing key metrics, and tiled graphs of real-time data. The UNCHR Refugees/Migrants Emergency Response dashboard (DB117, right) also is a juxtaposition of key metrics and simple visualizations, but includes annotations and guided narrative elements. Are both dashboards? Do design principles meant for one transfer to the other?

Abstract—Dashboards are one of the most common use cases for data visualization, and their design and contexts of use are considerably different from exploratory visualization tools. In this paper, we look at the broad scope of how dashboards are used in practice through an analysis of dashboard examples and documentation about their use. We systematically review the literature surrounding dashboard use, construct a design space for dashboards, and identify major dashboard types. We characterize dashboards by their design goals, levels of interaction, and the practices around them. Our framework and literature review suggest a number of fruitful research directions to better support dashboard design, implementation, and use.

Index Terms—Dashboards, literature review, survey, design space, open coding

1 Introduction

Visualization dashboards are ubiquitous. They are built and employed by nearly every industry, non-profit, and service organization to support data-driven decision making. They are used by students to track learning, and by individuals to monitor energy consumption and personal health. Despite their prevalence, the visualization research community has rarely given dashboards their due consideration, with few exceptions [46]. Are dashboards simply an extension of known visualization design principles? Or is there more to their design and use?

We argue that dashboards are worthy of discussion and research in their own right. Their ubiquity alone makes them worthy of study, as the potential for impact is vast. But beyond that, they are *interesting*. Dashboards are diverse, appearing in many different contexts. They are shifting and democratizing and diversifying as their use proliferates; their contexts of use are expanding beyond simple monitoring and single screen reports. Uniquely, compared to visualization modalities for presentation and exploration, dashboards bring together challenges of at-a-glance reading, coordinated views, tracking data and both private and shared awareness. Designers of dashboards must be mindful of literacy, contextually appropriate representations and visual language, and social framing. We identify dashboards as a distinct area of visualization that offers impactful directions for future research.

We took a two-pronged approach to understanding practices around dashboard design and use. We conducted an exploratory survey of dashboards "in-the-wild" with the goal of discovering and identifying different types of dashboard design. In parallel, we conducted a multi-domain literature review in order to understand the practices surrounding dashboard use. The domain review allowed us to build a characterization of uses and domains of dashboards and identify issues that the literature sees as urgent. These two complementary approaches mutually informed each other and allowed us to see the breadth of the ill-defined space of dashboards.

We contribute a design space for dashboards that goes beyond principles of visual encoding to include design dimensions such as functional design, purpose, audience, and data semantics. We identify diverse categories of dashboards with unique sets of characteristics across the dimensions. We also report issues and challenges surrounding dashboard use in practice, some of which emphasize the social context of dashboards as a primary interface to "big data." Ultimately, we identify a set of interesting and critical research opportunities. We hope that our work will inspire and engage the community to embrace dashboards, study the challenges surrounding their use, and develop innovative dashboard technologies with broad-reaching impact.

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Manuscript received xx xxx. 201x; accepted xx xxx. 201x. Date of Publication xx xxx. 201x; date of current version xx xxx. 201x. For information on obtaining reprints of this article, please send e-mail to: reprints@ieee.org. Digital Object Identifier: xx.xxxx/TVCG.201x.xxxxxxx

BONUS READING (SARIKAYA ET AL. 2019)

Clusters of Dashboard Designs

				Purpose				Audience			Visual Features					Data Semantics		
Goal	Cluster		# Examples	Strategic	Tactical	Operational	Learning	Audience	Vis Literacy	Domain Expertise	Construction	Interactivity	Modify Data/World	Highlighting	Multipage	Alerting+Notification	Benchmarks	Updateable
Decision-Making	1	Strategic Decision-Making	16	Y	Y	-	N	O	-	-	-	Y	N	N	Y	-	-	Y
	5	Operational Decision-Making	14	N	Y	Y	N	O	-	-	-	Y	N	N	Y	-	Y	Y
Awareness	3	Static Operational	10	N	N	Y	N	O	L	-	-	-	N	N	N	-	Y	Y
	4	Static Organizational	8	-	-	N	N	O	M	-	N	N	N	-	N	N	-	Y
Motivation and Learning	2	Quantified Self	7	N	N	Y	N	I	H	N	N	Y	N	-	Y	-	-	Y
	6	Communication	13	-	-	-	Y	P	M	N	N	-	N	-	-	N	N	Y
	7	Dashboards Evolved	15	-	-	-	-	P	H	-	-	-	-	-	-	-	-	Y

A QUICK "DASHBOARD" EXERCISE

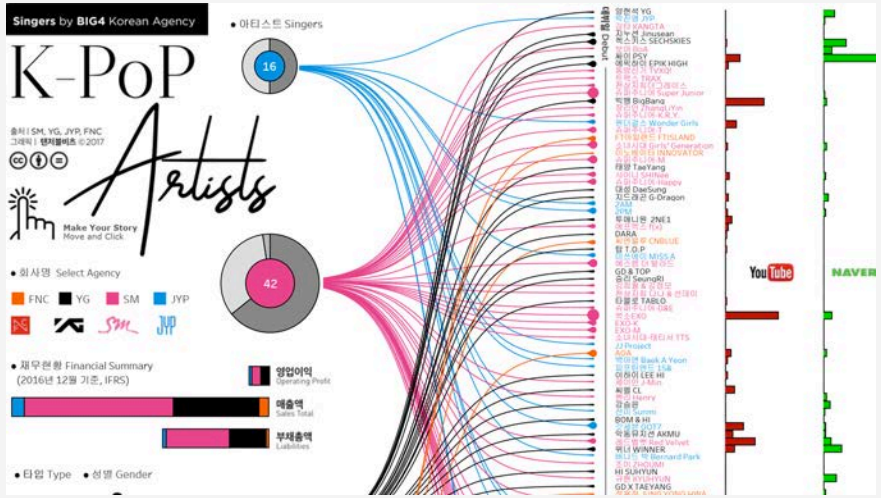
...Exploring the Tableau Public Gallery

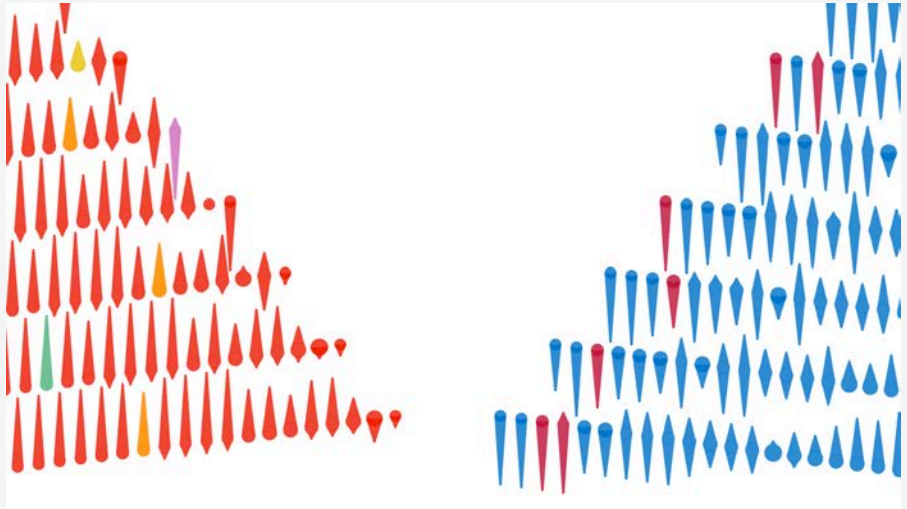
(MOST OF THESE AREN'T ACTUALLY DASHBOARDS IN THE TRADITIONAL SENSE)

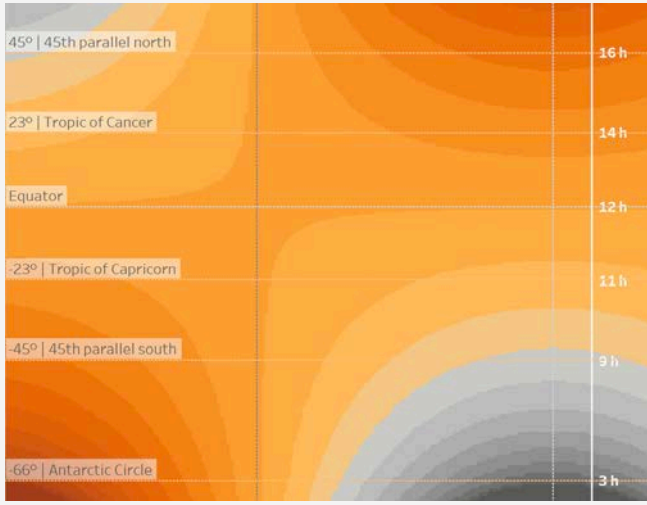
Gallery / Viz of the Day

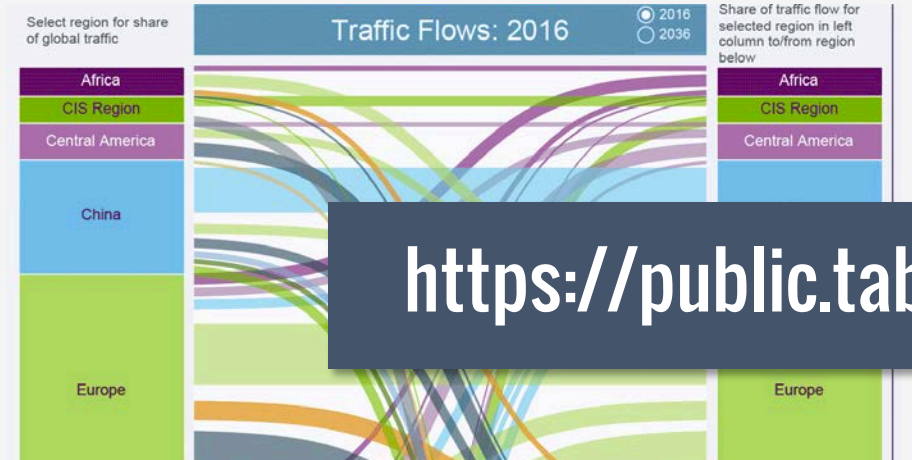
Stunning data visualization examples from across the web created with Tableau Public.

Viz of the Day Featured









https://public.tableau.com/s/gallery

GDP of Thailand | Tableau Pub

wjwillett

Secure https://public.tableau.com/en-us/s/gallery/gdp-thailand?gallery=votd

tableau public

GALLERY AUTHORS BLOG RESOURCES ACTIVITY SIGN IN

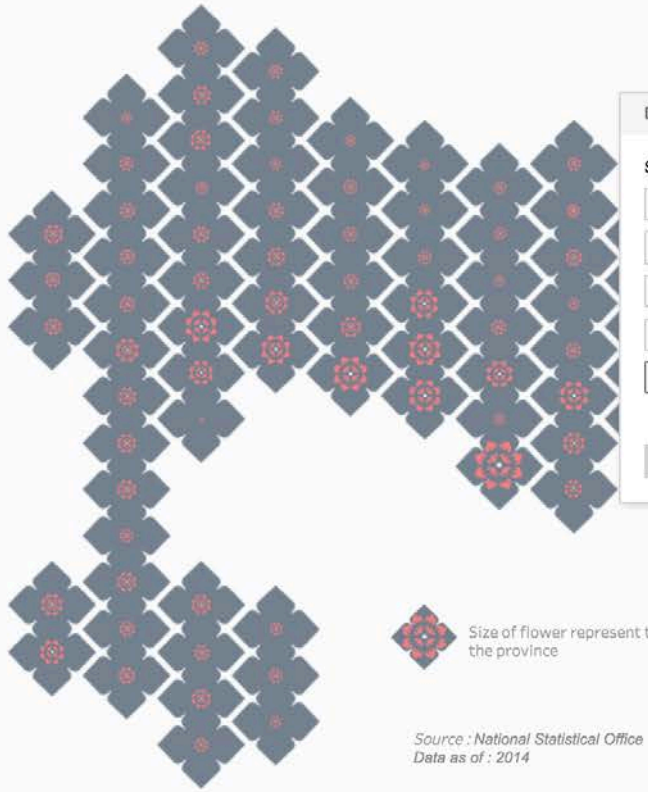
Gallery

March 29, 2018
4 days ago

Subscribe

GDP of Thailand

Thailand *formerly known as* ***Siam*** *is a country at the centre of the Indochinese peninsula in Southeast Asia. With a total area of approximately 513,000 km2 (198,000 sq mi), Thailand is the world's 50th-largest country. It is the 20th-most-populous country in the world, with around 66 million people. The capital and largest city is Bangkok.*
The Thai economy is the world's 20th largest by GDP at PPP and the 27th largest by nominal GDP. It became a newly industrialised country and a major exporter in the 1990s. Manufacturing, agriculture, and tourism are leading sectors of the economy. It is considered a middle power in the region and around the world. (Wikipedia)



Size of flower represent the GPP per head of the province

Overall
13,132,231MB

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Data

Crosstab

PDF

Tableau Workbook

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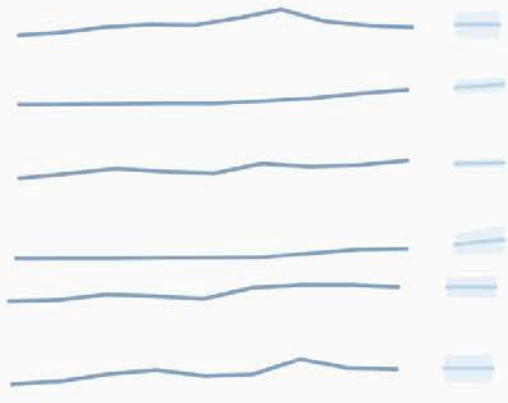
vincial Product of

g

547MB



Source : National Statistical Office
Data as of : 2014

Note : Bueng Kan was the newest province since 2011

tableau

TABLEAU DASHBOARD ARCHAEOLOGY

https://public.tableau.com/s/gallery

1. Find and download an interesting vis from the gallery.
2. Spend 10 mins opening it up and seeing how they made it.
   - How many sheets make up the dashboard?
   - What filters or actions do they use.
   - Did the authors have to do extra work outside of Tableau (generating their own coordinates, shapes, etc.)?
   - Anything else impressive or interesting?
3. Share with your neighbors.