

# Perception and data visualization design principles



ONLINE WORKSHOP • MARCH 5 & 12, 2021

Juan Velasco - 5W Infographics  
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- Art Director, **National Geographic** Washington DC
- Founder, **5W Infographics** New York / Madrid / Washington

# Day 1

Friday March 5

- Why data visualization matters
- Visual perception principles
- Design principles

# Day 2

Friday March 12

- Writing for clarity and insight
- Beyond graphs and charts
- Tools of data visualization
- Q&A and resources

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## Asynchronous learning between sessions

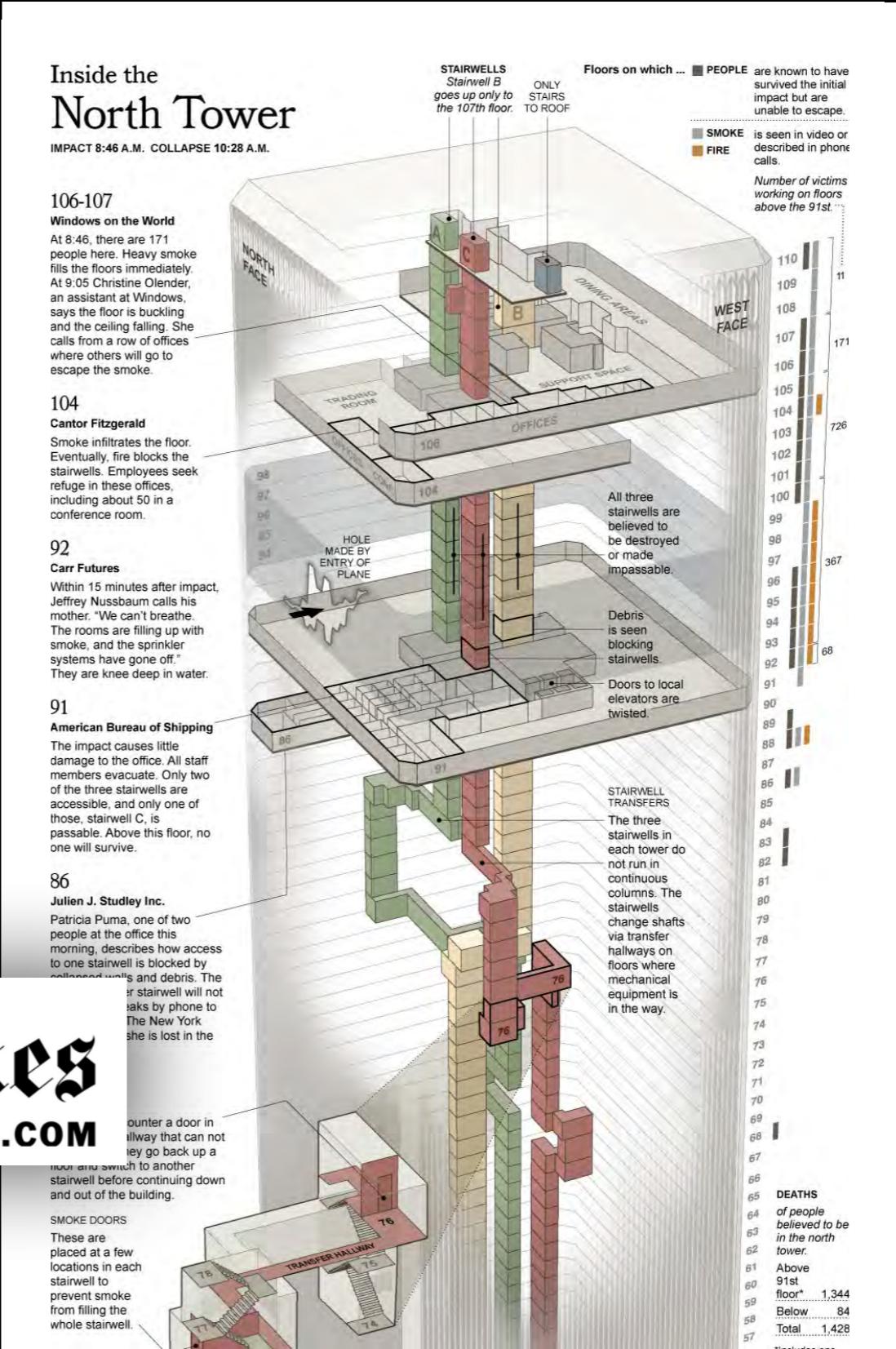
- Design a COVID-19 data-tracking dashboard
- Hands-on with data visualization tools

**DAY 1**

# Why data visualization **matters**

# Visual journalists, not just designers

## Over 2,500 graphics/year



VOL. 167, NO. 6

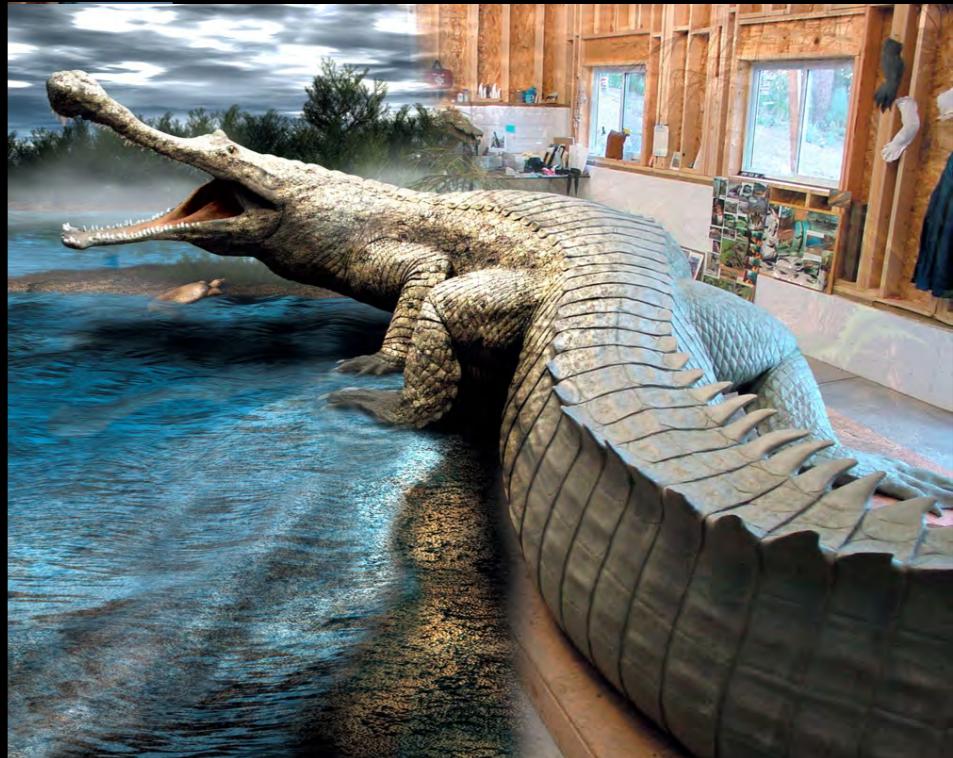


JUNE 1985

# NATIONAL GEOGRAPHIC



Explaining  
complex  
stories  
to large  
audiences



# Accurate and relevant

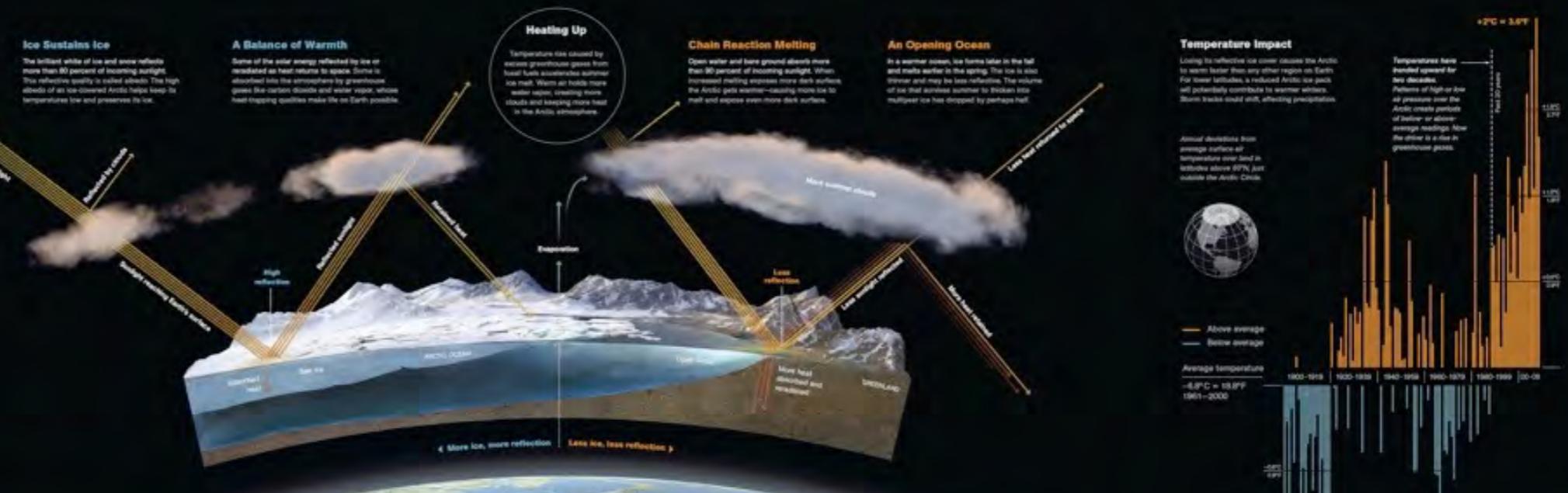
# Twilight of the Arctic Ice

The empire of ice at the top of the world is shrinking. The Arctic Ocean's summer ice pack covers little more than half its former reach, as a sweeping satellite image from September 2008 documents. Atop Greenland's formidable ice sheet, melting has also quickened. Sea ice, naturally expanding and contracting with the seasons, has covered this ocean year-round for most of the past three million years. But the Arctic is uniquely sensitive to climate change (right). Ten years ago global-warming models predicted the Arctic Ocean could be ice free in summer by 2100. Then the date dropped to 2050, and now to 2030—or sooner. As climate scientist Mark Serreze puts it, "Reality is exceeding expectations."



**North and South**

The Northern Hemisphere has experienced a greater temperature rise than the Southern, in part because it has more land, which warms faster than open oceans. Yet troubling signs of warming in Antarctica—where the vast continental ice sheet holds 85 percent of Earth's freshwater ice—make clear that the bottom of the world is also vulnerable.

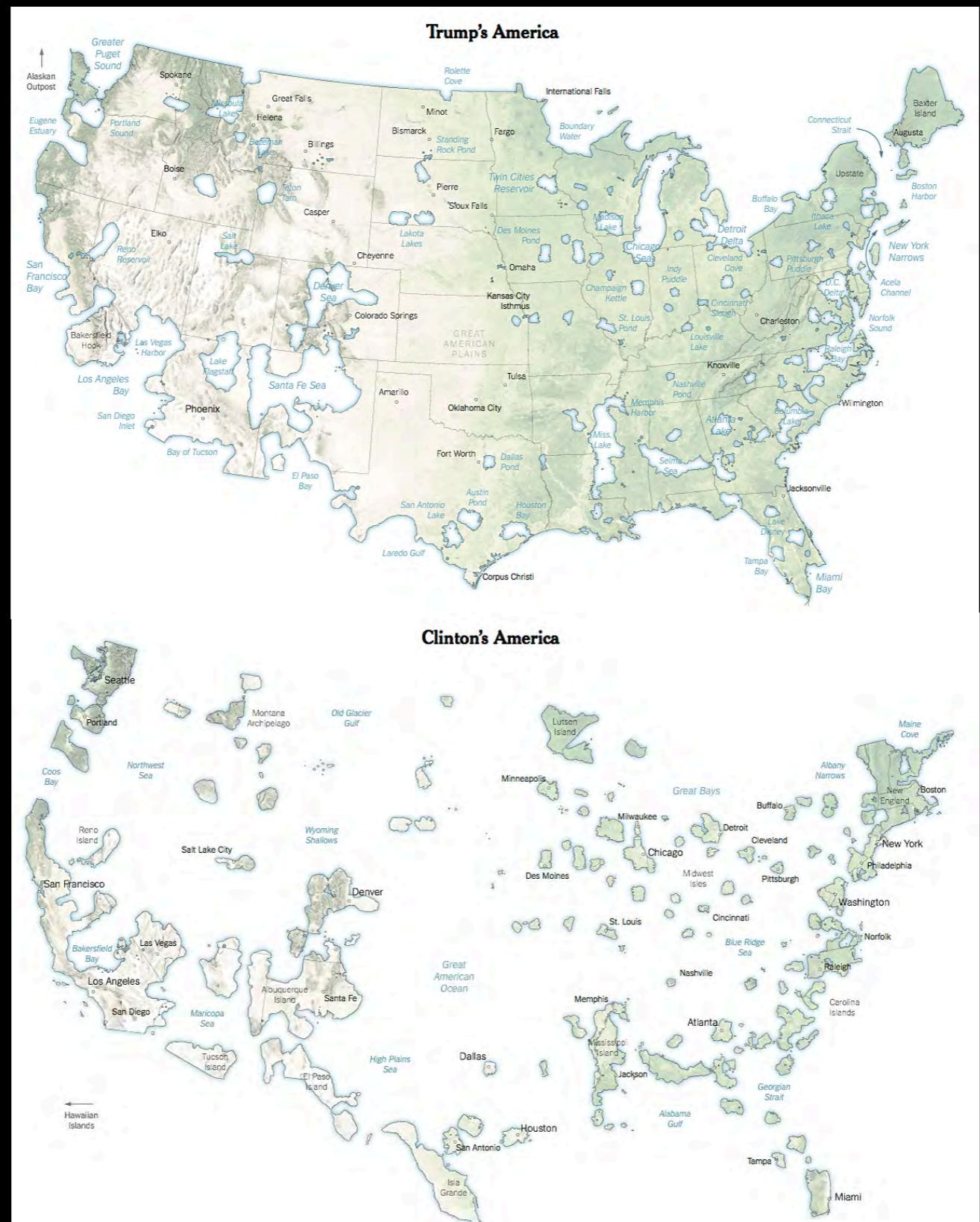


NATIONAL  
GEOGRAPHIC

RESEARCH BY NATIONAL GEOGRAPHIC AND THE UNIVERSITY OF TORONTO  
MAPS BY NATIONAL GEOGRAPHIC AND THE UNIVERSITY OF TORONTO  
DATA BY THE NATIONAL ARCTIC PROGRAM, THE NATIONAL SCIENCE FOUNDATION, THE CANADIAN SCIENCE INFORMATION SERVICE, THE CANADIAN METEOROLOGICAL SERVICE, AND THE GREENLAND ICE SHEET MELTING PROJECT  
GRAPHICS BY NATIONAL GEOGRAPHIC AND THE UNIVERSITY OF TORONTO  
PHOTOGRAPH BY JEFFREY WATSON, NATIONAL GEOGRAPHIC

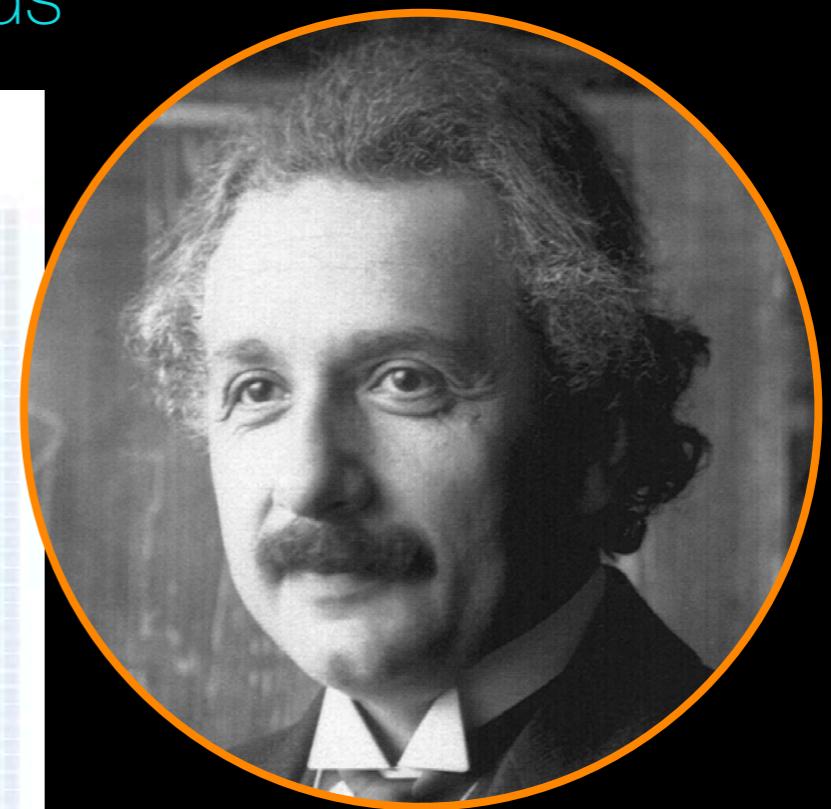
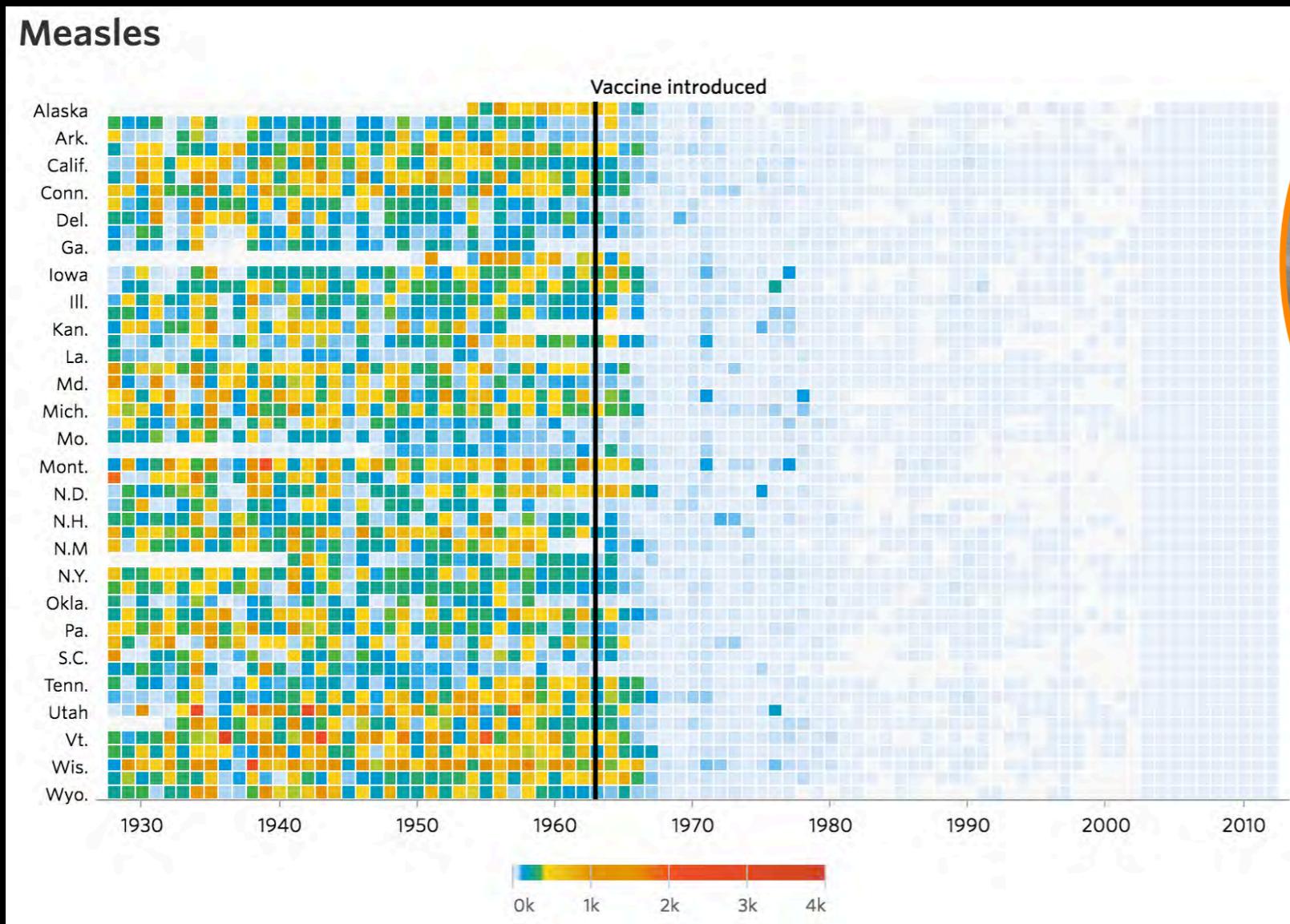


# Simple, memorable ideas



# Why visual?

An image is **worth more** than a thousand words

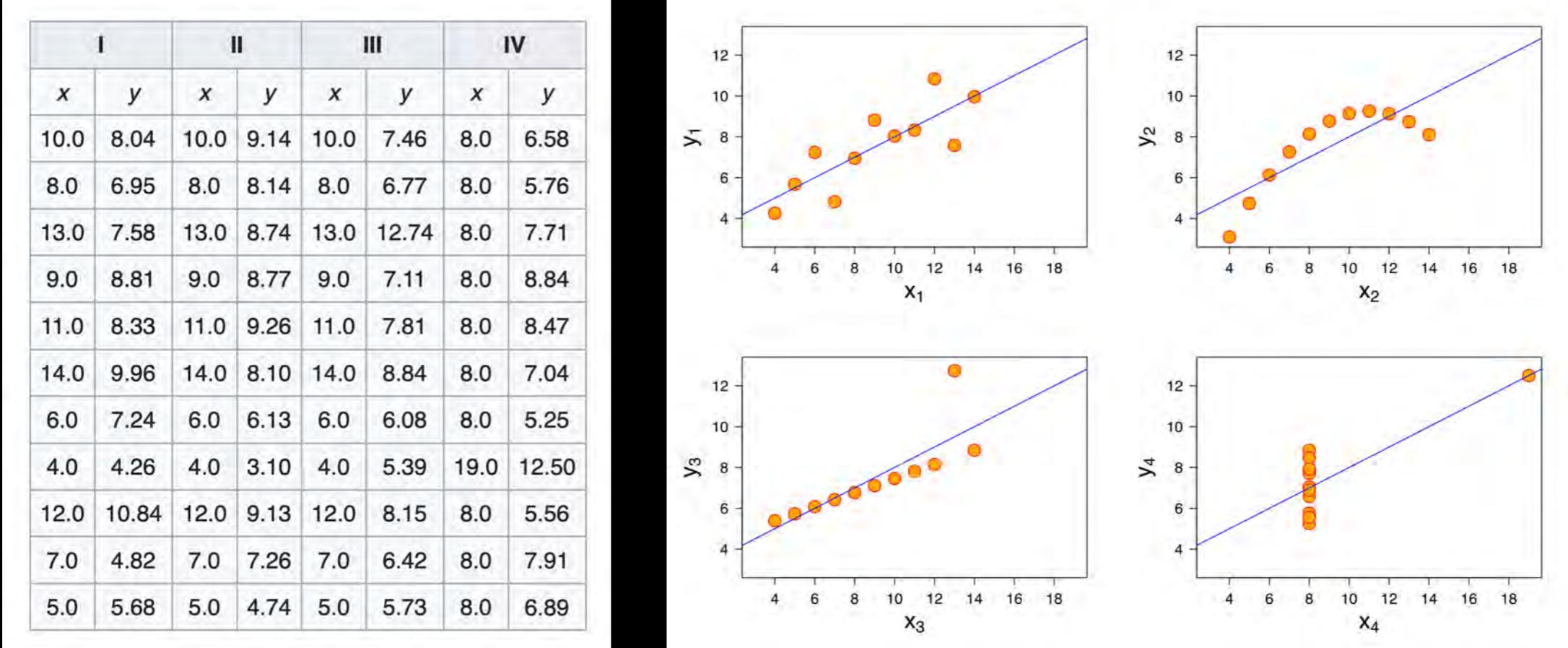


*If I can't  
picture it, I can't  
understand it.*

ALBERT EINSTEIN

# Graphics facilitate understanding.

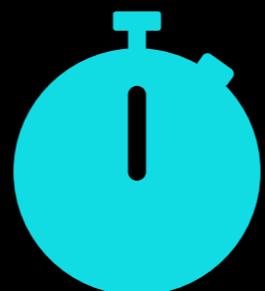
By placing datapoints across an axis, the patterns, trends and relationships behind the numbers are revealed.



Anscombe's quartet

Most “readers” **don’t read.**

They **scan** pages



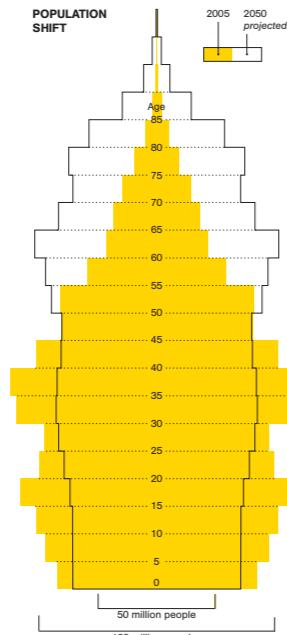
- Scan headlines
- Look at the photos and **the graphics**
- Only about **25%** read articles
- Subscribers spend 17 min/day reading the paper



## SHRINKING WORKFORCE

It's the biggest demographic revolution in history: The number of China's elderly is ballooning thanks to improvements in medicine and sanitation, while the number of people born after the government's one-child policy went into effect in 1979 is dwindling. China's immense workforce, key to today's boom, will shrink after 2015. The country should be able to fill jobs by continuing to tap underemployed rural laborers. But by 2050 close to a third of China's citizens will be over 60—three times the current proportion. With little social security and few pensions to ease the burden, China's only children will have to support two parents (and in many cases four grandparents) apiece—a heavy load even for urban factory workers, who typically save a quarter of their wages.

—Karen E. Lange



CHARLES M. BLOW, NG STAFF  
SOURCE: POPULATION DIVISION, UNITED NATIONS

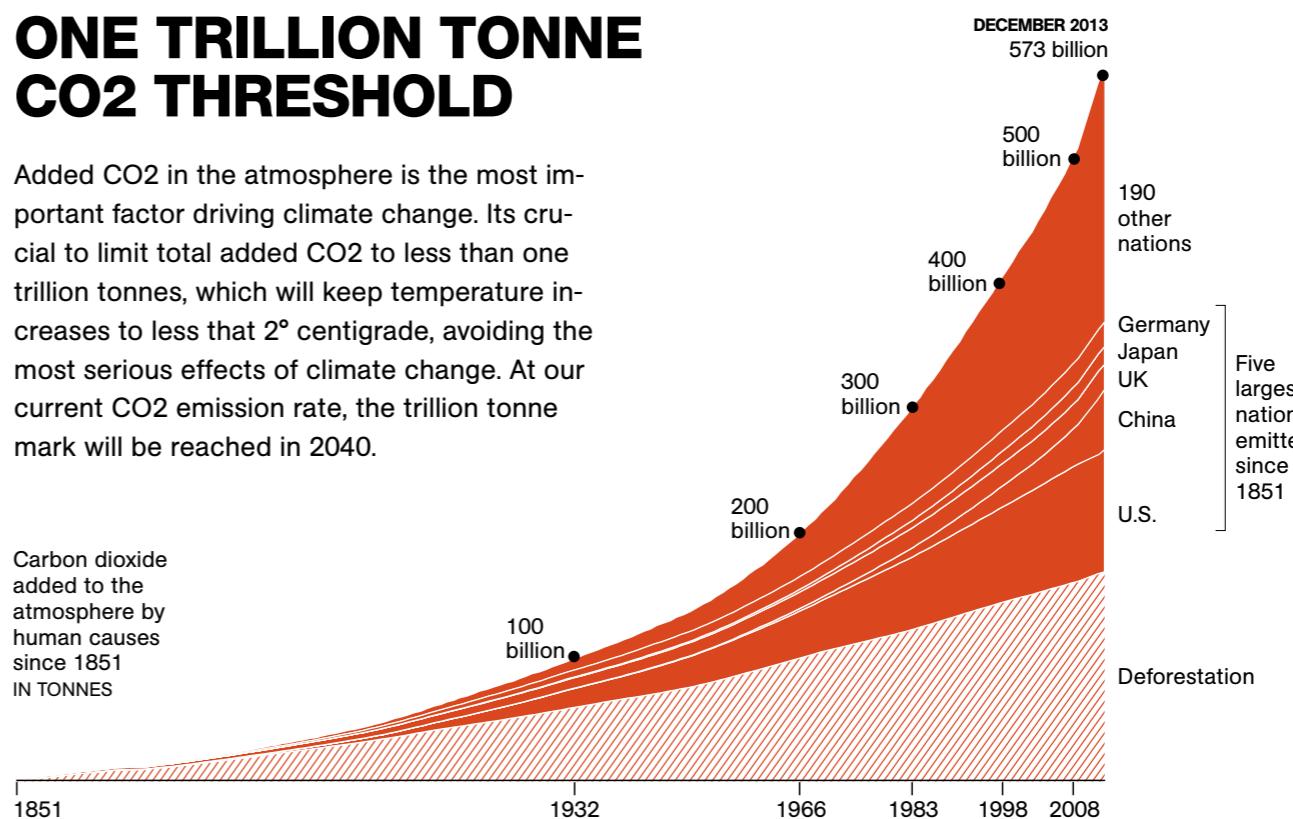


Coal and Climate Change

## THE ONE TRILLION TONNE CO<sub>2</sub> THRESHOLD

Added CO<sub>2</sub> in the atmosphere is the most important factor driving climate change. It's crucial to limit total added CO<sub>2</sub> to less than one trillion tonnes, which will keep temperature increases to less than that 2° centigrade, avoiding the most serious effects of climate change. At our current CO<sub>2</sub> emission rate, the trillion tonne mark will be reached in 2040.

Carbon dioxide added to the atmosphere by human causes since 1851  
IN TONNES



Infographics and data visualization summarize complex stories, **find the key message** and present it in a **impactful** and revealing way.

A good graphic **stands alone** and **summarizes** a story

problem, he does sometimes wonder if the solution he's been working on will ever be put to use. His toy carbon capture system, 50 feet high, is a

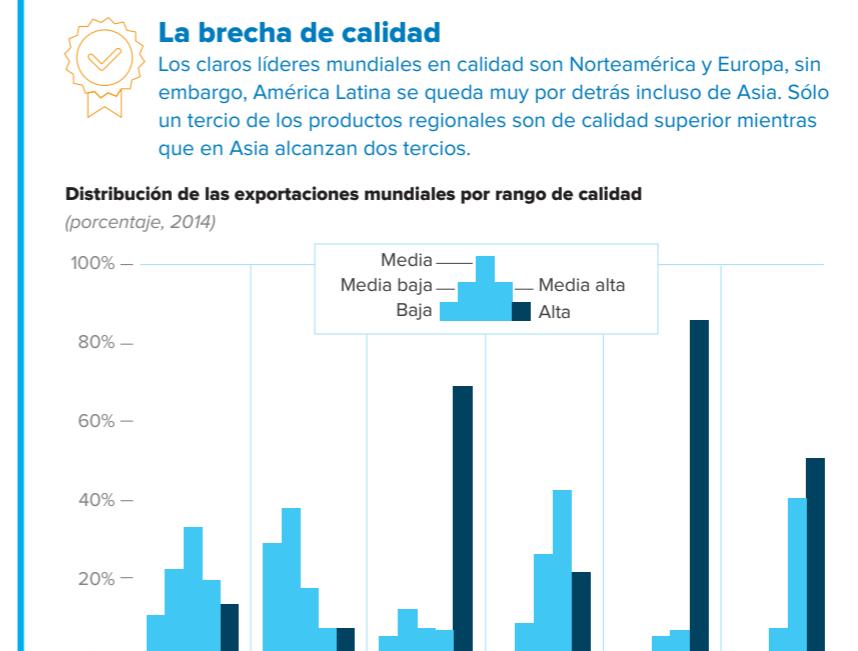
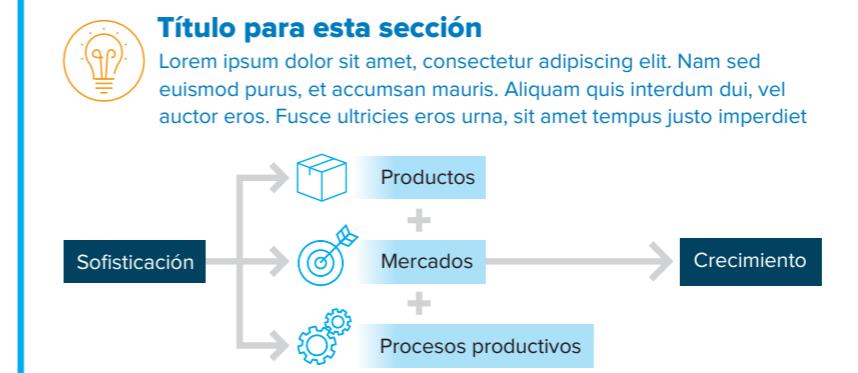
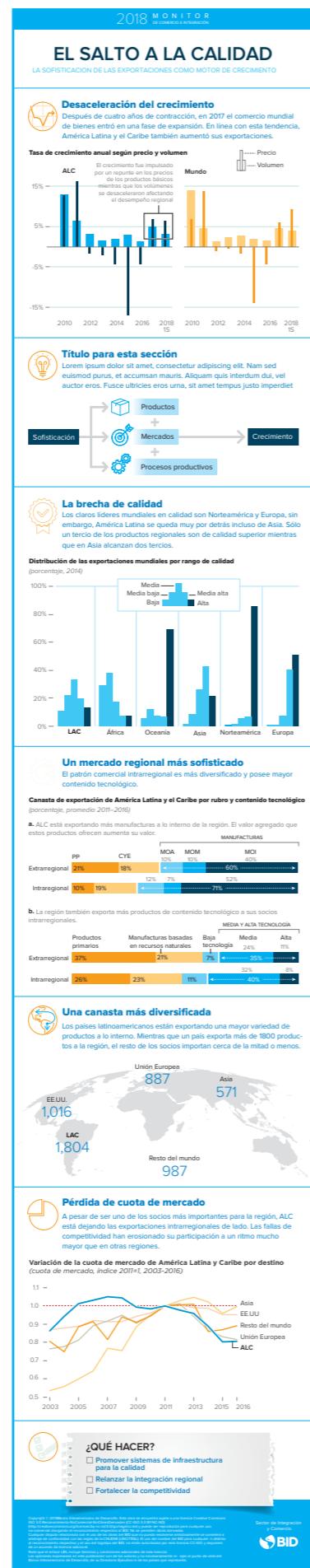
and too cold in winter. But the region is blessed with mineral resources, including some of the country's richest deposits of coal. "God is fair"



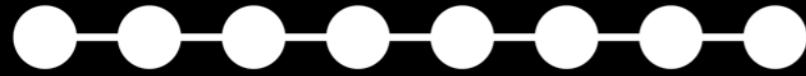
# Visual executive summary

# Visual highlights of a report for social media and public outreach

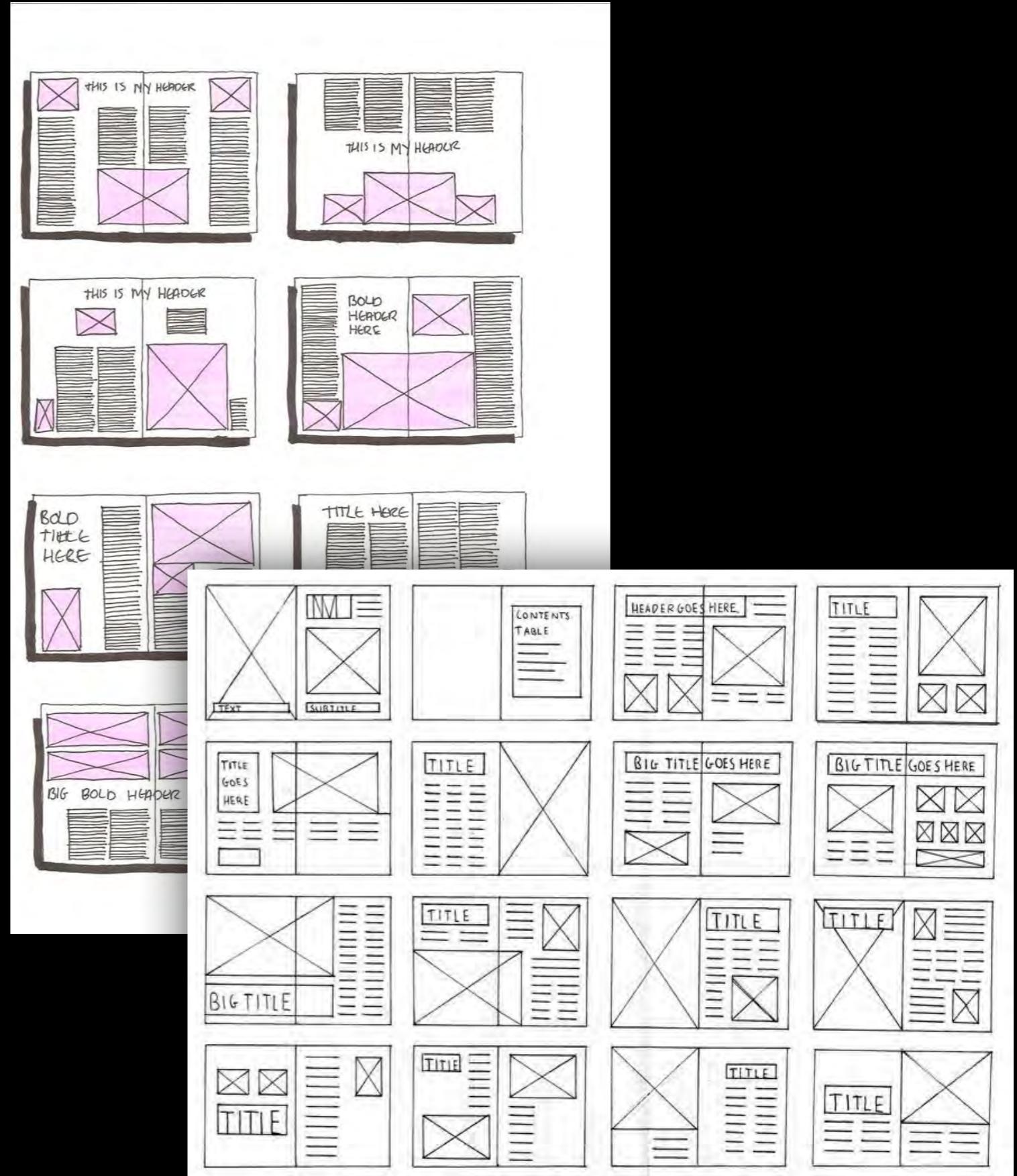
# Restrained use of color



Visual variety stimulates curiosity  
and facilitates the cognitive effort

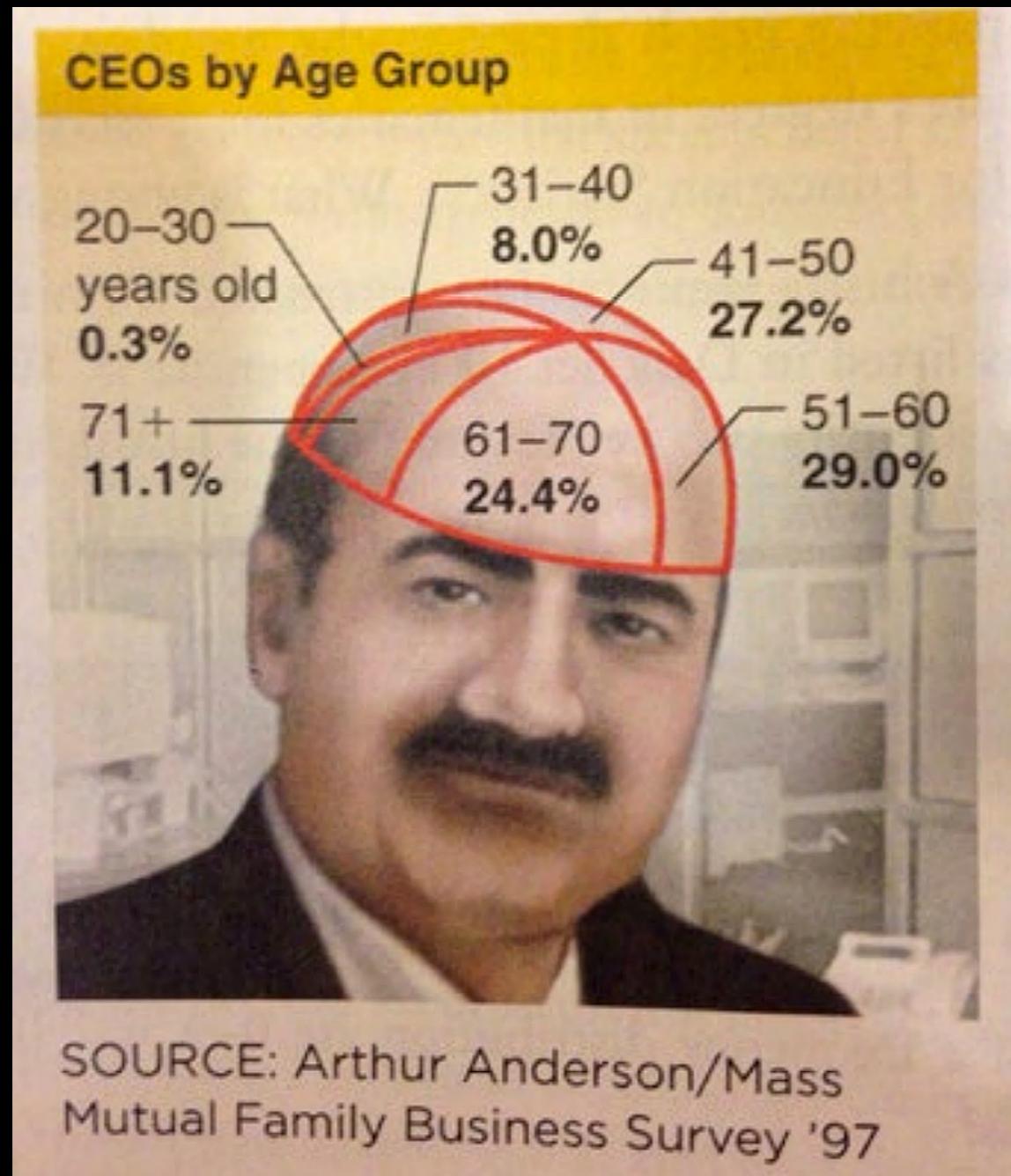


- Icons
- Infographics
- Summaries
- Quotes
- Sidebars
- Profiles
- Numbers / “fast facts”

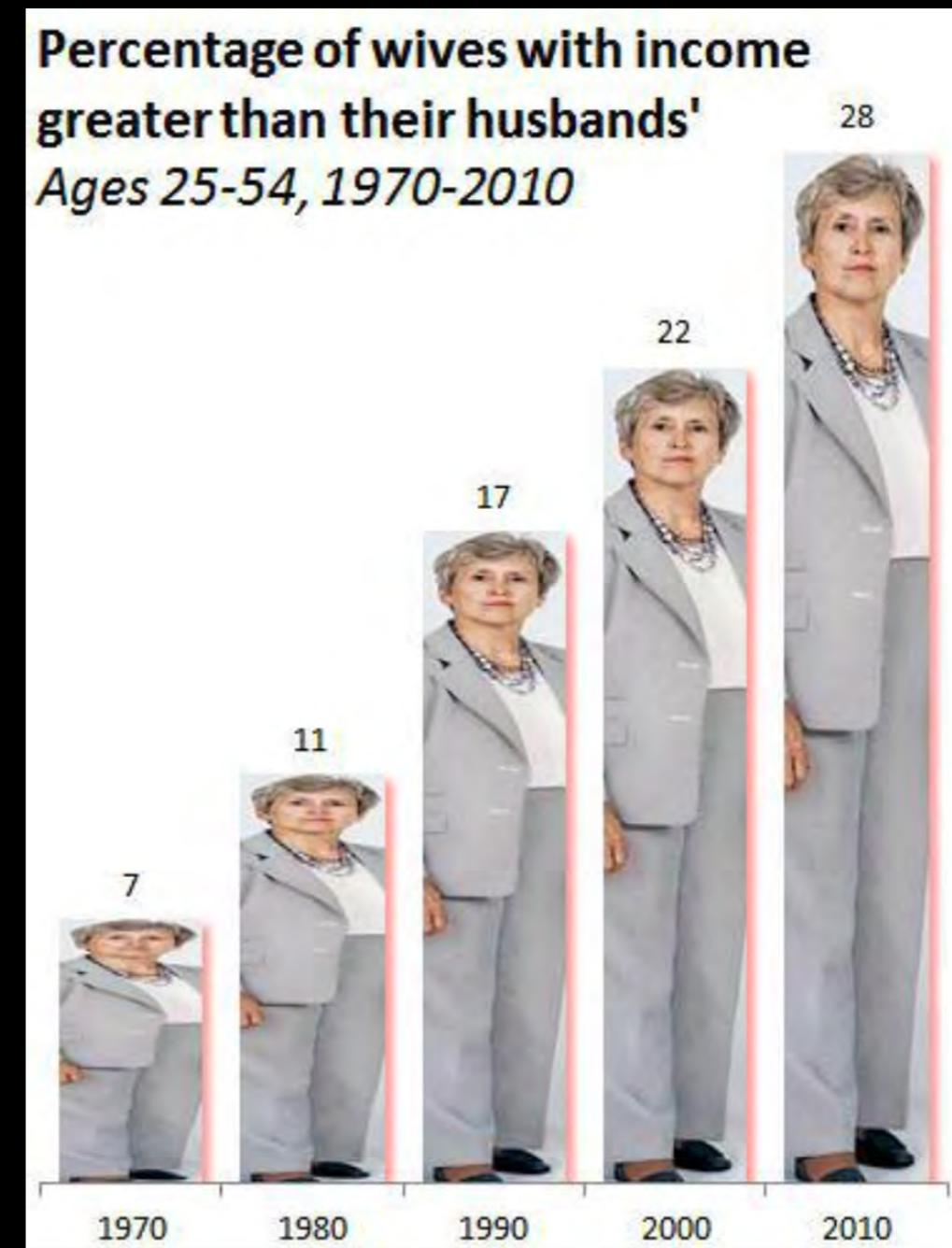


So we need them, but there are **so many** bad graphics out there!

### Unnecessary Illustration

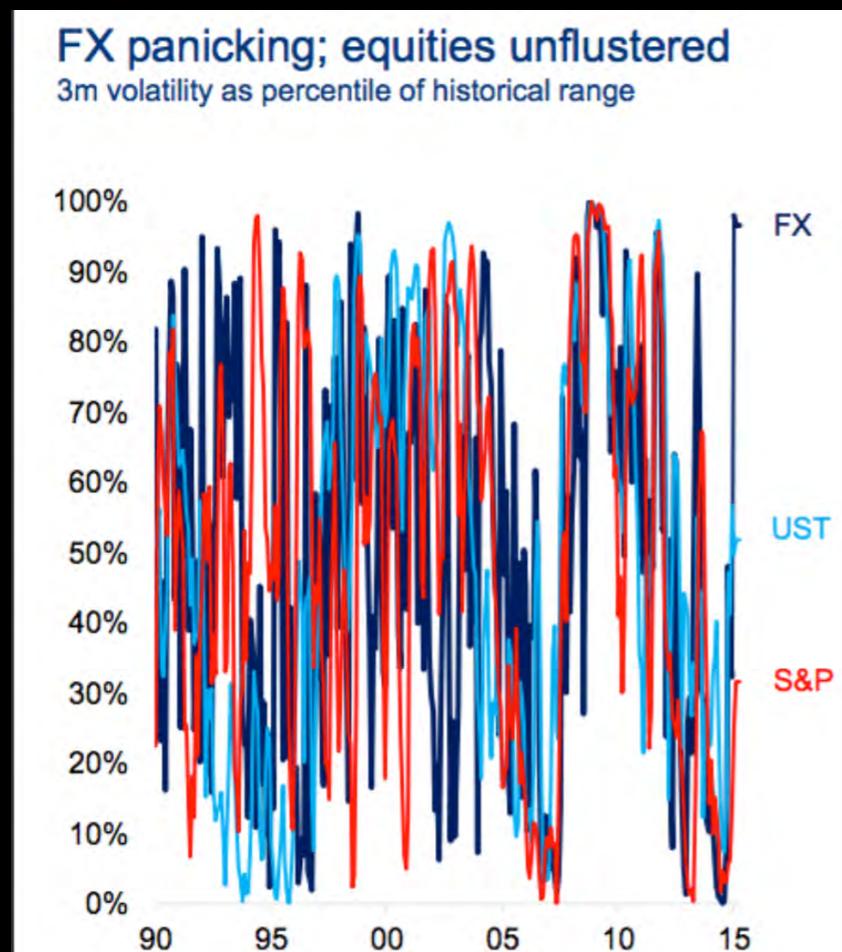


### Distraction

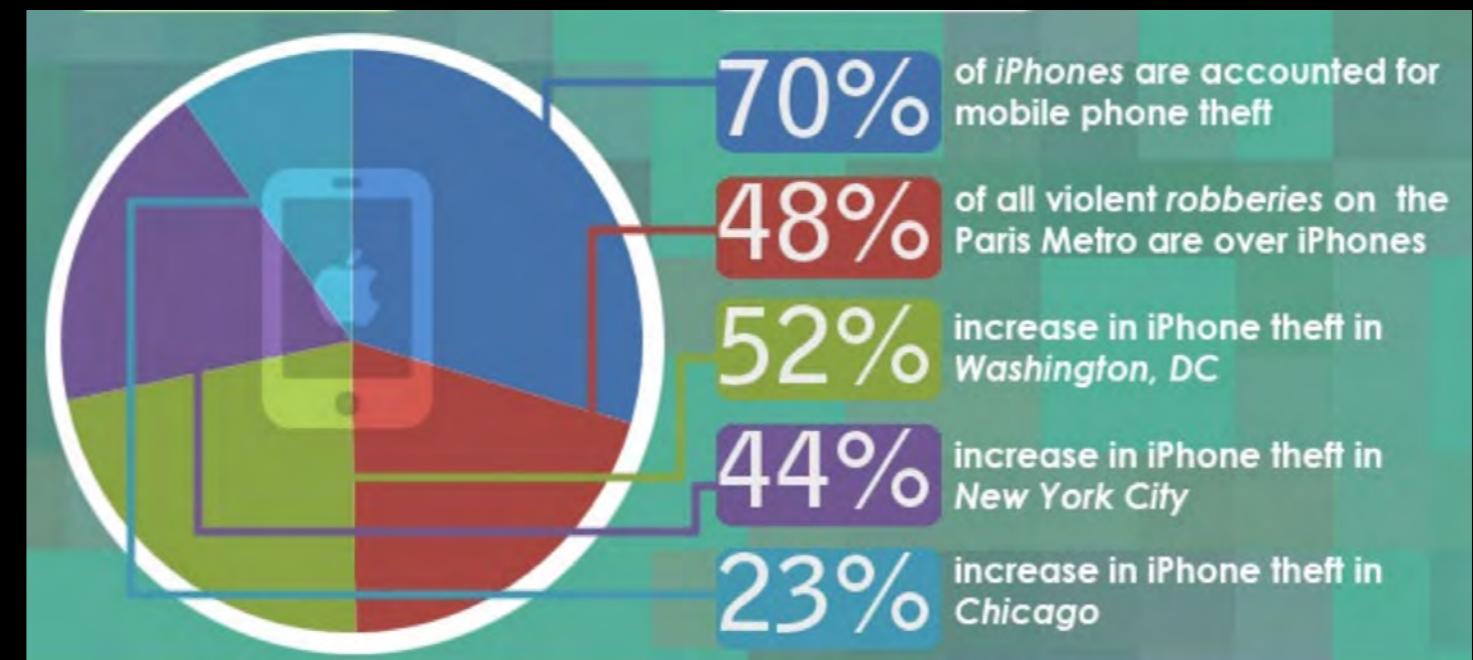


So we need them, but there are **so many** bad graphics out there!

## Unreadability



## Inappropriateness

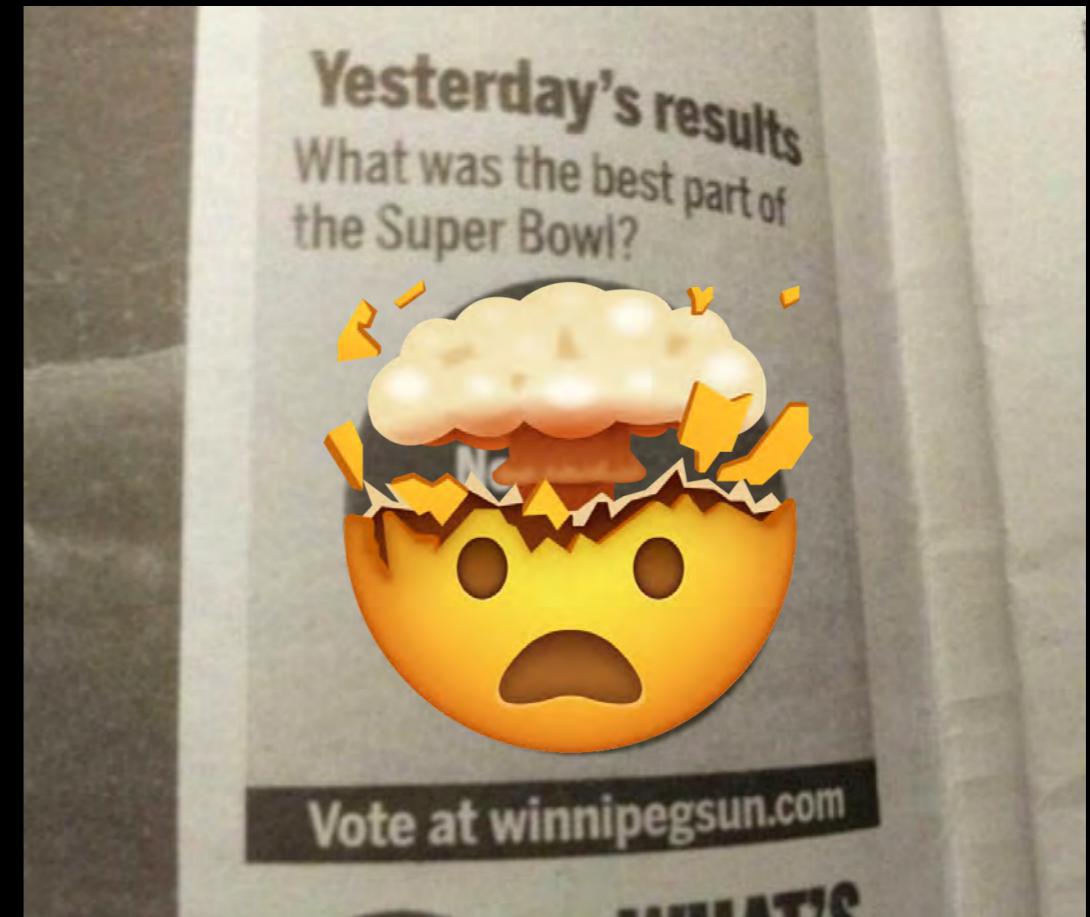


So we need them, but there are **so many** bad graphics out there!

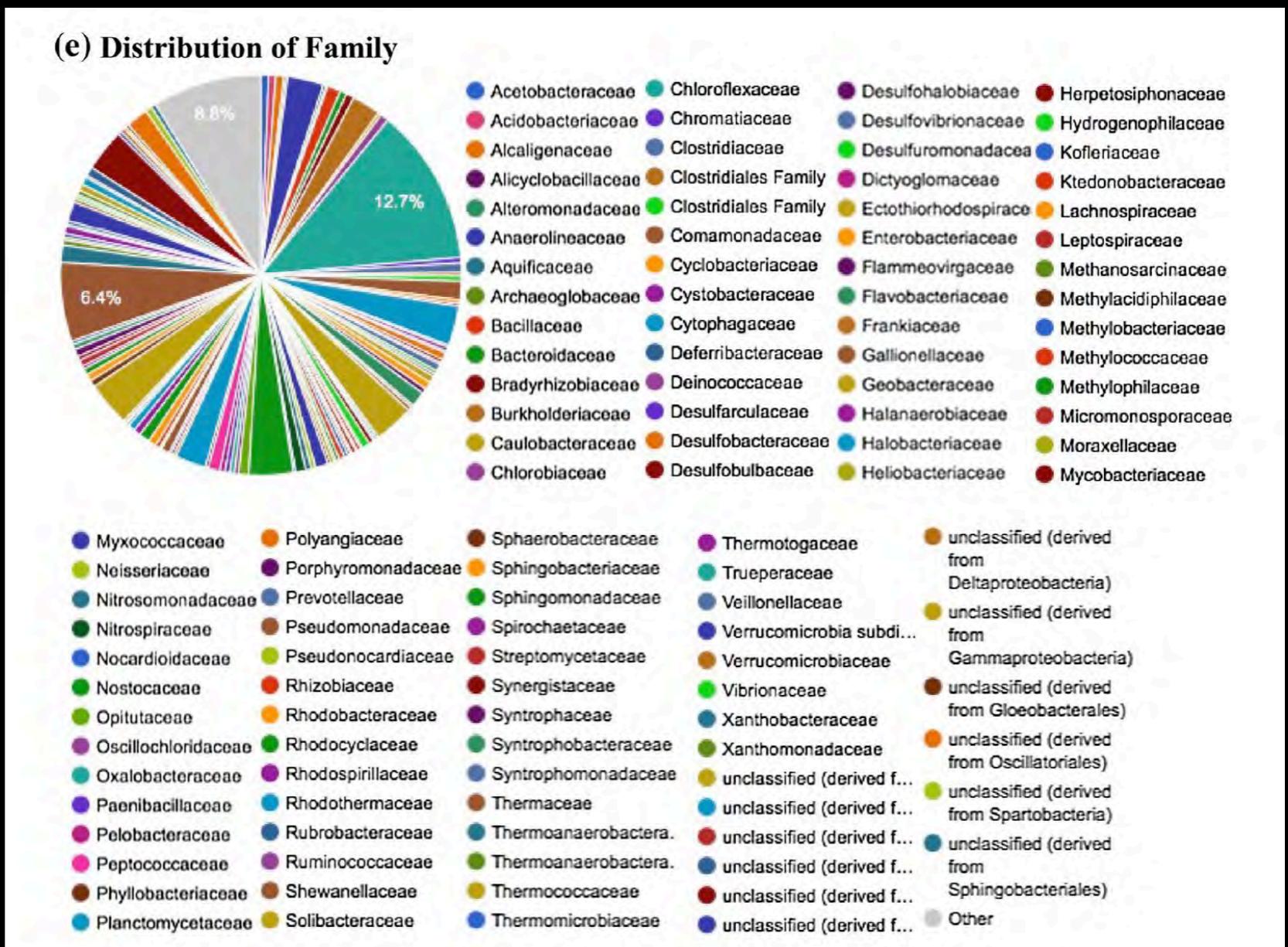
The perfect pie chart



And then, this ...



So we need them, but there are **so many** bad graphics out there!



So we need them, but there are **so many** bad graphics out there!

The screenshot shows the homepage of the **WTF Visualizations** website, which features a colorful, abstract background at the top. Below it is a circular logo with overlapping colored arcs (blue, red, yellow, green) and the text "WTFViz". The main title "WTF Visualizations" is displayed in a large, bold, dark font. Below the title, a subtitle reads "Visualizations that make no sense." A call to action encourages users to "For a discussion of what is wrong with a particular visualization, tweet at us [@WTFViz](#). Submit a [WTFViz you found](#)."

Below the main content area, there are two small links: "SUBMIT A POST" and "ARCHIVE".

The central visual is a bar chart titled "Truth of Hike in PETROLEUM PRICES" with the subtitle "% Increase in Petrol Prices \*with % change in International Crude Oil Prices". The chart displays the retail selling price in Delhi for four different dates: 16 May 2004, 16 May 2009, 16 May 2014, and 10 Sept. 2018. The bars show a general upward trend, but the chart is misleading due to its non-linear scale and the inclusion of international crude oil price increases, which are not directly related to the retail price in Delhi.

The chart includes the following data points:

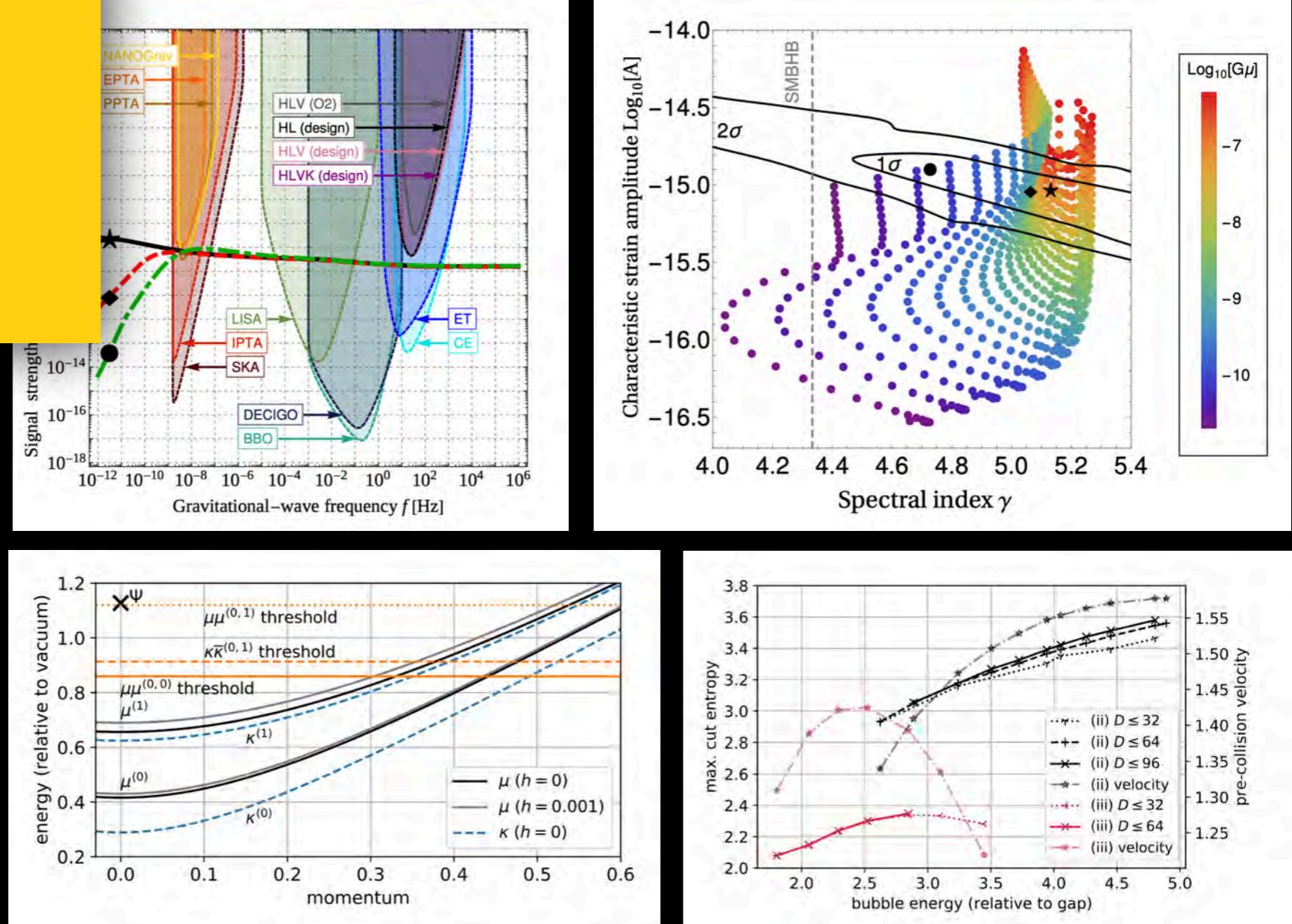
Date	Retail Selling Price in Delhi (₹)	International Crude Oil Price (\$)	% Increase in Petrol Prices
16 May 2004	₹ 33.71	\$36	20.5%
16 May 2009	₹ 40.62	\$58	61%
16 May 2014	₹ 71.41	\$107	75.8%
10 Sept. 2018	₹ 80.73	\$71	84% (from 2014)

A photograph of Prime Minister Narendra Modi is overlaid on the chart, with his hand on his forehead in a gesture of exasperation or despair. The caption "(Retail Selling Price in Delhi)" is located below the chart.

At the bottom of the page, the credits are listed as: <https://www.businessstoday.in/current/economy-politics/bjp-tells-petrol-price-hike-truth-on-twitter-with-graph-congress-fixes-it/story/282233.html>

# Information complexity

The nightmare of scientific papers

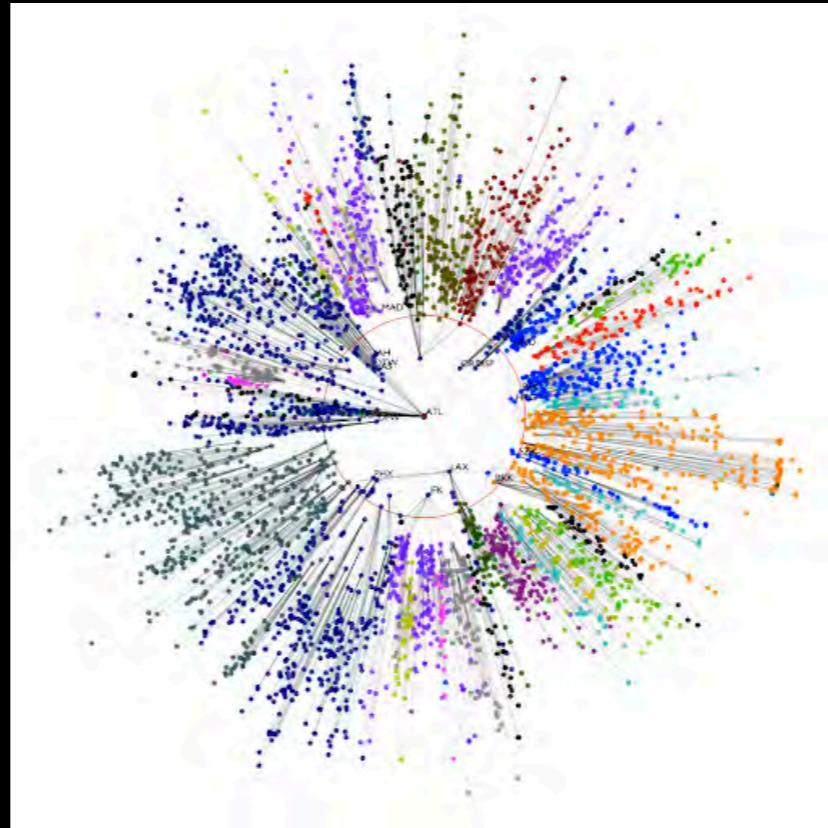


Some of it it's not about complex data, it's  
about poor design choices.

Working for academic publications

**doesn't exempt you from being clear**

**NONSENSE!**



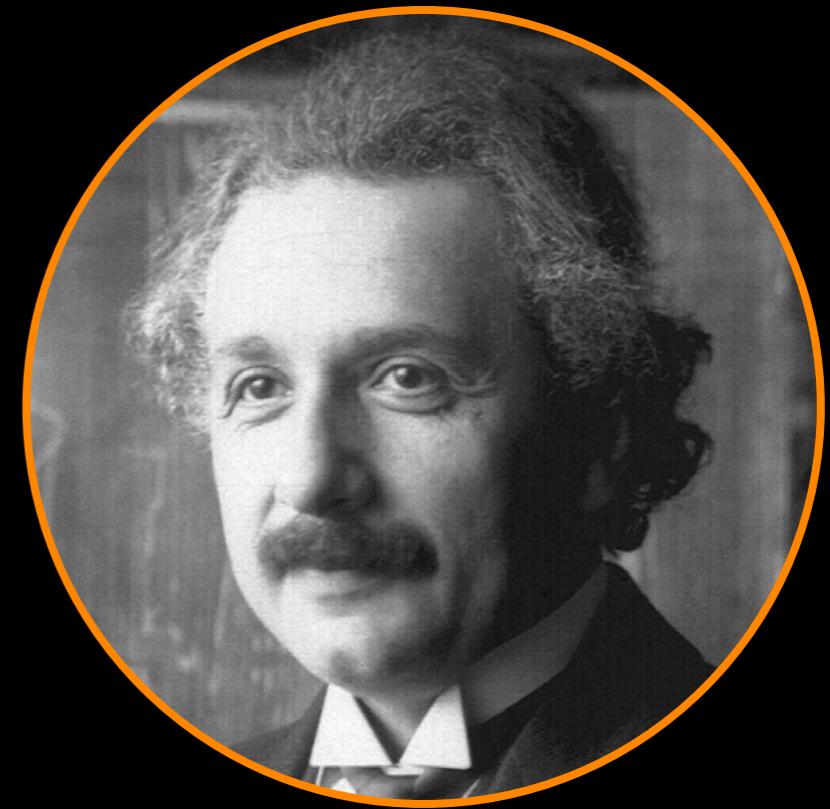
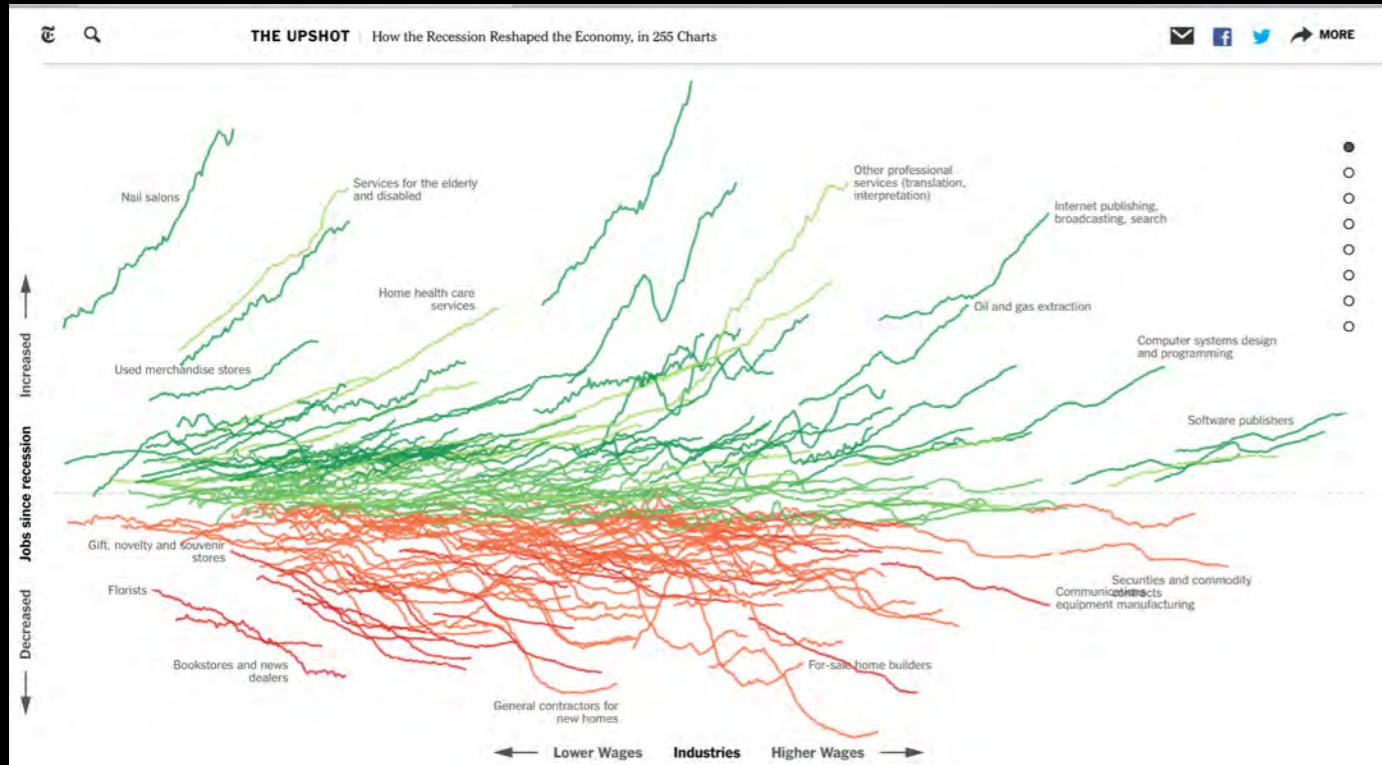
Scientists and researchers are as confused  
by bad data visualization as everyone else

# Complexity

The goal is not to **simplify**.

It is to **clarify**.

Clarifying sometimes means  
embracing some complexity

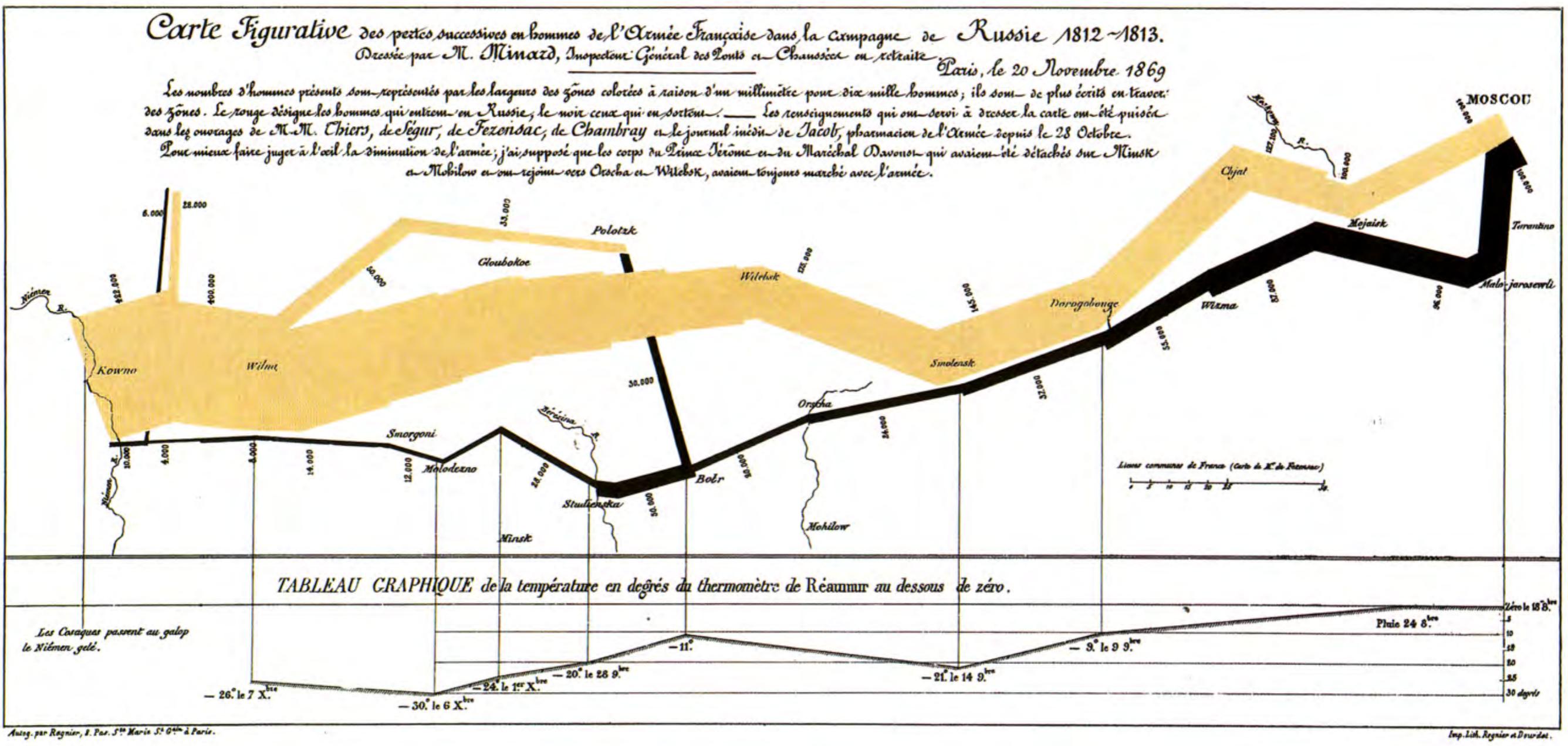


*Everything should be  
made as simple as  
possible, but not simpler*

ALBERT EINSTEIN

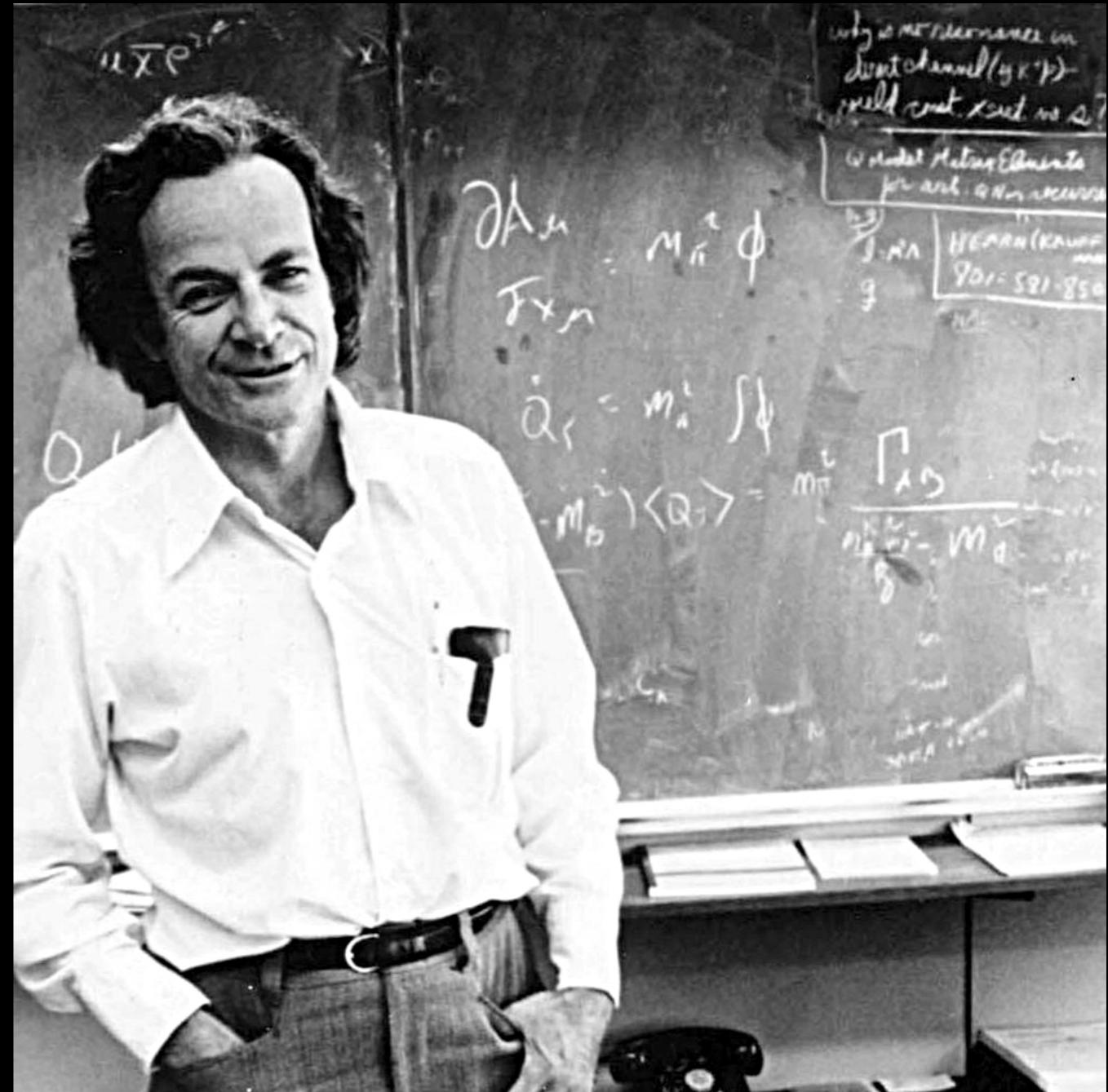
# Good graphics are multidimensional

Charles Minard's **flow map**, 1869 - Napoleon Russian invasion of 1812  
 422,000 soldiers departed. 4,000 came back



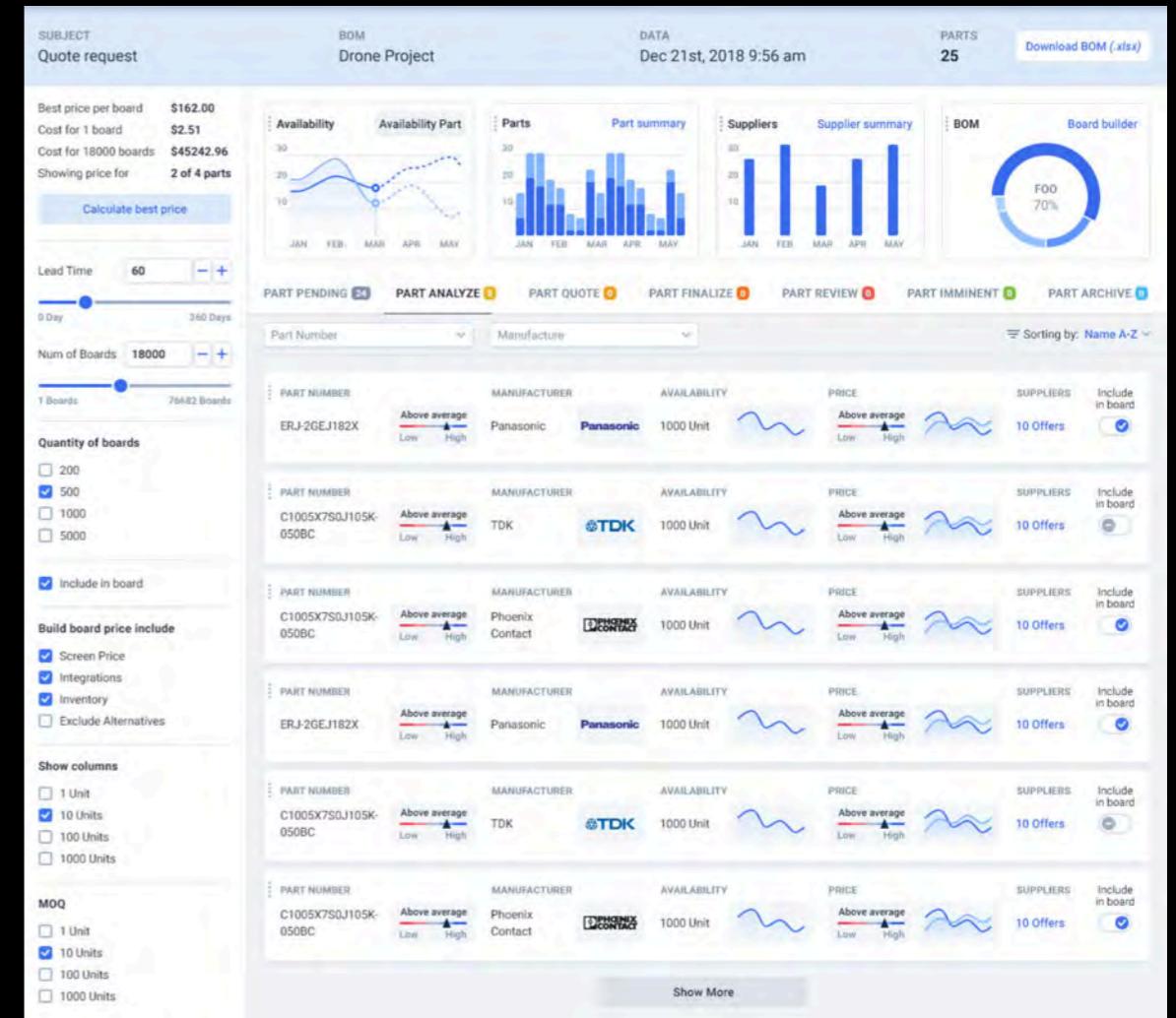
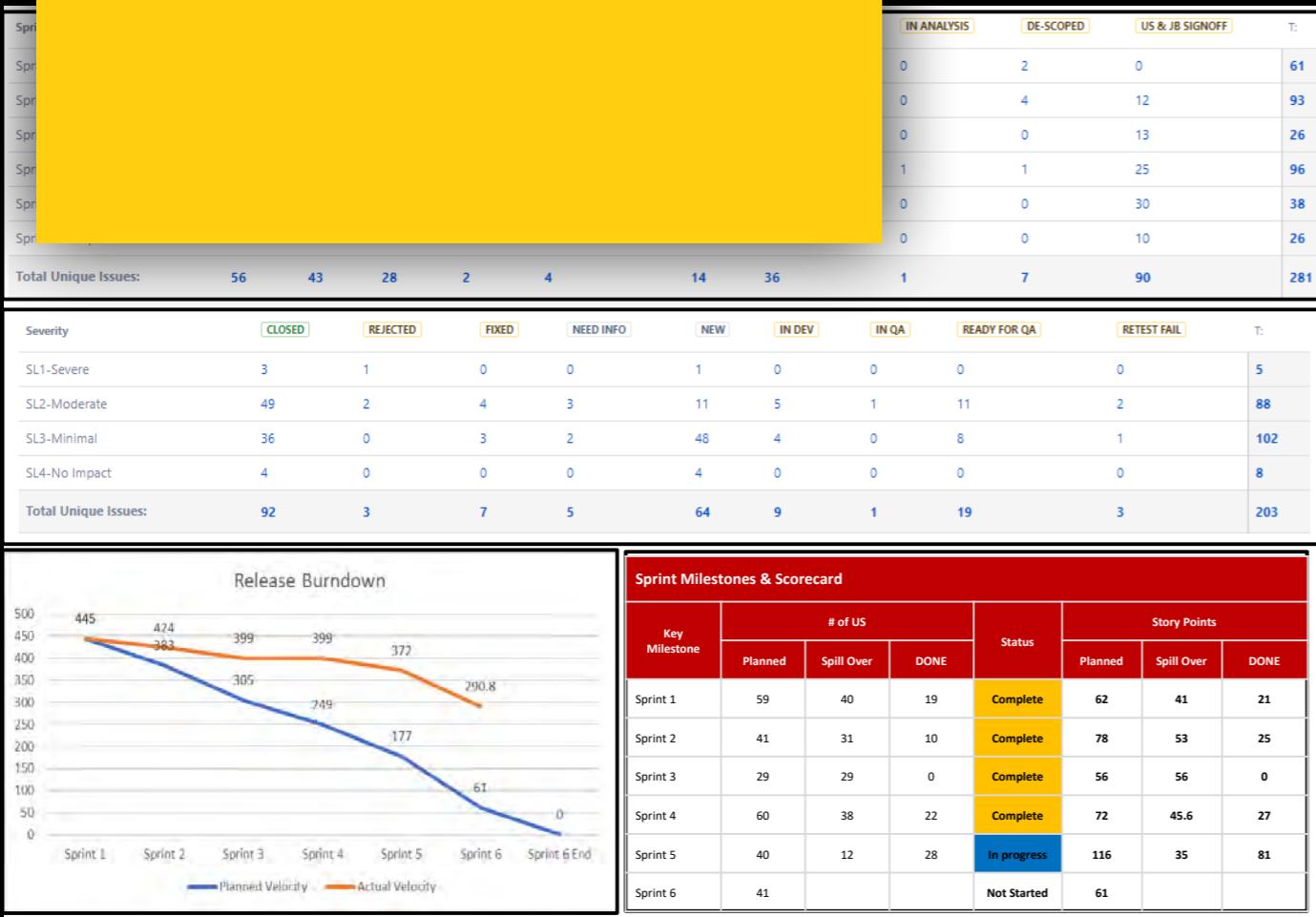
“If you can’t explain something in **simple terms**, you **don’t understand it** well enough.”

RICHARD FEYNMAN,  
PHYSICS NOBEL PRIZE



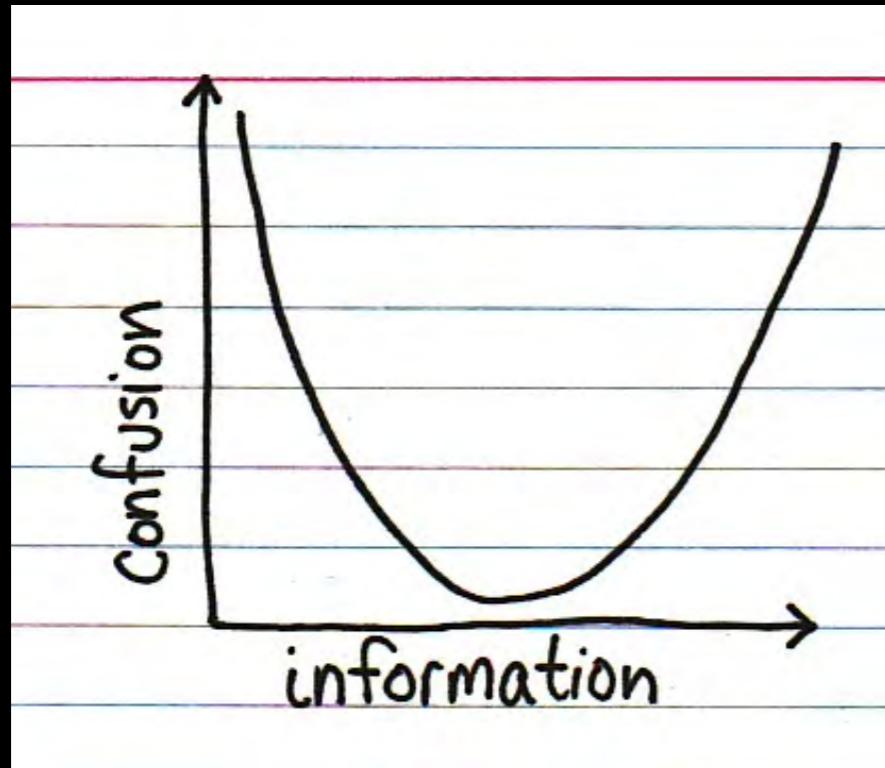
# Information density

Showing too much data makes it impossible to process



Humans are bad when at keeping track of multiple things. Don't overwhelm users with data. It leads to...

## Analysis **Paralysis**



Don't tell the full story. Summarize, surface only key info and trends.

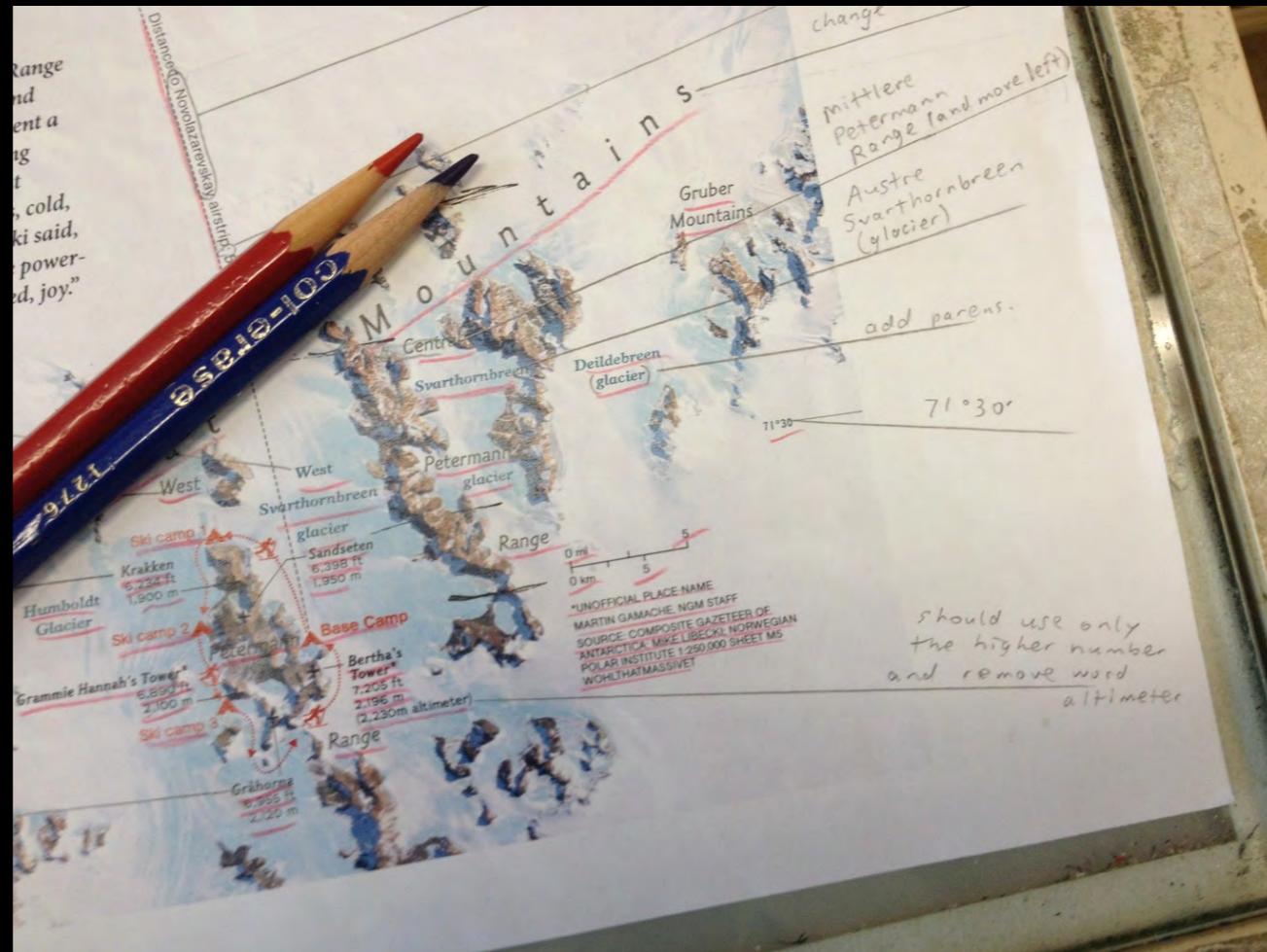
**Focus on the insights first,  
not the data**

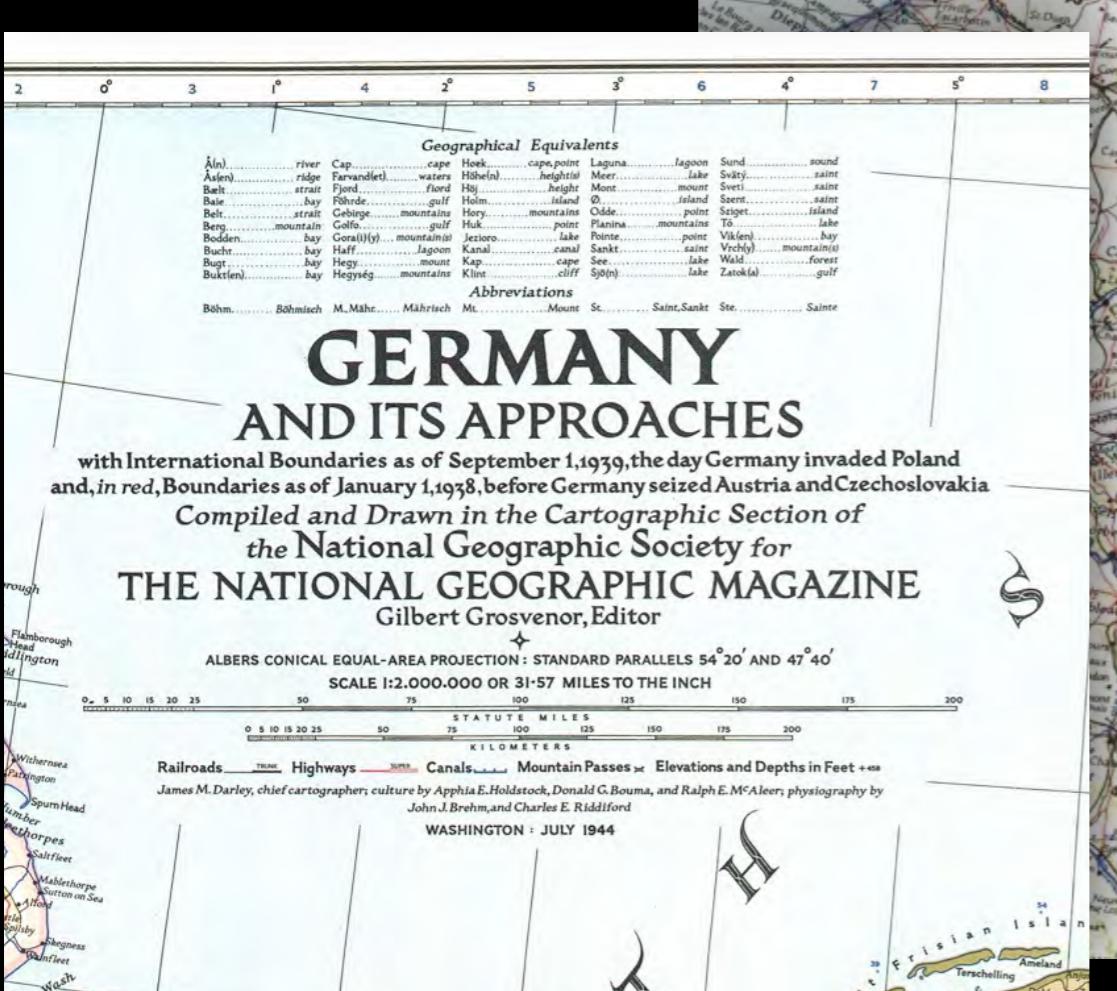
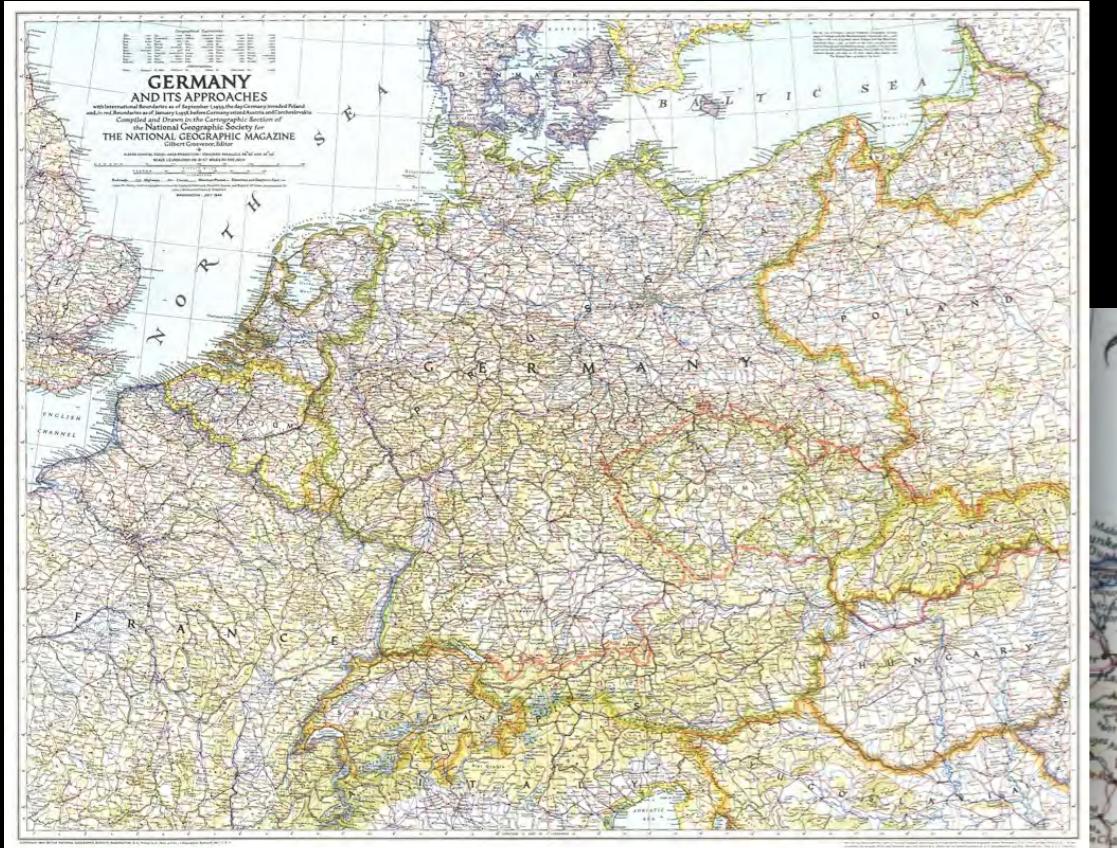
**Edit** and **prioritize**



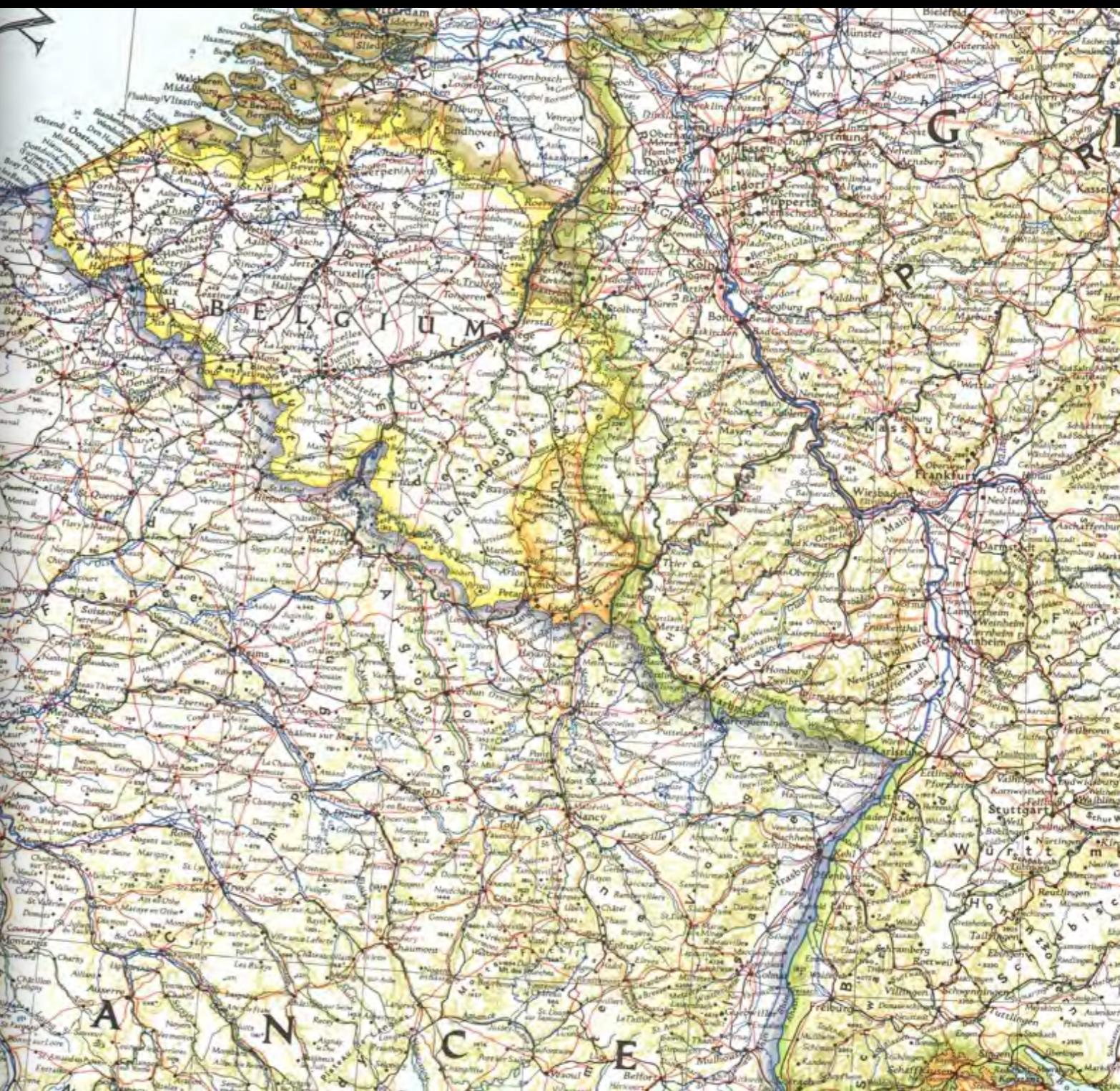
# Editing

Deciding how much information we choose to keep or discard is a critical step in the process; if we do good research, some **good and relevant** information may need to be edited out for the sake of **focus** and **legibility**.



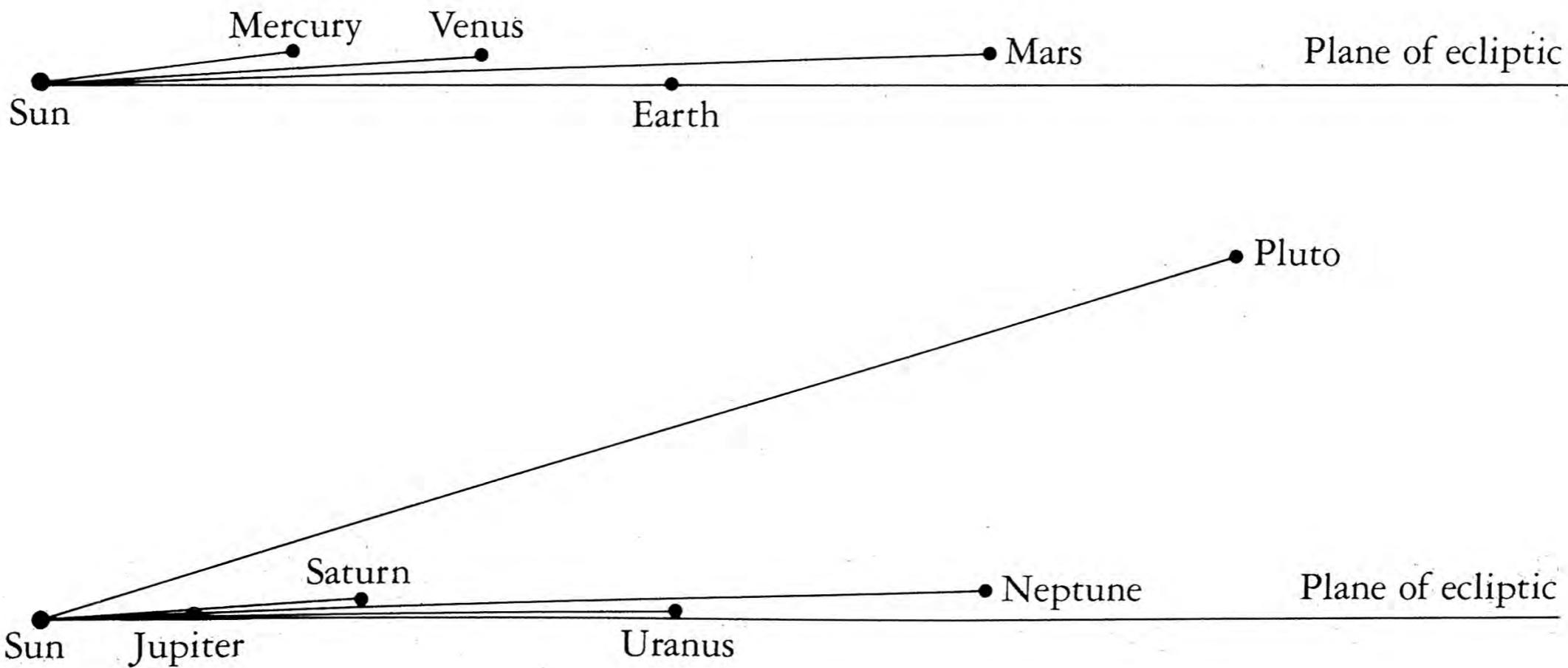


You can show Belgium with 1000 lines ...



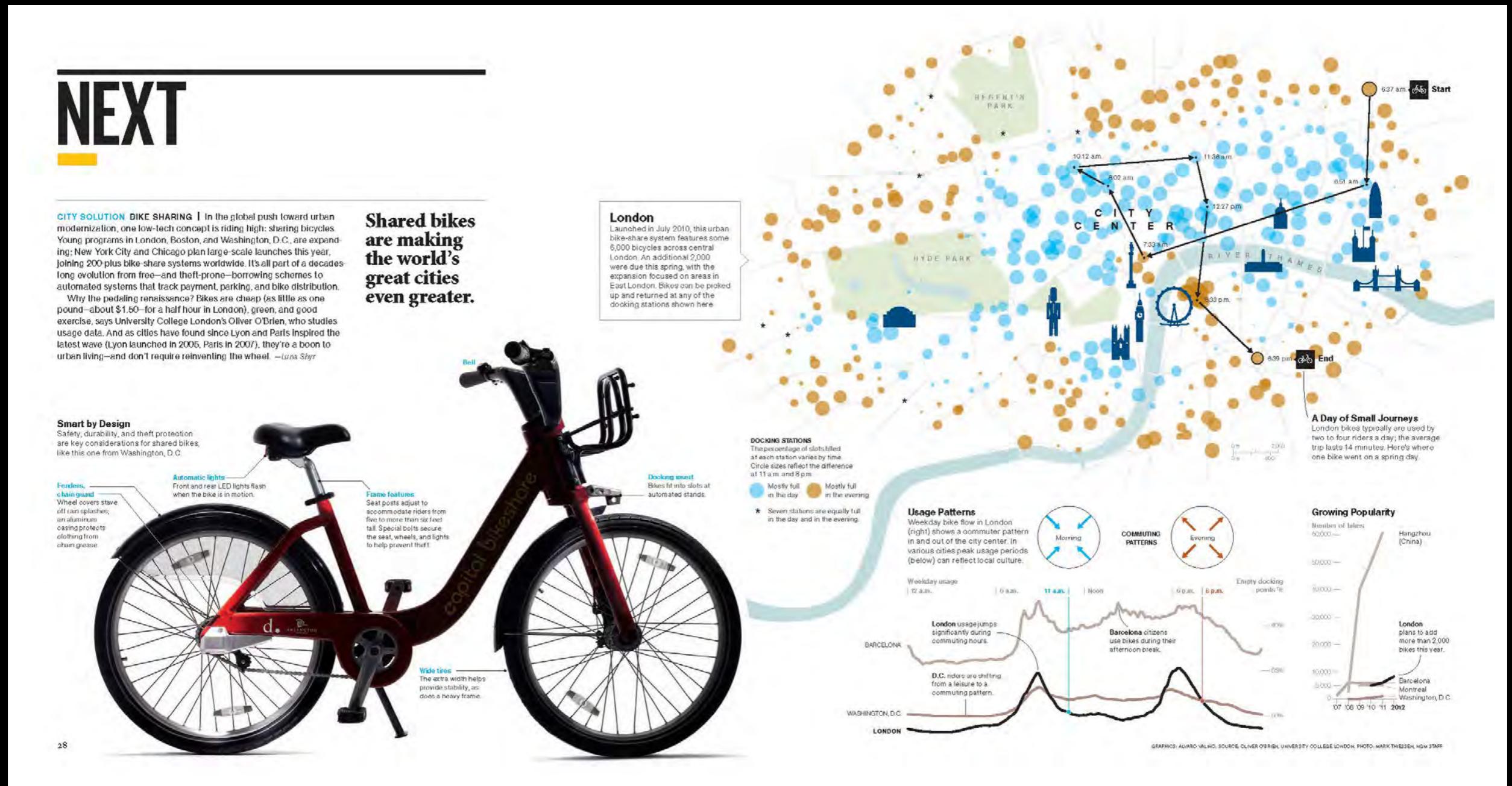
... or the Solar System with 9 lines

### THE COLD PLANETS AND THE SMALL BODIES



# Visual simplification (editing out) brings clarity

1. Take information out (this will make you uncomfortable. **Just let go**).
2. Unclutter what remains



# Find the key message



1

## The consequences of glacier retreat are uneven between plant species

Gianalberto Losapio<sup>1\*</sup>, Bruno EL Cerabolini<sup>2</sup>, Chiara Maffioletti<sup>3</sup>, Duccio Tampucci<sup>3</sup>, Mauro Gobbi<sup>4</sup> and Marco Caccianiga<sup>3</sup>

<sup>1</sup>Department of Biology, Stanford University, CA, USA

<sup>2</sup>Department of Biotechnologies and Life Sciences, University of Insubria, Varese, Italy

<sup>3</sup>Department of Biosciences, University of Milan, Milan, Italy

<sup>4</sup>MUSE – Museum of Science, Trento, Italy

Correspondence\*:

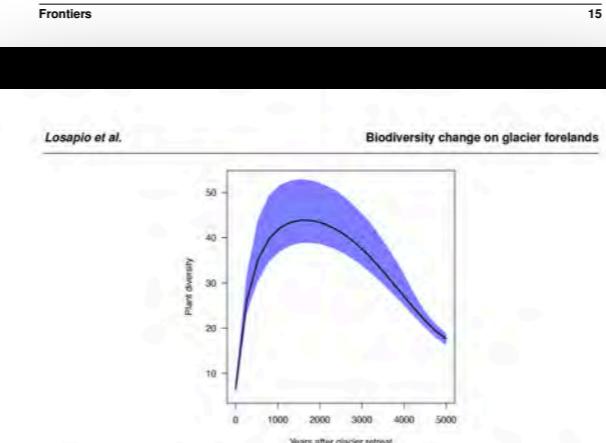
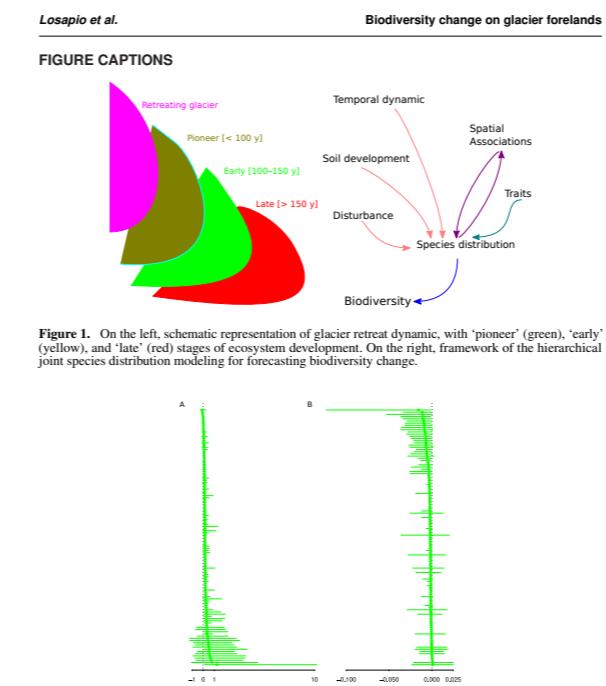
Gianalberto Losapio, Department of Biology, Stanford University, 327 Campus dr., 94305 Stanford CA, USA  
losapiog@stanford.edu

## 2 ABSTRACT

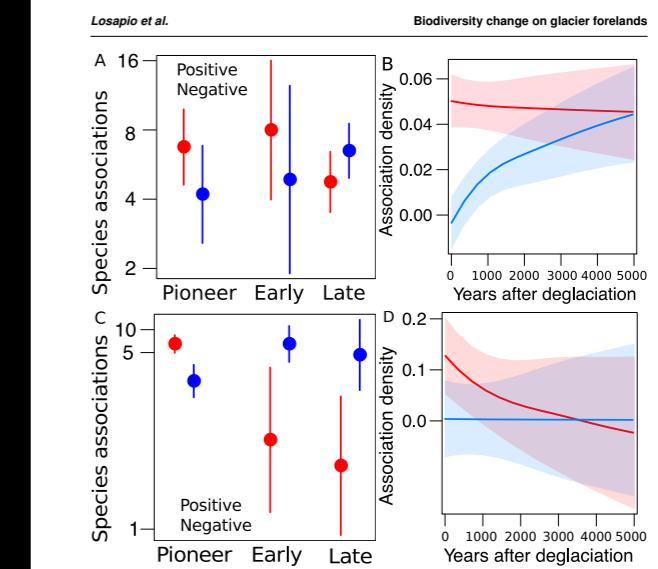
Glaciers are retreating worldwide, exposing new terrain to colonization by plants. Recently-deglaciated terrains have been a subject of ecological studies for a long time, as they represent a unique natural model system for examining the effects of global warming associated with glacier retreat on plant species and the spatio-temporal dynamic of plant communities. However, we still have a limited understanding of how physical and biotic factors interactively influence species persistence and community dynamics after glacier retreat and glacier extinction. Using hierarchical joint species distribution models, we integrated data on species occurrence at fine spatial scale, spatio-temporal context, environmental conditions, leaf traits and species-to-species associations in plant communities spanning 0 to ca 5,000 years on average after glacier retreat. Our results show that plant diversity initially increases with glacier retreat, but ultimately decreases after glacier extinction. The 22% of plant species non-linearly respond to glacier retreat and will locally disappear with glacier extinction. At the local scale, soil carbon enrichment and reduction of physical (topographic) disturbance positively contribute to distribution patterns in 66% of the species, indicating a strong signal of environmental filtering. Furthermore, positive and negative associations among species play a relevant role (up to 34% of variance) in driving the spatio-temporal dynamics of plant communities. Global warming prompts a shift from facilitation to competition: positive associations prevail among pioneer species, whereas negative associations are relatively more common among late species. This pattern suggests a role of facilitation for enhancing plant diversity in recently-deglaciated terrains and of competition for decreasing species persistence in late stages. In summary, although plant diversity initially increases with glacier retreat, more than a fourth of plant species are substantially declining and will disappear with glacier extinction. Leveraging community survey data and hierarchical models is valuable for forecasting biodiversity change and mitigating cascading effects of glacier retreat on mountain ecosystems.

Keywords: Biodiversity change, Community dynamic, Competition, Facilitation, Glacier forelands, Global warming, Hierarchical modeling, Plant networks, Primary succession

1

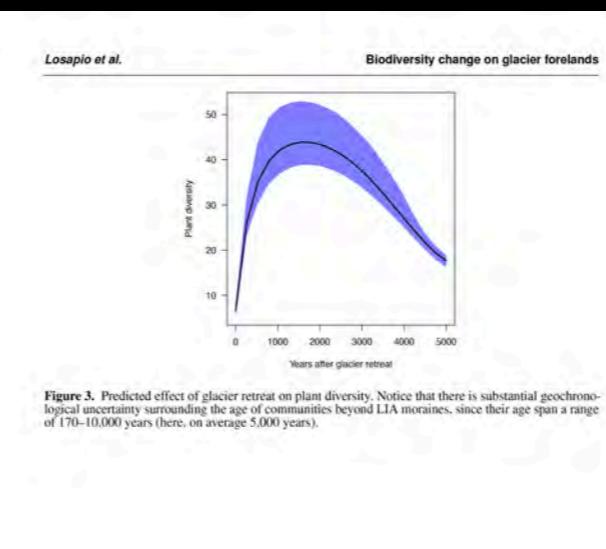


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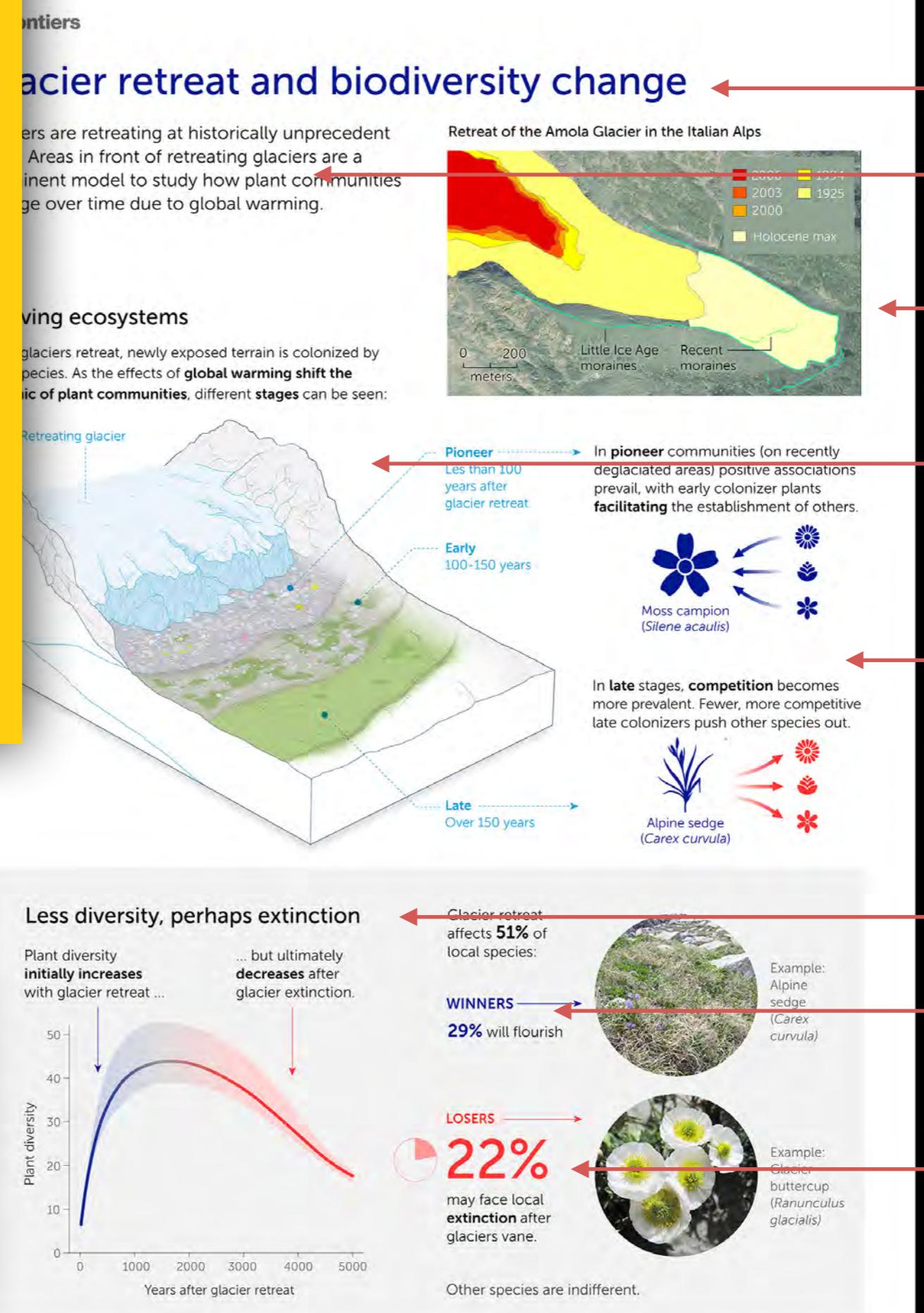
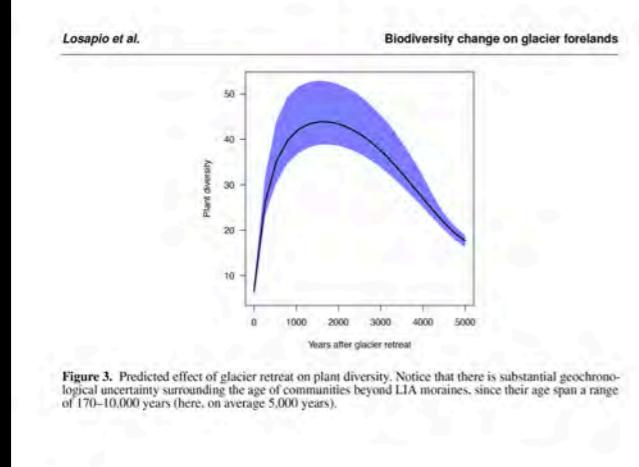
Frontiers

17

# Information accessibility: tell a story

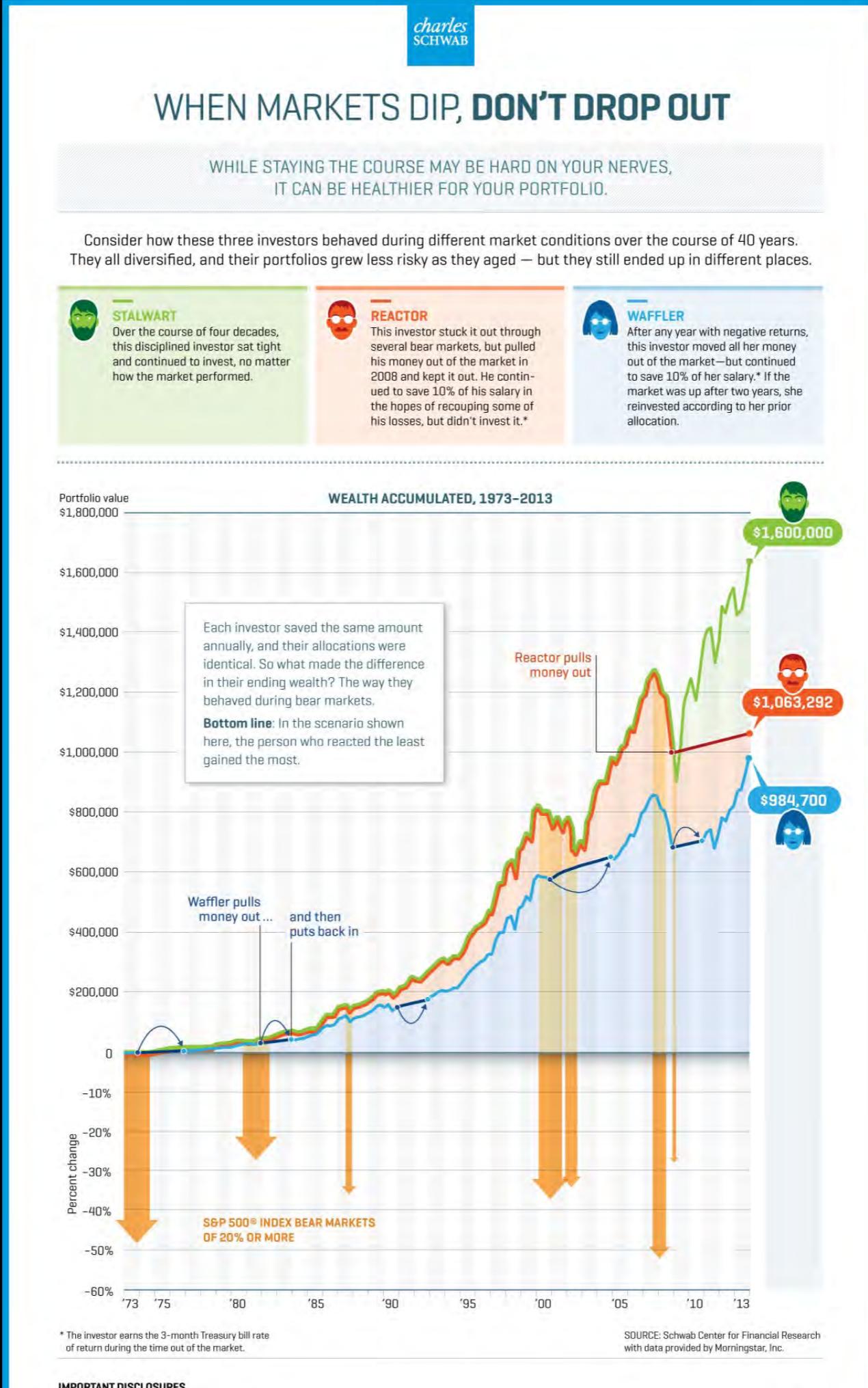
## The 5 Ws

Surface your key message and build a narrative around it



- WHO, WHAT  
Headline
- Introduction:  
set it up
- WHEN, WHERE  
Context
- WHY  
Process
- MAKE IT  
RELATABLE  
Examples
- WHY WE CARE  
The key message
- Winners and losers
- MAKE IT  
MEMORABLE  
Big A\*\* number

# IDEA, ANGLE AND STRUCTURE



## Idea

Investors shouldn't drop out of the stock market during recessions

## Angle

Make it relatable by showing the stories of three investors over a long term period

## Structure

1. Introduce the investors and their investing style.
2. Then compare their outcomes

# WHEN MARKETS DIP, DON'T DROP OUT

WHILE STAYING THE COURSE MAY BE HARD ON YOUR NERVES,  
IT CAN BE HEALTHIER FOR YOUR PORTFOLIO.

Consider how these three investors behaved during different market conditions over the course of 40 years. They all diversified, and their portfolios grew less risky as they aged — but they still ended up in different places.



## STALWART

Over the course of four decades, this disciplined investor sat tight and continued to invest, no matter how the market performed.



## REACTOR

This investor stuck it out through several bear markets, but pulled his money out of the market in 2008 and kept it out. He continued to save 10% of his salary in the hopes of recouping some of his losses, but didn't invest it.\*



## WAFFLER

After any year with negative returns, this investor moved all her money out of the market—but continued to save 10% of her salary.\* If the market was up after two years, she reinvested according to her prior allocation.

Portfolio value  
\$1,800,000

### WEALTH ACCUMULATED, 1973–2013



\* The investor earns the 3-month Treasury bill rate of return during the time out of the market.

SOURCE: Schwab Center for Financial Research with data provided by Morningstar, Inc.

## Context

Enable context and comparisons.  
The personal stories and how they relate to the general trend showing the recessions during the cycle

## WHEN MARKETS DIP, DON'T DROP OUT

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### WEALTH ACCUMULATED, 1973–2013



\$1,600,000

Each investor saved the same amount annually, and their allocations were identical. So what made the difference in their ending wealth? The way they behaved during bear markets.

**Bottom line:** In the scenario shown here, the person who reacted the least gained the most.

Reactor pulls  
money out



\$1,063,292



\$984,700

Waffler pulls  
money out...  
and then  
puts back in

\$800,000

\$600,000

\$400,000

\$200,000

\$0

-10%

-20%

-30%

-40%

-50%

-60%

'73

'75

'80

'85

'90

'95

'00

'05

'10

'13

S&P 500® INDEX BEAR MARKETS  
OF 20% OR MORE

\* The investor earns the 3-month Treasury bill rate of return during the time out of the market.

SOURCE: Schwab Center for Financial Research with data provided by Morningstar, Inc.

## Bottom line

Whenever possible:  
show a quick bottom  
line or conclusion for  
readers to remember.  
Always go back to  
the key message

## Information accessibility: relevant and relatable

### The readers

Experts / insiders?  
Policy makers?  
The general public?

Taylor the narrative and level of complexity to your intended audience. **Test it** with the appropriate type of reader

Speed of understanding is important and information relevant to our audience is even more important

## The “Curse of Knowledge”

Knowing a lot about something and assuming the reader will too

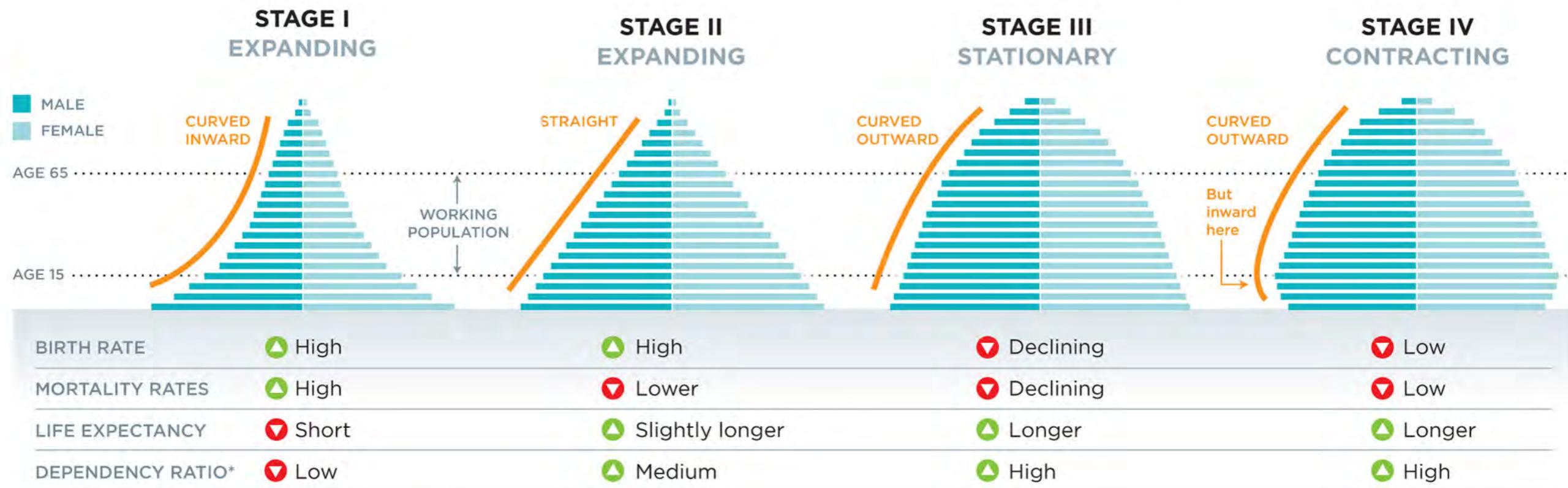
*“It simply doesn’t occur to the writer that readers haven’t learned their jargon, don’t seem to know the intermediate steps that seem to them to be too obvious to mention, and can’t visualize a scene currently in the writer’s mind’s eye”*

STEVEN PINKER

# THE SHAPES OF POPULATION GROWTH

COUNTRIES CAN BE CATEGORIZED INTO FOUR STAGES DEPENDING ON THEIR RATE OF POPULATION GROWTH

Each bar in the charts below represents the number of people of a specific age (0 to 100 years).



\*Working population supporting non-working population

Find an angle that makes the story relatable, close to the reader

Literal makes it relatable

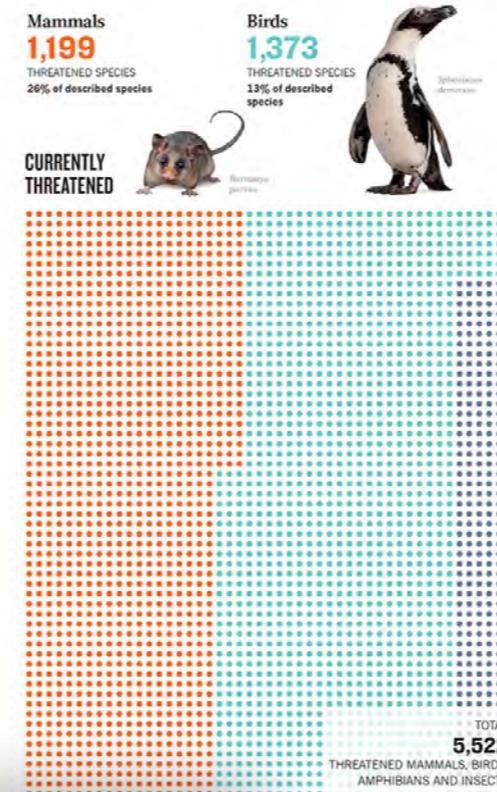
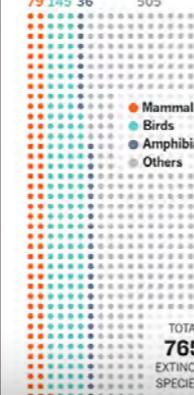


## Life under threat

Thousands of species are currently deemed to be threatened, but the true number of species at risk of extinction may be much higher. Estimates suggest that between 500 and 36,000 species might be disappearing each year. The best data are for well-studied groups—mammals, birds and amphibians. Much less is known about threats to other groups, such as insects and fish.

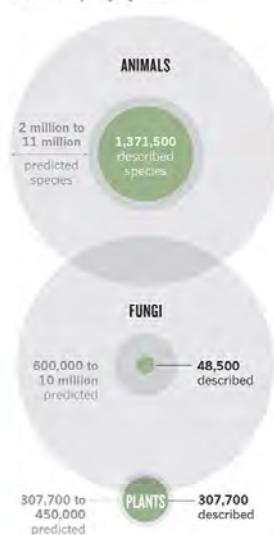
### ALREADY EXTINCT

TOTAL DOCUMENTED SINCE 1500



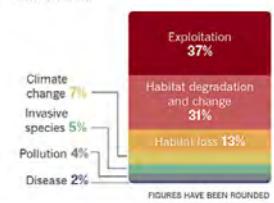
## How many species are there?

Estimates of the number of species of animals, fungi and plants vary significantly. That uncertainty clouds understanding of how many species are threatened and how many are going extinct.



## Main threats

Hunting, fishing and other forms of exploitation are a major factor in declines in animal populations, according to the Living Planet Index. Habitat degradation and loss are also dominant threats. Climate change is expected to become a bigger factor over time.



SOURCES: Already Extinct, Currently Threatened: IUCN Red List; How many species are there?: S. L. Pimm et al. *Science* **344**, 1246752 (2014); B. R. Schaffers et al. *Trends Ecol. Evol.* **27**, 501–510 (2012); IUCN Red List; March towards mass extinctions: Pimm et al.; C. Moat et al. *Science* **341**, 237 (2013); Main threats: IUCN Living Planet Report 2014.

11 DECEMBER 2014 | VOL 516 | NATURE | 161

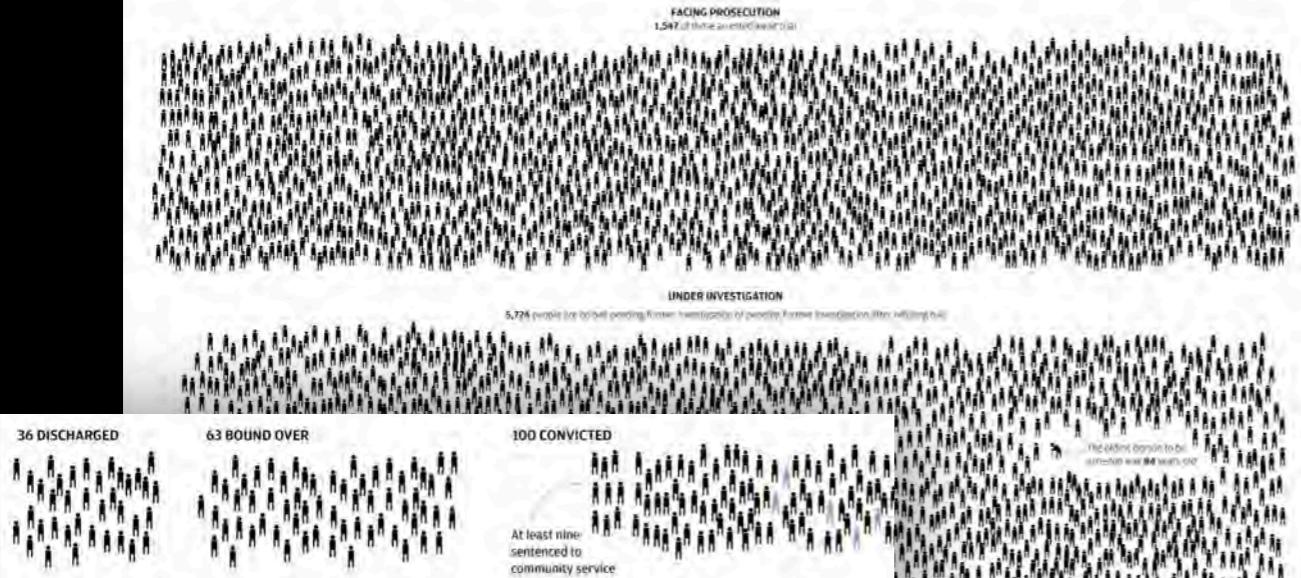
NATIONAL GEOGRAPHIC Creative; S. demersus: Life on white/Alamy;



## Arrested development

Hong Kong police made 8,981 arrests between June 9, 2019, and May 29, 2020, in connection with the protests. Here is where they stand.

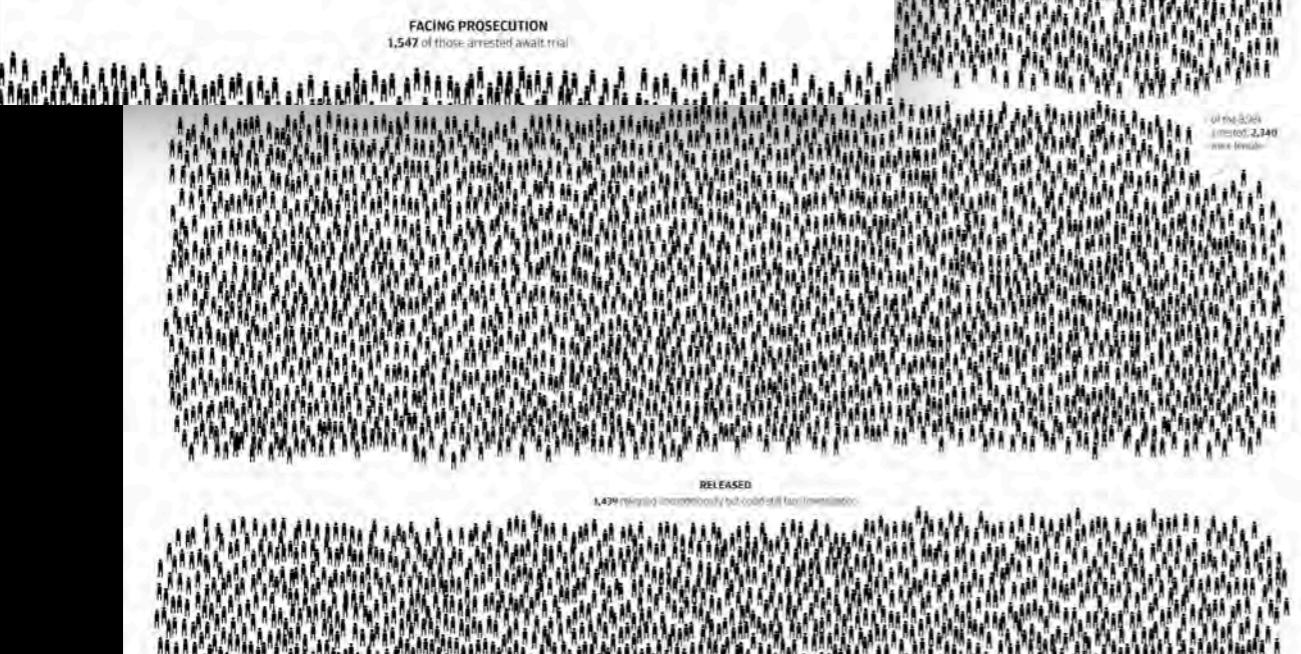
By Adolfo Arranz [adolfo.arranz@scmp.com](mailto:adolfo.arranz@scmp.com)



## Arrested development

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"All the News.  
That's Fit to Print."

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\$6.00

# The New York Times

Late Edition  
Today, plenty of sunshine, chilly  
high 56. Tonight, increasing clouds-  
ness, low 29. Tomorrow, intervals of  
snow and rain, little to no accumulation,  
high 41. Weather map, Page 36.

STORMS EXPOSING  
A NATION PRIMED  
FOR CATASTROPHE

CLIMATE CHANGE WRATH

Unprepared for Threats  
Facing Power Grids,  
Water and Roads

This article is by Christopher  
Taburek, Brad Plumer and Hiroko  
Tabuchi.

Even as Texas struggled to re-  
store electricity and water over  
the past week, signs of the risks posed  
by increasingly extreme weather to America's aging infrastructure were cropping up across the country.

The compact-spanning winter  
storms triggered blackouts in Texas,  
Oklahoma, Mississippi and several other states. One-third of oil production in the nation was halted. Drinking-water systems in Ohio were knocked offline.

Road networks nationwide were paralysed and vaccination efforts in states were derailed.

The crisis carries a profound warning. As climate change brings more frequent and intense storms, floods, heat waves, wildfires and other extreme events, it is placing growing stress on the foundations of the country's economy: Its network of roads and railways, sprawling power plants, electrical grids, industrial waste sites and even homes. Failures in just one sector can set off a domino effect of breakdowns in hard-to-predict ways.

Much of this infrastructure was built decades ago, under the expectation that it would remain stable or at least fluctuate within predictable bounds. Now climate change is upending that assumption.

"We are colliding with a future of extremes," said Alice Hill, who oversaw planning for climate risks on the National Security Council during the Obama administration. "We base all our choices

Continued on Page 22

A \$16.752 BILL Texans have reported soaring electric fees during a winter storm. PAGE 24

*Associated Press*

## The Toll: America Approaches Half a Million Covid Deaths

Feb. 29, 2020: First report of a U.S. death in Washington State

Each dot represents one death from Covid-19 in the U.S.

U.S. VIRUS DEATHS  
NEARING 500,000  
IN JUST ONE YEAR

MORE THAN IN 3 WARS

Empty Spaces in Cities,  
Towns, Restaurants,  
Homes and Hearts

By JULIE BOSMAN

CHICAGO — A nation numbly staring at death is confronting a number that still has the power to shock: 500,000.

Roughly one year since the first known death by the coronavirus in the United States, an unfathomable toll is nearing — the loss of half a million people.

No soldier has ever counted so many deaths in the pandemic. More Americans have perished from Covid-19 than on the battlefields of World War I, World War II and the Vietnam War combined.

The milestone comes at a hopeful moment. New virus cases are down sharply; deaths are slowing and vaccines are steadily being administered.

But there is concern about emerging variants of the virus, and it may be months before the pandemic is contained.

Each death has left untold numbers of survivors, each a victim of loss that has swept over towns and cities. Each death has left an empty space in communities across America: A bar stool where a regular used to sit, one side of a bed unkept in a home kitchen with two children.

The living find themselves amid vacant places once occupied by their spouses, parents, neighbors and friends — the nearly 500,000 coronavirus dead.

In Chicago, the Rev. Ezra Jones stands at his pulpit on Sundays, looking out over an empty nave. That spot belonged to Moses Jones, his 83-year-old uncle, who liked to drive to church in his green Chevy Malibu, arrive early and chat everybody up before settling into his seat by the door. He died of the coronavirus in April.

"I will see him there," said Mr. Jones, the pastor. "It never goes away."

There is a street corner in

Plano, Texas, that was occupied

Continued on Page 8

Russia Fears  
But Can't Quit  
Open Internet

By ANTON TROJANOVSKI

MOSCOW — Margarita Simonyan, the editor in chief of the Kremlin-controlled television network, recently called on the government to block access to Western social media.

She wrote: "Foreign platforms in Russia must be shut down."

Her choice of social network for sending the message was telling.

While the Kremlin fears an open internet shaped by American companies, it just can't quit it.

Russia's winter of discontent, waves of nationwide protests set off by the return of the opposition leader Alexei A. Navalny, has been fuelled by a desire for a free and open internet. The state controls the television airwaves, but online Mr. Navalny's dramatic arrest upon arrival in Moscow, his investigation into President Vladimir V. Putin's purported secret palace and his supporters' calls for protest are all broadcast to an audience of many millions.

For years, the Russian government has been putting in place the technological and legal infrastructure to clamp down on freedom of speech online, leading to frequent protests that the country could be heading toward internet censorship akin to China's great firewall.

But even as Mr. Putin faced the biggest protests in years last month, his government appeared unwilling — and, to some degree, unable — to impose a ban or take other drastic measures to limit the spread of digital dissent.

The hesitation has underscored the challenge Mr. Putin faces as he tries to blunt the political implications of cheap high-speed internet

Continued on Page 16

TRACKING AN OUTBREAK 4.9

Israel Funds Vaccines for Syria

To secure the release of an Israeli civilian, Israel secretly agreed to finance a supply of Russian-made Covid-19 vaccines for Syria, an official said.

PAGE 16

SPORTS 35-37

Osaka Wins Australian Open

Naoomi Osaka, 23, is now 4 for 4 in Grand Slam finals after a straight-set victory over Jennifer Brady, 25, who was in her first final.

PAGE 16

SUNDAY STYLES

Sit. Roll Over. Wait Your Turn.

Dog trainers are overwhelmed, thanks to a boom in pet adoptions and sales, spurred by work-from-home policies and social isolation.

PAGE 16

SUNDAY BUSINESS

Boredom Is Making Us Buy

Yet another pandemic side effect: consumers who are eager to make online purchases, and not just of groceries. Witness sales of Miracle-Gro.

PAGE 16

SUNDAY REVIEW

Katie Engelhart

PAGE 4



# Be friendly, didactic... even humorous

THE BIG IDEA | CLIMATE CONTROL

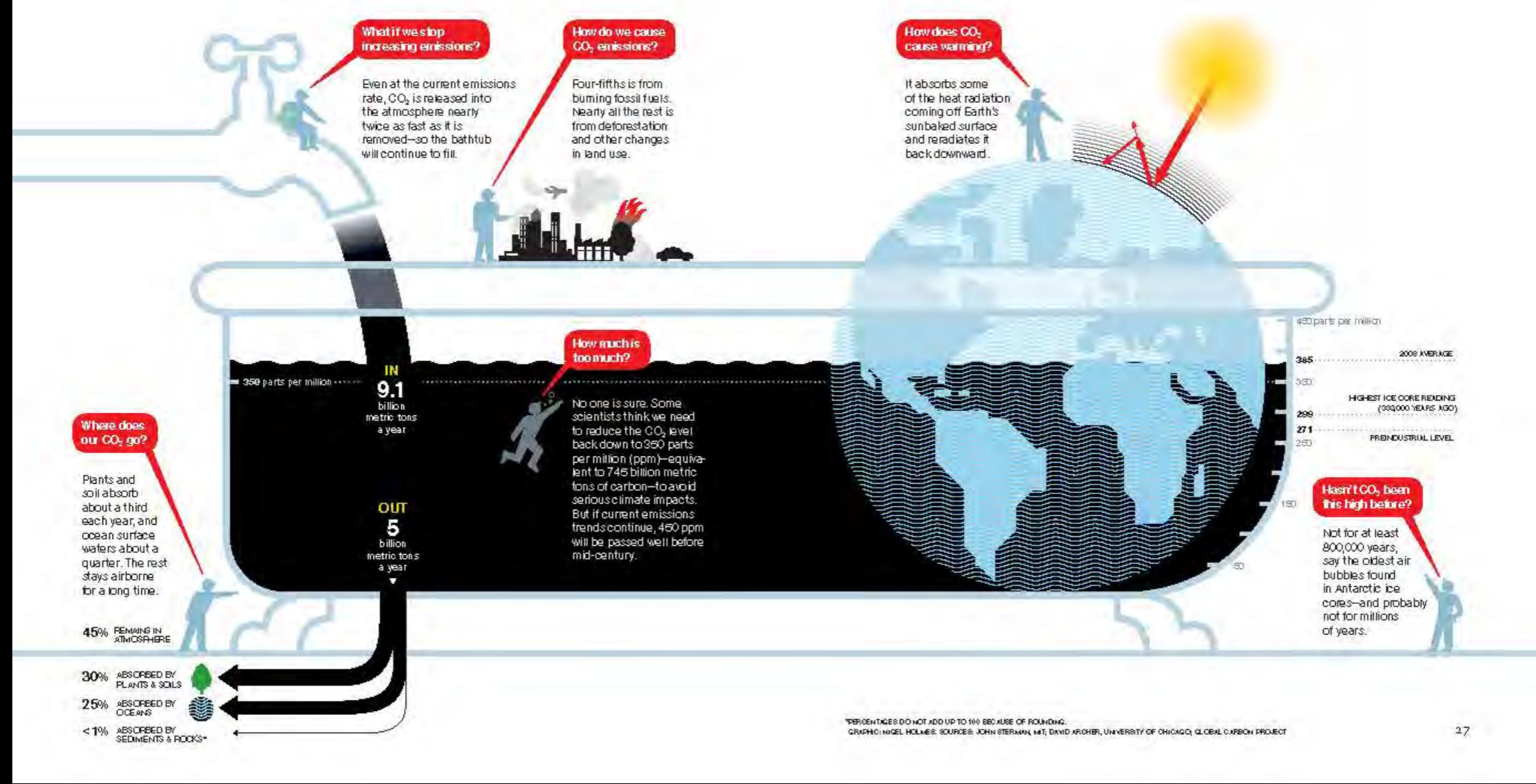
## The Carbon Bathtub

It's simple, really: As long as we pour CO<sub>2</sub> into the atmosphere faster than nature drains it out, the planet warms. And that extra carbon takes a long time to drain out of the tub.

A fundamental human flaw, says John Sterman, impedes action on global warming. Sterman is not talking about greed, selfishness, or some other vice. He's talking about a cognitive limitation, "an important and pervasive problem in human reasoning" that he has documented by testing graduate students at the MIT Sloan School of Management. Sterman teaches system dynamics, and he says his students, though very

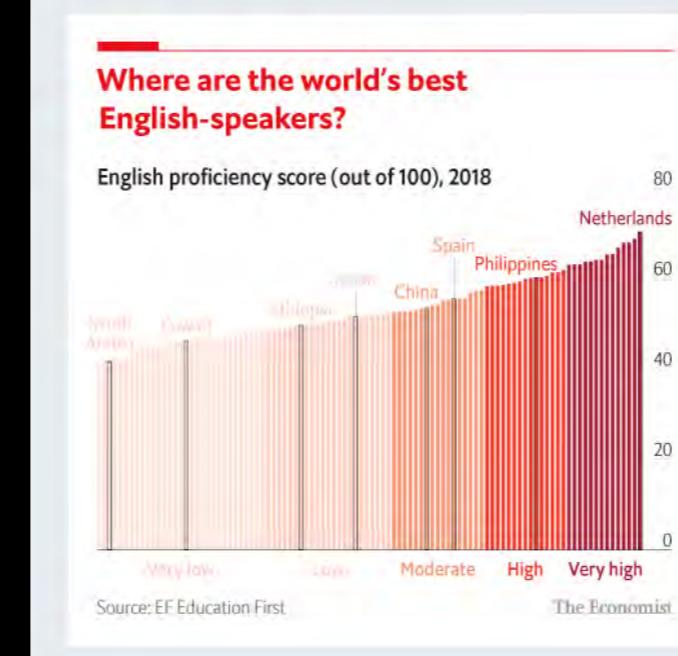
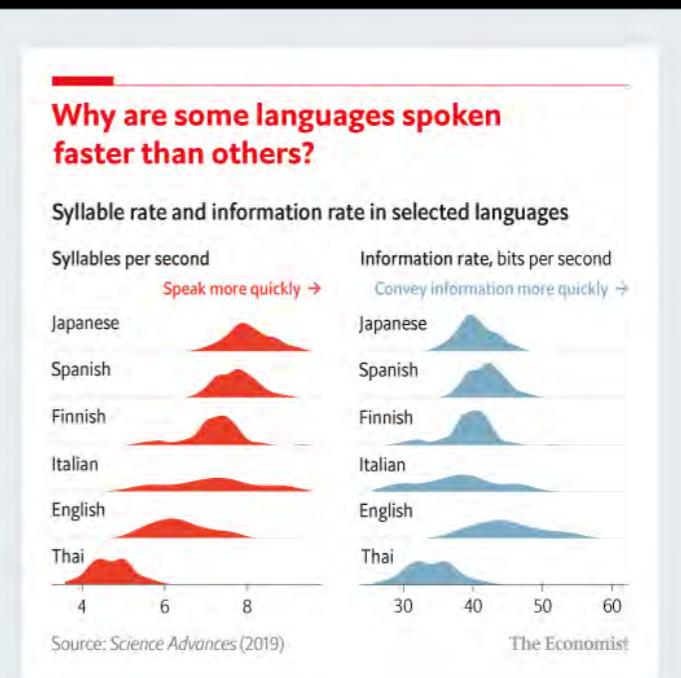
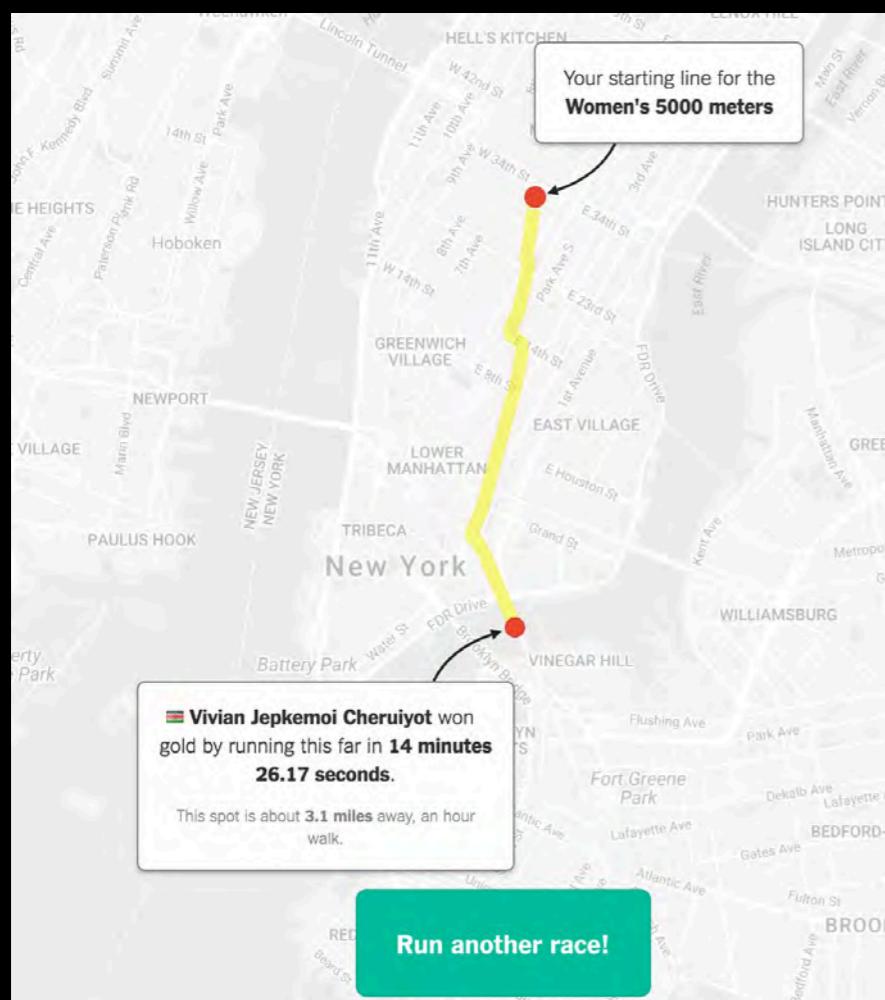
bright and schooled in calculus, lack an intuitive grasp of a simple, crucial system: a bathtub.

In particular, a tub with the tap running and the drain open. The water level can stand for many quantities in the modern world. The level of carbon dioxide in Earth's atmosphere is one. A person's waistline or credit card debt—both of which have also become spreading problems of late—are two more. In all (Continued on next page)



Compare with what you know

Let readers “find themselves” in the data (maps, rankings)



## Show the **near** and the **far**

A “**far**” view, which is the national picture, how places compare, why you should care about this story as a whole; and a “**near**” view, the readers’ own personal stories – their town, their hospital, their school, etc. – all of the details that matter to them personally.

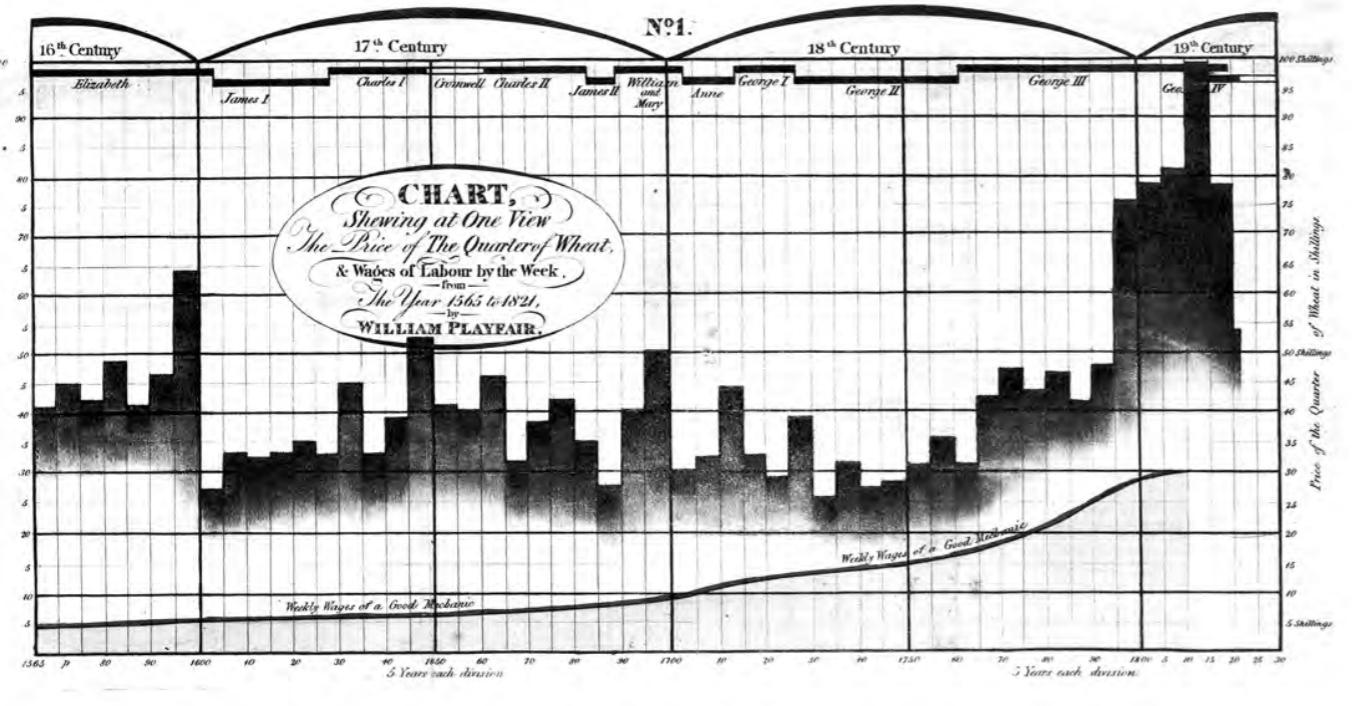
## A classic narrative **arc**

**World + character + plot**

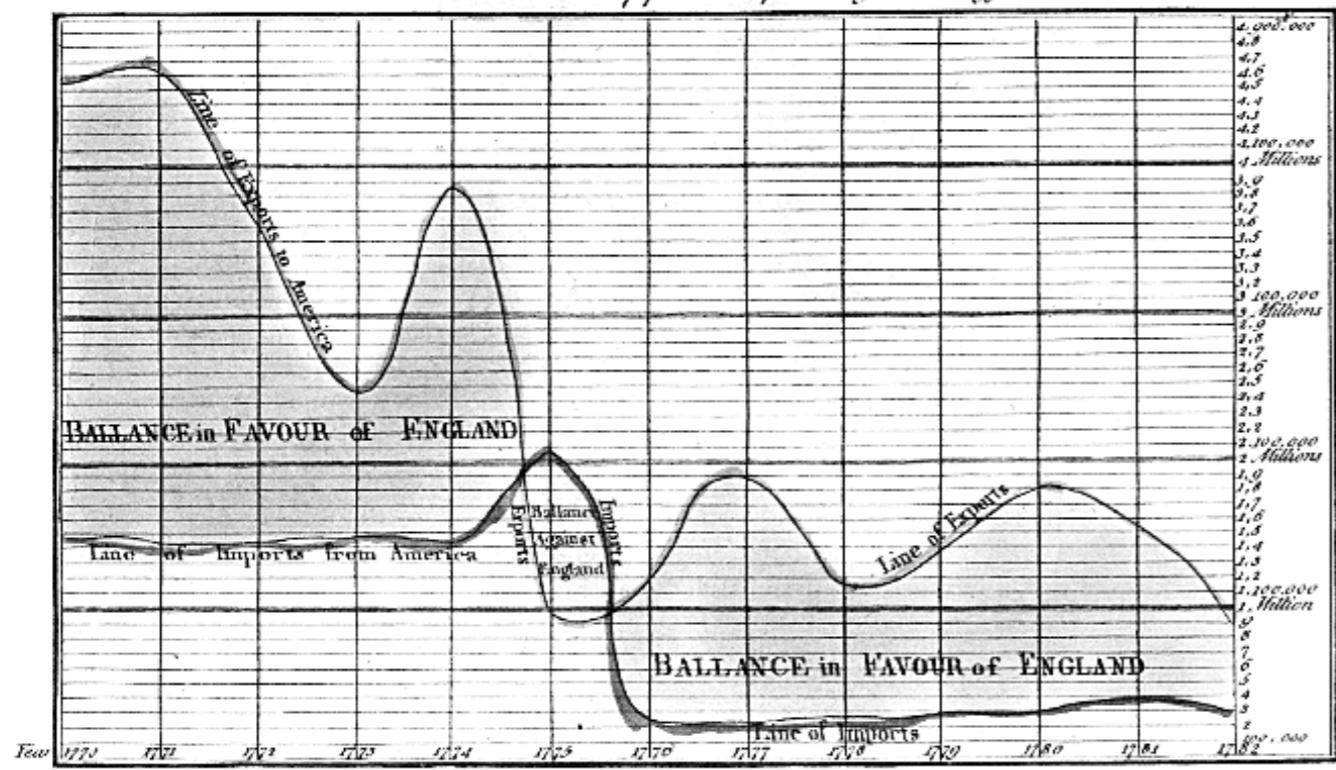
**Character + world + plot**

# William Playfair (1759-1823)

- Engineer
- Political economist
- Secret agent



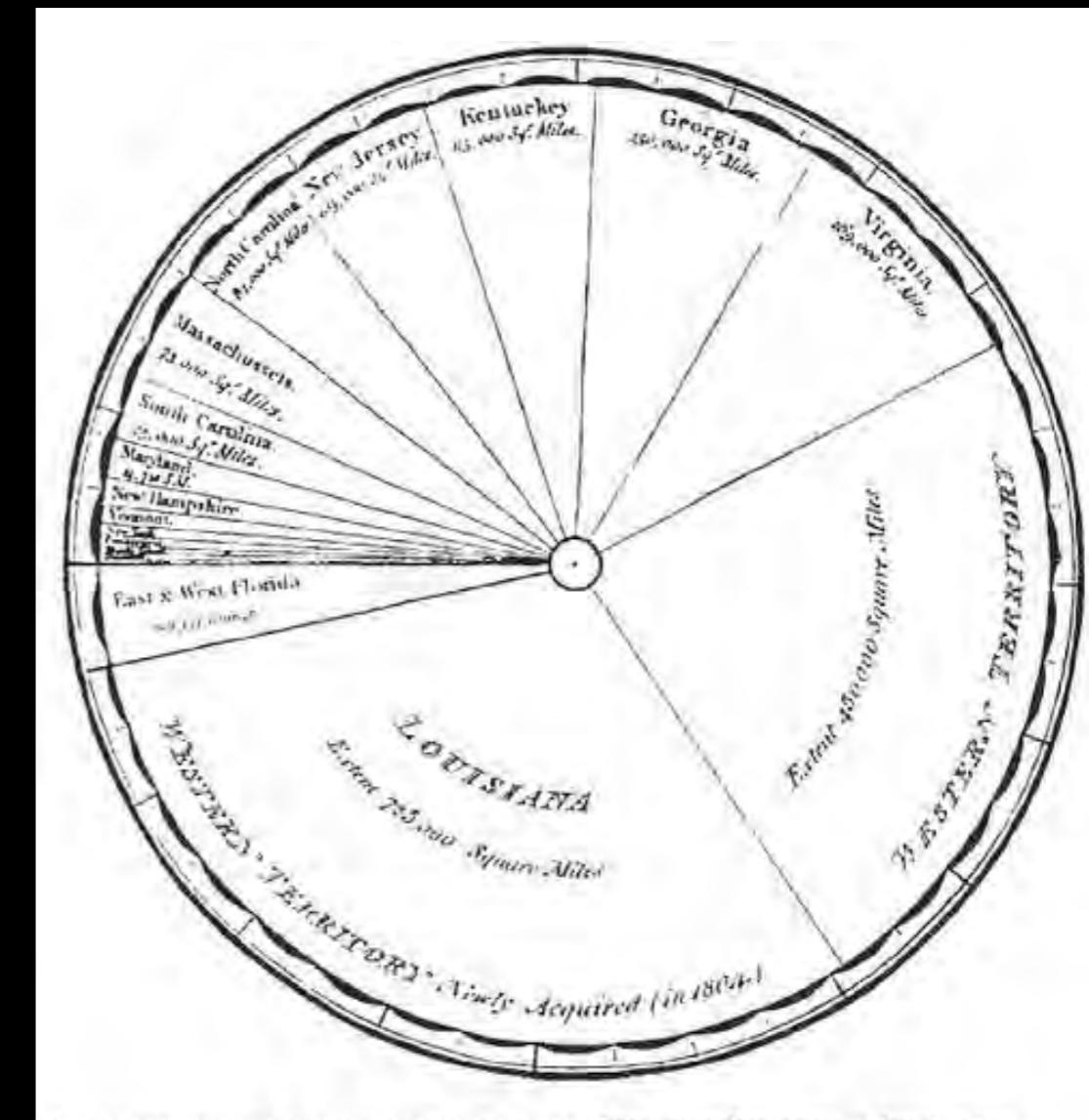
*CHART of IMPORTS and EXPORTS of ENGLAND to and from all NORTH AMERICA From the Year 1770 to 1782 by W. Playfair*



The Bottom Line is divided into Years the right hand Line into HUNDRED THOUSAND POUNDS

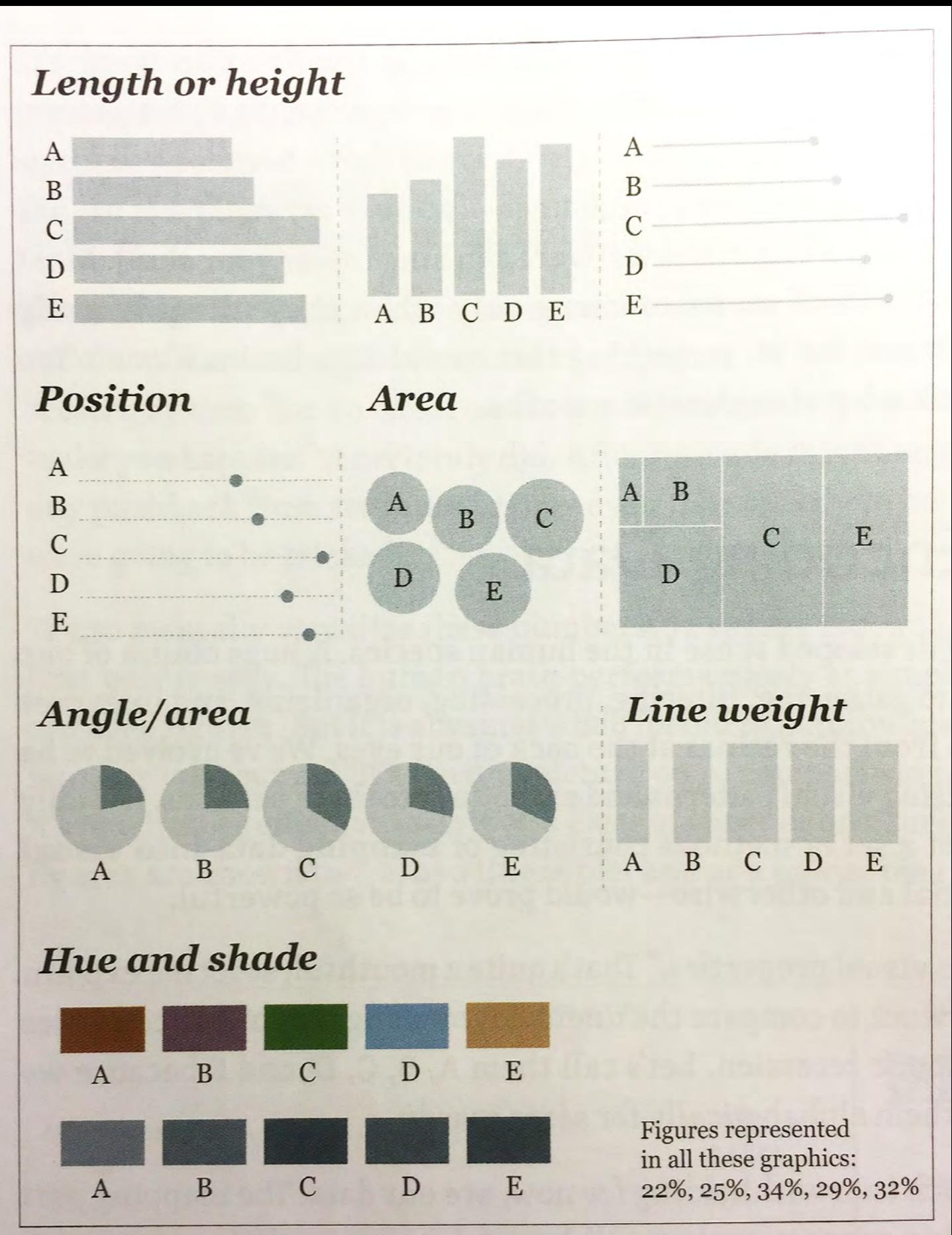
Published as the Act directs 20<sup>th</sup> Aug<sup>t</sup> 1785.

J. Dodsley Sculp<sup>r</sup>



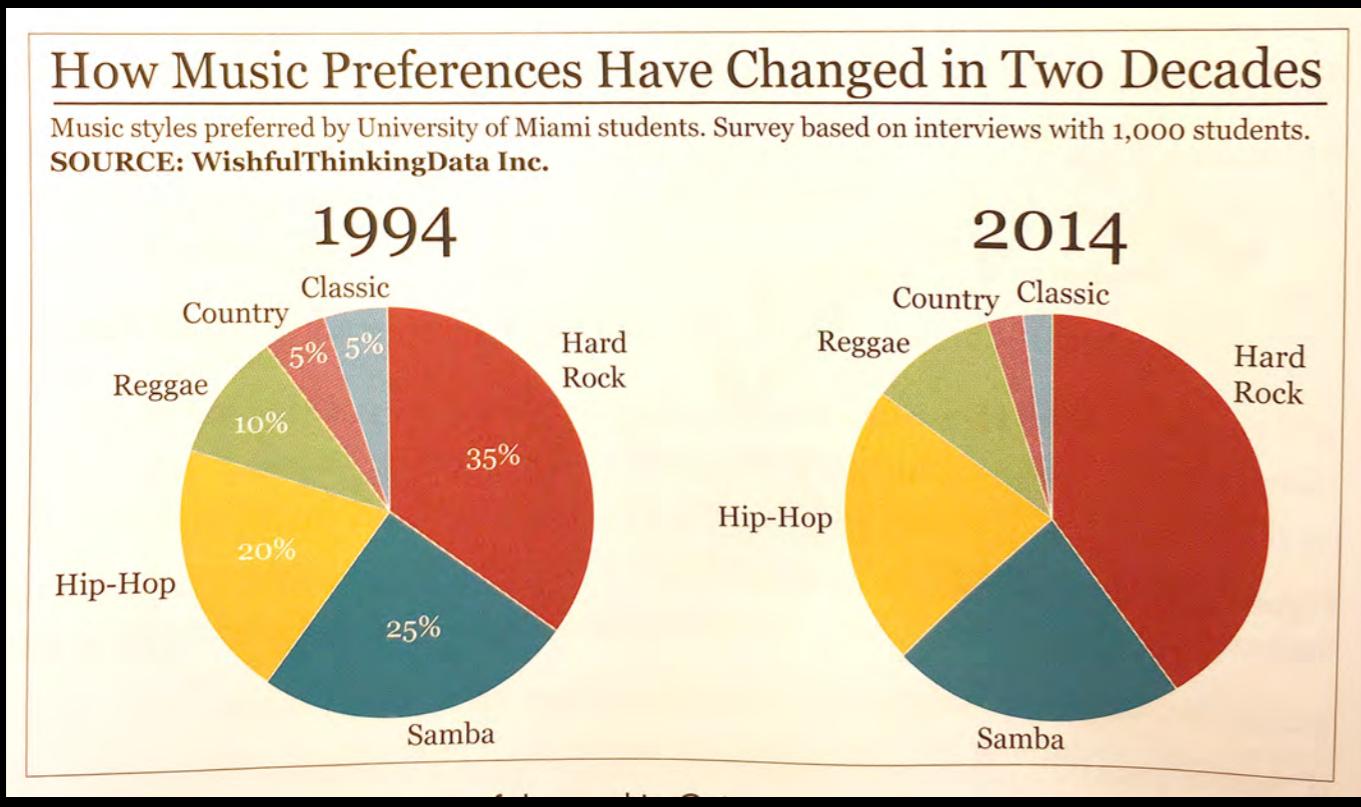
## Functionality

Each data set has a limited number of chart types that are correct to use. It's not a matter of taste.



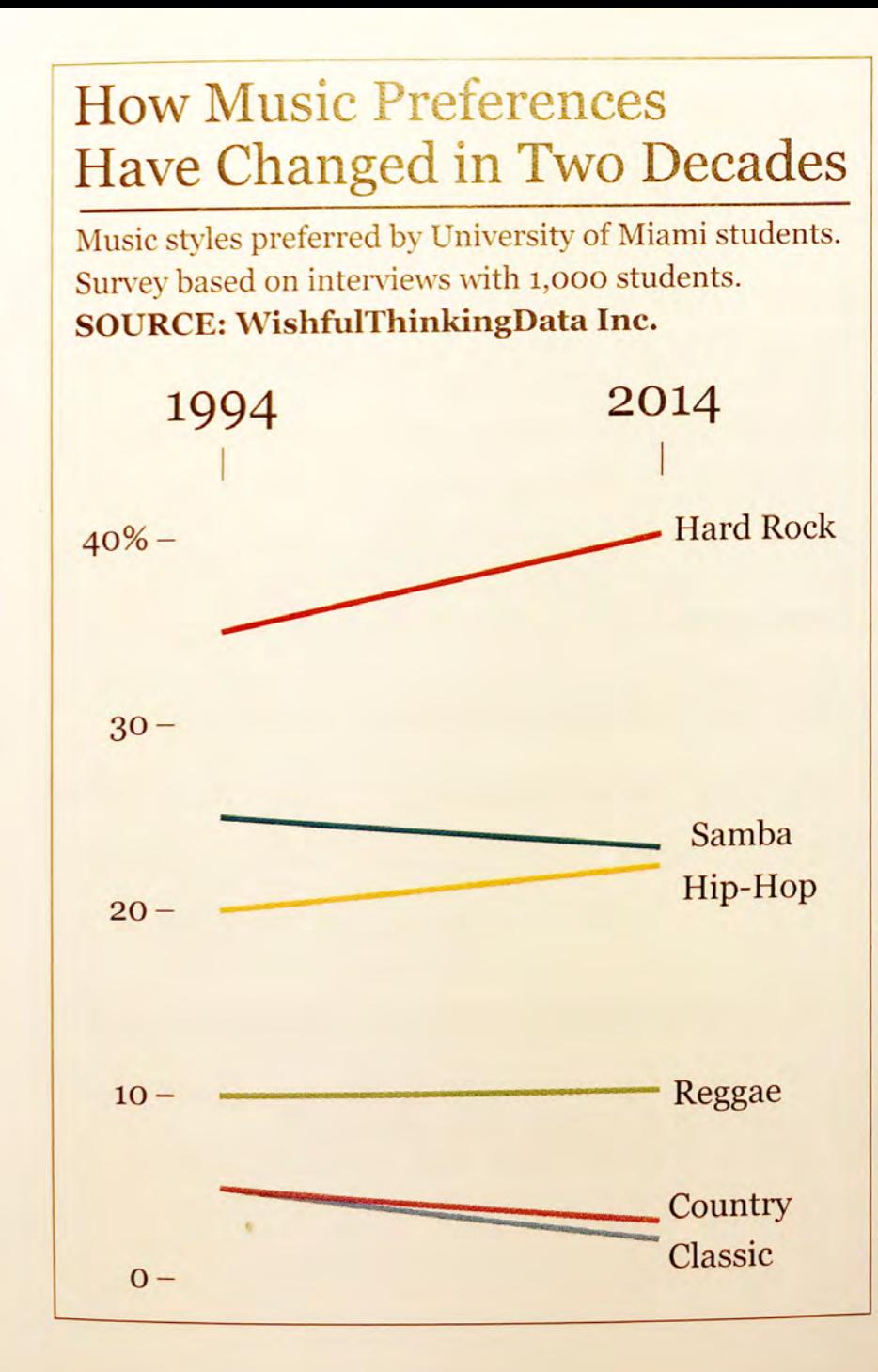
# Functionality

Among the correct charts that can be used for a data set, we should strive to find the most **revealing**.

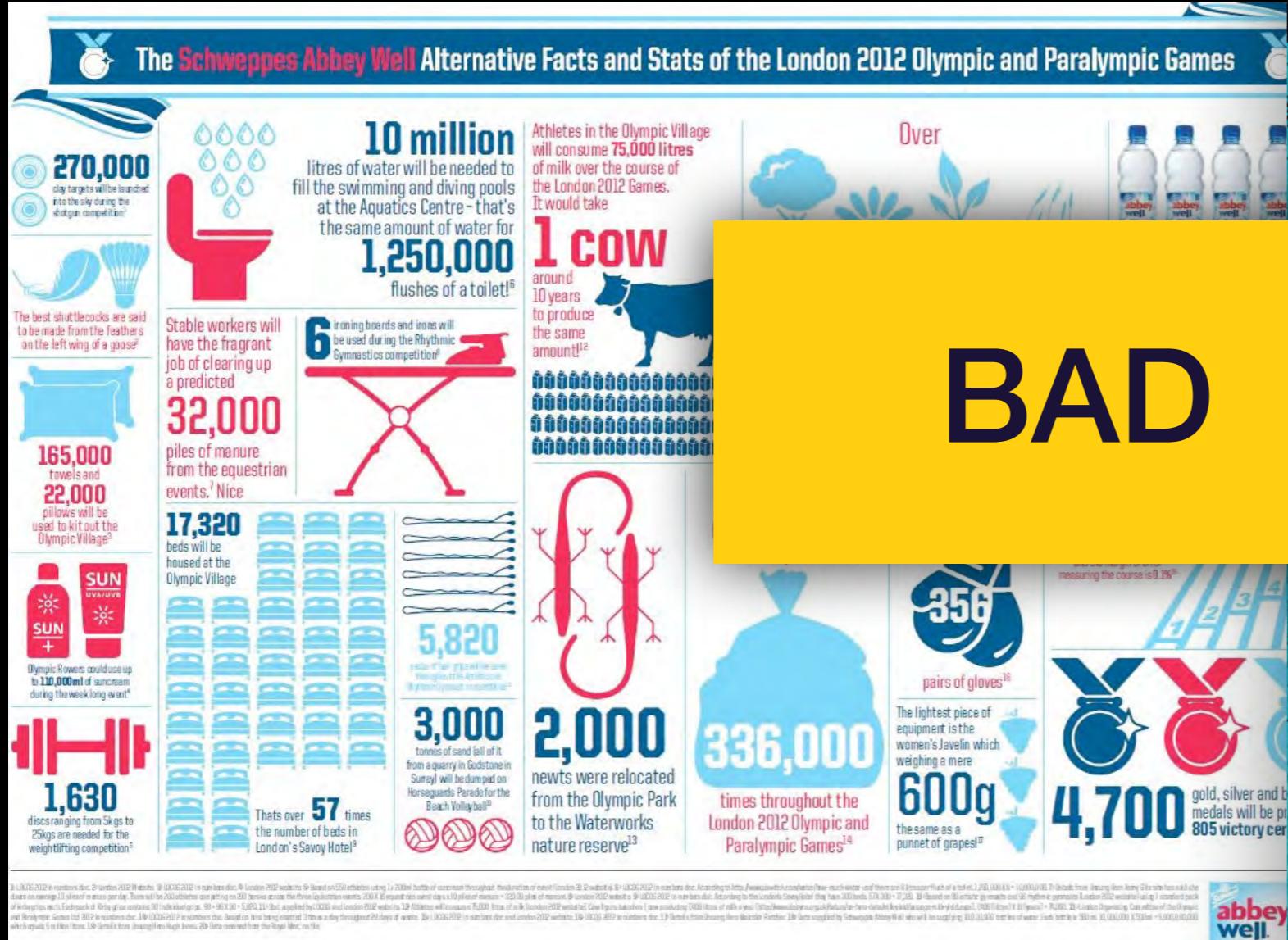


“The only design worse than a pie chart is several of them”

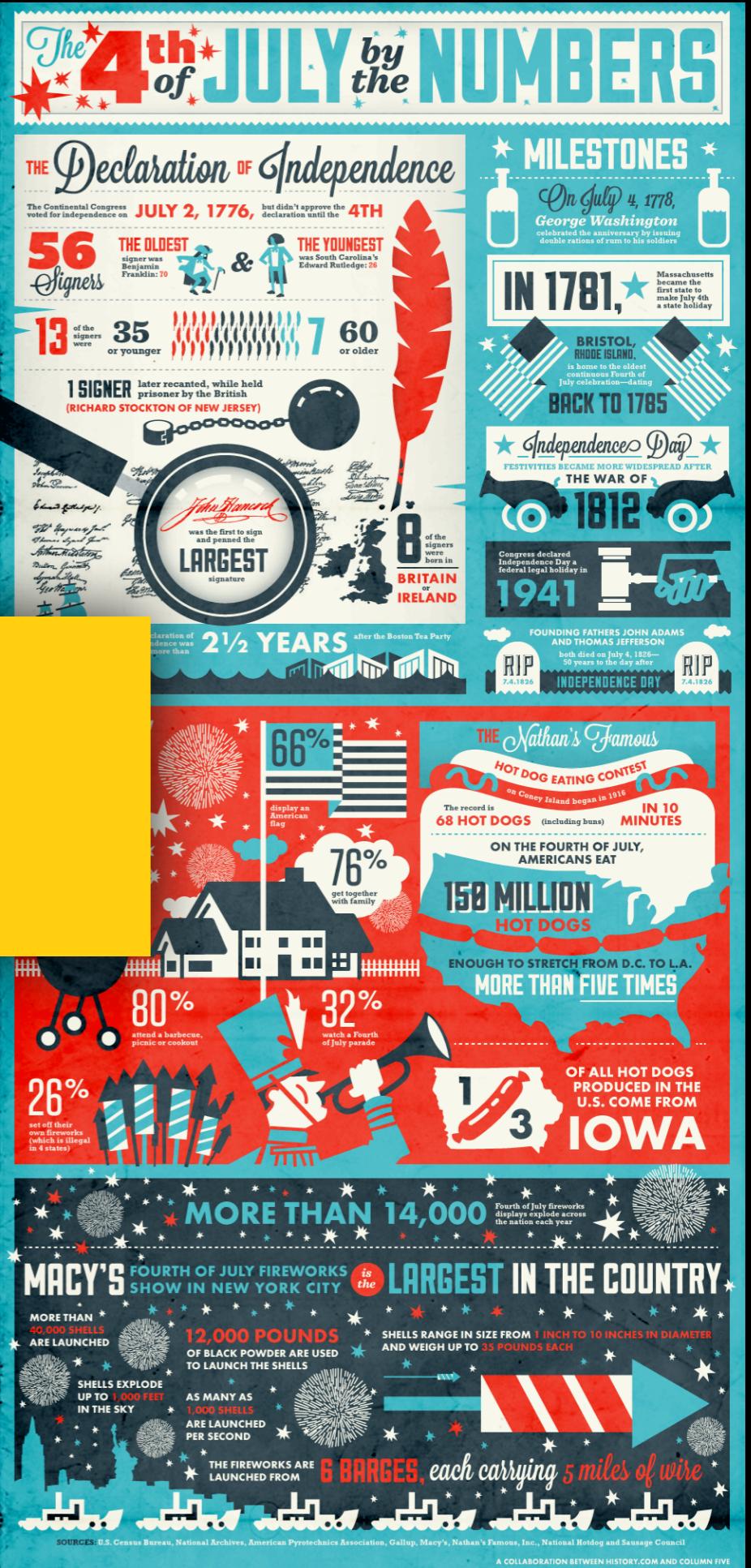
Edward Tufte, *The Visual Display of quantitative information*



The quality of a graphic  
is proportional to the quality  
of **insight** it provides



# BAD



## Compared to what? Always provide context

A number by itself means very little.  
We know our data is relevant or irrelevant, big or small,  
improving or getting worse, when we find adequate  
**comparisons** to put them in context.

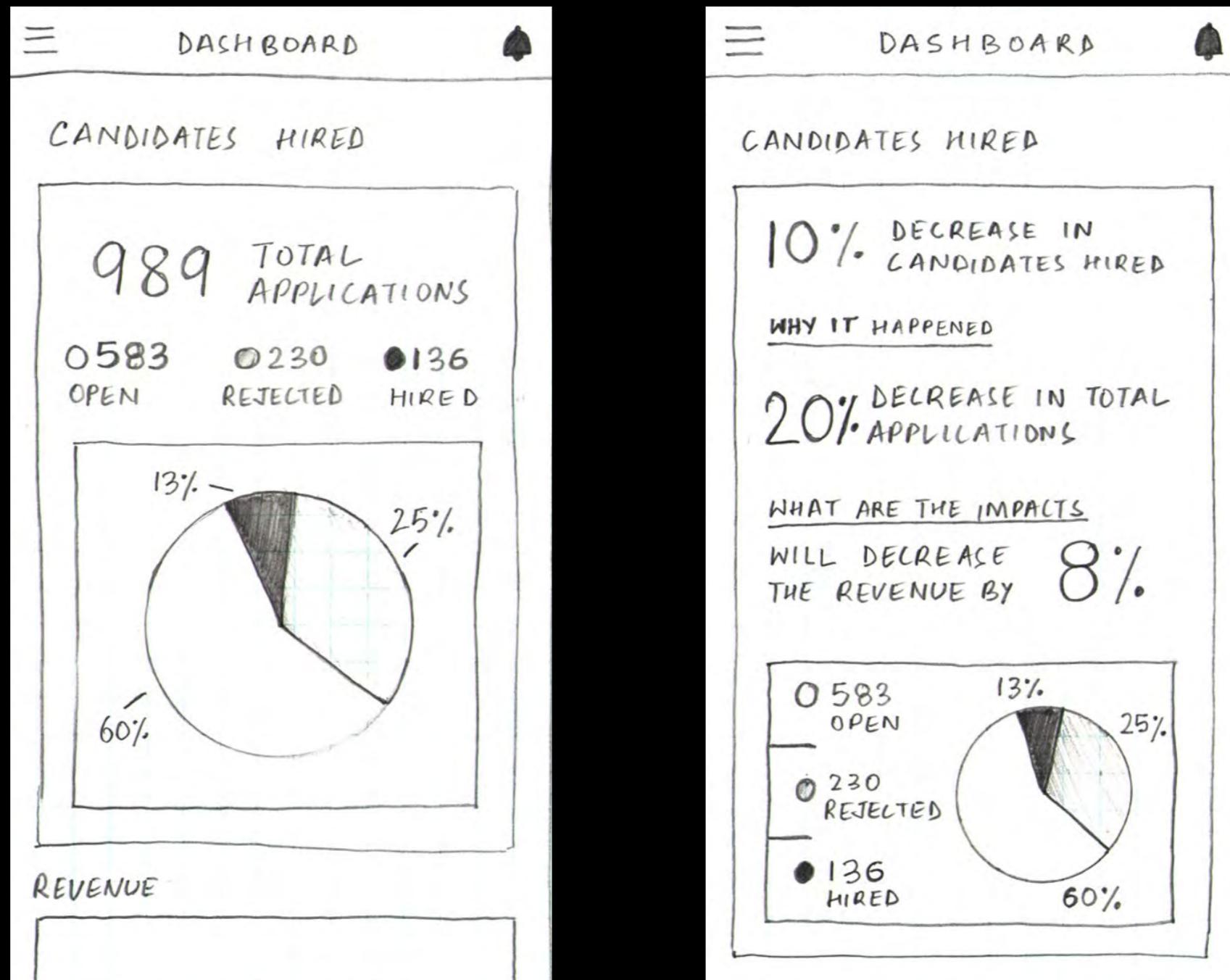


**SO WHAT?**



# Show **insights**, not just data

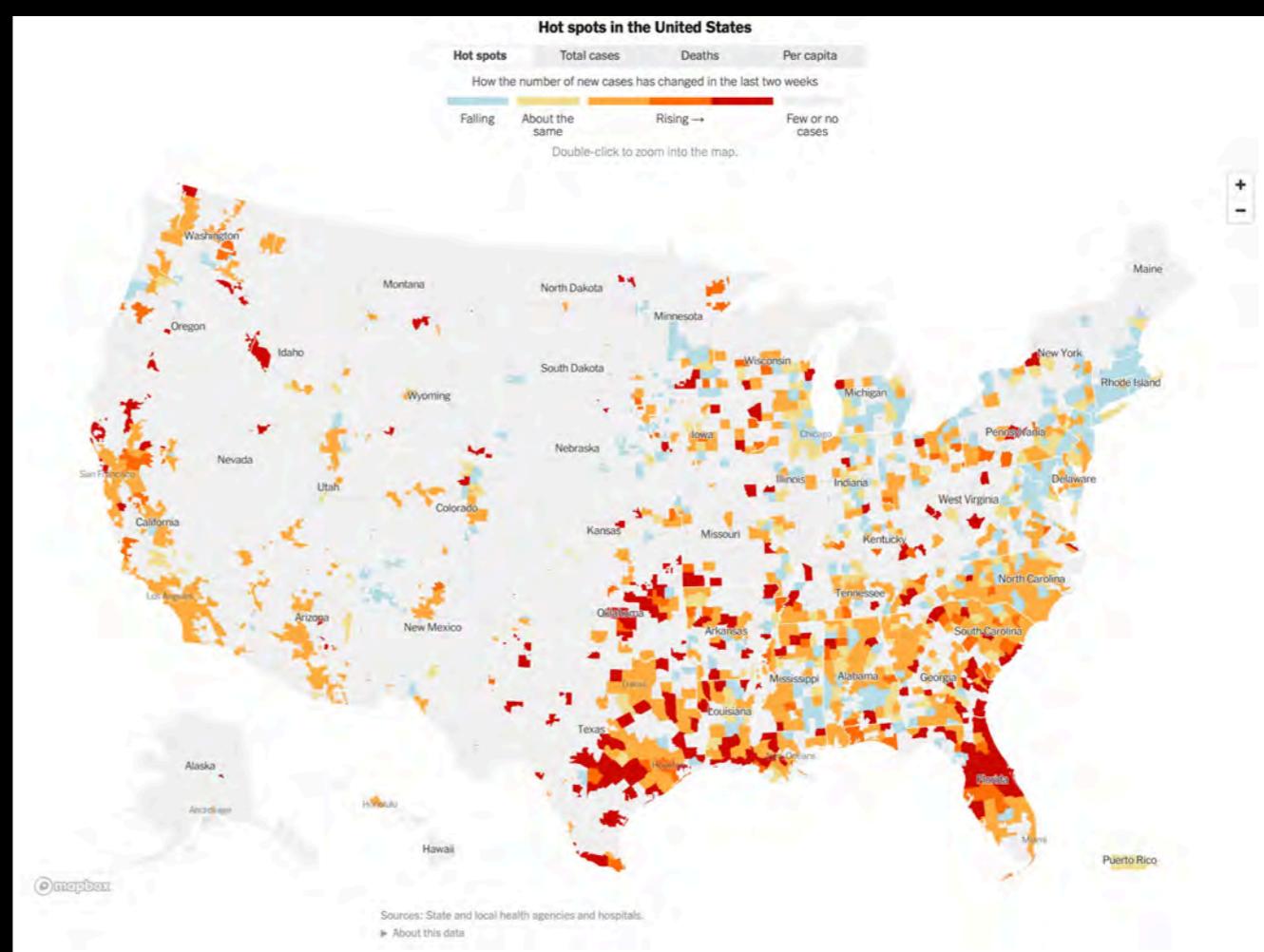
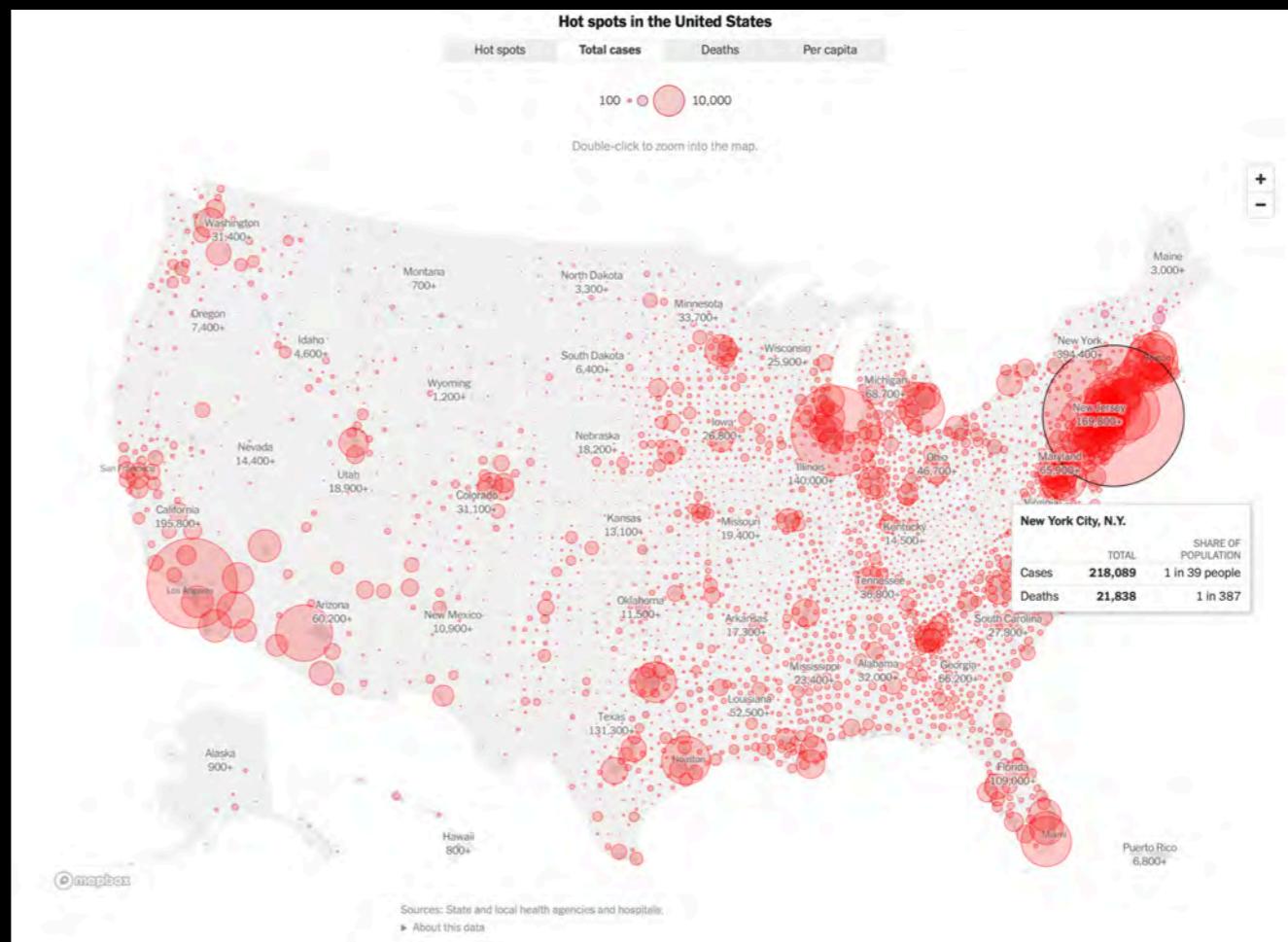
We confuse data with **insights**. A user is not just concerned about reviewing his data, they want to see what they can do with this data.



# IMPORTANT



Introducing a **time dimension** often brings greater insight



# Decoration

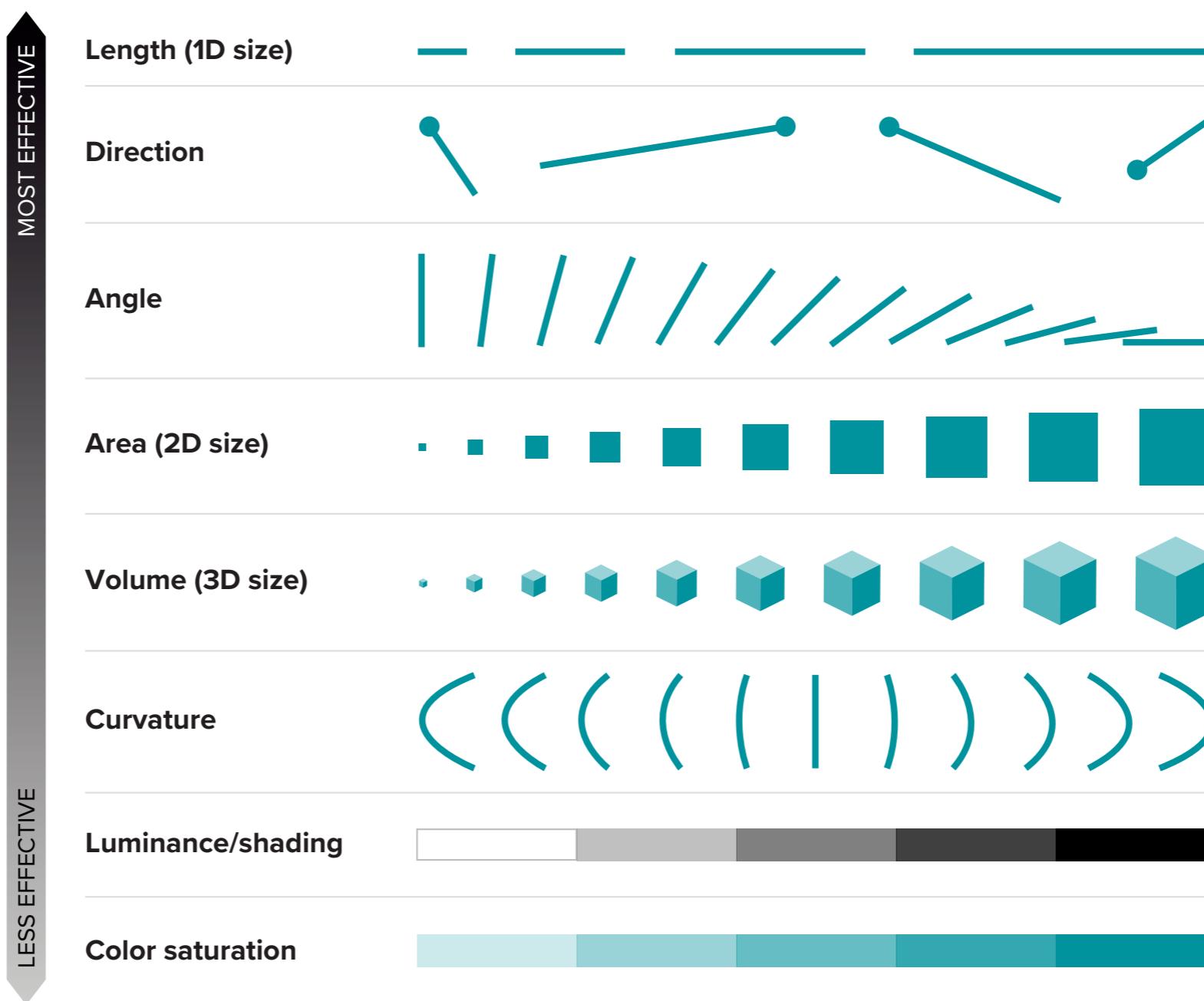
It's tempting to approach infographics from purely a design and aesthetics perspective, but that's only one half of the equation. An infographic is not an illustration, it's an **explanation**. A lot of time is spent in aesthetics rather than on substance and insight.

# Visual perception principles

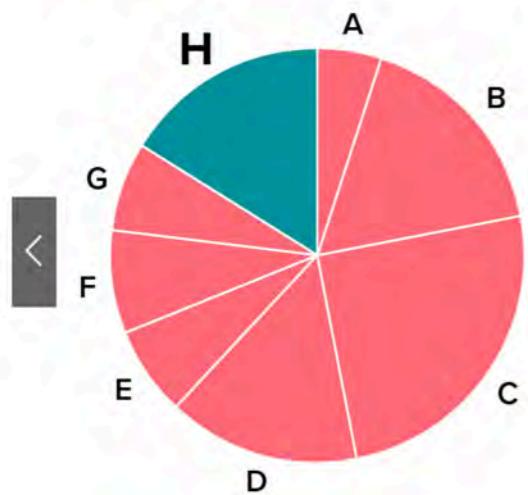
William Cleveland and Robert McGill, Bell Lab, 1984

## Ranking of Visual Elements

For quantitative/ordered data:



### Challenge 1 Answer



Which is the third largest segment in the pie chart?

A

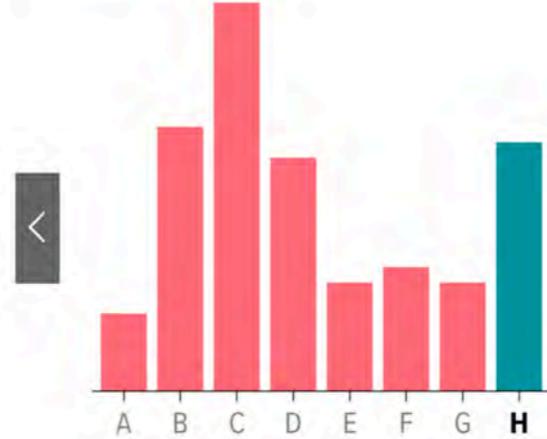
H

B

D



### Challenge 2 Answer



Which is the third tallest bar?

H

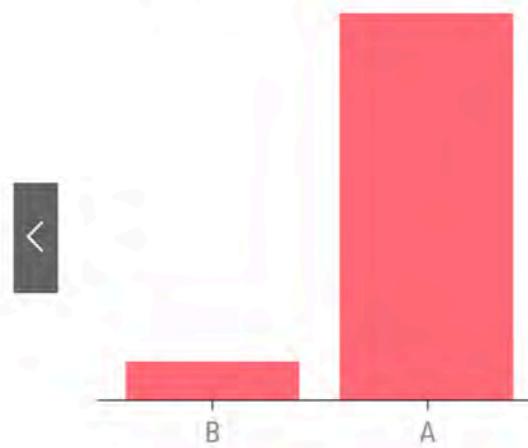
B

D

F



### Challenge 3 Answer



The value of A is how many times as large as the value of B?

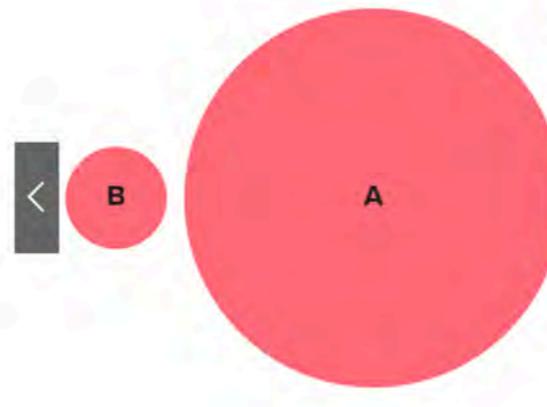
9

8

10

5

### Challenge 4 Answer



The area of circle A is how many times as large as the area of circle B?

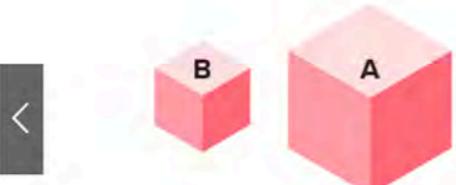
4

7

10

14

### Challenge 5 Answer



The volume of cube A is how many times as large as the volume of cube B?

3

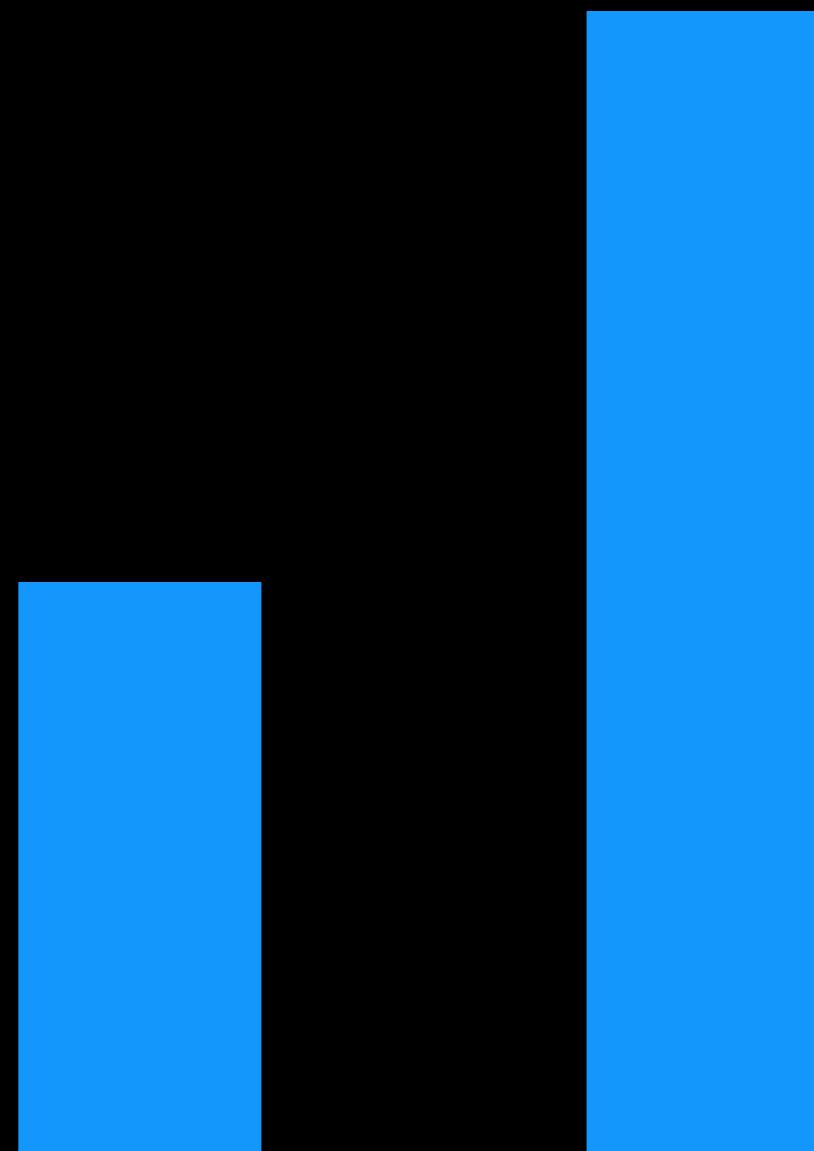
5

7

8

## Bars: easiest to interpret

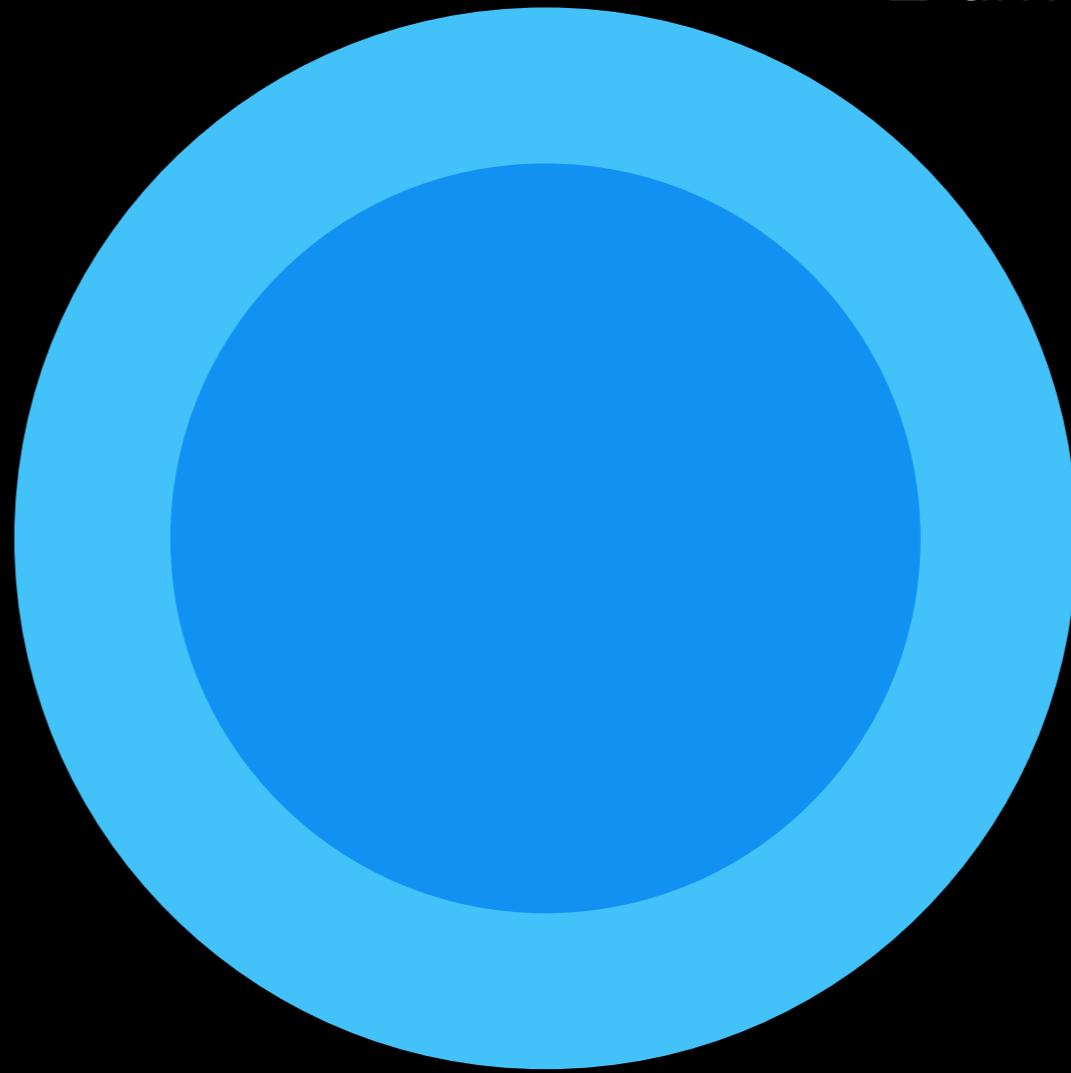
The length grows in one dimension



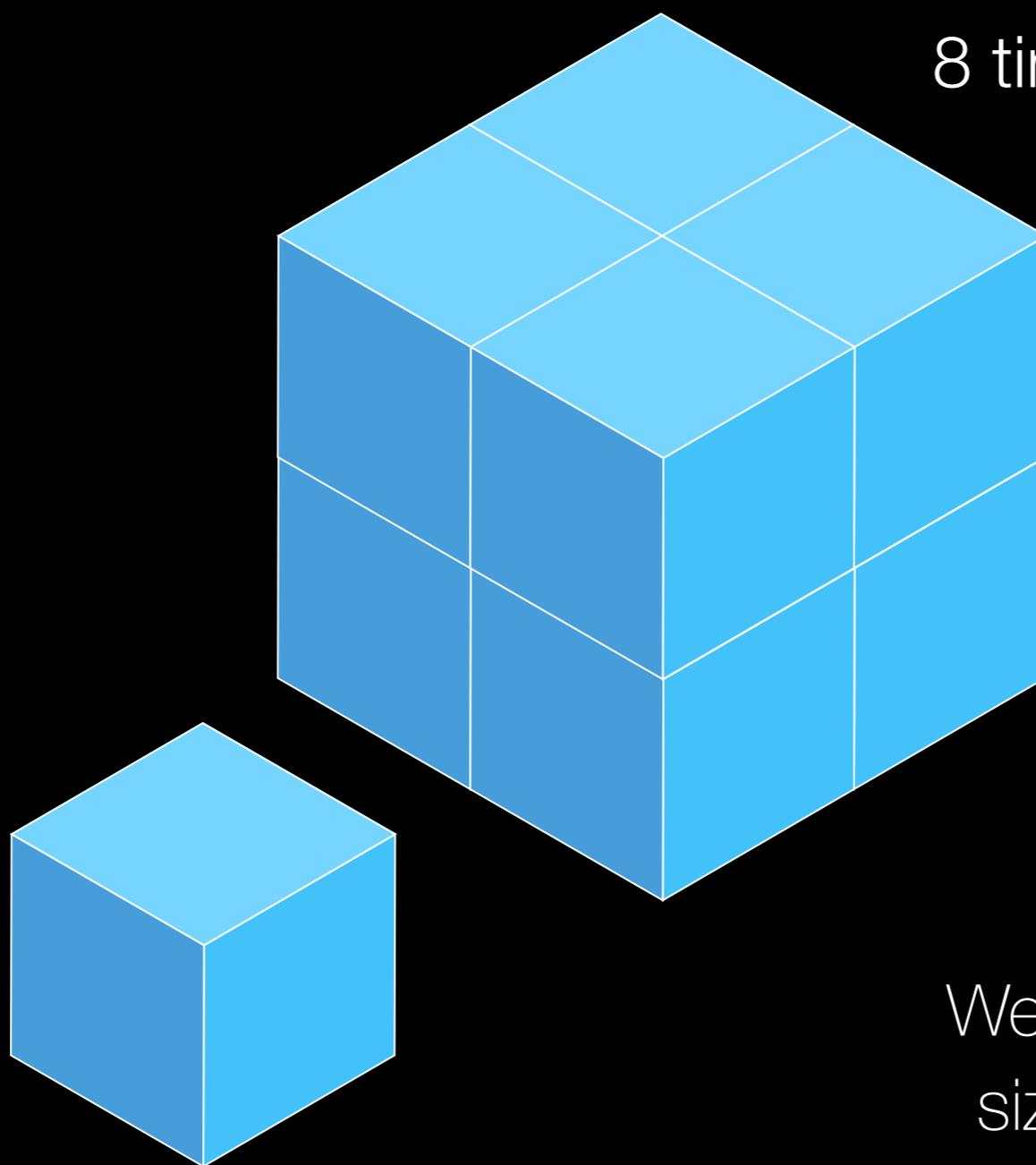
2 times bigger

Circles: want readers to compare **area**,  
but they tend to compare **length**

2 times bigger



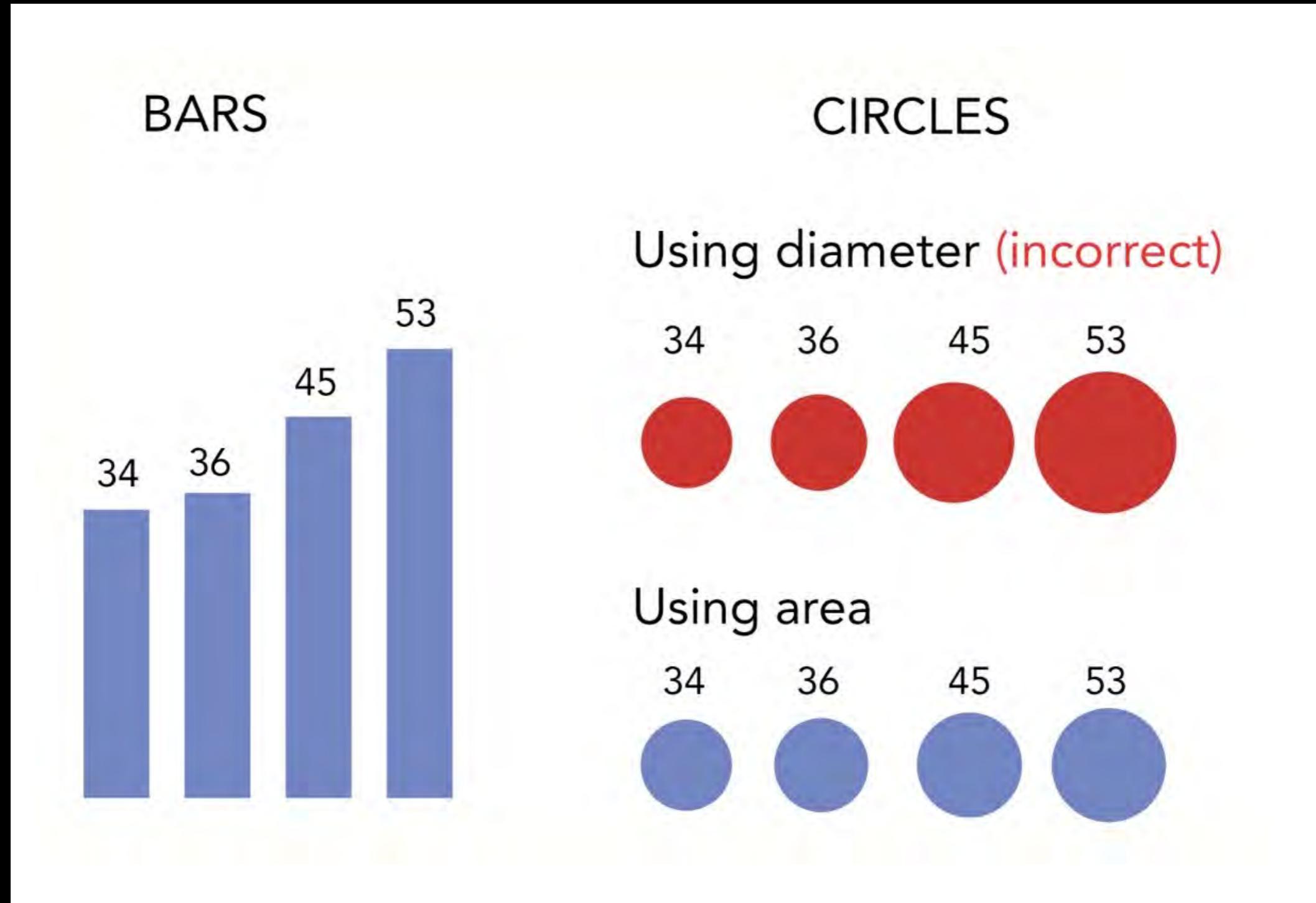
# Volume



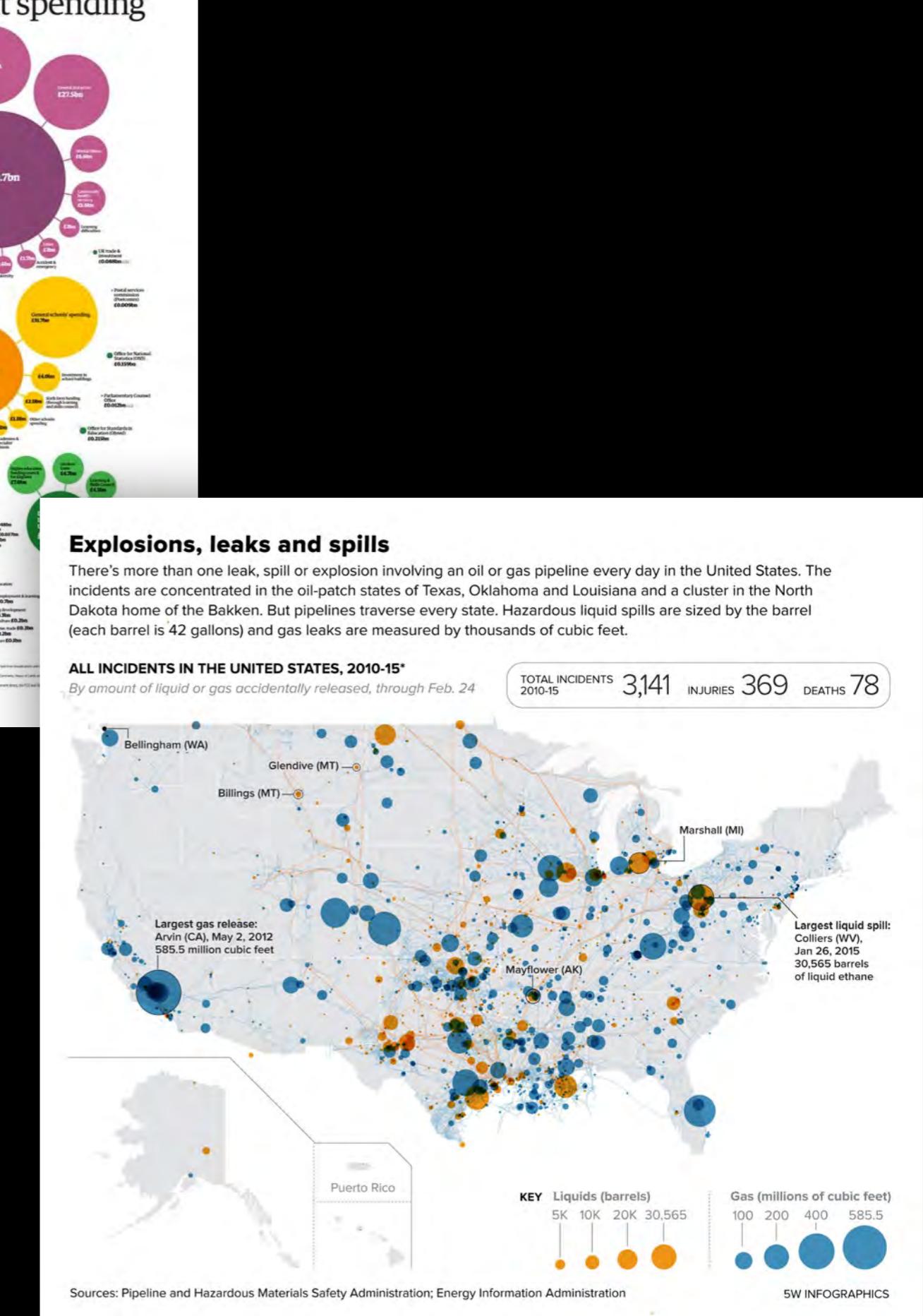
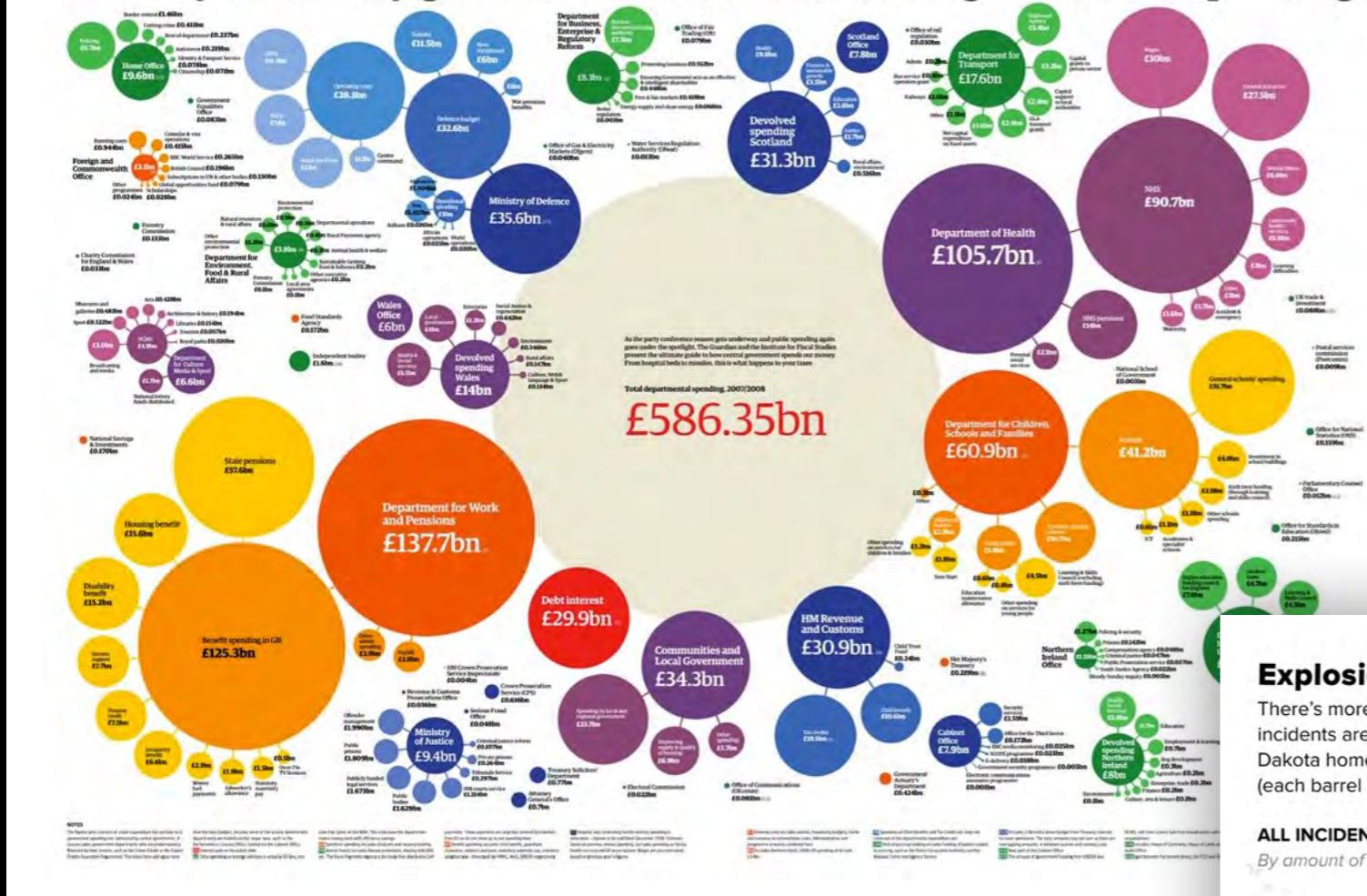
8 times bigger

We have trouble grasping  
size differences that are  
not one-dimensional

## The bubble plague

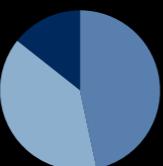


## Where your money goes: the definitive atlas of UK government spending

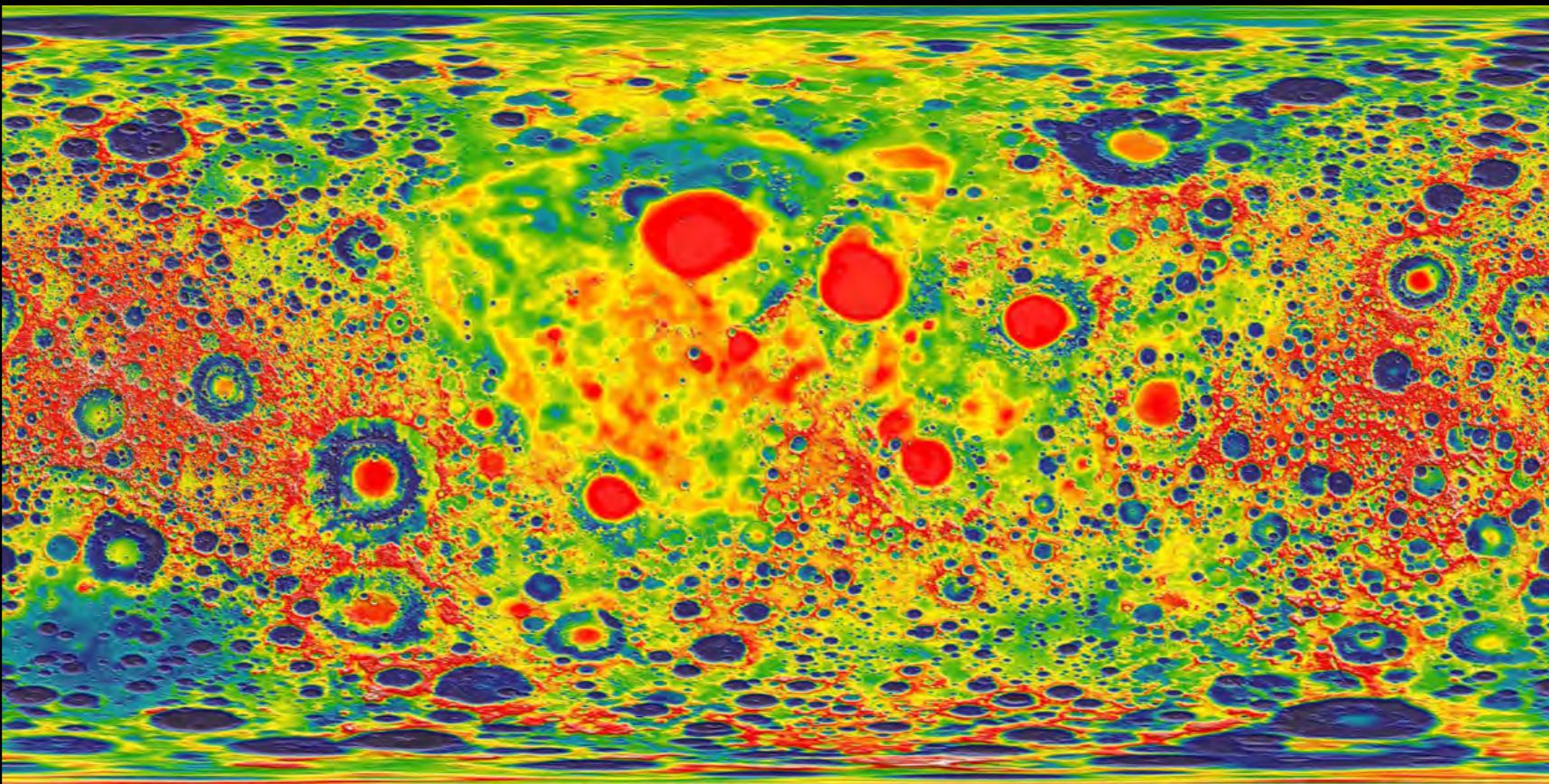


Use circles only when you have very large and very small numbers together.  
And in maps

That means no pies, either



# Ruinous rainbows



## Rainbow Vs Grayscale



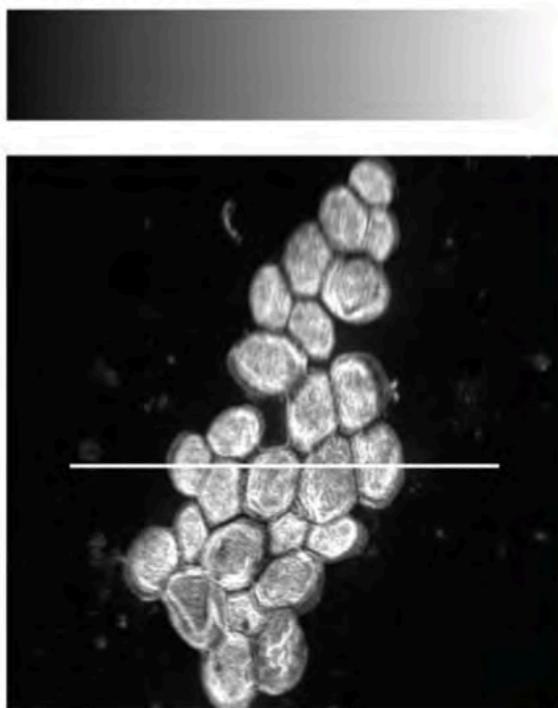
SOURCE: SOURCE

5W INFOGRAPHIC / KNOWABLE

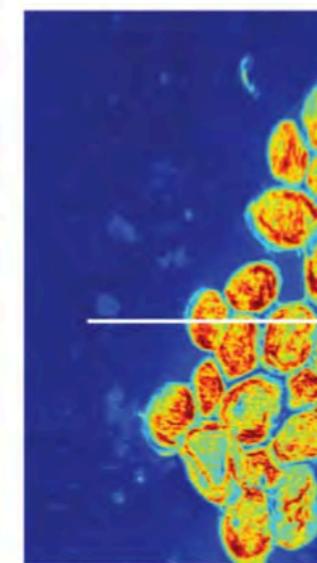
We tend to see the brightest colors as representing peaks and darker colors as valleys.

## Alternative color scales

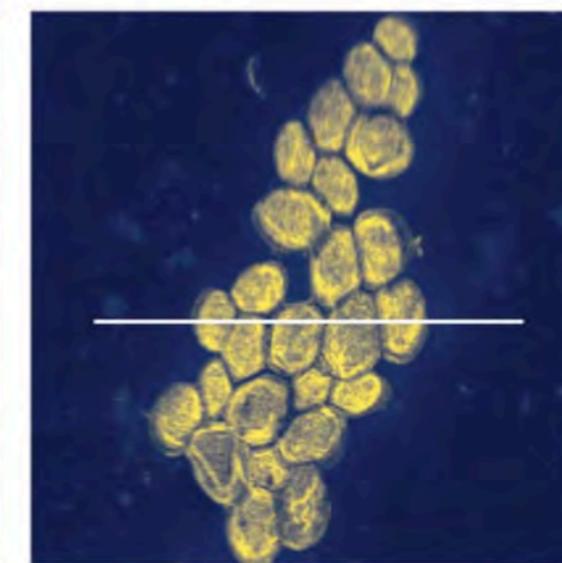
Grayscale



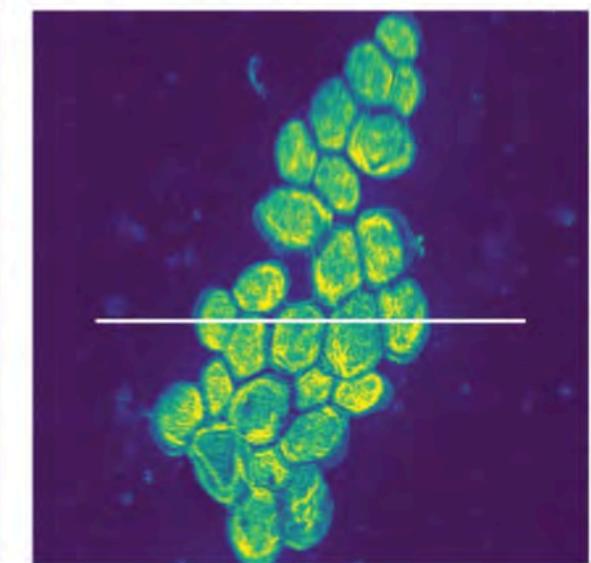
Rainbow scale



Cividis

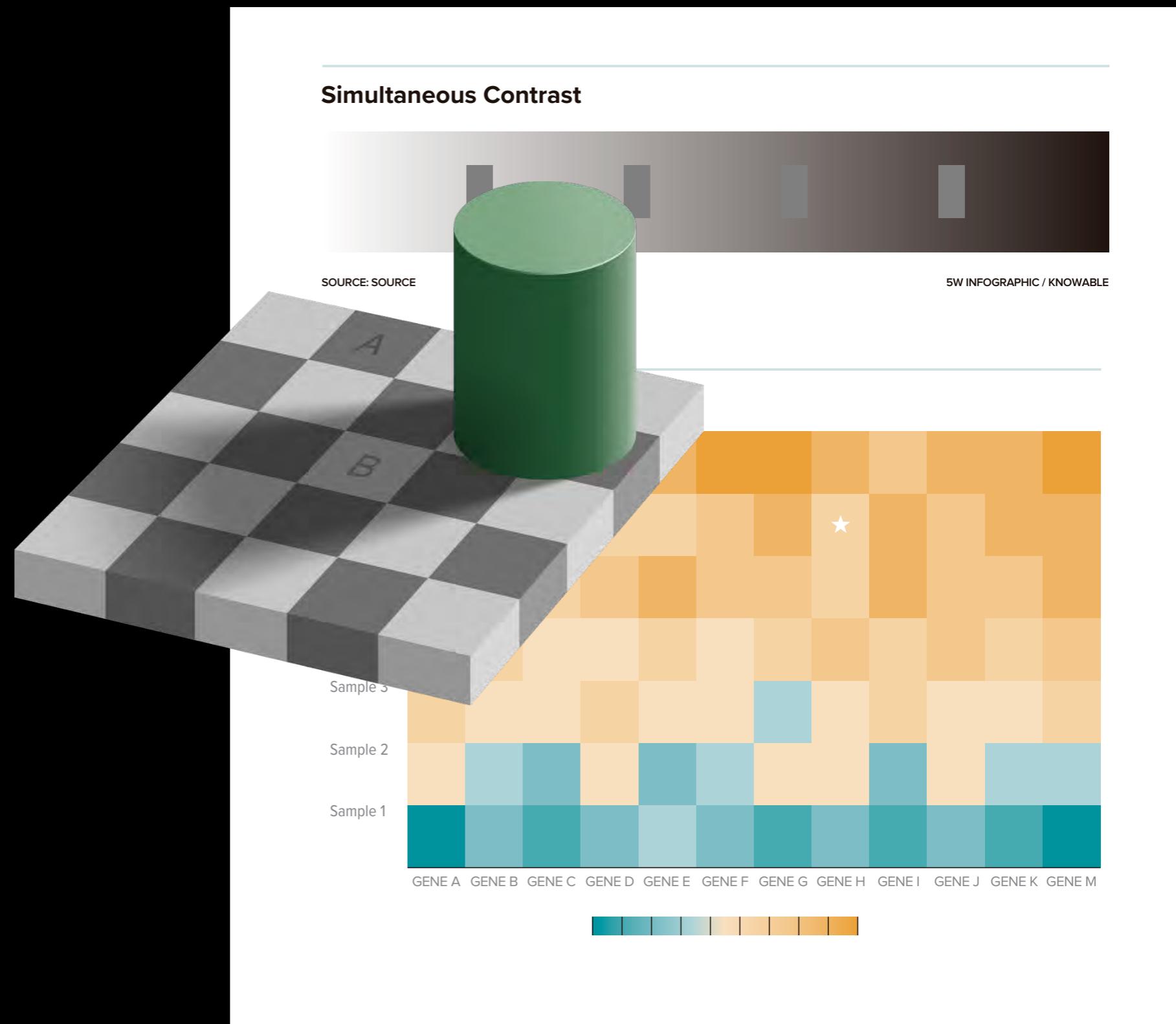


Viridis



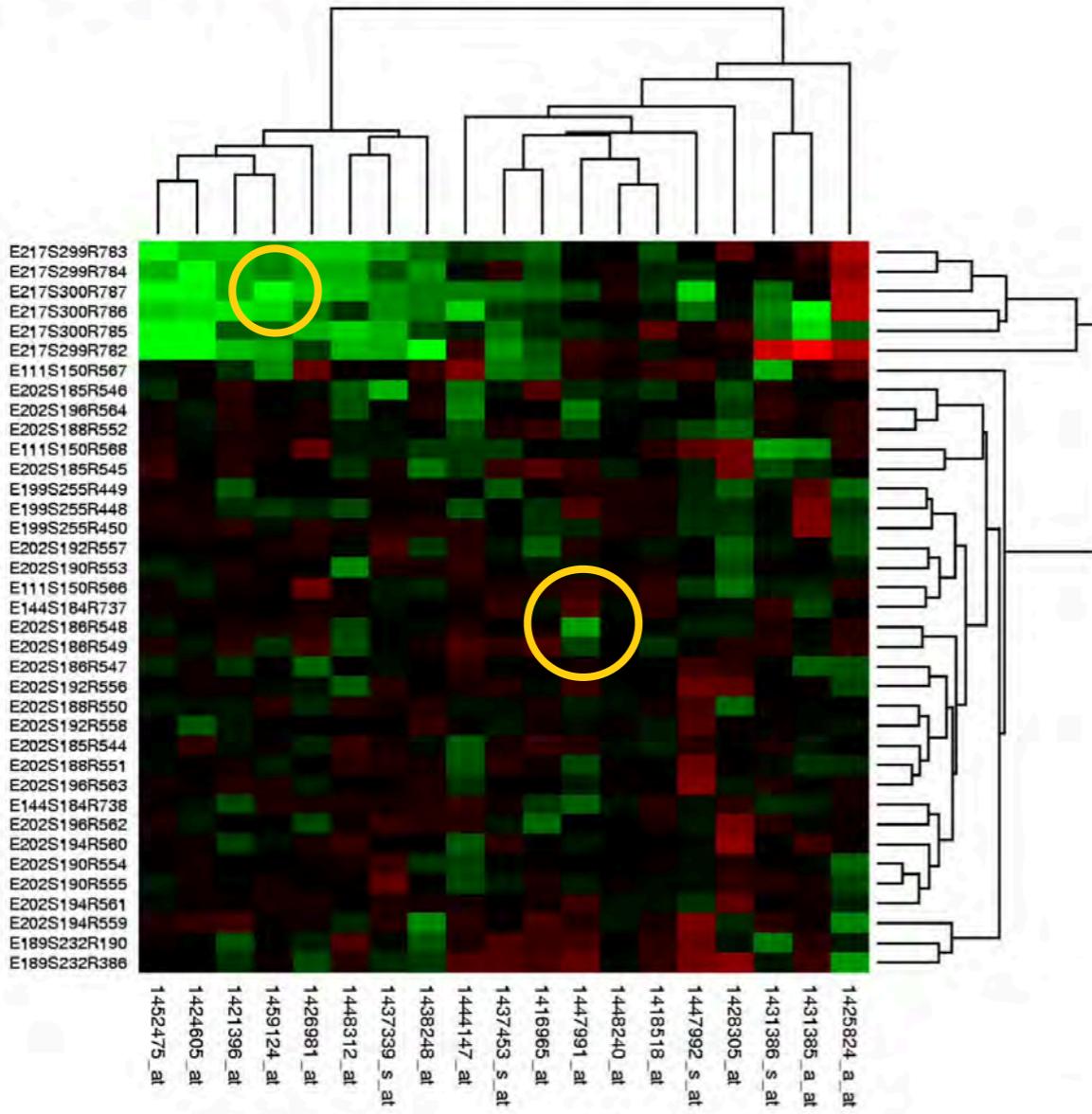
# Hazardous heat maps

Our perception of color is influenced by other nearby colors



# Highlight tables

## Highlighting gene activity with heat maps



The best expected goal differentials in the World Cup

Team	Expected goals			Actual goals			Gap
	For	Against	Net	For	Against	Net	
Brazil	12.3	3.0	+9.3	8	3	+5	-4.3
Spain	8.8	4.2	+4.7	7	6	+1	-3.7
Uruguay	6.9	2.5	+4.5	7	3	+4	-0.5
England	10.4	6.1	+4.3	12	6	+6	+1.7
France	7.9	3.8	+4.1	10	4	+6	+1.9
Belgium	11.8	7.9	+3.9	14	6	+8	+4.1
Croatia	9.9	6.7	+3.2	12	5	+7	+3.8
Sweden	7.5	5.2	+2.3	6	4	+2	-0.3
Germany	5.6	4.0	+1.6	2	4	-2	-3.6
Iceland	4.5	3.2	+1.3	2	5	-3	-4.3
Australia	3.2	2.3	+0.9	2	5	-3	-3.9
Senegal	2.7	2.0	+0.7	4	4	+0	-0.7
Portugal	4.5	4.4	+0.1	6	6	+0	-0.1
Poland	3.3	3.7	-0.4	2	5	-3	-2.7
Nigeria	2.9	3.5	-0.7	3	4	-1	-0.3
Saudi Arabia	3.3	3.9	-0.7	2	7	-5	-4.3
Serbia	3.3	4.5	-1.1	2	4	-2	-0.9
Iran	3.3	4.5	-1.2	2	2	+0	+1.2
Switzerland	5.0	6.4	-1.4	5	5	+0	+1.4
Peru	2.2	3.8	-1.6	2	2	+0	+1.6
Argentina	4.7	6.4	-1.6	6	9	-3	-1.4
Japan	4.8	6.5	-1.7	6	7	-1	+0.7
Costa Rica	2.7	4.7	-2.0	2	5	-3	-1.0
Colombia	3.8	5.9	-2.1	6	3	+3	+5.1
Morocco	2.7	5.1	-2.4	2	4	-2	+0.4
Mexico	5.3	7.8	-2.5	3	6	-3	-0.5
Russia	5.2	7.7	-2.5	11	7	+4	+6.5
Egypt	2.5	5.2	-2.7	2	6	-4	-1.3
Denmark	2.9	5.8	-2.9	3	2	+1	+3.9
Tunisia	4.3	8.4	-4.0	5	8	-3	+1.0
South Korea	2.7	7.1	-4.3	3	3	+0	+4.3
Panama	2.2	7.2	-5.1	2	11	-9	-3.9

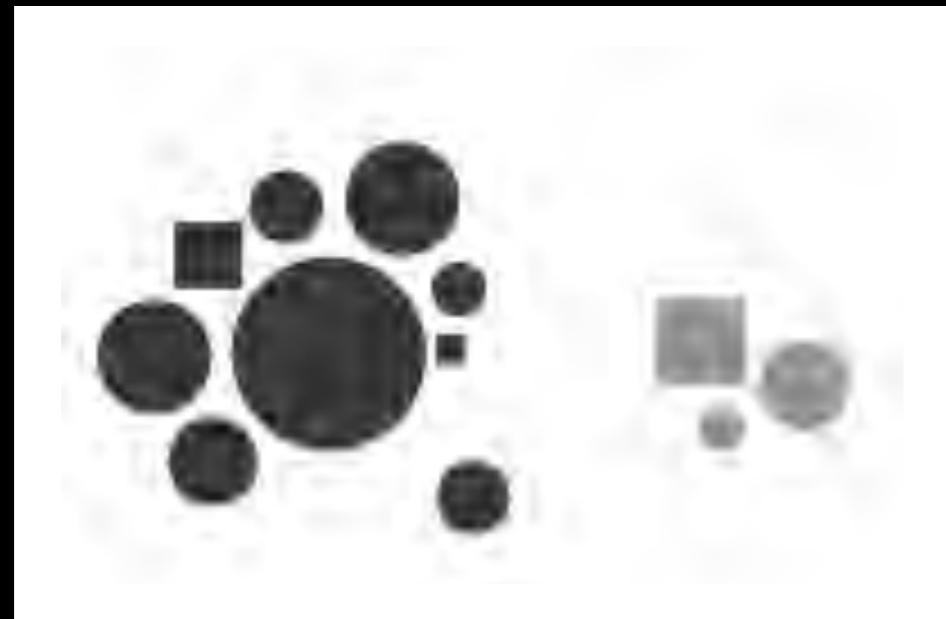
Follow **design principles** -  
principles of interpretation

In the 1900s, the **Gestalt School of Psychology** studied  
human perception through a series of experiments. It found  
**six principles for easy interpretation of information**

**1**

## **Proximity**

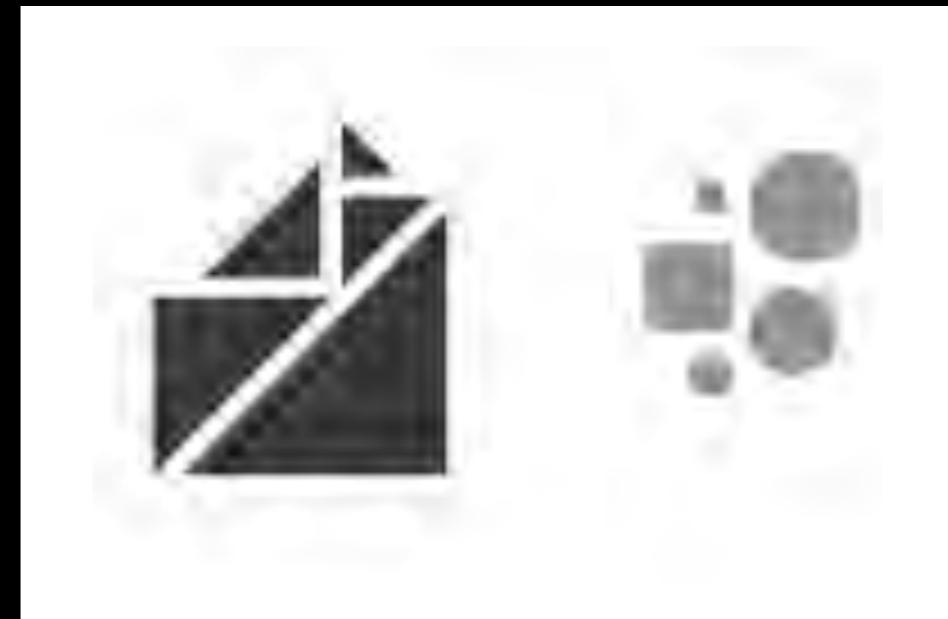
Our brains can group multiple elements or forms together that are located near one another.



**2**

## **Similarity**

When objects are similar in shape, size, color or orientation, our brains will correlate them even when they aren't grouped together.



**3**

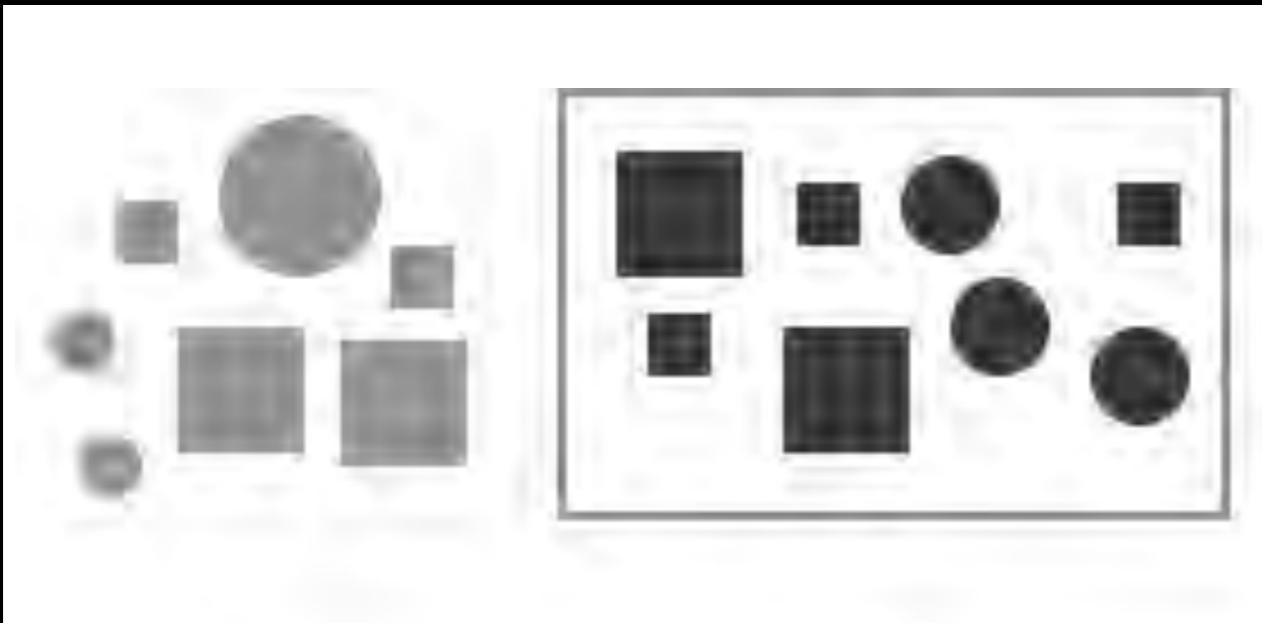
### **Enclosure**

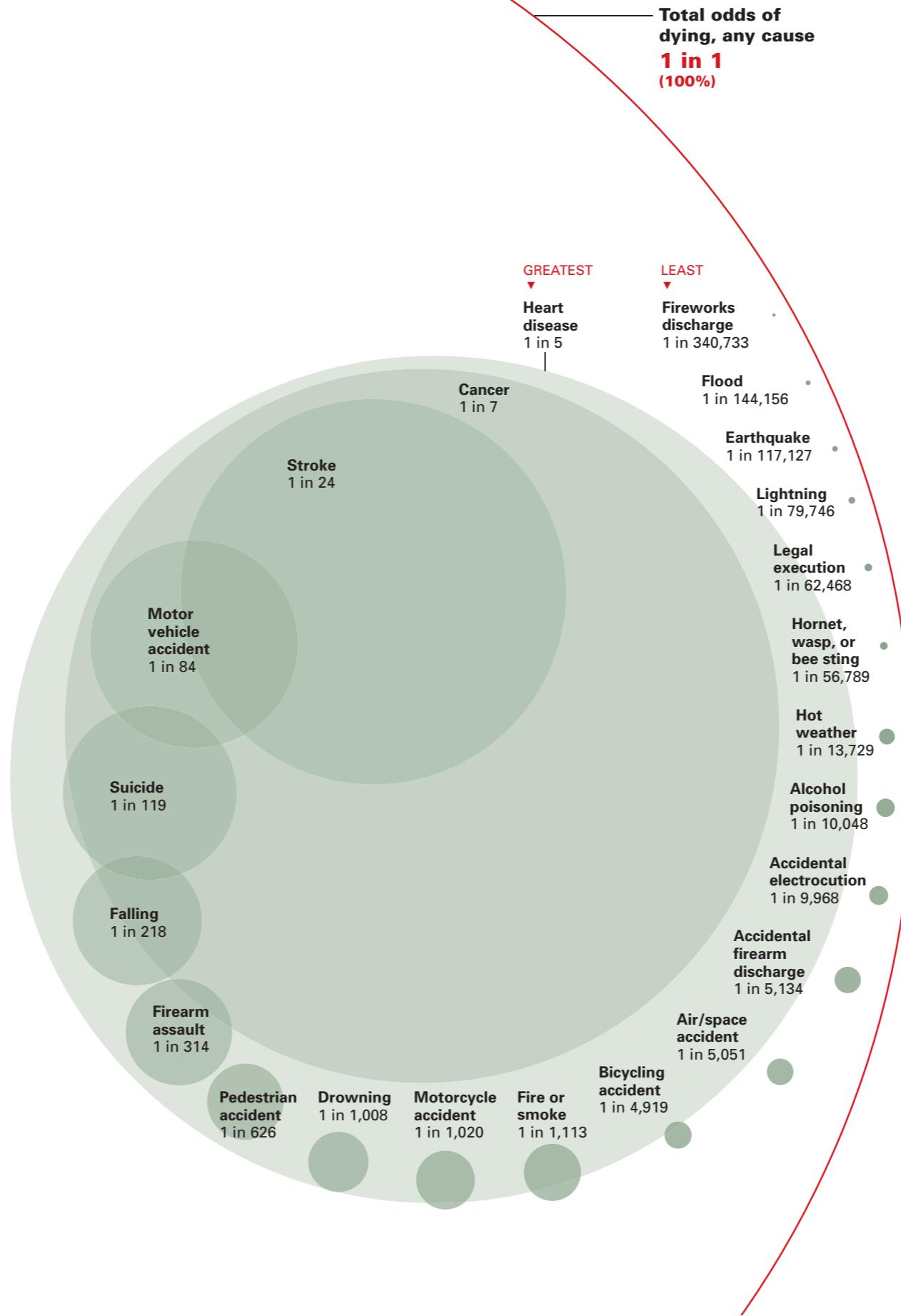
We perceive that objects are a part of a group if they're surrounded by a border.

**4**

### **Closure**

When a figure is incomplete, our brains will create regions and fill in the missing elements.





**5**

## **Continuity**

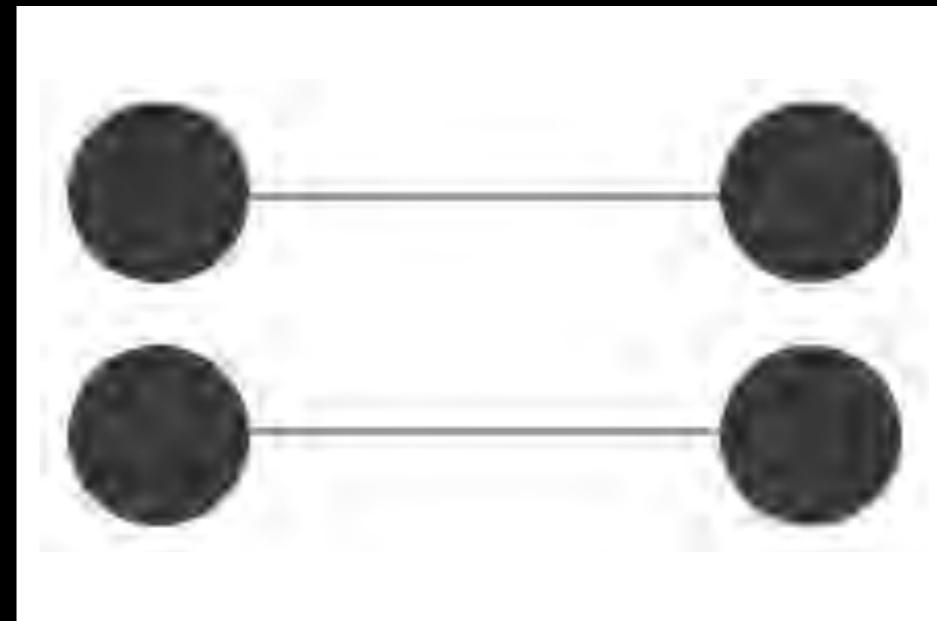
We perceive aligned objects to be a continuous body or series.



**6**

## **Connection**

Objects or forms connected by a line will be seen as a pair or group.

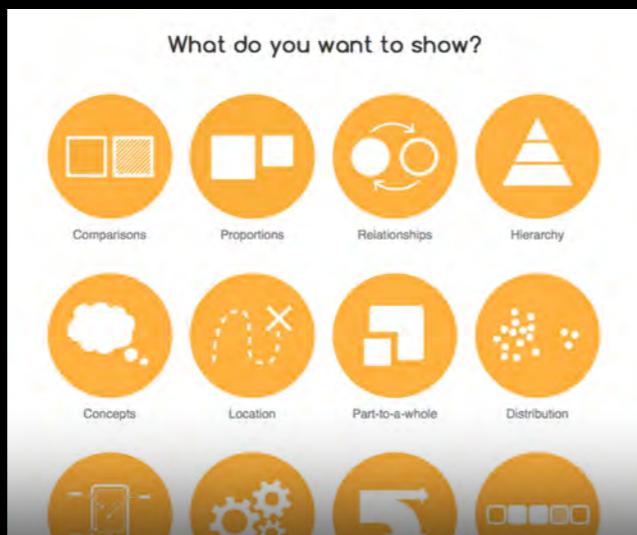


# Design principles

# What type of chart?

[datavizcatalogue.com](http://datavizcatalogue.com)

[datavizproject.com](http://datavizproject.com)



**Comparisons**  
Visualisation methods that help show the differences or similarities between values.  
Based on position on an axis:

- Bar Chart, Box & Whisker Plot, Bubble Chart, Histogram, Line Graph, Marimekko Chart
- Multi-set Bar Chart, Nightingale Rose Chart, Population Pyramid, Radar Chart, Radar Bar Chart, Radar Column Chart
- Span Chart, Stacked Area, Stacked Bar Graph

No Axis:

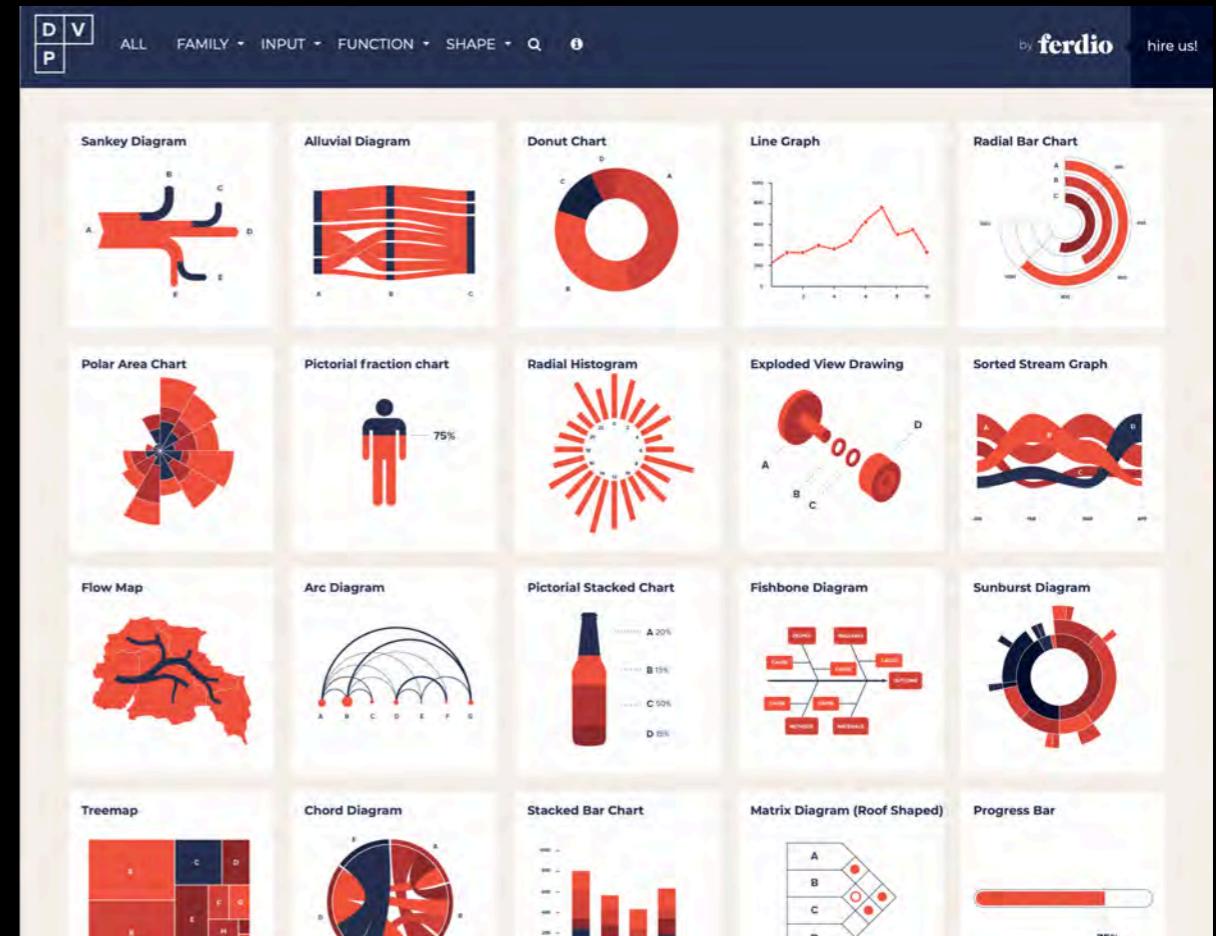
- Chord Diagram, Choropleth Map, Donut Chart, Dot Matrix Chart, Parallel Sets, Pictogram Chart

**Histogram**

**Description**  
A histogram visualizes the distribution of data over a continuous interval or certain time period. Each bar in a histogram represents the tabulated frequency at each interval/bin. The total area of the histogram is equal to the number of data.

**Anatomy**  
Height of bar = Frequency per individual interval or "bin".  
(Frequencies)  
(Intervals or Time Period)

**Functions**  
Comparisons, Data over Time, Distribution, Patterns, Probability, Range



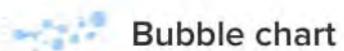
I would like to see...

## Relationship

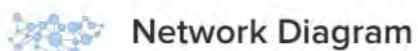
Static



Scatter chart



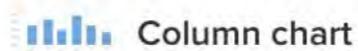
Bubble chart



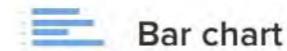
Network Diagram

## Comparison

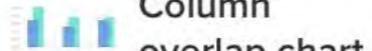
Static



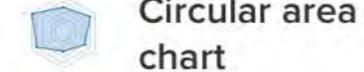
Column chart



Bar chart



Column overlap chart



Circular area chart

Over Time



Line chart

## Composition

Static



Pie/Donut chart



Tree map



Heat map



Sunburst chart

Over Time



Stacked column chart



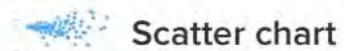
Stacked area chart



Waterfall chart

## Distribution

Static



Scatter chart



Histogram chart



Bell curve

## Spider chart

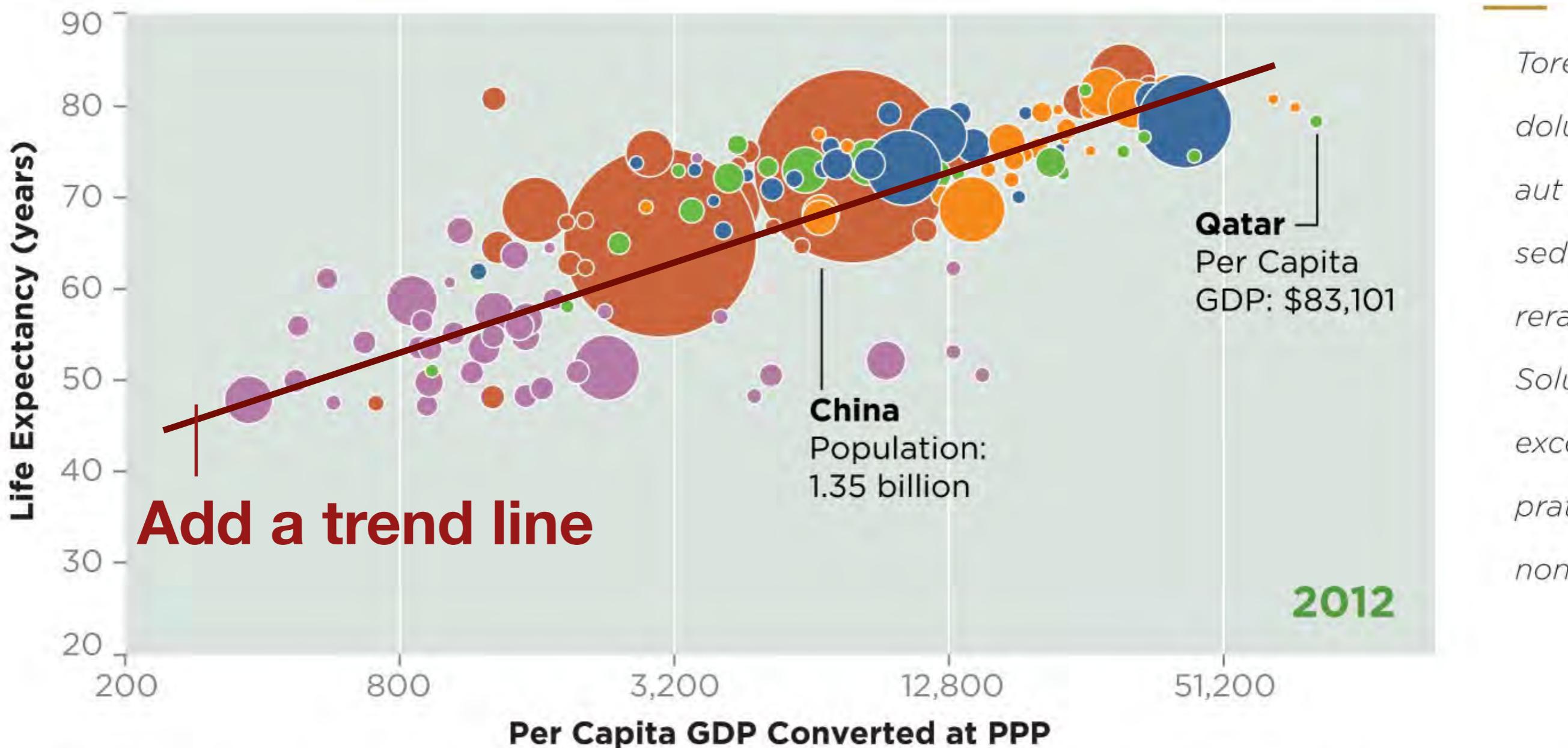
Technically correct, but difficult to understand for most readers



## Scatterplots

Relationship between datasets or **correlation**. How much a variable is affected by another

**Up to 4 variables:** horizontal position, vertical position, color and size



# Pie charts

## PURPOSE

To **compare values or proportions in relation to each other** and/or to the whole. Since the whole can always be expressed as 100%, pies are commonly used to show percentages.

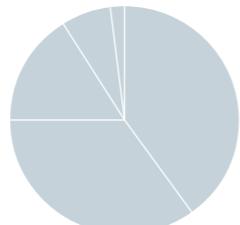
## DO'S

- **MAKE SURE YOU HAVE A COMPLETE DATASET** (all the values to sum 100 percent). If we don't have all the values, use bars.
- **START AT 12 O'CLOCK** and arrange the slices from largest to smallest, in a clockwise direction. If a particular slice needs to be clearly highlighted put it first, in a stronger color.
- **ADD A NOTE** that says "percentages don't add up to 100% due to rounding" if the shown values don't add exactly to 100 percent, a frequent occurrence if we have rounded values.
- **USE VERY FEW SHADES OF COLOR.** Many colors will not enhance comprehension and may confuse.

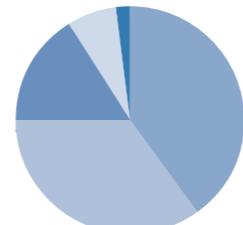


Use either one muted color or different shades or variations of the same color to display all data. Highlight the most important number with a strong tone if needed. Some strategies are:

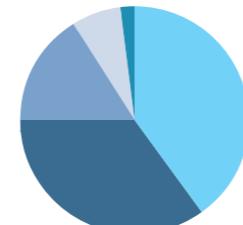
**1.** All the slices  
in the same color



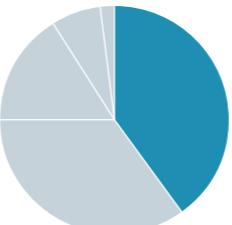
**2.** Shades of  
the same color



**3.** Different colors  
within the same family



**4.** A highlight color for  
the most important piece

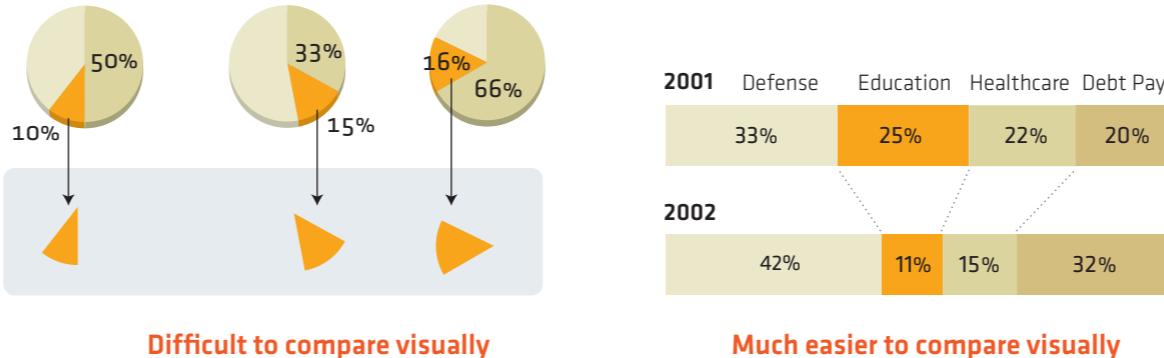


# How to use different types of charts

## DON'T'S

- **DON'T COMPARE PIE CHARTS TO OTHER PIE CHARTS.** One pie is relatively easy to read, but it is visually difficult to compare value across different pie charts. The slices to be compared may be rotated in different angles.

**ALTERNATIVE:** Percentage bars or stacked bars:



Difficult to compare visually

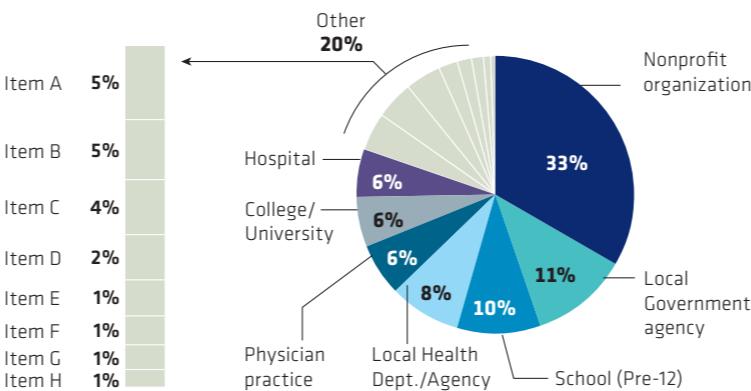
Much easier to compare visually

- **DON'T USE MORE THAN 7 OR 8 SLICES.** The overall impression is confusing and labeling will be hard to do.

**SOLUTION:** to combine the small slices them in an “others” category.

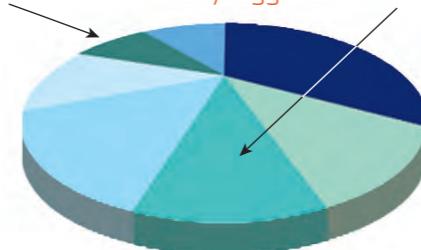
If the precise values are essential:

- **ZOOM** in on them in a separate chart, or
- **LIST** or table with the values next to the pie.



- **DON'T USE PERSPECTIVE OR THREE-DIMENSIONAL EFFECTS.** They can severely distort proportions.

THIS SLICE is actually bigger than THIS ONE



# How to use different types of charts

## ALTERNATIVE DESIGNS FOR PIES

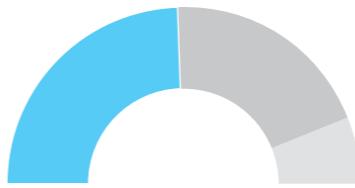
### DONUT CHART

Essentially the same as a pie chart, with a more contemporary look. It may look like a round percentage bar but remember that we are still plotting area, not the length of each segment (it looks too similar to a conventional pie chart to do otherwise without confusion).



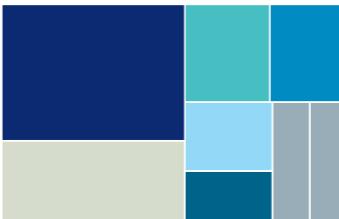
### HALF DONUT

Often used for elections charts, but valid in any other context. They are easier to compare than whole pie charts.



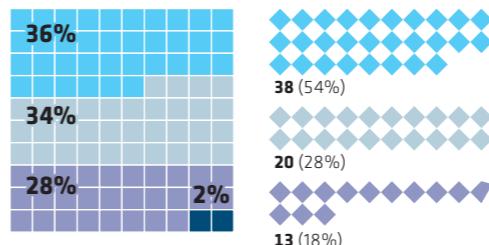
### TREE MAP

Rectangular shapes that can be arranged by size or relative importance



### SMALL UNITS

Small squares or any other shapes. Each shape can represent one percentage point or absolute values (in which case is best to label both the value and the percentage)



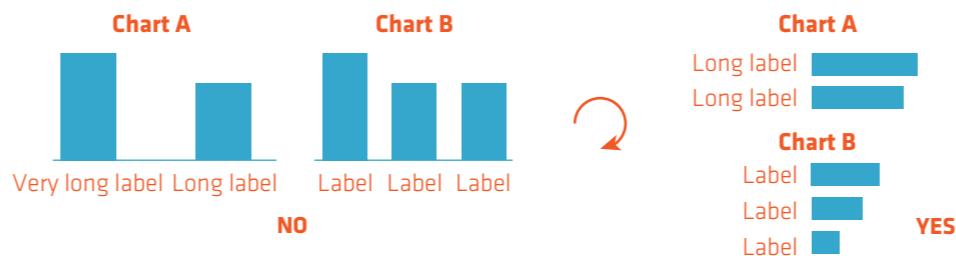
# Bar charts

## PURPOSE

- To **compare one or more variables for multiple categories**
- To show **evolution of a variable over time**. The variable should start at zero for each period of time (a continued evolution such as stock market prices would require a fever line chart). Example: Annual revenue of a company for several years.

## DO'S

- **USE VERTICAL BARS FOR TIME SERIES** Although it's not incorrect to do otherwise, time series typically run horizontally on the x-axis from left to right. Respect the habits of the readers.
- **ROTATE TO USE CONSISTENTLY SIZED HORIZONTAL BARS.** Long labels often force us to have wide bars and/or large gaps between them, and to have inconsistent bars sizes in a presentation. It looks clunky and amateurish. In most cases we can flip the axis for consistently thin bars even when we use long labels. **Don't use vertical or diagonal labels.**



- **USE RELATIVELY THIN BARS WITH NARROWER GAPS.** Leave gaps that are about half the width of the bars. If the negative space is similar to the bars, it may create some visual vibration and confusion between data and non-data. Gaps wider than the bars mean the chart is oversized.



# How to use different types of charts

Use a highlight color bar or a line to show average values. Lines are also used for benchmarks.

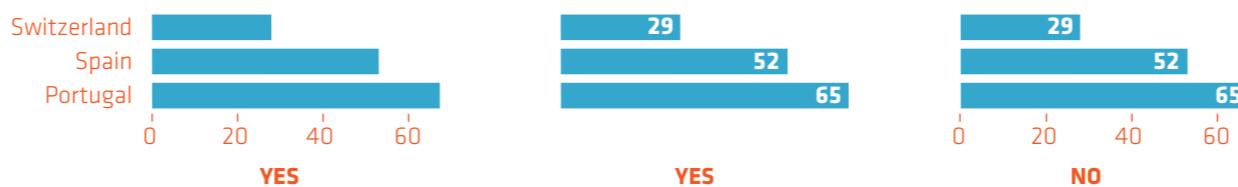


- **SORT** If a particular order is essential, use it. For all other cases, don't use a random order, sort the bars by default (from largest to smallest or viceversa). If a particular bar is of high interest show it first in a highlight color, followed by sorted bars. Bars showing totals and averages should be highlighted too.

## DON'TS

### • DON'T USE EXACT VALUES AND A SCALE REDUNDANTLY

Gridlines and tick marks help guide the reader's eye to know the approximate values. If we are not labeling exact values for each bar, the scale is essential. If we are, it's unnecessary and should be deleted.



- **DON'T TRUNCATE THE SCALE** While there is flexibility with line charts, bar chart scales **should always start at the zero value**. If you want to highlight small differences, show unit or percentage change instead.



### • DON'T USE BARS IF YOU HAVE VERY LARGE AND VERY SMALL VALUES

The largest value may be so large that small values become nearly invisible or too hard to differentiate from each other.



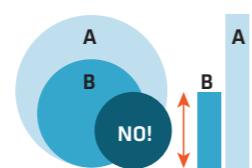
NO

Differences in the values are lost



NO

This commonly used "break" symbol defies the purpose of visualizing data. We are not showing real differences



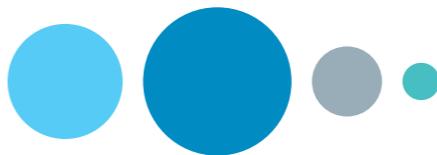
**ALTERNATIVE:** **Bubble charts** compare areas rather than lengths. They de-emphasize visual differences, making it possible to include very large and very small values in the same chart. Remember to **PLOT THE AREA, NOT THE DIAMETER OR WIDTH** of the circle. However, sometimes the differences in values may be so large that a **text table** or a **highlight table** is the only option.

# How to use different types of charts

## ALTERNATIVE DESIGNS FOR BARS

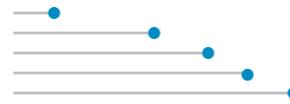
### BUBBLE CHART

Using circles. Remember to plot area, not length (diameter).



### LOLLIPOP CHART

Thin lines with small circles at the data points.



### WORD CLOUD

Type is sized according to the numerical values.



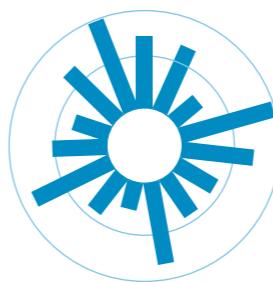
### CIRCULAR BAR CHART

An engaging design useful in squarish layouts, it can also show percentages for multiple variables.



### RADIAL BAR CHART

A concentric arrangement with a radial scale.



### HIGHLIGHT TABLE

A text table with shades of color indicating the magnitude of values. Useful to visualize patterns behind large sets of numbers.

	Category A	Category B	Category C
Category A	2	4	2
Category B	4	8	2
Category C	2	6	8
Category D	8	2	6

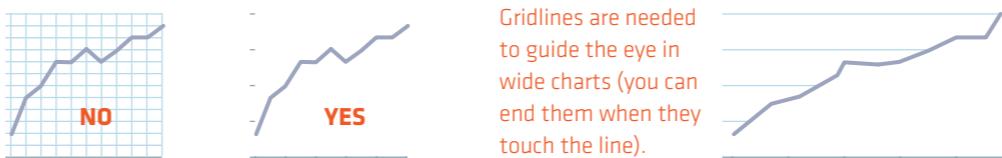
# Line charts

## PURPOSE

To display **continuous evolution over time of variables that instead of starting from zero for each period of time, are added or subtracted from the value of the previous period**. Examples: Temperature, the daily value of an stock market index, population of a country.

## DO'S

- **TRUNCATE THE BASELINE IF NEEDED** to show small differences clearly. Unlike a bar chart, a line chart doesn't always require a zero baseline. For example, if we track fever in a patient or the daily change of a stock with a range in the thousands from a zero baseline we'll get a flat, unhelpful line that obscures the relevant message.
- **AVOID BUSY GRIDLINES** by showing some of them but not all (for example, every 5 years instead of every year. Or, even better, **USE ONLY TICK MARKS** instead of the gridlines to avoid clutter).



Gridlines are needed to guide the eye in wide charts (you can end them when they touch the line).

- **PLACE LABELS DIRECTLY** next to each line, rather than using a key (which requires readers to dart back and forth many times cross-referencing between the key and the line). Use a legend only when space is tight and lines intersect extensively. The order should match the ranking of the end points since they are the most current.



Direct labeling whenever possible



Key needed. Follow the order of the end points

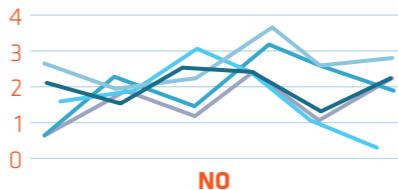
# How to use different types of charts

- **USE A DIFFERENT COLOR OR STYLE FOR PROJECTED DATA.** If a portion of the line shows future data, change the style (dotted, different color, etc.)

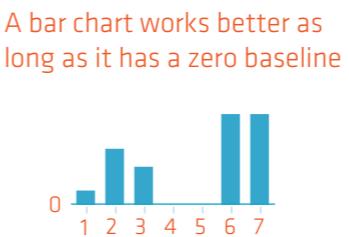
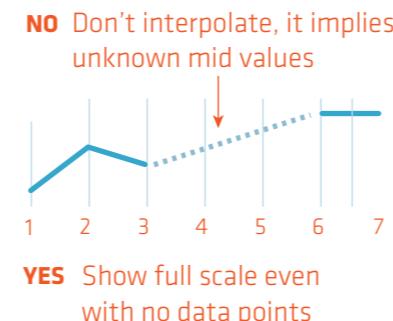
## DON'TS

- **DON'T USE MORE THAN FOUR OR FIVE LINES** unless they barely intersect with each other. It creates big confusion even using different colors.

**ALTERNATIVE:** **Small multiples.** In many cases a better solution is an array of small individual charts (known as small multiples) shown side by side. Arrange them horizontally if possible to share the same y-scale and make them comparable.



- **DON'T USE UNEVEN INTERVALS.** Space intervals in the x-axis should be proportional to the time intervals between them, regardless of whether we have data points for each time period or not. However, in most cases we should not interpolate missing data, and if we do we need to indicate it.



- **DON'T USE STACKED AREA CHARTS.** Stacked area charts show the evolution of multiple data series. They are confusing because only the portion at the bottom has a common baseline for all datapoints. On any portion above it, the moving baseline distorts the perceived movement of the values. The only exception is when the cumulative value of all variables added together is the most important take away message, rather than how the parts evolve.



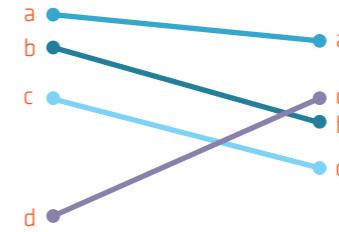
# How to use different types of charts

## ALTERNATIVE DESIGNS FOR LINE CHARTS

There is no real equivalent to line charts but there are related alternative ways of showing evolution over time.

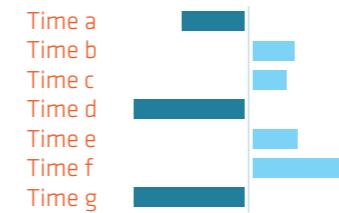
### SLOPE CHART

It compares change between two points in time with a line. It can indicate simple ranking or movement along a numerical scale. It indicates the comparative rate of change and elements bucking the trend.



### SPLIT AXIS BAR CHART

It plots the comparison between two points in time by charting the change that has occurred in that time frame (in units or percentage points).



### STEP CHART

It plots evolution of a variable that is not continuous but has constant-value segments that jump to a next level at certain points, like stamp prices or mortgage rates.

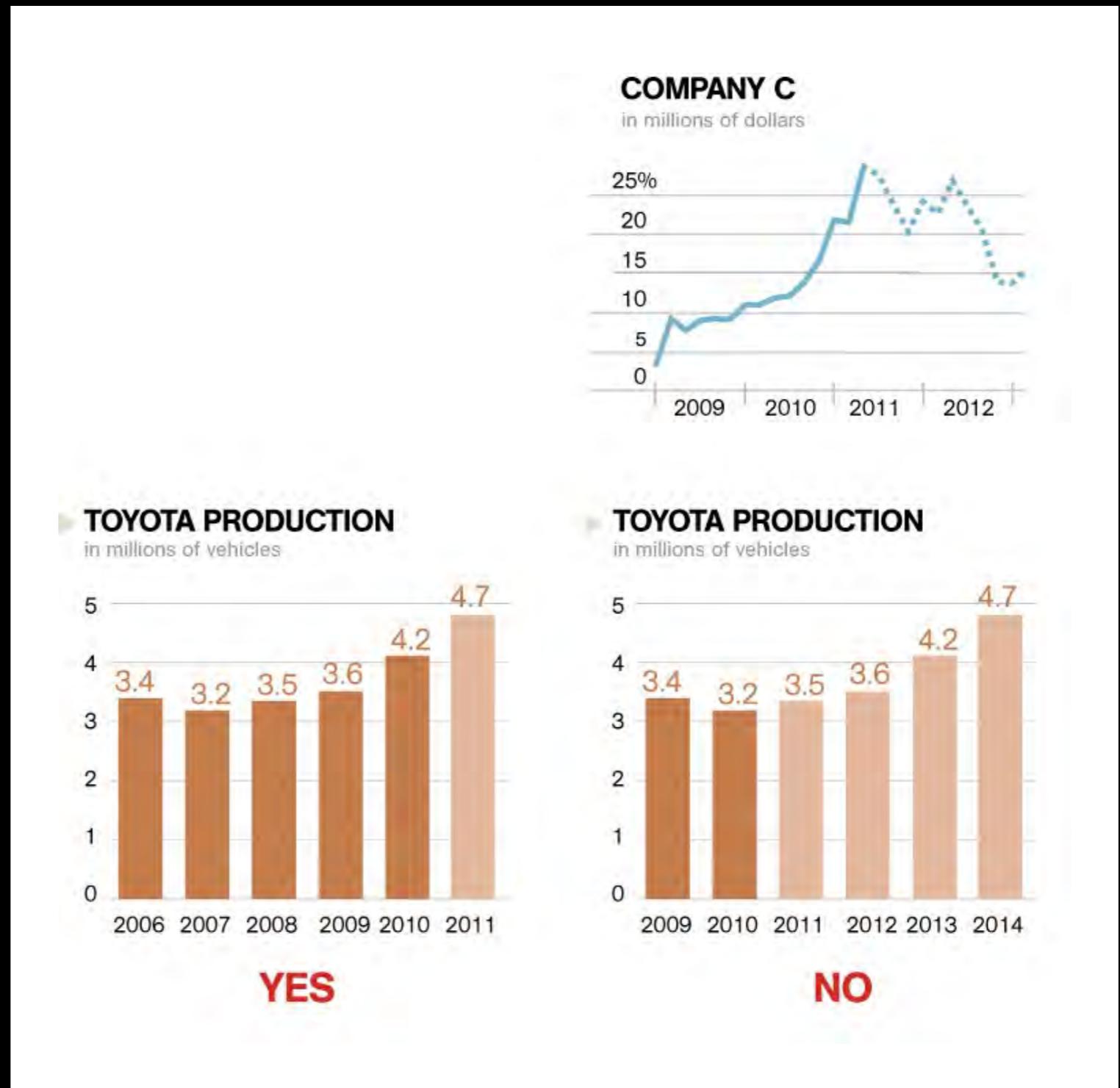


## Projections

Future data must be shown in different style to differentiate from known numbers

## Extrapolation

Don't project too far into the future because we don't know what the data will be far into the future



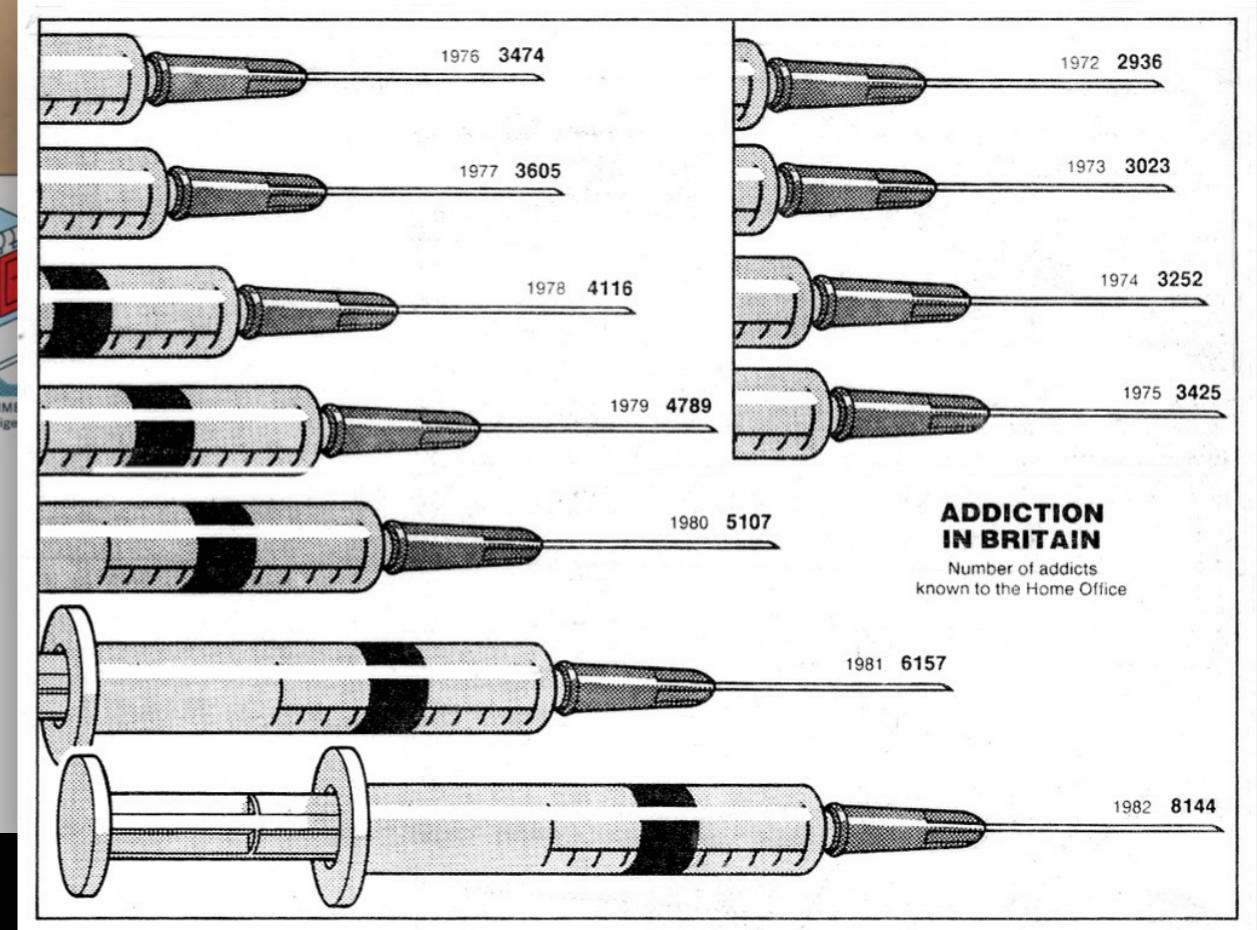
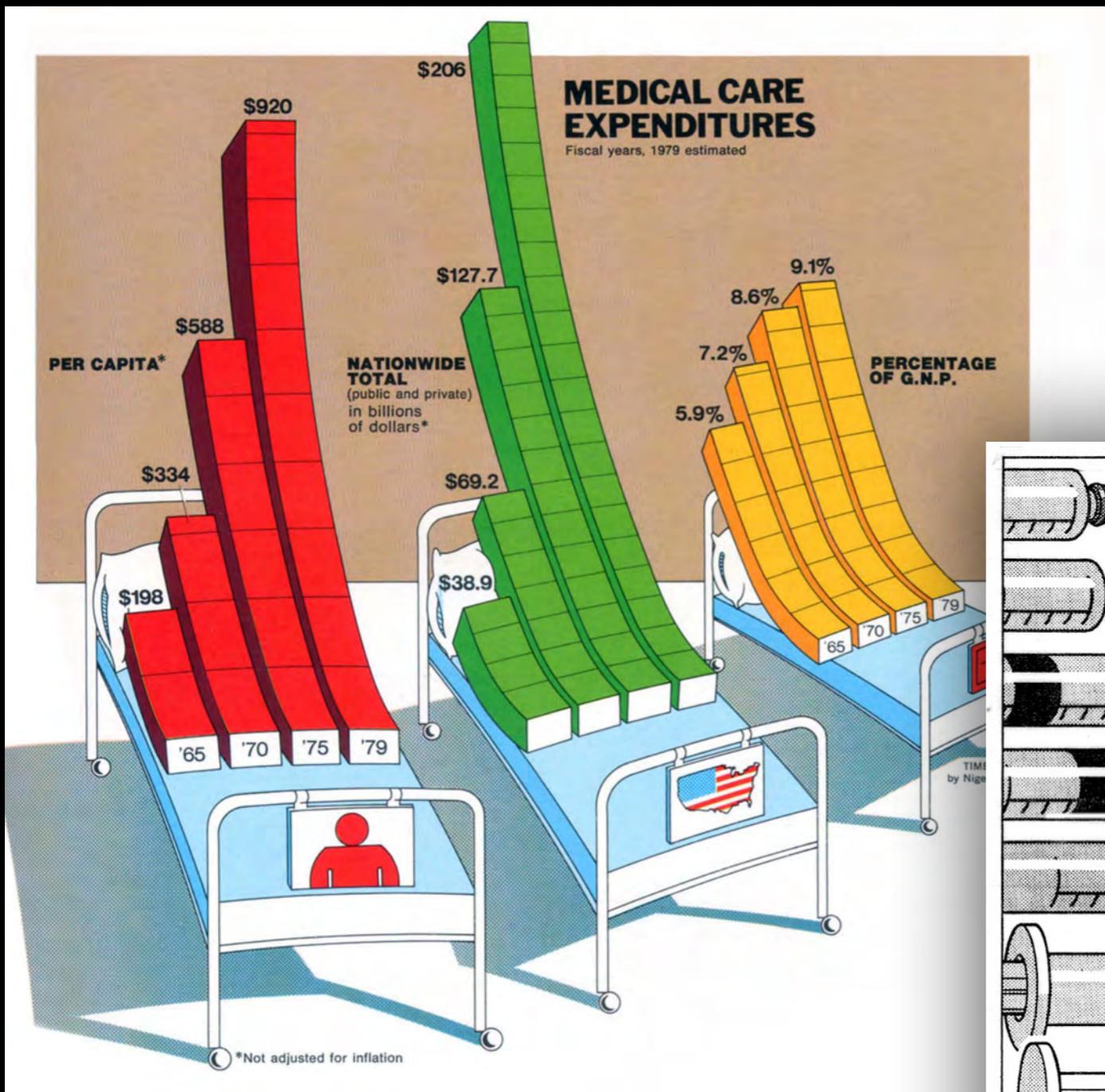
# Data distortion

Never use perspective or 3D effects in chart.  
You will distort the relative proportions

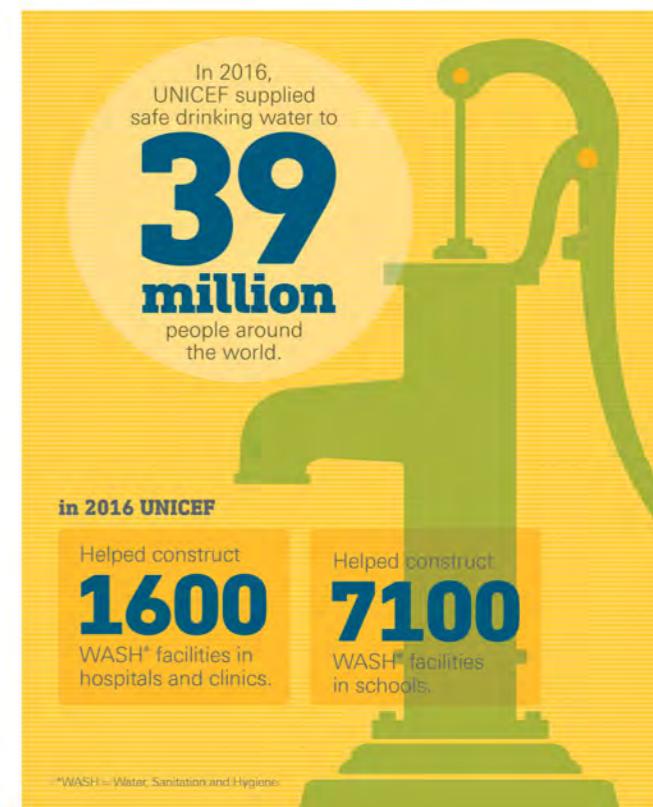
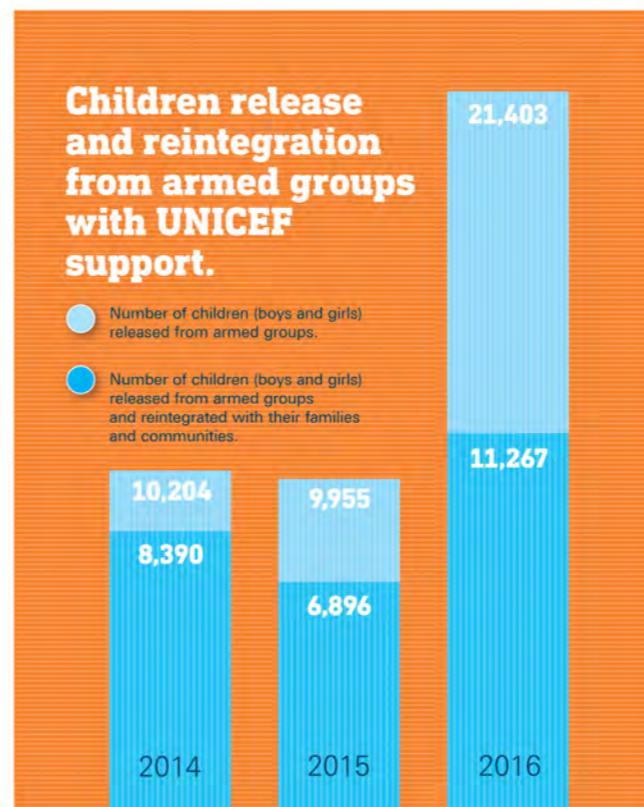
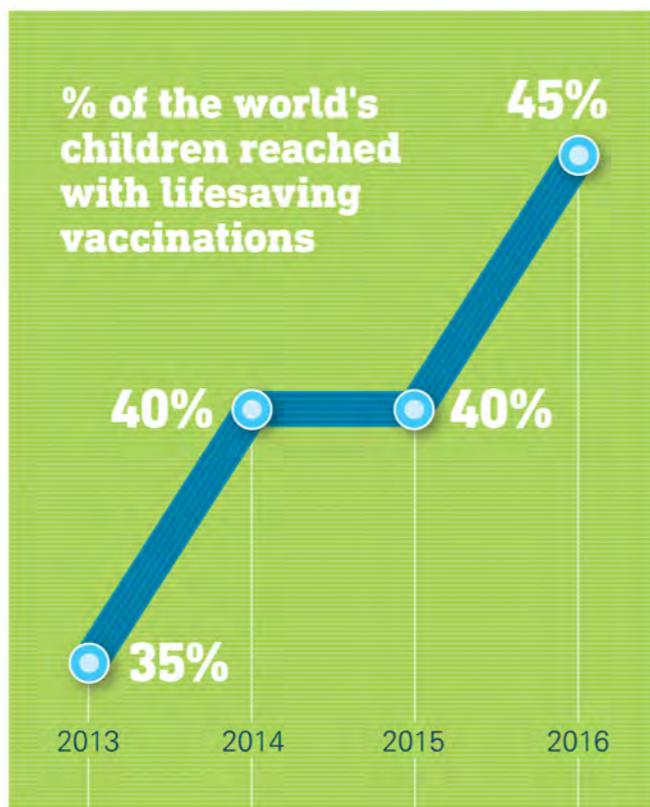
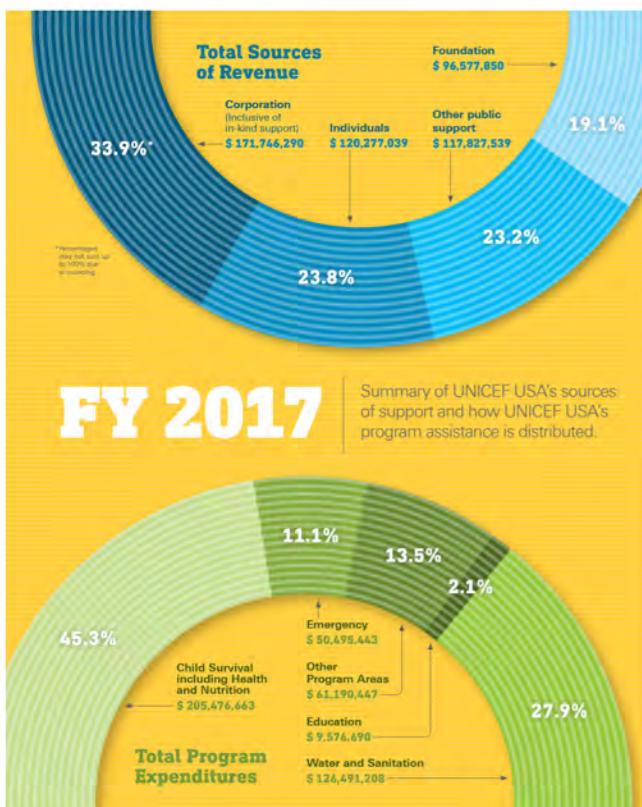
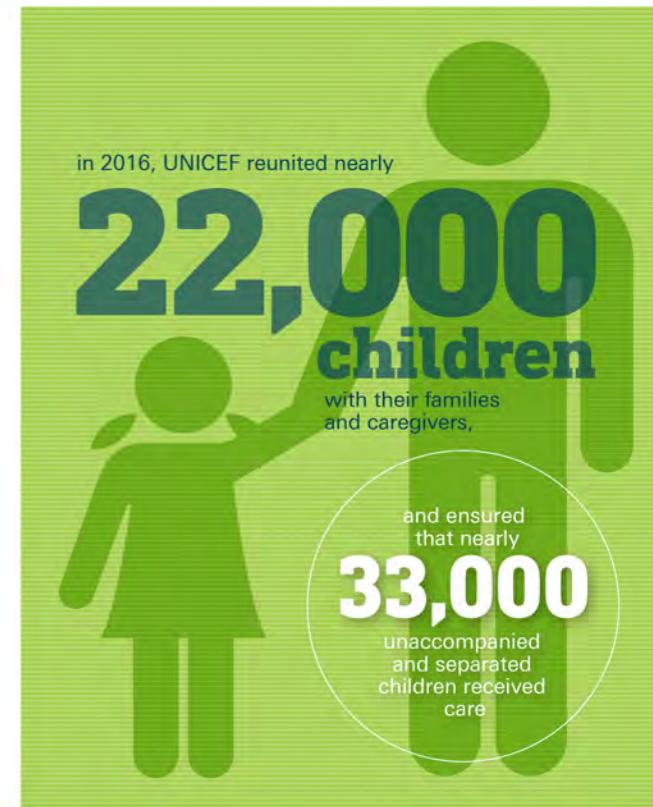
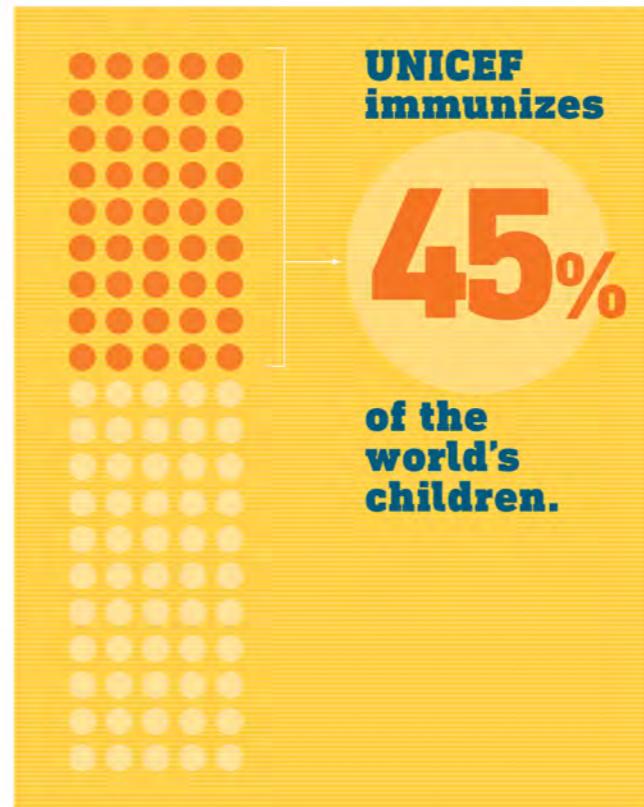
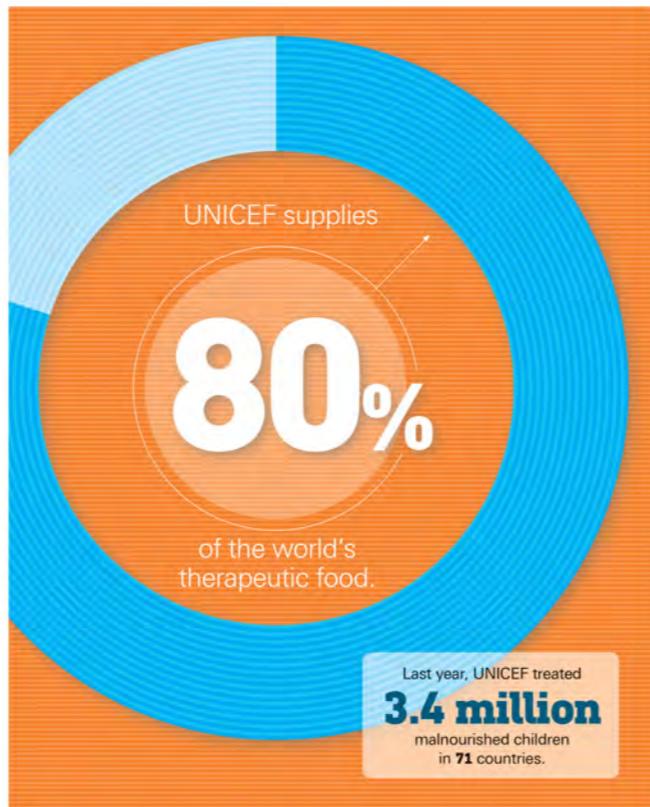
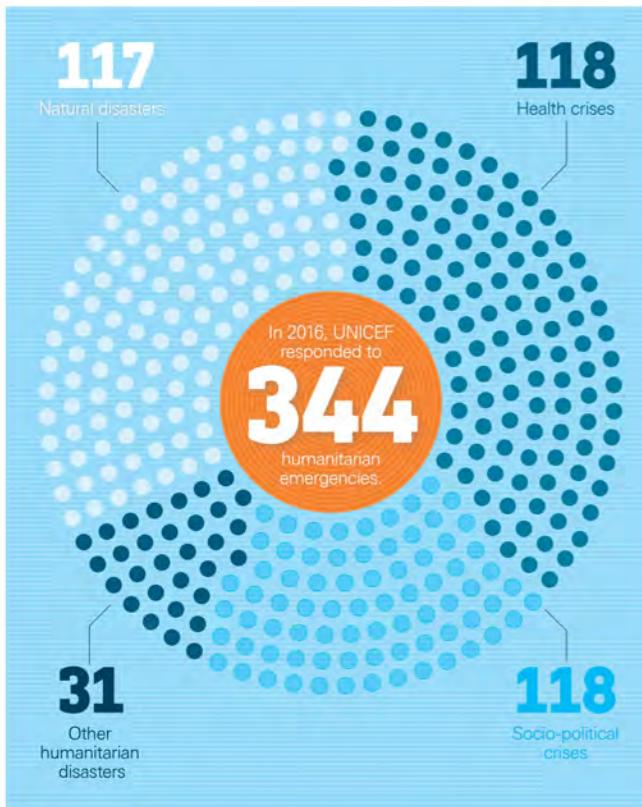


# Charts that are drawings NO

- It takes time to do good illustration. The standard of quality needs to be high. Avoid a cartoonish look. Hire professional illustrators if needed.
- Some readers think of information as less serious or reliable when accompanied by large cartoonish illustrations.
- Charts that are illustrations at the same time nearly always distort the data.

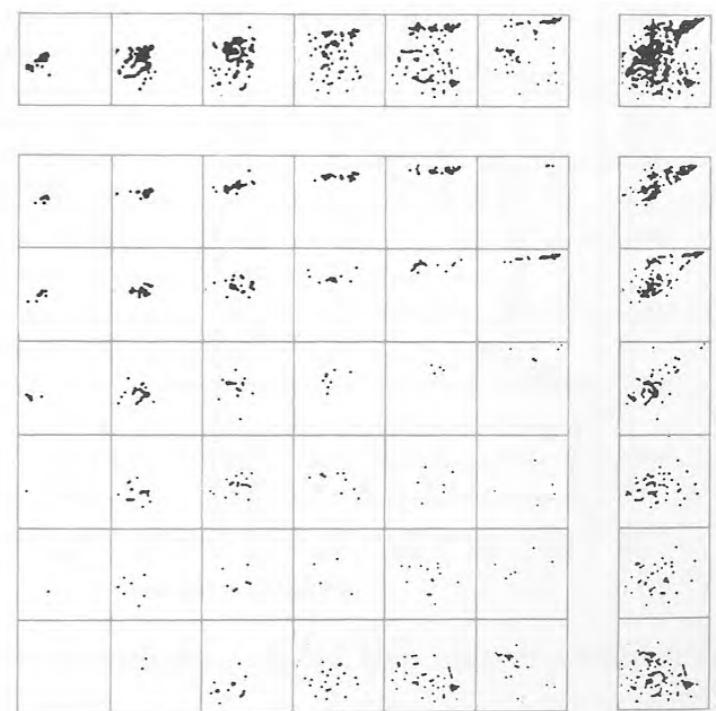
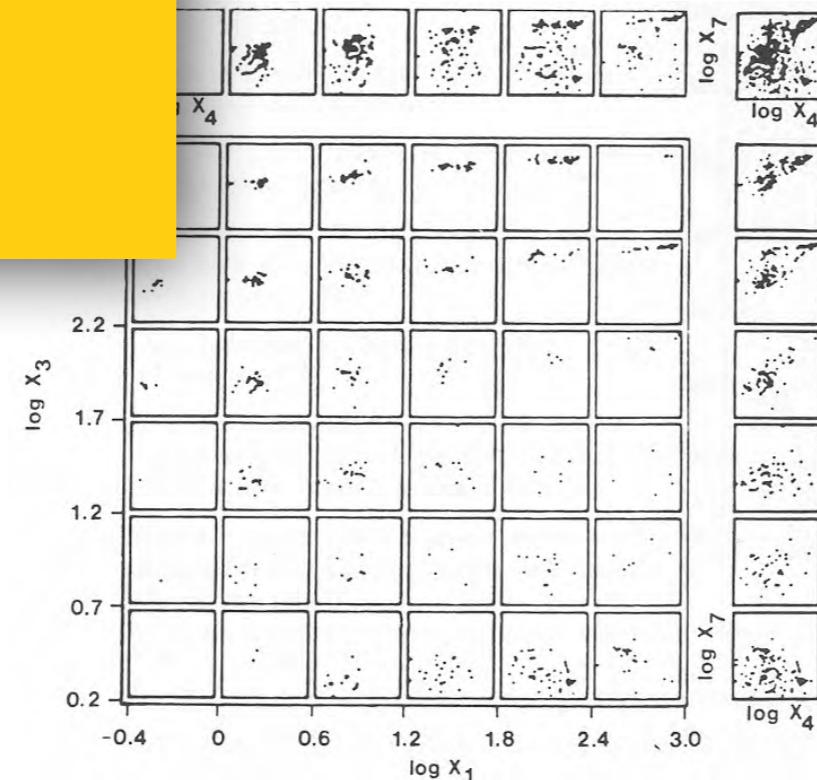


# Embellishing is ok - losing the charts integrity is not



# Data distraction

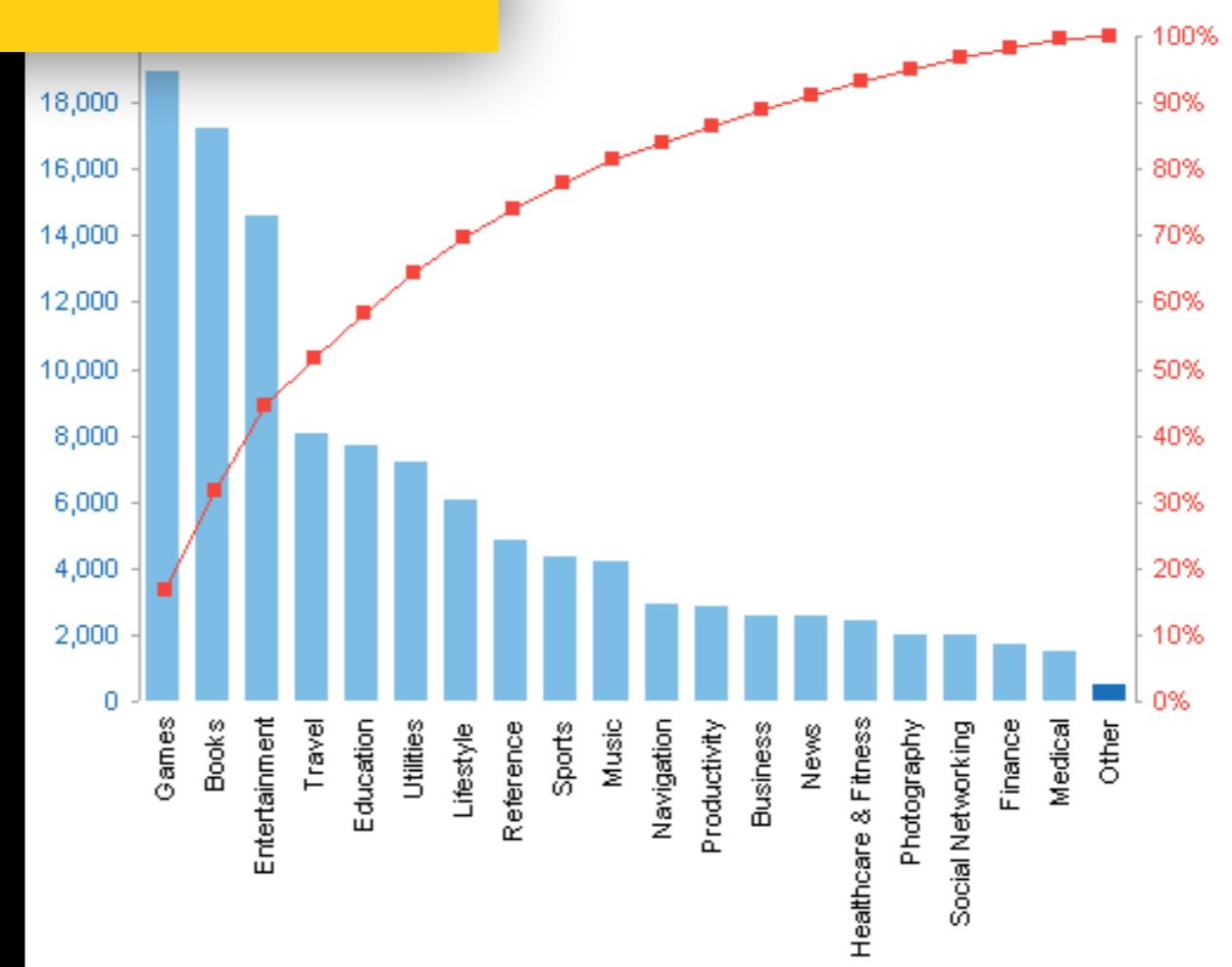
Avoid clutter like too many gridlines.  
Let the reader focus on the data.



## Scale trouble

### Don't mix unrelated information

Don't chart two uncorrelated series with one scale on the left and one on the right. Saving space is not a good reason.



Dual axis charts are only acceptable when you have a strong correlation between data sets



## Scale trouble

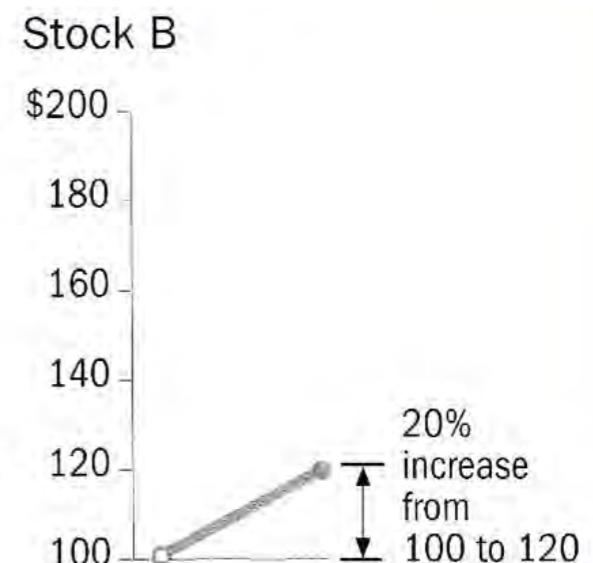
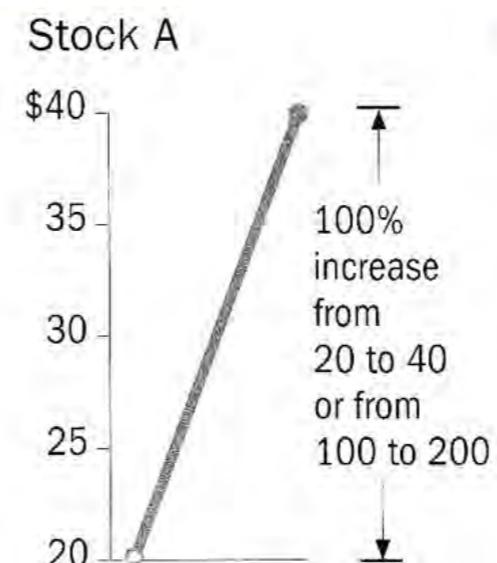
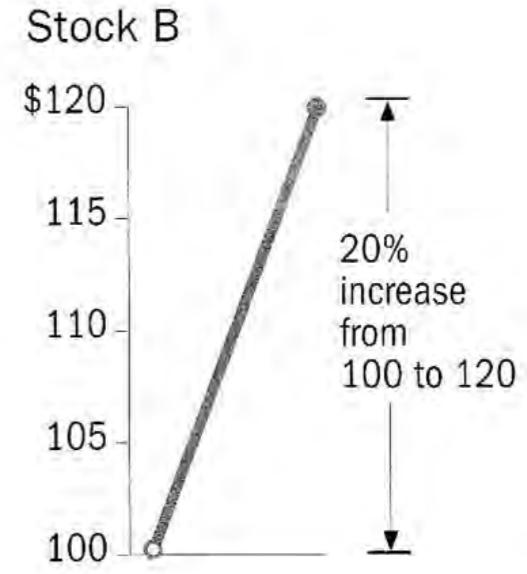
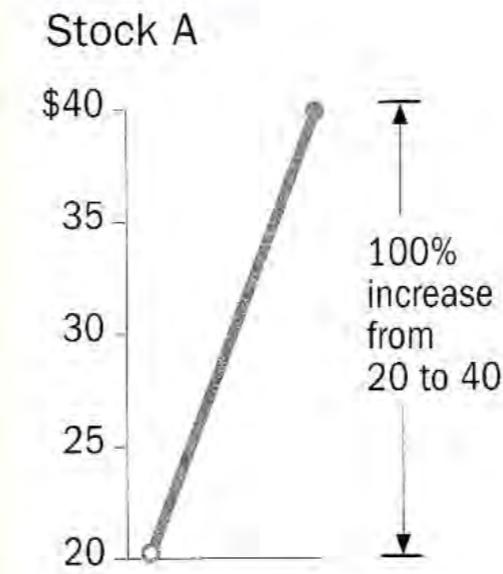
### Biased comparision

Anytime two charts are next to each other, the reader will compare.

Use comparable scales to show that stock A goes up MORE than B

### Fair comparison

The ranges of the y-axis on both charts should represent the same percentage change



# Scale trouble

Careful with log scales

Equities have the potential to increase wealth more than other asset classes.

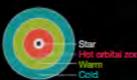


# Scale trouble

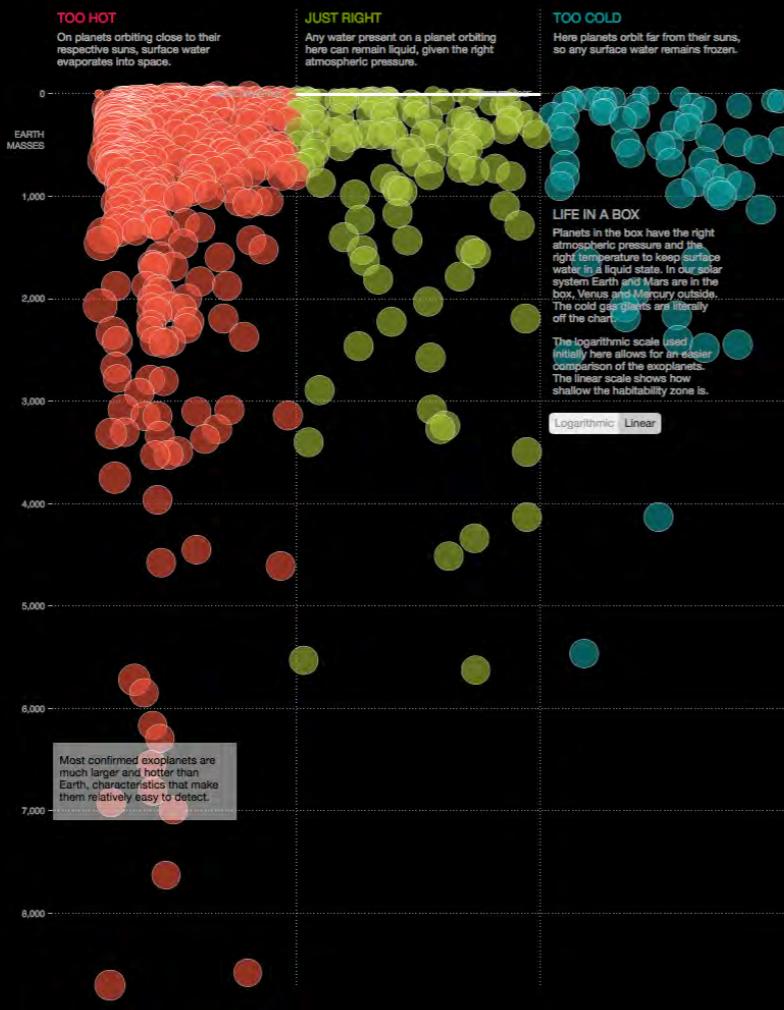
Up until now, they allowed us to avoid dealing with the scale problem. Readers don't have to pay attention to the numbers, because they have a much easier time understanding large shifts in scale within the same chart. **Explain prominently** what the scale is doing.

## GOLDILOCKS WORLDS: JUST RIGHT FOR LIFE?

Of the 1,780 confirmed planets beyond our solar system, as many as 16 are located in their star's habitable zone, where conditions are neither too hot nor too cold to support life. Size also matters: A planet that's too small can't maintain an atmosphere; one that's too large will have a crushing atmosphere. [A recently detected planet 493 light-years from Earth, Kepler-186f](#), is close to Earth's size and is located in its solar system's habitable zone.



GRAPHIC BY JOHN TOMANO AND XAQUÍN G.V., NGM STAFF.  
SOURCE: ABEL MÉNDEZ, PLANETARY HABITABILITY LABORATORY, UNIVERSITY OF PUERTO RICO AT ARECIBO  
Note: Exoplanet mass estimated from mass-radius relationship when not available.

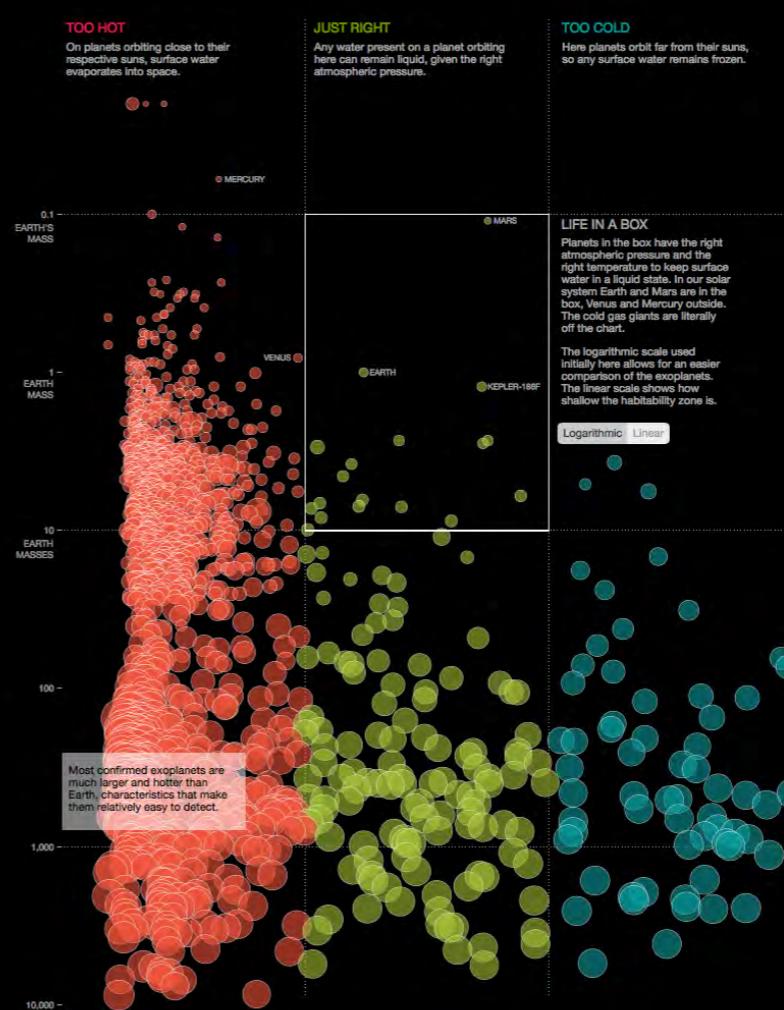


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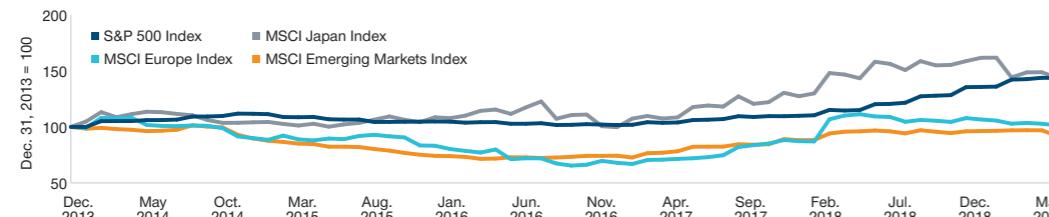
GRAPHIC BY JOHN TOMANO AND XAQUÍN G.V., NGM STAFF.  
SOURCE: ABEL MÉNDEZ, PLANETARY HABITABILITY LABORATORY, UNIVERSITY OF PUERTO RICO AT ARECIBO  
Note: Exoplanet mass estimated from mass-radius relationship when not available.



# Scale trouble

**(Fig. 1) U.S. and Global Earnings Growth Has Stalled**

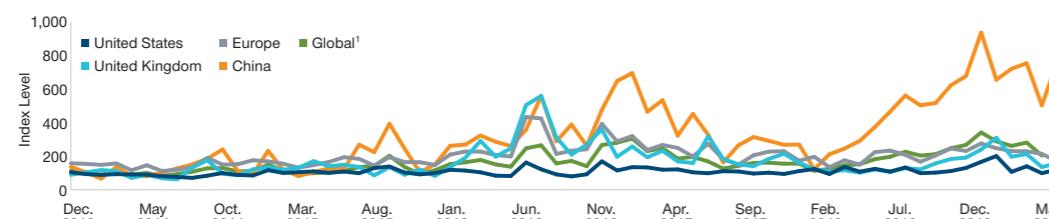
Cumulative Growth in Earnings Per Share by Region  
December 2013 Through May 2019



Sources: Standard & Poor's (see Additional Disclosures) and MSCI (see Additional Disclosures). T. Rowe Price calculations using data from FactSet Research Systems Inc. All rights reserved.

**(Fig. 2) Escalating Trade Disputes Are Fueling Uncertainty**

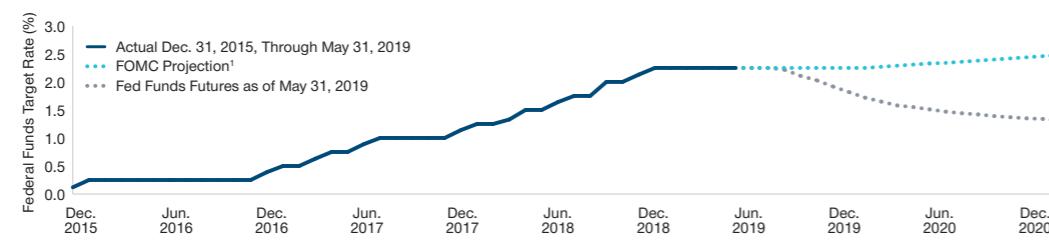
Economic Policy Uncertainty Indices  
December 2013 through May 2019



Source: Economic Policy Uncertainty, policyuncertainty.com. ©2012 by Economic Policy Uncertainty.  
<sup>1</sup> Global Index through April 30, 2019.

**(Fig. 3) Investors Expect the Fed to Cut Rates**

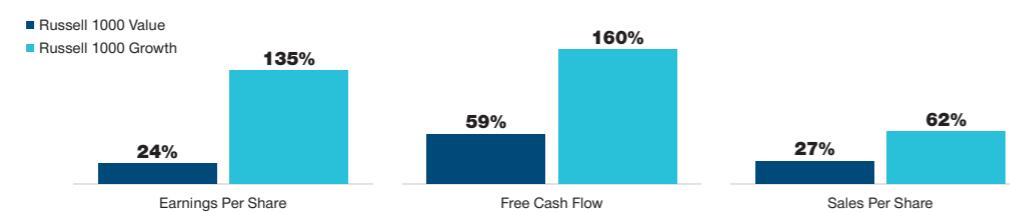
Futures Markets Versus FOMC Projections of the Federal Funds Rate  
As of May 31, 2019



Sources: Federal Reserve Board/Haver Analytics. T. Rowe Price analysis using data from FactSet Research Systems Inc. All rights reserved.  
<sup>1</sup> Median of participants' forecasts in the March 20, 2019, Federal Open Market Committee Summary of Economic Projections.

**(Fig. 4) Disruption Tilts the Fundamentals Toward Growth**

Cumulative Changes, June 30, 2007, through May 31, 2019

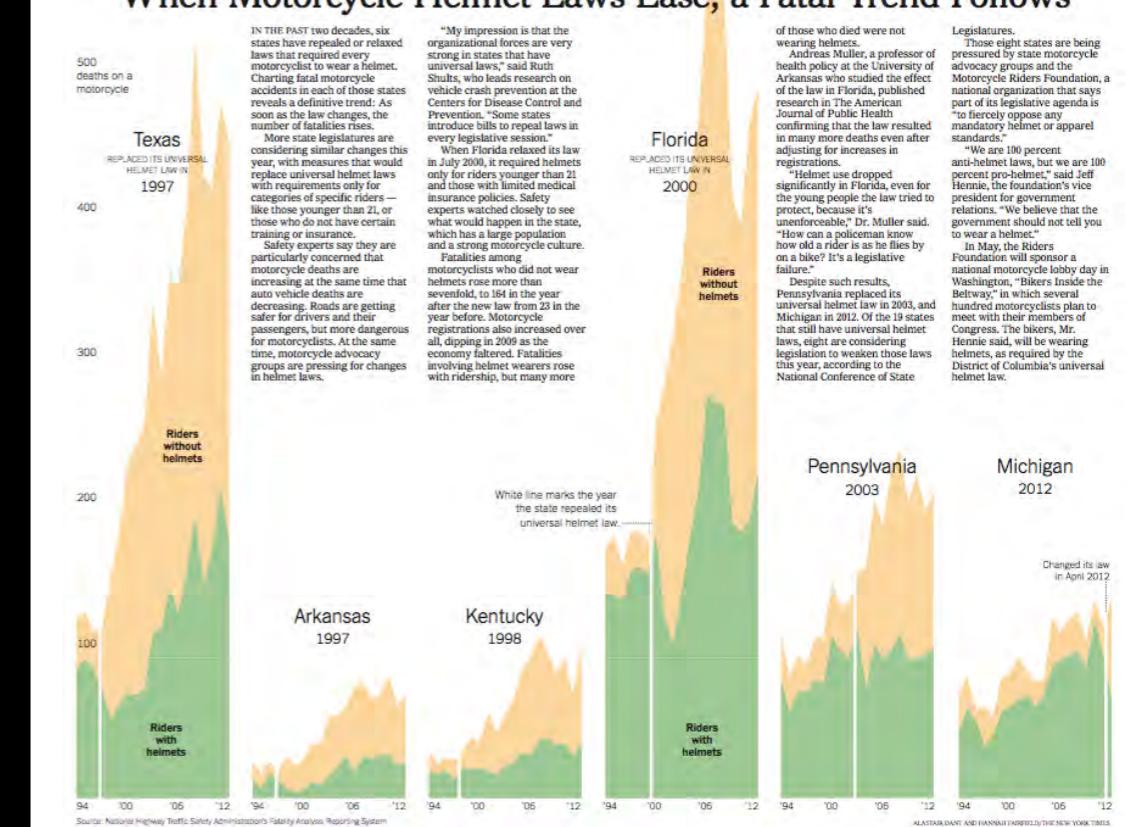


Source: Russell (see Additional Disclosures). T. Rowe Price analysis using data from FactSet Research Systems Inc. All rights reserved.

- Horizontal is not the ideal design for most charts, which plot differences across the **vertical axis**

- Emphasize differences with a more **vertical layout**

## When Motorcycle Helmet Laws Ease, a Fatal Trend Follows



**Legislatures:**

- Those eight states are being pressured by state motorcycle advocacy groups and the Motorcycle Riders Foundation, a national organization that says part of its legislative agenda is "to fiercely oppose any mandatory helmet or apparel standards."
- "We are 100 percent anti-helmet laws, but we are 100 percent pro-helmet," said Jeff Hennie, the foundation's vice president for government relations. "How can a policeman know how old a rider is as he flies by on a bike? It's a legislative failure."
- Despite such results, Pennsylvania replaced its universal helmet law in 2003, and Michigan in 2012. Of the 19 states that still have universal helmet laws, eight are considering legislation to weaken those laws this year, according to the National Conference of State Legislators.

**Legislatures:**

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Those eight states are being

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Motorcycle Riders Foundation,

a national organization that

says part of its legislative

agenda is "to fiercely op-

pose any mandatory hel-

met or apparel stan-

dards."

# The scaffold of your graphic

## Layout and typography II

### TIPS

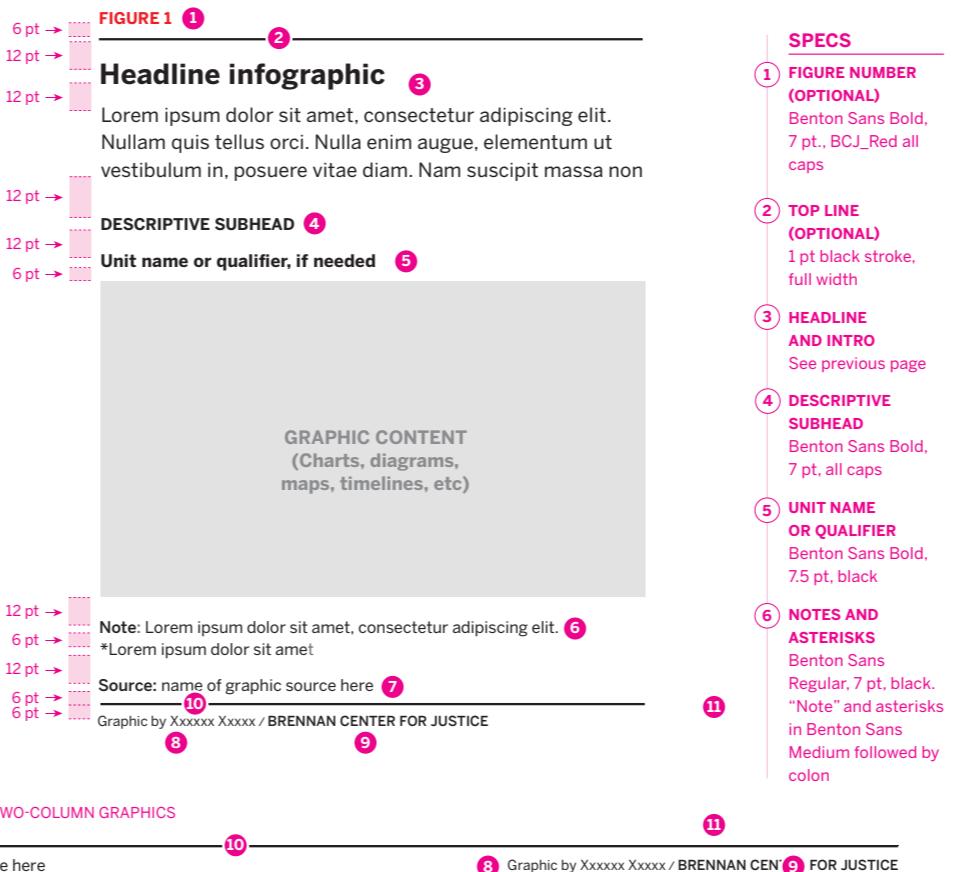
#### DESCRIPTIVE SUBHEAD, UNITS AND QUALIFIERS

The descriptive subhead is an exact description of what a graphic shows (for example "Revenue of the top ten car manufacturers". The unit and other qualifiers appear in the line below (for example "2018, in millions of dollars")

#### BREVITY

To avoid lengthy text in the body of the graphic, qualifiers and explanations that are not critical to understand a graphic should be shown as footnotes.

BCJ's infographics are not enclosed in a background box. The top black line and a headline should be part of all graphics. The figure number, introduction paragraph, source, credit and bottom rules are all optional elements depending on the needs and placement of the graphic. If they are present, use the style below.



LINE, SOURCE AND CREDIT IN TWO-COLUMN GRAPHICS

(7) Source: name of graphic source here

10

(8) Graphic by Xxxxxx Xxxxxx / BRENNAN CEN (9) FOR JUSTICE

11

(7) **SOURCE**  
Benton Sans Regular,  
7 pt. "Source" in  
Benton Sans Medium,  
followed by colon.  
Left-aligned.

(8) **FREELANCER CREDIT**  
(if needed)  
Benton Sans  
Regular, 6 pt, BCJ\_  
Red, followed by "/"  
and BCJ credit.

(9) **BCJ CREDIT**  
Benton Sans  
Medium, 6 pt, all  
caps. Right-aligned  
in 2-col graphics.  
(10) **BOTTOM LINE (OPTIONAL)**  
1 pt black

(11) **ARRANGEMENT**  
1 col: Source above  
line, credit below,  
both on left side  
2 col: Source on left  
side, credit on right  
side. Both below  
the line.

# The scaffold of your chart

## Bar charts Time series |

### TIPS

#### SHOW SCALE OR SHOW NUMBERS, BUT NOT BOTH

Use a scale on the left side of the bar chart, or show the value above each bar instead.

#### SCALE LABELS

- Always spell out the first time period (month, year, etc.) on the x-axis. After that use abbreviations only space is too tight (for example, '10 instead of 2010).

- Don't use too many labels and tick marks. Just enough to provide a visual guide.

- Always include the time label and tick mark for the most recent data-point in the chart, even if it doesn't fall into your regular intervals.

#### BAR CHART WITH SCALE (DON'T USE NUMBERS)

Year	Value
2011	2
2013	4,000
2015	2
2017	2
2019	2
2021	2

### SPECS

#### 1 UNITS AND UNIT NAME

Benton SansReg, 7.5 pt, 100% black. 6 pt. distance to numbers.

#### 2 TICK MARKS

4 pt long, 100% black, 3 pt distance from number

#### 3 BASELINE

0.4 pt black. Use only if scale starts at zero.

#### 4 GRID LINES (IF NEEDED)

0.5 pt, 20% black.

#### 5 BARS AND GAPS

Bars: About 12 pt. wide, color BCJ\_Graph3  
Gaps: 1/3 of width

#### 6 PROJECTIONS

Bar color: BCJ\_Graph1  
"Projected" label: Benton Sans Regular all caps, 6.5 pt., 65% black

#### 7 NUMBERS

Benton Sans Medium, 8 pt

#### 8 HIGHLIGHTED BAR

Bar color: BCJ\_Red  
Highlighted number: "Benton Sans Bold, 8 pt, BCJ\_Red"

#### BAR CHART WITH NUMBERS (Y-SCALE NOT NEEDED)

Year	Value
2011	3
2013	25
2015	11
2017	24
2019	36
2021	30

Brennan Center for Justice

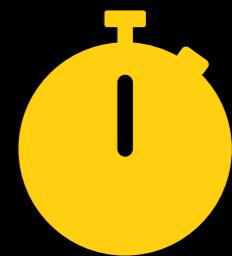
11

**Homework exercise:**  
Design a COVID-19  
data-tracking dashboard

## HOMEWORK EXERCISE

### Design a COVID-19 data-tracking dashboard

Estimated time:  
**1.5 hour**



1. Review existing dashboards online\*
2. Decide which types of **charts, maps or other elements** you want to have as part of it.
3. Decide their **relative important and hierarchy** to decide on size and location. What is your **focus**? What is **secondary**? Think about **narrative order** and **type hierarchy** to clarify and emphasize that structure.
4. Make a quick hand sketch and email it to me: **jvelasco@5wgraphics.com**

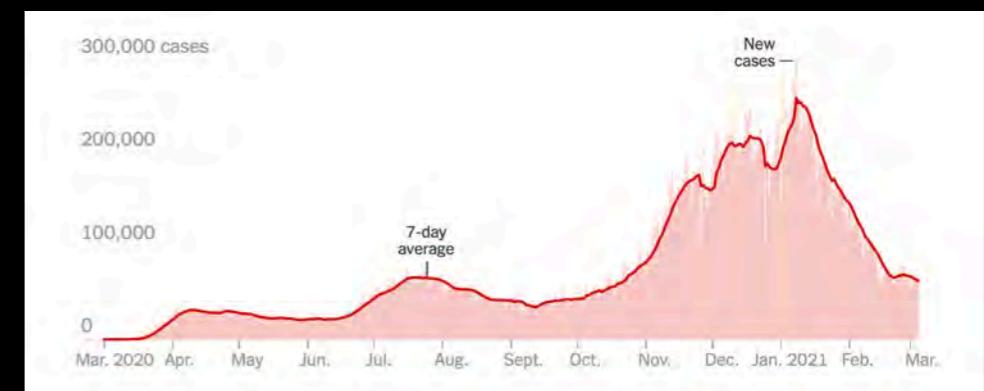
#### \*START HERE

John Hopkins: <https://coronavirus.jhu.edu/map.html>

The New York Times: <https://nyti.ms/3fBeph7>

CDC: <https://www.cdc.gov/covid-data-tracker>

Worldometers: <https://www.worldometers.info/coronavirus/>



WEB - TO UPDATE FREQUENTLY

# COVID-19 IN SINGAPORE

6<sup>th</sup> AUG 2020

DORSCON LEVEL

ORANGE

TOTAL CASES

54,254 1 critical

ACTIVE CASES

6,459 12% of total cases

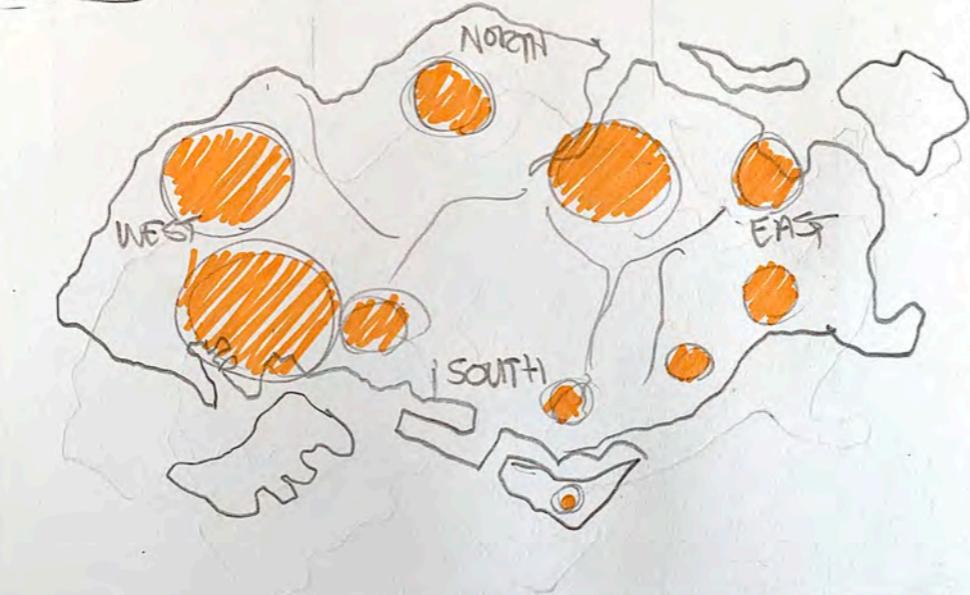
DISCHARGED

47,768 87.9% of total cases

DECEASED

27 0% of total cases

SPREAD



CLUSTERS

NORTH

110

20

50

30

10

SOUTH

40

90

3

5

EAST

20

70

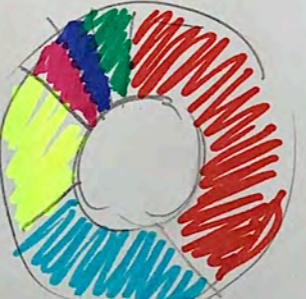
2

WEST

50

20

NATIONALITY



DAILY NEW CASES SINCE MARCH 1<sup>st</sup>

2000+  
1800  
1600  
1400  
1200  
1000  
800  
600  
400  
200  
0

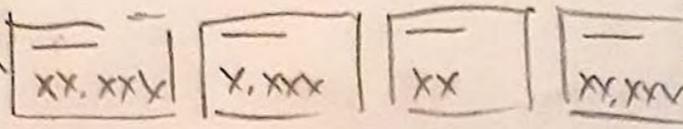
FIRST CLUSTER  
OF FOREIGN WORKER  
IN DOMESTICATES

MAR APR MAY JUN JUL AUG

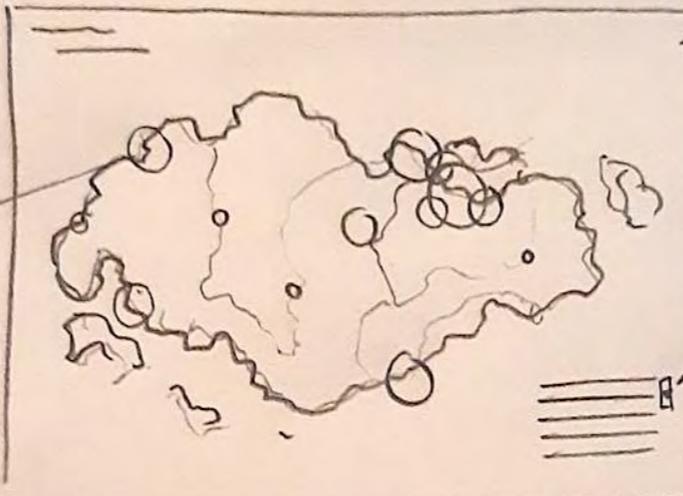
LAST BATCH  
OF FOREIGN  
WORKERS

1. Total Cases
2. Active Cases
3. Death Cases
4. Recovered

## SINGAPORE COVID-19 DASHBOARD -



Circle to show which area is most infected



Map of cases

- To know which area they get infected.

Nationality pie chart

List of Nationality

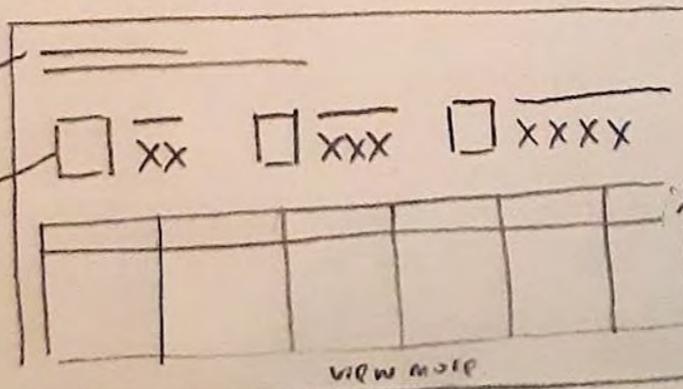


Age and Gender Bar Graph.  
Male & Female.

1-15, 16-30, 31-45,  
46-60, 61 and above

Case details

1. Average age
2. Imported case
3. Local transmission cases.



1. Case
2. Infected date
3. Age
4. Gender
5. Nationality
6. Days in Hospital

# THE GLOBAL RACE FOR A COVID-19 VACCINE



## VACCINES IN DEVELOPMENT STAGES

345



216



154



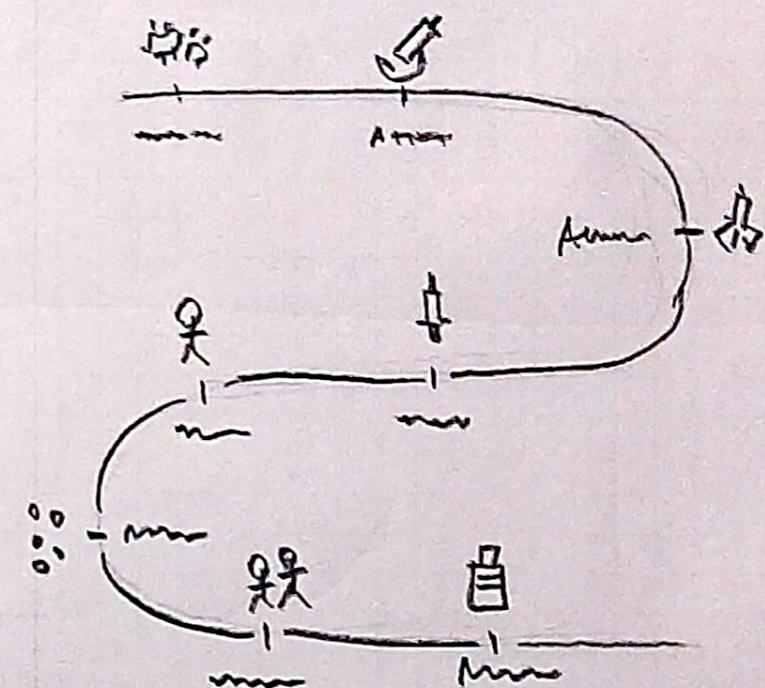
6



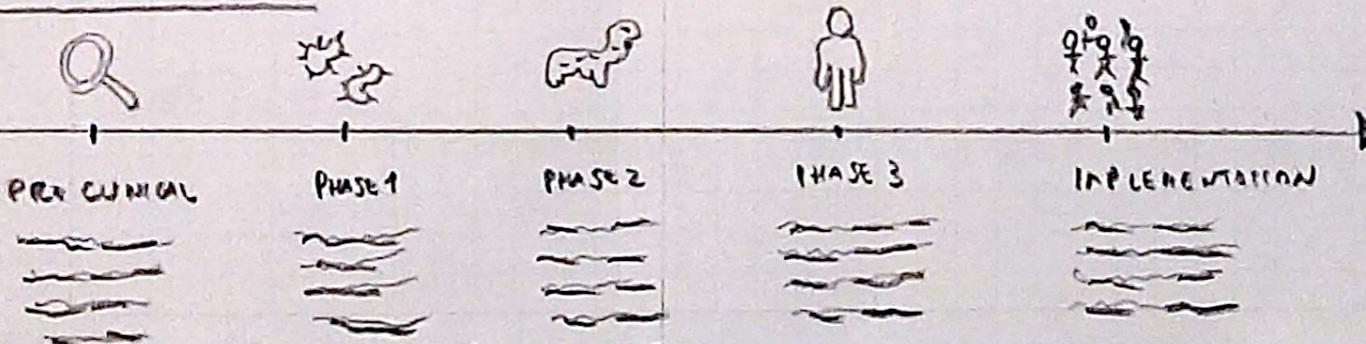
IMPLEMENTATION

- USA
- CHINA
- EUROPE
- INDIA

## HOW VACCINES WORK



## PHASES EXPLAINED



## RECORD SPEED TO HUMAN TRIALS

Number of days

COVID-19

H1N1

EBOLA

SARS

ZIKA

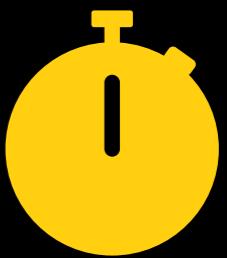
OPTIONAL

## Interactive data visualization

Watch video tutorial and use the data files sent to you to follow step by step and get a taste of:

- Tableau
- Flourish
- Datawrapper
- Excel

Estimated time:  
**3.5 hours**



The image displays three side-by-side screenshots of data visualization platforms:

- Datawrapper:** The homepage features a large teal banner with the text "Enrich your stories with charts, maps and tables." Below it are sections for "Charts", "Maps", and "Tables".
- Tableau Public:** Shows a grid of various data visualizations and a central callout: "Your data has a story. Share it with the world." It includes links for "Data Storytelling", "Spark Conversation", and "Be Inspired".
- Flourish:** Features a large globe graphic and the text "Beautiful, easy, powerful data visualization & storytelling". A prominent "Get started for free" button is visible.

*That's all Folks!*

THANKS!