Data Visualization

What and why?

David S. Goodsell. 2018

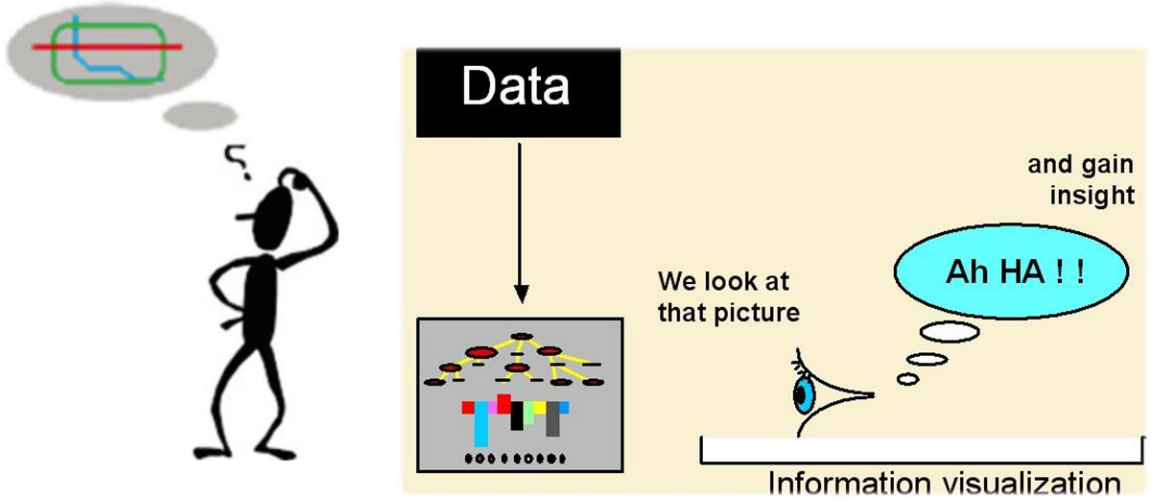
M126 | Maria Roussou

What is Visualization

- The formation of a mental image of something
- The formation of mental visual images

various dictionaries

- …a human cognitive activity
  insight…
  first impression…
  a feeling for…
  sense…
  awareness…
  …



Spence (2014)

Difference between Data and Information

- **Data**: facts or details from which information is derived. Individual pieces of data are rarely useful alone.
- **Information**: when data is processed, organized, structured or presented in a given context so as to make it useful

The difference is subtle!*

(*) This why the terms are often used interchangeably

What is Information Visualization

- ...the study of (interactive) visual representations of abstract data to reinforce human cognition

Wikipedia

- ...the use of **computer-supported interactive** visual representations of abstract data to amplify cognition

Card, Mackinlay & Shneiderman (1999)

- Computer-supported
- Interactive
- Visual representations
- Abstract data
- **Amplify cognition**

What is Information Visualization

- The underlying philosophy of information visualization:

…solving a problem simply means representing it so as to make the solution **transparent**

Simon (1996)

What is Data Visualization

- ...the graphic representation of data...
- producing images that communicate relationships among the represented data to viewers of the images...
- a systematic mapping between graphic marks and data values in the creation of the visualization.

Wikipedia

What is Data Visualization

A data visualization presents data visually in a systematic way:

- Mapping variables to visual encodings
- Geometric elements to represent data
- Reference elements

- …to augment human capabilities

What is Data Visualization

- Data visualization refers to graphics that take a large data set and compresses it into an understandable image by virtue of a computer. [ref]

- Computer-based visualization systems provide visual representations of datasets designed to help people carry out tasks more effectively.

- Visualization is suitable when there is a need to **augment human capabilities** rather than replace people with computational decision-making methods.

The principle task of information visualization is to allow for information to be derived from data

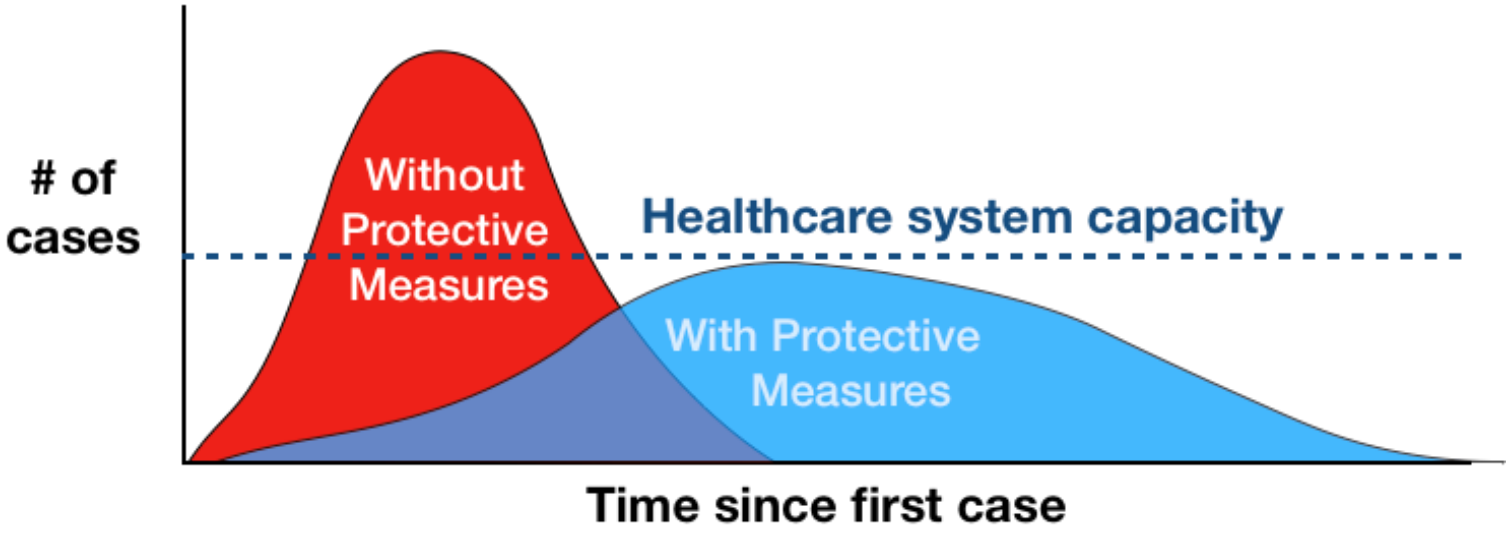
Data visualization is both an **art** and a **science**

- Psychology studies data perception, or the impact of some elements on perception, such as colors and shapes.
- Computer science and Statistics developed several new areas like machine learning and data mining techniques.
- Graphical and multimedia designs are critical to building infographic dashboards.

Aparicio & Costa (2015)

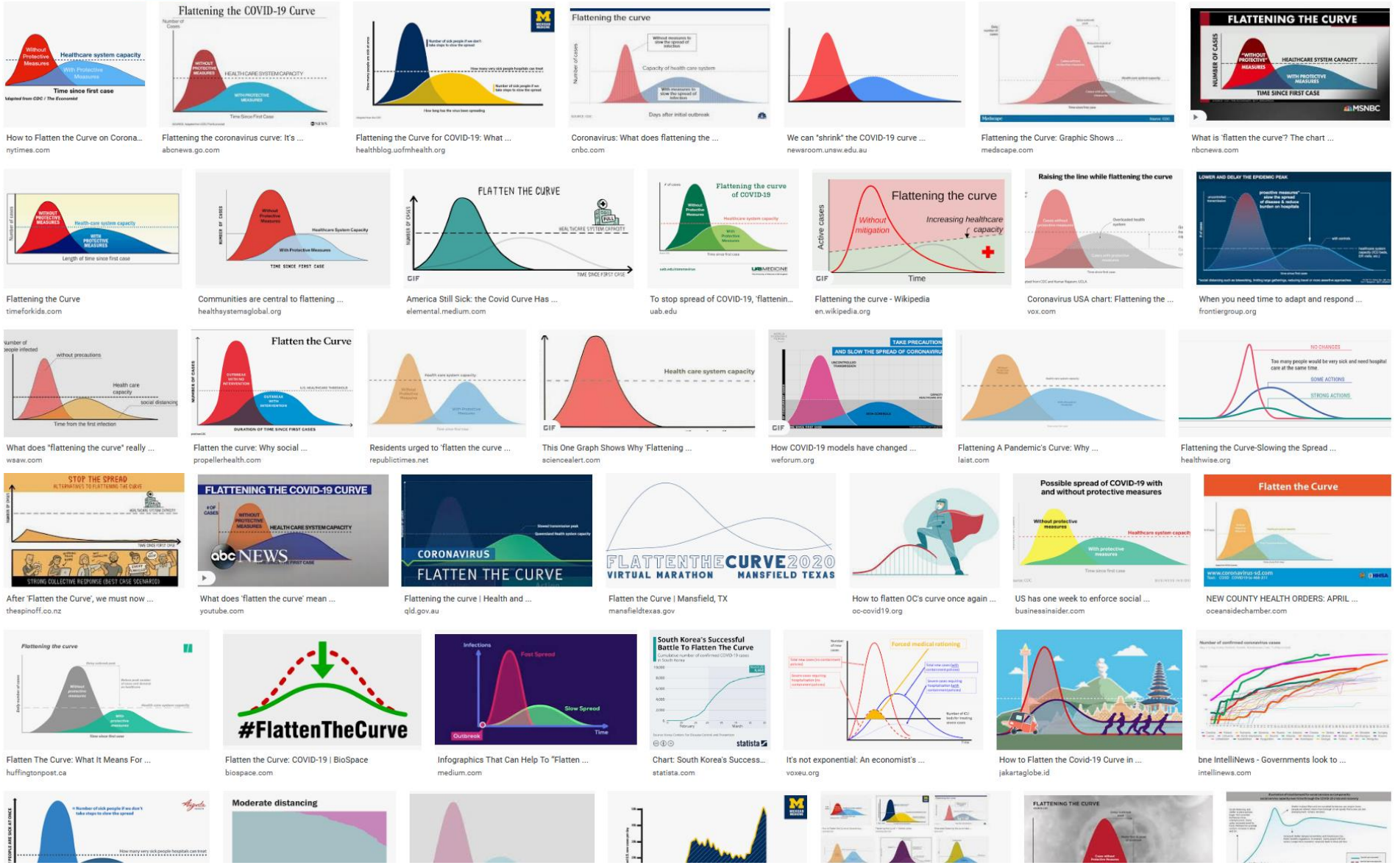
A timely (COVID-19 pandemic) example

- Flattening the curve



Adapted from CDC / The Economist Drew Harris, Thomas Jefferson University

…visualized in many creative ways



How to Flatten the Curve on Corona... nytimes.com

Flattening the coronavirus curve: It's ... abcnews.go.com

Flattening the Curve for COVID-19: What ... healthblog.uofmhealth.org

Coronavirus: What does flattening the ... cnbc.com

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Flattening the Curve: Graphic Shows ... medscape.com

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Communities are central to flattening ... healthaystemsglobal.org

America Still Sick: the Covid Curve Has ... elemental.medium.com

To stop spread of COVID-19, 'flattenin... uab.edu

Flattening the curve - Wikipedia en.wikipedia.org

Coronavirus USA chart: Flattening the ... vox.com

When you need time to adapt and respond ... frontiergroup.org

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Flatten the curve: Why social ... propellerhealth.com

Residents urged to 'flatten the curve ... republictimes.net

This One Graph Shows Why 'Flattening ... sciencealert.com

How COVID-19 models have changed ... weforum.org

Flattening A Pandemic's Curve: Why ... laist.com

Flattening the Curve-Slowing the Spread ... healthwise.org

After 'Flatten the Curve', we must now ... thespinoff.co.nz

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Flattening the curve | Health and ... qld.gov.au

Flatten the Curve | Mansfield, TX mansfieldtexas.gov

How to flatten OC's curve once again ... oc-covid19.org

US has one week to enforce social ... businessinsider.com

NEW COUNTY HEALTH ORDERS: APRIL ... oceansidechamber.com

Flatten The Curve: What It Means For ... huffingtonpost.ca

Flatten the Curve: COVID-19 | BioSpace biospace.com

Infographics That Can Help To "Flatten ... medium.com

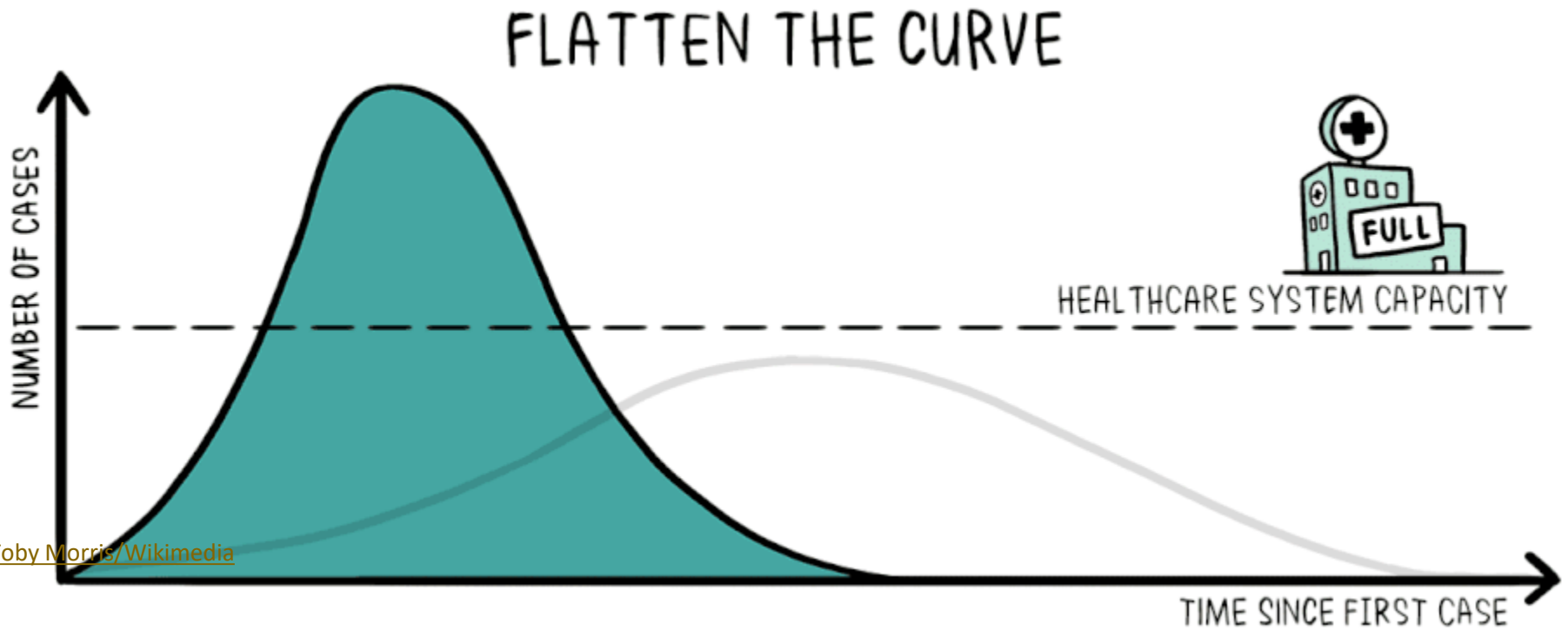
Chart: South Korea's Success... statista.com

It's not exponential: An economist's ... voxeu.org

How to Flatten the Covid-19 Curve in ... jakartaglobe.id

bne IntelliNews - Governments look to ... intellinews.com

…visualized in many creative ways

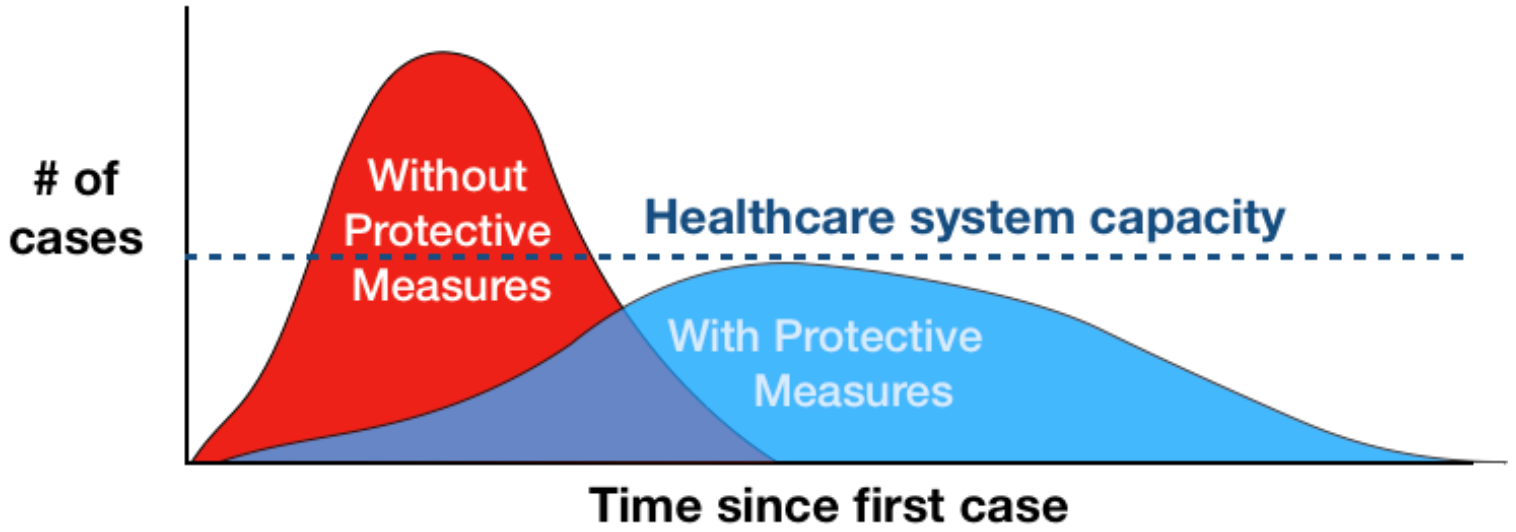


Siouxsie Wiles and Toby Morris/Wikimedia

…visualized in many creative ways

ΣΚΙΤΣΟ ΤΟΥ ΔΗΜΗΤΡΗ ΧΑΝΤΖΟΠΟΥΛΟΥ

why is this viz so effective?



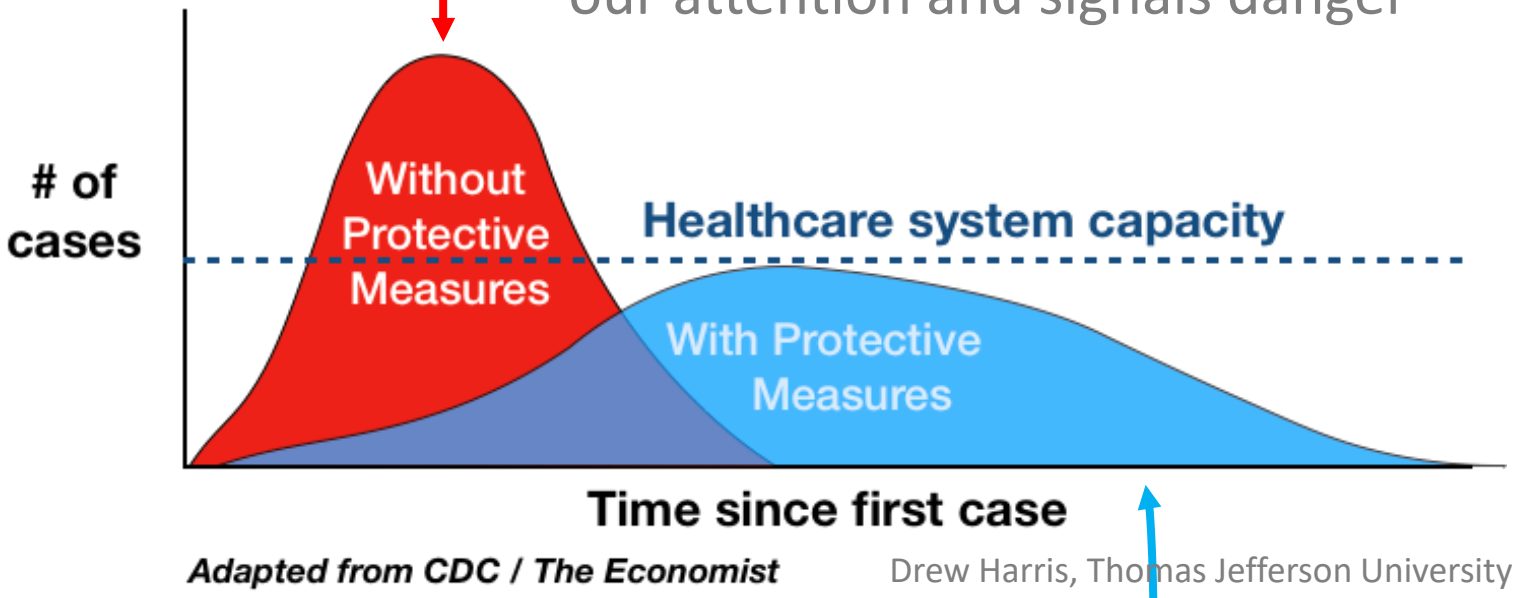
Adapted from CDC / The Economist

Drew Harris, Thomas Jefferson University

why is this viz so effective?

- We're hardwired to understand visual cues:

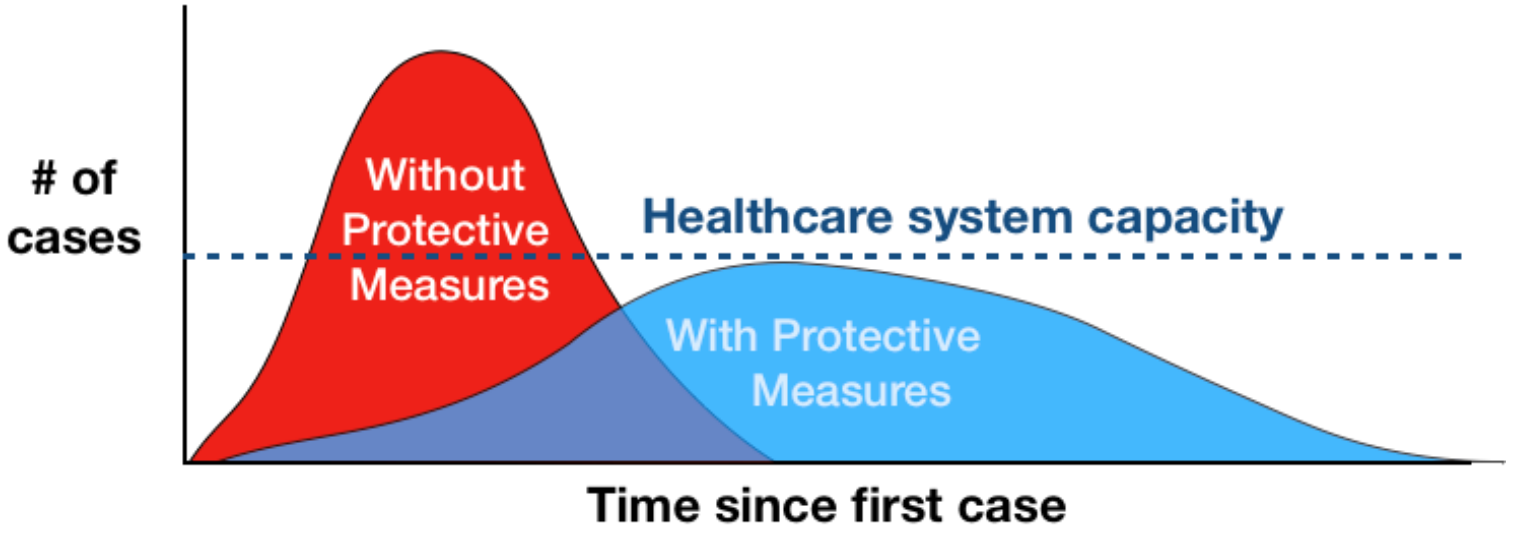
The bright red of the steep curve grabs our attention and signals danger



The gentle blue slope brings calm

why is this viz so effective?

- The message is simple:
  - The short hill is better than the tall hill!



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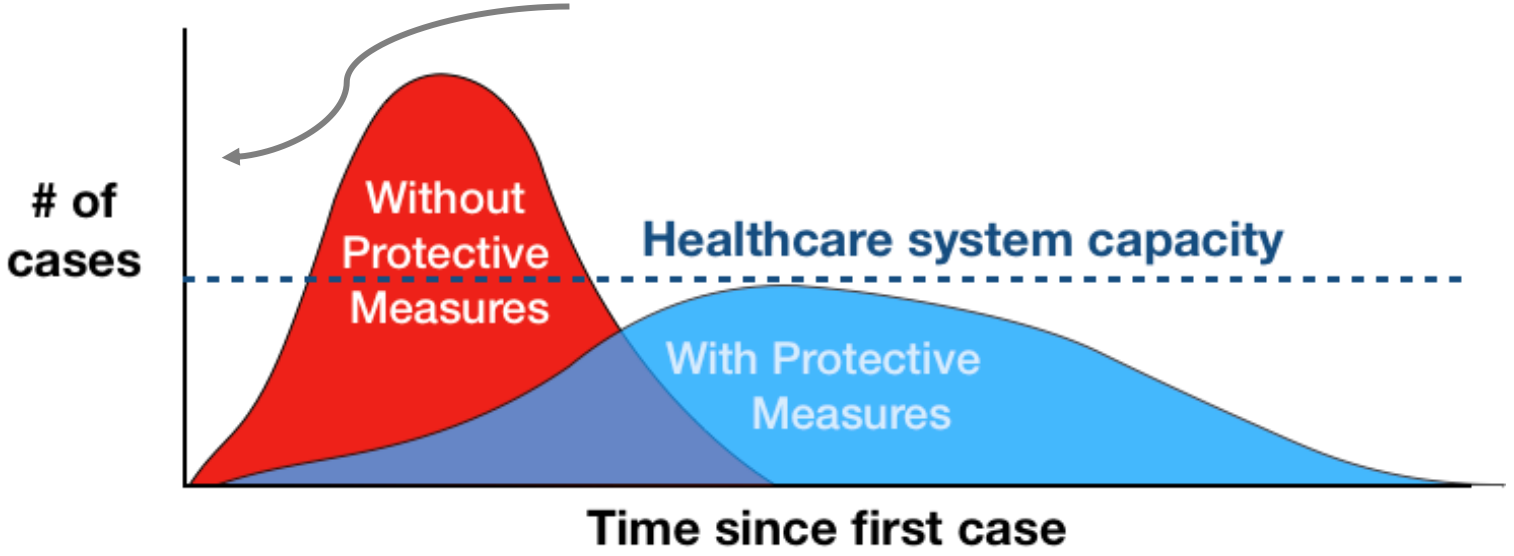
Drew Harris, Thomas Jefferson University

why is this viz so effective?

- Our interpretation is straightforward:
  - The axes lend an aura of scientific authority

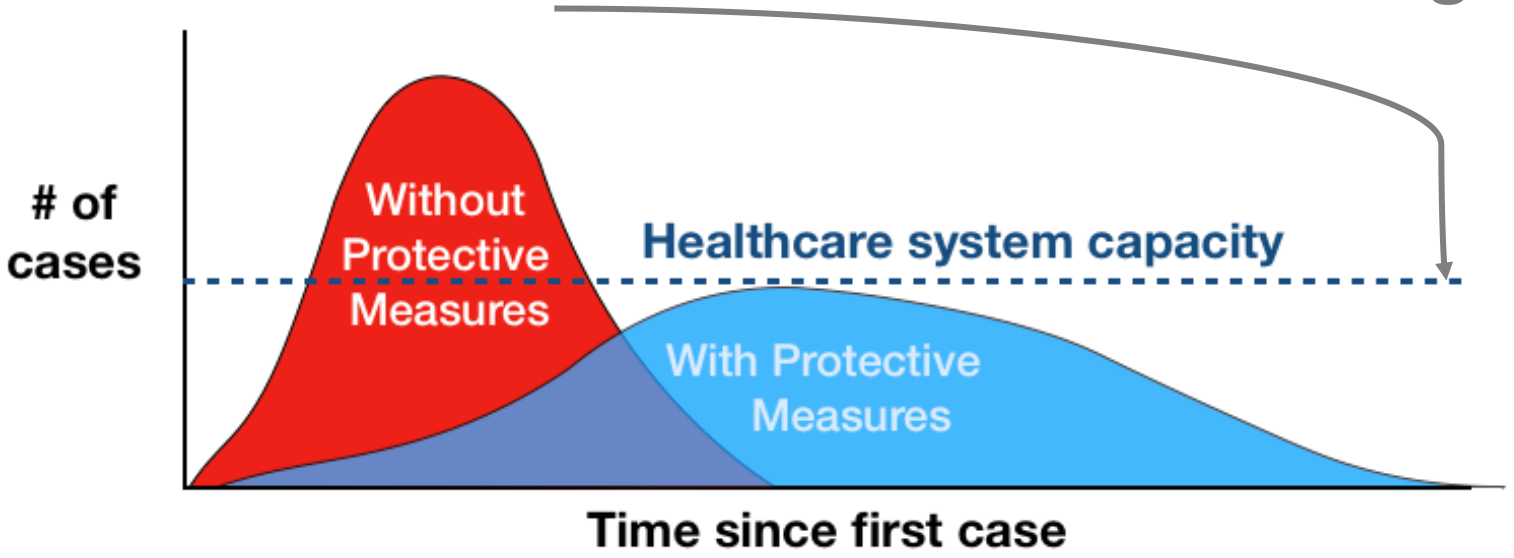


Adapted from CDC / The Economist

Drew Harris, Thomas Jefferson University

why is this viz so effective?

- Our interpretation is straightforward:
  - The line is a threshold: “don’t go beyond it”



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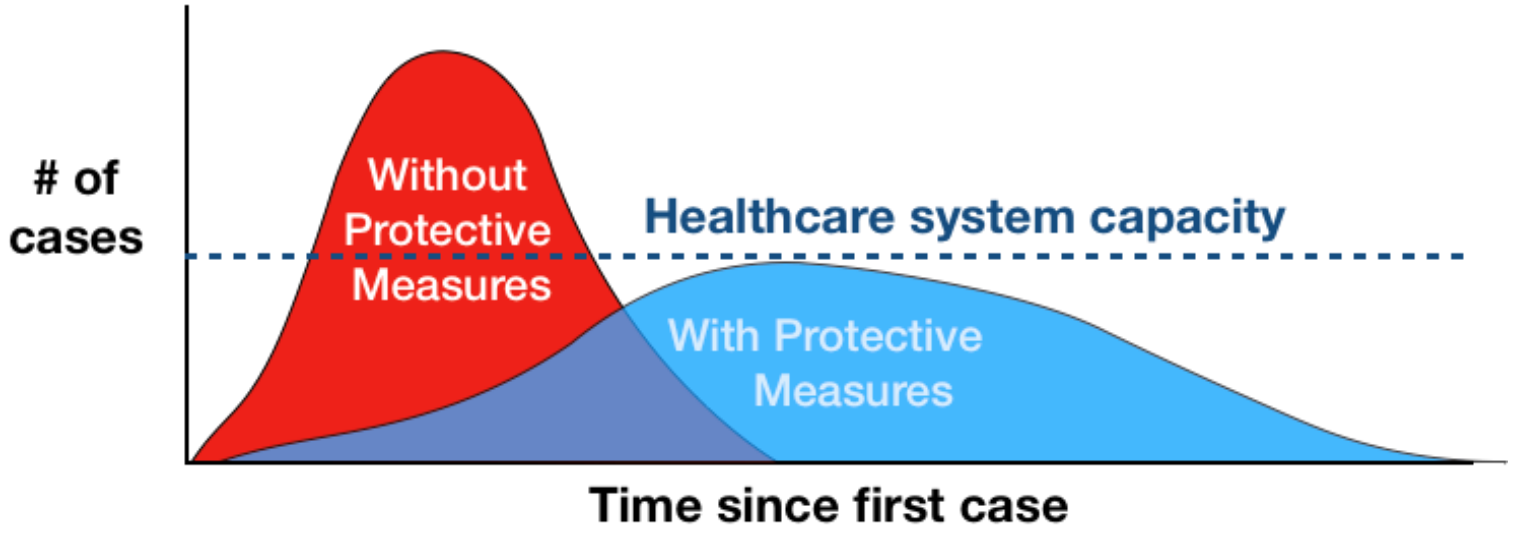
why is this viz so effective?

- The genius lies in the chart's implicit promise that our fate is in our own hands



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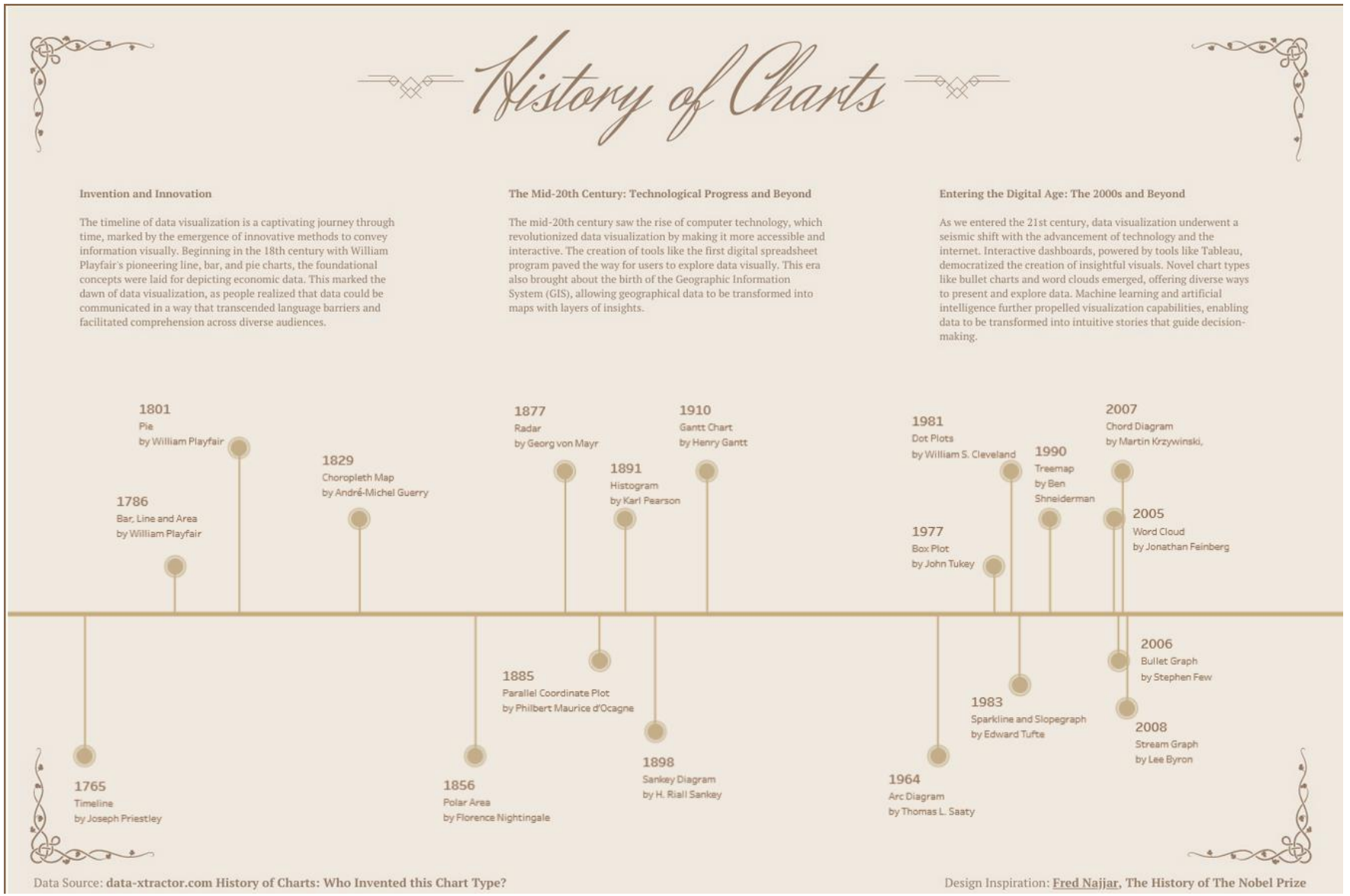
The power of viz is communication

Charts are not illustrations.

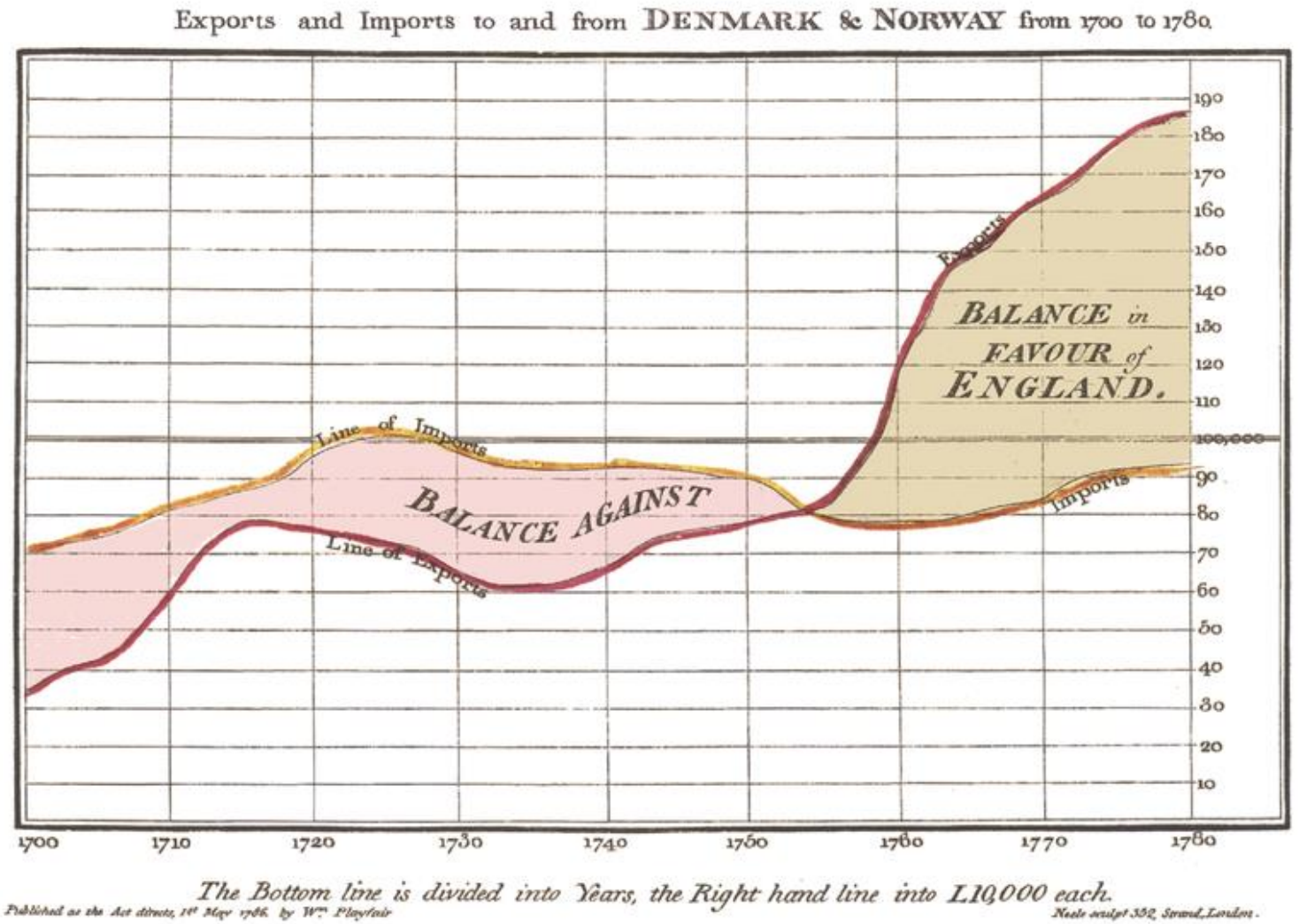
Charts are arguments.

Alberto Cairo

What is Data Visualization – history

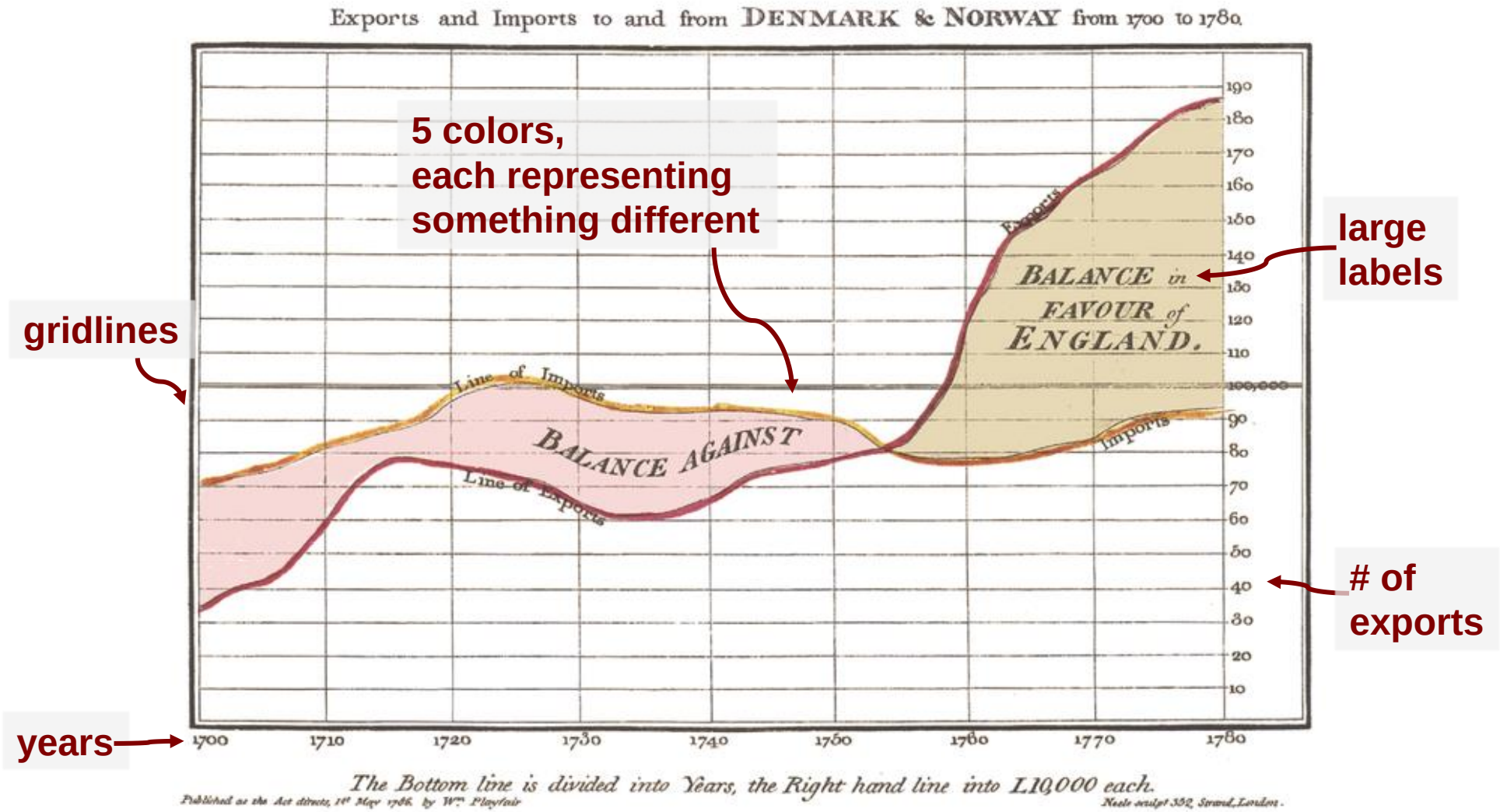


What is Data Visualization – data driven



the inventor of the pie chart, the bar graph, and the line graph ← William Playfair, 1786

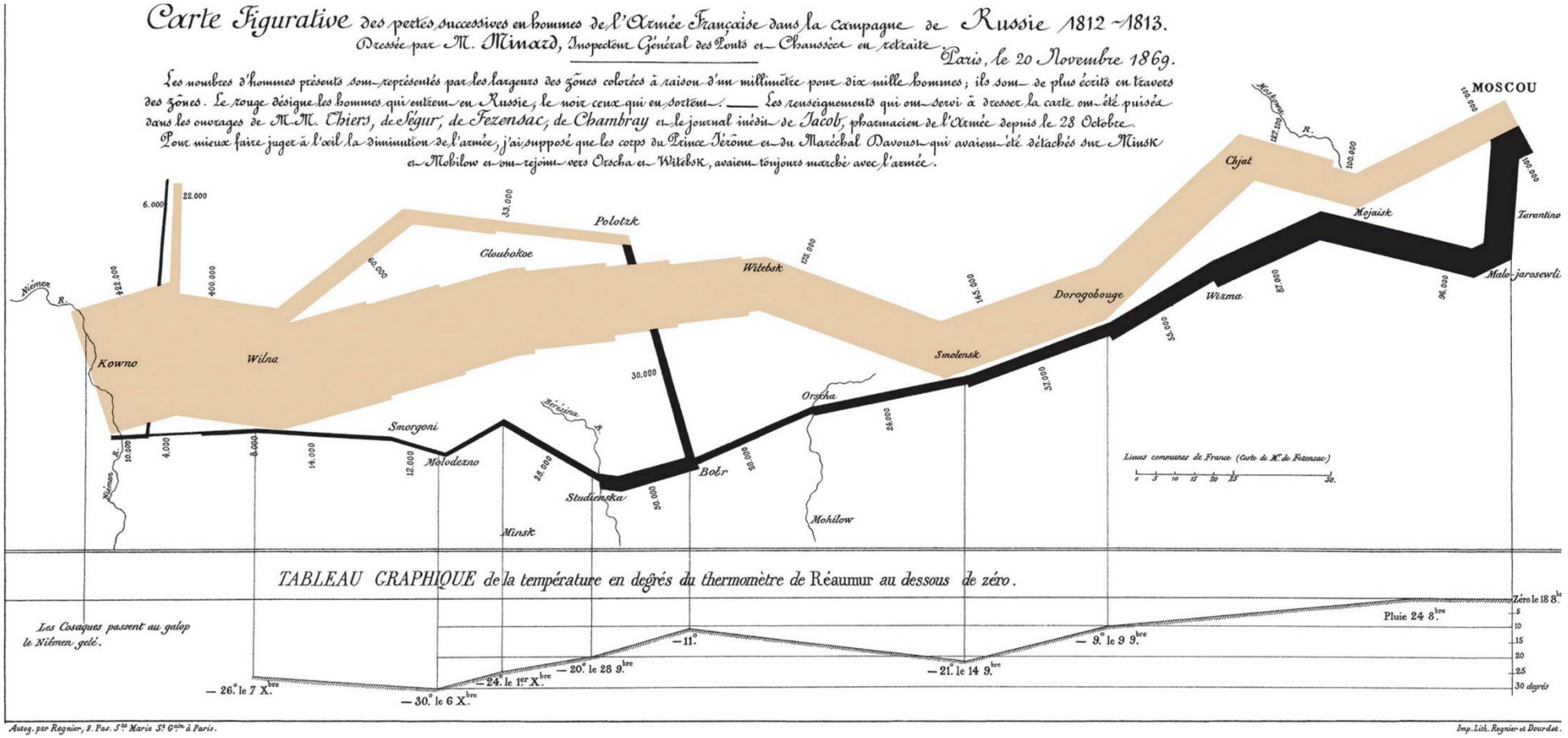
What is Data Visualization – data driven



the inventor of the pie chart, the bar graph, and the line graph ← William Playfair, 1786

What is Data Visualization - storytelling

- Besides the visual representation, data vis “tells” a story…

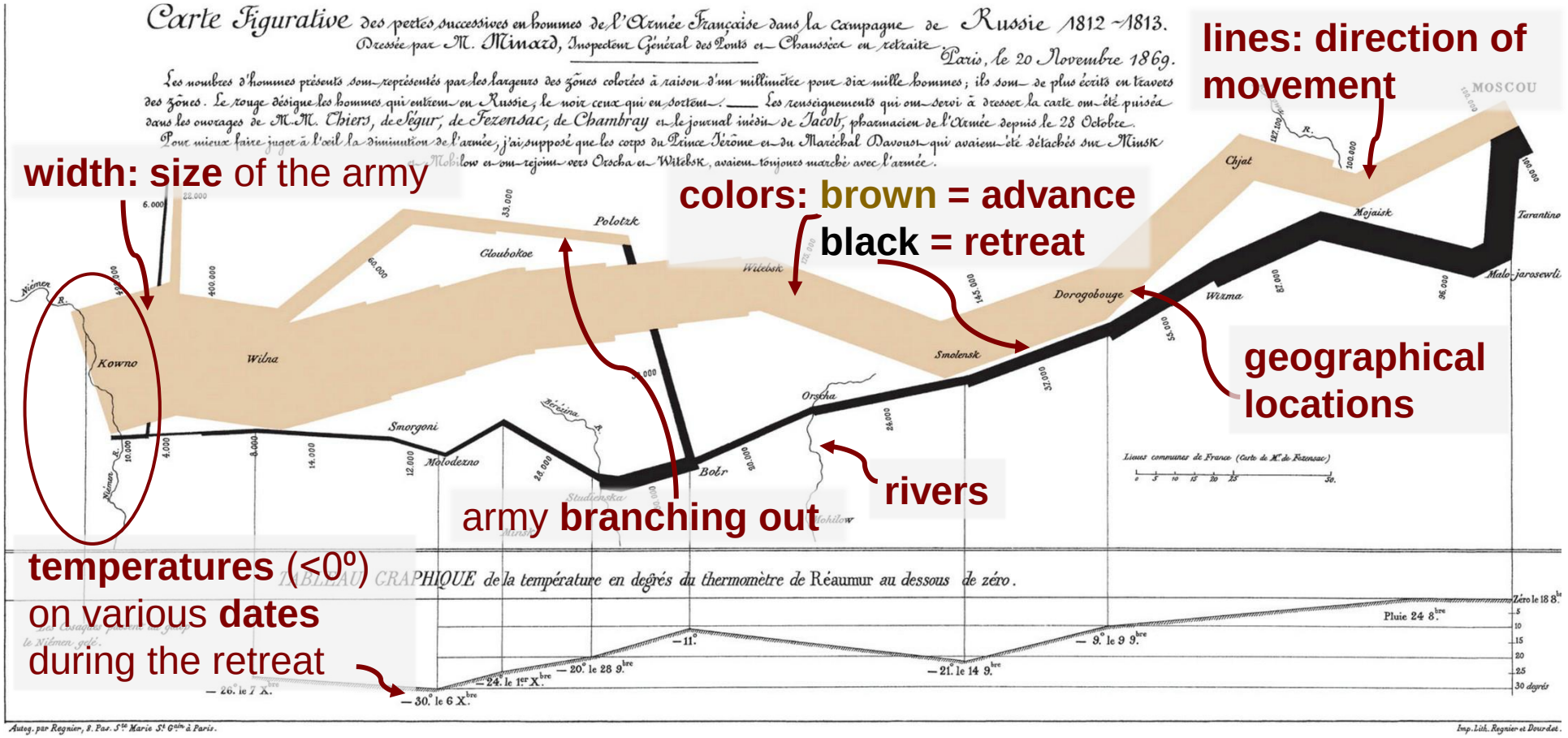


Napoleon’s 1812 march east to Moscow, with a massive army of over 400,000, and the retreat west

Charles Joseph Minard (Napoleon’s mapmaker), 1869

What is Data Visualization - storytelling

- Known as the best statistical drawing ever created (Tufte). Why?

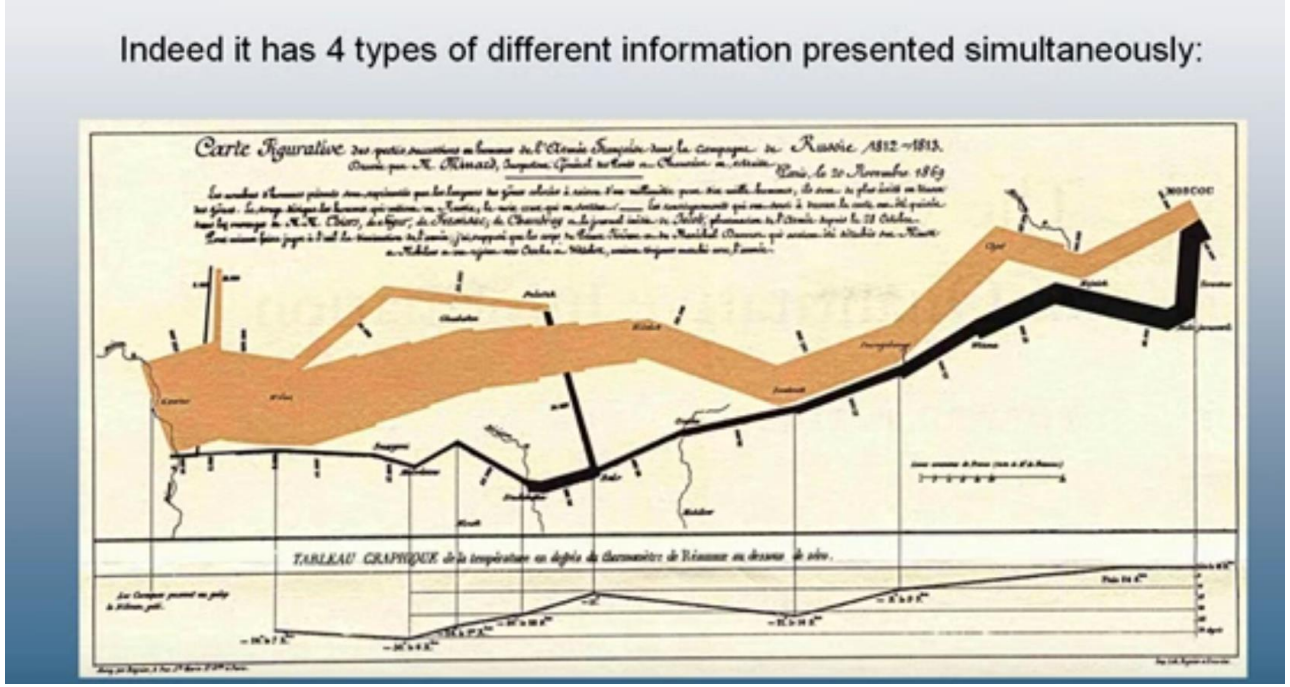


- Analyzing Minard's Visualization Of Napoleon's 1812 March

What is Data Visualization - storytelling

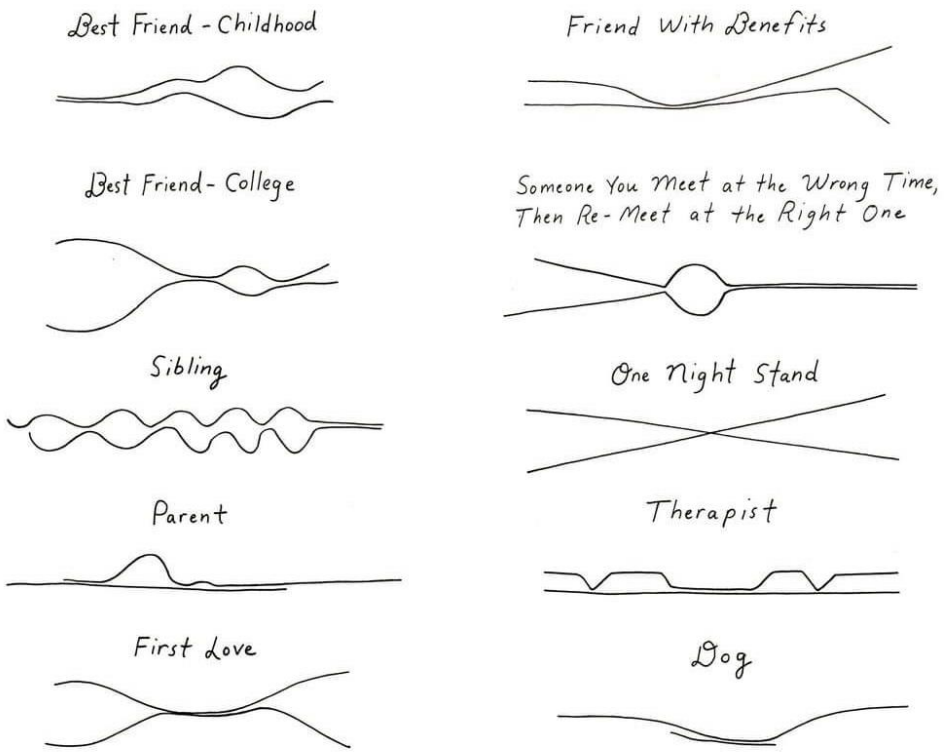
- Many dimensions of data combined in a single graph:
  - loss of life at a time and location
  - temperature
  - direction of movement, historical context
  - geography

video



What is Data Visualization - storytelling

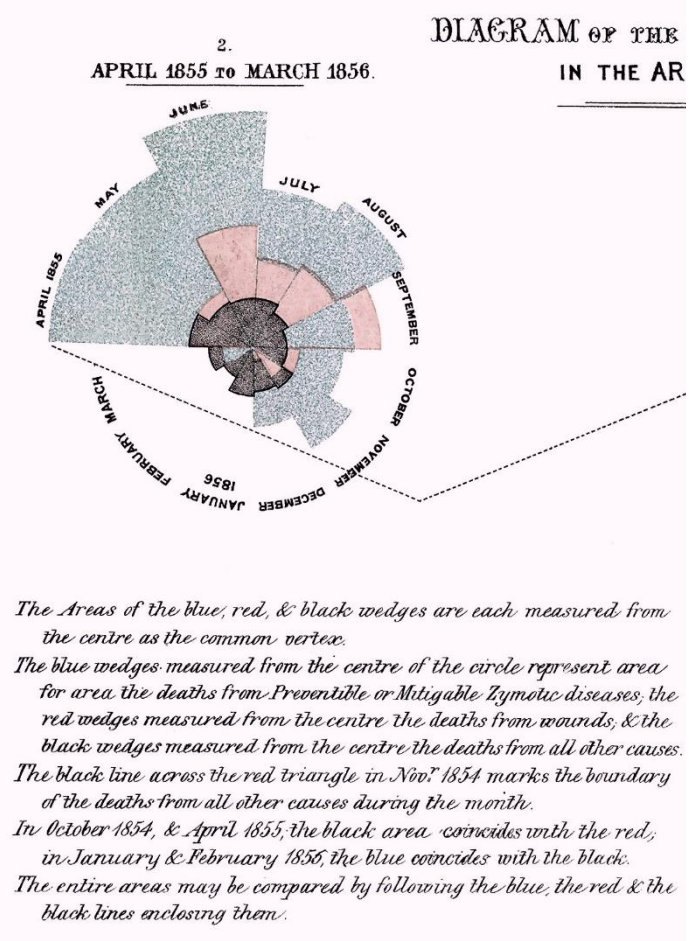
- Even with the simplest of representation elements (plain lines), one can tell a story…

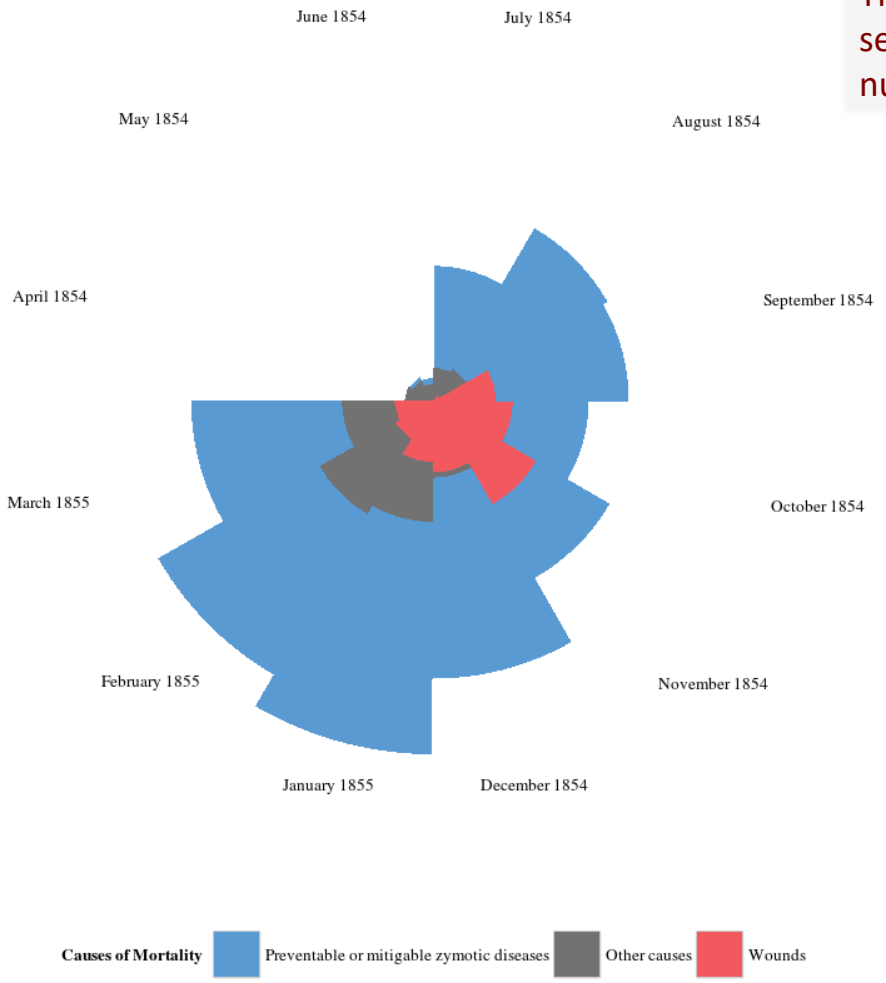


"Closeness Lines Over Time"
de Recat Jan. 2019

What is Data Visualization – data driven

- Diagram of the Causes of Mortality in the Army of the East



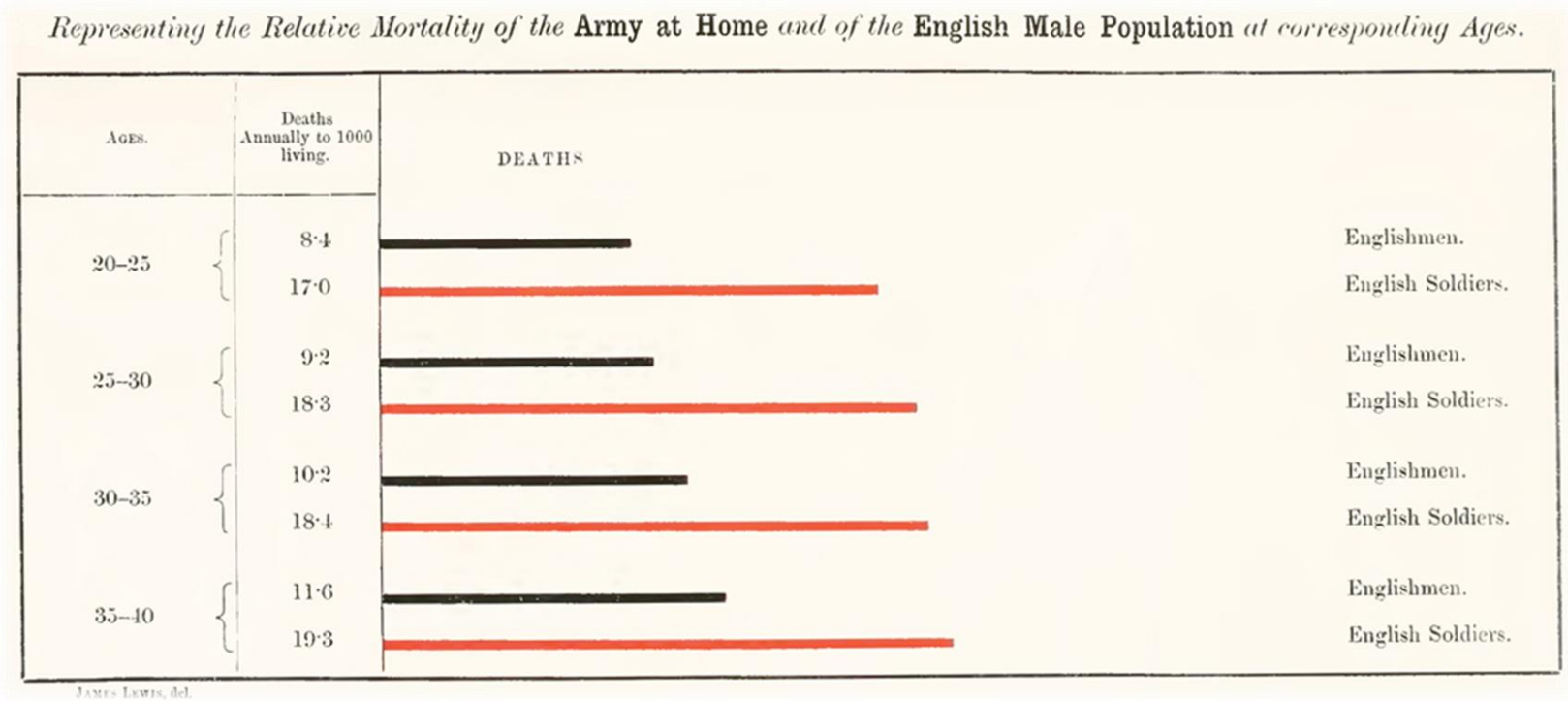


The area of each monthly segment is proportional to the number of hospital deaths

Florence Nightingale 1858

What is Data Visualization – data driven

- Mortality of army at home vs. civilians



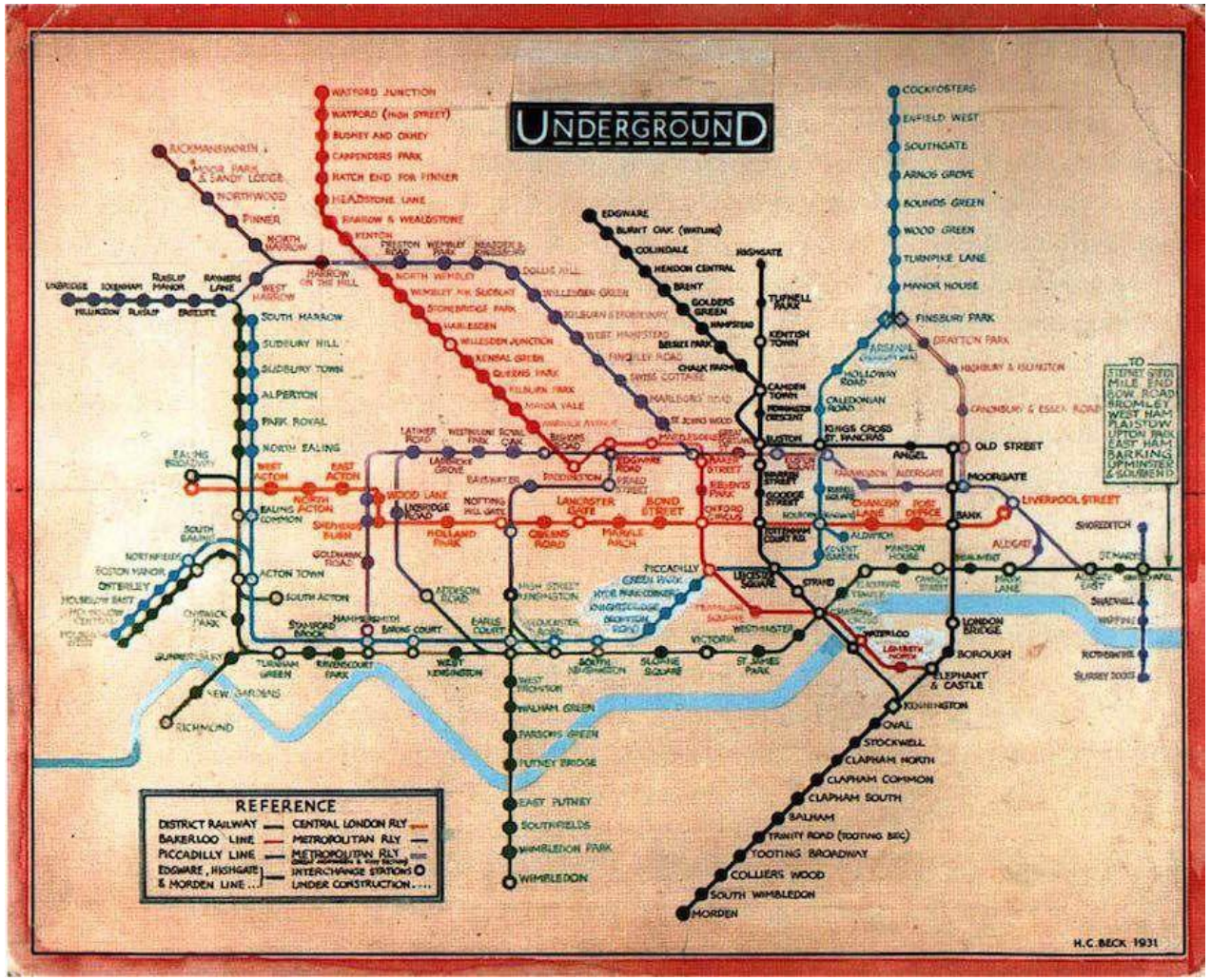
Florence Nightingale
1858

What is Data Visualization – a mental map

- Original London underground map

What is Data Visualization – a mental map

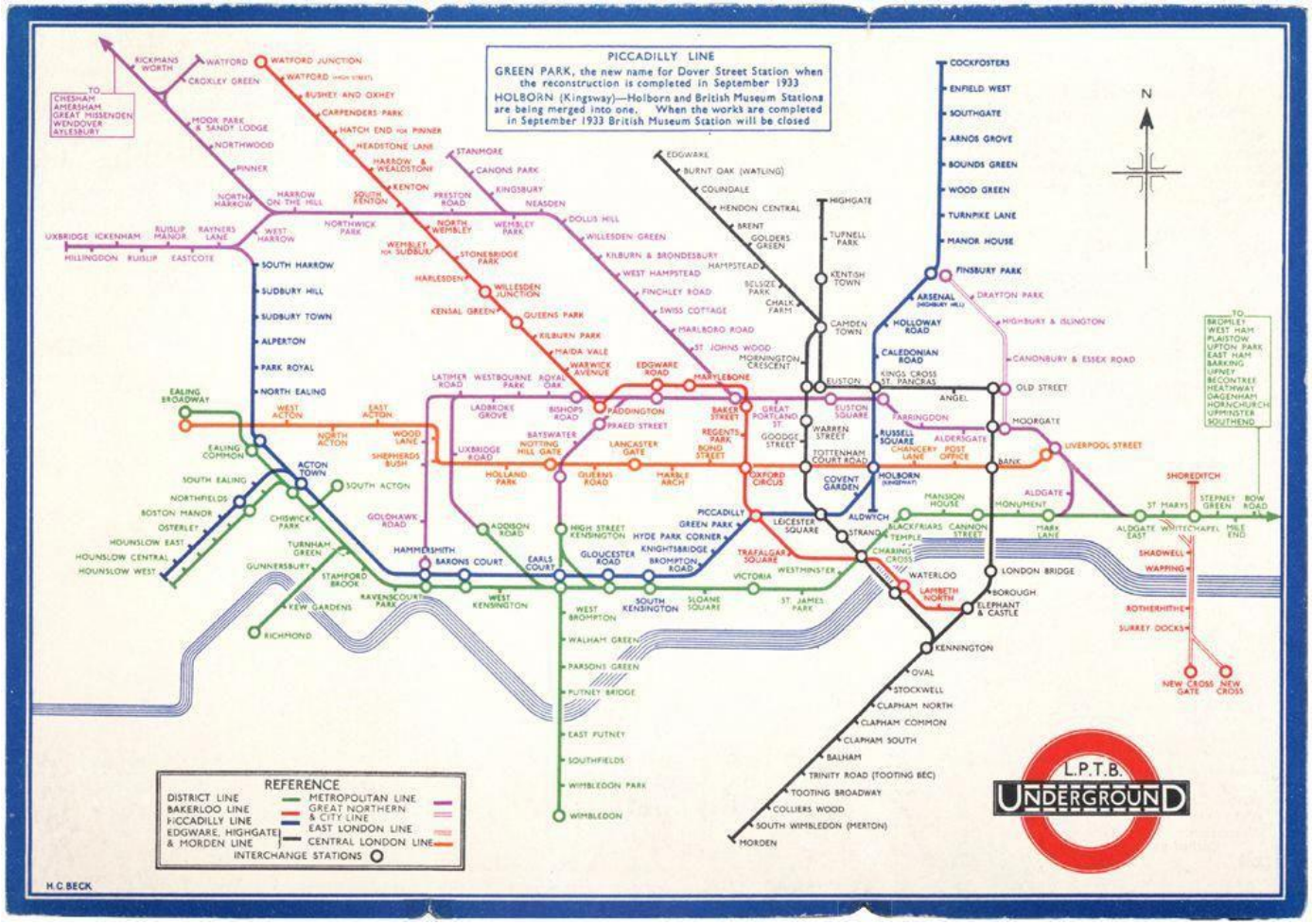
- New London underground map, laid out like an electrical circuit



Harry Beck, 1931

What is Data Visualization – a mental map

- New London underground map, laid out like an electrical circuit



Harry Beck, 1931

What is Data Visualization – a mental map

The full story of the tube map in fun videos

by Jay Foreman

#1

The Tube Map nearly looked very different

#2

What went wrong with the Tube Map?

What is Data Visualization – a mental map

"…do we still need the Tube Map at all? These days you're more likely to plan your journey with an app than a map so why does it matter if the map is a clutter?

It matters because the Tube Map is so much more than just a useful journey planner. It represents London, in every interpretation of that word.

For visitors, it's **the first thing you look at** when you want to **familiarise yourself** with the city.

For Londoners, it's **the way the city looks in our brains**.

It creates **order out of chaos**, **simplicity out of complexity**."

Excerpt from What went wrong with the Tube Map?

What is Data Visualization – a human cognitive activity

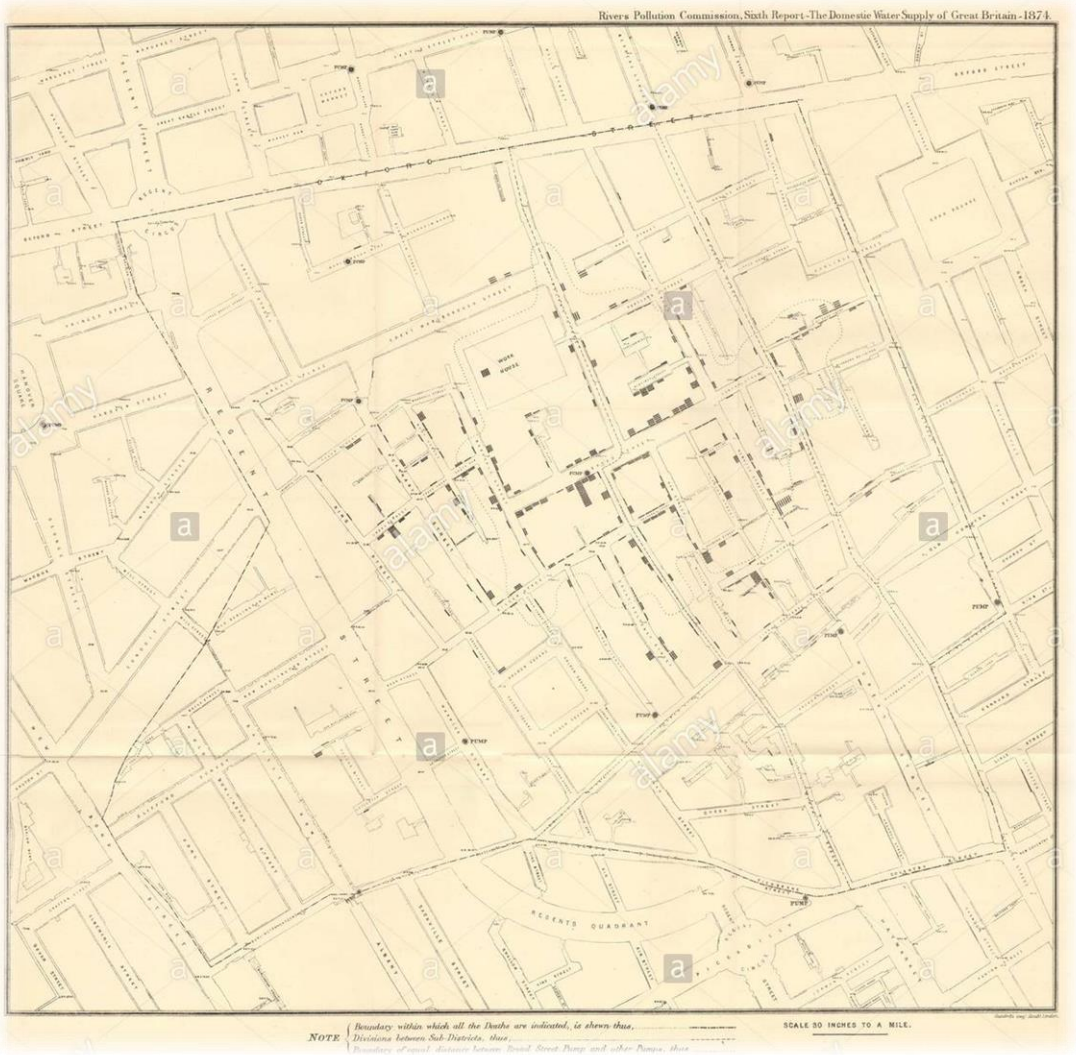
- Without looking back at the previous 3 examples (Minard, Nightingale, Beck), sketch out the essential details of what you remember.

  What do they have in common?

They are **well remembered** albeit not in full detail
The viewer departs with an **image in their mind**

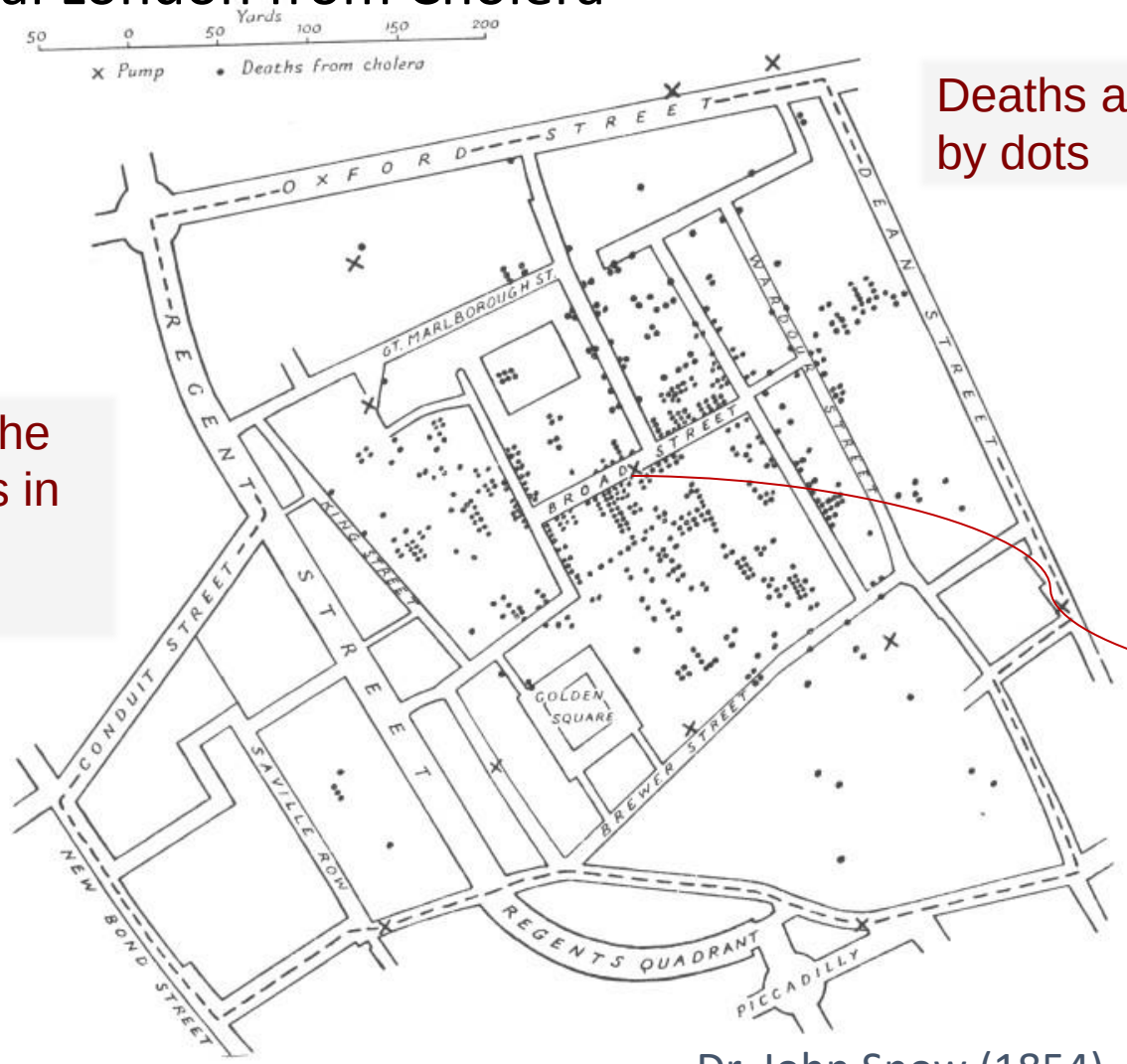
What is Data Visualization – data driven

- Deaths in central London from Cholera



What is Data Visualization – data driven

- Deaths in central London from Cholera



Deaths are marked by dots

the location of the 11 water pumps in the area are marked with Xs

modern reconstruction of the Broad St. Pump | Photo: M. Roussou, 2022

Dr. John Snow (1854)

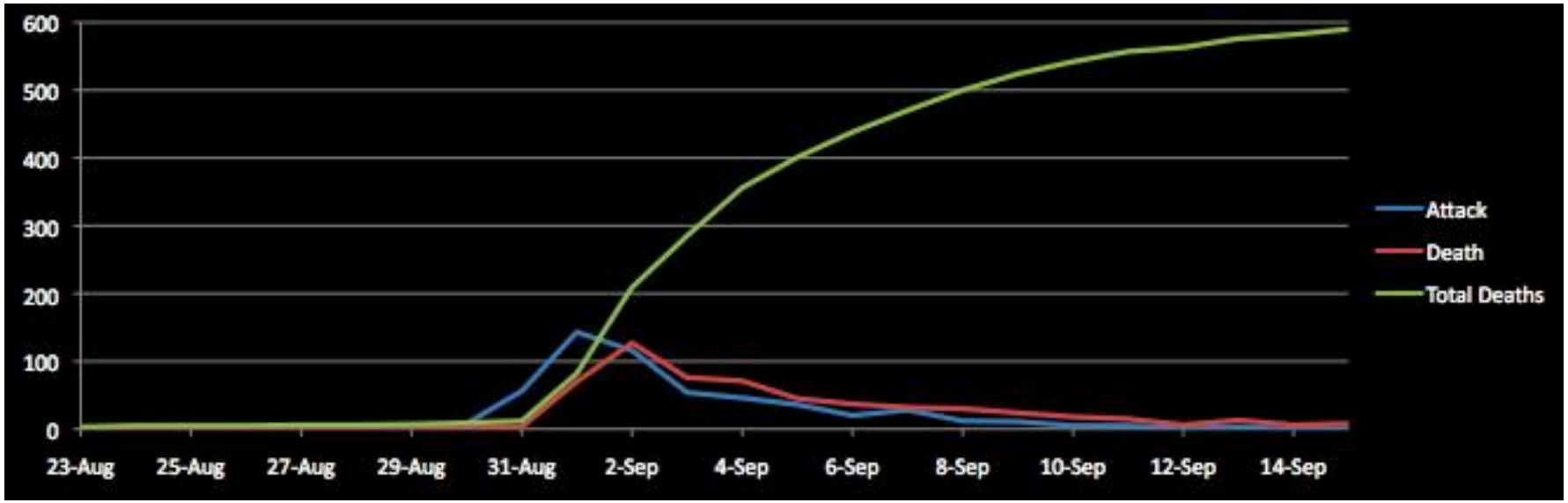
What is Data Visualization - data driven

- Deaths in central London from Cholera – a chart of the data

"Very few of the fifty-six attacks placed in the table to the 31st August occurred till late in the evening of that day. The eruption was extremely sudden, as I learn from the medical men living in the midst of the district, and commenced in the night between the 31st August and 1st September."

"On September the 8th - the day when the handle of the pump was removed - there were twelve attacks;…"

"During the decline of the epidemic the deaths were more numerous than the attacks, owing to the decease of many persons who had lingered for several days in consecutive fever."



What is Data Visualization – data driven

John Snow's visualization has a number of good features that you should strive for:

1. Place data in the appropriate context for assessing cause and effect
2. Allow the viewer to make quantitative comparisons
3. Encourage search for alternative explanations and contrary cases
4. Indicate level of certainty and possible errors in the data

3. Encourage search for alternative explanations and contrary cases

- There are areas near the Broad Street pump with no/few fatalities and there are a few fatalities far from the pump. Those suggest that maybe our hypothesis is wrong.
- John Snow visited families of the deceased that lived far from the pump. Some preferred the taste of the water at Broad Street as it was usually more clear than the others. Some had children that went to school near the Broad Street Pump.
- What about the areas near the pump with no fatalities. One was a brewery employing 70 men. The other was a work house with over 500 inmates that had only 5 deaths from cholera, and it had its own water pump.
- As a result of John Snow's work this was the last great cholera outbreak in London.

What is Data Visualization – data driven

The full story of John Snow in a fun video series:

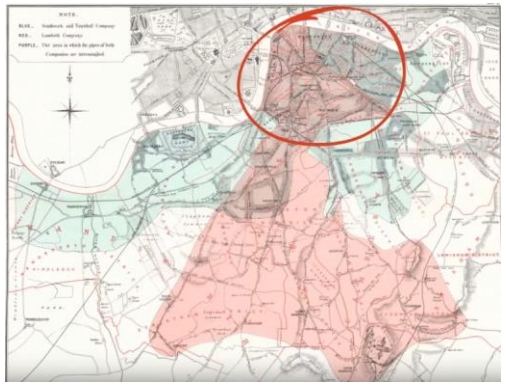
England: The Broad Street Pump

by Extra Credits

#1

You Know Nothing, John Snow

#2



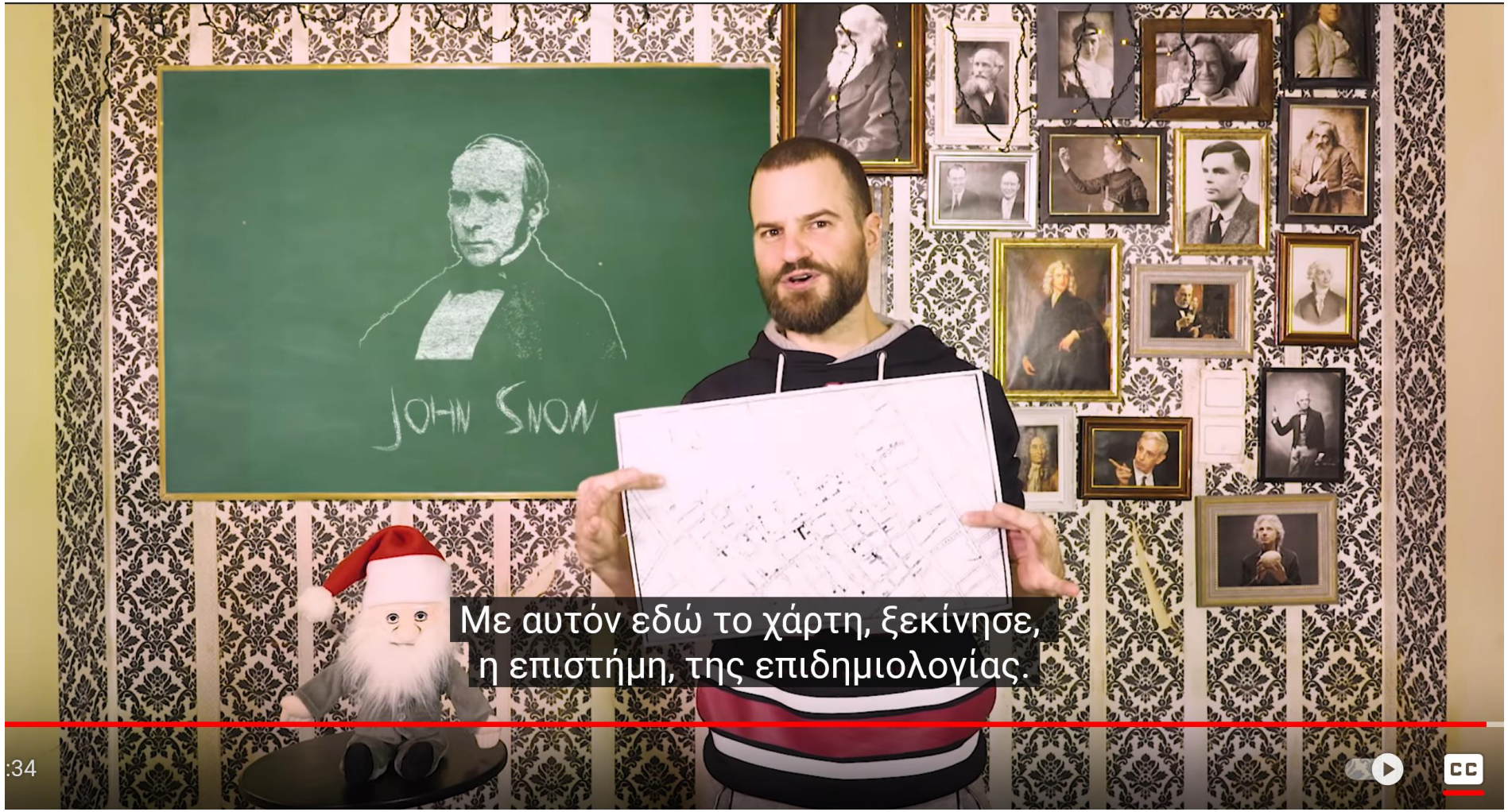
Epidemiology Begins!

#3

Map of the Blue Death

What is Data Visualization – data driven

…but also in Greek:

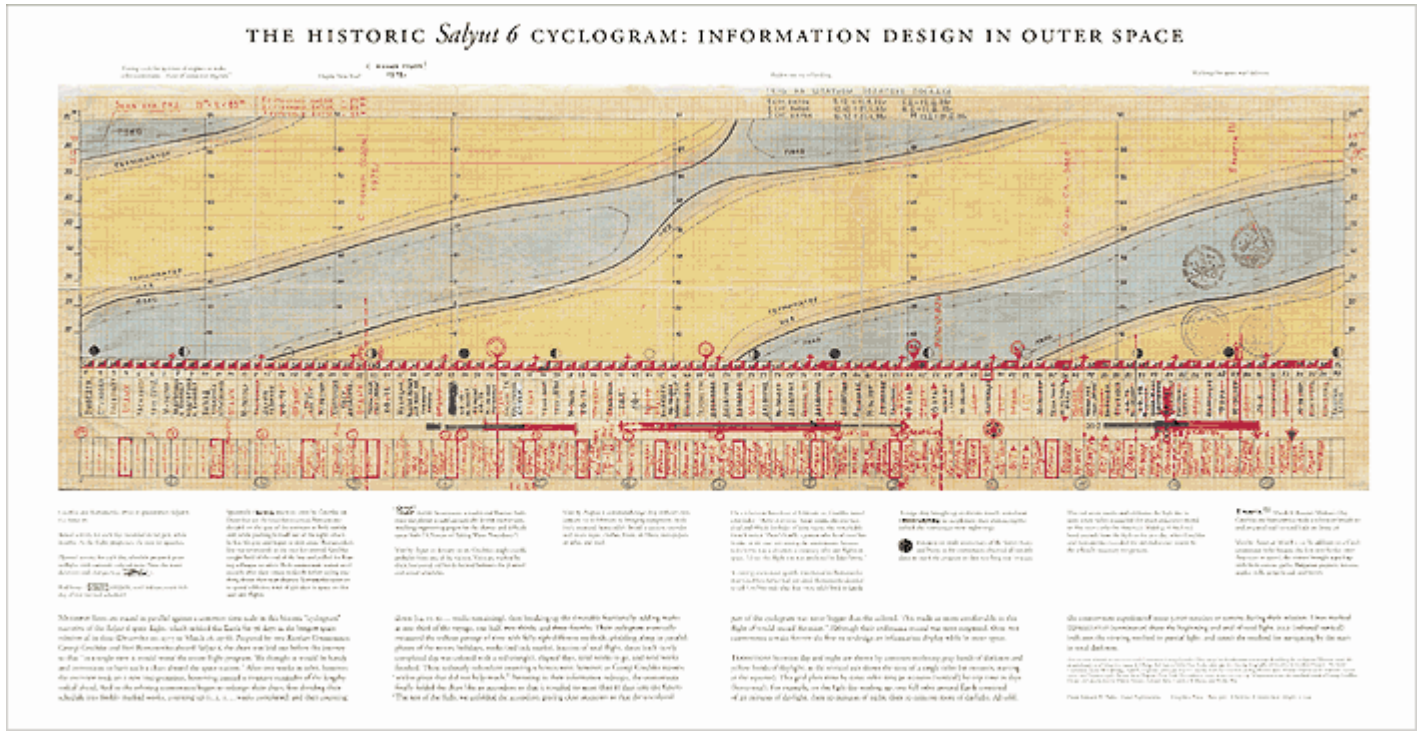


Mikeius

What is Data Visualization - storytelling

- Historic Visual Diary of Spaceflight: Cyclogram

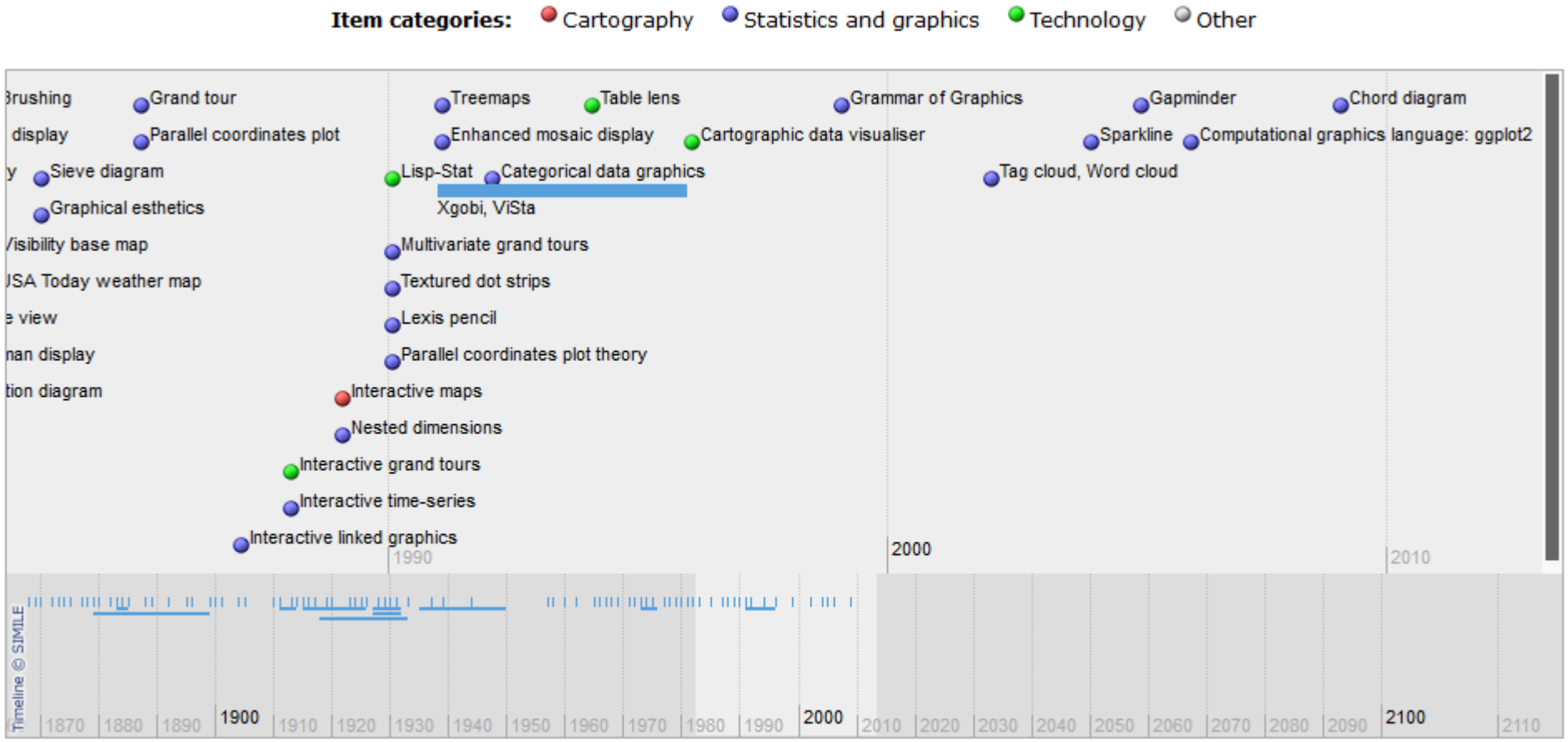
  Some 22 parallel time-series show 1500 sunrises and 1500 sunsets during the flight, a schedule for space walks and baths, and visits of resupply ships bringing equipment, fresh fruit, and gingerbread.



Georgi Grechko
Russian cosmonaut of Salyut6

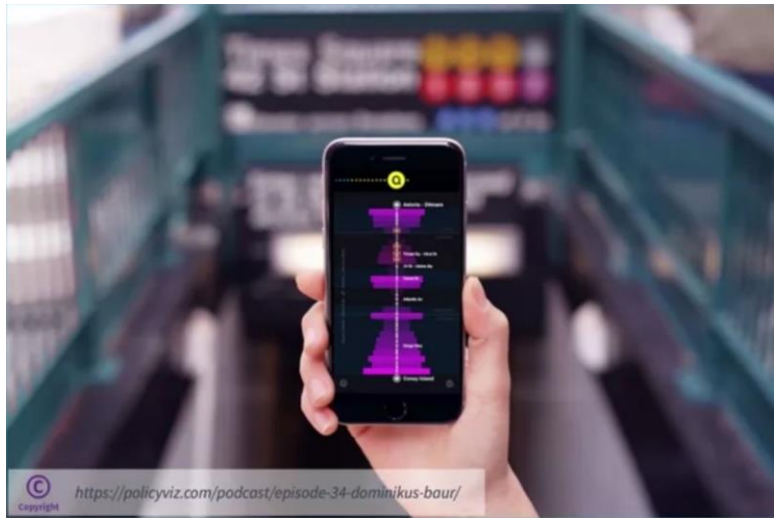
The history of data visualization

- Milestones in the history of thematic cartography, statistical graphics, and data visualization



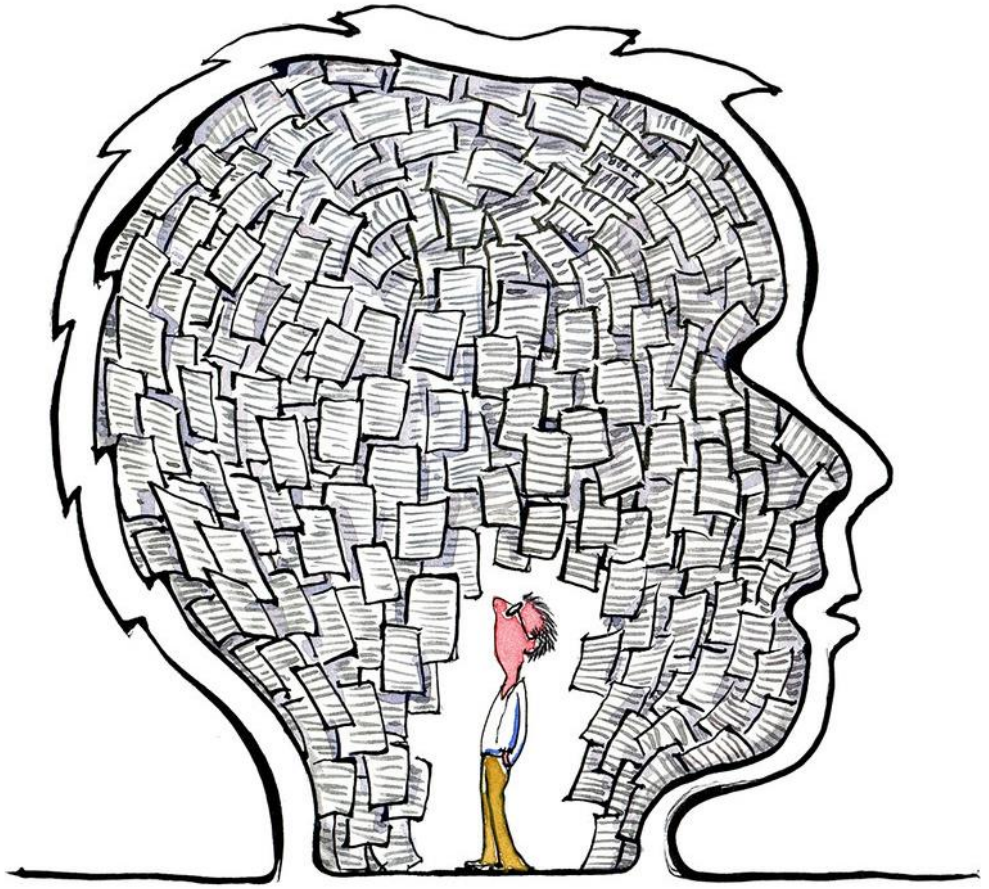
Viewing visualizations…

- …everywhere



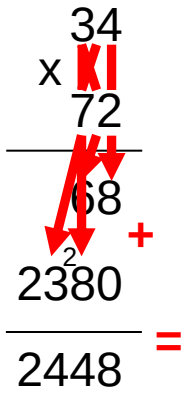
Why visualize?

- Humans are visual creatures.
- Peer-reviewed studies have shown that we can consume information more quickly when it is expressed in diagrams than when it is presented as text.
- Visualizing data is not just creating pretty pictures.



Why visualize?

- E.g., multiplying 2-digit numbers, like 34 x 72, can be 5 times slower (!) if done mentally vs. using pen and paper:

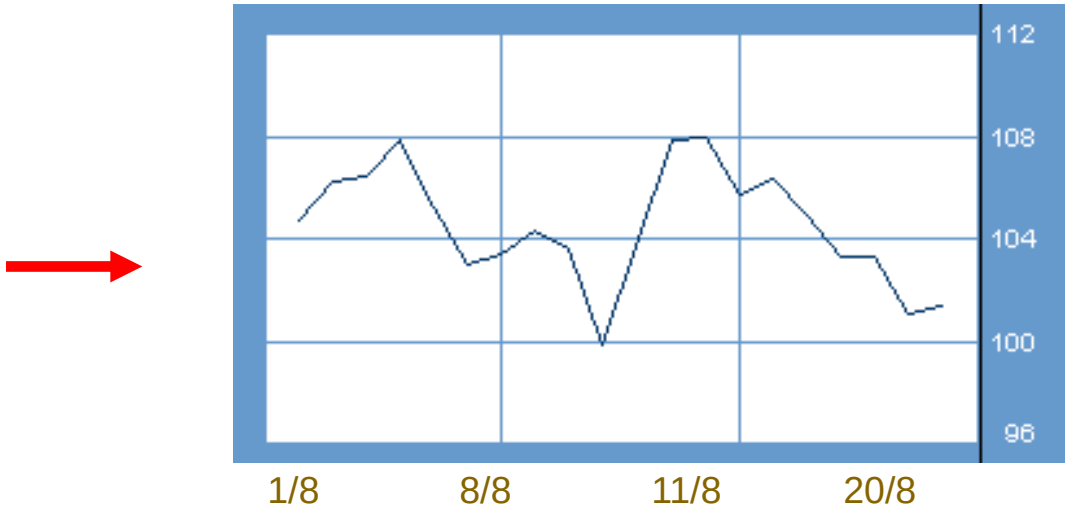


- With 4- or 5-digit numbers this would be impossible using just our brain.

Why visualize?

- E.g.: identifying the deviation of the price of a stock at a specific date range is easier when looking a chart vs. looking at numbers:

1/8 104 3/4
4/8 106 1/4
5/8 106 1/2
6/8 107 7/8
8/8 105 ¼
11/8 103
18/8 104
19/8 107 15/16
20/8 108
21/8 105 3/4
22/8 106 3/8



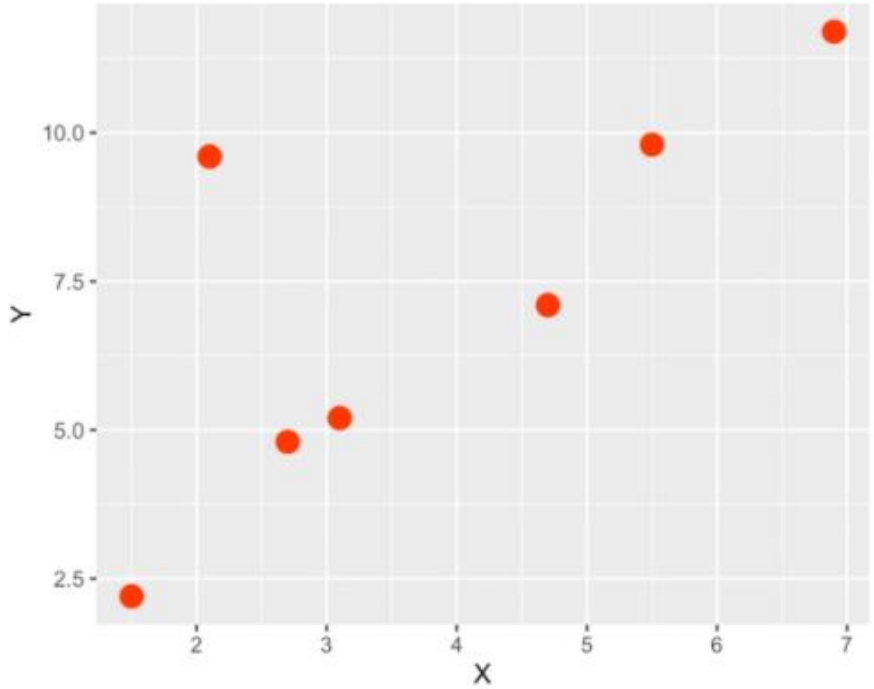
- If the date range is bigger, e.g. a year, it would've been almost impossible to define the price deviation through the number table

Why visualize?

- E.g.: identifying the deviation of the price of a stock at a

SPOT OUTLIERS

X	Y
1.5	2.2
2.1	9.6
5.5	9.8
3.1	5.2
6.9	11.7
4.7	7.1
2.7	4.8



Why visualize?

Because **information spaces** can be:

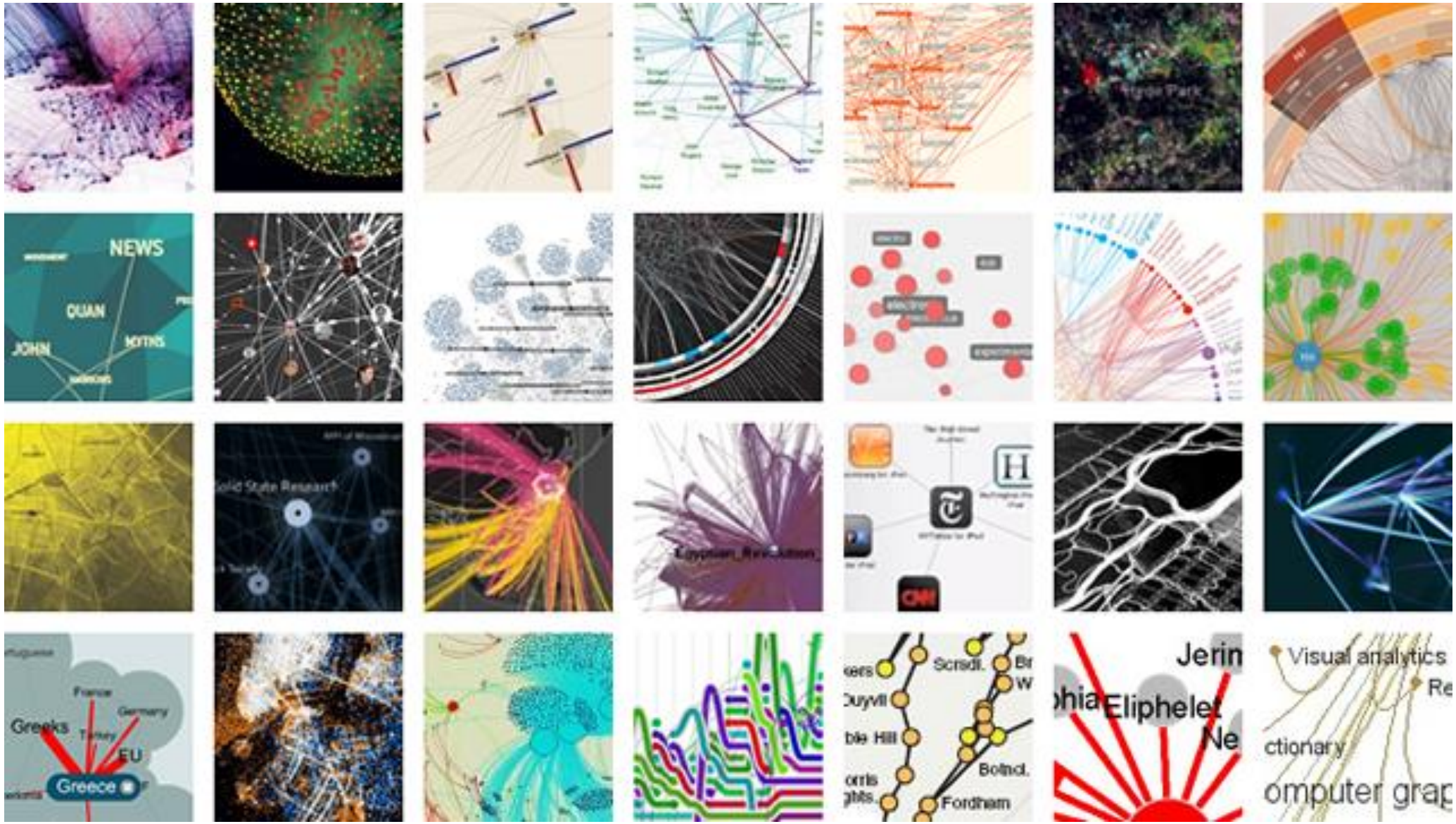
- large
- abstract
- complex
- continuously becoming larger and larger...

Information spaces

- The World Wide Web (WWW)
- Stock exchange
- Scientific data (biology, physics, mathematics, etc.)
- Road traffic data, network data
- Atmospheric data, seismic data, meteorological data, climate change…
- A novel (data can be sentences, words, letters…)
- SETI@home (Search for Extraterrestrial Intelligence): space radio data collected via radio-telescopes

- …more at Geisler, G. (2005). Making Information More Accessible : A Survey of Information Visualization Applications and Techniques, 1–25. Retrieved from http://www.ischool.utexas.edu/~geisler/info/infovis/paper.html

Information spaces



Why visualize?

People create visualizations as part of

- exploratory data analysis
  - See patterns
  - Inspire new questions

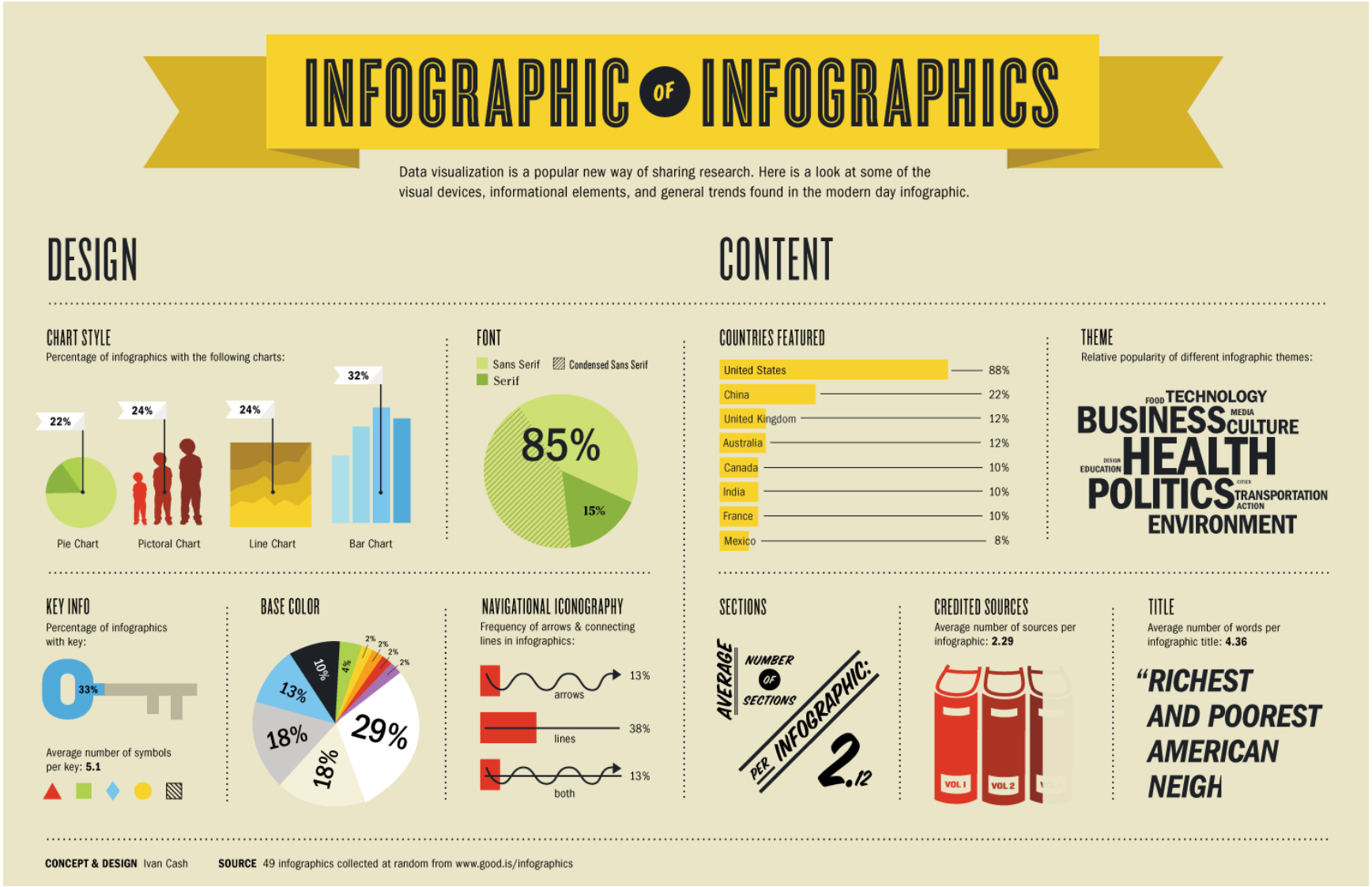
or

- to convey a story about their data to an audience
  - What do you want to convey?
  - Show it clearly

Infographics - examples

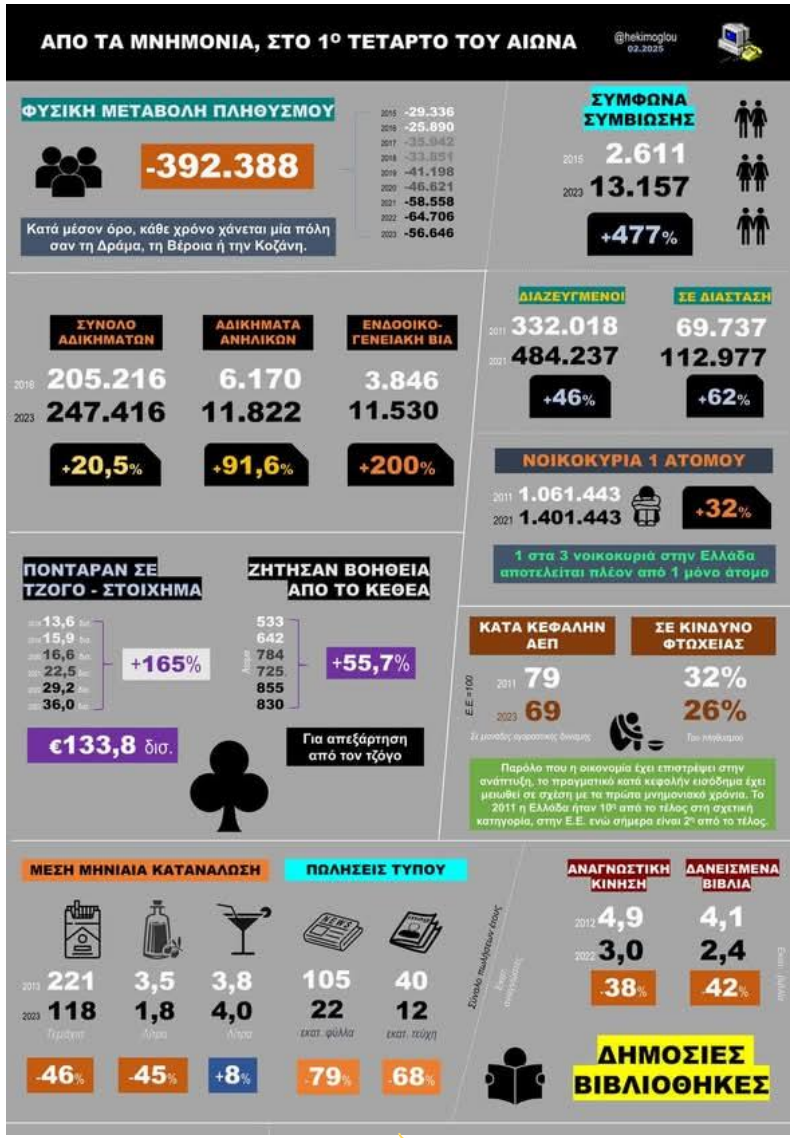
- infographics

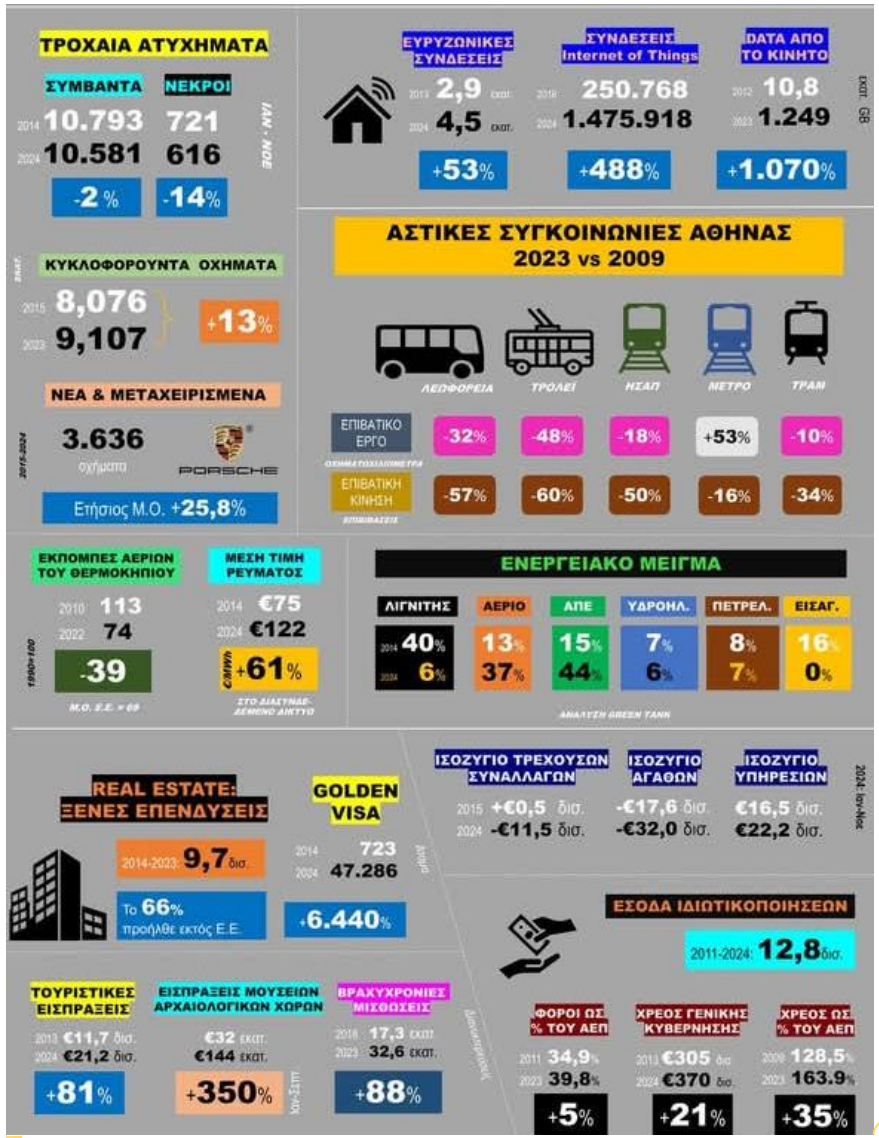
Infographics



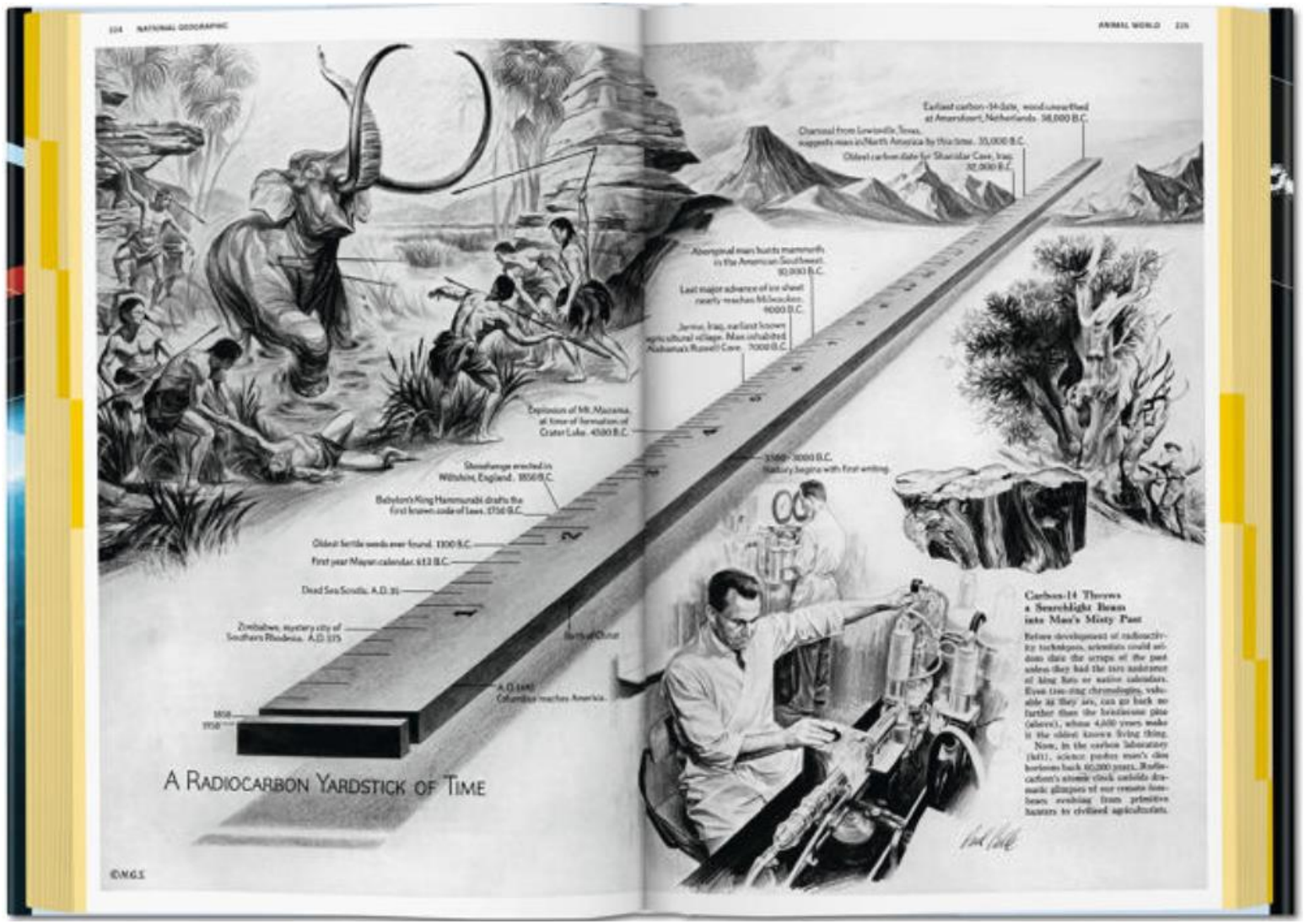
Infographics

Contemporary Greece in one infographic…



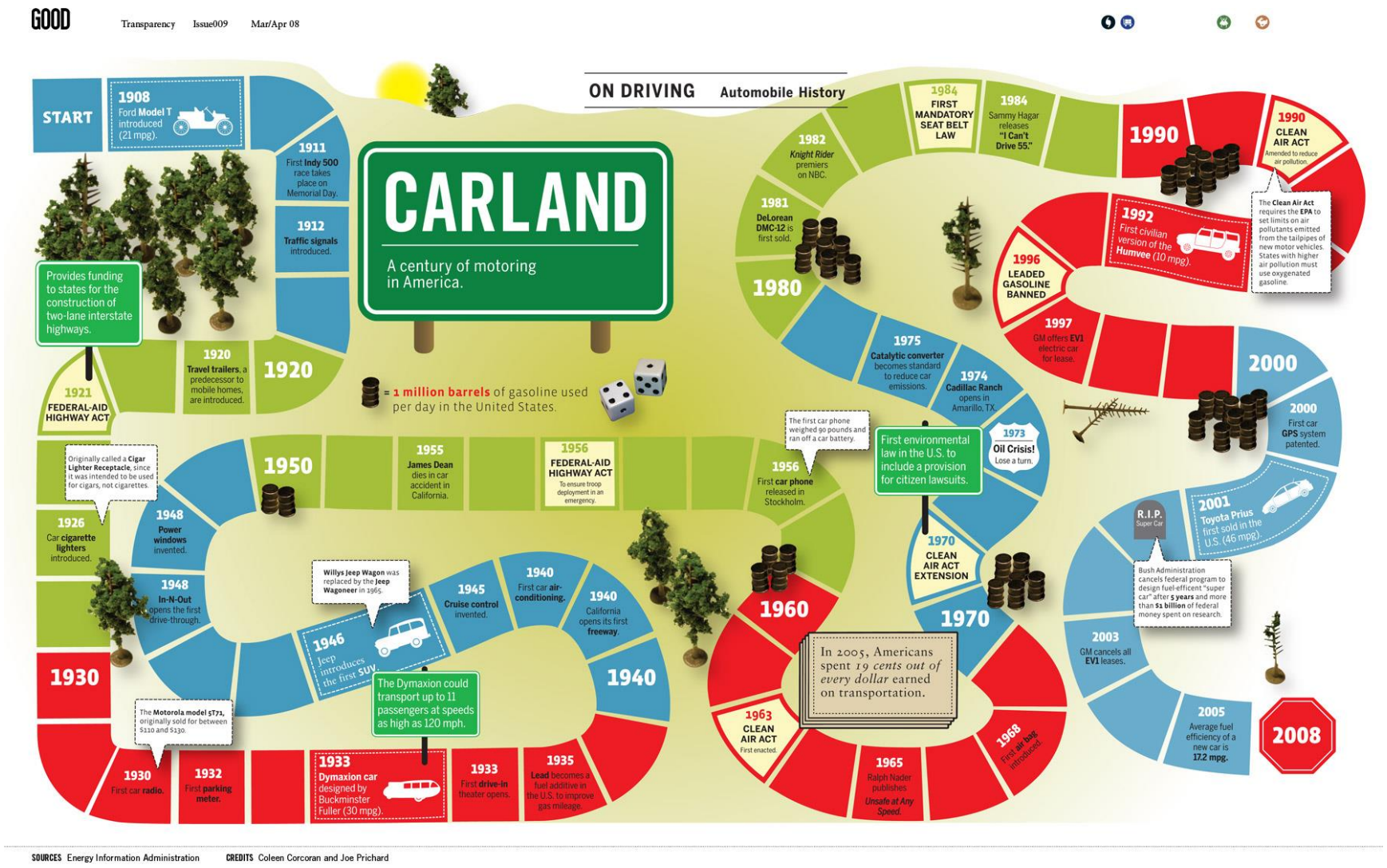


Infographics



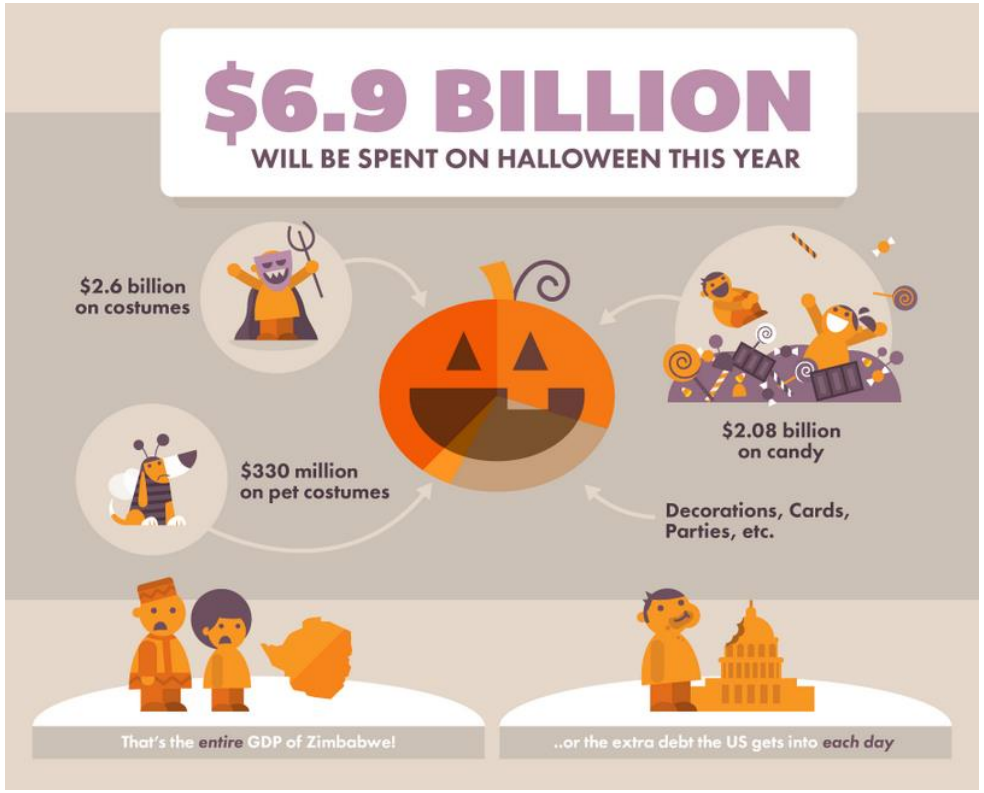
National Geographic Infographics

Infographics



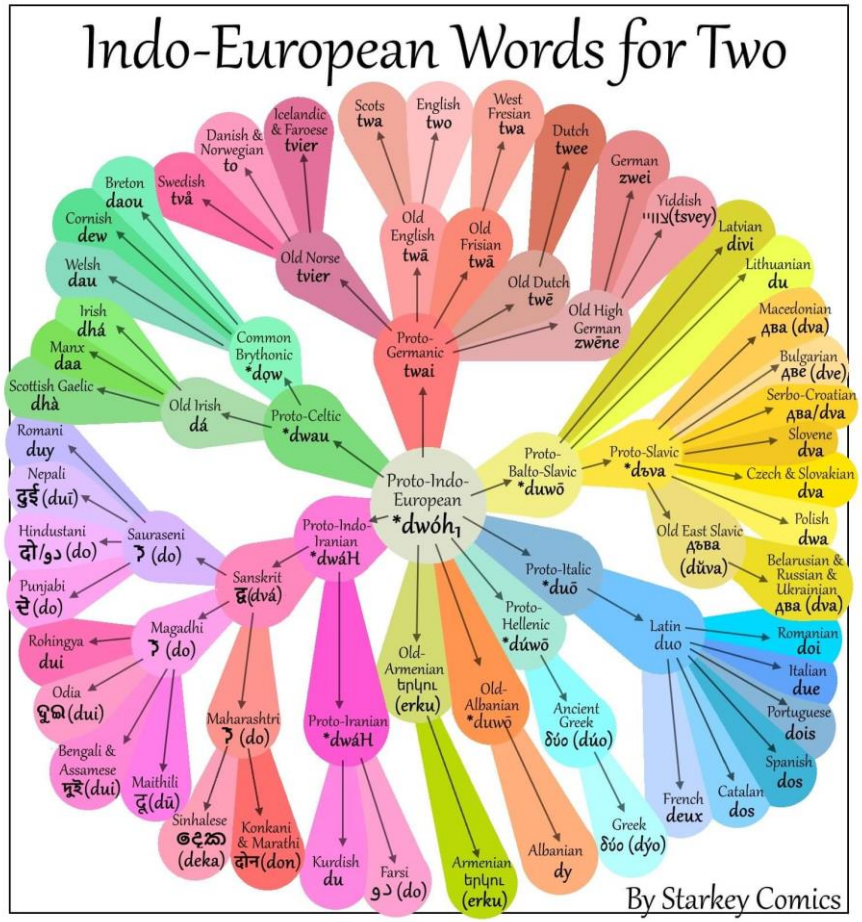
Infographics

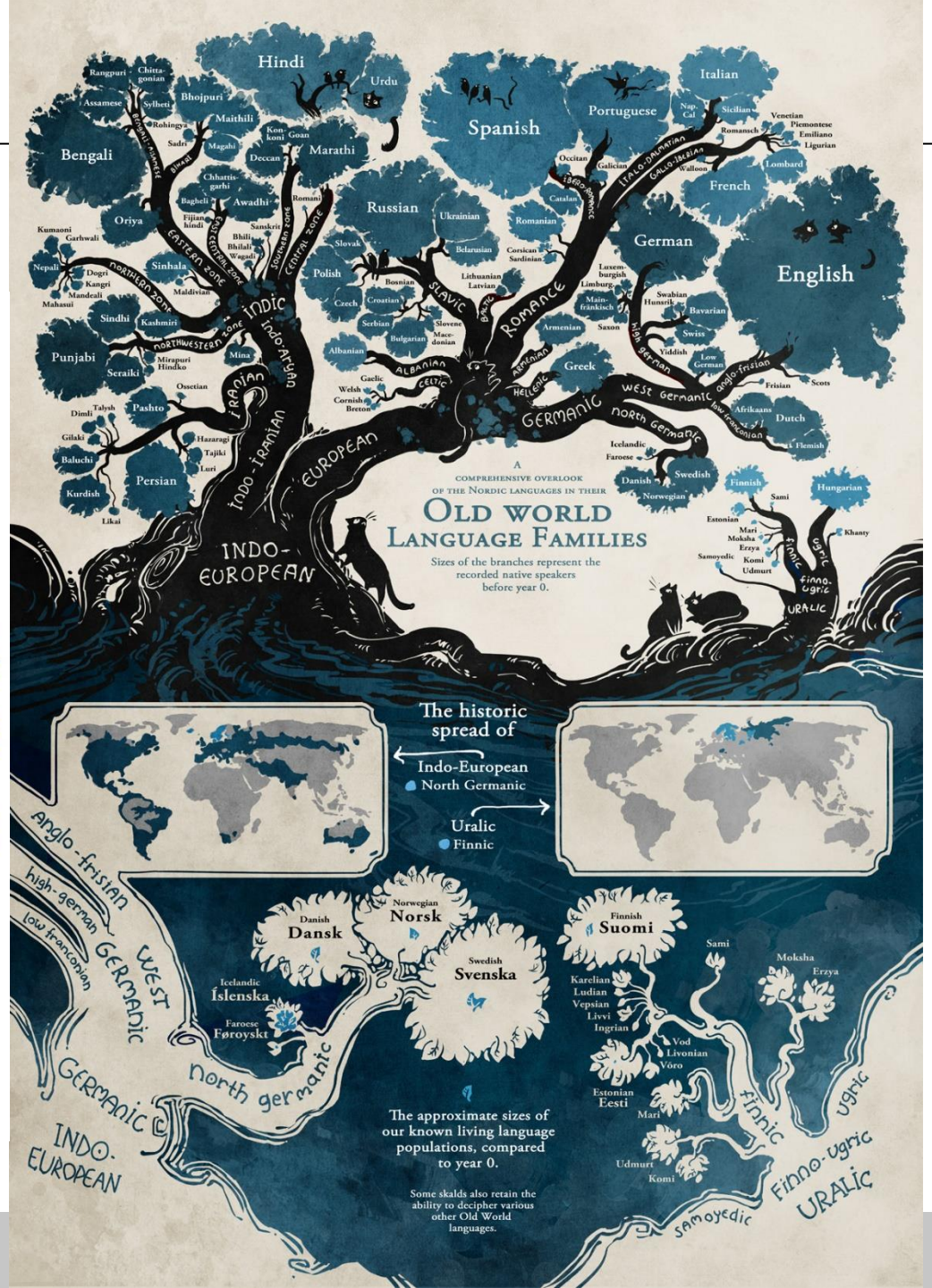
Infographics



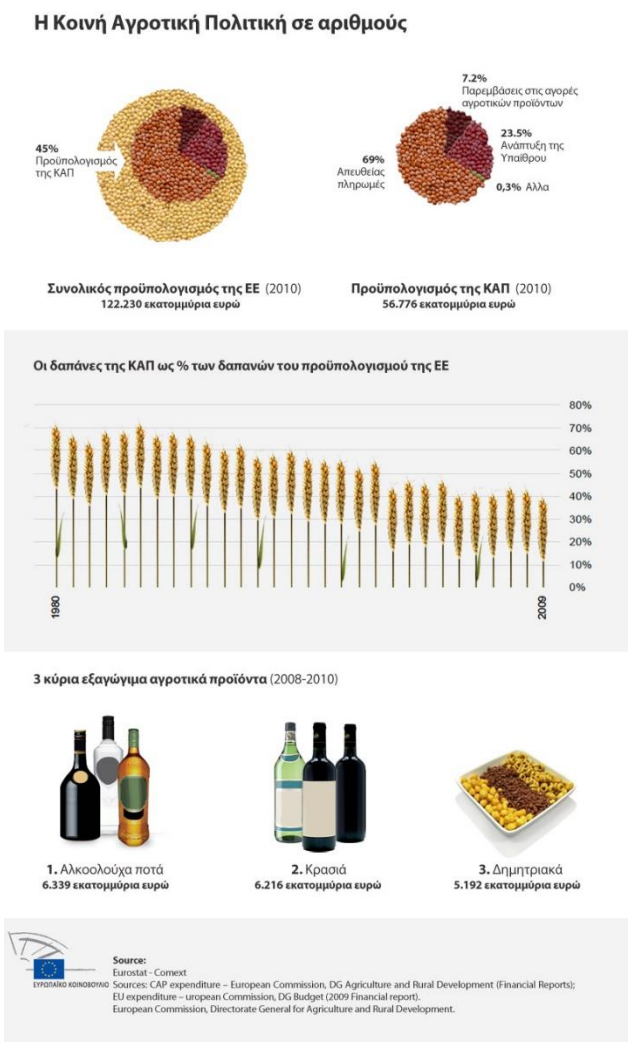
Infographics

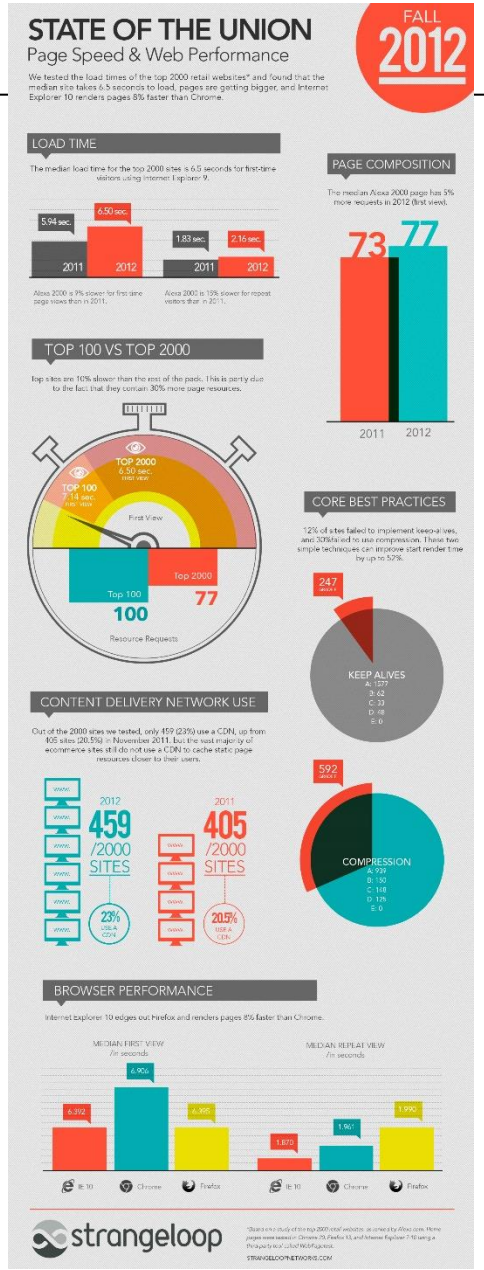
Infographics

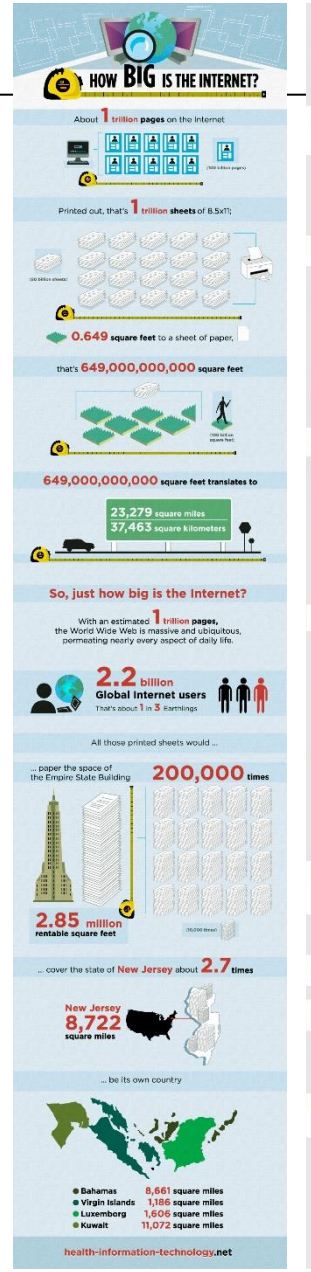


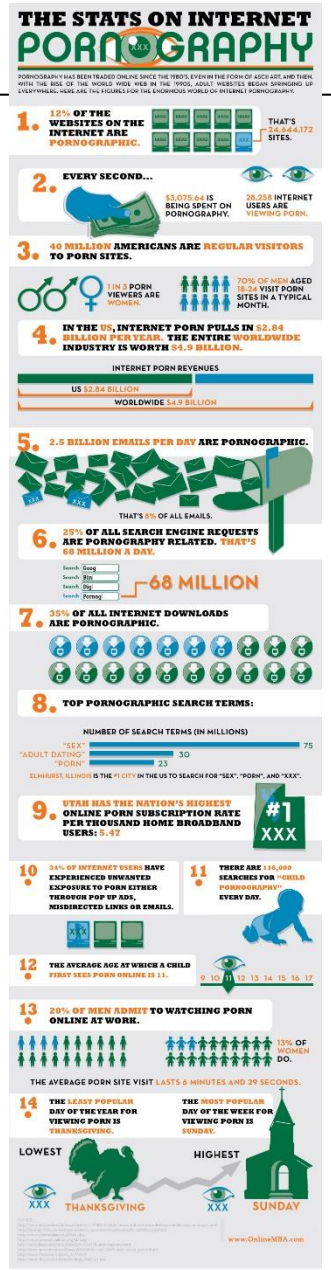


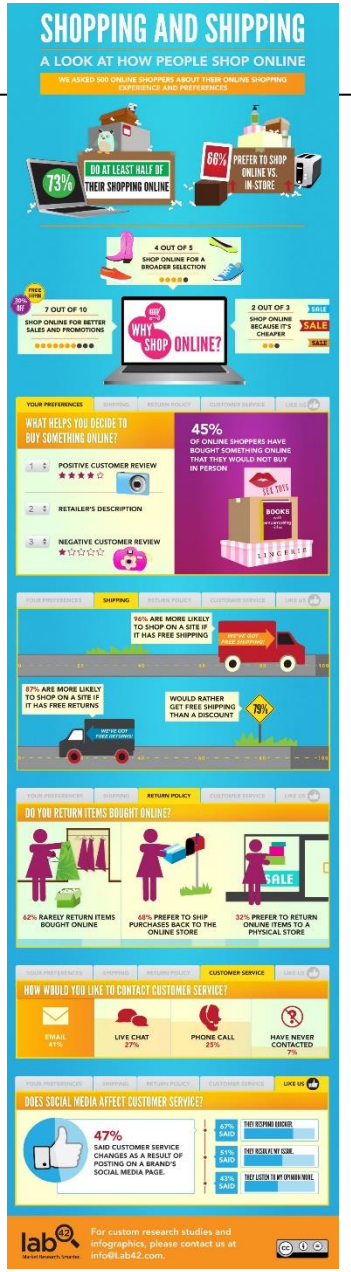
Infographics

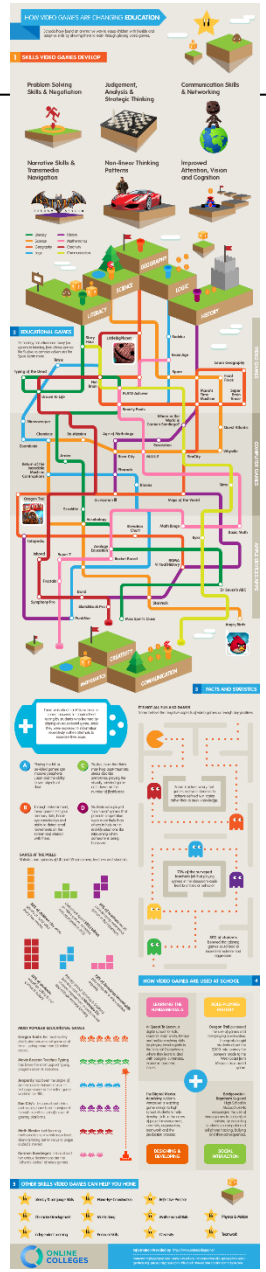








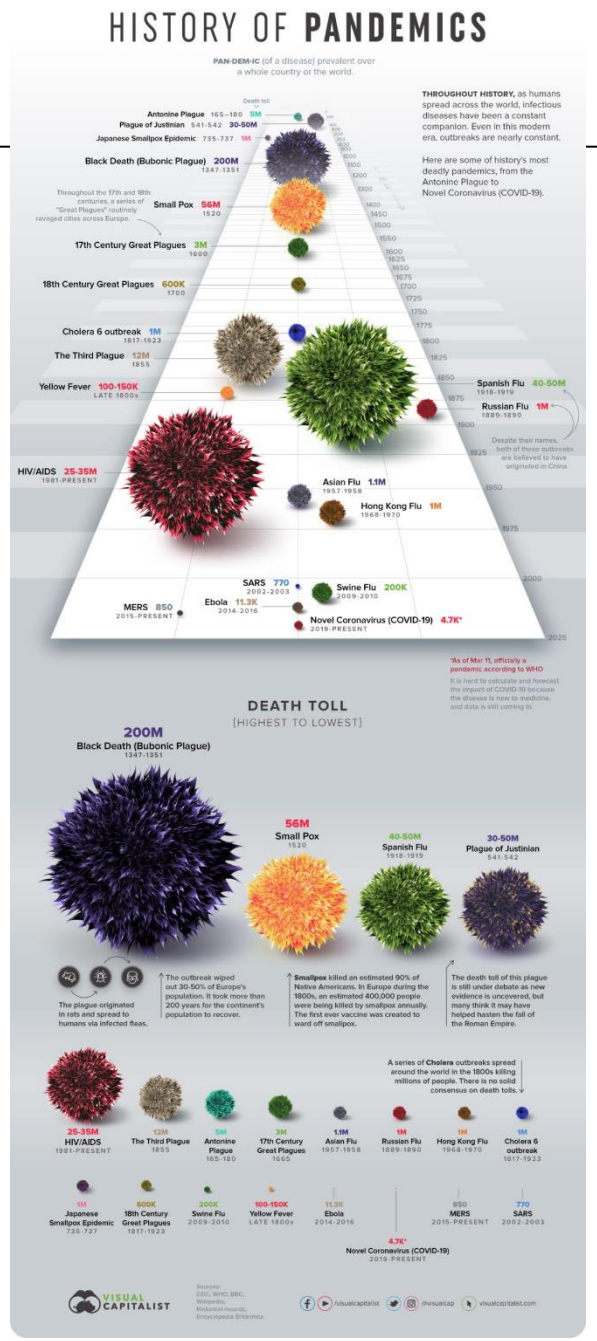




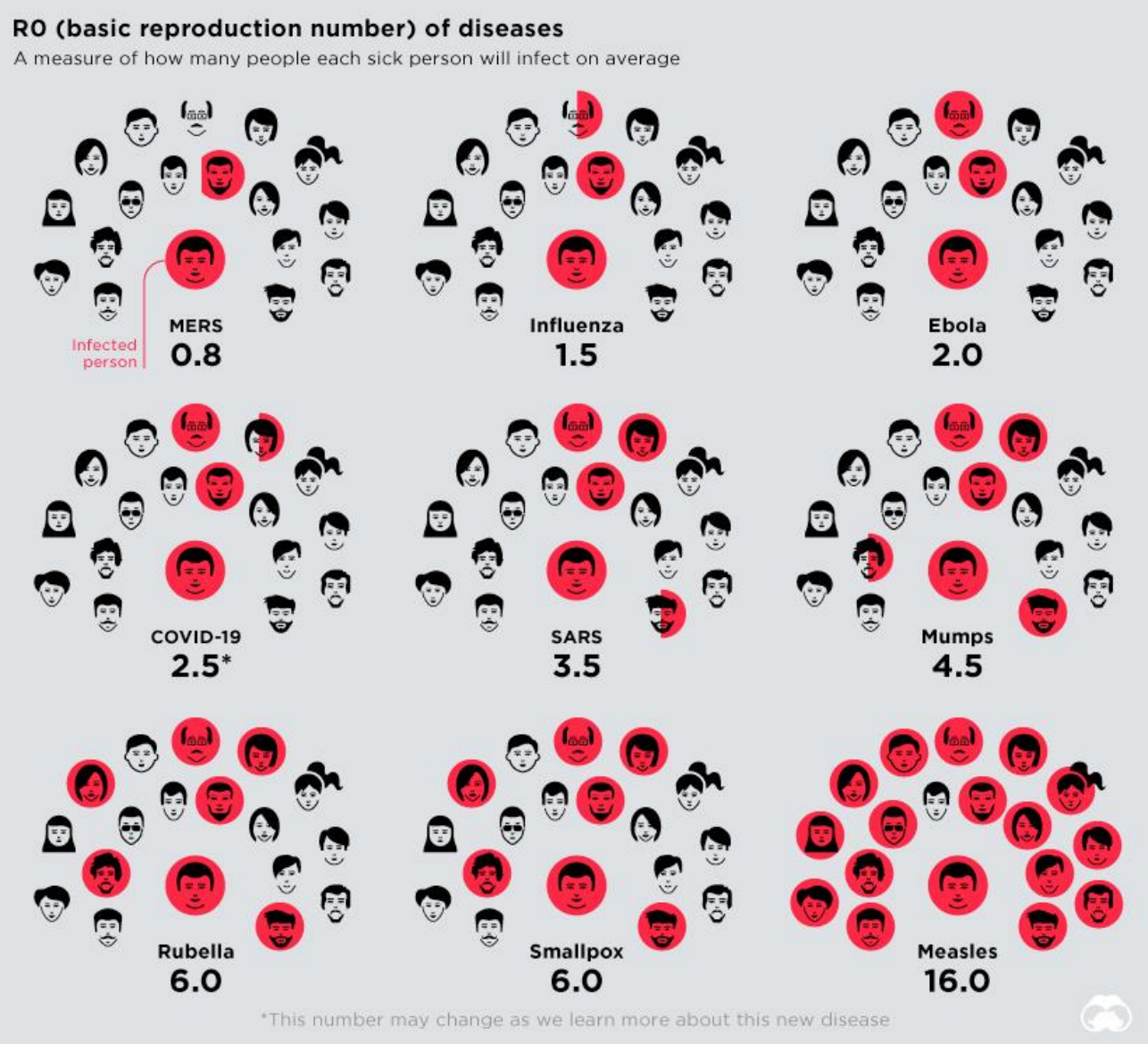
Infographics

- Visualizing the History of Pandemics, March 14, 2020

Name	Time period	Type / Pre-human host	Death toll
Antonine Plague	165-180	Believed to be either smallpox or measles	5M
Japanese smallpox epidemic	735-737	Variola major virus	1M
Plague of Justinian	541-542	Yersinia pestis bacteria / Rats, fleas	30-50M
Black Death	1347-1351	Yersinia pestis bacteria / Rats, fleas	200M
New World Smallpox Outbreak	1520 – onwards	Variola major virus	56M
Great Plague of London	1665	Yersinia pestis bacteria / Rats, fleas	100,000
Italian plague	1629-1631	Yersinia pestis bacteria / Rats, fleas	1M
Cholera Pandemics 1-6	1817-1923	V. cholerae bacteria	1M+
Third Plague	1885	Yersinia pestis bacteria / Rats, fleas	12M (China and India)
Yellow Fever	Late 1800s	Virus / Mosquitoes	100,000-150,000 (U.S.)
Russian Flu	1889-1890	Believed to be H2N2 (avian origin)	1M
Spanish Flu	1918-1919	H1N1 virus / Pigs	40-50M
Asian Flu	1957-1958	H2N2 virus	1.1M
Hong Kong Flu	1968-1970	H3N2 virus	1M
HIV/AIDS	1981-present	Virus / Chimpanzees	25-35M
Swine Flu	2009-2010	H1N1 virus / Pigs	200,000
SARS	2002-2003	Coronavirus / Bats, Civets	770
Ebola	2014-2016	Ebolavirus / Wild animals	11,000
MERS	2015-Present	Coronavirus / Bats, camels	850
COVID-19	2019-	Coronavirus – Unknown (possibly	4,700 (as of Mar 12,

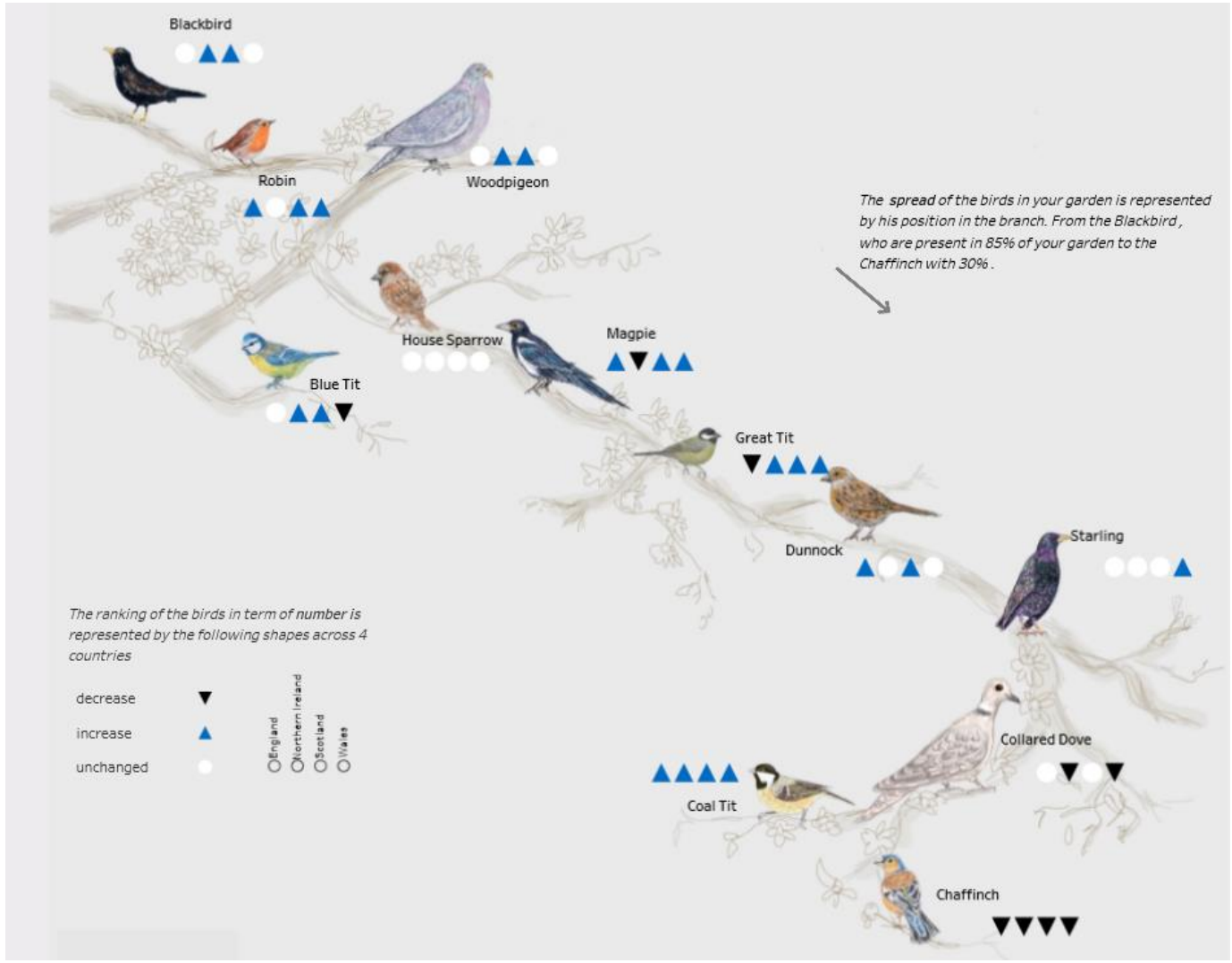


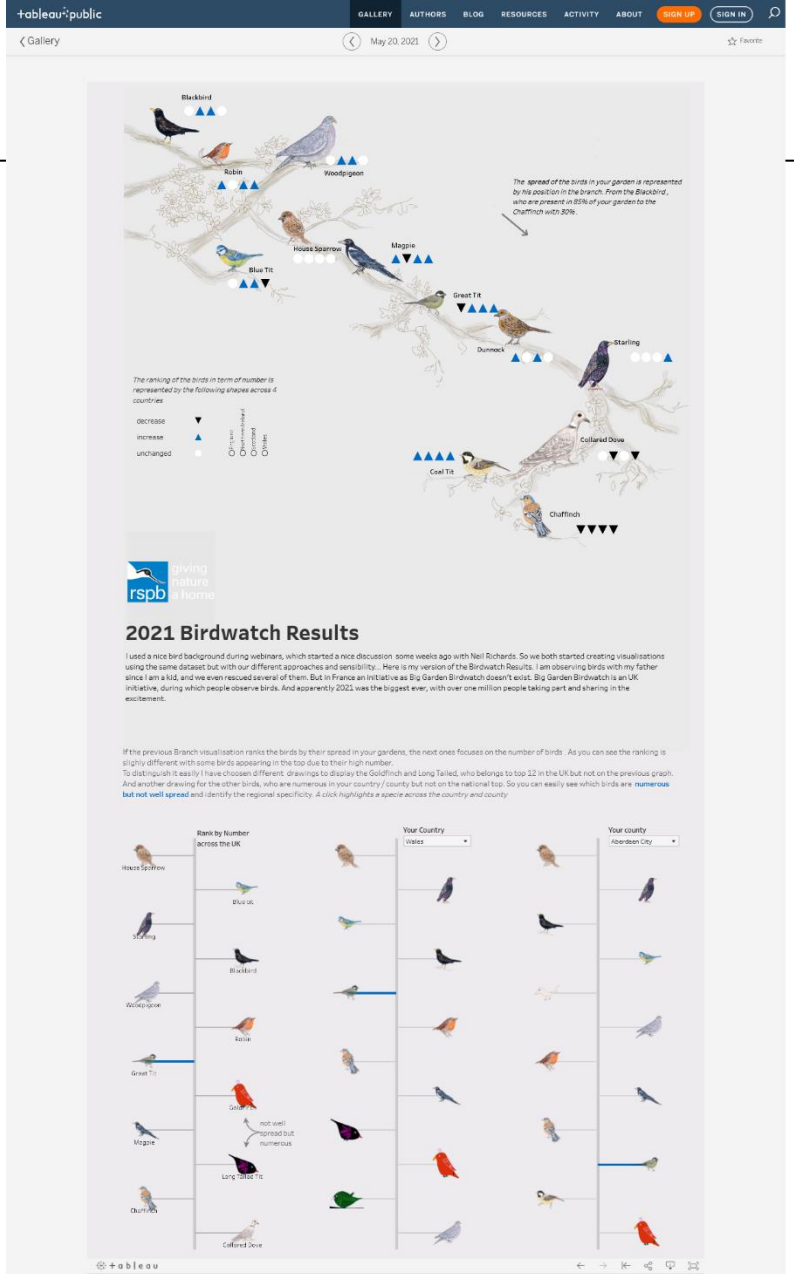
tracking infectiousness



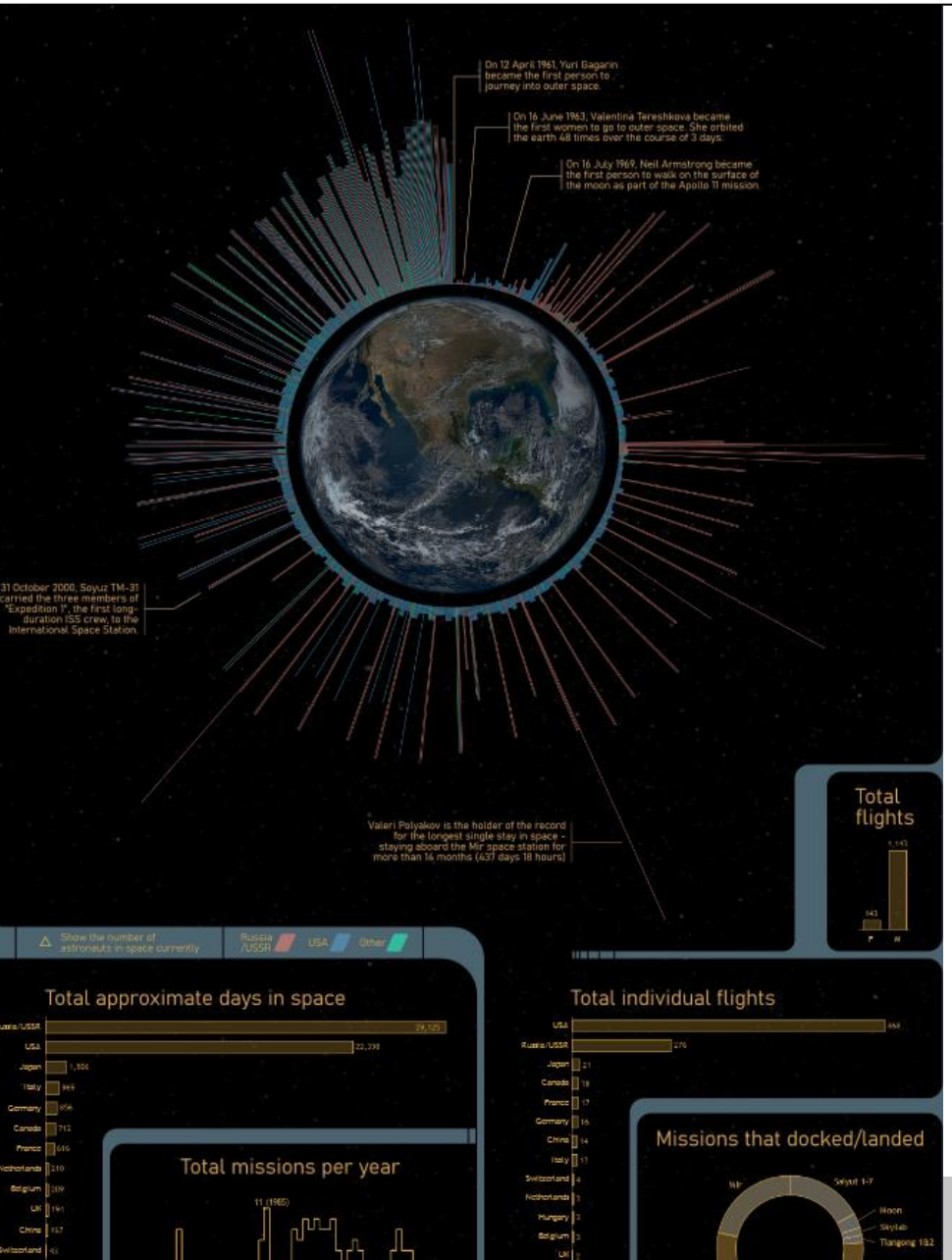
Infographics

- Is it a bird?



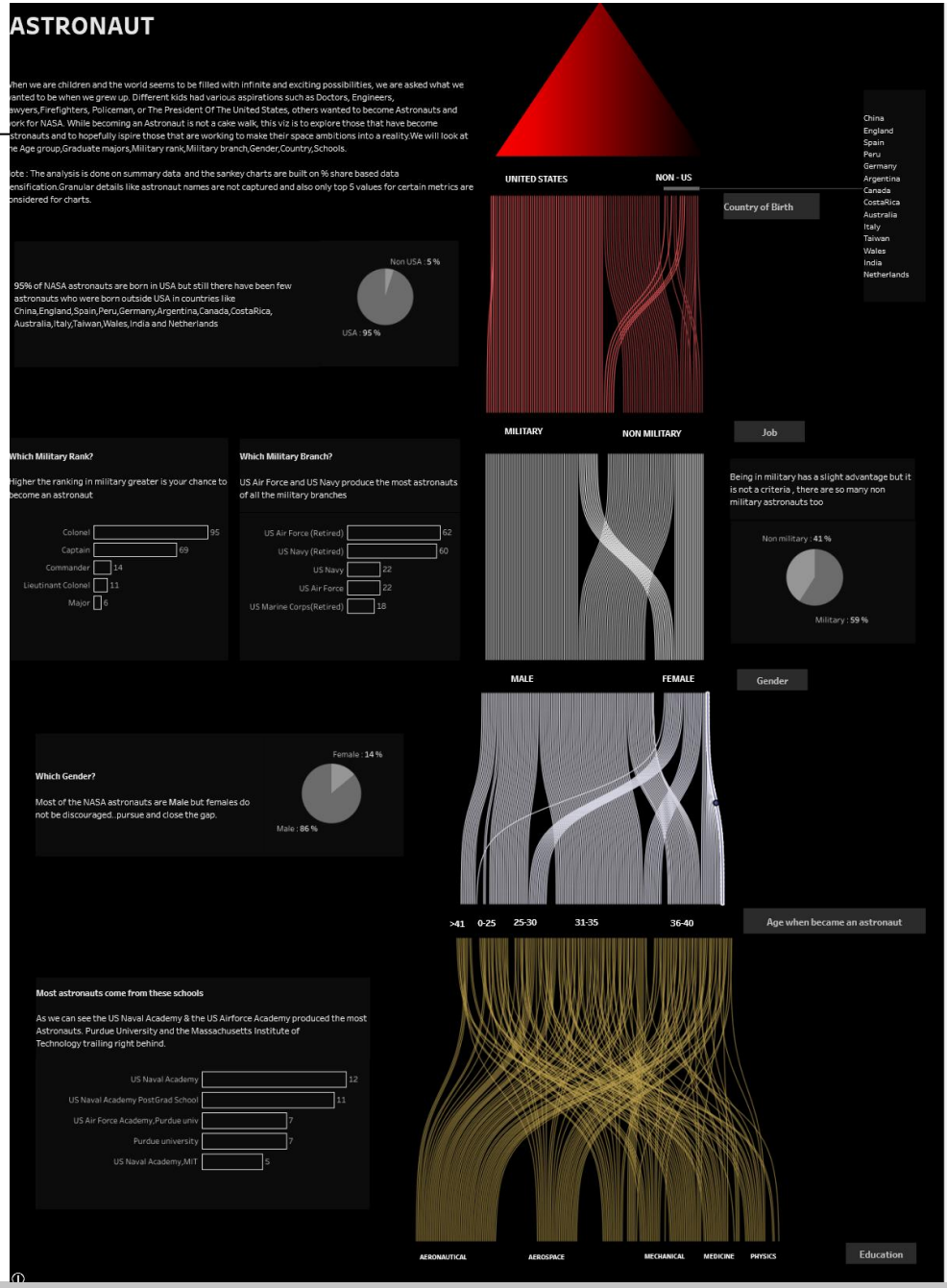


Infographics... with some interactivity



What does it take to become an astronaut?

60 Years of Human Space Flight

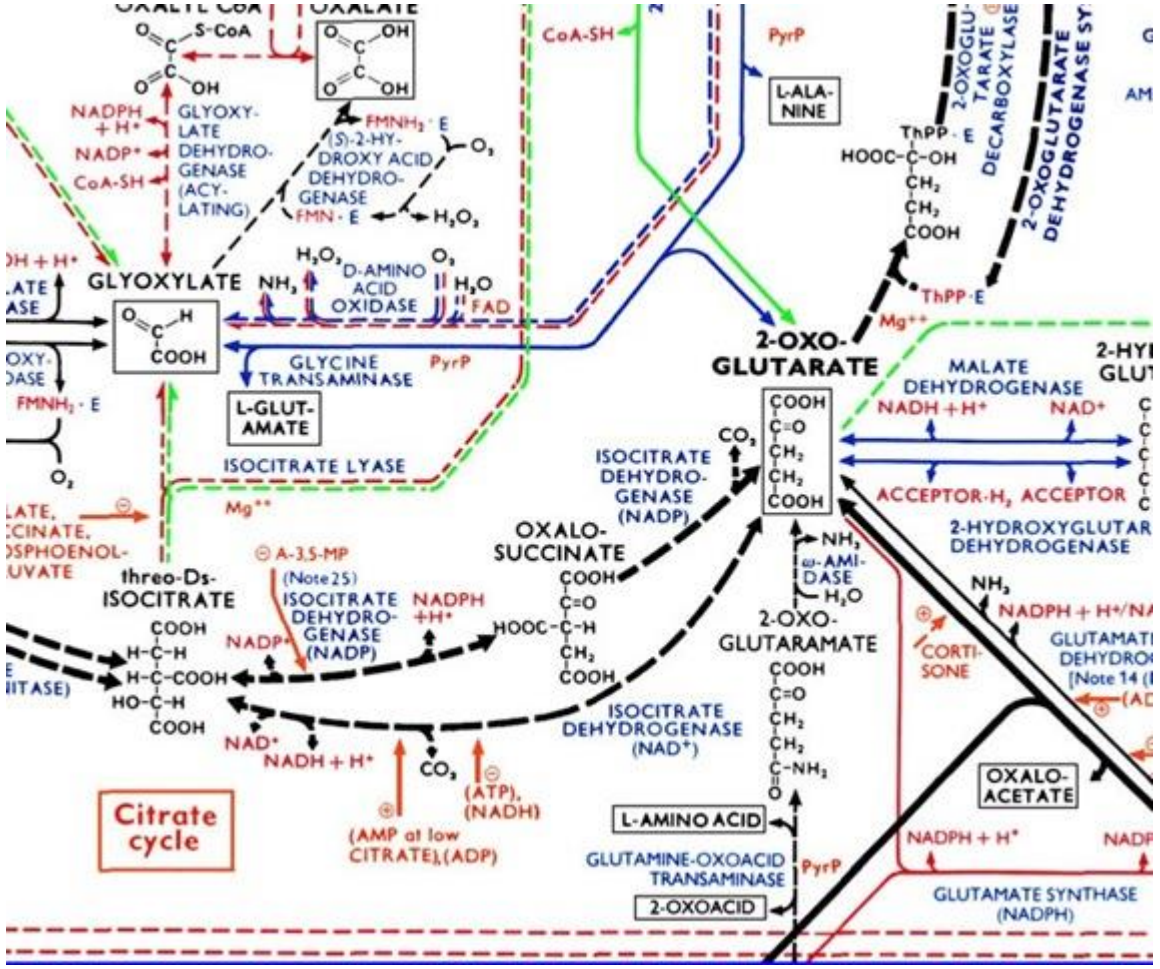


DataVis vs. Infographics

	Data Visualization	Infographic
Method of generation	More numbers used	Original images created
Quantity of data	More data	Less data, more conclusions
Degree of aesthetic treatment	Less artful, more focused on information itself	More artful
Interactive vs. static	Interactive (data changes)	Static (data remains fixed)

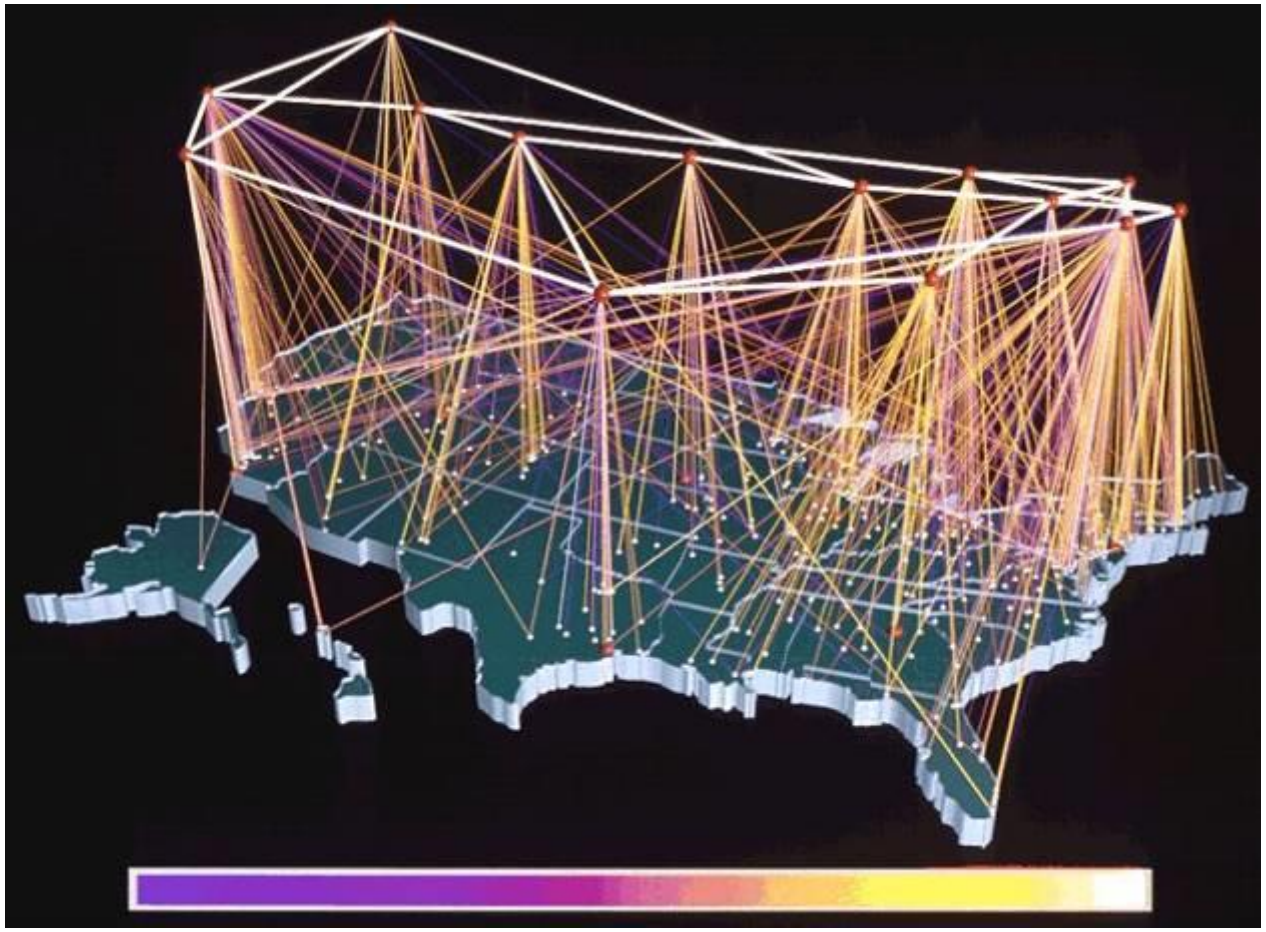
DataVis examples

- Chemistry



DataVis examples

- NSFNET T1 backbone traffic (09/1991)



- purple=0 bytes ... white=100 billion bytes

DataVis examples

- Facebook “friendships” visualized (December 2010 – sample of 10m. pairs)

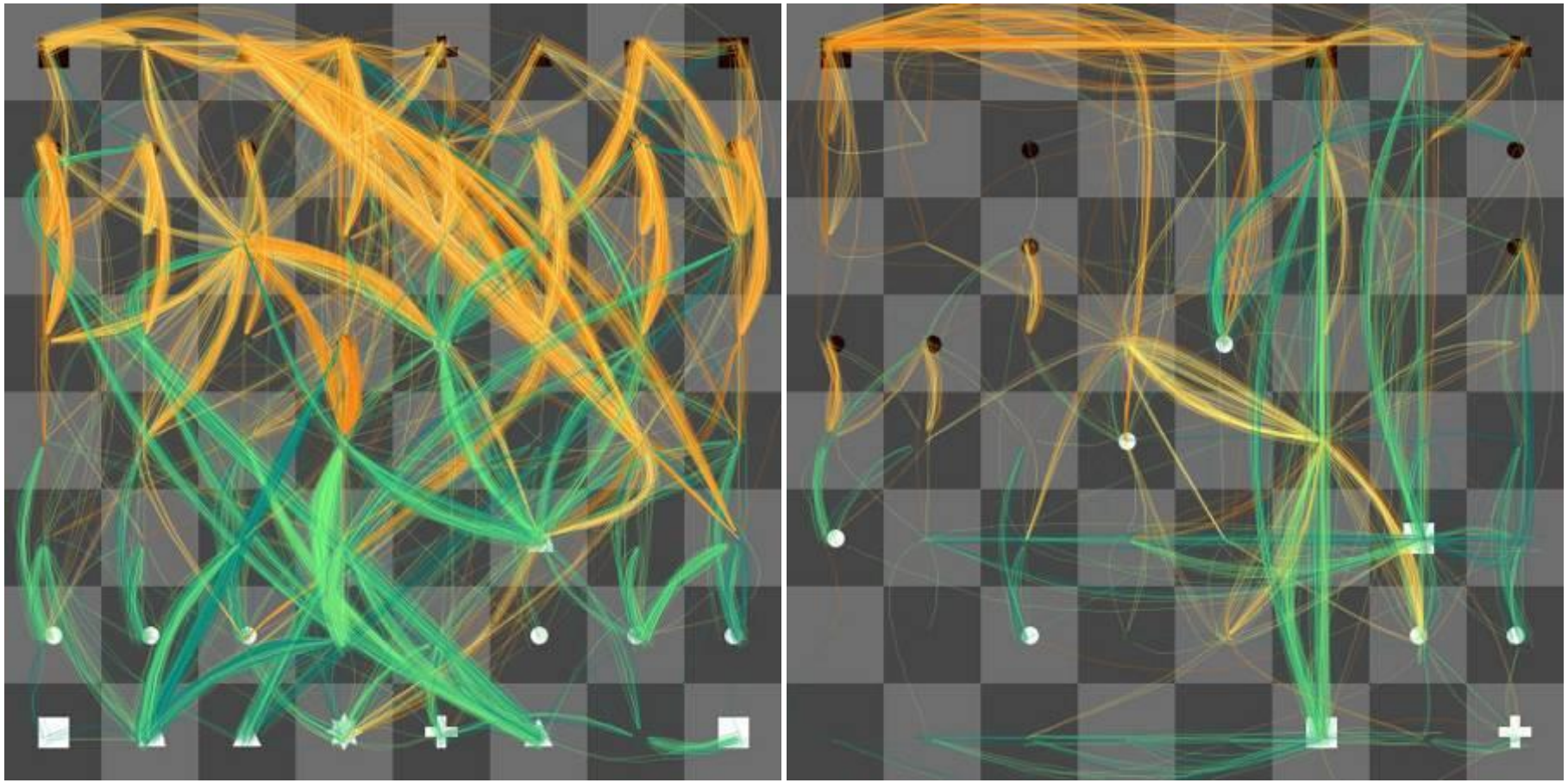
DataVis examples

- Οι κινήσεις καραβιών μέσα από τα ημερολόγια (φύλλα πορείας) τους, από το 1945

https://www.reddit.com/r/MapPorn/comments/dmkkpe/this_map_is_drawn_entirely_from_shipping_logs/

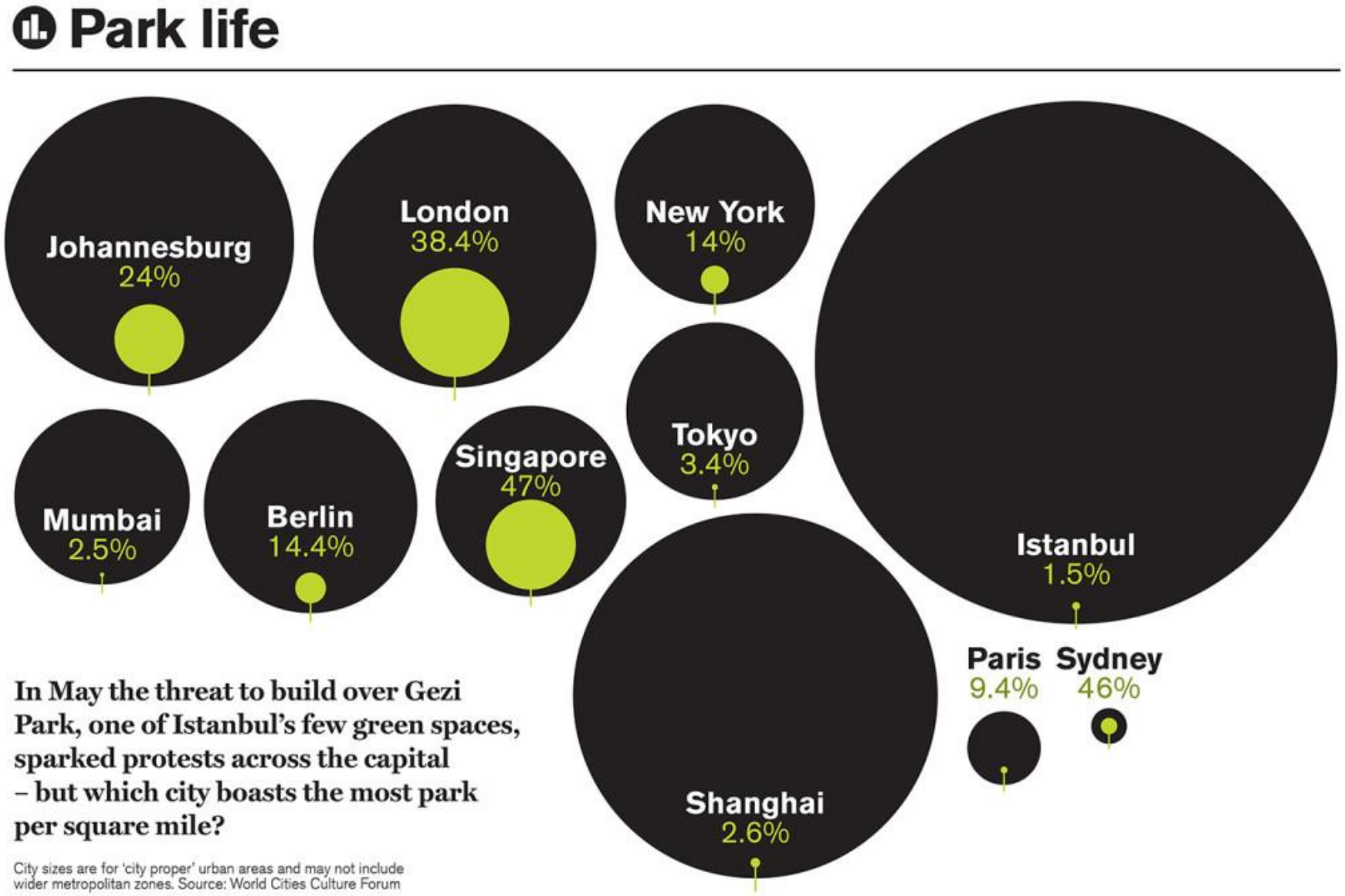
DataVis examples

- Possible moves in a game of chess

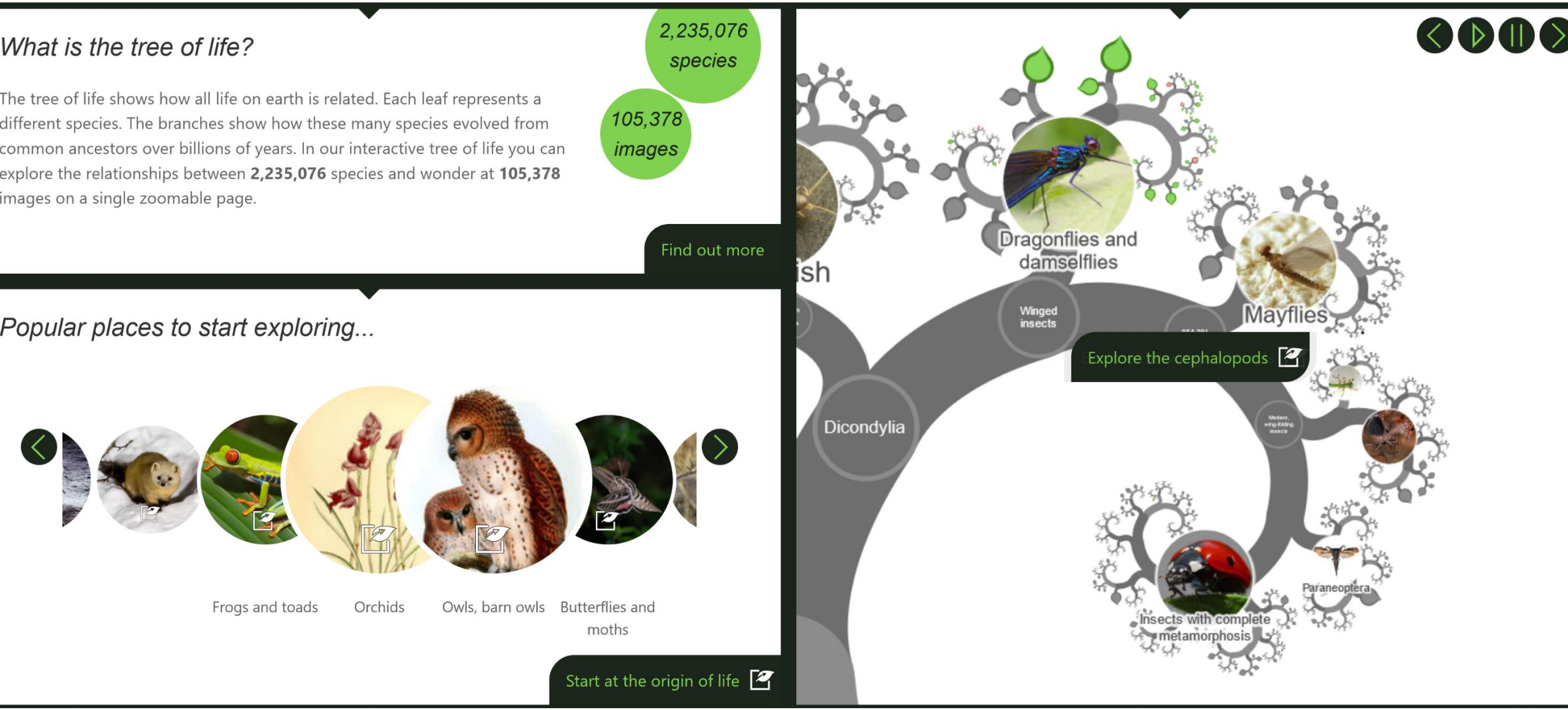


http://turbulence.org/spotlight/thinking/method.html

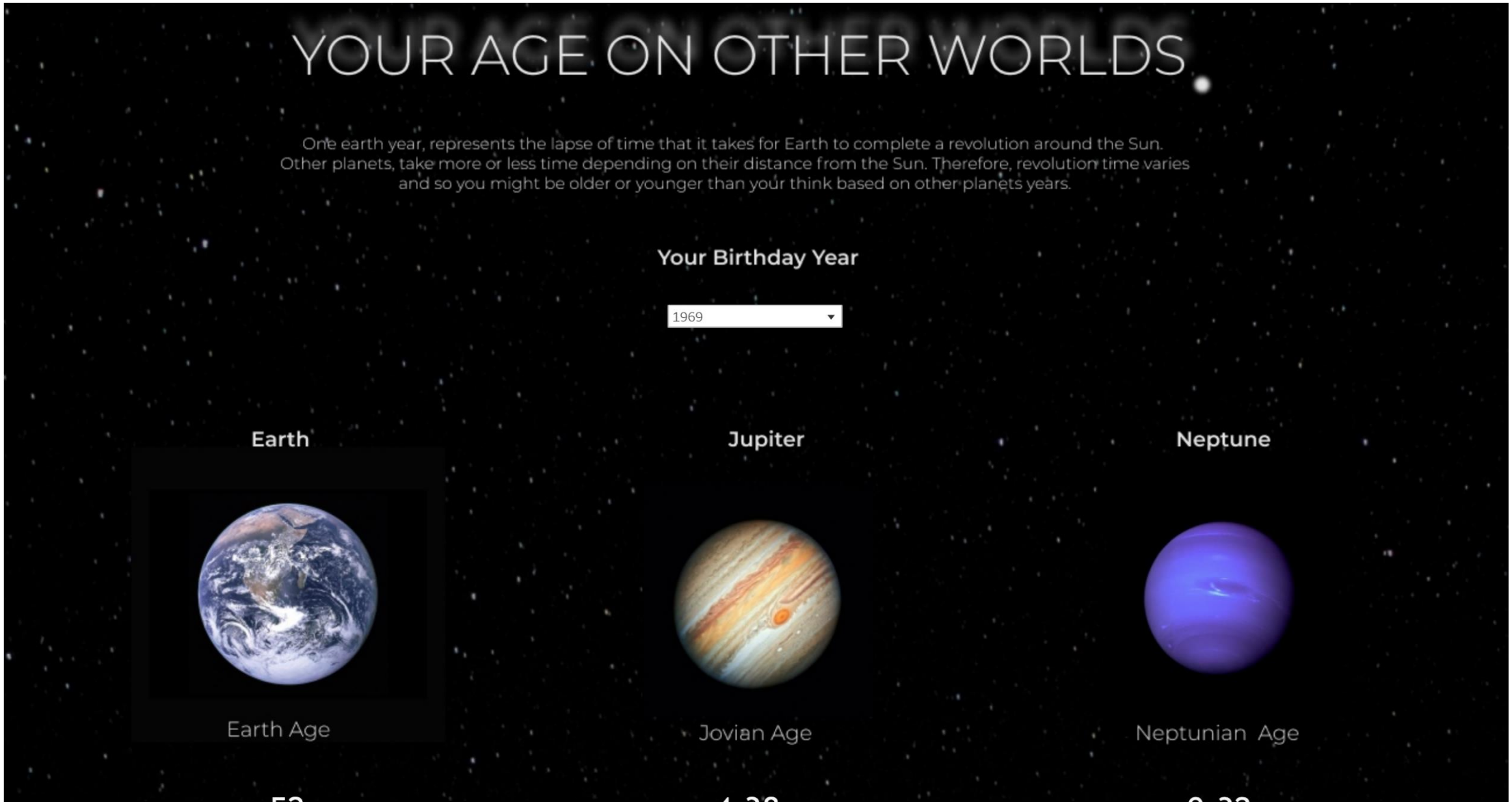
DataVis examples



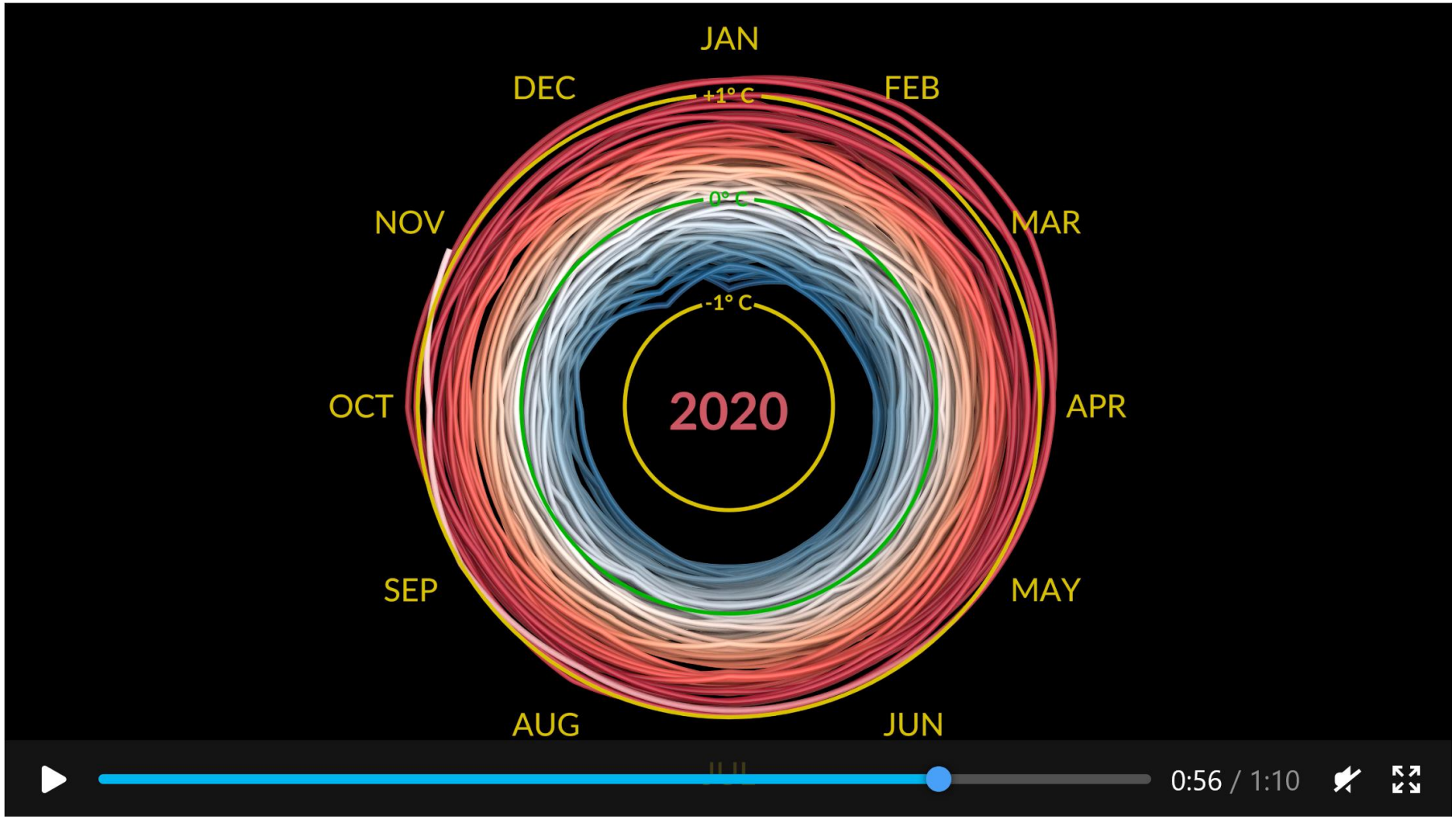
DataVis examples: **OneZoom tree of life explorer**



DataVis examples



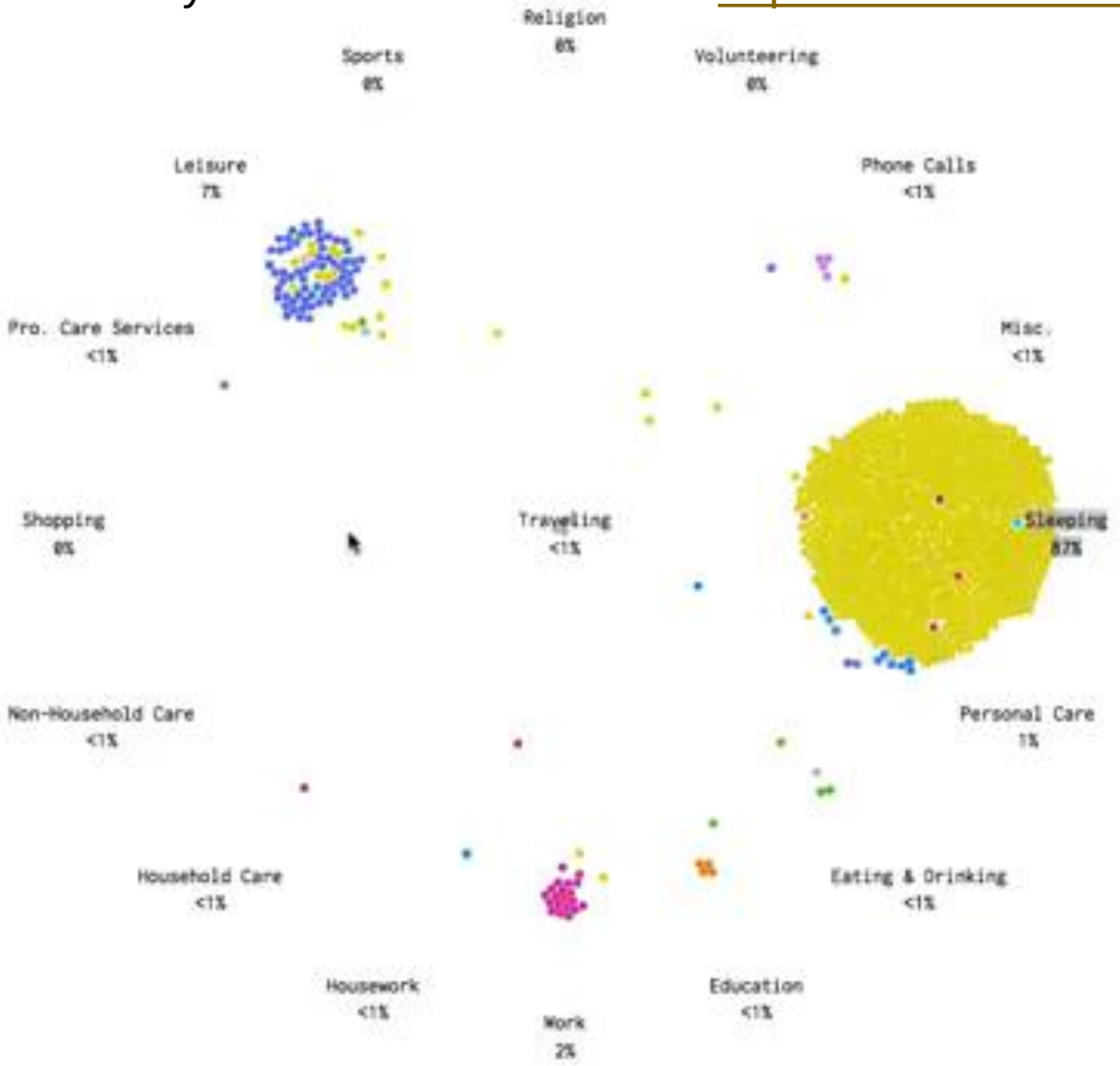
Animation –example of powerfully and simply conveying a message



NASA Climate Change, https://svs.gsfc.nasa.gov/4975

DataVis examples

A Day in the Life of Americans https://lnkd.in/dTb5Xhf



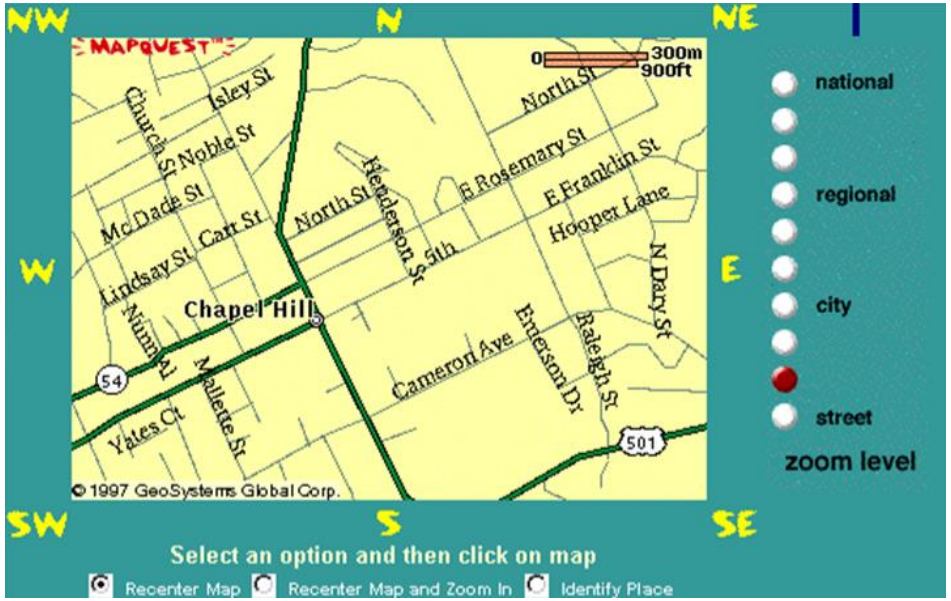
https://flowingdata.com/projects/2015/timeuse-simulation/

Maps - examples

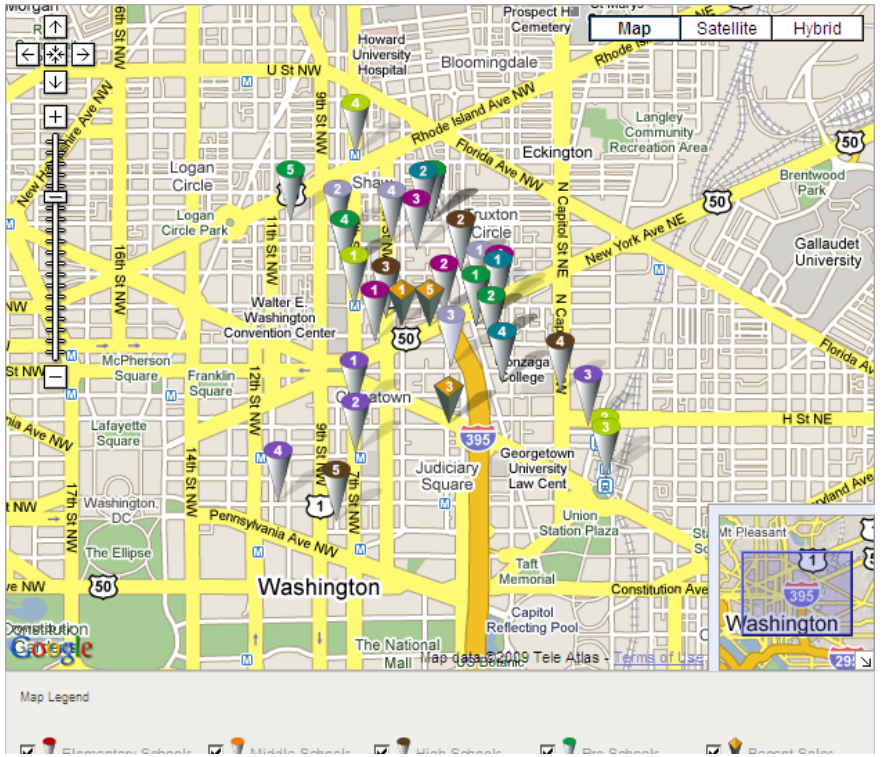
- Geographic maps
- Cartograms

DataVis examples

- online map services

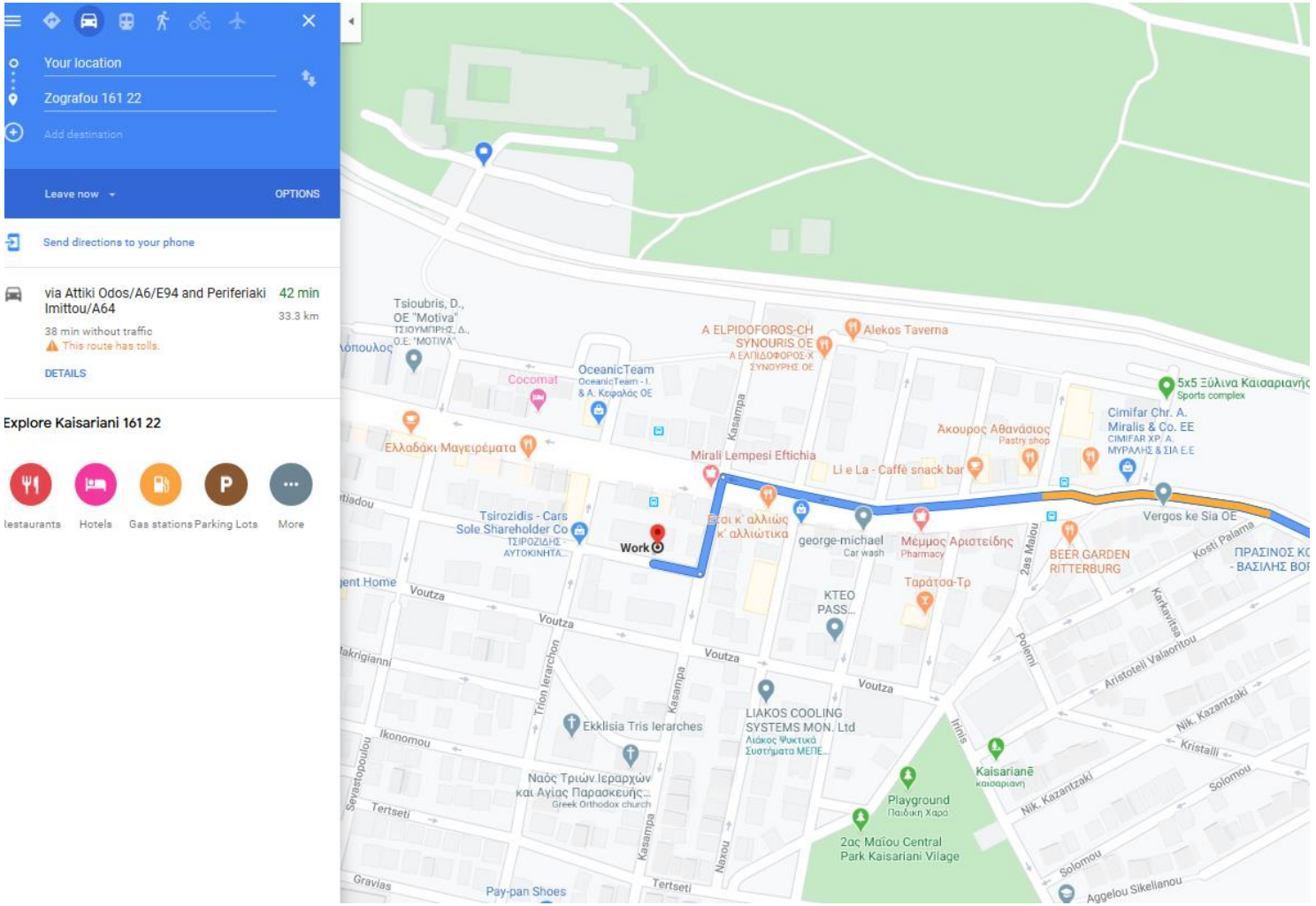


Mapquest



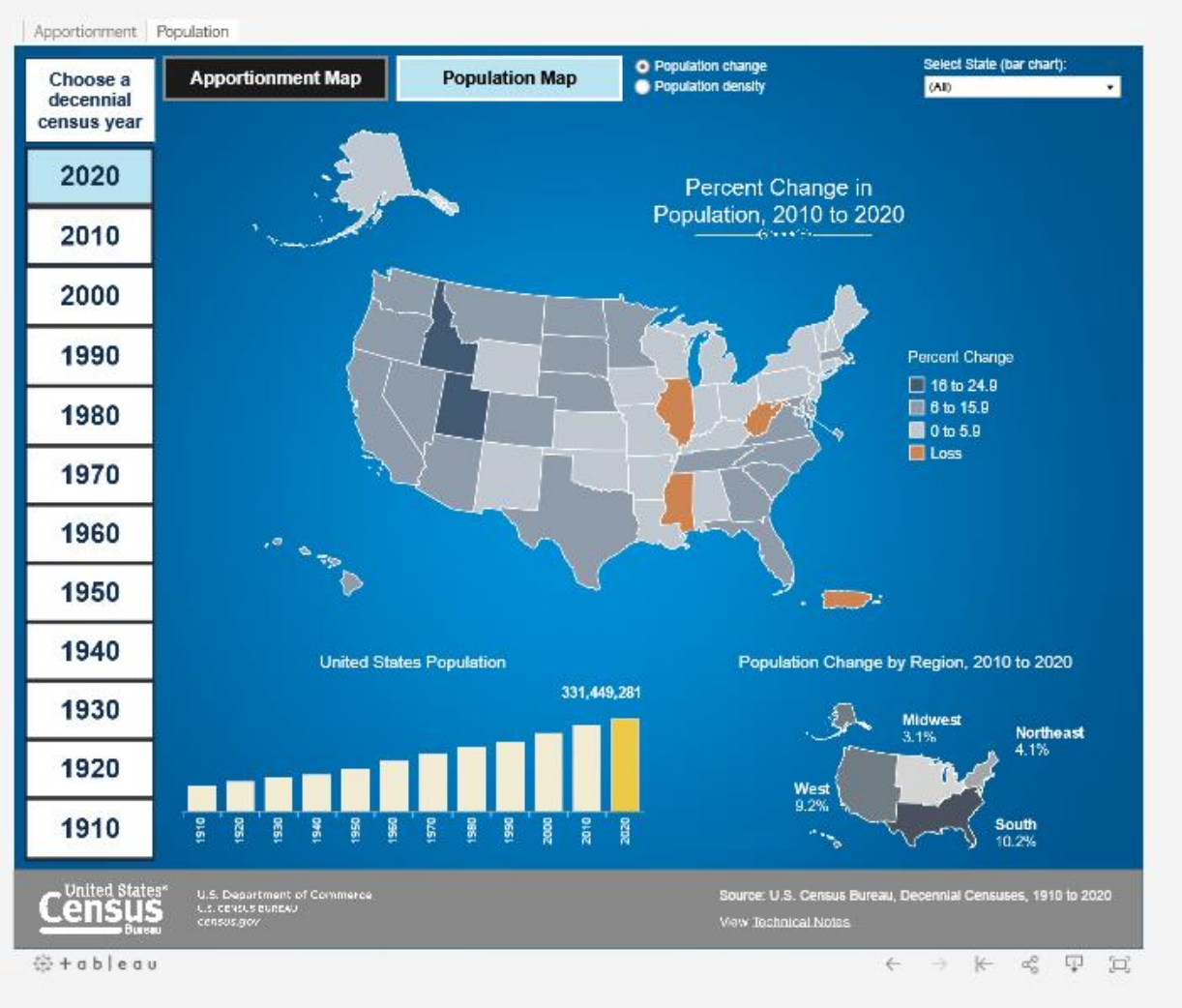
DataVis examples

- Google Maps



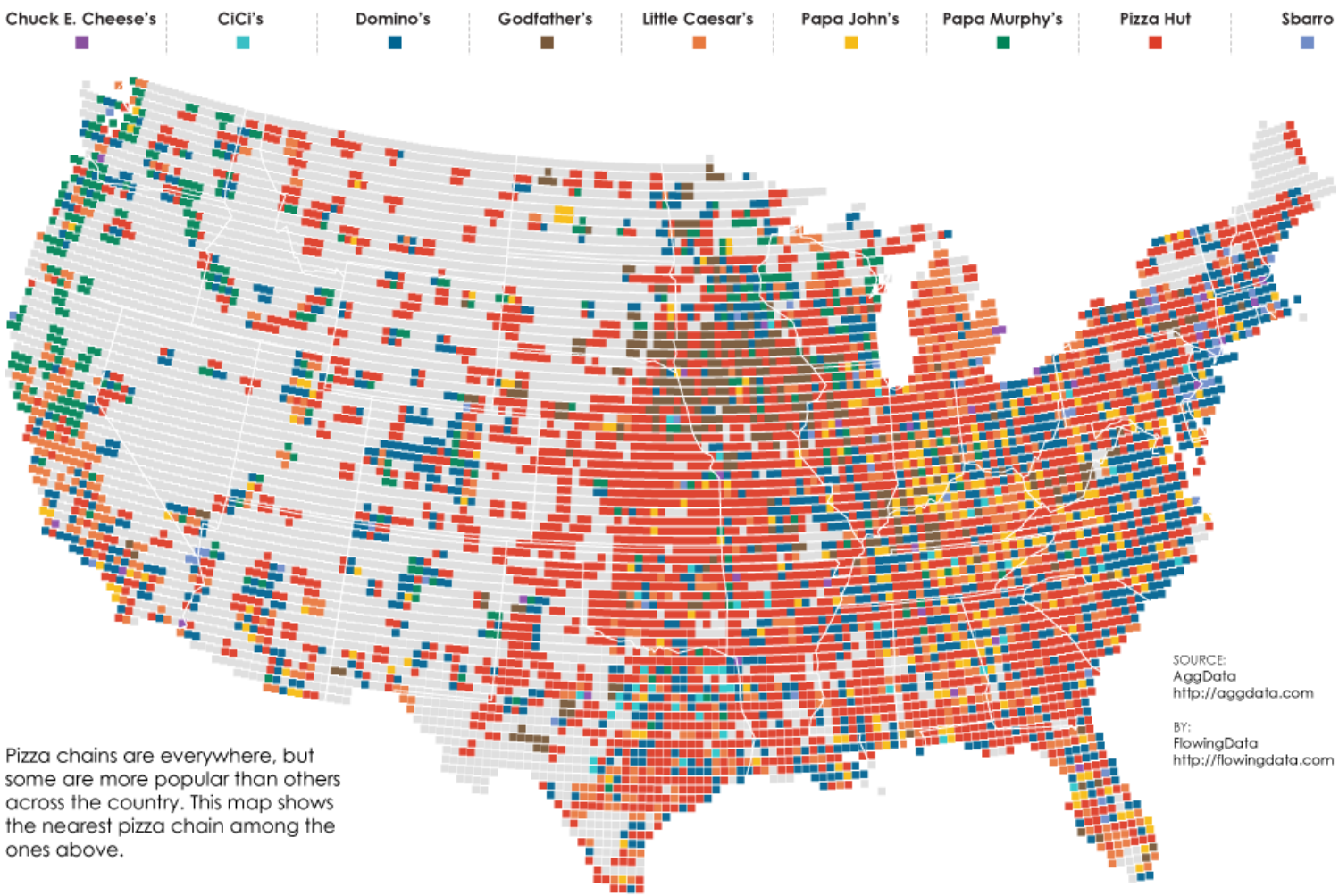
DataVis examples

- Historical population and apportionment in the USA



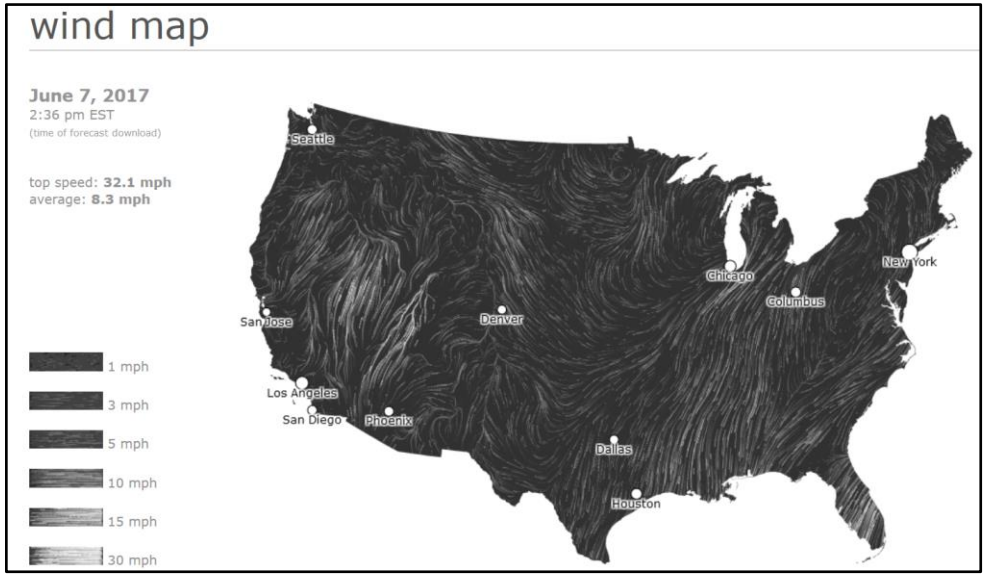
DataVis examples

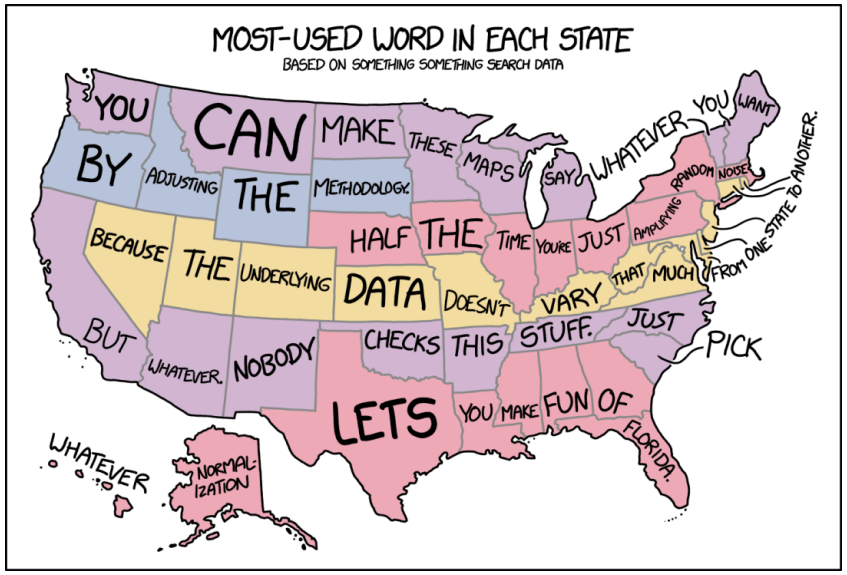
- Pizza restaurant chains in the USA



DataVis examples

- Places & Spaces: mapping science

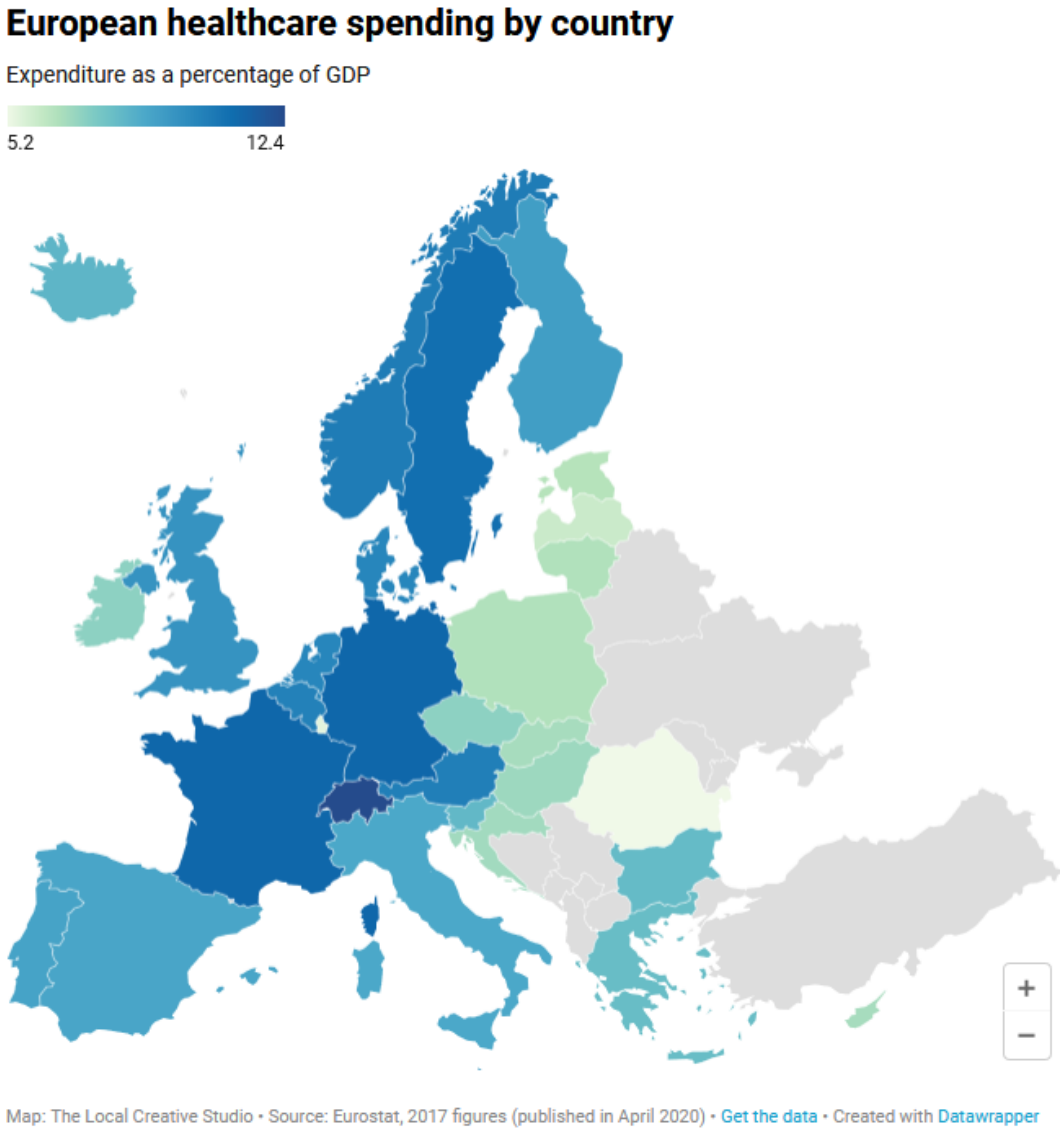




http://hint.fm/wind/

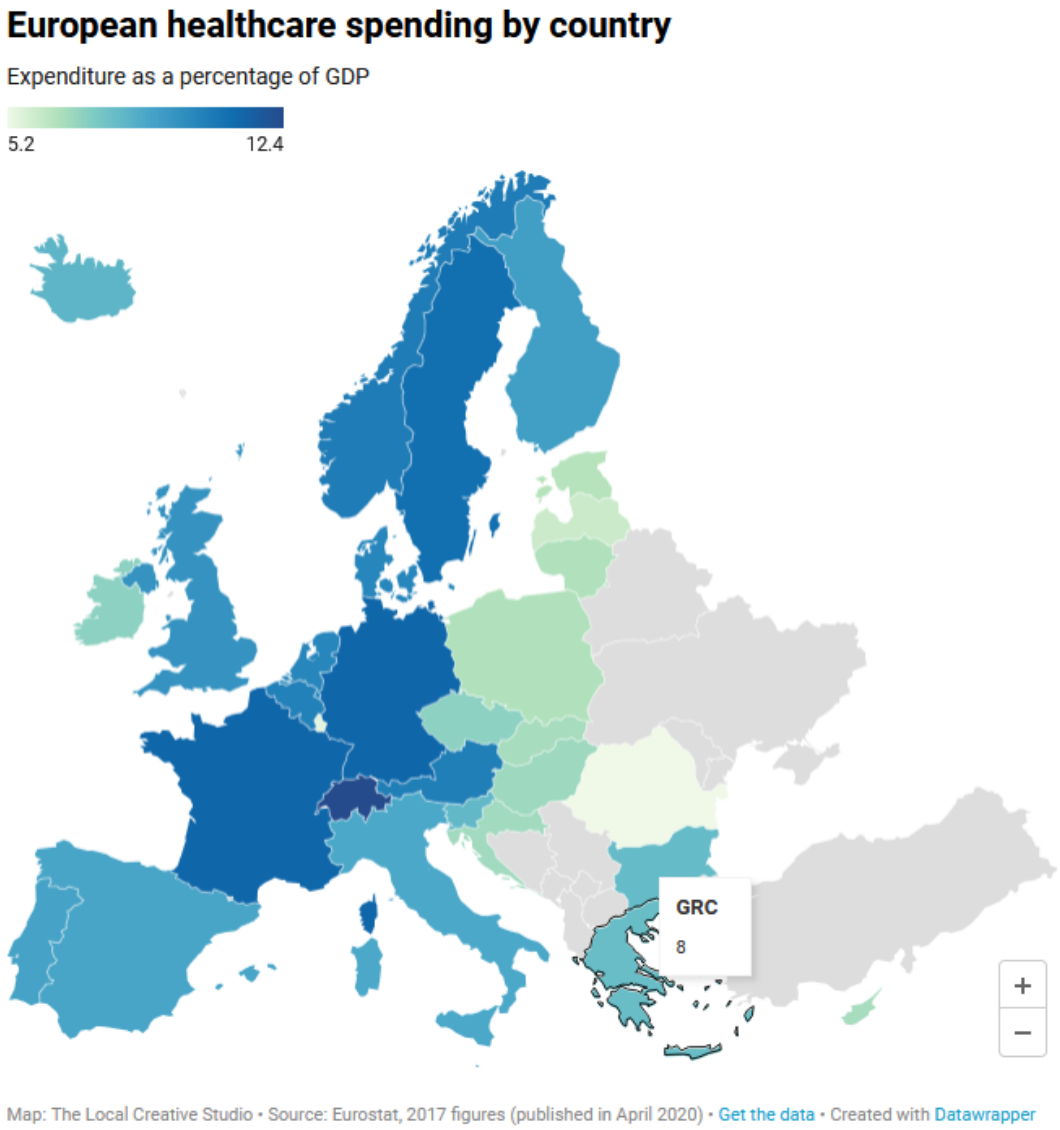
Less is more

- Interactive maps



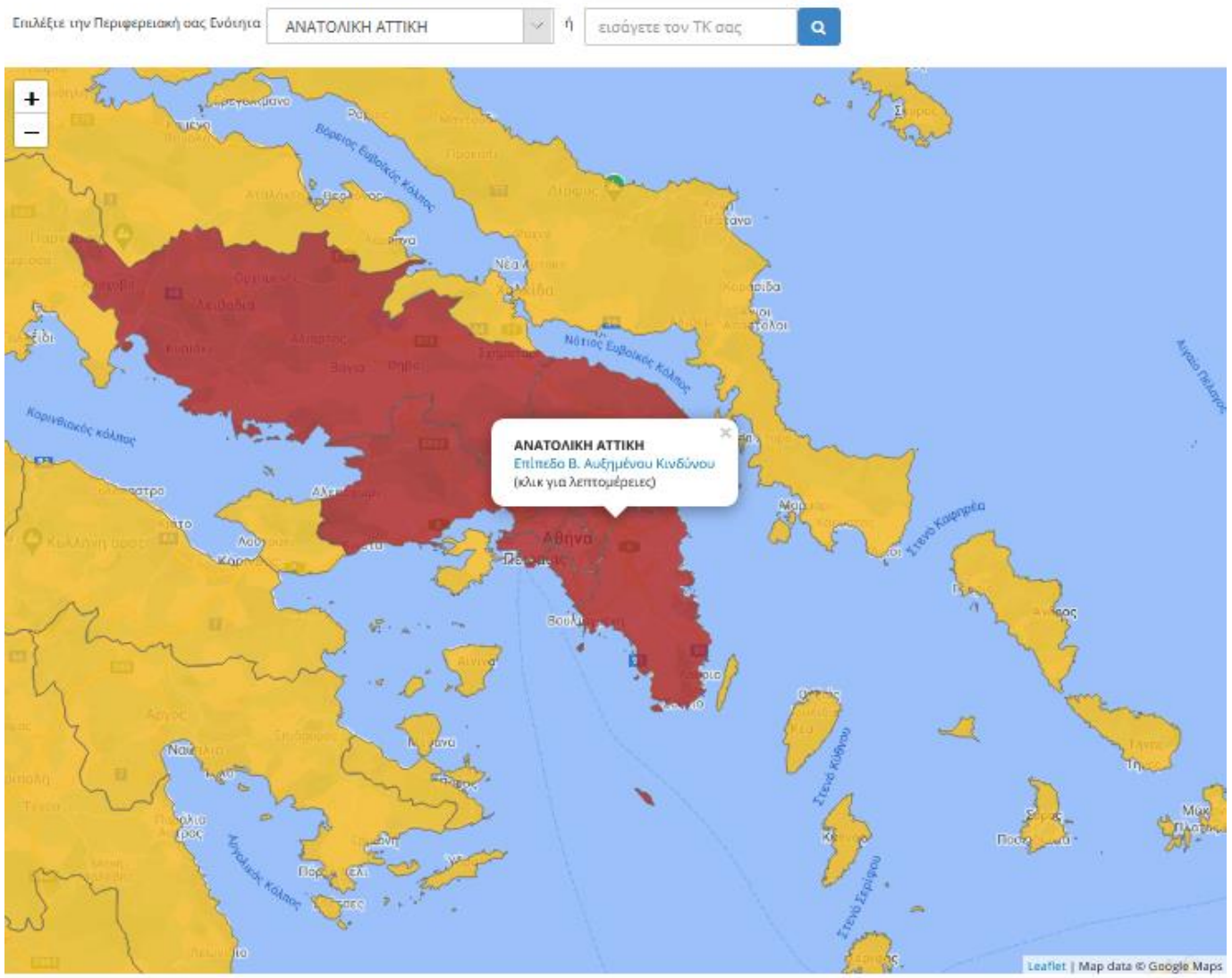
Less is more

- Interactive maps

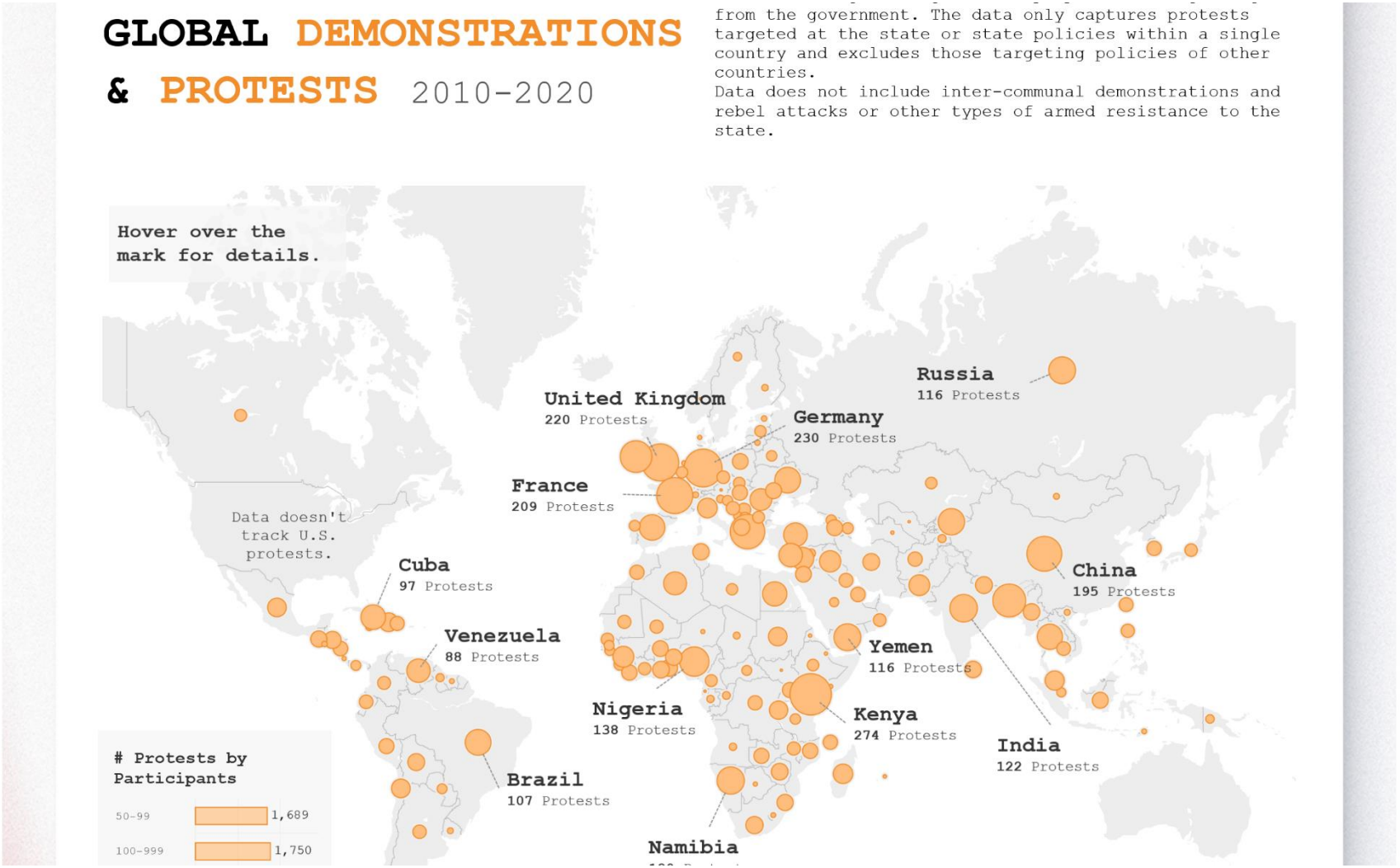


Less is more

- Interactive maps

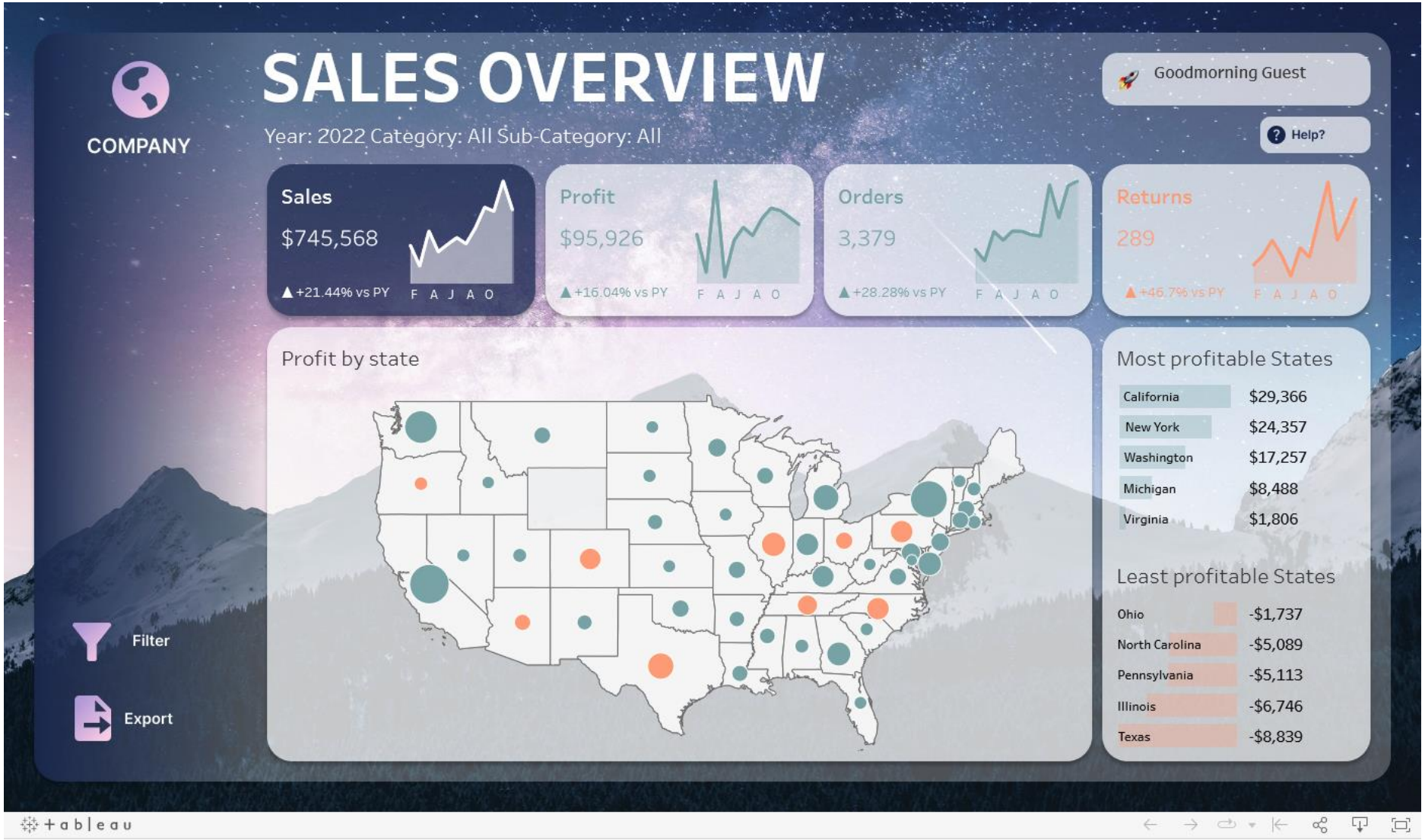


Bubble chart on map



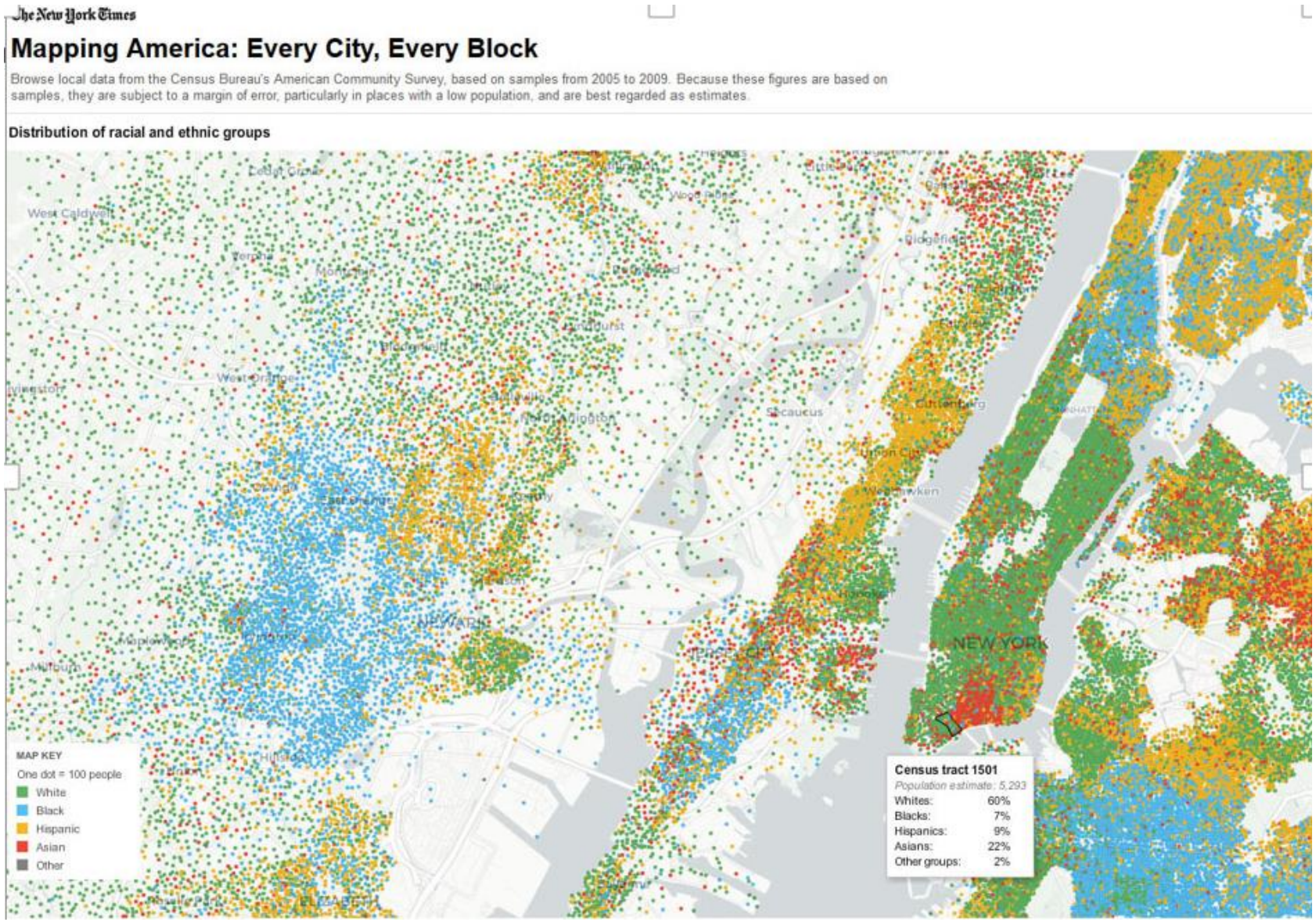
https://public.tableau.com/app/profile/m.azhar/viz/GlobalDemonstrationsandProtests/Dashboard1

Bubble chart on map



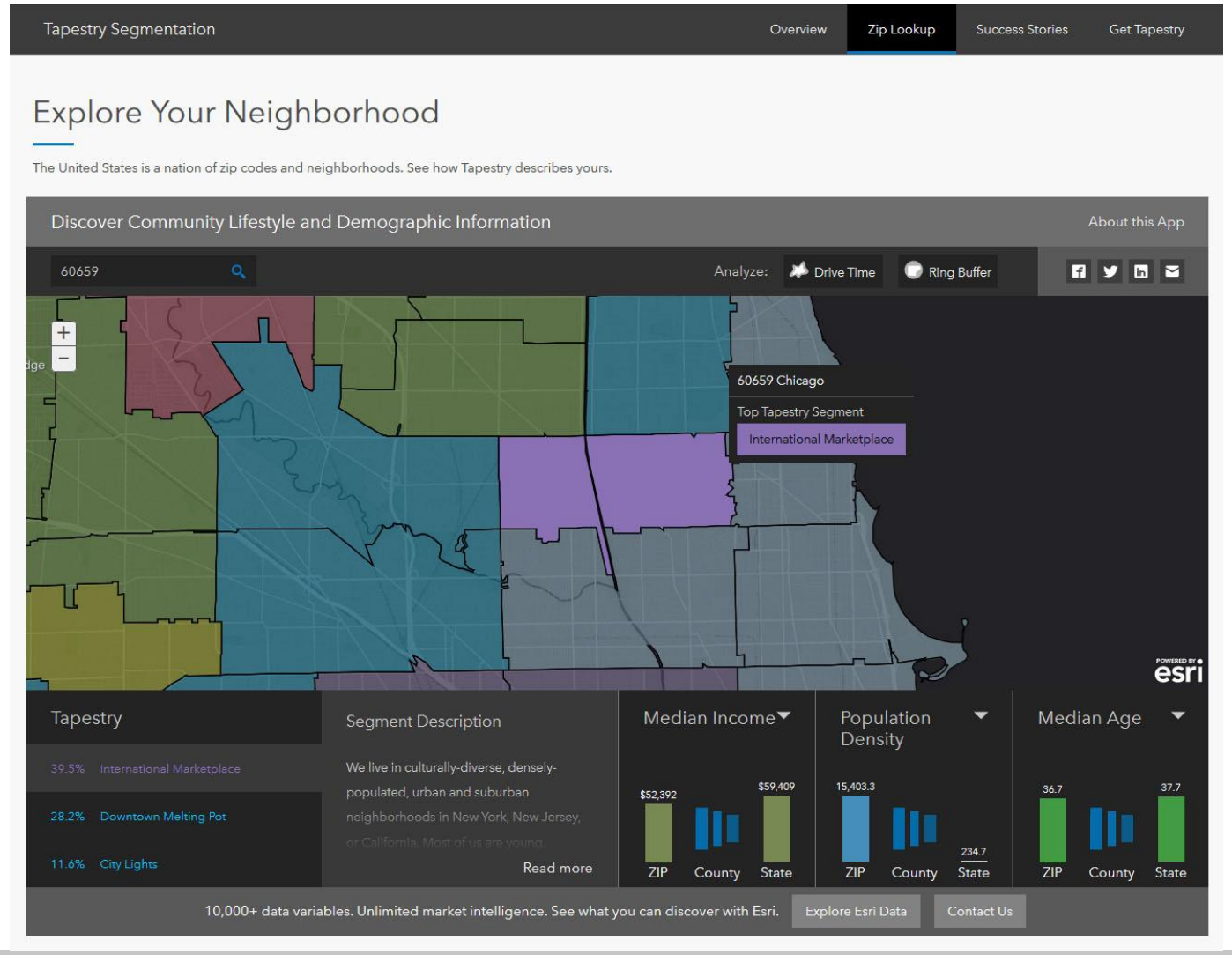
https://public.tableau.com/app/profile/joris.van.den.berg/viz/SunCycleSalesDashboard/SunCycleSalesDashboard

DataVis examples



DataVis examples

- Explore Your Neighborhood



DataVis examples

- cartograms

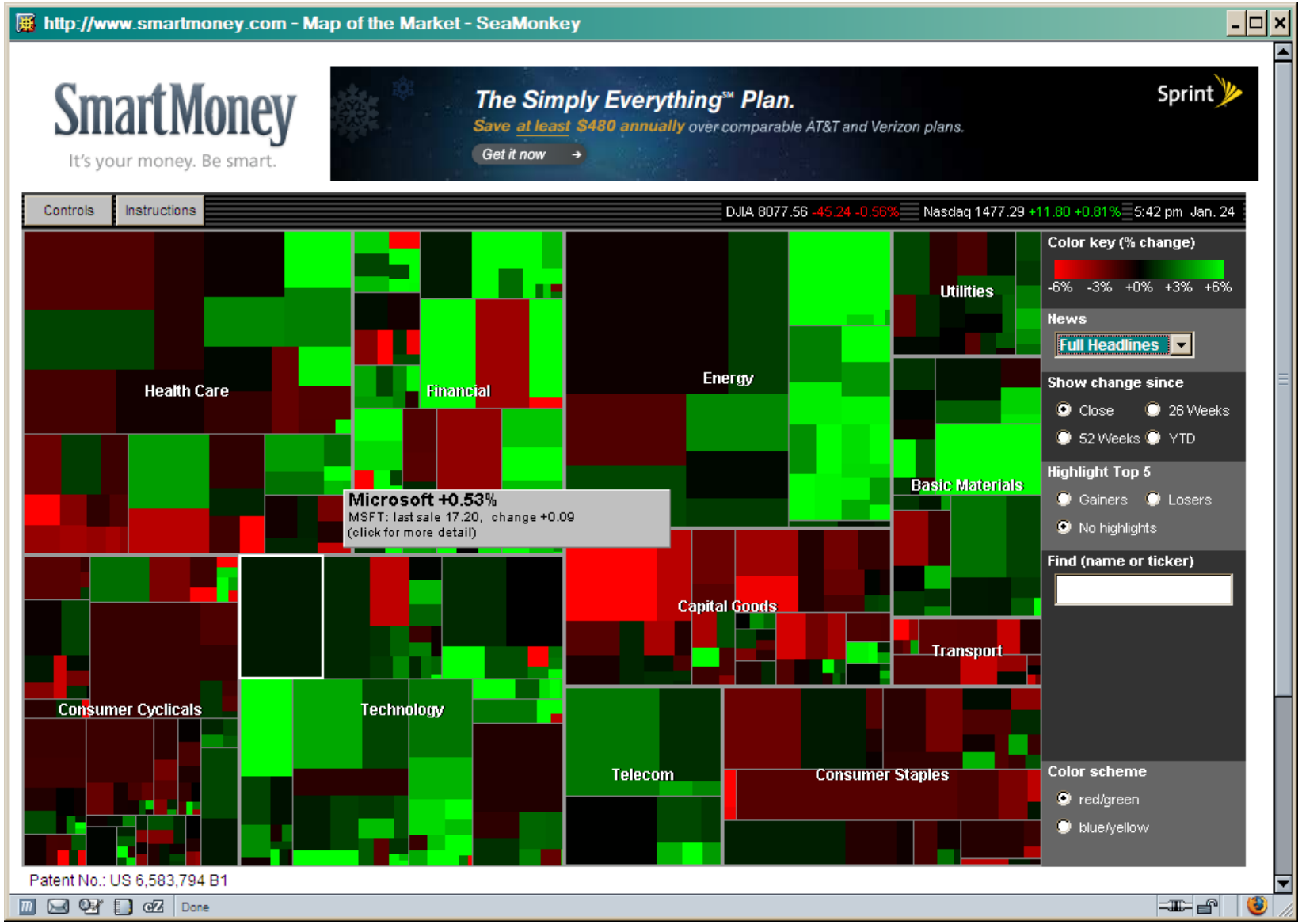
DataVis examples

- cartograms

Maps - examples

- treemaps

DataVis examples

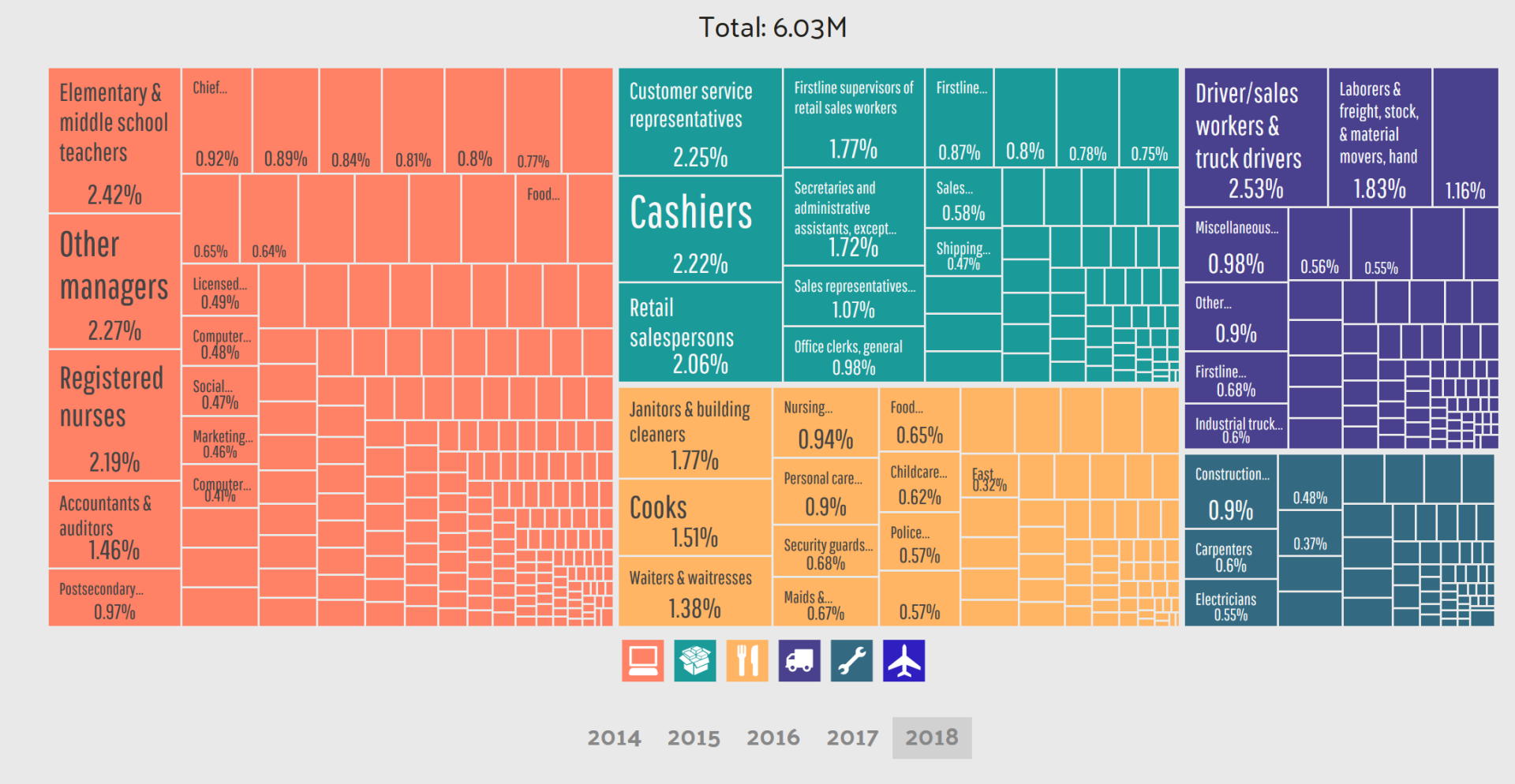


DataVis examples

http://www.naftemporiki.gr/finance/treeMap?data=turnover&market=ATH&type=market

DataVis examples

- https://datausa.io/profile/geo/illinois#category_occupations



DataVis examples

- News headlines categorized

http://newsmap.jp/

Interactivity - examples

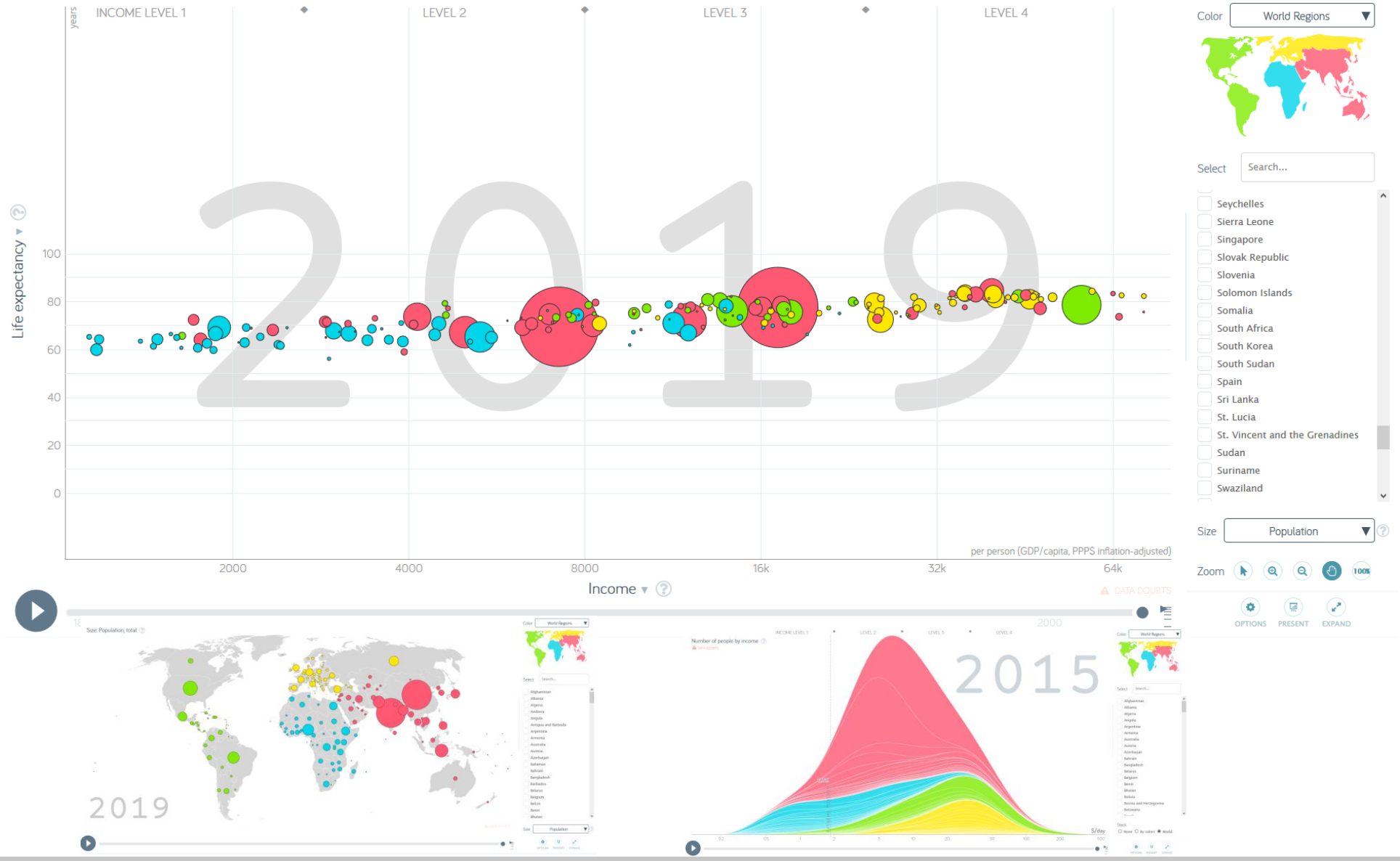
- Charts
  - line charts
  - bar charts
  - pie charts
  - bubble charts
  - scatterplots
  - time series plots, timelines
  - spider/radar charts
  - box and whisker diagrams / charts
- Interactivity
  - Queries, filtering, selection, etc.

DataVis examples

- Homefinder (DC) real estate
  - The city is within the diamond shape
  - Houses on sale shown as yellow dots

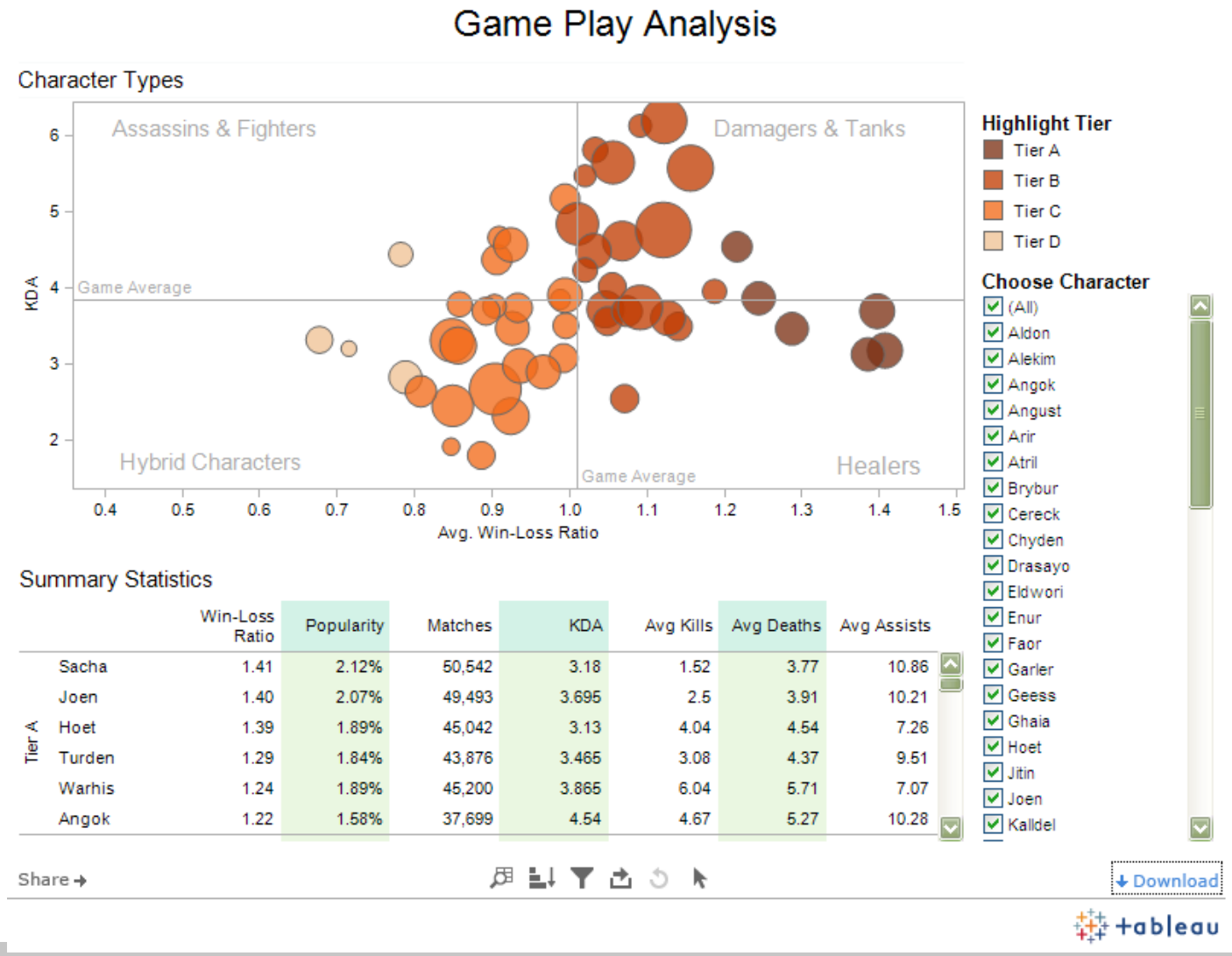
In Card et al. (1999)

DataVis examples – bubble charts



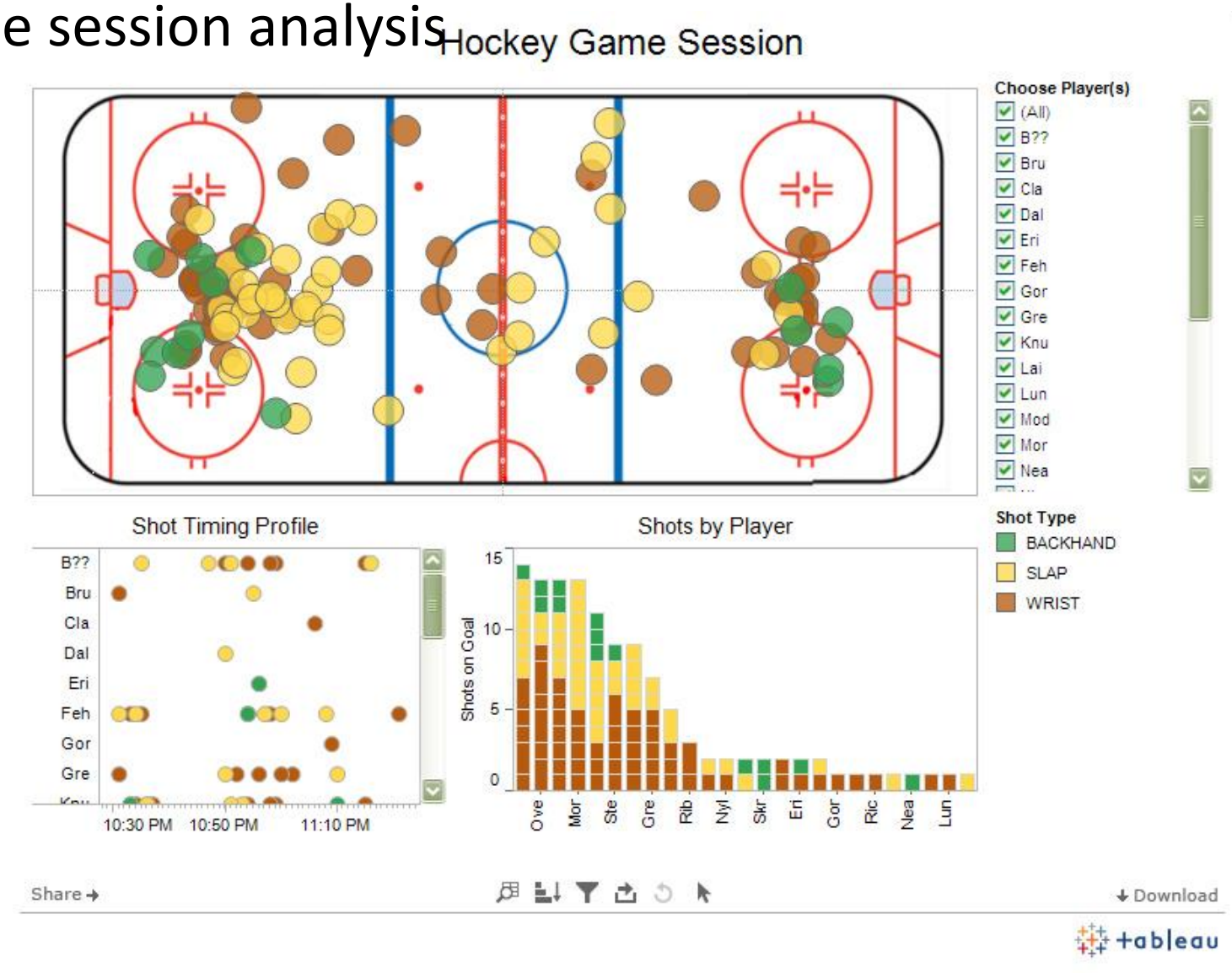
DataVis examples

- Game play analysis between characters of a game



DataVis examples

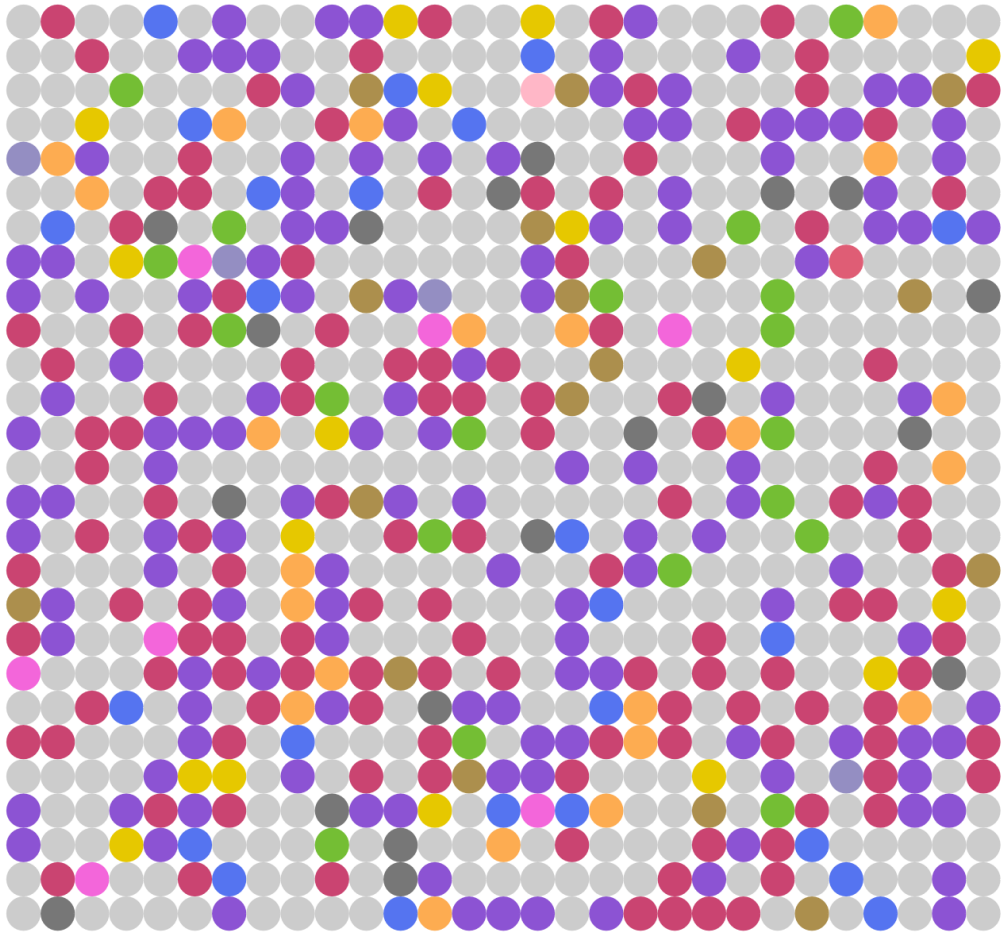
- Hockey game session analysis



DataVis examples

- How You Will Die: # of people who died in the USA, 1999 - 2014

I am **male** **White** and currently **50** years old. LIVE



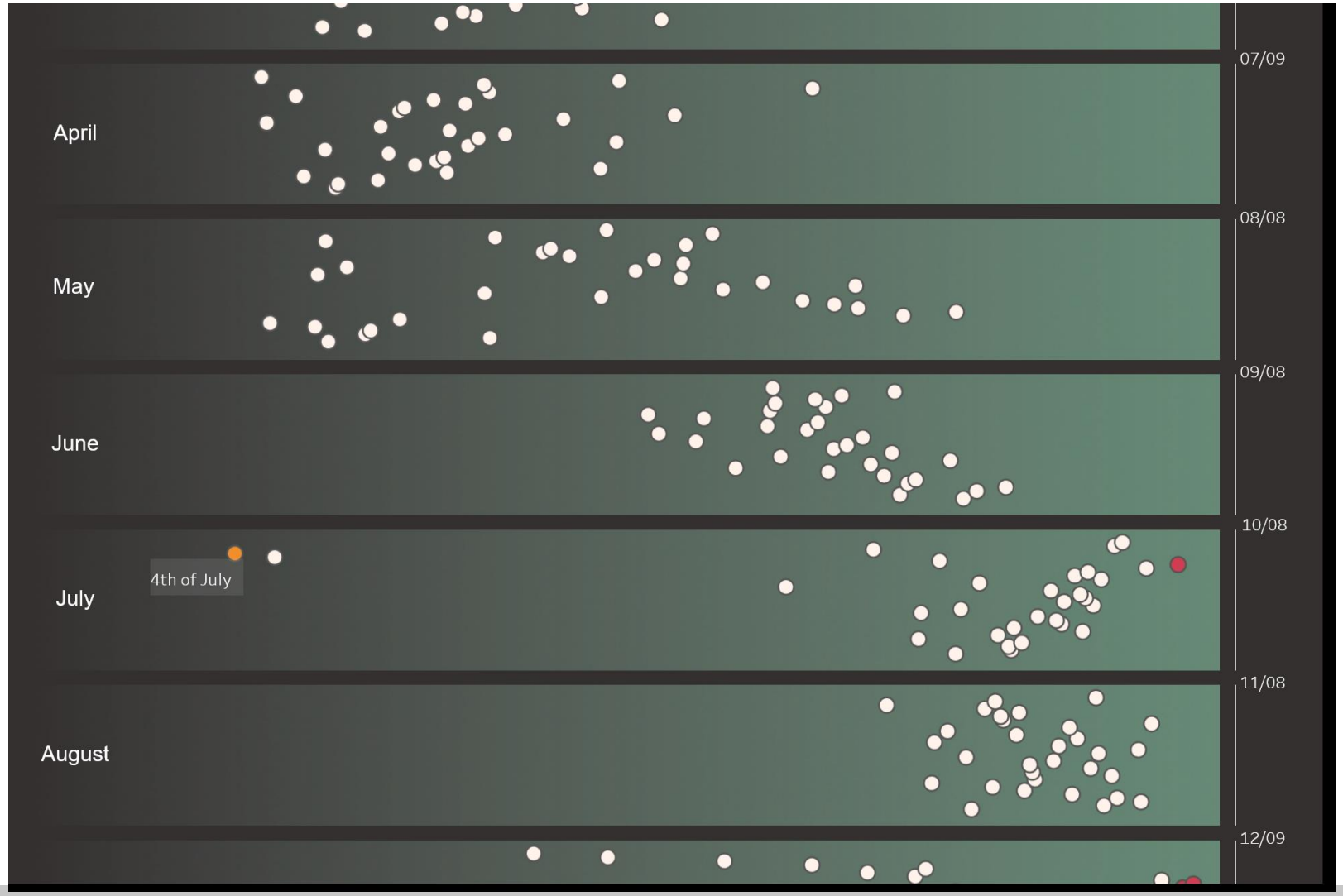
AGE OF DEATH	DIED SO FAR	STILL ALIVE
75 years	50%	50%

CAUSE OF DEATH SO FAR

5%	Infection
32%	Cancer
0%	Blood
6%	Endocrine
1%	Mental
2%	Nervous
34%	Circulatory
6%	Respiratory
4%	Digestive
0%	Musculoskeletal
4%	Genitourinary
0%	Perinatal
0%	Congenital
5%	External Causes
0%	Other

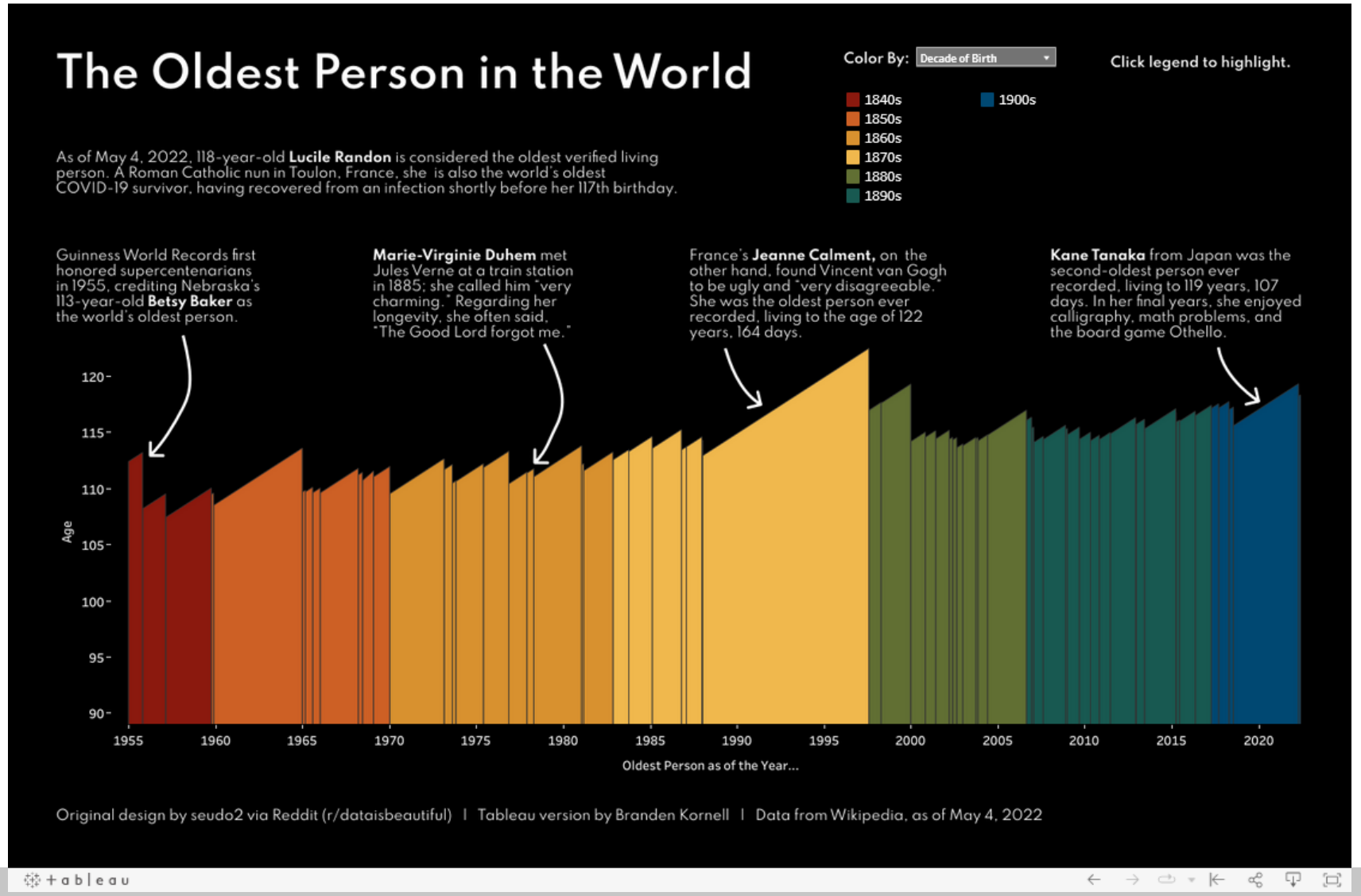
DataVis example

- How common is your birthday?



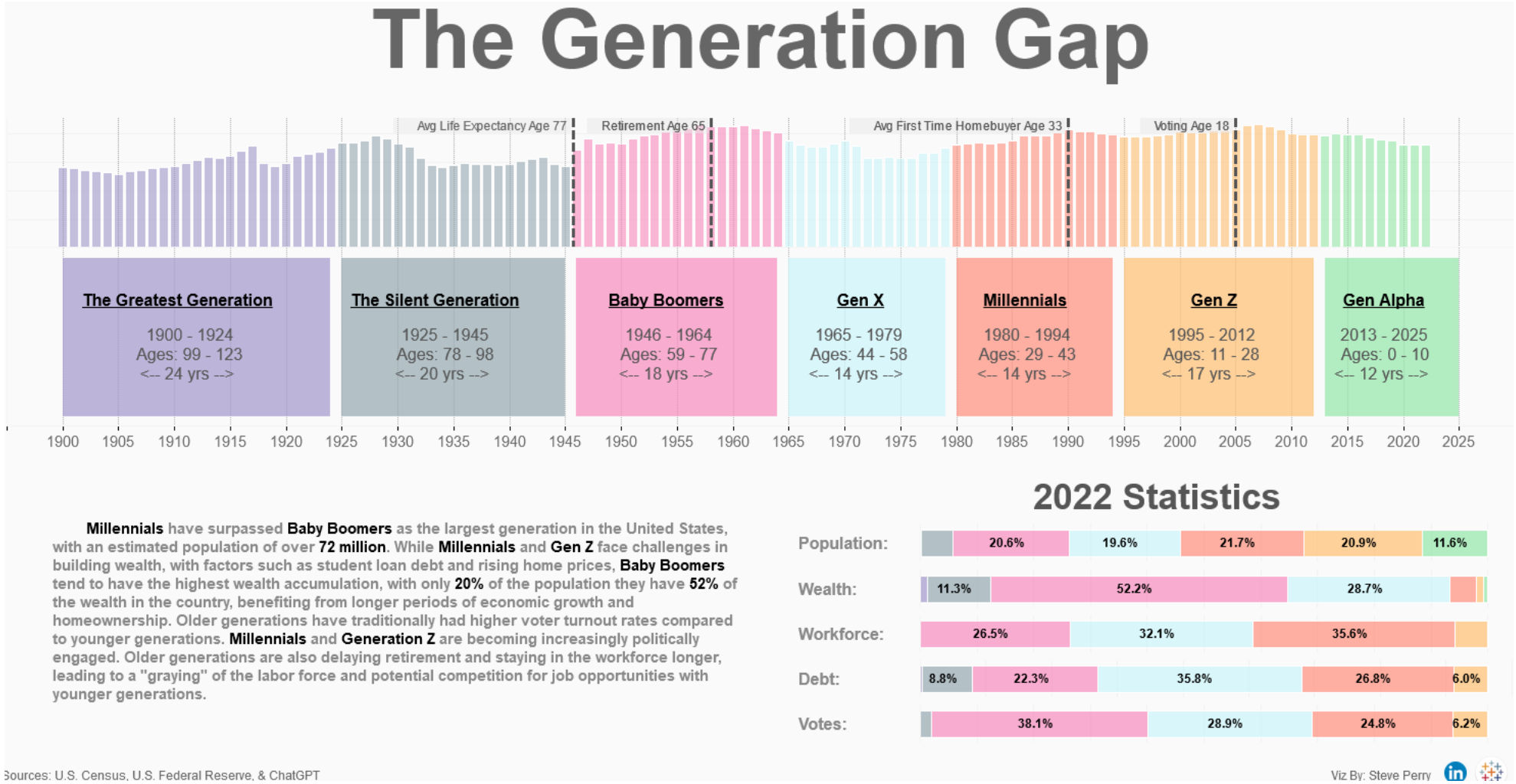
DataVis examples

- The oldest person in the world (1955-2022)



DataVis examples

- Bar charts (in small multiples)



DataVis examples

- Real time positions of marine vessels

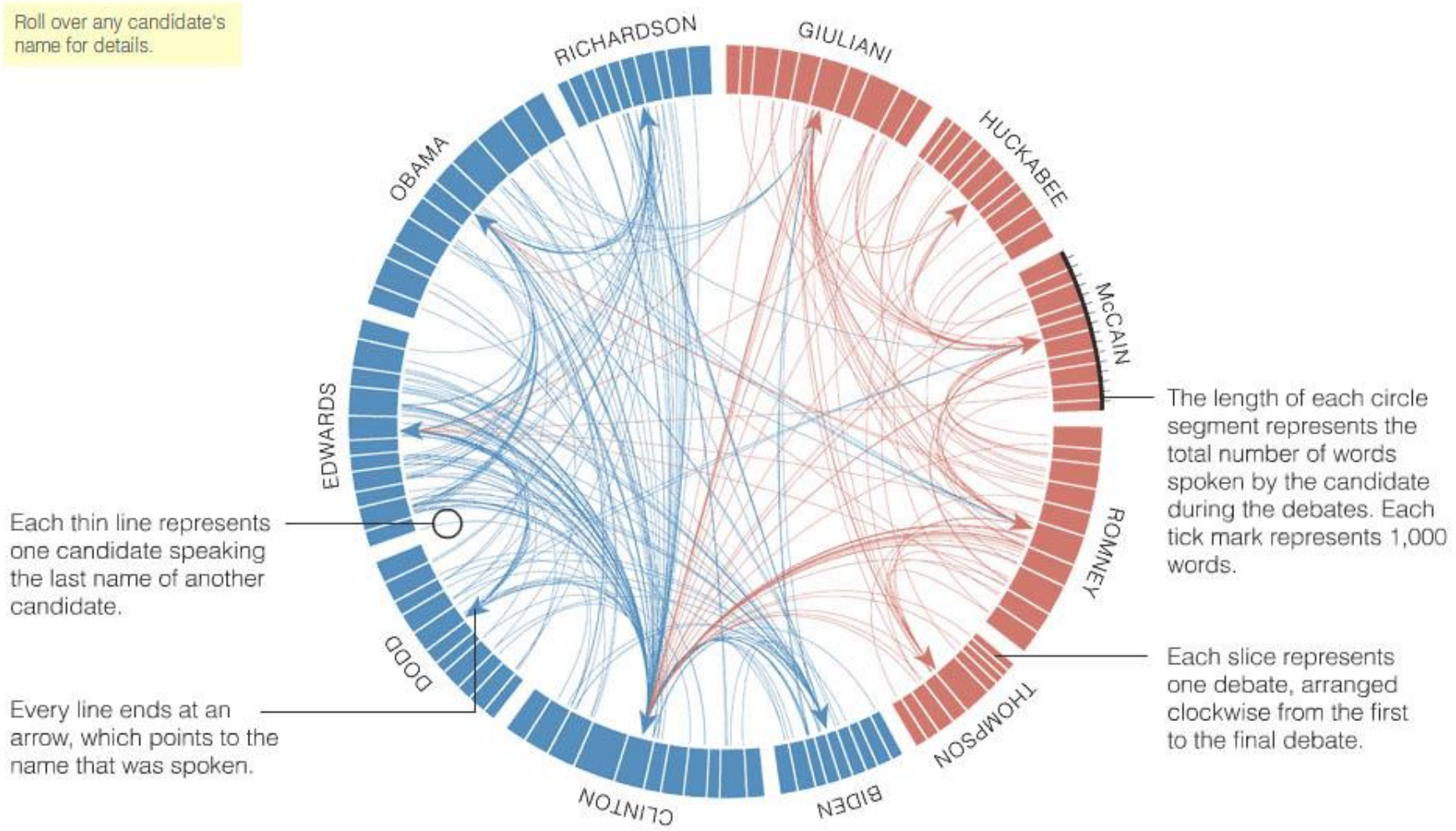
DataVis examples

December 15, 2007

SIGN IN TO E-MAIL OR SAVE THIS | FEEDBACK

Naming Names

Names used by major presidential candidates in the series of Democratic and Republican debates leading up to the Iowa caucuses.



http://www.nytimes.com/interactive/2007/12/15/us/politics/DEBATE.html

DataVis examples

December 15, 2007

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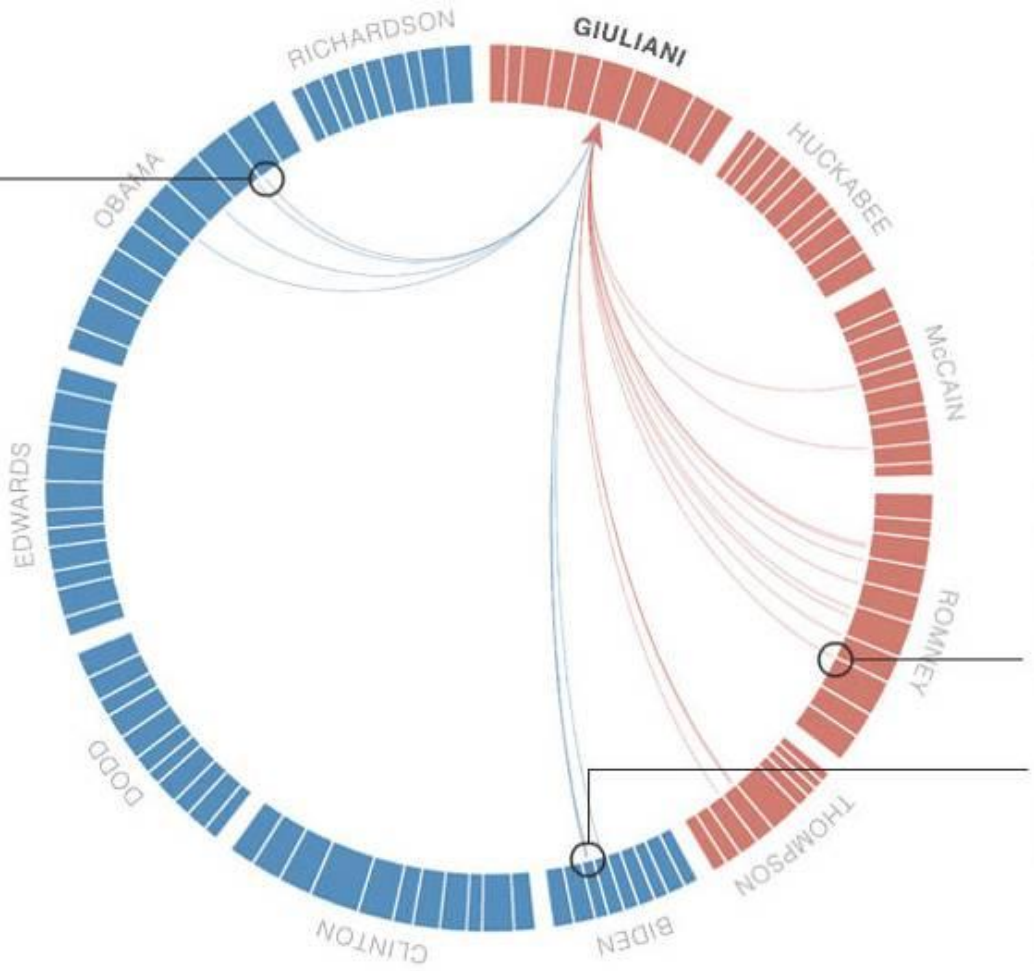


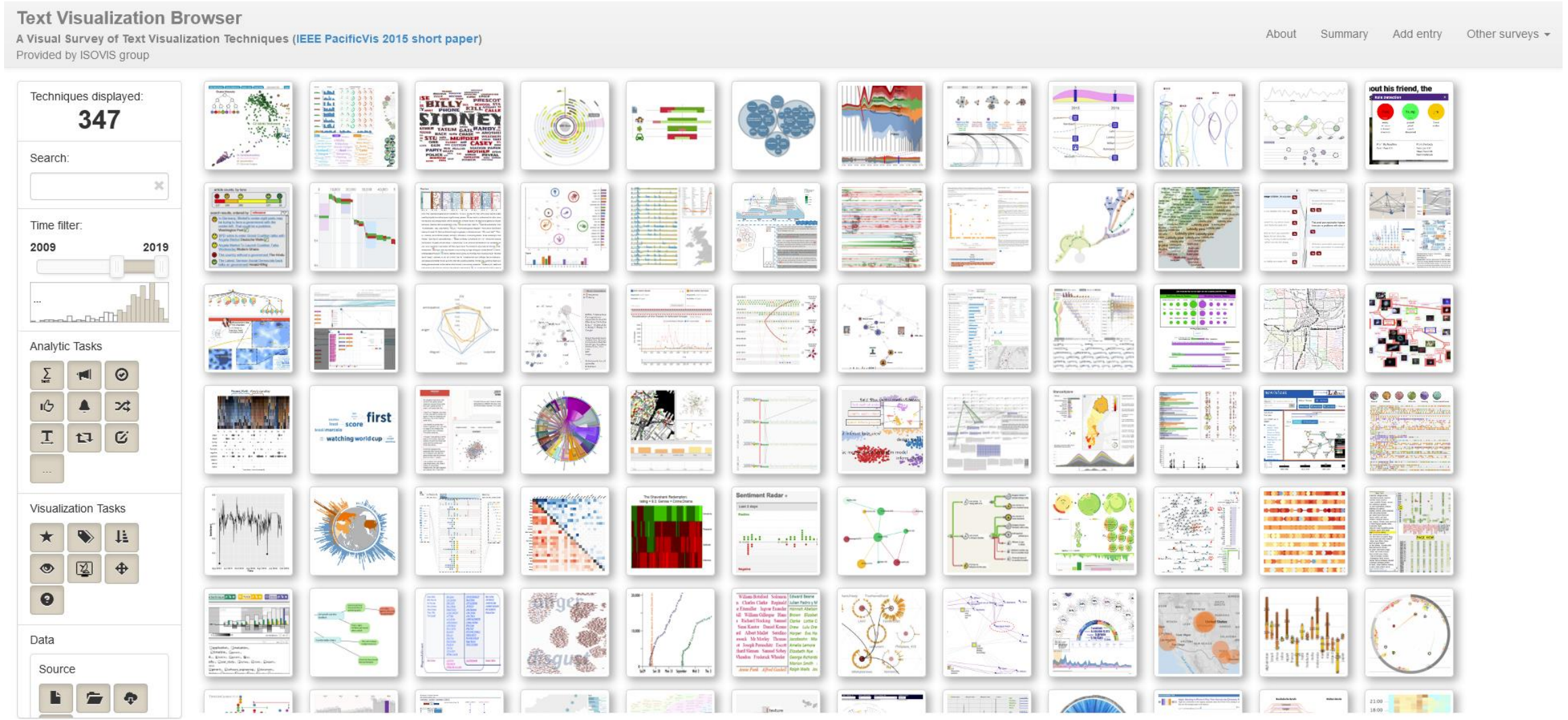
Mr. Obama
"Listen to the Republican candidates' debates and how they frame this issue. And if you were a Muslim overseas listening to Rudy Giuliani say, they are coming here to try to kill you, which is the tenor of many of the speeches that are delivered by the Republican candidates, you would get an impression that they are not interested in talking and resolving issues peacefully."

Mr. Romney
"They didn't report everybody they found that was here illegally, and this, this just happens to be a difference between Mayor Giuliani and myself and probably others on the stage as well, which is we're going to have to recognize in this country that we welcome people here legally. But the mayor said, and I quote almost verbatim, which is, if you happen to be in this country in an undocumented status — and that means you're here illegally — then we welcome you here. We want you here. We'll protect you here."

Mr. Biden
"Rudy Giuliani. I mean, think about it. Rudy Giuliani. There's — there's only three things he mentions in a sentence: a noun and a verb and 9/11. I mean, there's nothing else."

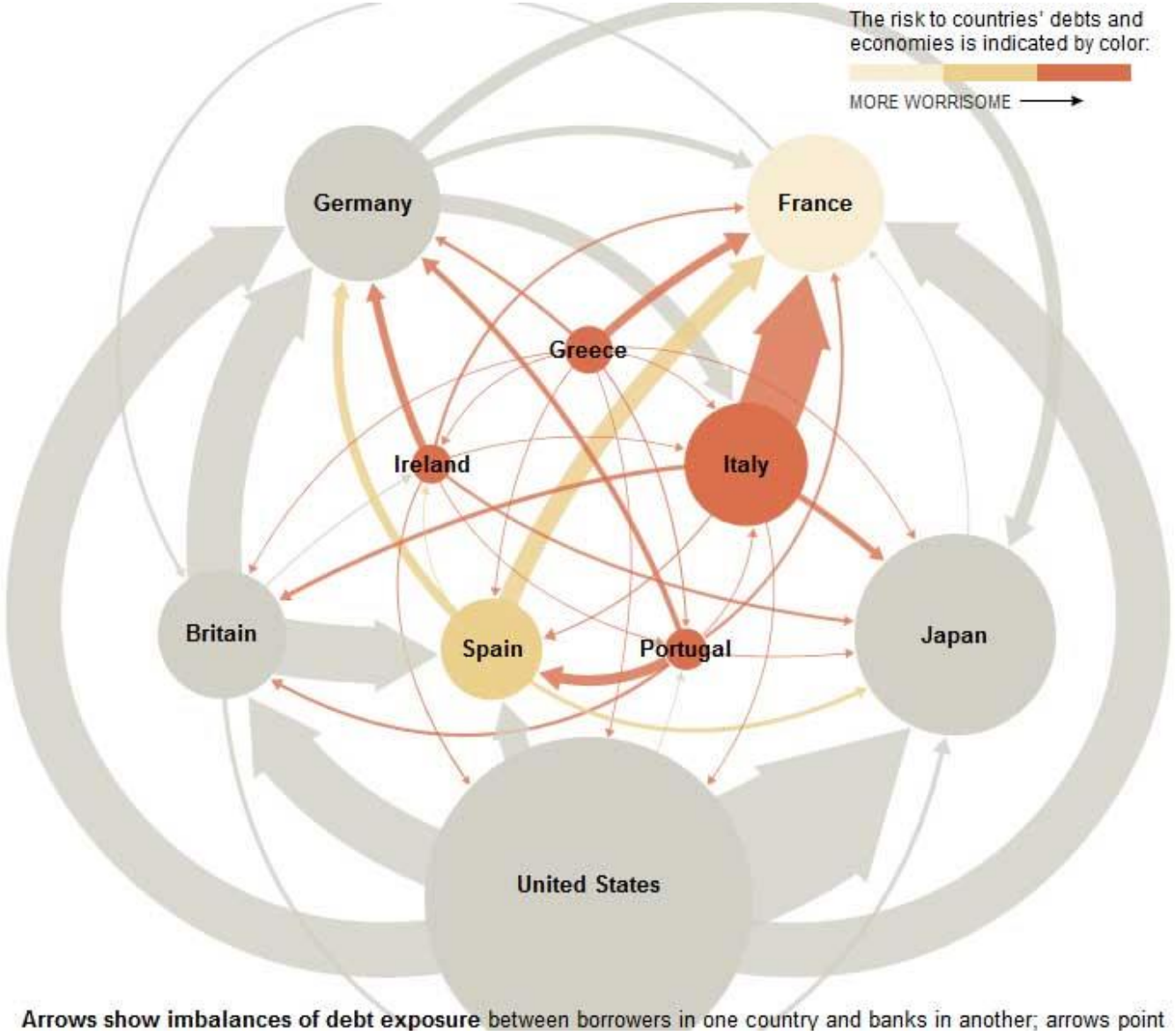
http://www.nytimes.com/interactive/2007/12/15/us/politics/DEBATE.html

Text Visualization Browser



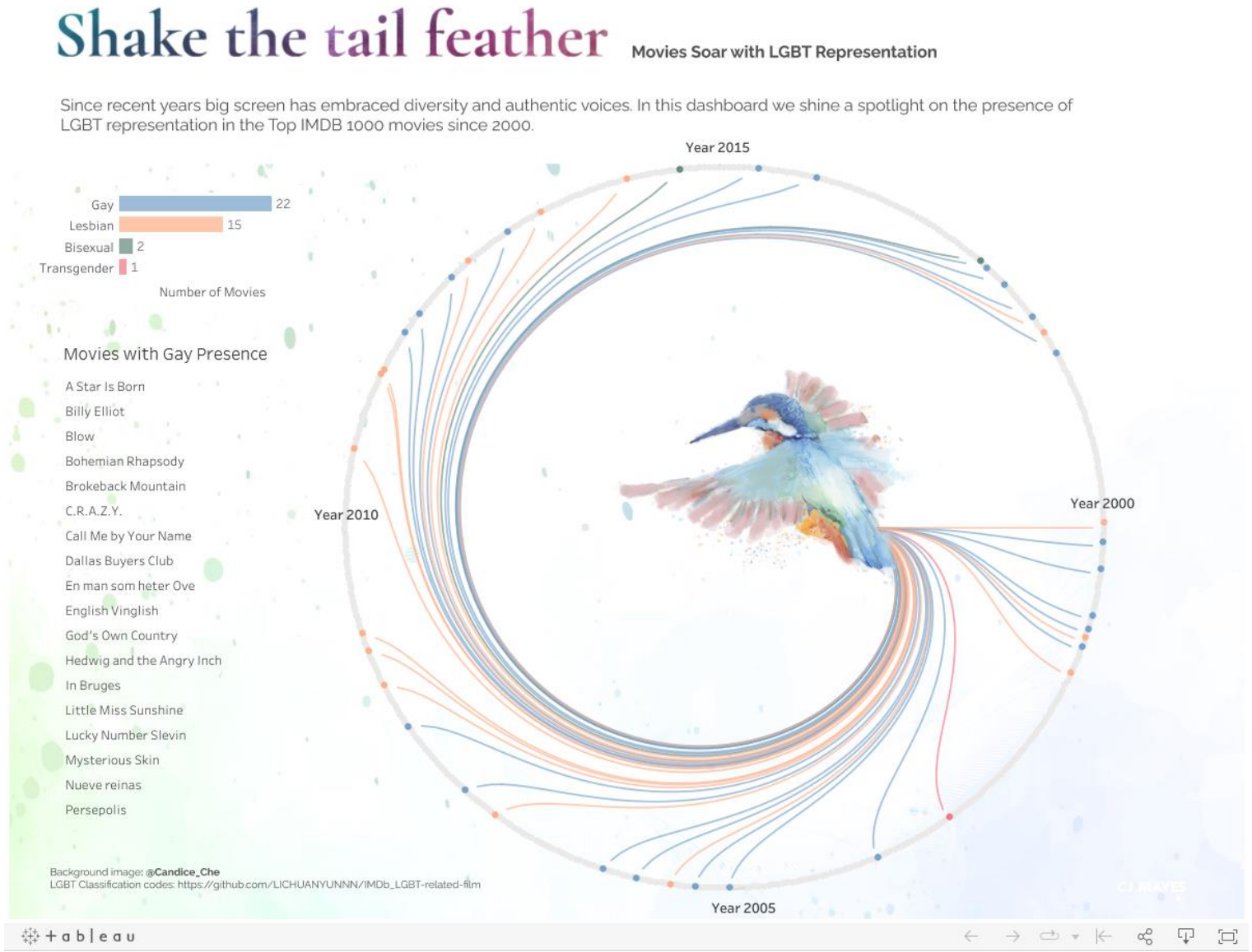
A Visual Survey of Text Visualization Techniques (IEEE PacificVis 2015 short paper)

DataVis examples



http://www.nytimes.com/interactive/2011/10/23/sunday-review/an-overview-of-the-euro-crisis.html?ref=greece

DataVis examples



https://public.tableau.com/app/profile/chang.che6023/viz/ShakeYourtailfeather-MovieswithLGBTpresence/Shakethetailfeather

DataVis examples

The World's Electricity Tapestry:

Exploring the Electricity profile of each country.

A dive into country specific Electricity mix - unveiling how much is generated per capita, and the generation sources.

1. Although the terms "electricity" and "energy" are often used interchangeably, it's important to understand that electricity is just one component of total energy consumption.

2. Comparisons of electricity generation often reflect population size (i.e. generation increases due to population rise). It does not tell us about how much electricity the average person in a given country consumes relative to another.

3. This is why the per capita electricity generation - i.e., per person, should also be considered. The largest producers — Iceland, Norway, USA and Canada — generate hundreds of times as much electricity as the smallest.

Electricity generation per capita as at 2022:

Each country's generation figures, grouped by region.

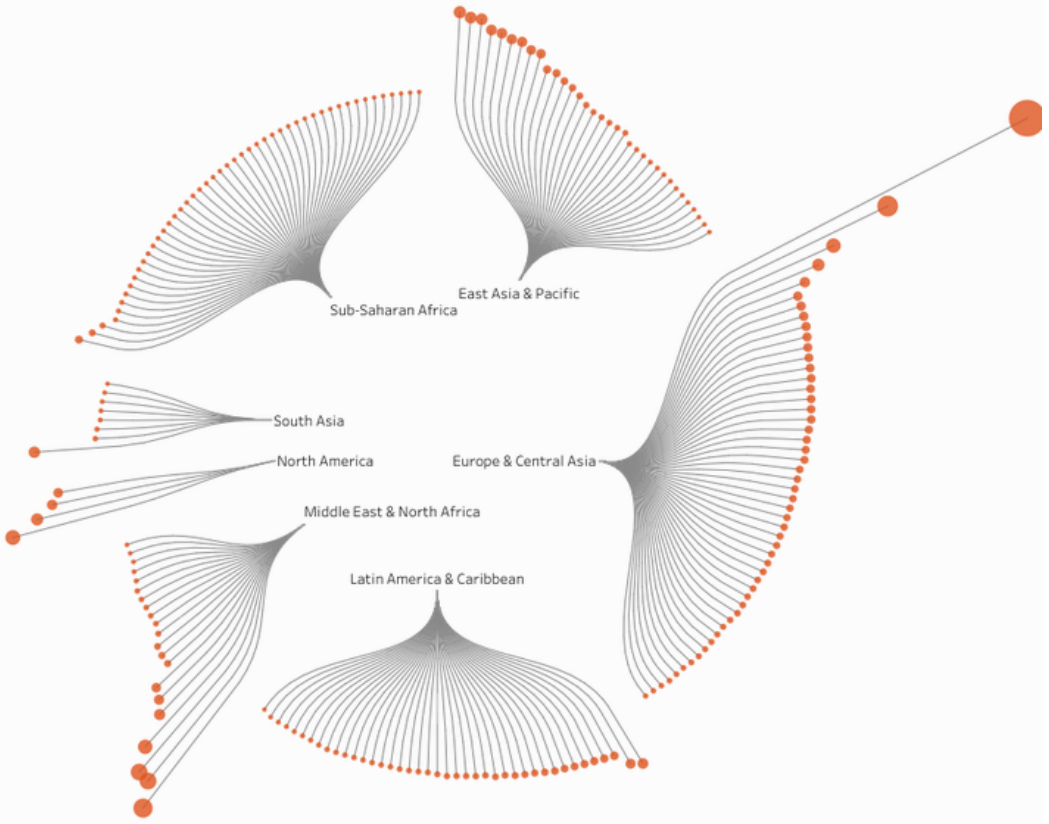
On the visualisation to the right, we see the differences in average electricity generation per capita across the world.

Clearly, there are large inequalities between countries.

In many low-income countries, per capita electricity generation is several magnitudes lower than in the richest countries.

This is magnified at a regional level as well.

Hover over each country to view historic trends.

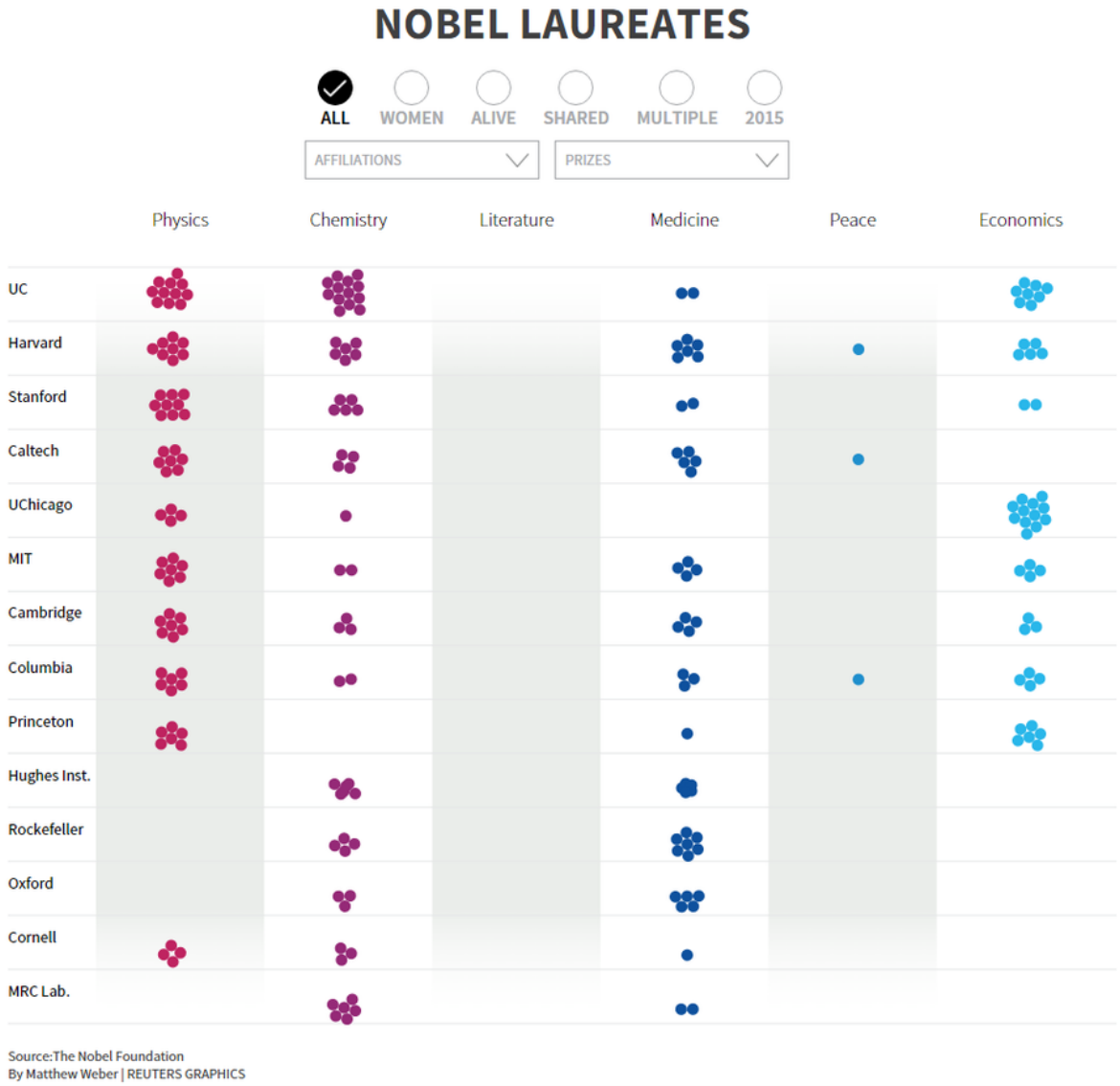


Generation per capita:
20
10,000
20,000
30,000
40,000
53,285

Show chart as:
Tree diagram

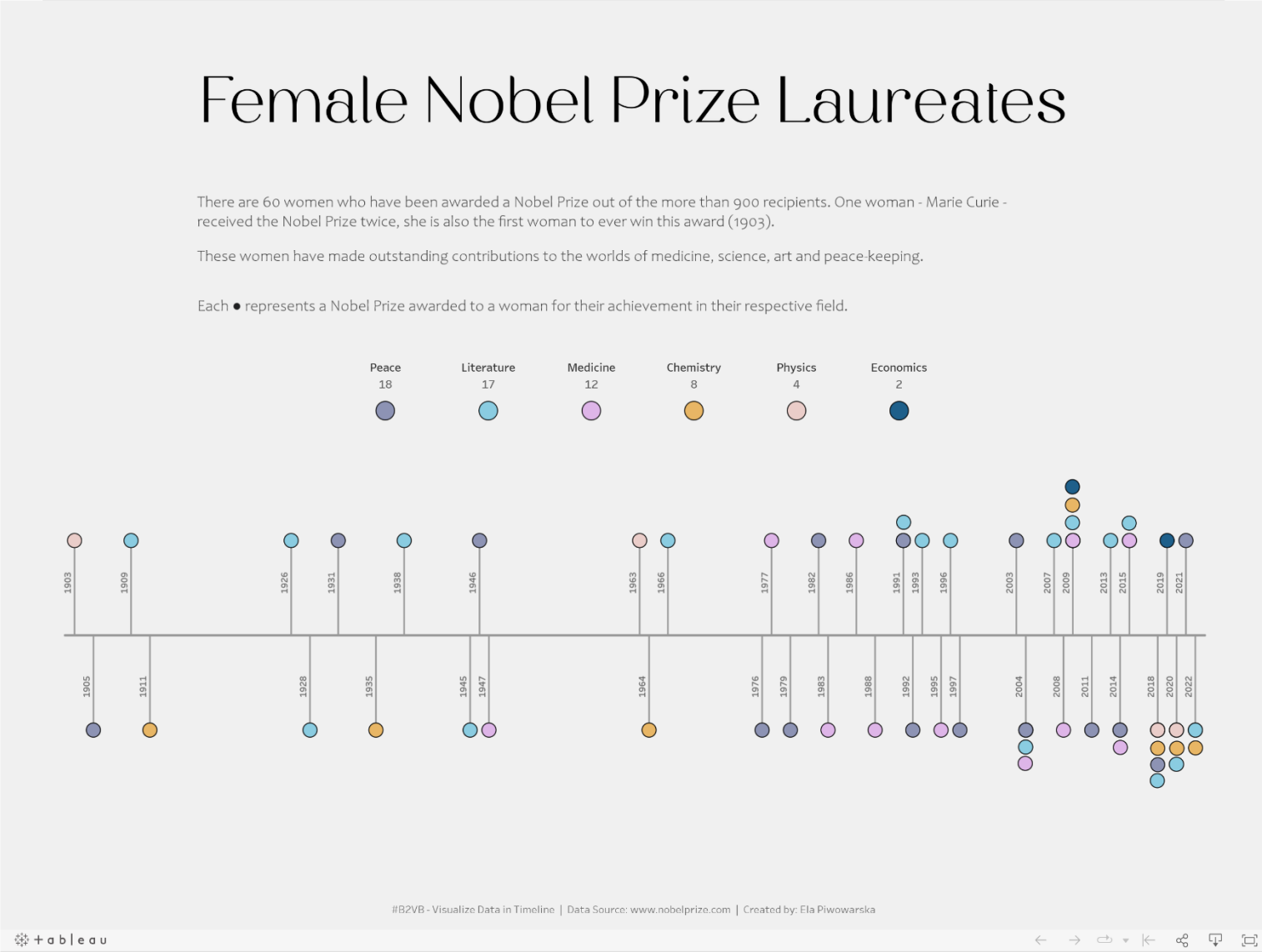
https://public.tableau.com/app/profile/rush1056/viz/Electricitygenerationpercapita2022/ElectricityGenerationpercapita2022

DataVis examples



http://graphics.thomsonreuters.com/15/nobels/

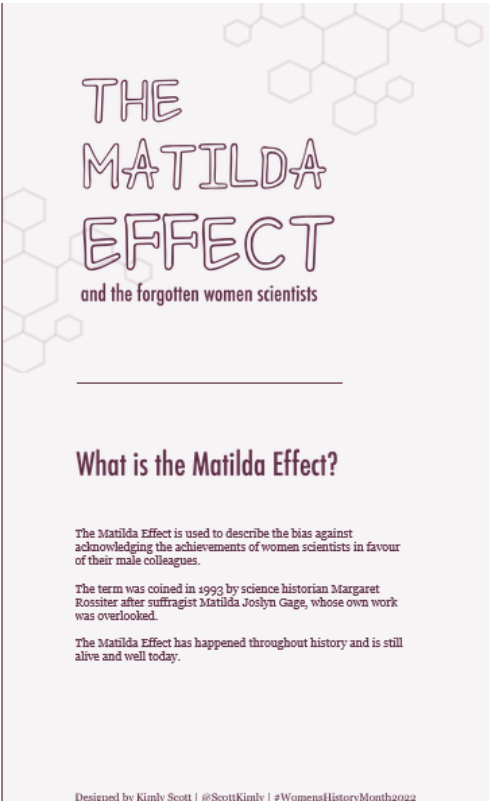
DataVis examples

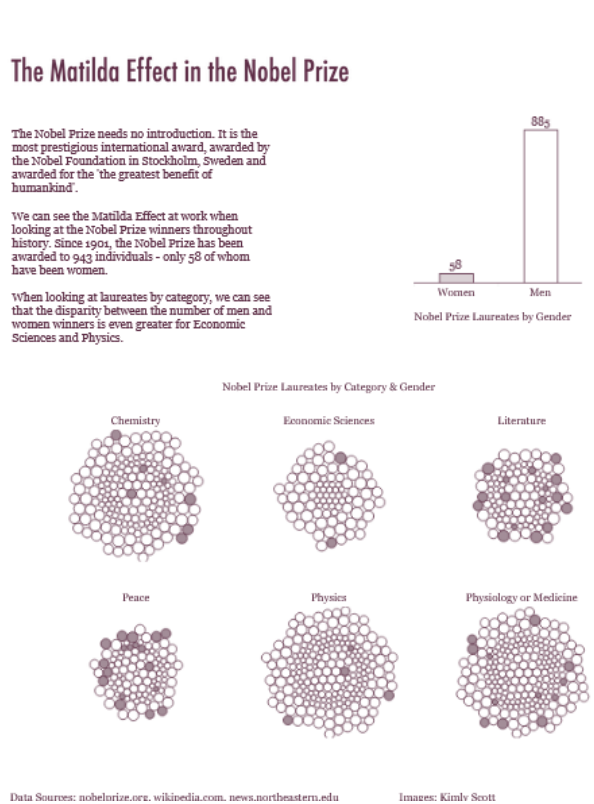


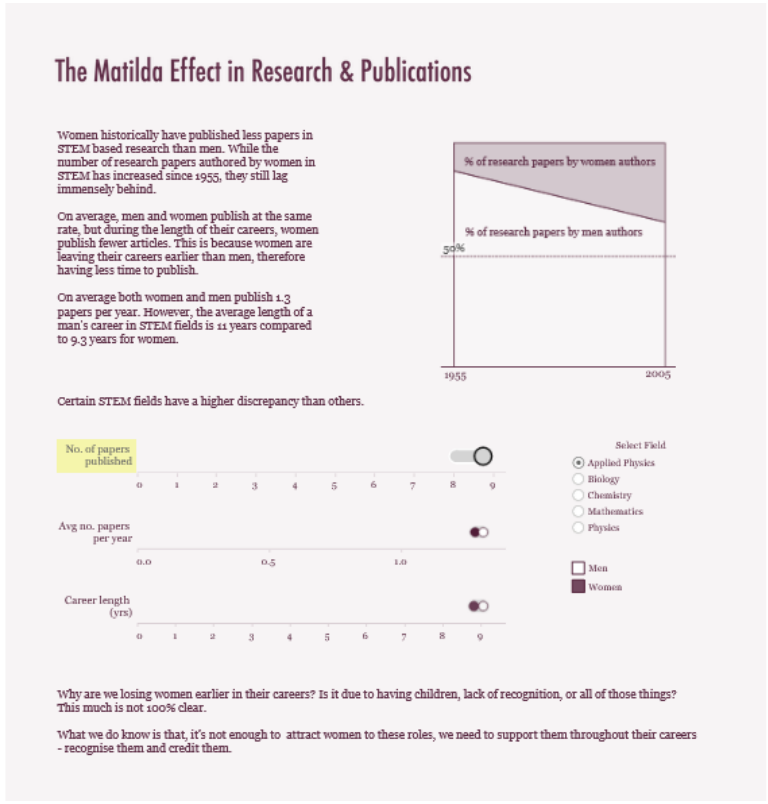
https://public.tableau.com/app/profile/ela.piwowarska/viz/B2VB-FemaleNobelPrizeLaureates/B2VB

DataVis examples

- The Matilda Effect and the forgotten women scientists



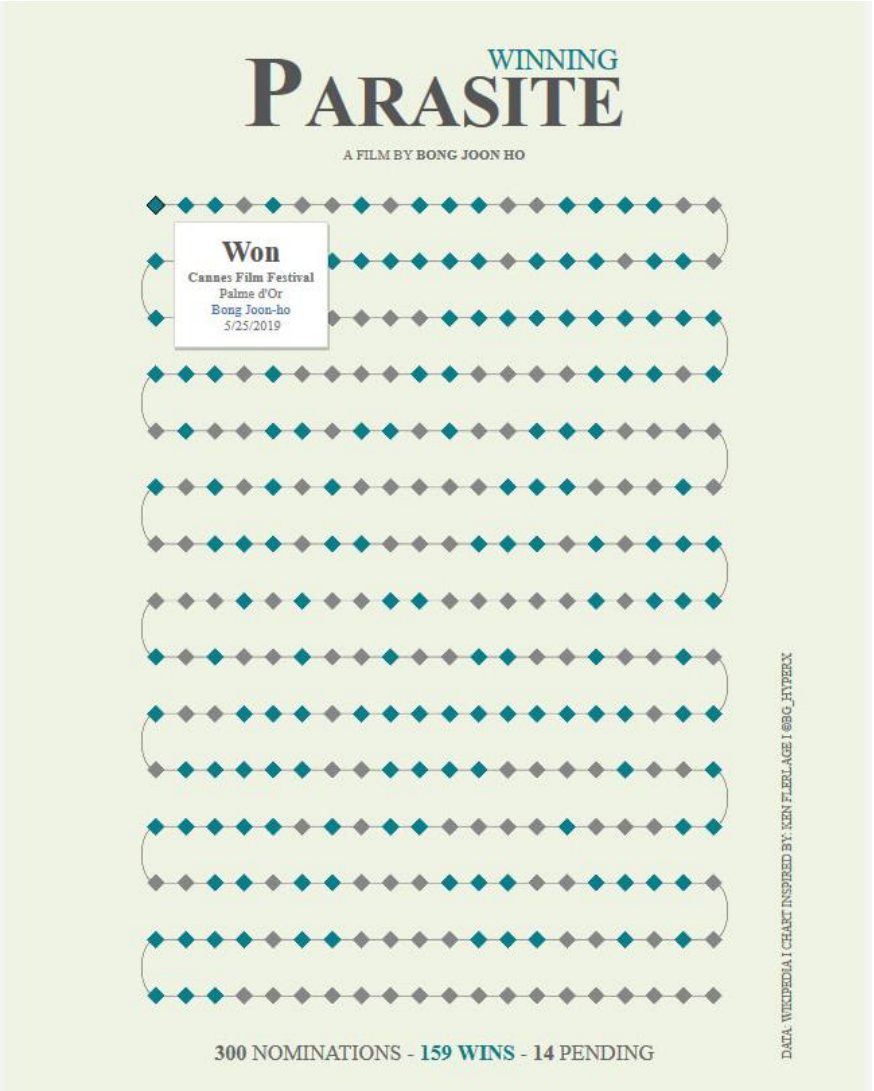




https://public.tableau.com/app/profile/kimly.scott/viz/TheMatildaEffect/TheMatildaEffect

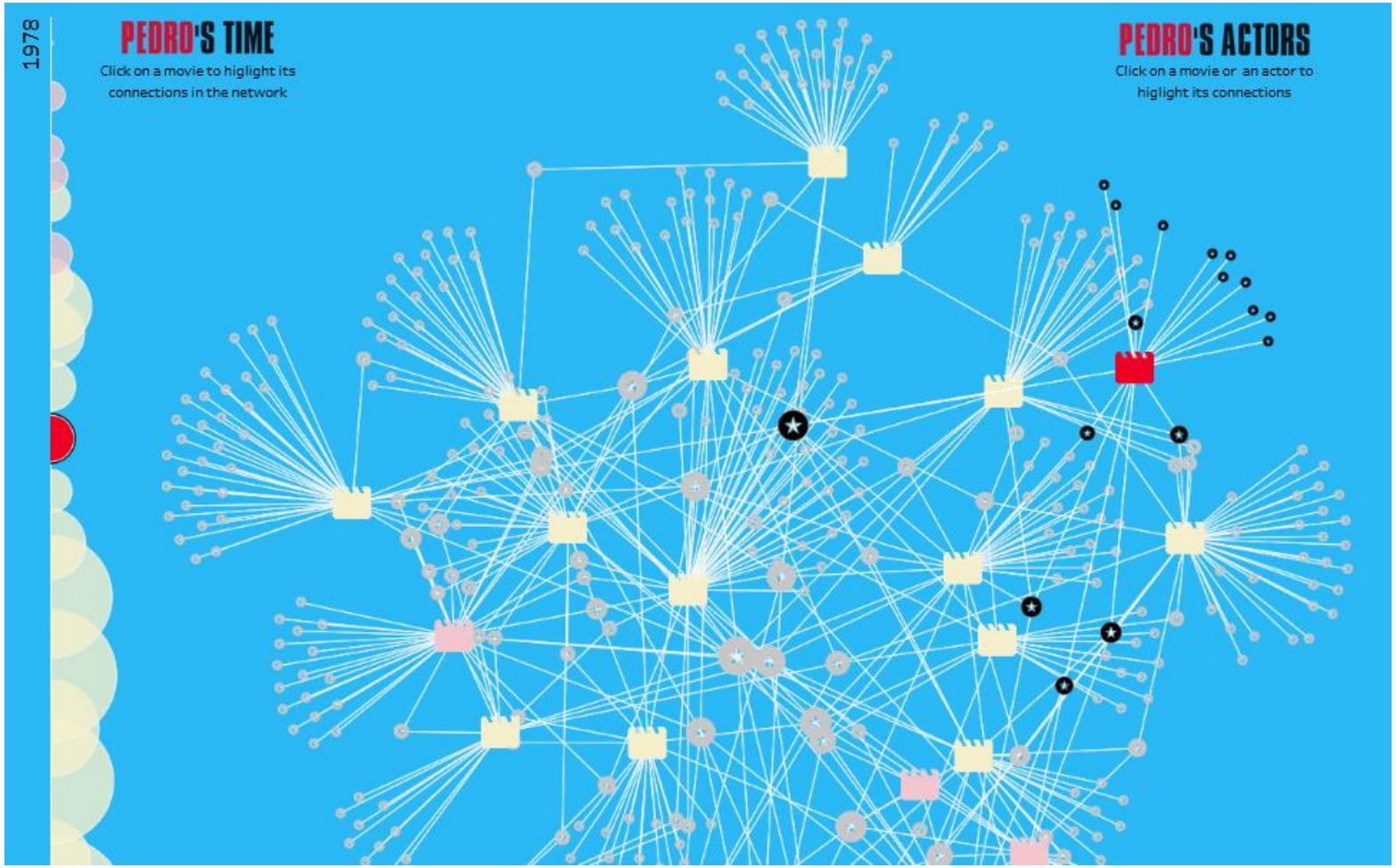
DataVis examples

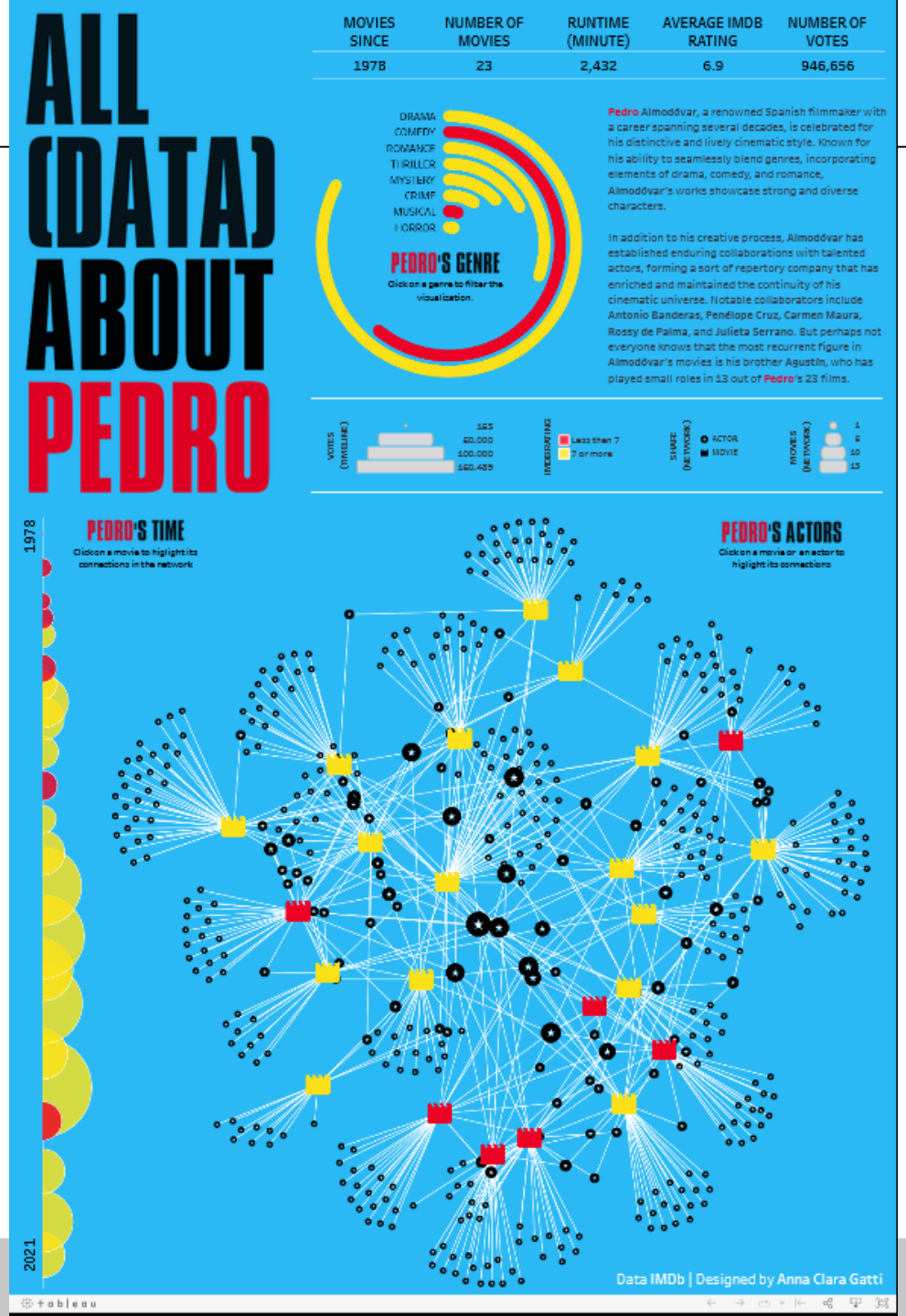
- Parasite: A film by Bong Joon Ho – award nominations & wins



DataVis examples

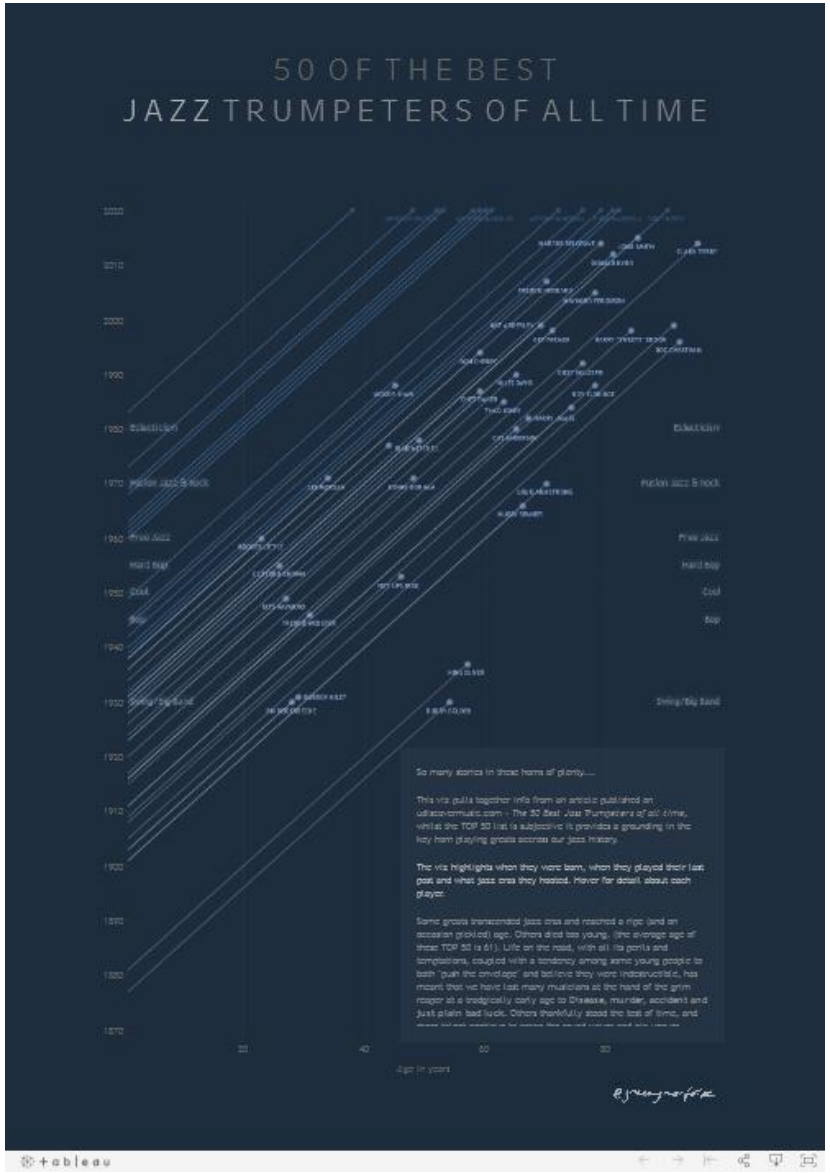
- P. Almodovar’s films & actors





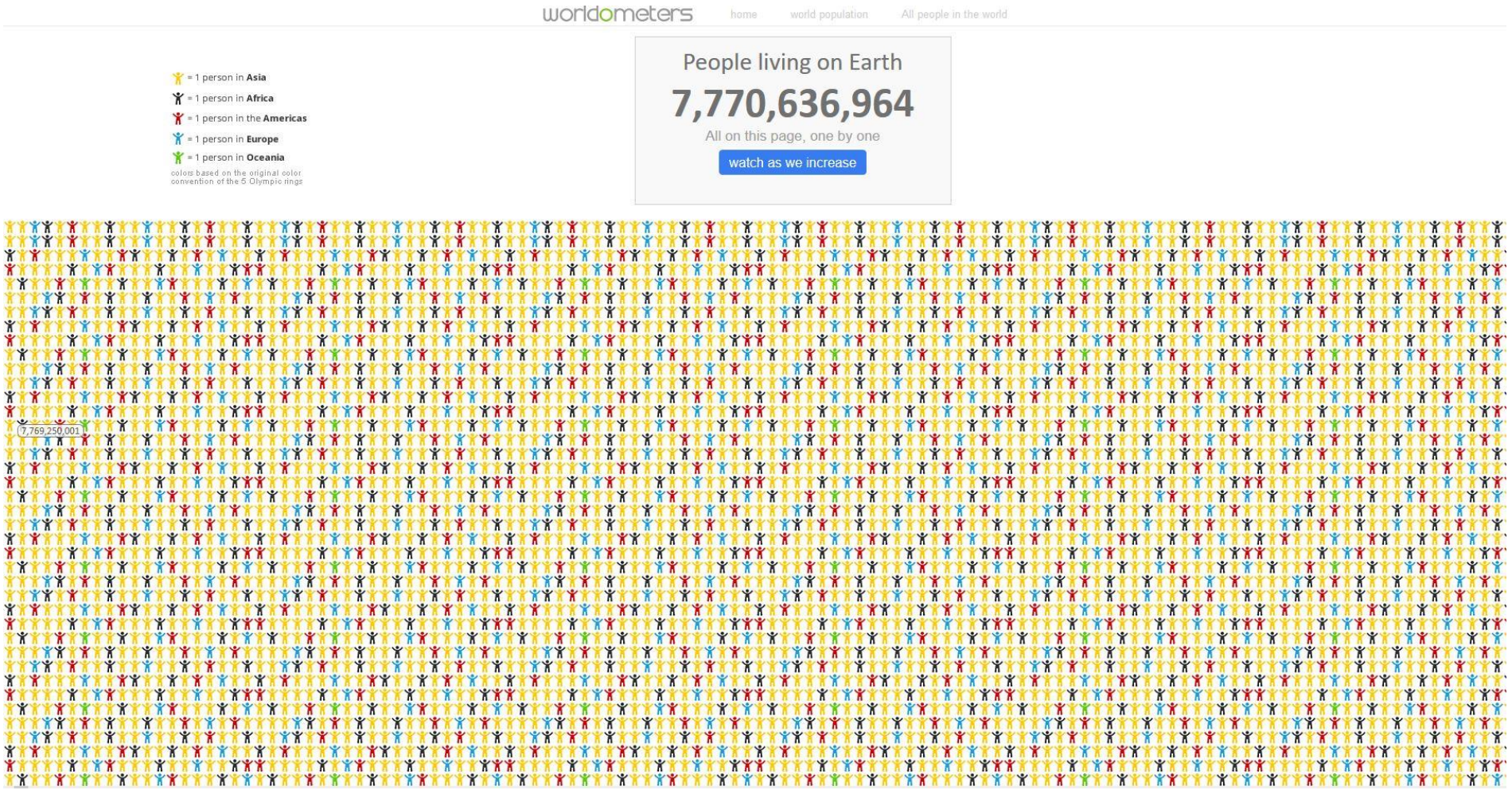
DataVis examples

- 50-great-jazz-trumpeters



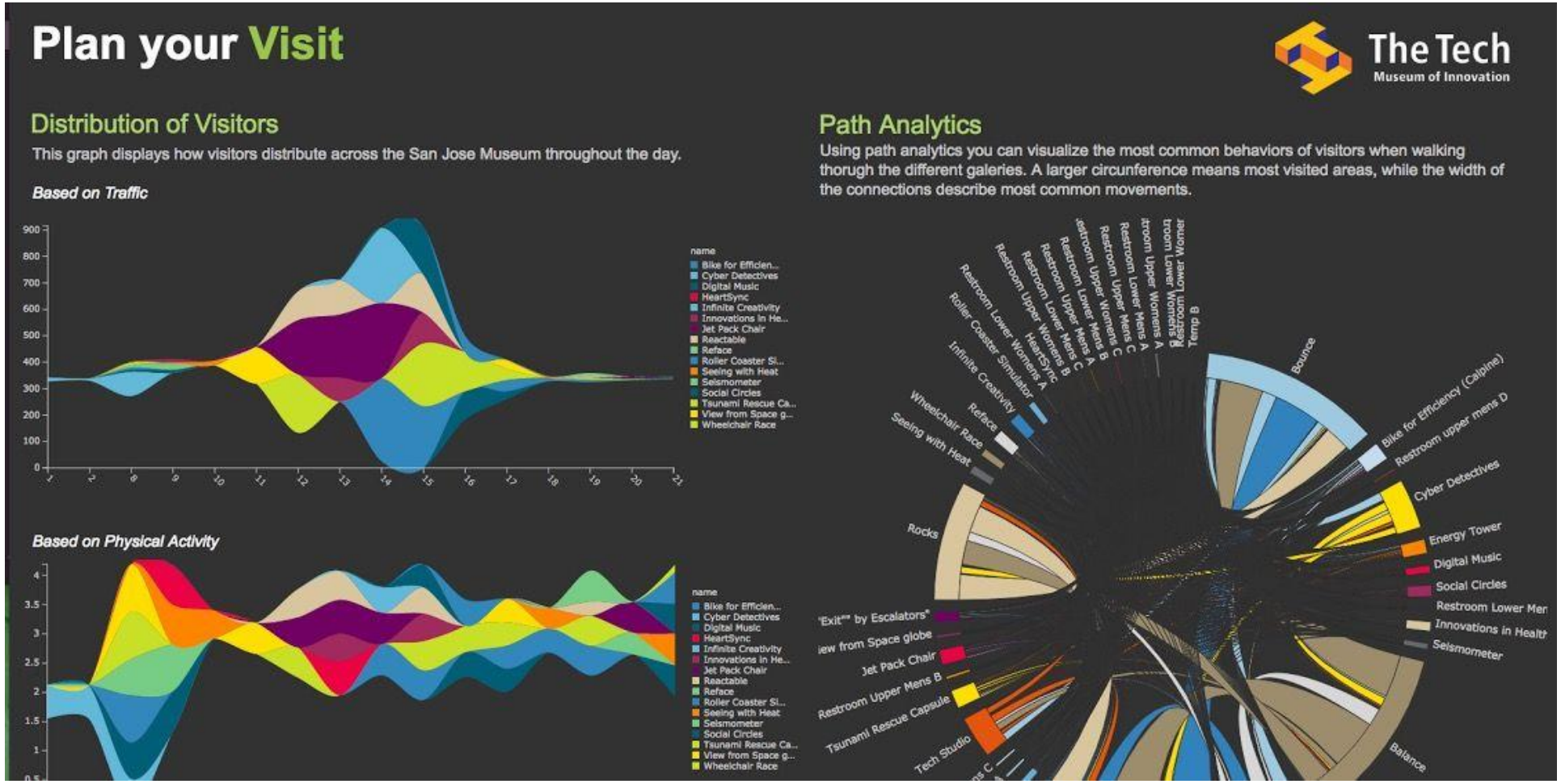
DataVis examples

- Current World Population - worldometer



DataVis examples

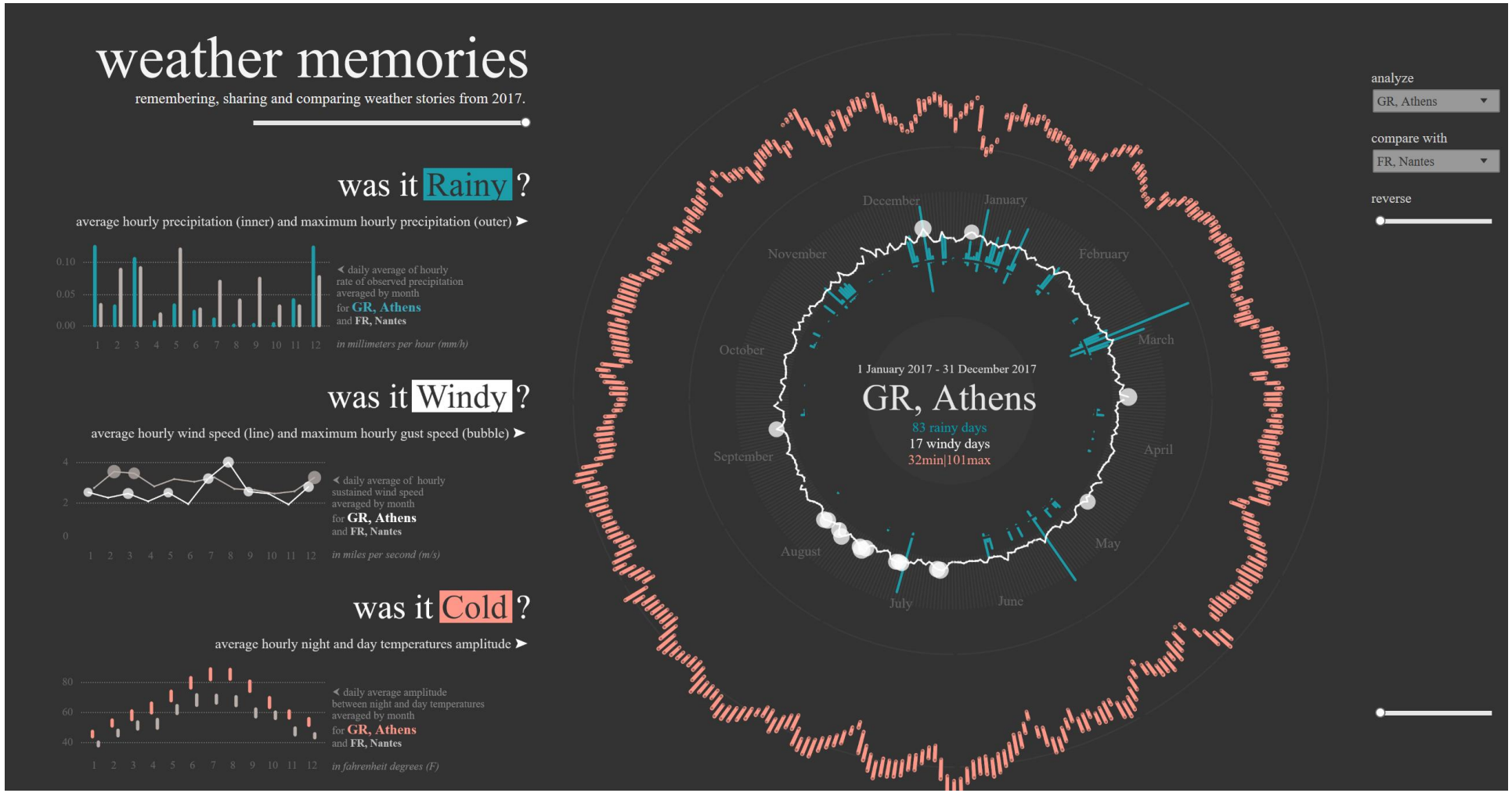
- Analysis of visitor paths in the museum



The Tech Museum of Innovation

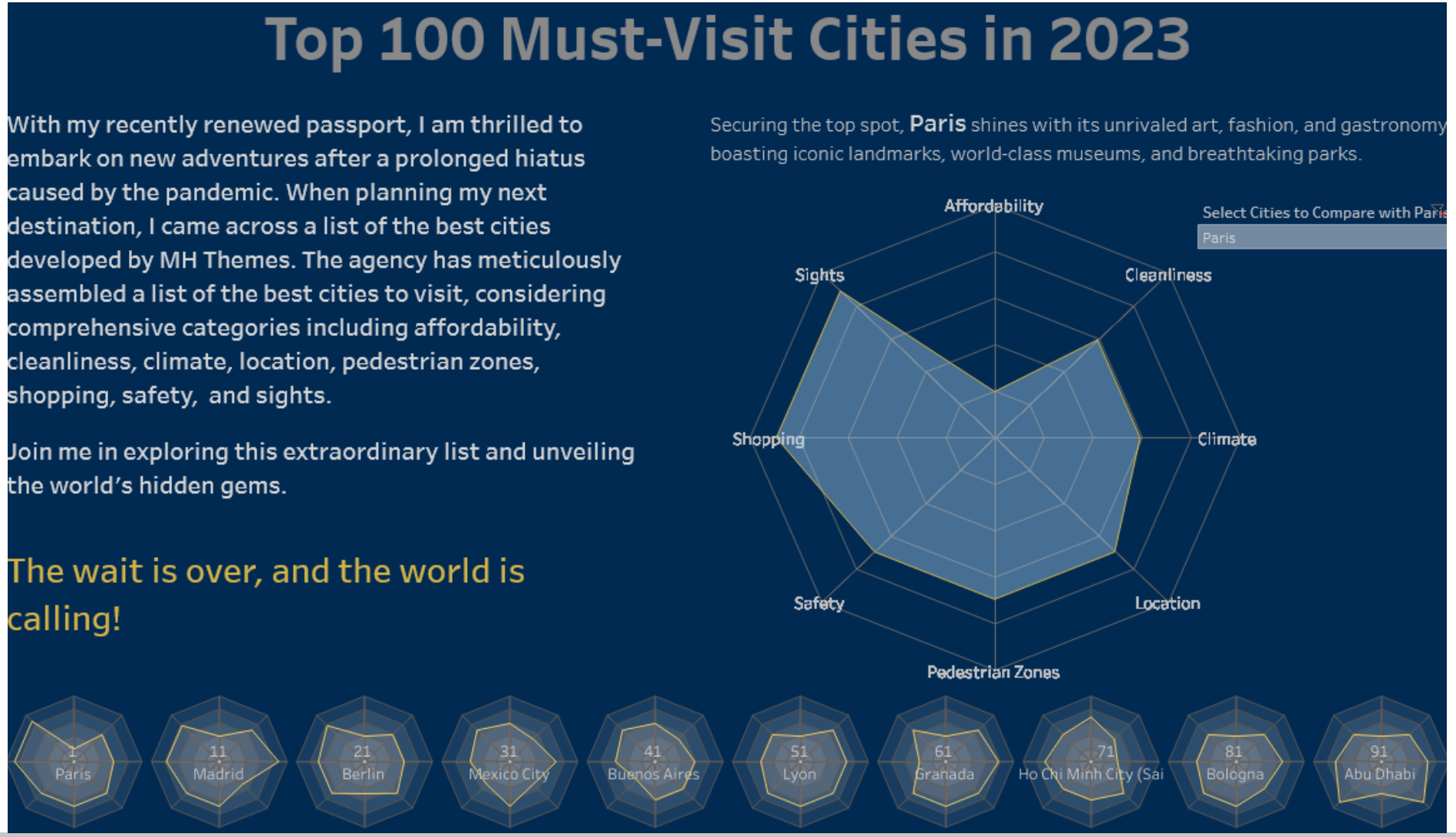
DataVis examples

- The weather per location, in a year

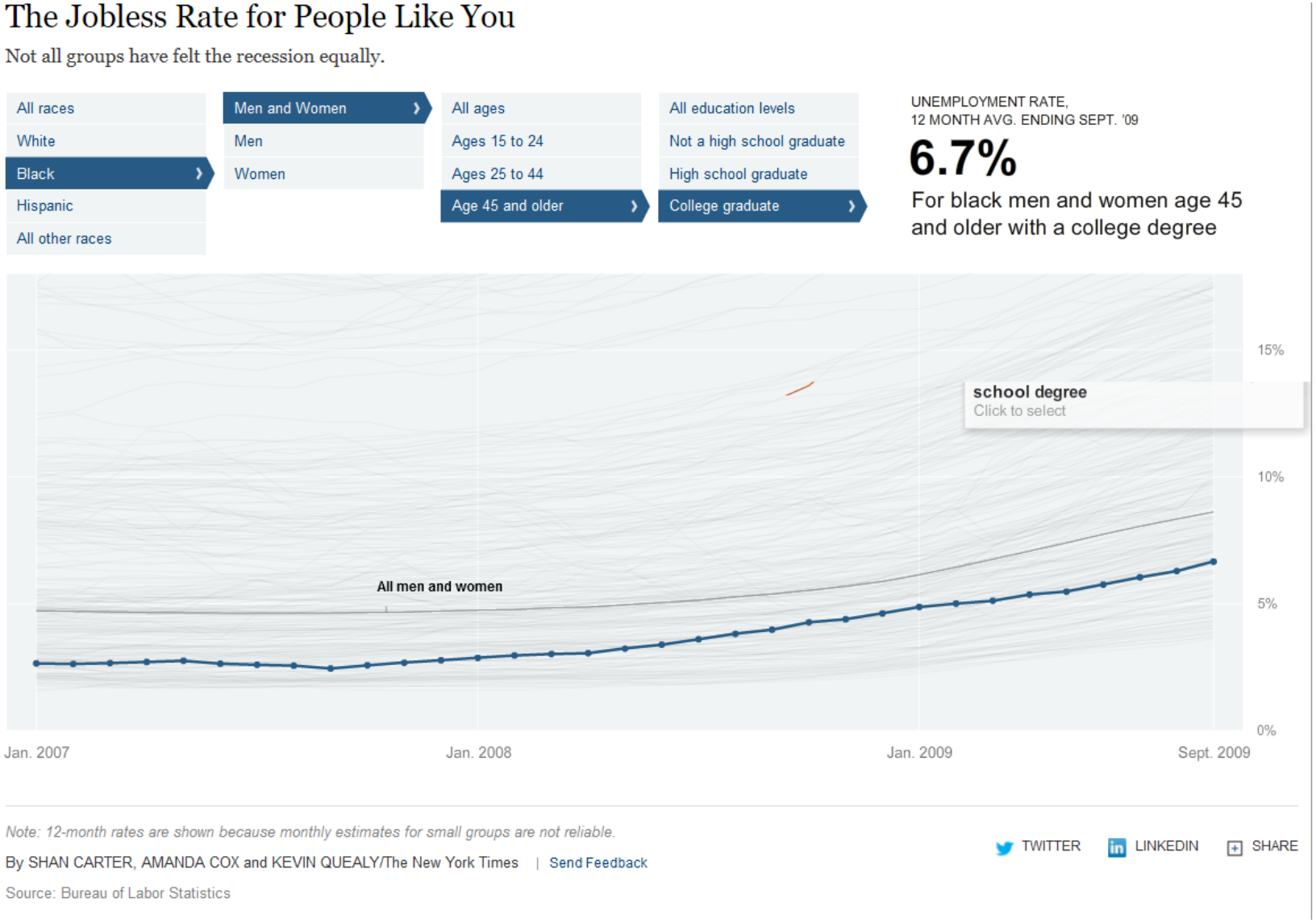


DataVis examples

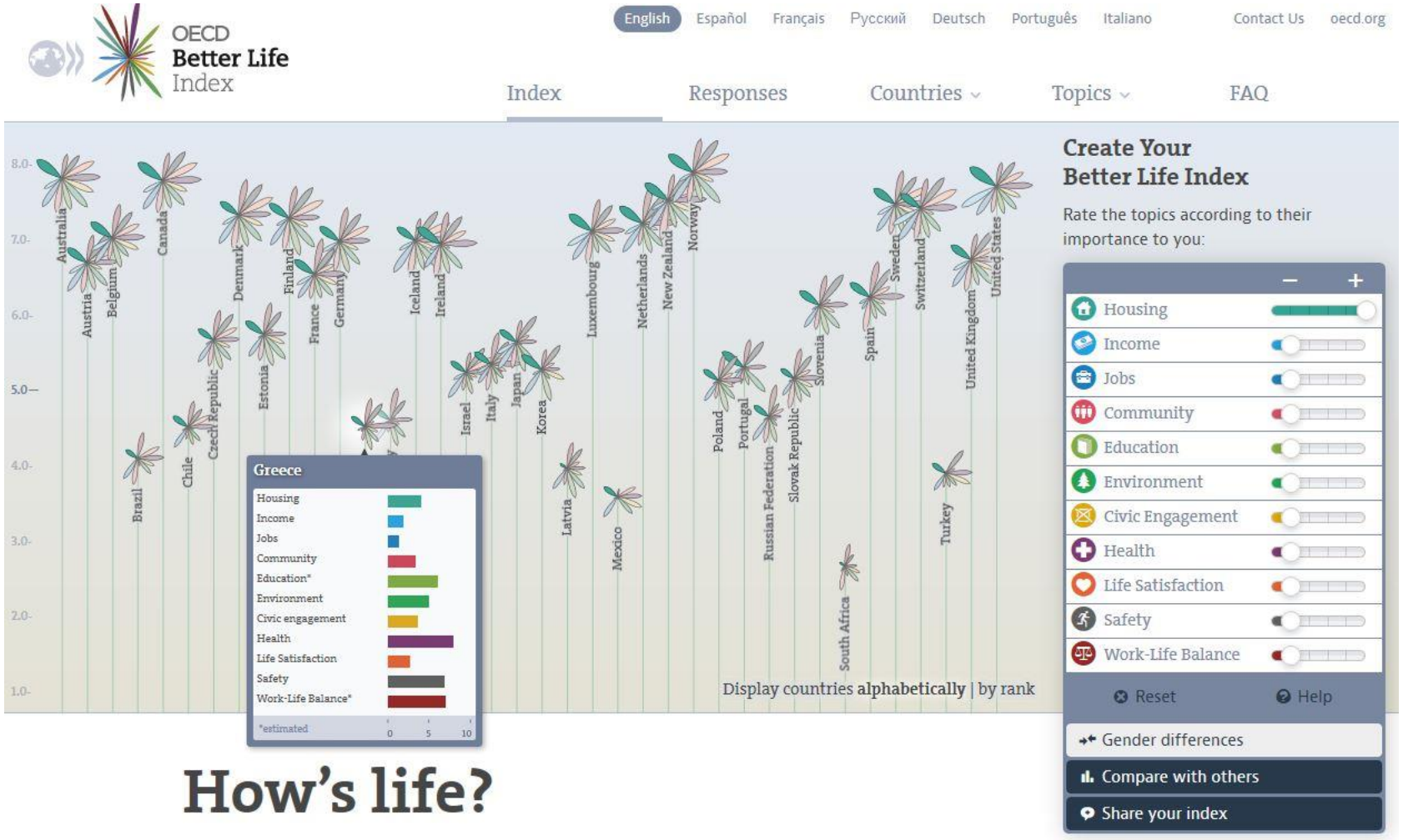
- Spider charts



DataVis examples

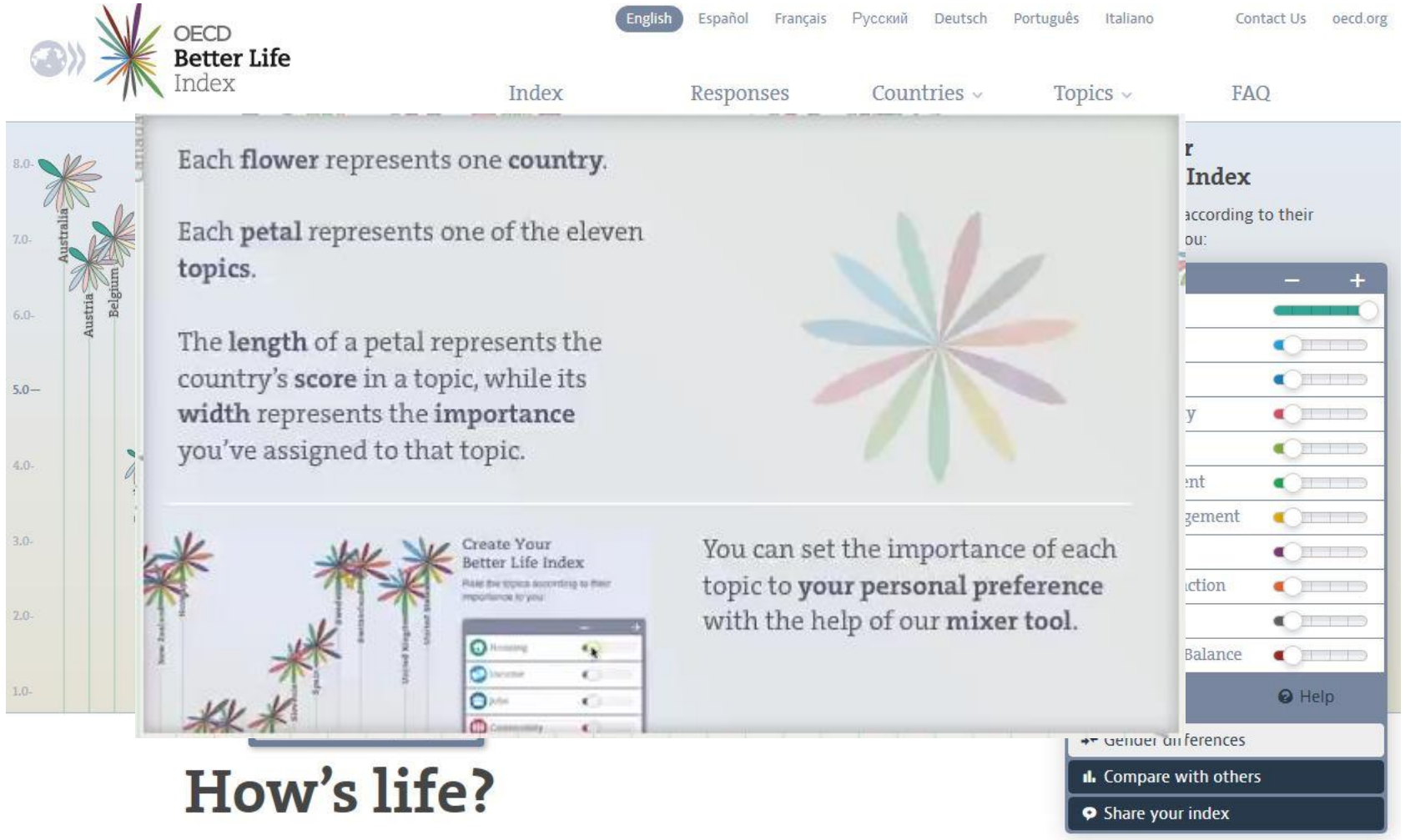


DataVis examples



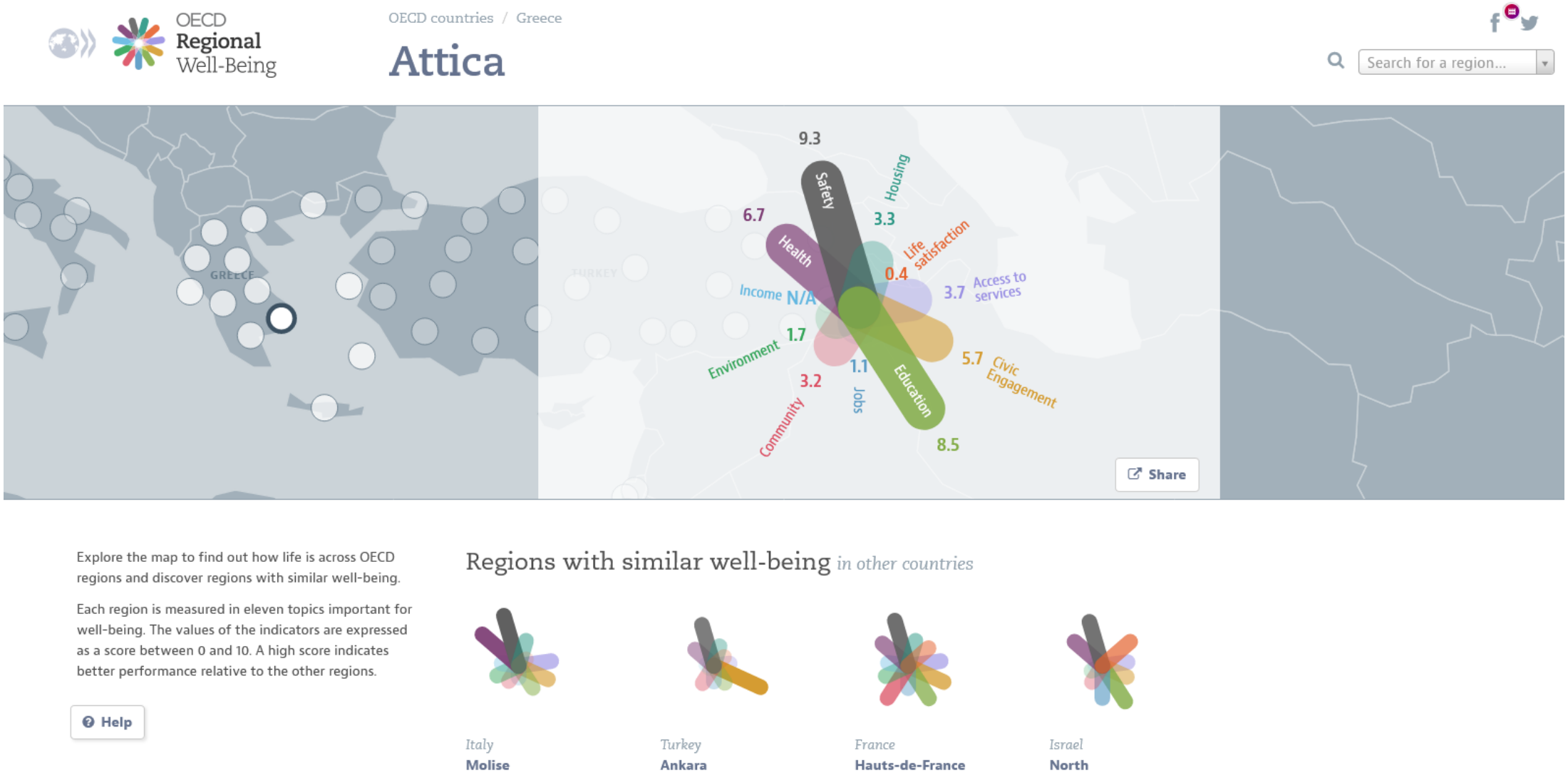
http://www.oecdbetterlifeindex.org/#/51111111111

DataVis examples



http://www.oecdbetterlifeindex.org/#/51111111111

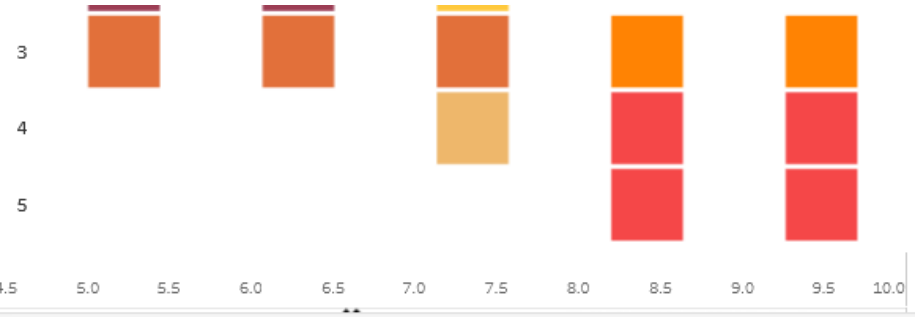
DataVis examples



DataVis examples

Development Index =
0.3799*[Freedom to make life choices] + 0.5964*[Health life expectancy (/100)] + 0.5860*[Social support] + 0.00007*[Generosity] + 0.1845*(1- [Perceptions of corruption]) + 0.6828*[Log GDP per capita]

The Development and Happiness Indexes were divided in **five parts**, which were determined by the amplitude of the values (MAXIMUM minus MINIMUM) and divided in quintiles. The value 1 represents the lowests scores, while 5 represents the highests. Then, combining with other analysis, it was possible to draw and validate the clusters as it is shown. Check their characteristics on the tooltips below!

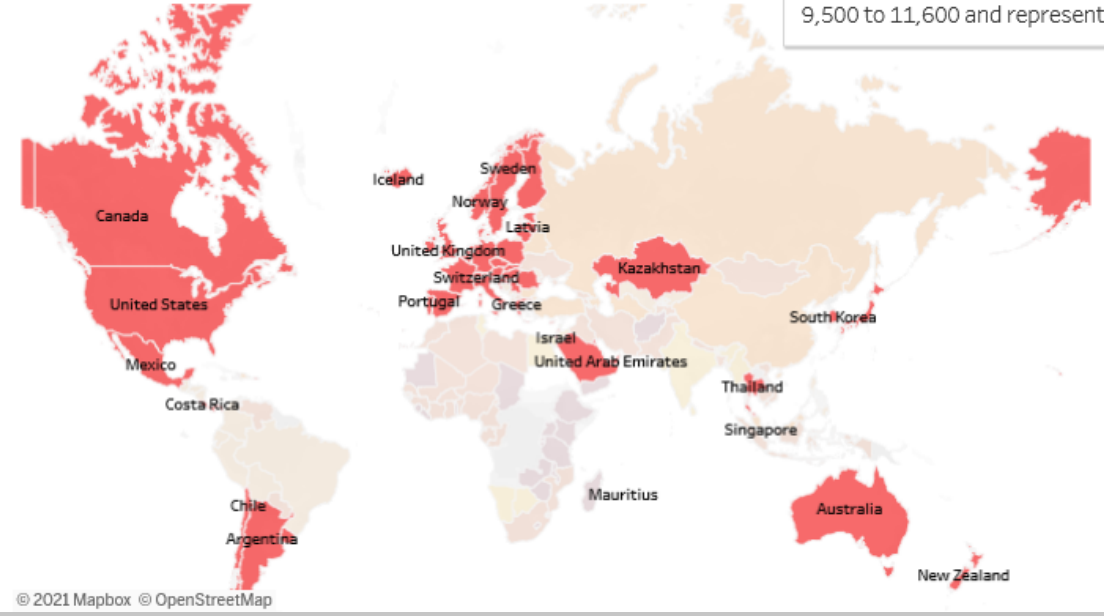


✓ Keep Only ⊘ Exclude

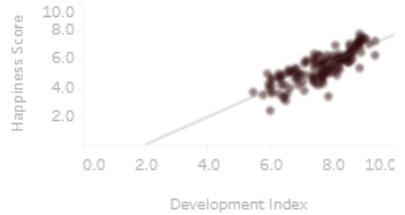
Enjoyers:

This cluster is composed by majority of high development countries, such as Europe, North America and most developed countries from Oceania (Australia, New Zeland), Middle East (Israel, Saudi Arabia), Asia (Japan, South Korea) and Latin America (Chile, Argentina, Uruguay).

These are countries that have a both Indexes high, as well as the GDP per capta, which ranging from 9,500 to 11,600 and represents the highest GDP range from all of the clusters.



This model using the calculated Development Index explains 66,96% of the happiness behaviour between countries.

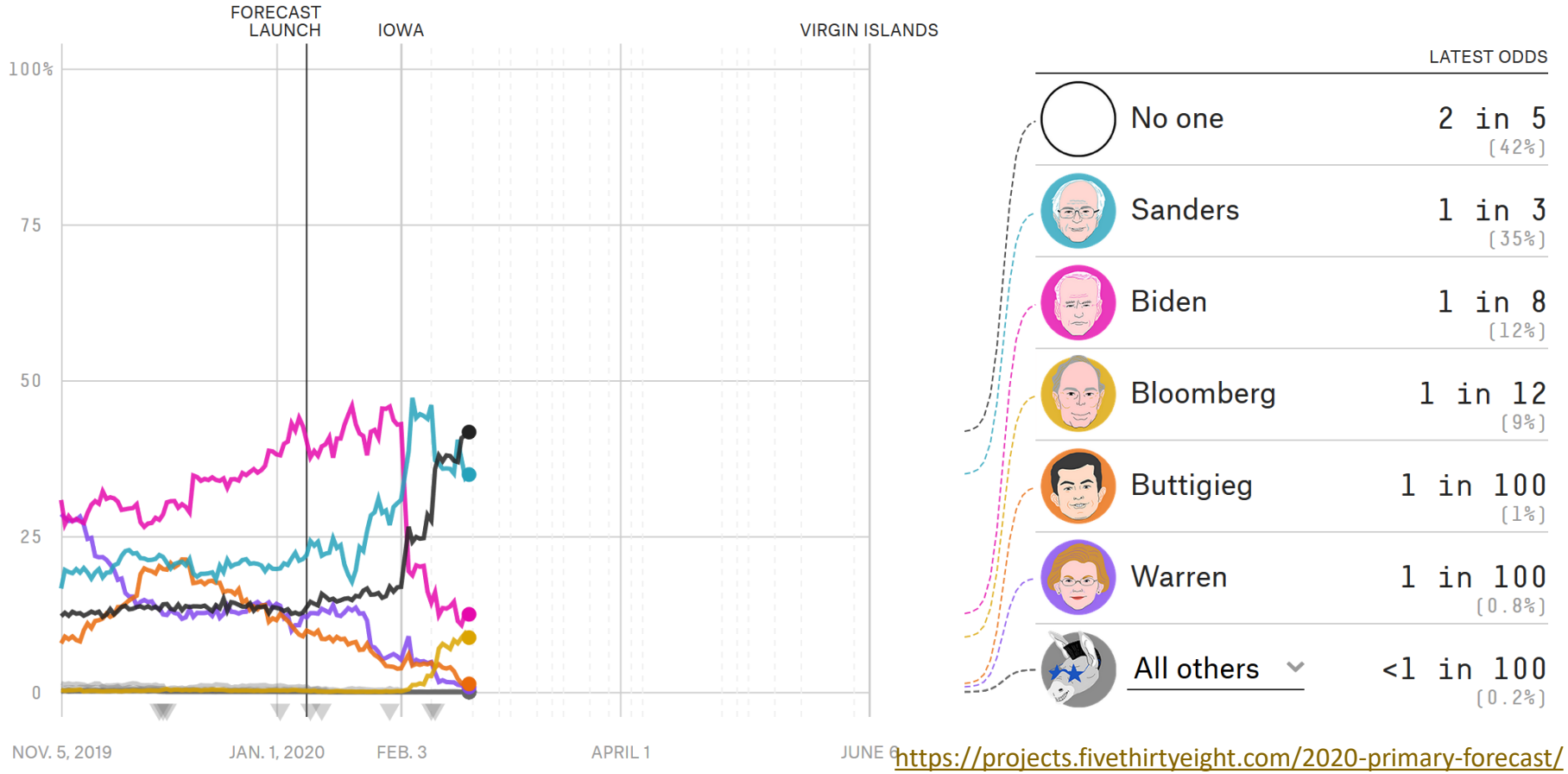


DataVis examples

UPDATED FEB. 21, 2020, AT 12:46 AM

Who Will Win The 2020 Democratic Primary?

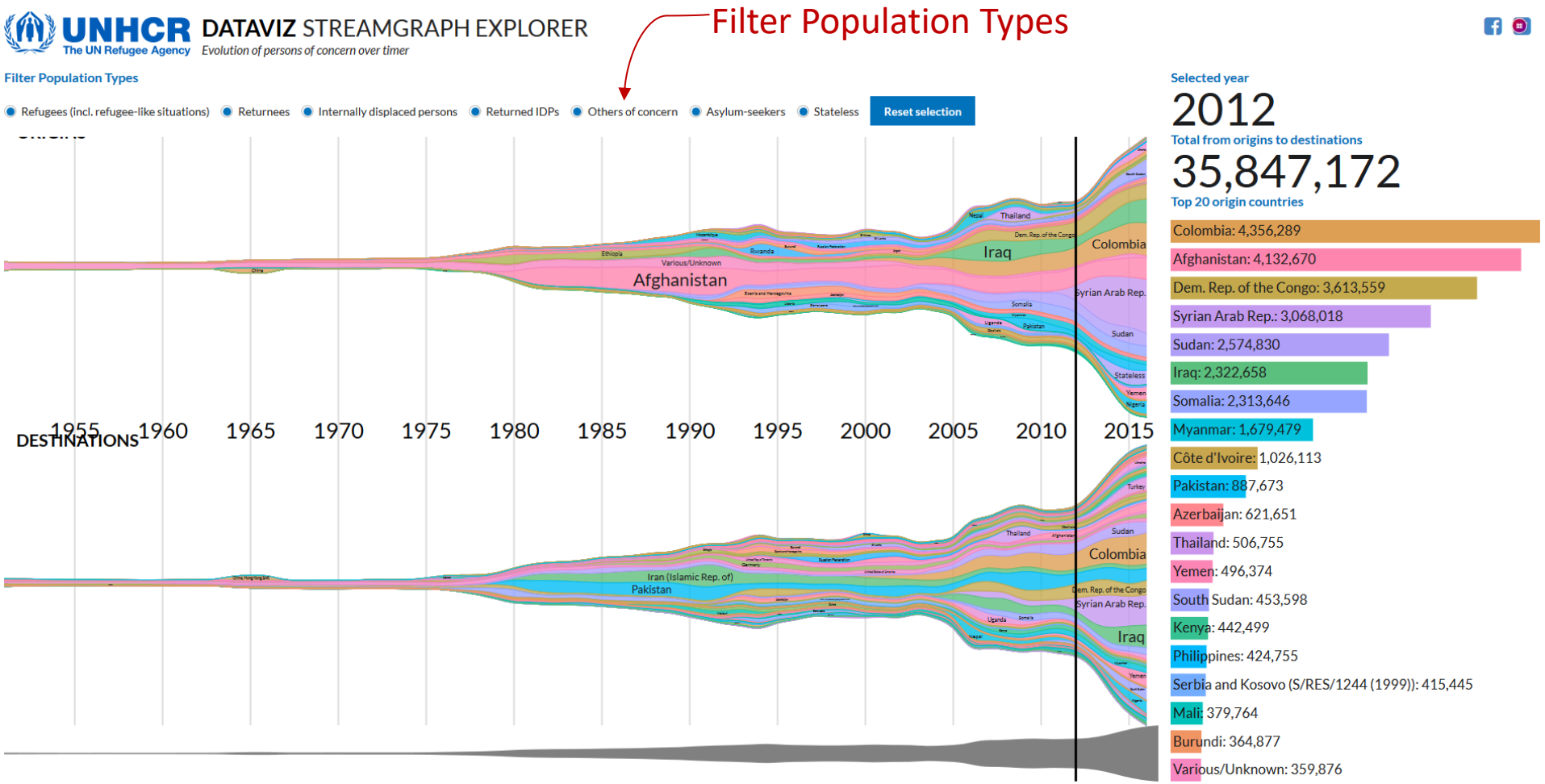
How each candidate's chances of winning more than half of pledged delegates have changed over time



https://projects.fivethirtyeight.com/2020-primary-forecast/

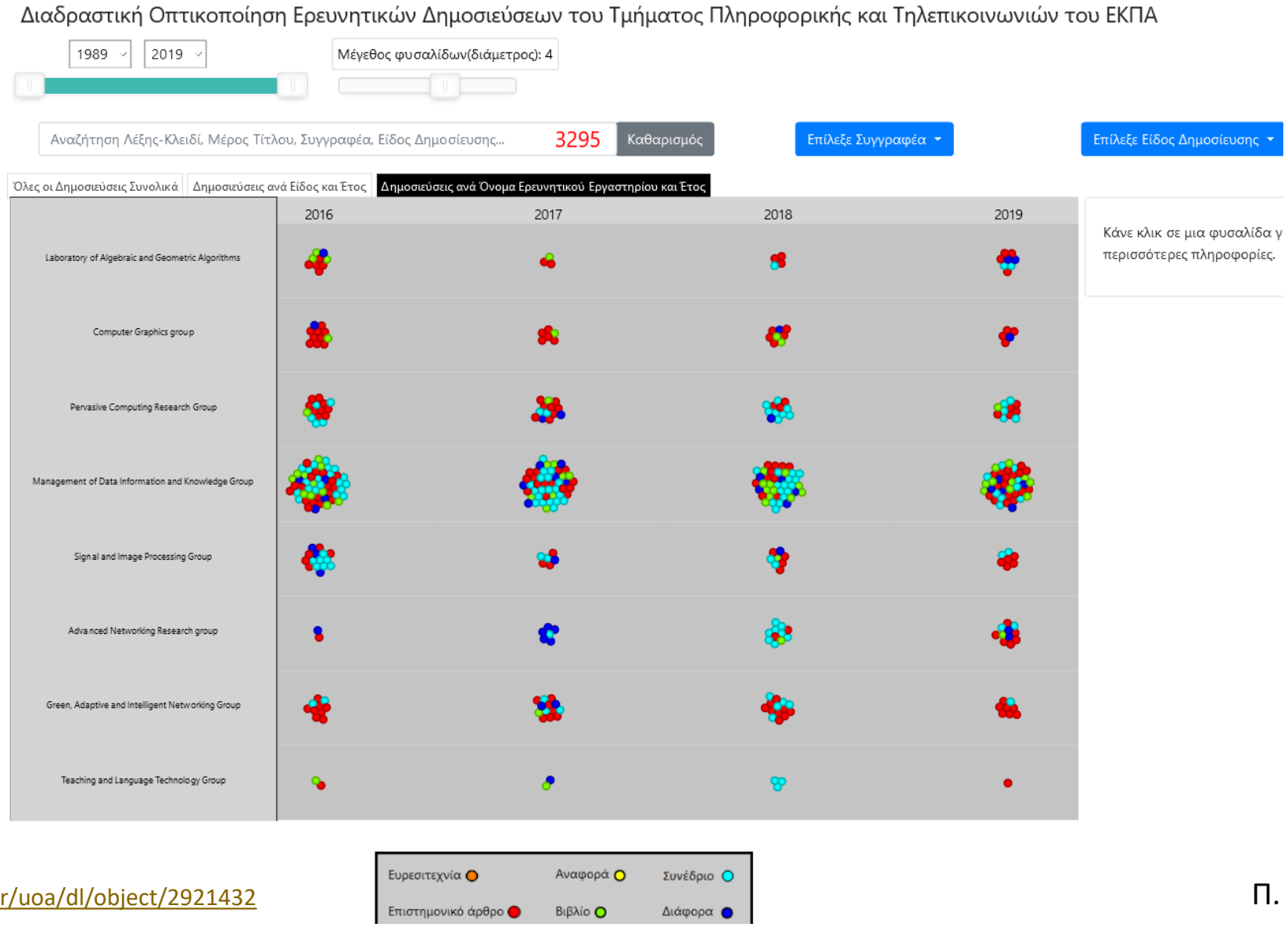
DataVis examples

- UNHCR Evolution of persons of concern over timer



https://datavis.tech/projects/unhcr-streamgraph-explorer/ & https://unhcr.github.io/dataviz-streamgraph-explorer/#types=1-2-3-4-5-6-7

DataVis examples

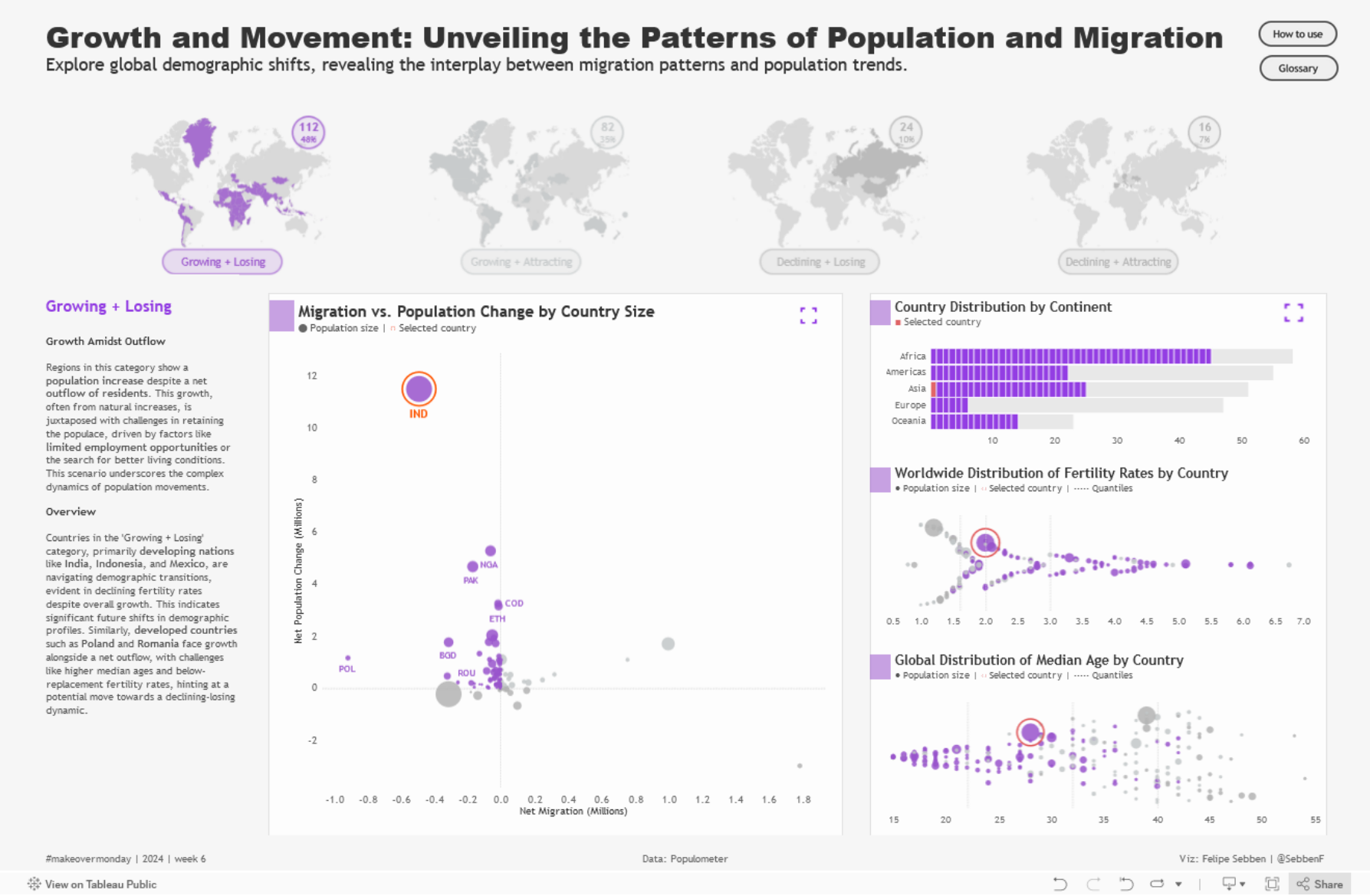


https://pergamos.lib.uoa.gr/uoa/dl/object/2921432

Π. Ξένος, 2020

- Combinations of visualizations on dashboards

DataVis examples



DataVis examples

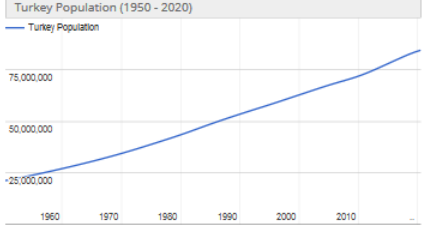
- Current World Population - worldometer

W / Population / World / Asia / Western Asia / Turkey

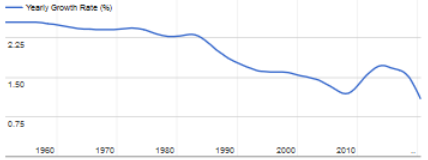
Turkey Population (LIVE)

84,072,603

Turkey Population (1950 - 2020)



Yearly Population Growth Rate (%)



Country | Continent | World

- The current population of **Turkey** is **84,068,992** as of Sunday, March 15, 2020, based on Worldometer elaboration of the latest United Nations data.
- Turkey 2020 population is estimated at **84,339,067** people at mid year according to UN data.
- Turkey population is equivalent to **1.08%** of the total world population.
- Turkey ranks number **17** in the list of countries (and dependencies) by population.
- The population density in Turkey is 110 per Km² (284 people per mi²).
- The total **land** area is 769,630 Km2 (297,156 sq. miles)
- **75.7 %** of the population is **urban** (63,803,445 people in 2020)
- The **median age** in Turkey is **31.5 years**.

Population of Turkey (2020 and historical)

Year	Population	Yearly % Change	Yearly Change	Migrants (net)	Median Age	Fertility Rate	Density (P/Km²)	Urban Pop %	Urban Population	Country's Share of World Pop	World Population	Turkey Global Rank
2020	**84,339,067**	1.09 %	909,452	283,922	31.5	2.08	110	75.7	63,803,445	1.08 %	7,794,798,739	17

World Population by Region

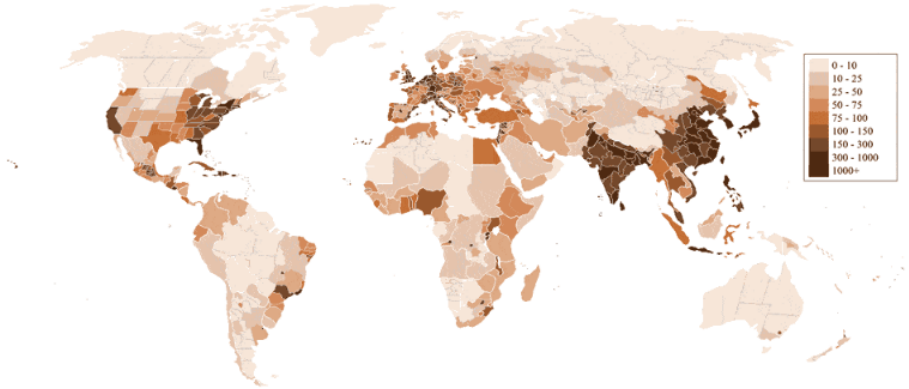
back to top ↑

#	Region	Population (2020)	Yearly Change	Net Change	Density (P/Km²)	Land Area (Km²)	Migrants (net)	Fert. Rate	Med. Age	Urban Pop %	World Share
1	Asia	**4,641,054,775**	0.86 %	39,683,577	150	31,033,131	-1,729,112	2.2	32	0 %	59.5 %
2	Africa	**1,340,598,147**	2.49 %	32,533,952	45	29,648,481	-463,024	4.4	20	0 %	17.2 %
3	Europe	**747,636,026**	0.06 %	453,275	34	22,134,900	1,361,011	1.6	43	0 %	9.6 %
4	Latin America and the Caribbean	**653,962,331**	0.9 %	5,841,374	32	20,139,378	-521,499	2	31	0 %	8.4 %
5	Northern America	**368,869,647**	0.62 %	2,268,683	20	18,651,660	1,196,400	1.8	39	0 %	4.7 %
6	Oceania	**42,677,813**	1.31 %	549,778	5	8,486,460	156,226	2.4	33	0 %	0.5 %

World Population Density (people/km^2)

back to top ↑

Population density map of the world showing not only countries but also many subdivisions (regions, states, provinces). See also: World Map



Courtesy of Junuxx at en.wikipedia [CC-BY-SA-3.0 or GFDL], via Wikimedia Commons

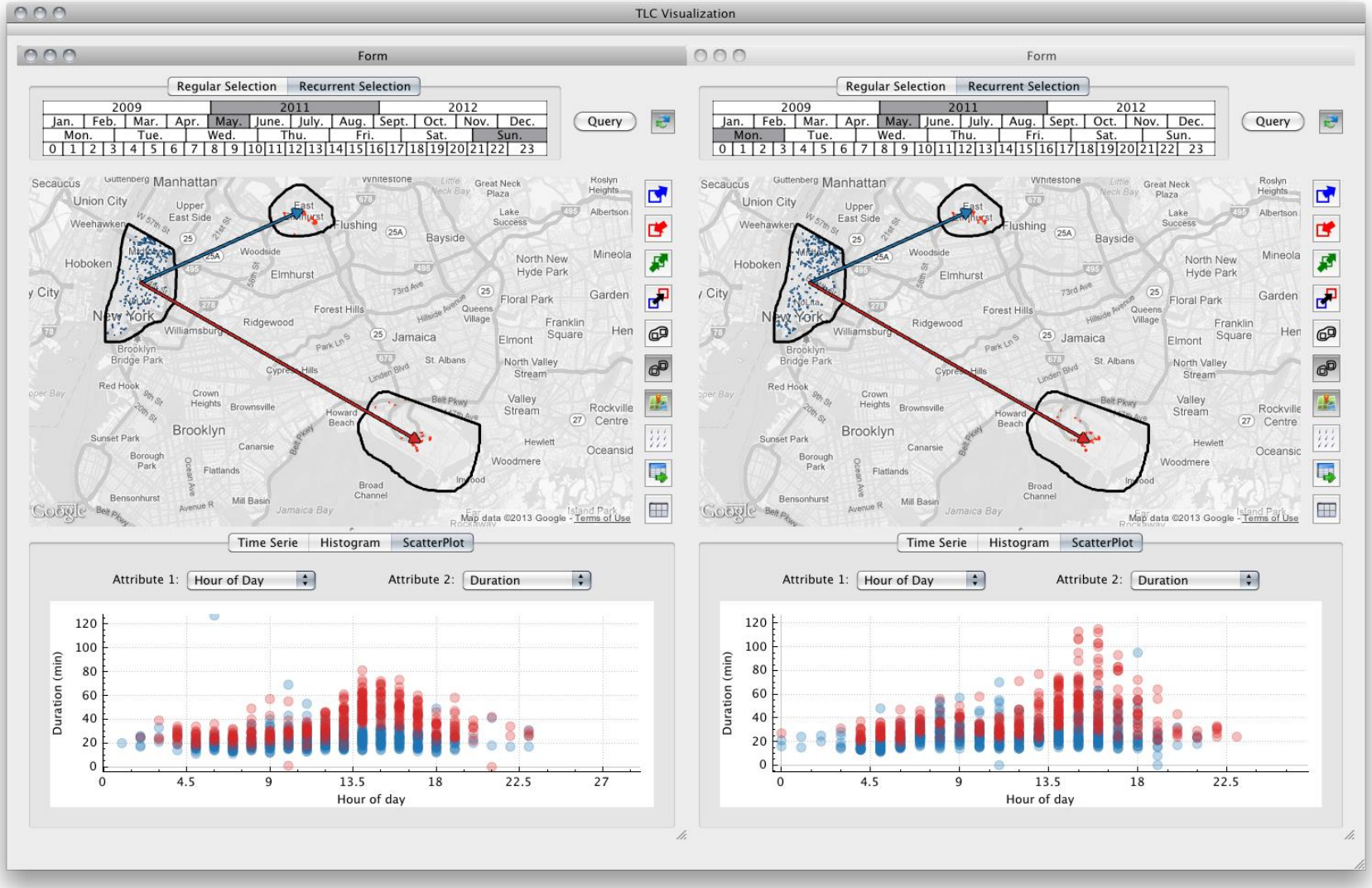
World Population by Religion

back to top ↑

According to a recent study (based on the 2010 world population of 6.9 billion) by The Pew Forum, there are:

- **2,173,180,000 Christians** (**31%** of world population), of which 50% are Catholic, 37% Protestant, 12% Orthodox, and 1% other.
- **1,598,510,000 Muslims (23%)**, of which 87-90% are Sunnis, 10-13% Shia.

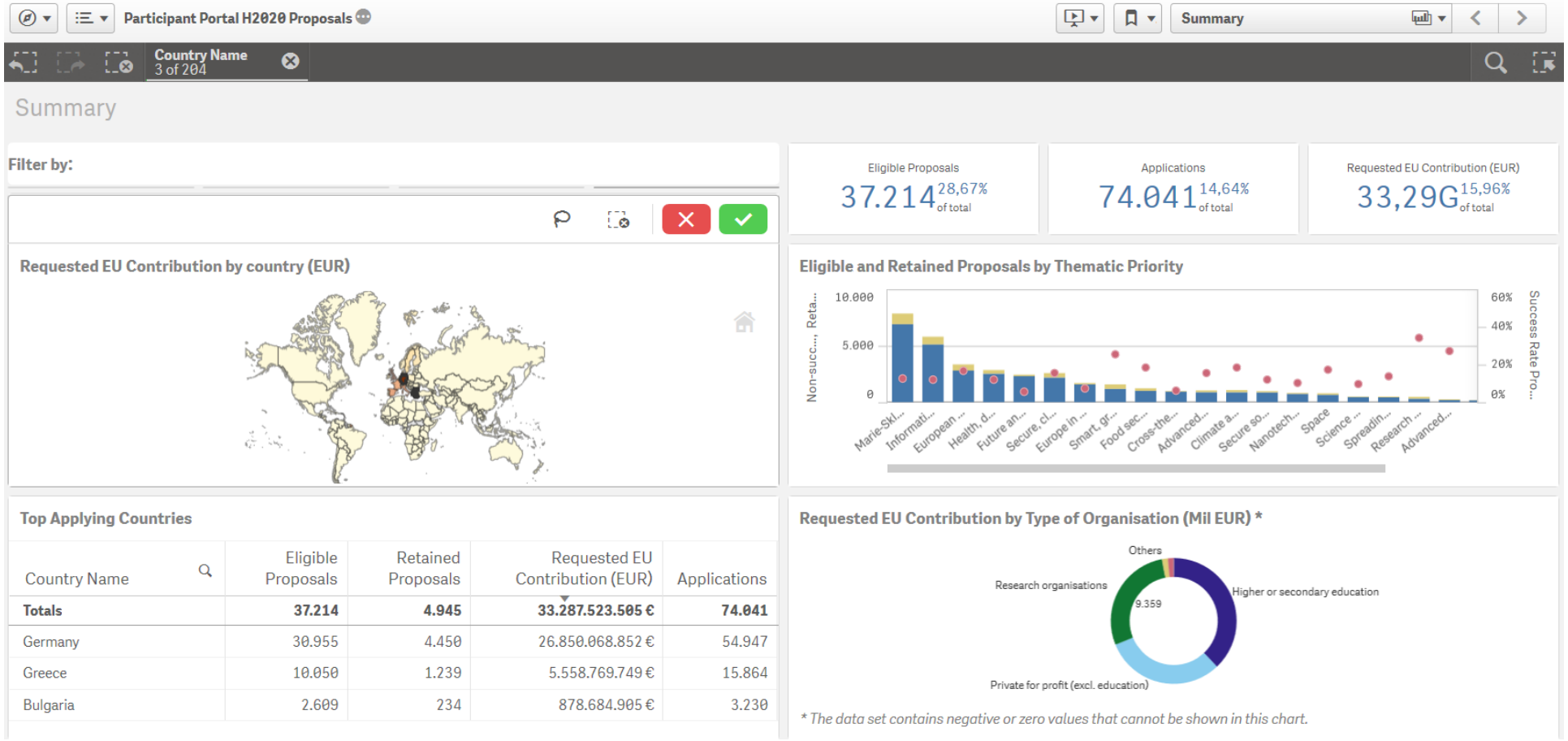
DataVis dashboards



New York City Taxi Trips http://vgc.poly.edu/projects/taxivis/

DataVis dashboards

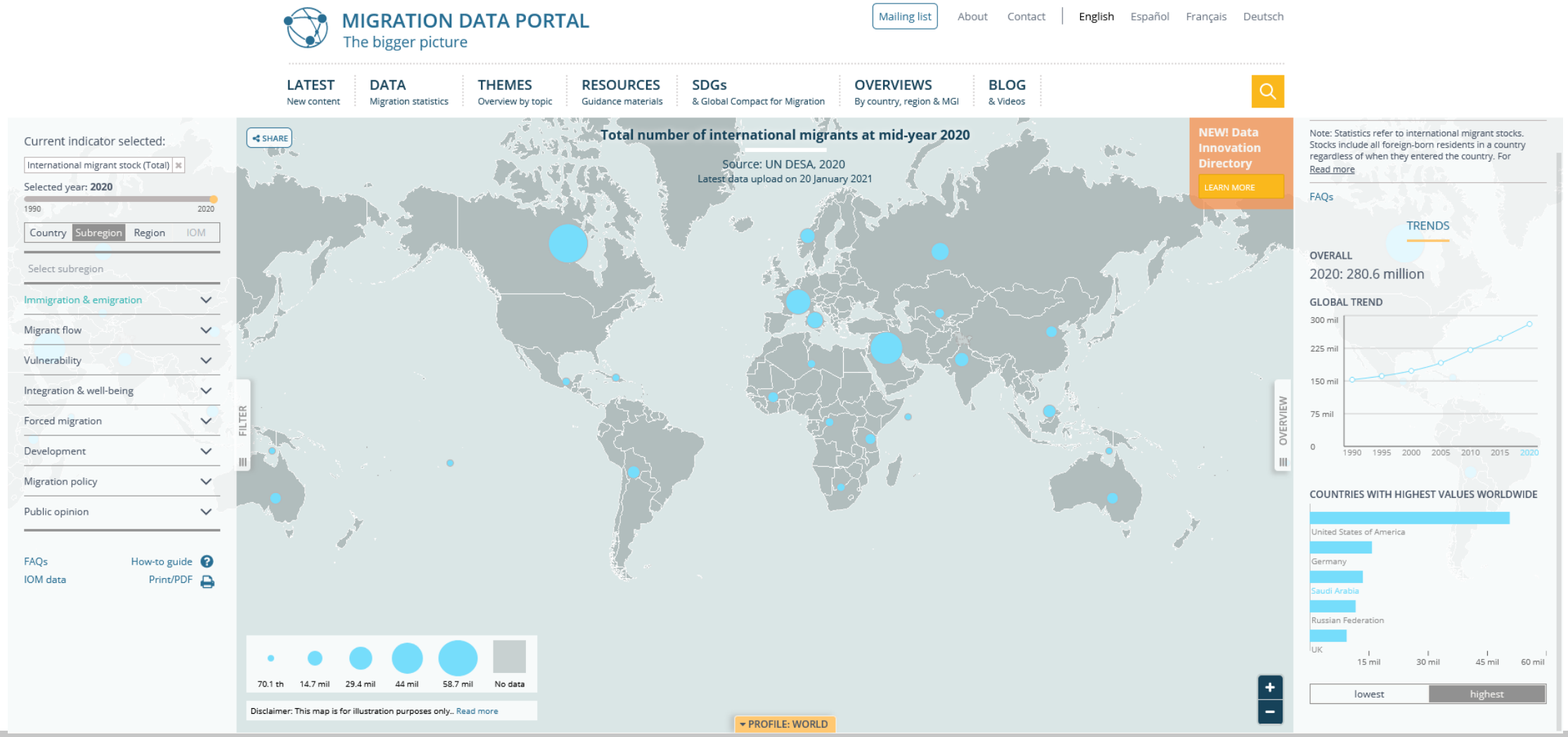
- European Commission funding, 2017



European Commission, 2017

DataVis dashboards

- Migration Data Portal

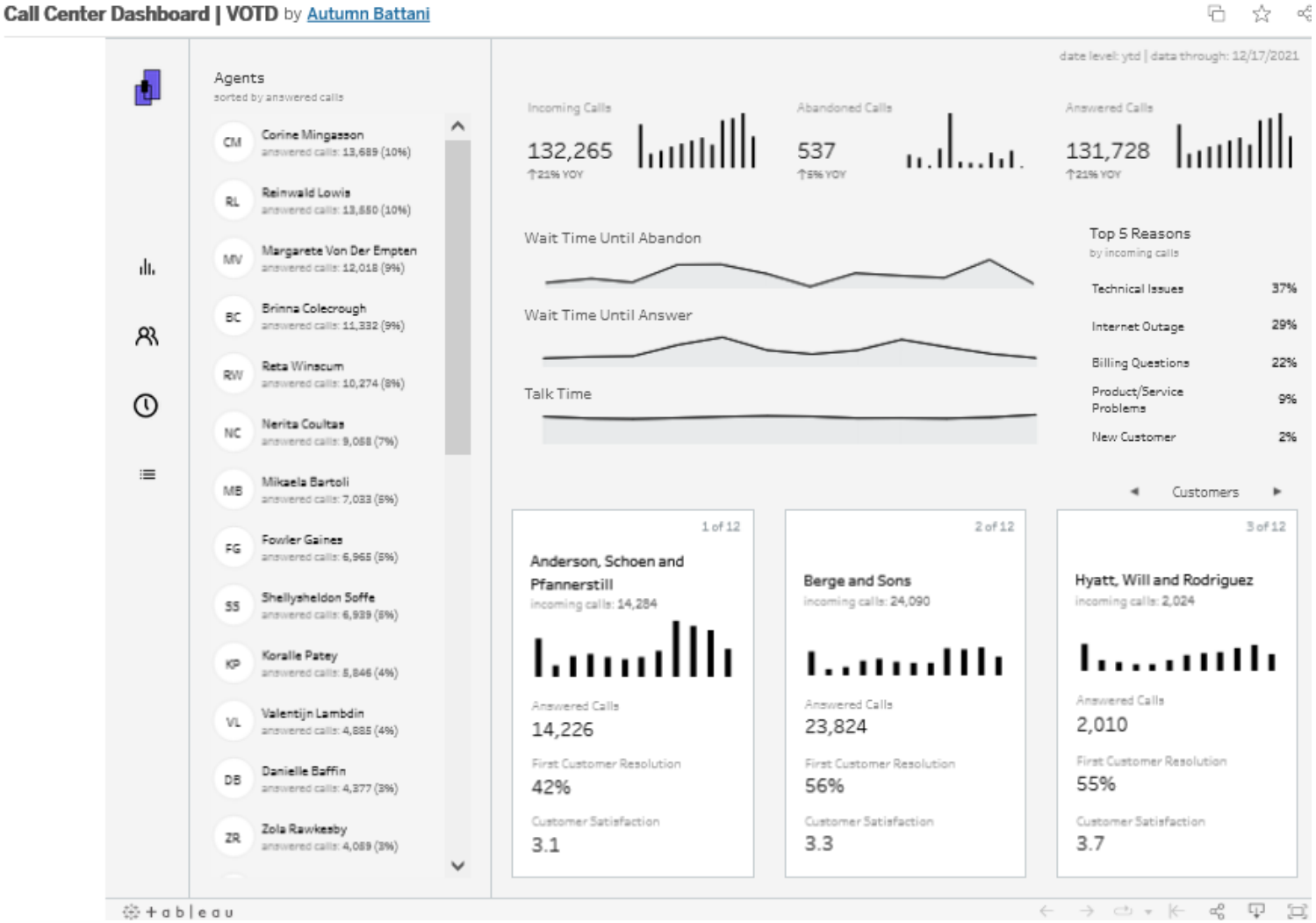


DataVis dashboards

- IMF DataMapper

DataVis dashboards

- CallCenter Dashboard

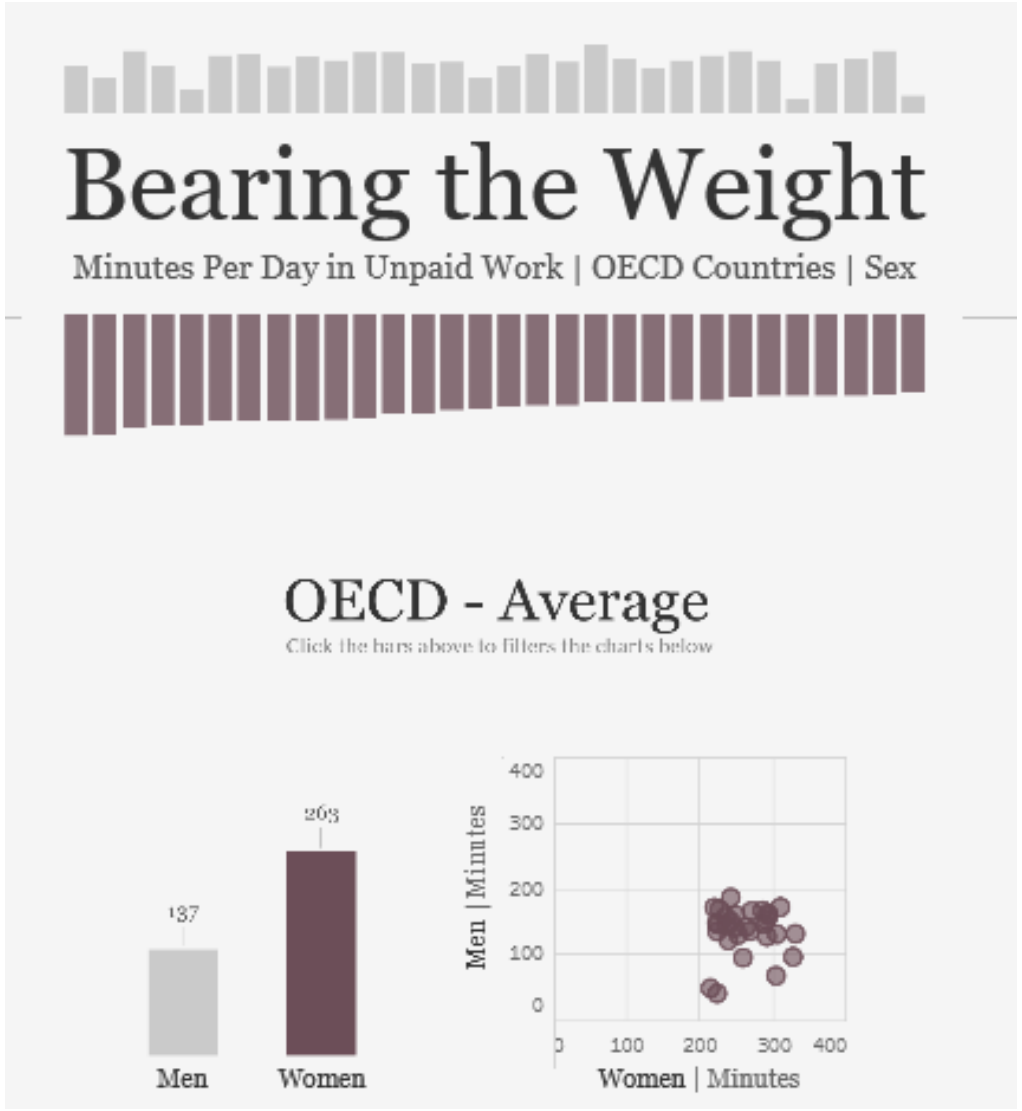


DataVis dashboards

- radial
  &
- map

DataVis dashboards

- Bars
- Scatter plot



Back to the 80s

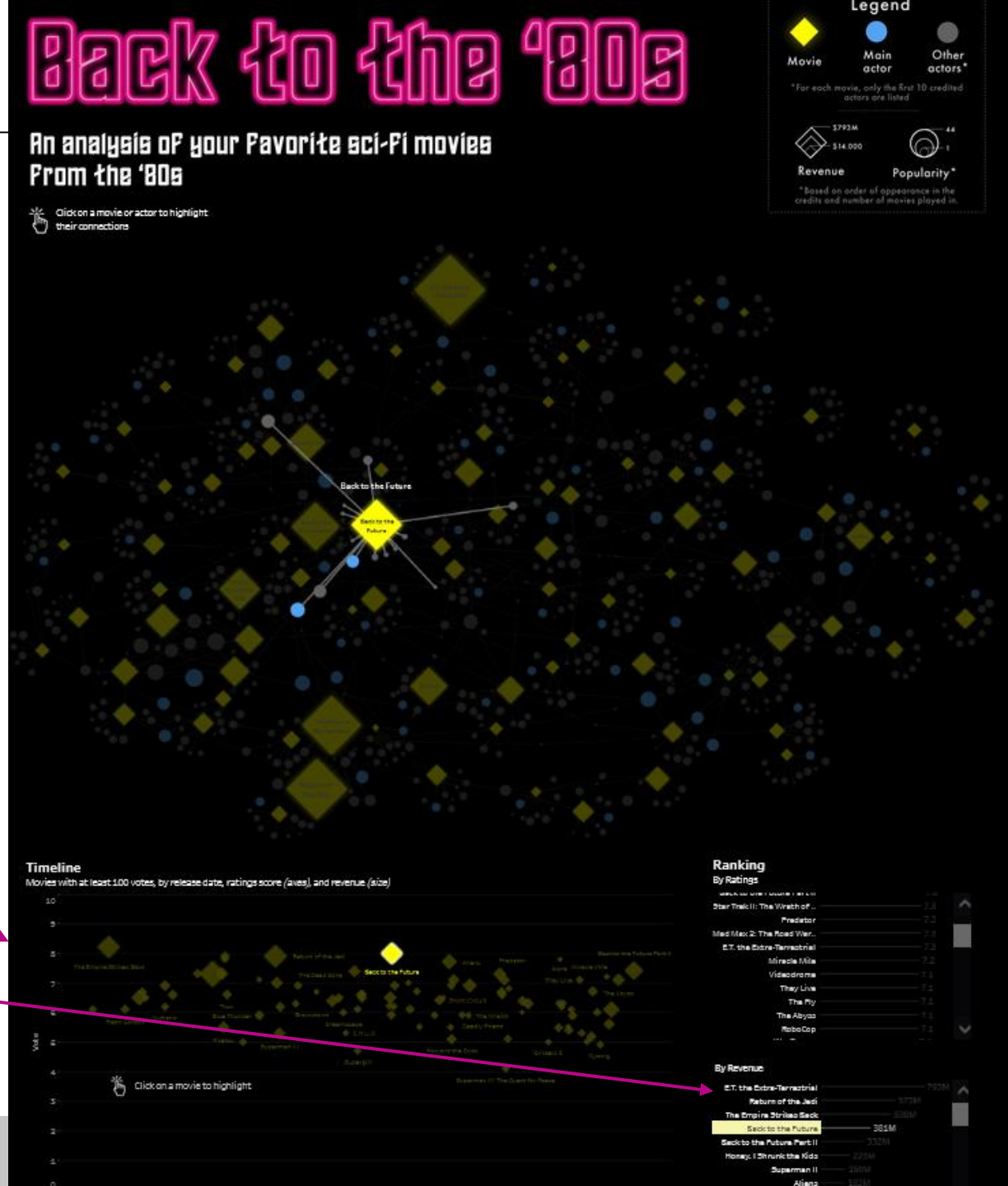
An analysis of your favorite movies from the 80s

[Data from Kaggle]

A choice on the top viz

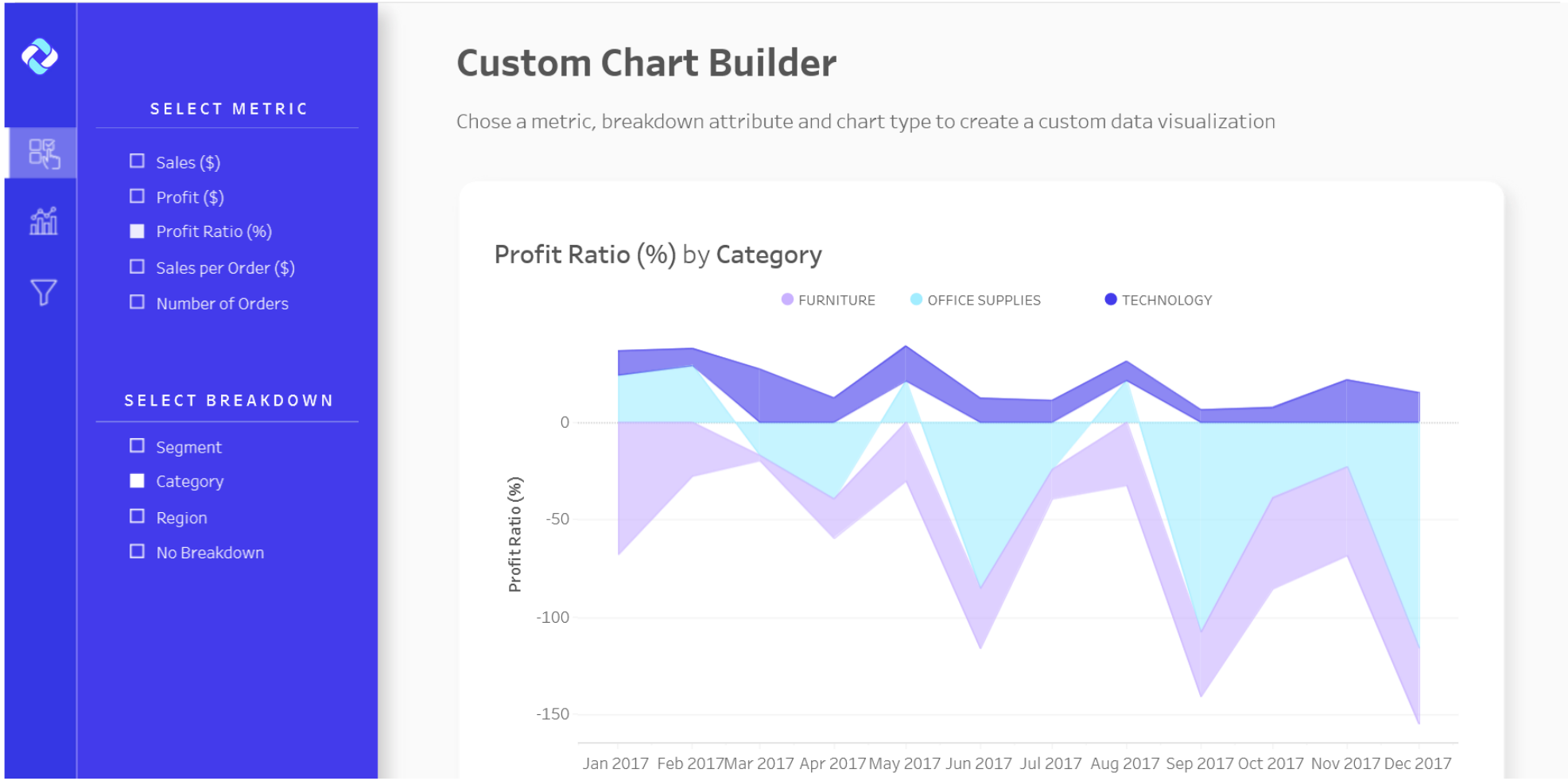
“filters” the same movie on a timeline viz

and on the list



Viz Builder

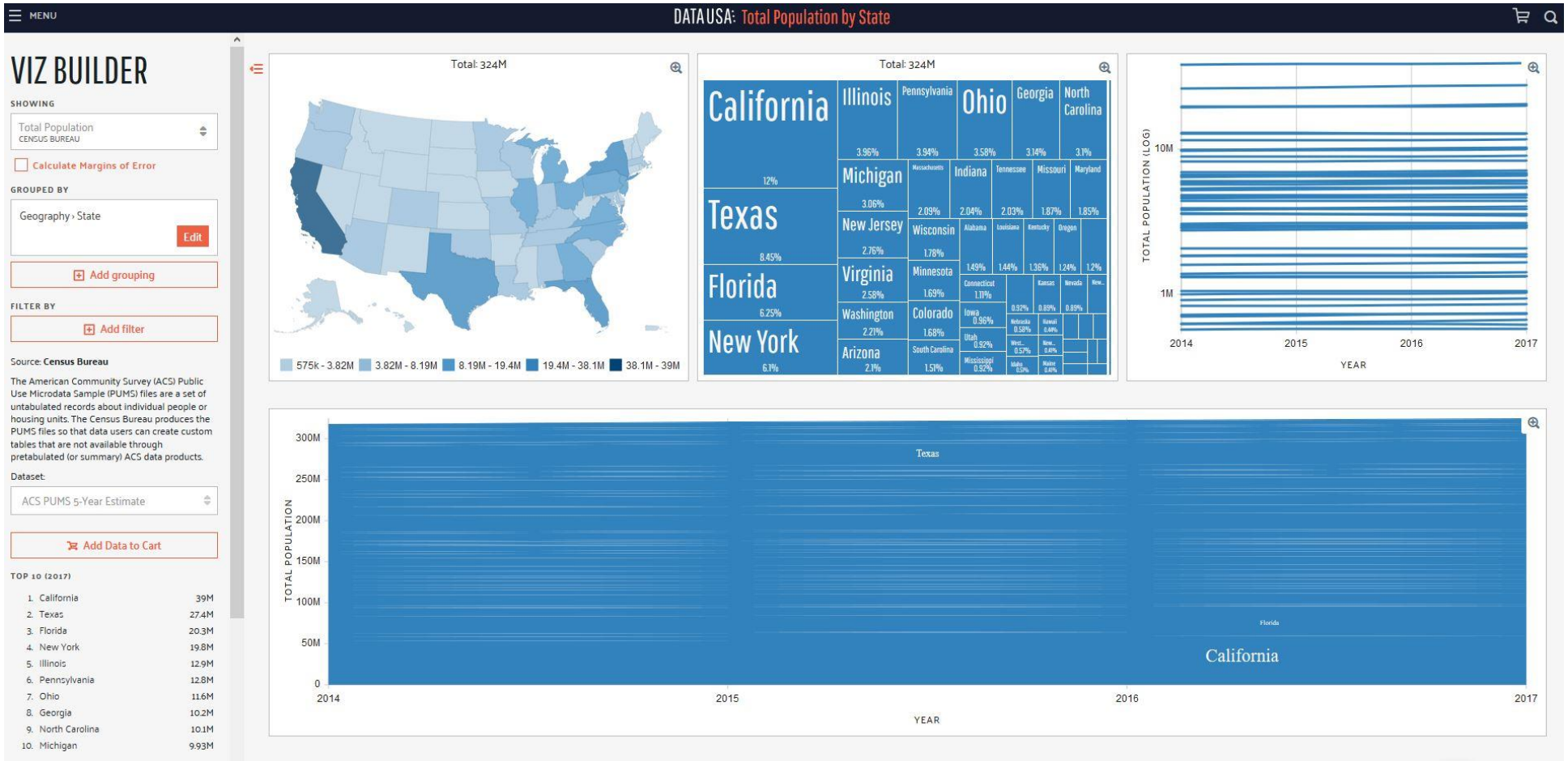
- “Building” simple charts



https://public.tableau.com/app/profile/kasia.gasiewska.holc/viz/CustomChartBuilder/CustomChartBuilder

Viz Builder

- "Building" visualizations of USA data with a filters-based interface



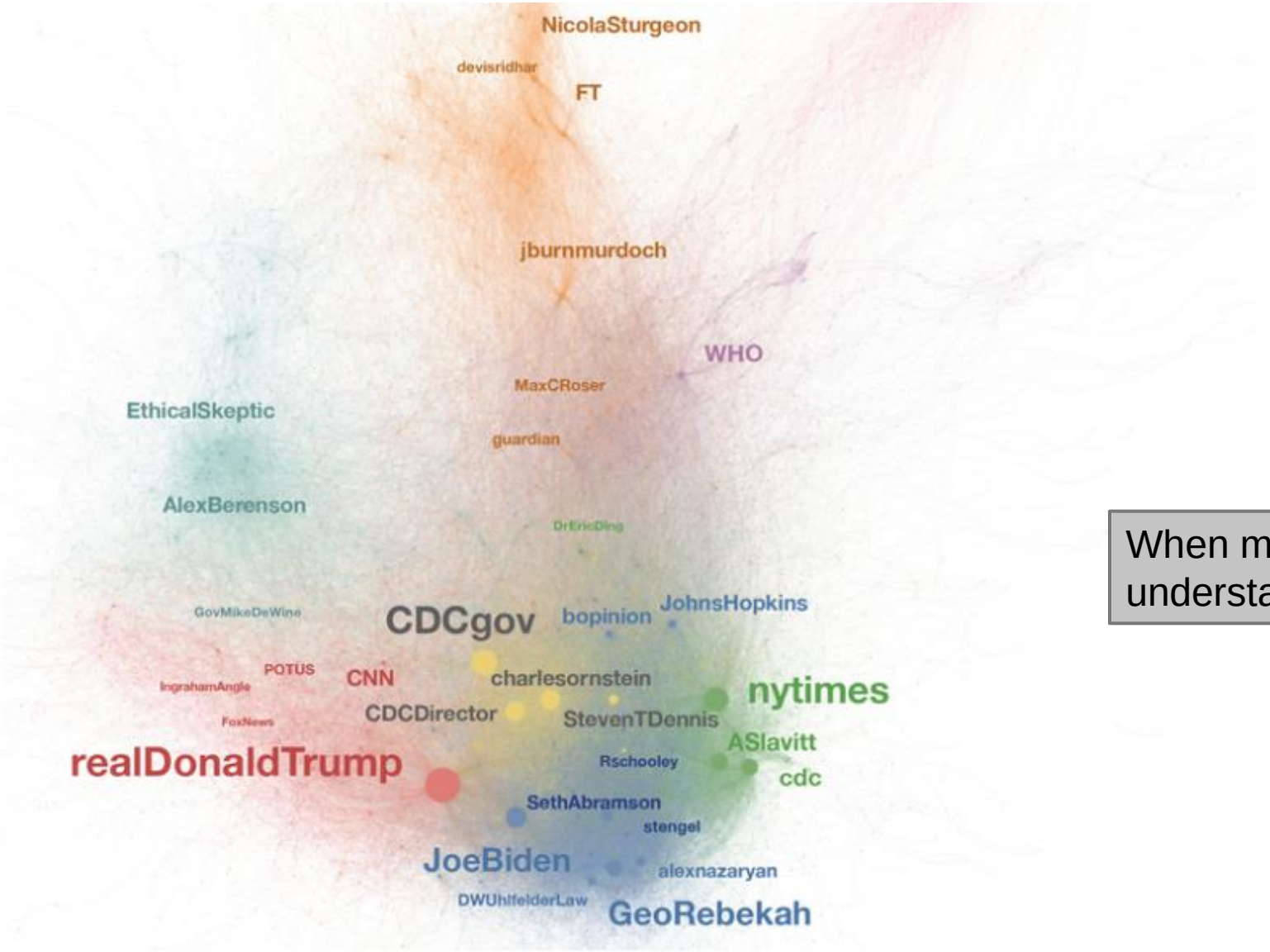
Video demo: https://vimeo.com/343322385

COVID 19 data visualization

- Shneiderman, B. (2020, April). **Data Visualization's Breakthrough Moment in the COVID-19 Crisis**. *Nightingale: The Journal of the Data Visualization Society*. Retrieved from https://medium.com/nightingale/data-visualizations-breakthrough-moment-in-the-covid-19-crisis-ce46627c7db5

- Ackerman, D. (2021, March). When more Covid-19 data doesn't equal more understanding. *MIT News*. Retrieved from https://news.mit.edu/2021/when-more-covid-data-doesnt-equal-more-understanding-0304

COVID 19 data visualization



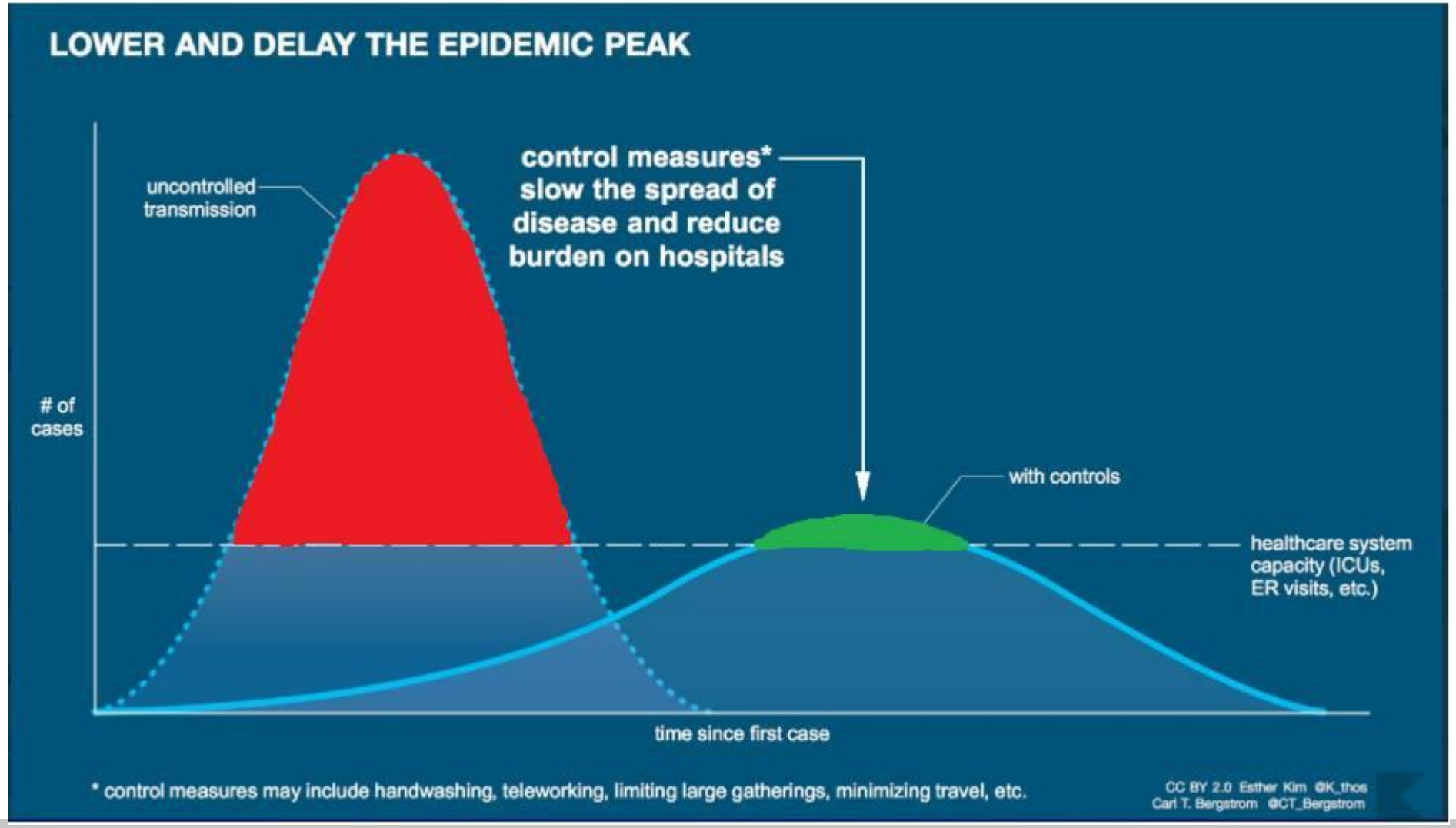
This figure shows a network visualization of Twitter users appearing in the research. Color encodes community and nodes are sized by their degree of connectedness.

Courtesy of the researchers

When more Covid-19 data doesn't equal more understanding. *MIT News*.

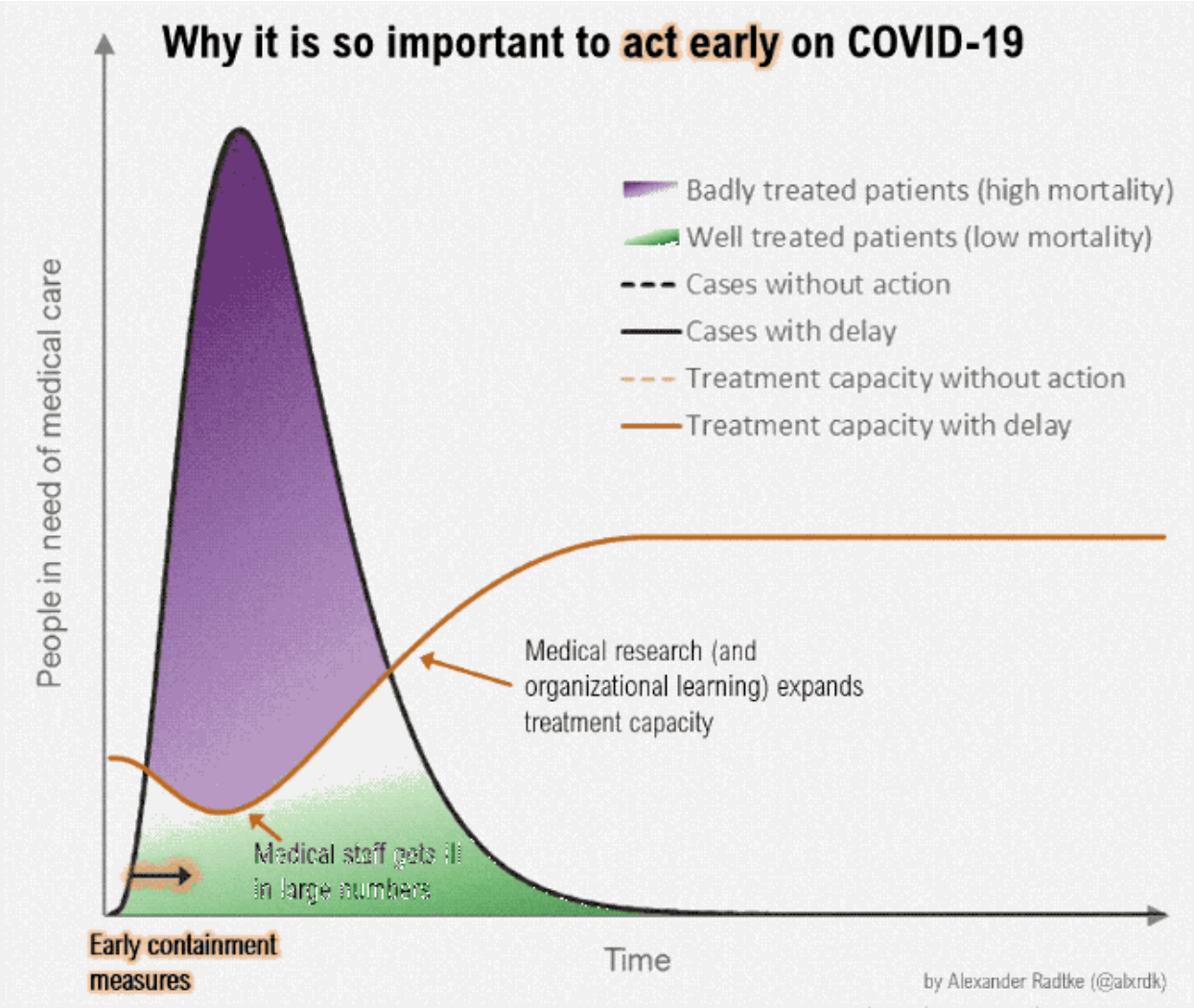
COVID 19 data visualization

- COVID-19 epidemic: Flatten the curve



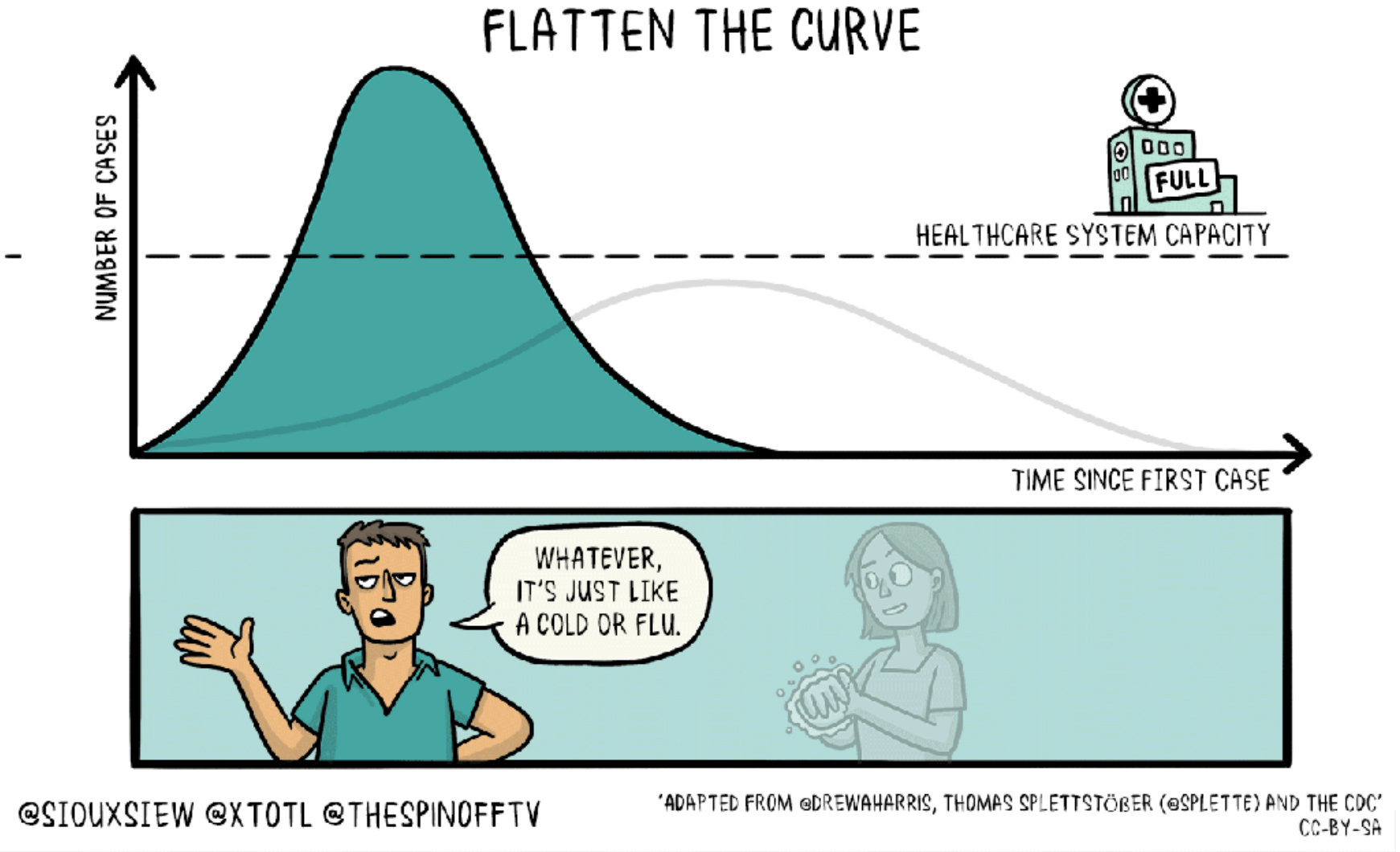
COVID 19 data visualization

- COVID-19 epidemic: Flatten the curve



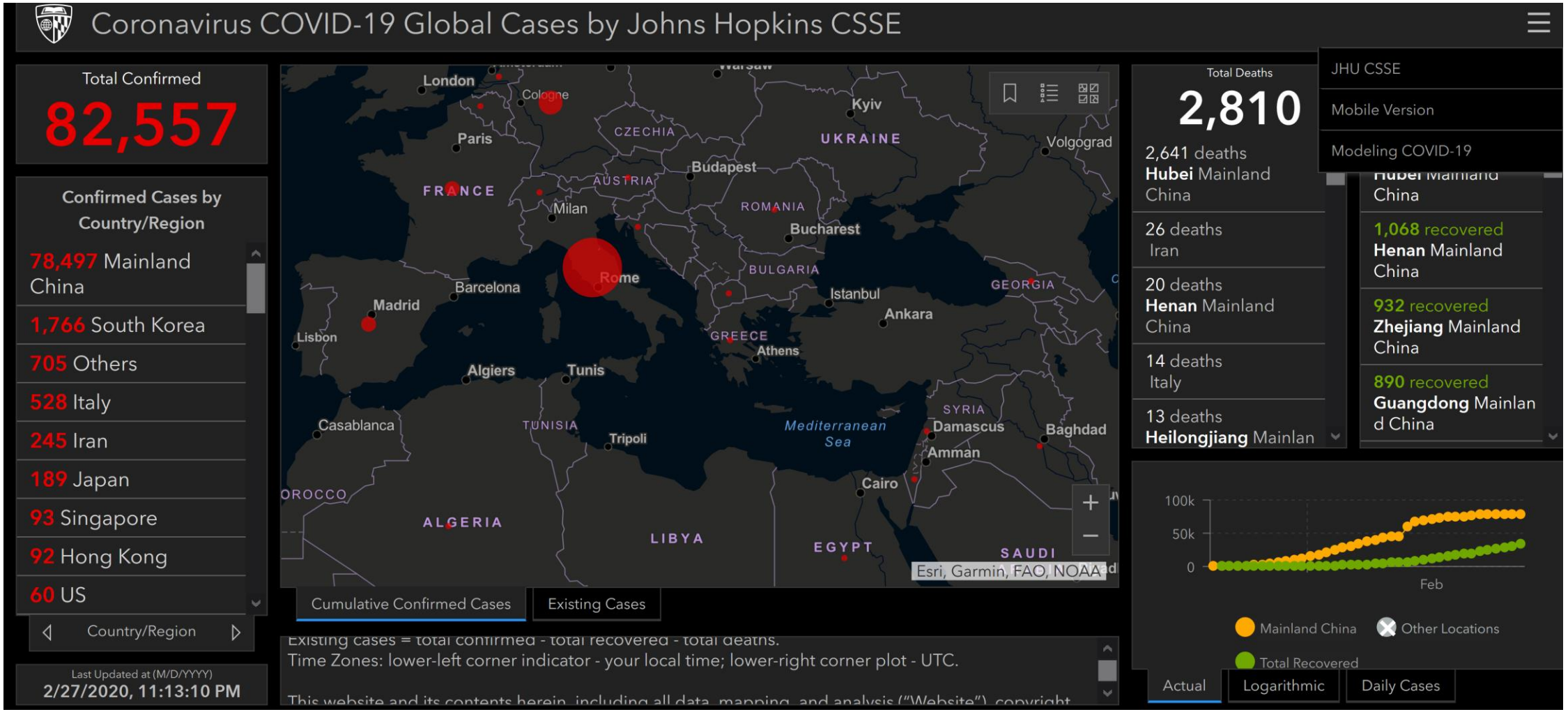
COVID 19 data visualization

- COVID-19 epidemic: Flatten the curve



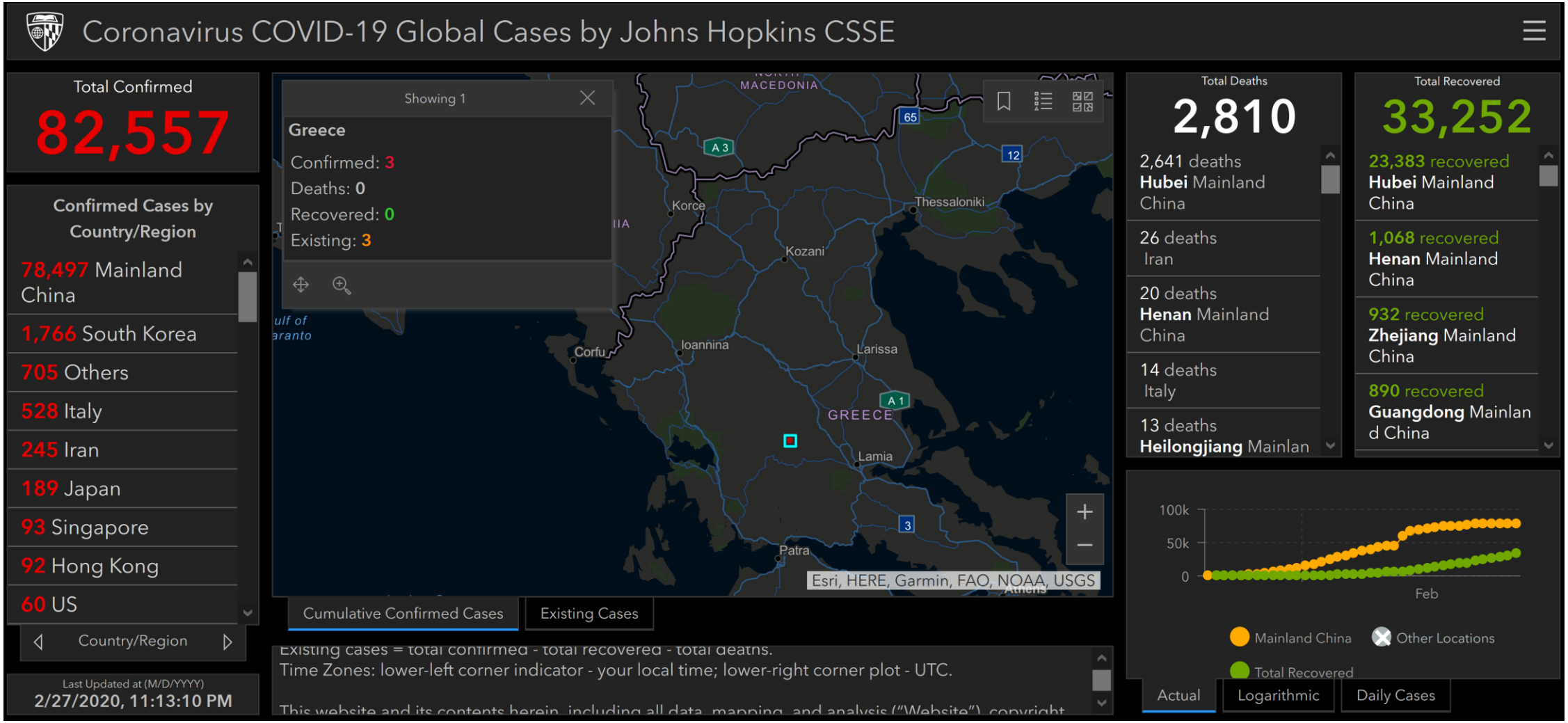
COVID 19 data visualization

- COVID-19 epidemic: Real-time outbreak

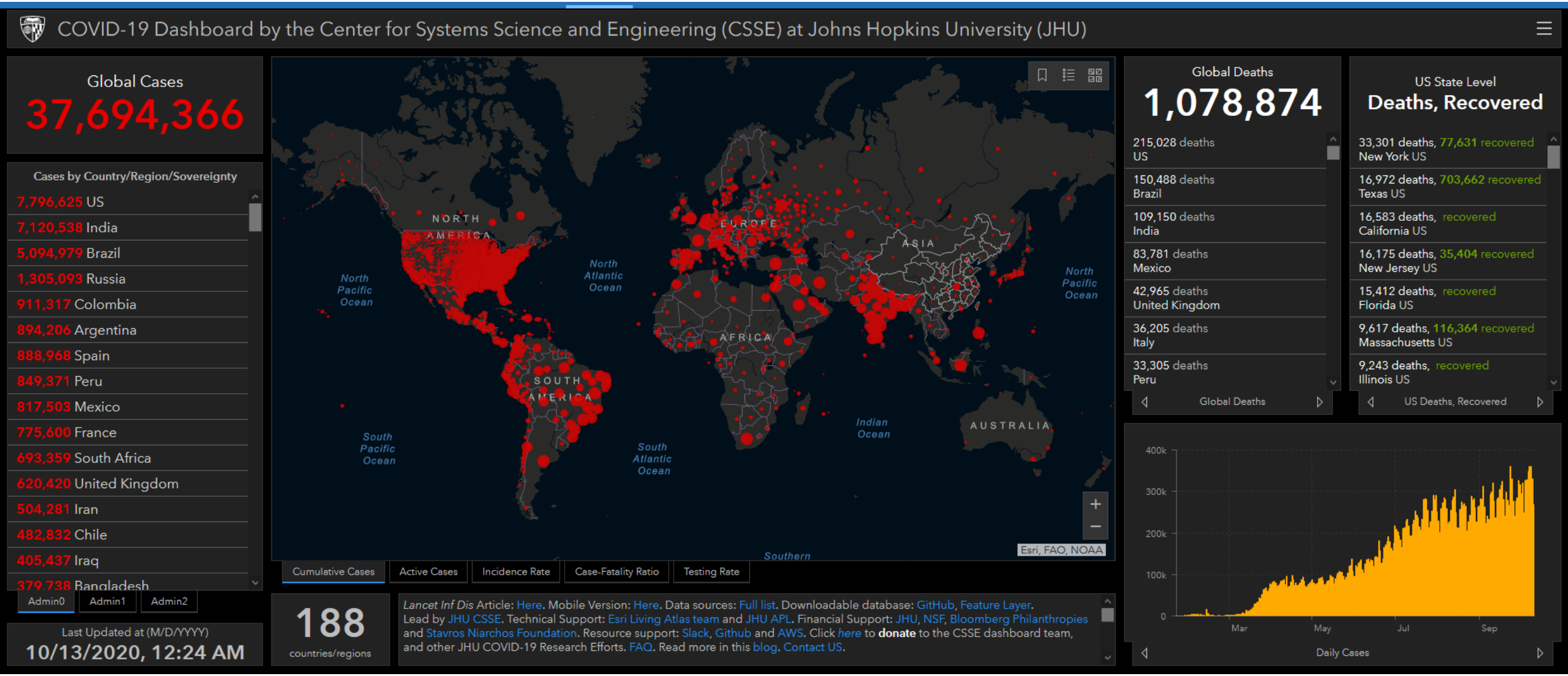


COVID 19 data visualization

- COVID-19 epidemic: Real-time outbreak



COVID 19 data visualization

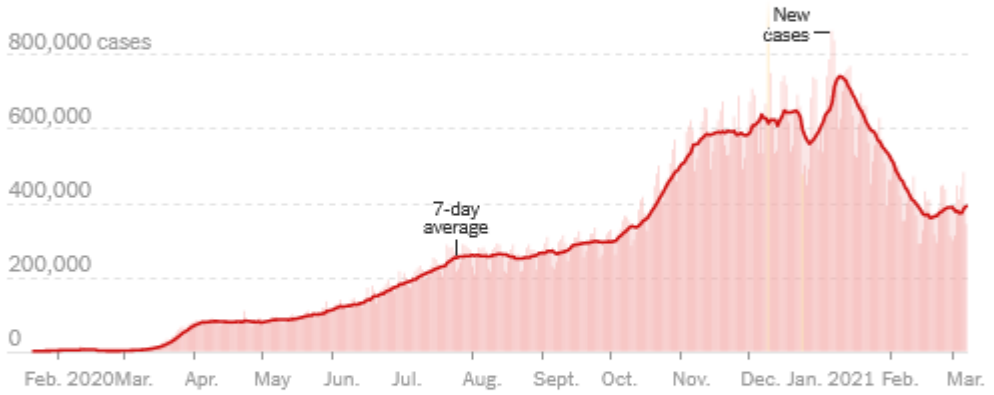


Johns Hopkins University COVID-19 dashboard

COVID 19 data visualization

Coronavirus World Map: Tracking the Global Outbreak

Updated March 8, 2021, 12:04 A.M. E.T.

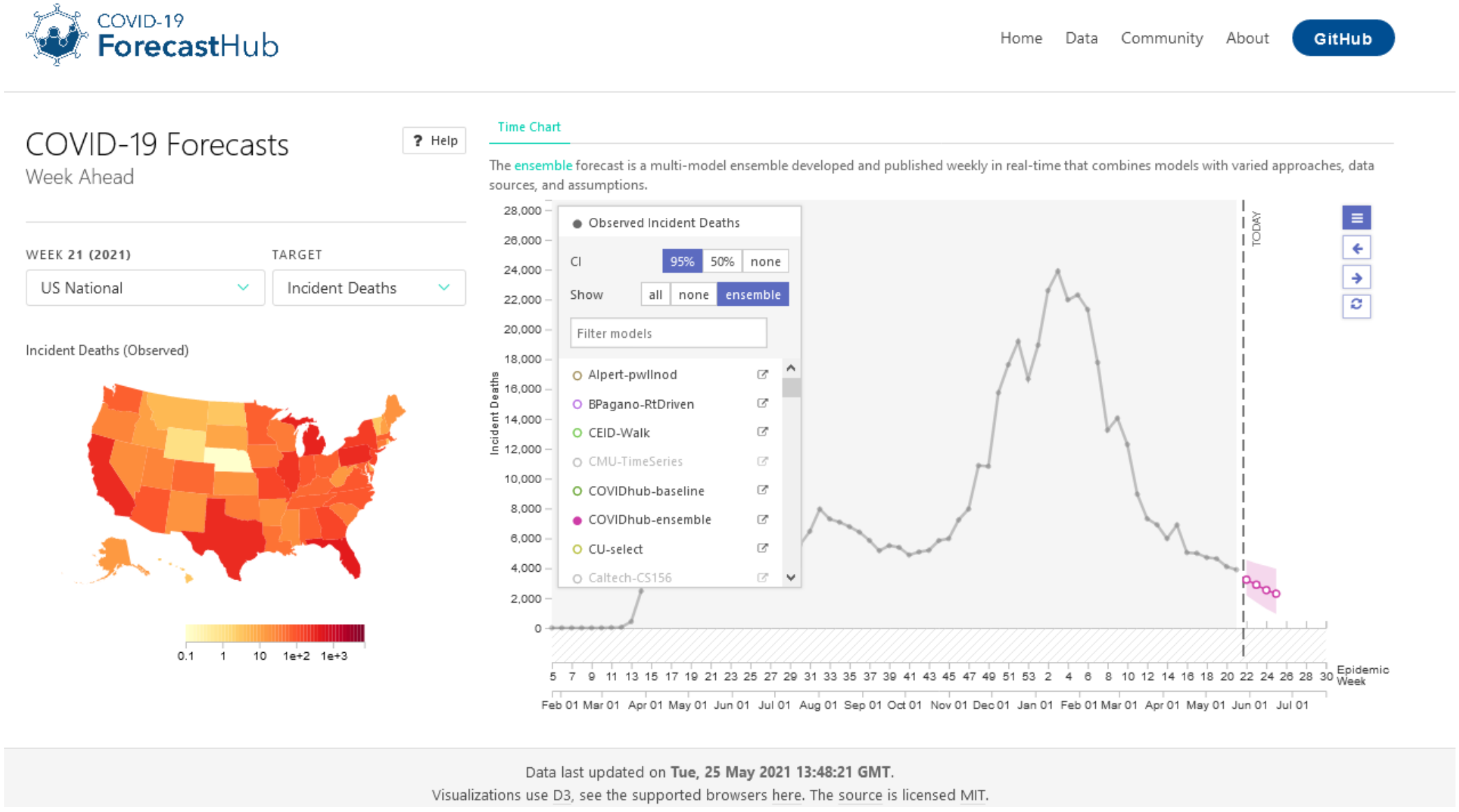


	TOTAL REPORTED	ON MARCH 7	14-DAY CHANGE
Cases	116.8 million+	342,103	+7% →
Deaths	2.5 million+	5,260	-8% →

Day with reporting anomaly. 14-day change trends use 7-day averages.

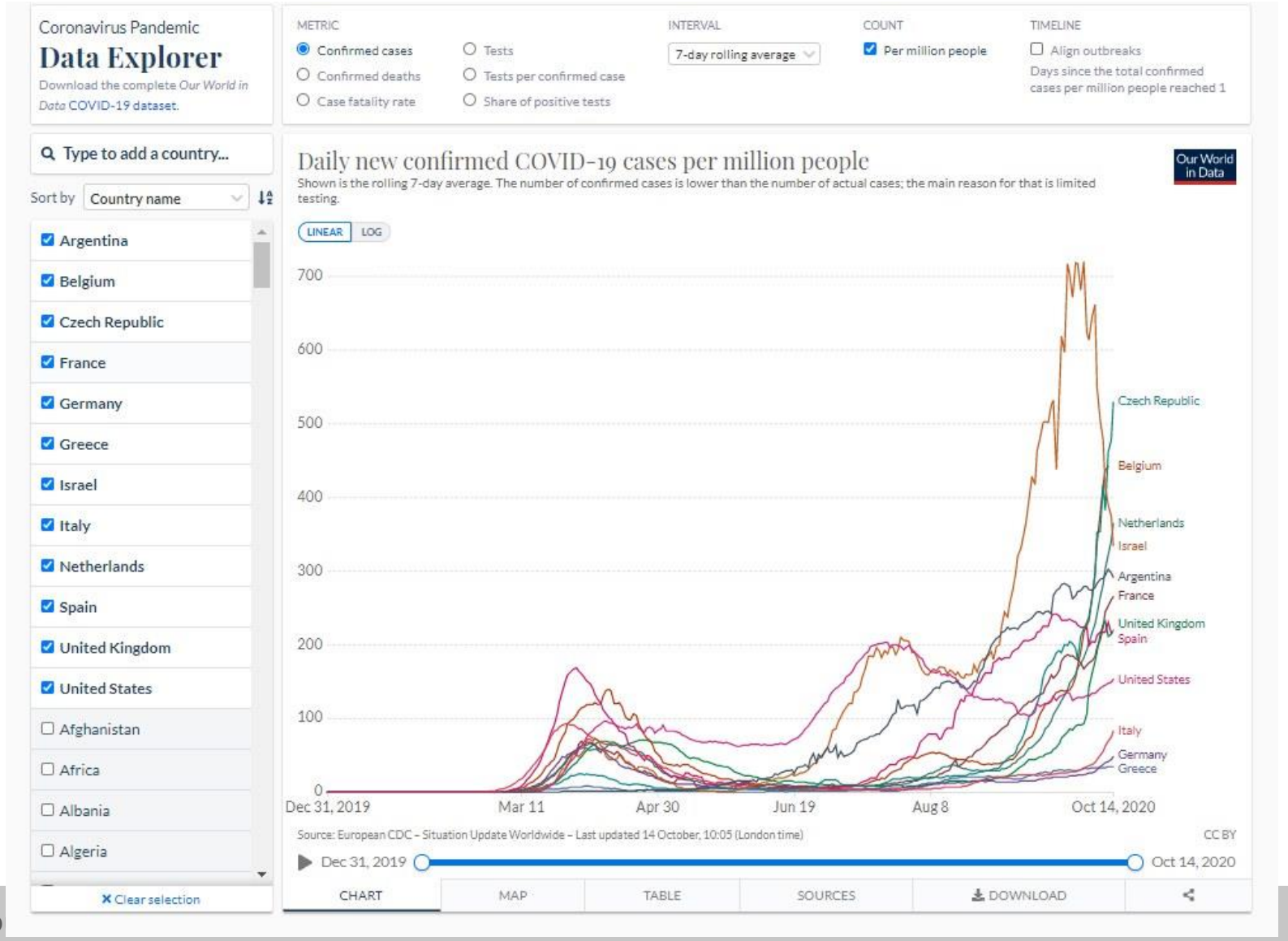
Jump to: Map | Country table | New cases | Tips

COVID 19 data visualization



Linear & logarithmic daily cases

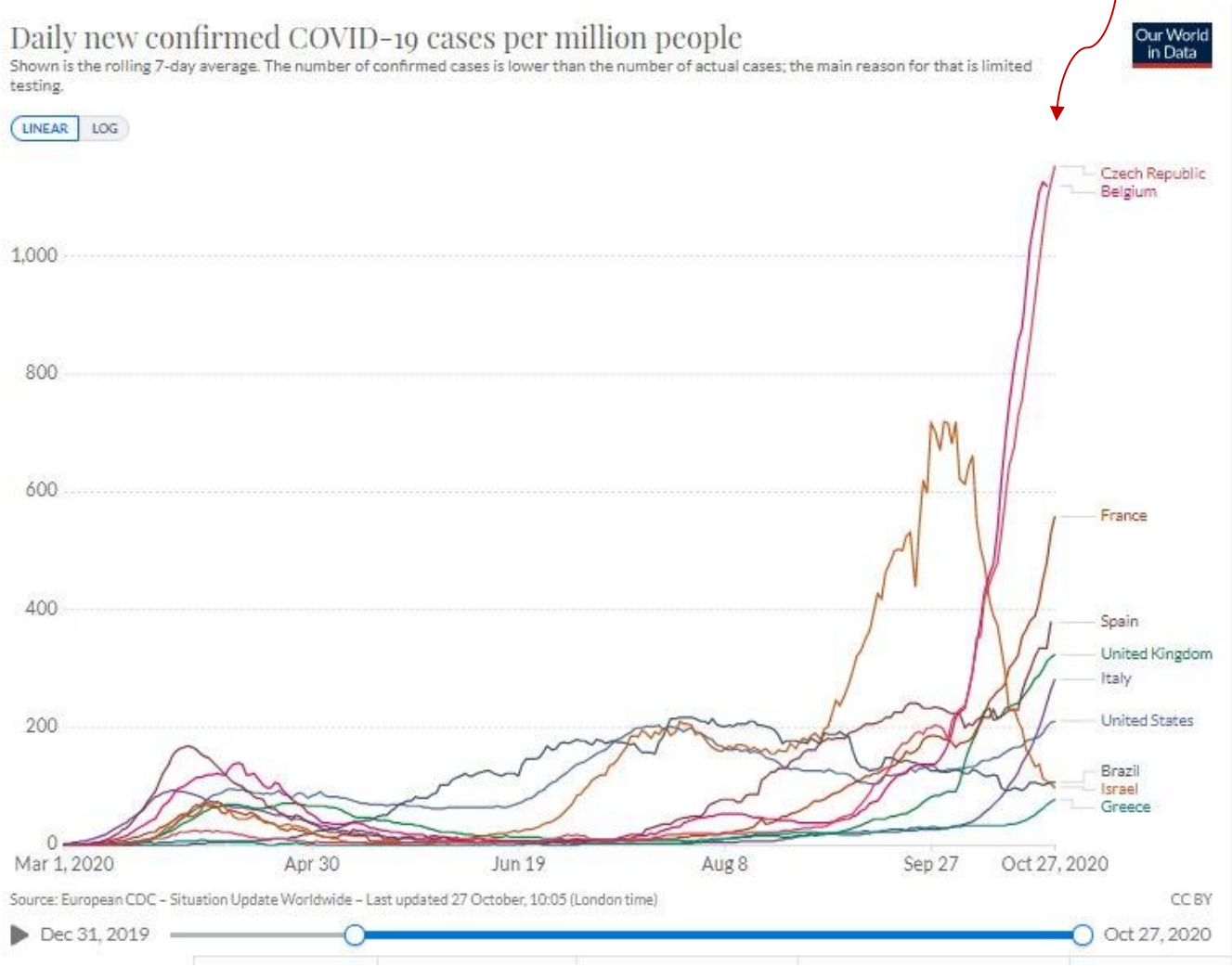
- Our World in Data – ECDC data



Linear & logarithmic daily cases

- Our World in Data

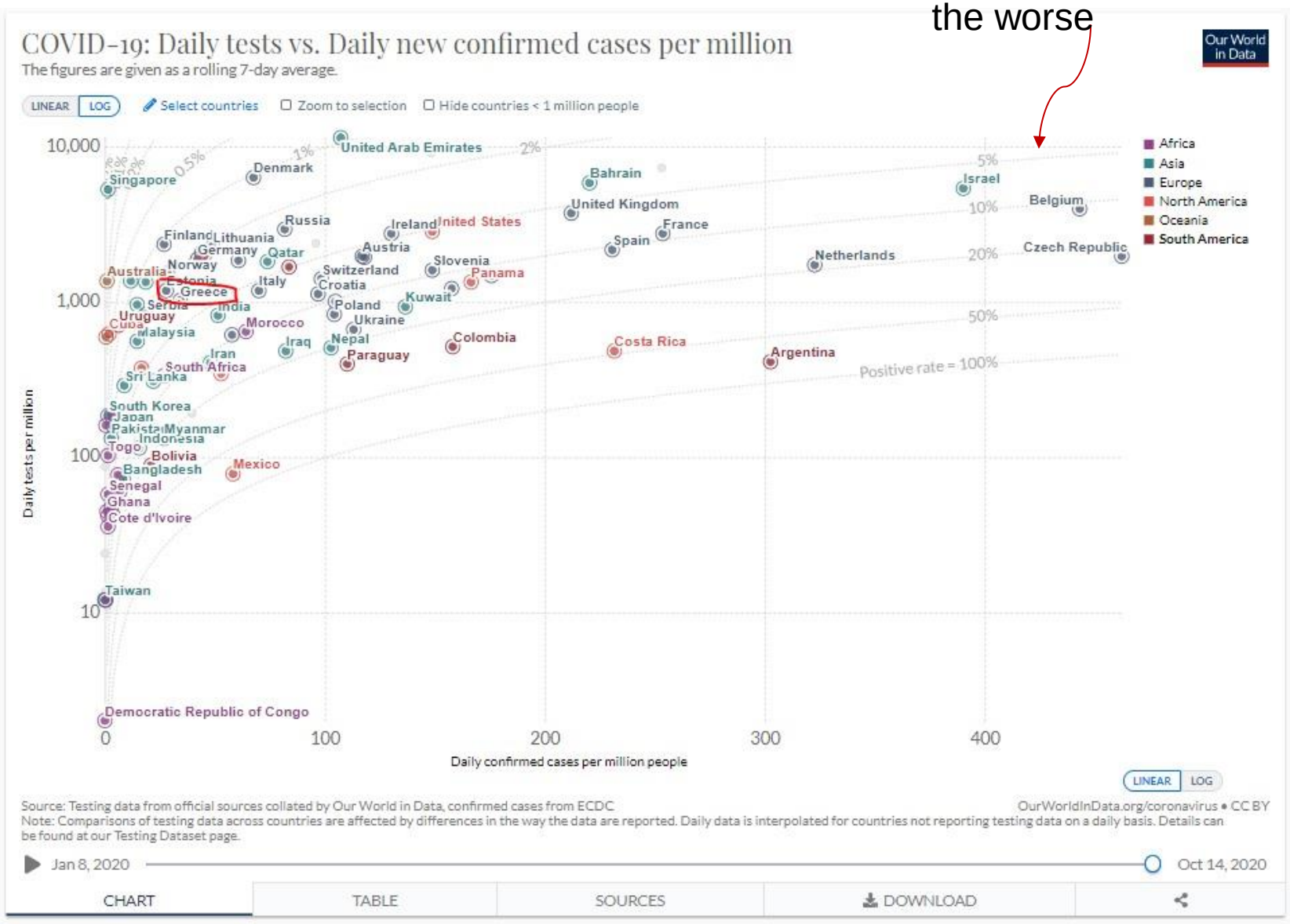
the more up here
the worse



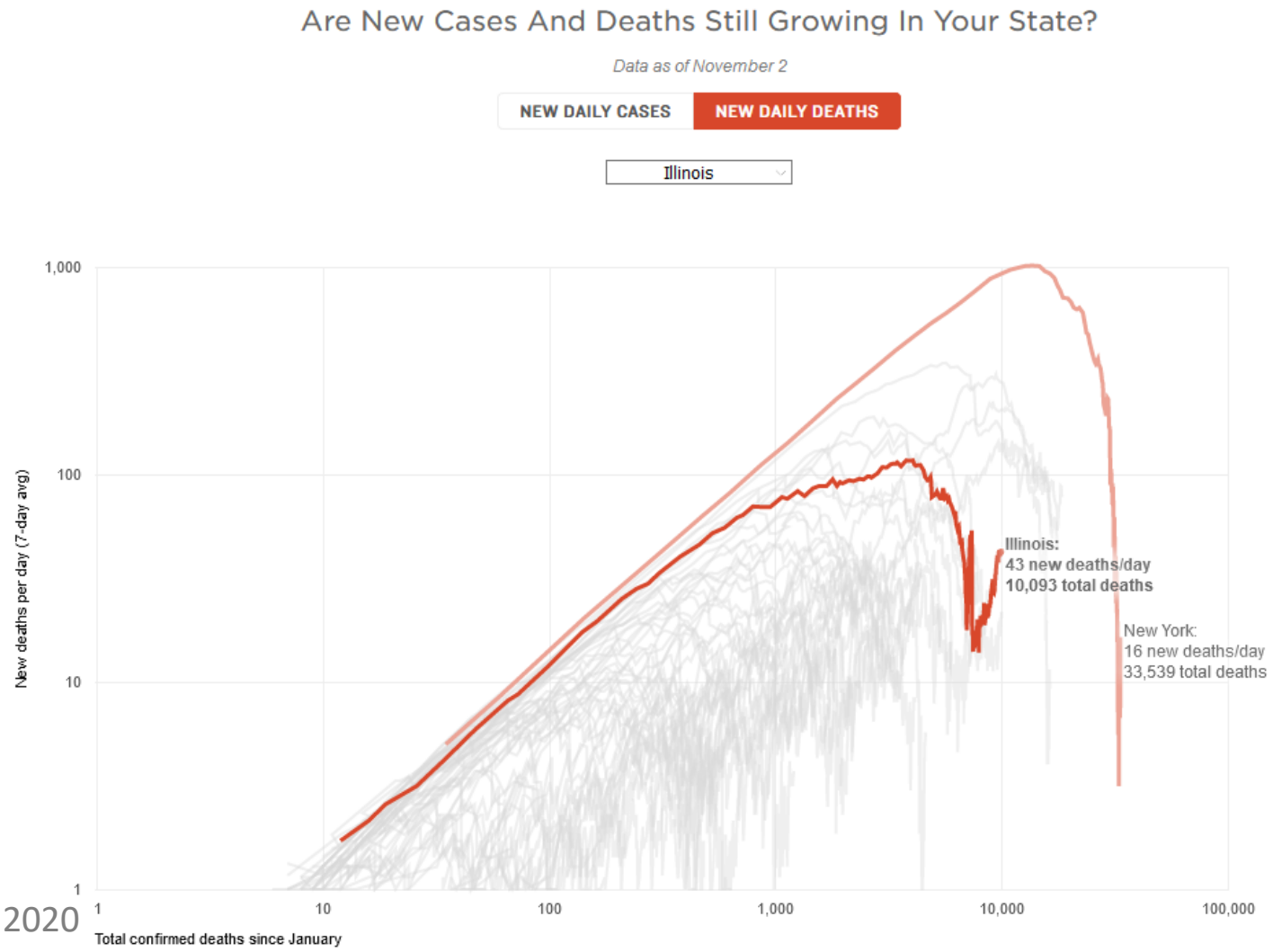
Linear & logarithmic daily tests vs. cases

- Our World in Da

the more up here
the worse

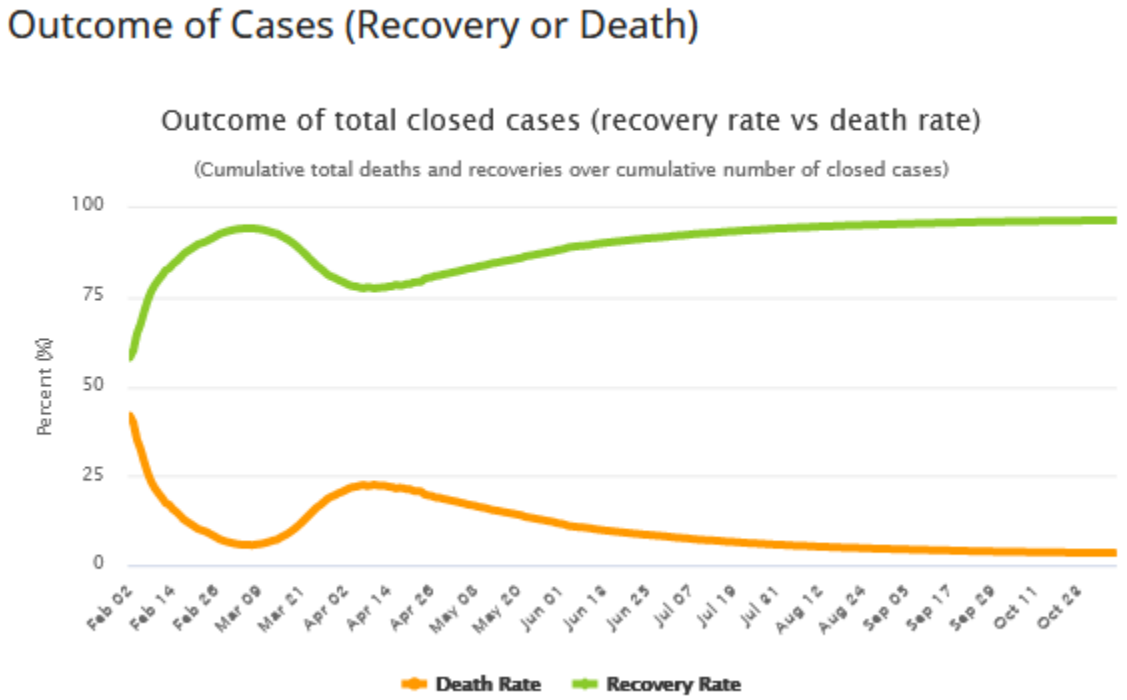


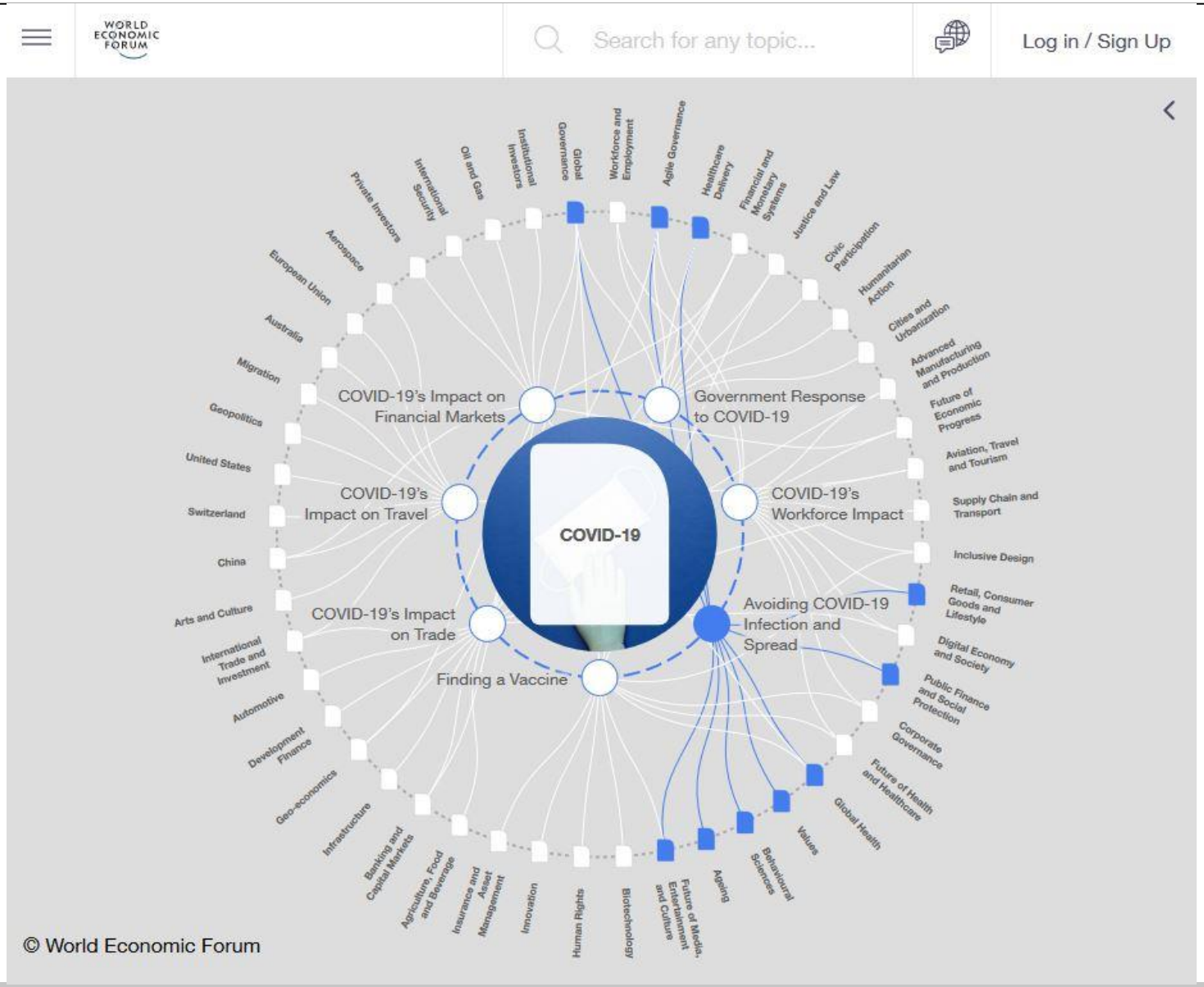
- Compare state outbreaks - daily growth or decline



New York Times Interactive, 2020

- Worldometer

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COVID-19's Impact on Financial Markets
Government Response to COVID-19
COVID-19's Impact on Travel
COVID-19's Workforce Impact
COVID-19's Impact on Trade
Avoiding COVID-19 Infection and Spread
Finding a Vaccine
Global Governance
Workforce and Employment
Agile Governance
Healthcare Delivery
Financial and Monetary Systems
Justice and Law
Civic Participation
Humanitarian Action
Cities and Urbanization
Advanced Manufacturing and Production
Future of Economic Progress
Aviation, Travel and Tourism
Supply Chain and Transport
Inclusive Design
Retail, Consumer Goods and Lifestyle
Digital Economy and Society
Public Finance and Social Protection
Corporate Governance
Future of Health and Healthcare
Global Health
Values
Behavioural Sciences
Ageing
Future of Media, Entertainment and Culture
Biotechnology
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Innovation
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International Security
Oil and Gas
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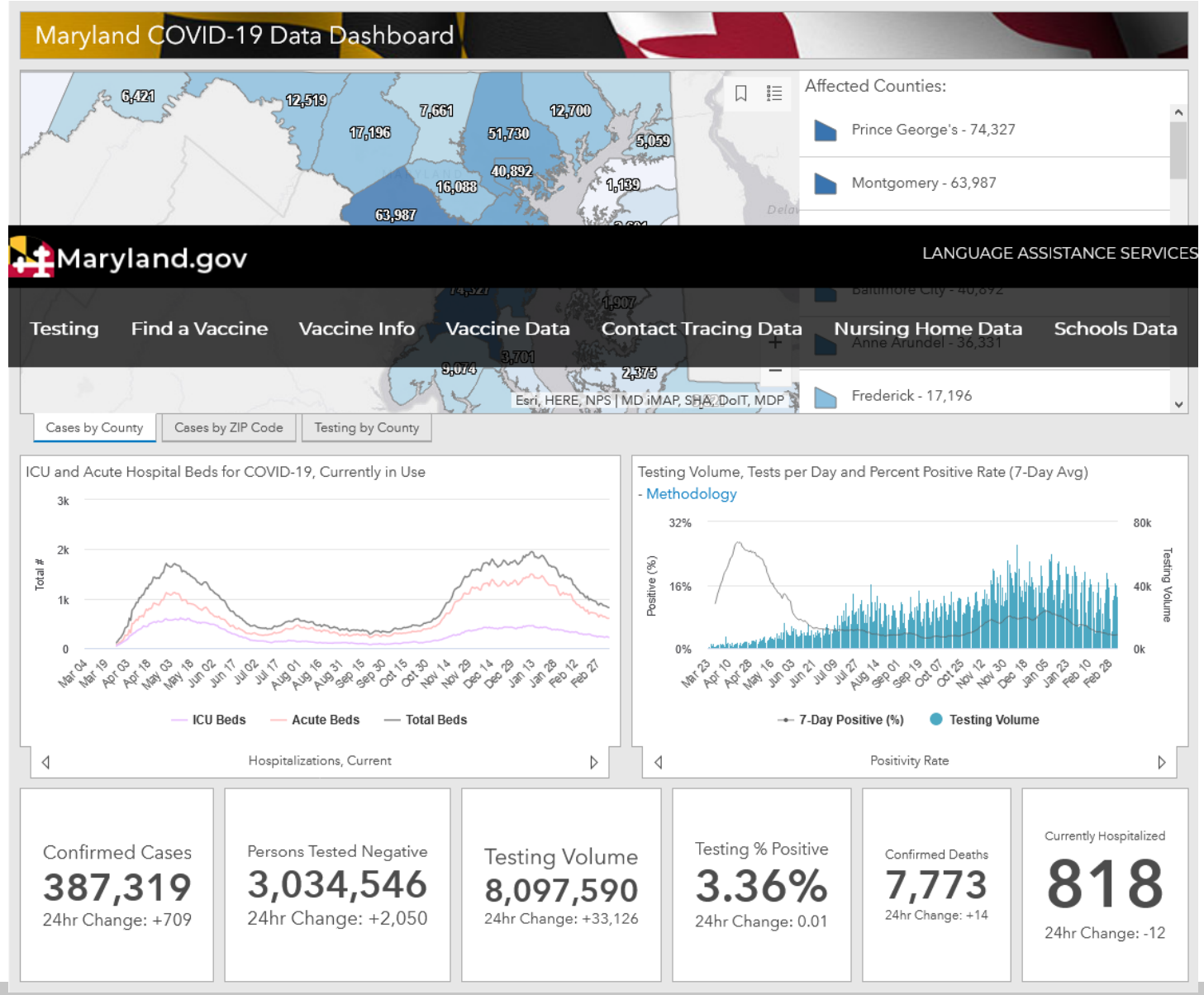
COVID 19 data visualization

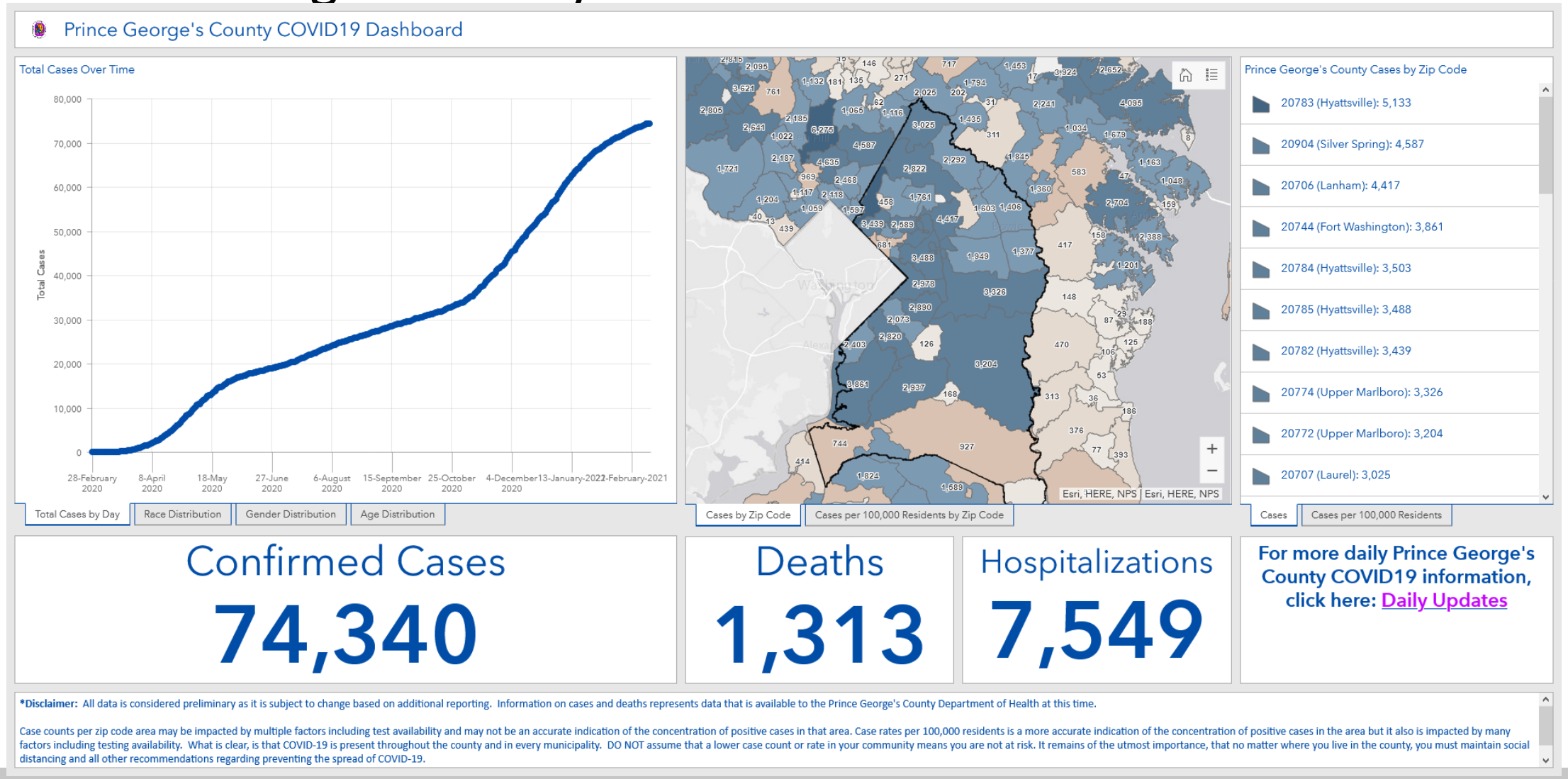
COVID 19 data visualization

- dashboards



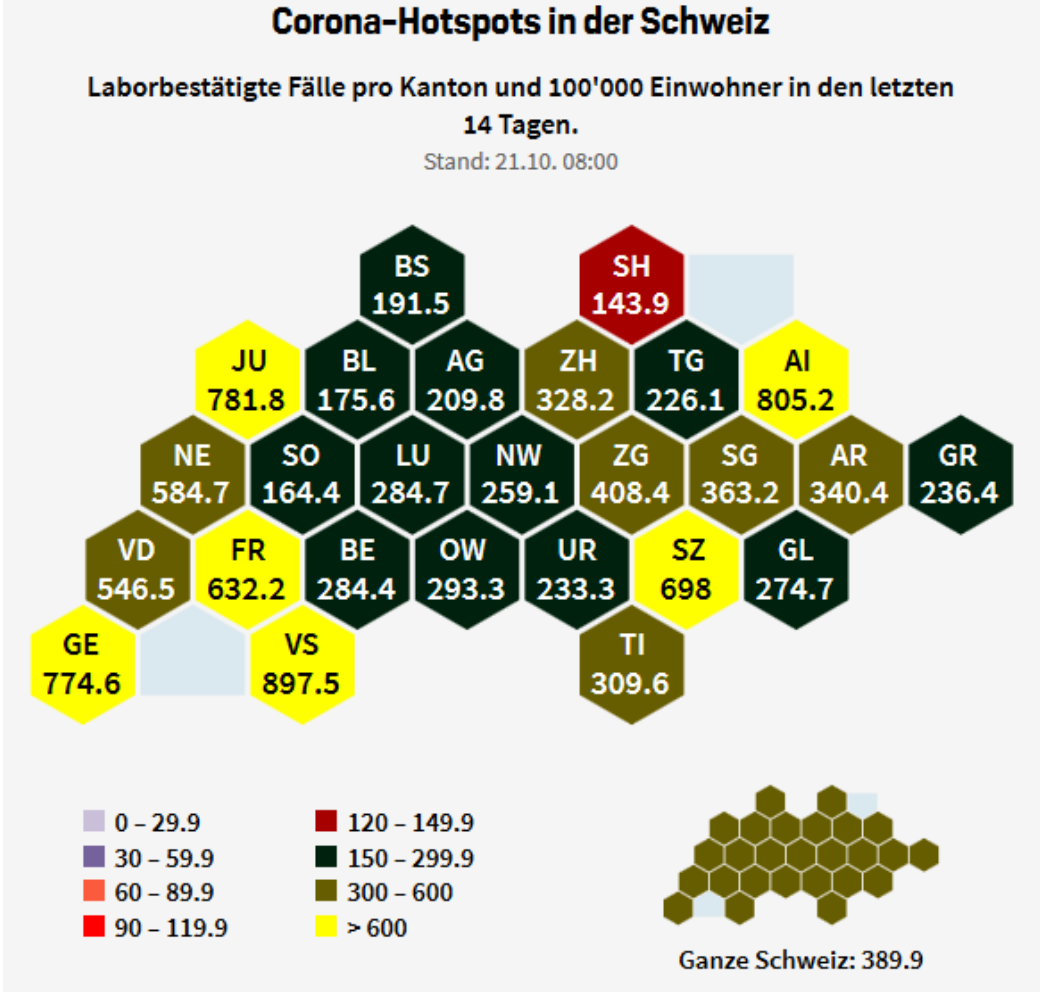
COVID 19 data visualization

- Prince George's County COVID19 Dashboard



Misleading use of color scale

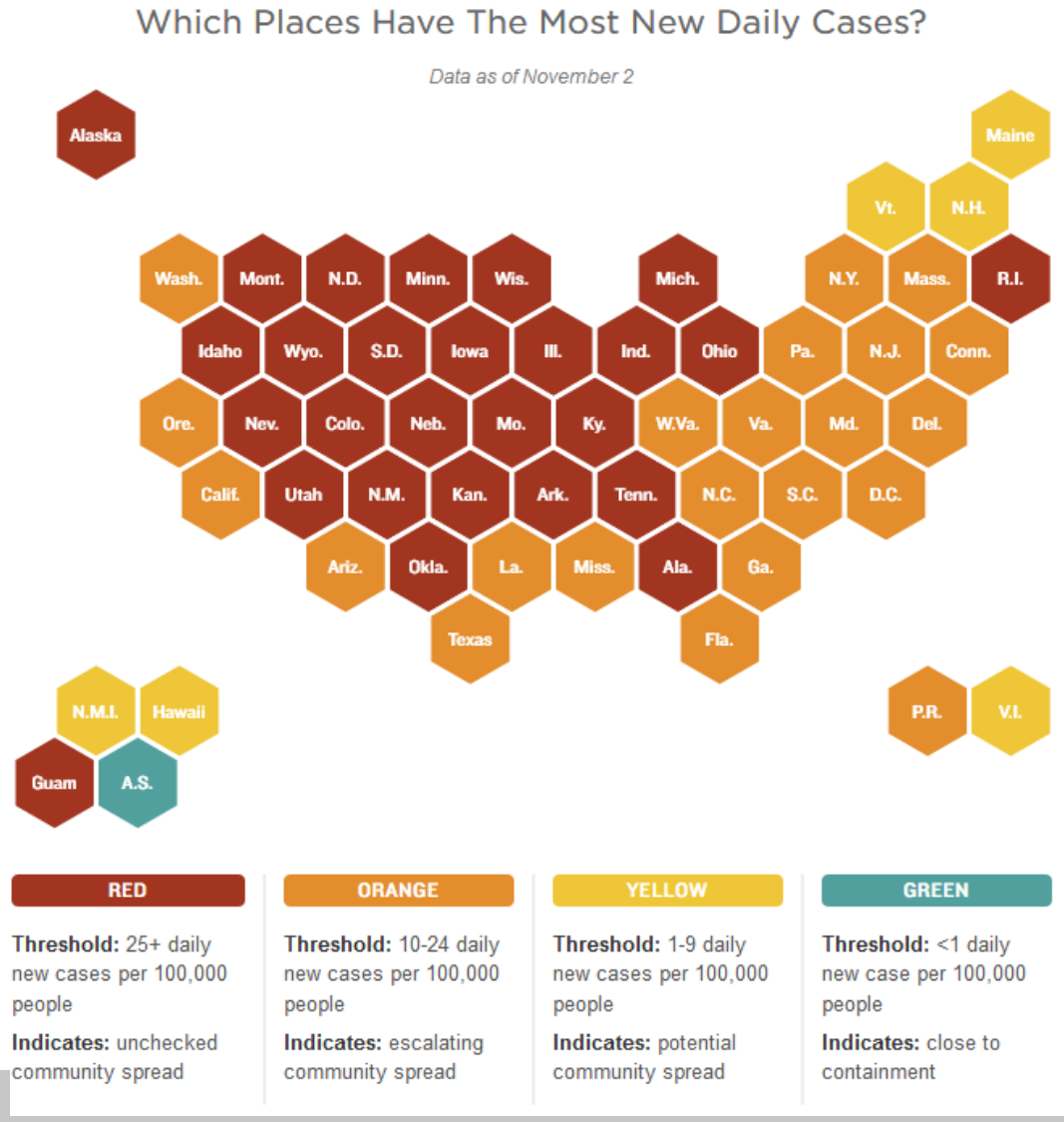
- New COVID-19 cases in Switzerland, by canton



https://www.reddit.com/r/dataisugly

More rational use of color scale

- New COVID-19 cases in the USA, by state

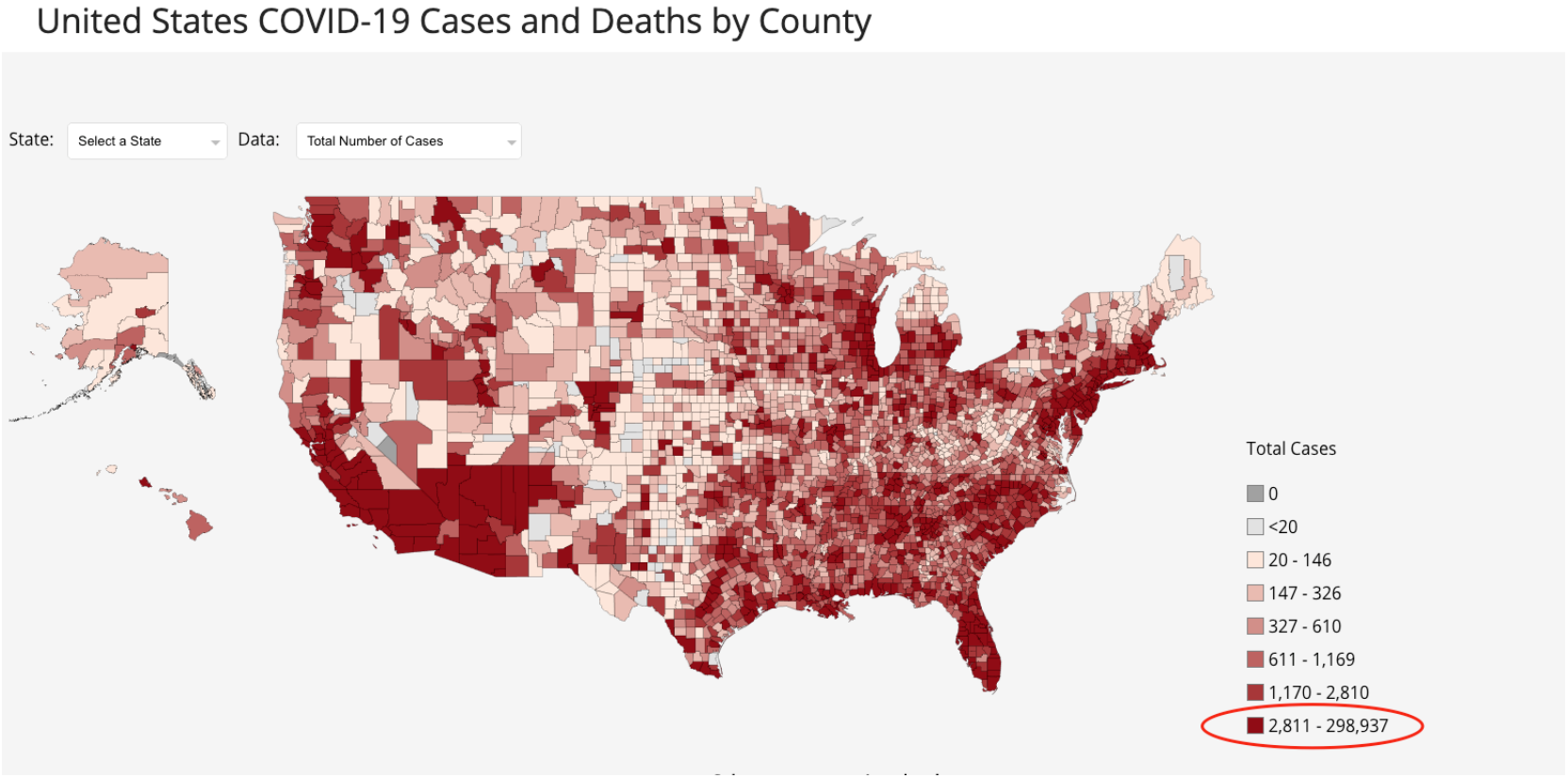


https://www.reddit.com/r/dataisugly

NPR site

Misleading use of color scale

- ~3000 or ~300000?



https://www.reddit.com/r/dataisugly

- **List of Visualizations related to the Coronavirus Covid-19 Pandemic**
  https://docs.google.com/document/d/1g_t_v_2JsYtO5CePwCkcD1m-rRfUuaSupumWbWiF0cs/edit

Data-driven storytelling

- Scrollytelling
- (interactive) video – documentaries

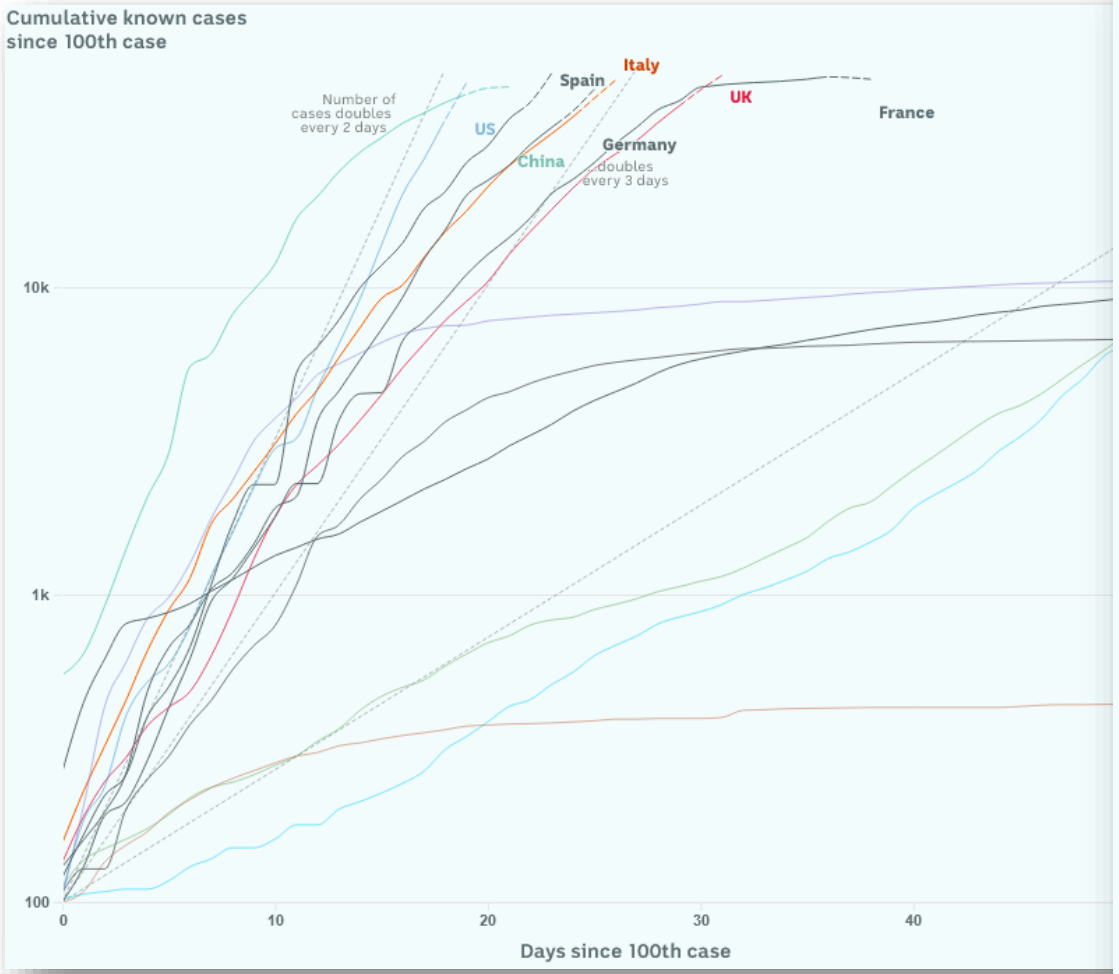
Scrollytelling

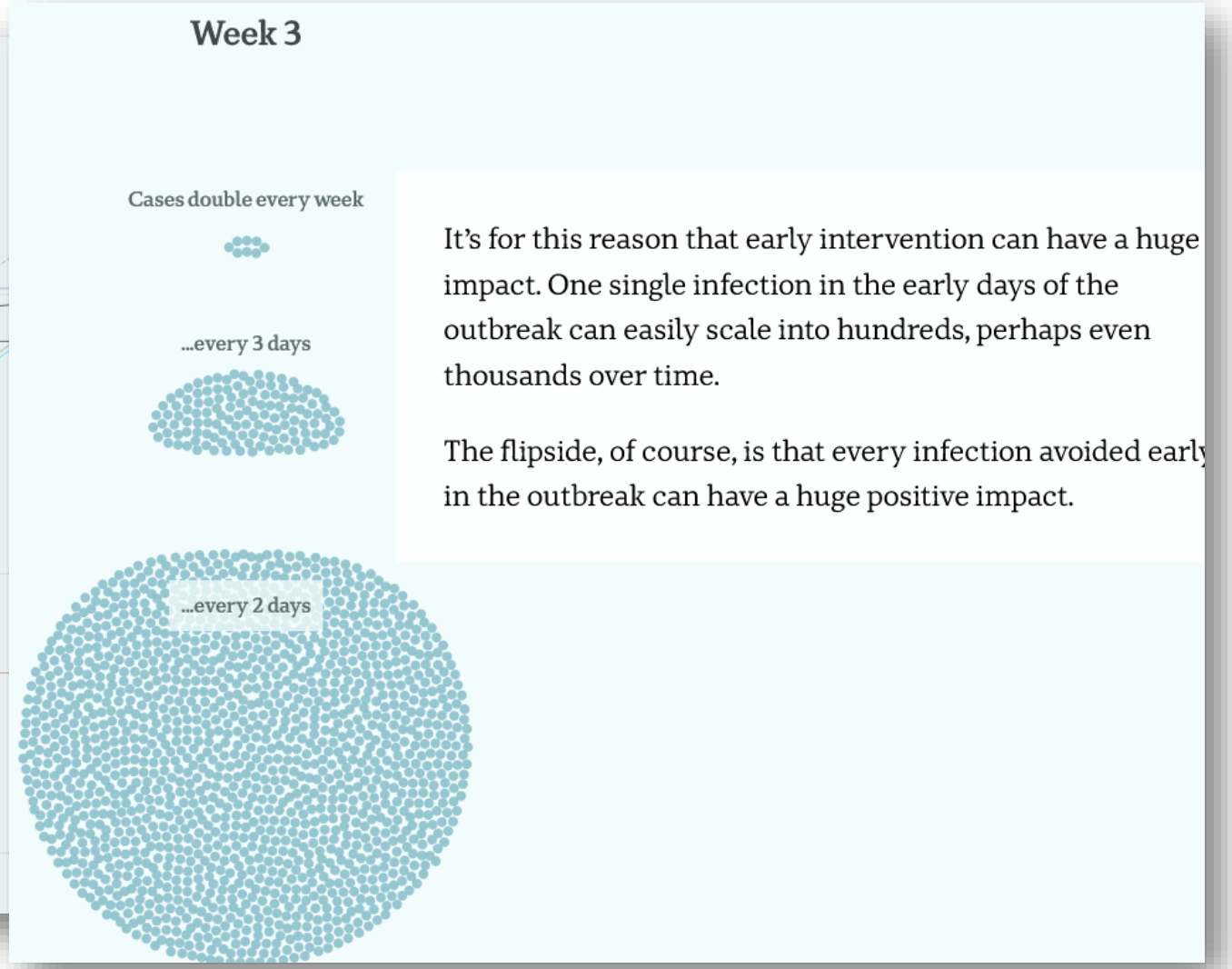
- How the virus got out

https://www.nytimes.com/interactive/2020/03/22/world/coronavirus-spread.html

Scrollytelling

- What we can learn from the countries winning the coronavirus fight

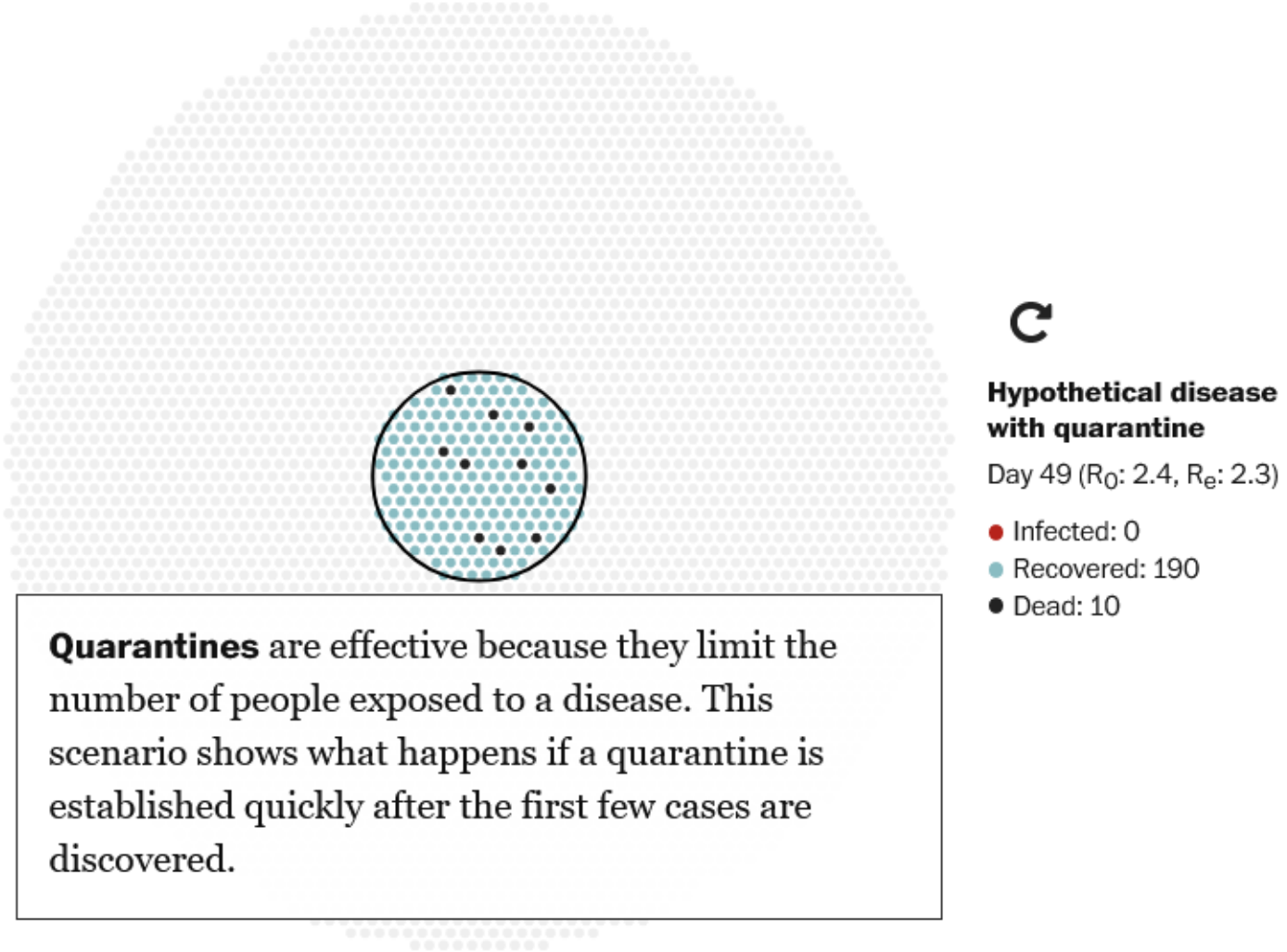




https://www.abc.net.au/news/2020-03-26/coronavirus-covid19-global-spread-data-explained/12089028?nw=0

Scrollytelling

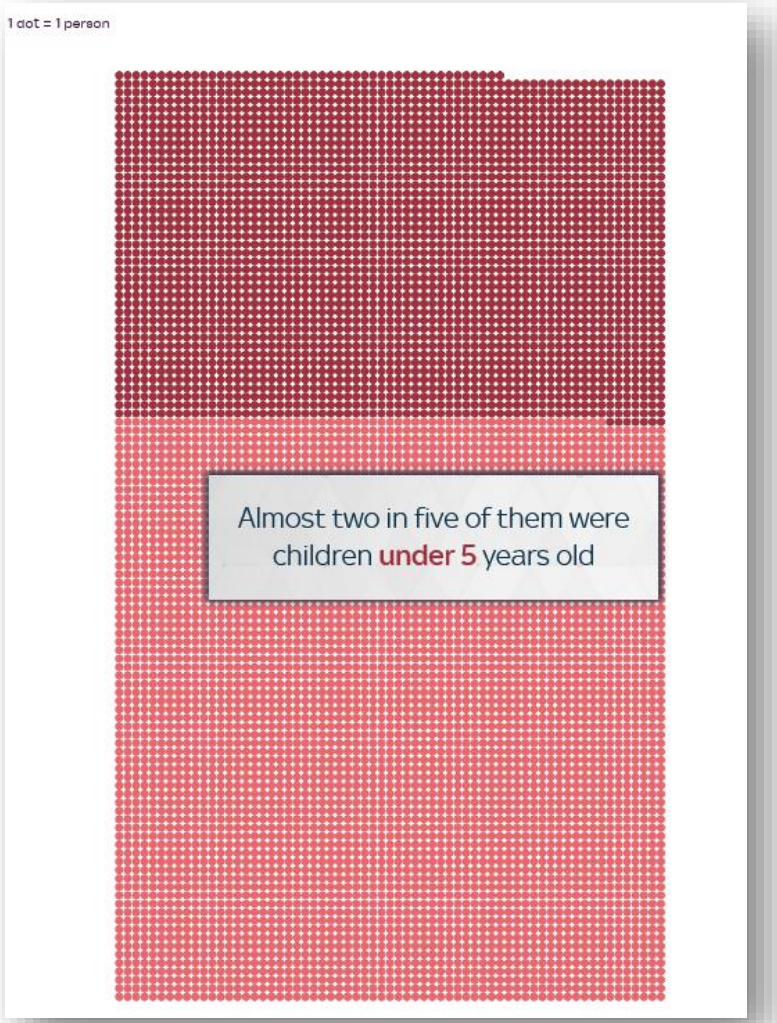
- How epidemics like covid-19 end (and how to end them faster)

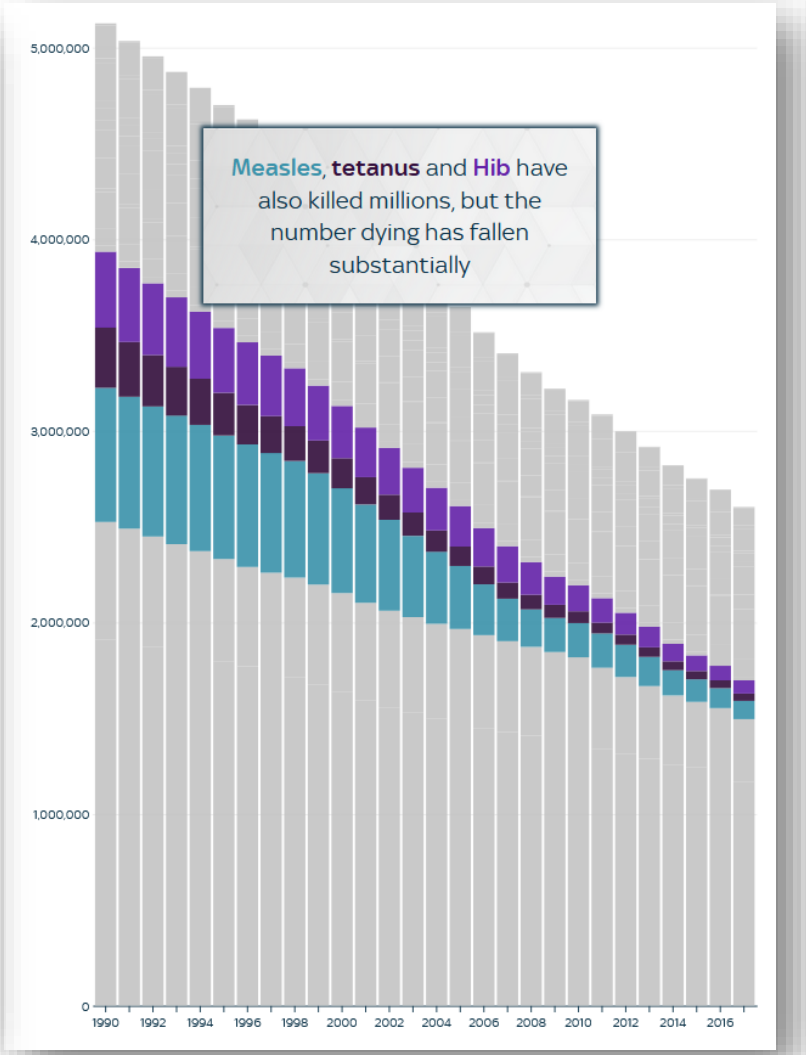


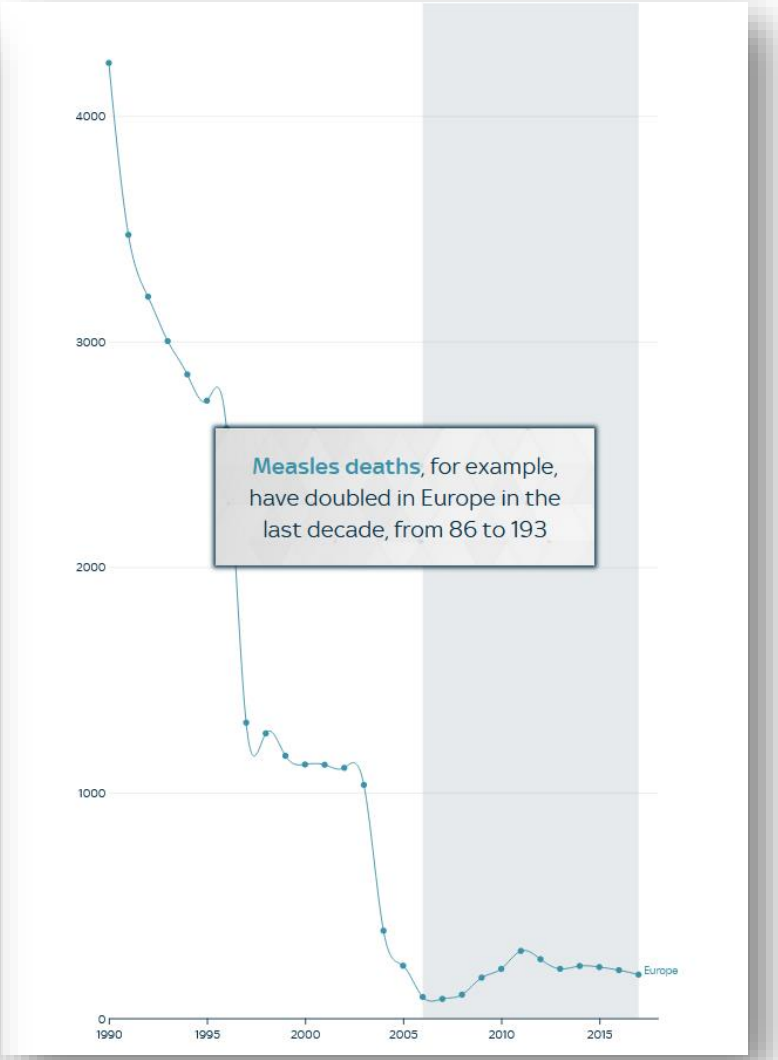
https://www.washingtonpost.com/graphics/2020/health/coronavirus-how-epidemics-spread-and-end/

Scrollytelling

- The state of vaccination







https://news.sky.com/story/why-7-000-people-die-needlessly-every-day-11770982

Scrollytelling

- An Incalculable Loss

https://www.nytimes.com/interactive/2020/05/24/us/us-coronavirus-deaths-100000.html

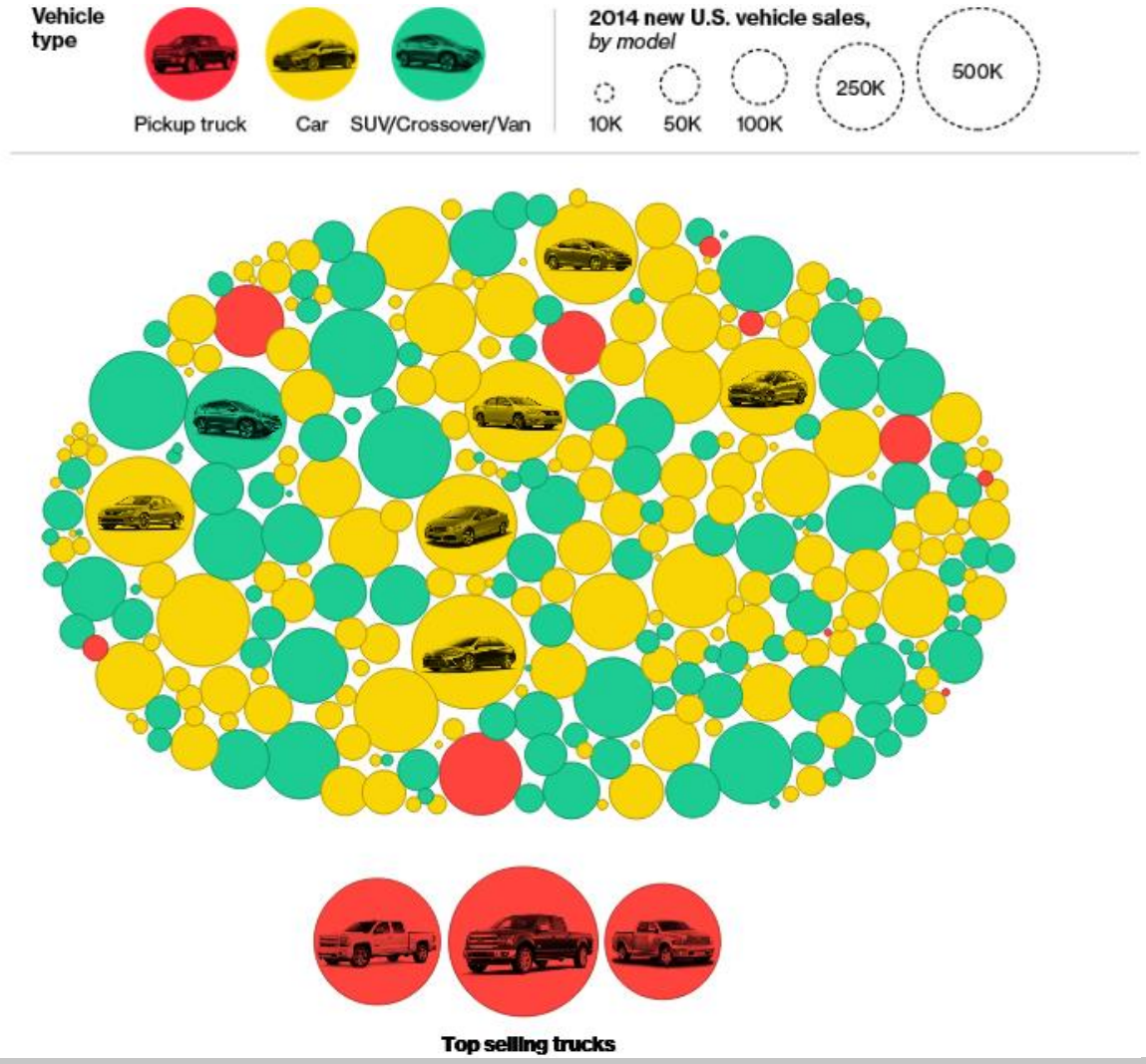
Scrollytelling

- Scientific Proof that Americans are Completely Addicted to Trucks

The #2 and #3 top sellers are also pickups.
Chevy's Silverado came in distant second, followed by Fiat Chrysler's Ram truck. The top three trucks combined for 1.7 million sales, or one in every ten new vehicles sold in 2014.

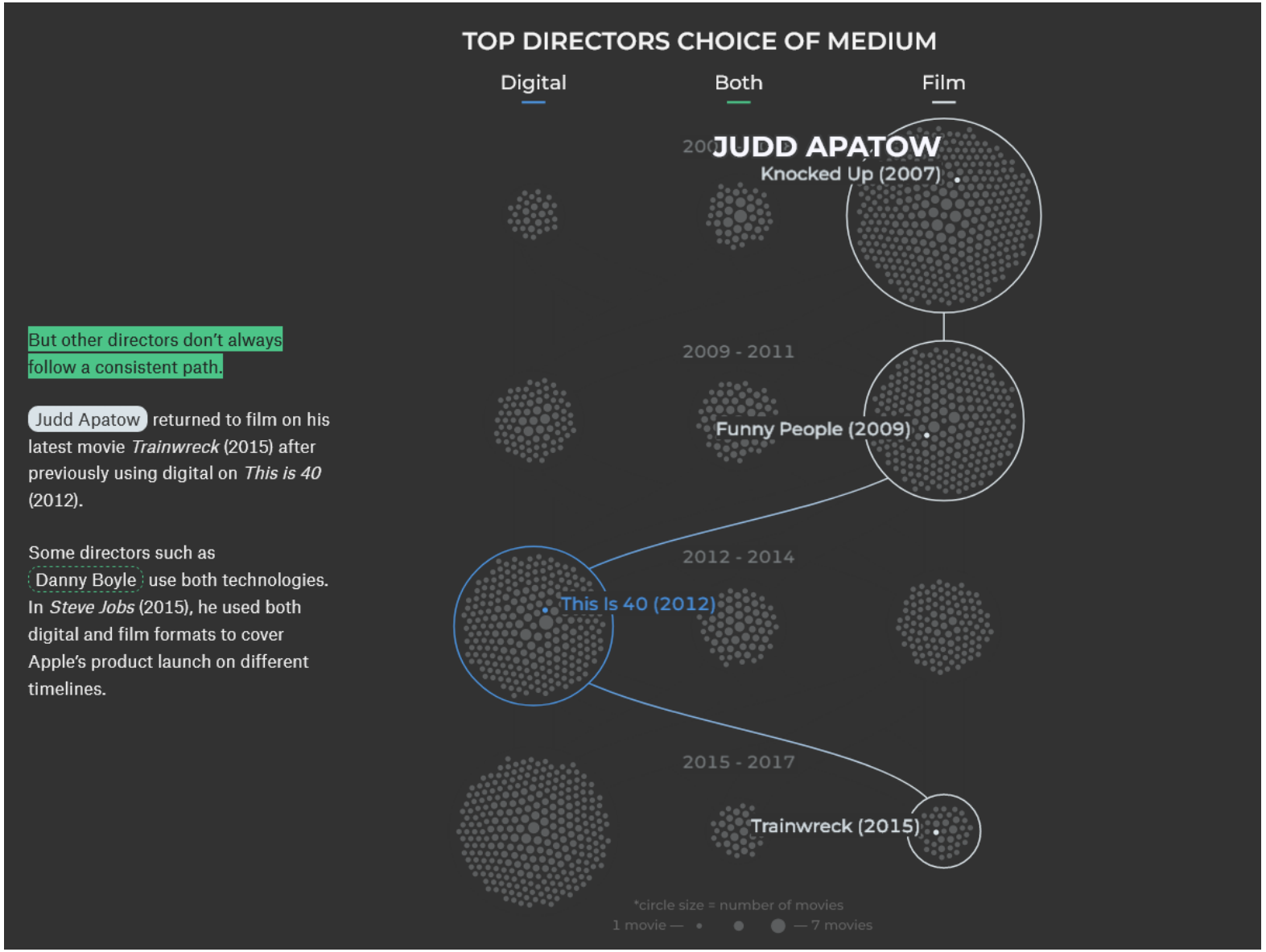
Big vehicles are booming and cars aren't keeping up.
Sales of light trucks grew five times faster than cars last year, increasing 10 percent compared to 1.8 percent for cars.

Since the end of the recession, sales of cars and trucks had been neck and neck: Americans bought about 39,000 more trucks than cars in 2013. But in 2014, light trucks dramatically pulled away, outselling cars by 685,000 vehicles. Sales of midsize cars,



Scrollytelling

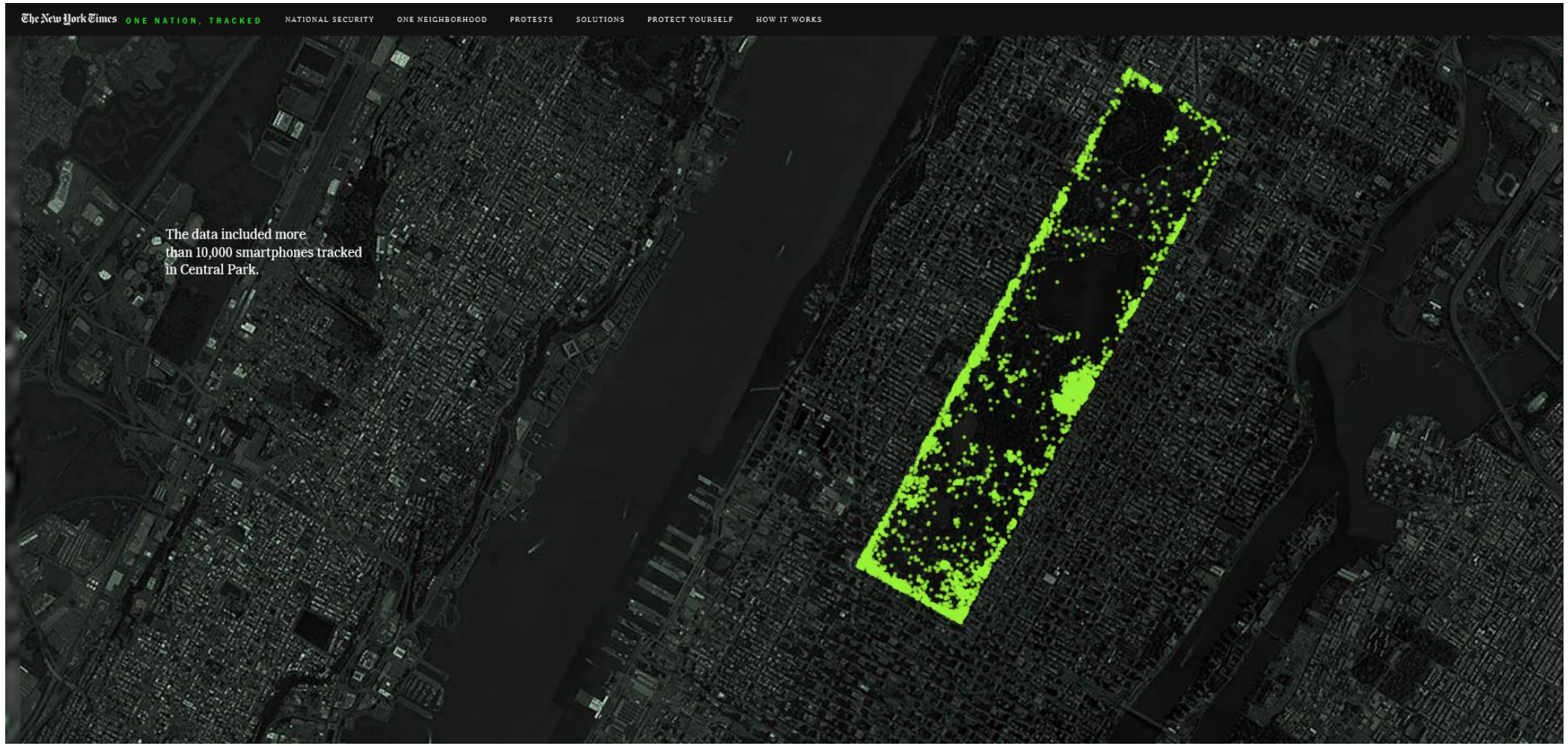
- Film or Digital?
  Breaking Down Hollywood's Choice of Shooting Medium



https://pudding.cool/2018/08/filmordigital/

Scrollytelling

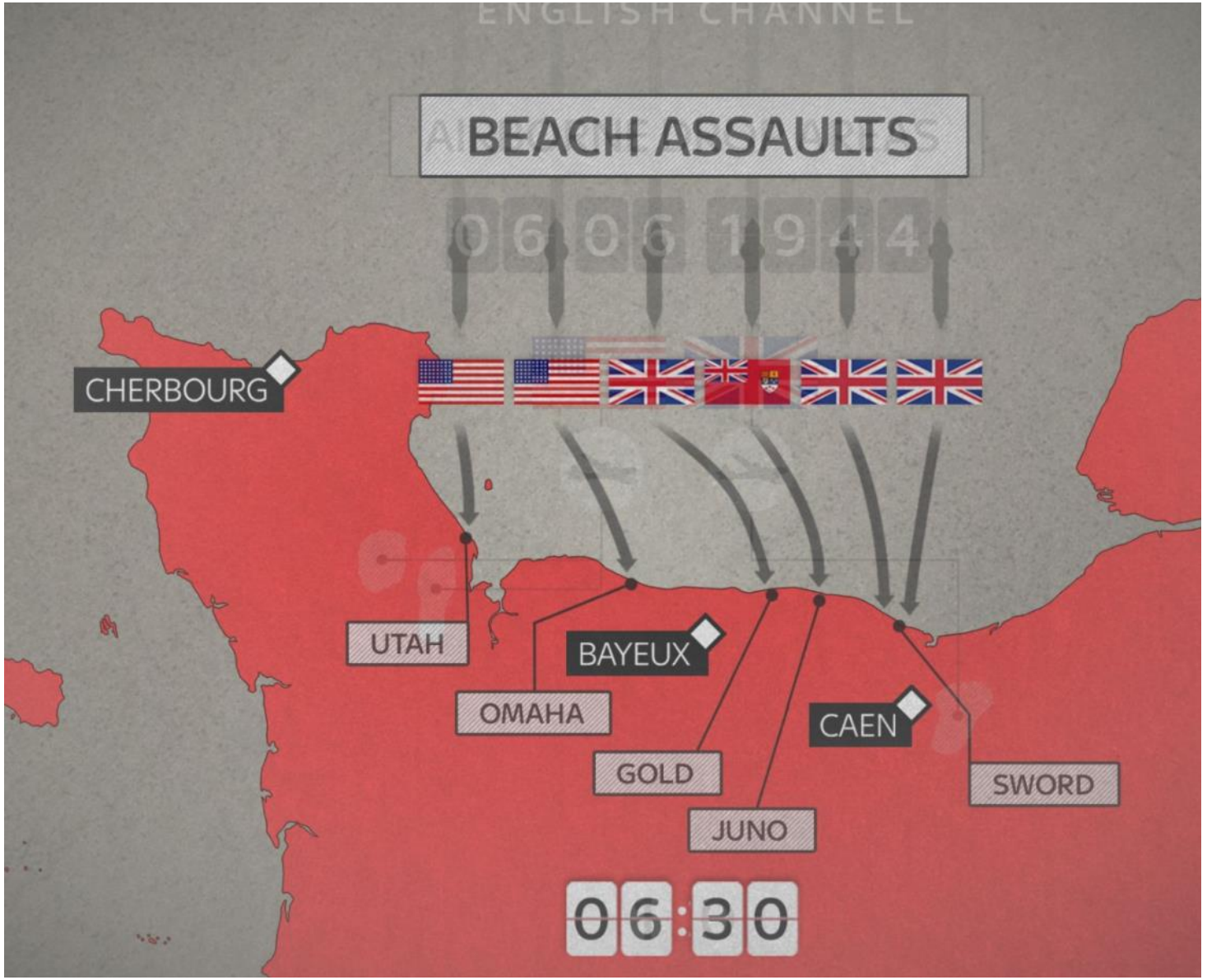
- One nation, tracked An investigation into the smartphone tracking industry



https://www.nytimes.com/interactive/2019/12/19/opinion/location-tracking-cell-phone.html

Scrollytelling

- **Day of reckoning**
  The story of 24 hours that changed the world

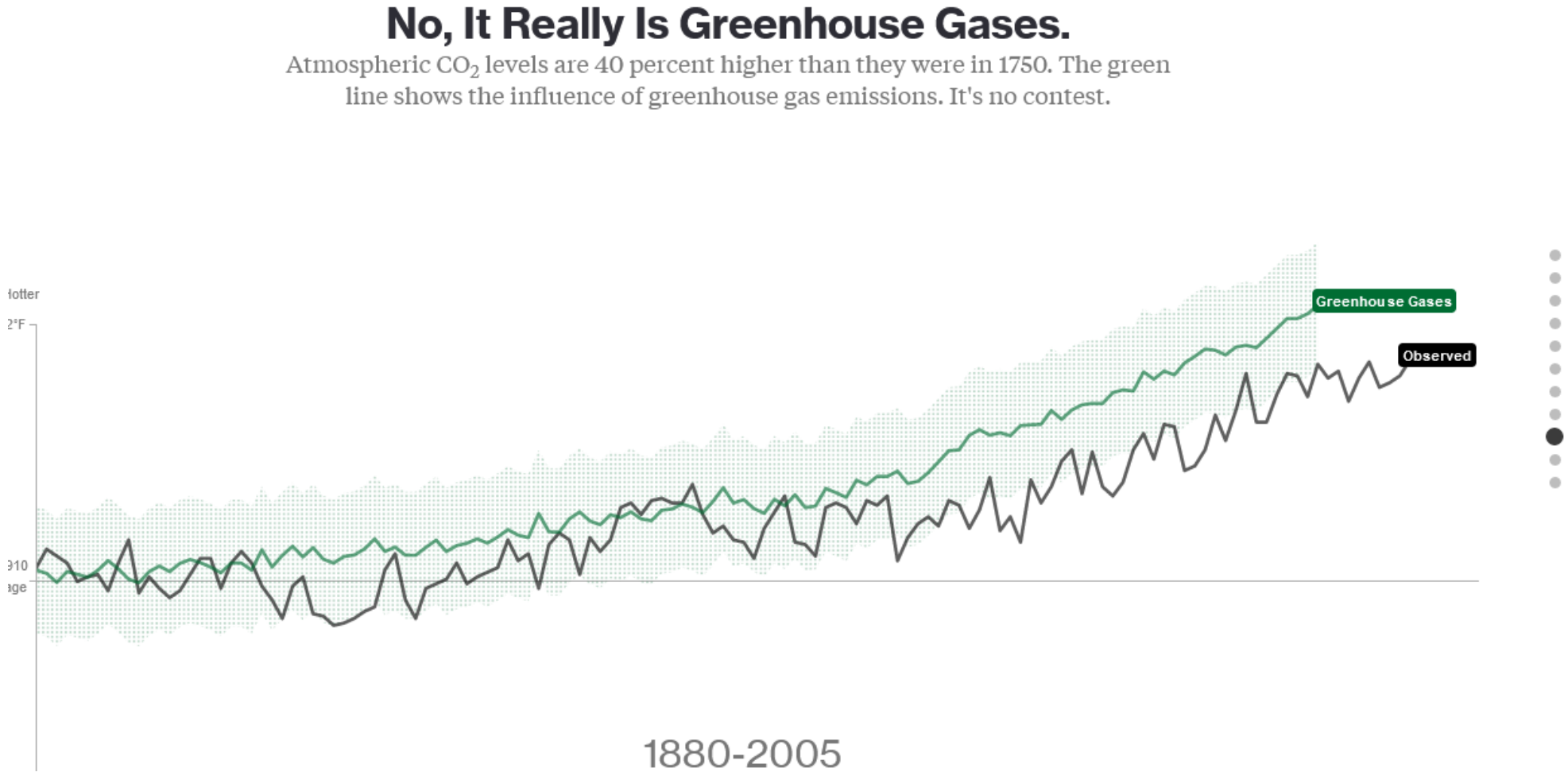


https://news.sky.com/story/d-day-the-story-of-24-hours-that-changed-the-world-11732907

Scrollytelling

- What's Really Warming the World?

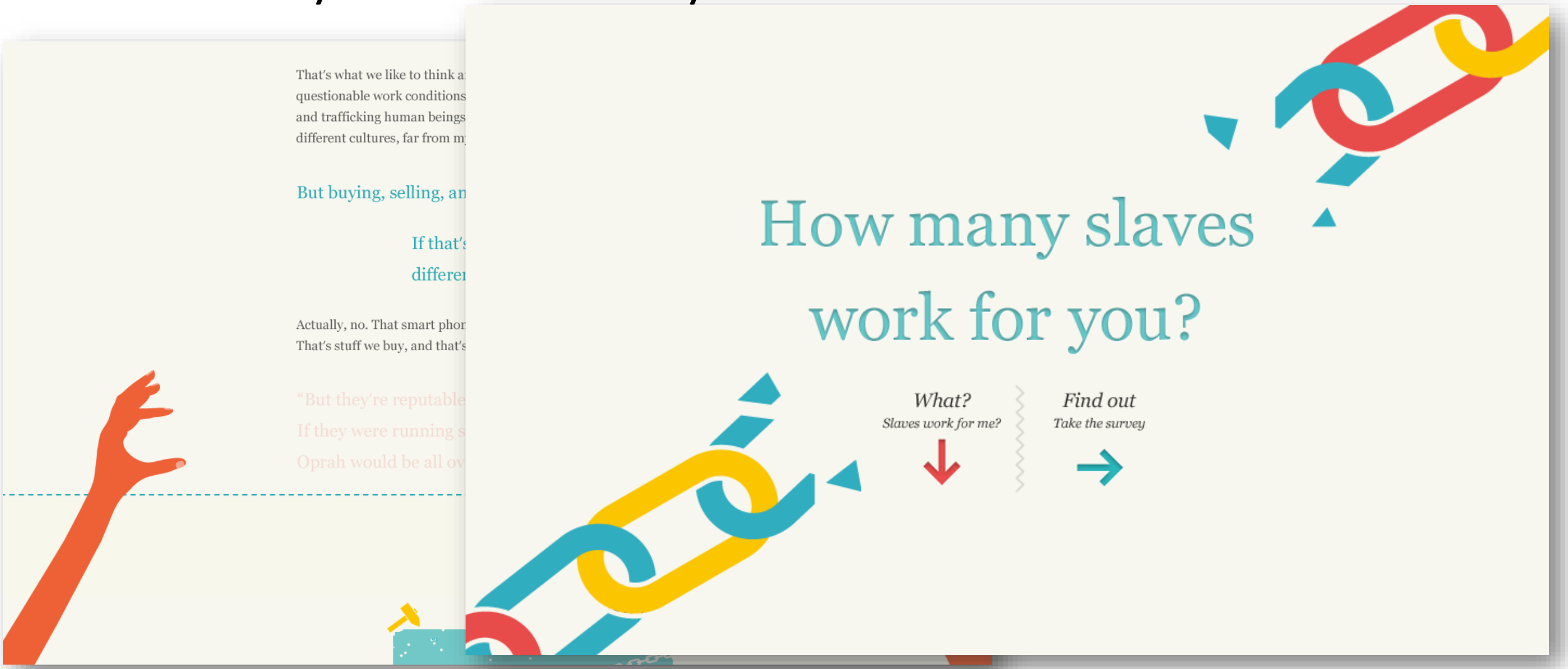
  Climate deniers blame natural factors; NASA data proves otherwise



https://www.bloomberg.com/graphics/2015-whats-warming-the-world/

Scrollytelling

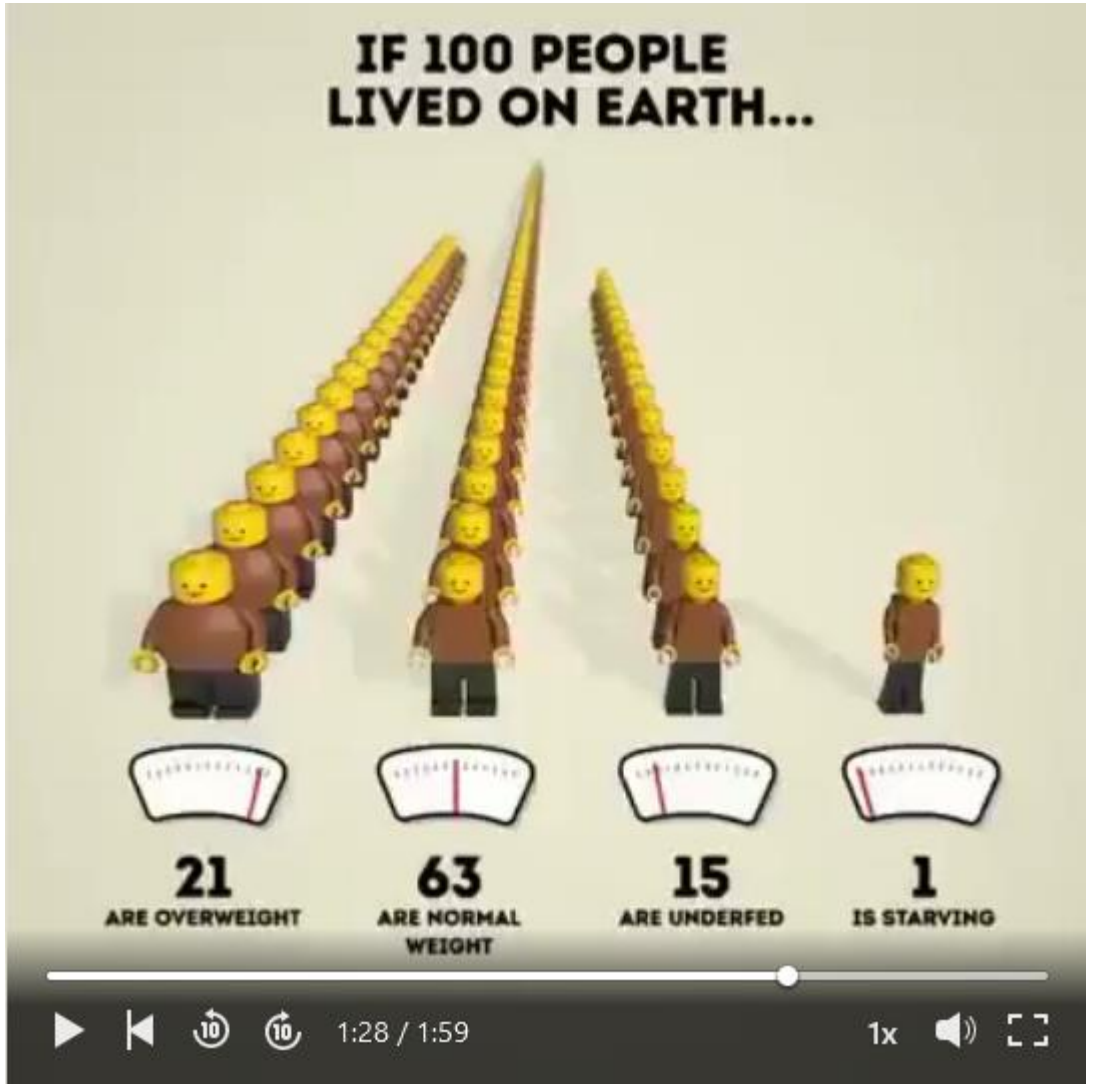
- How many slaves work for you?



http://slaveryfootprint.org/

Scrollytelling

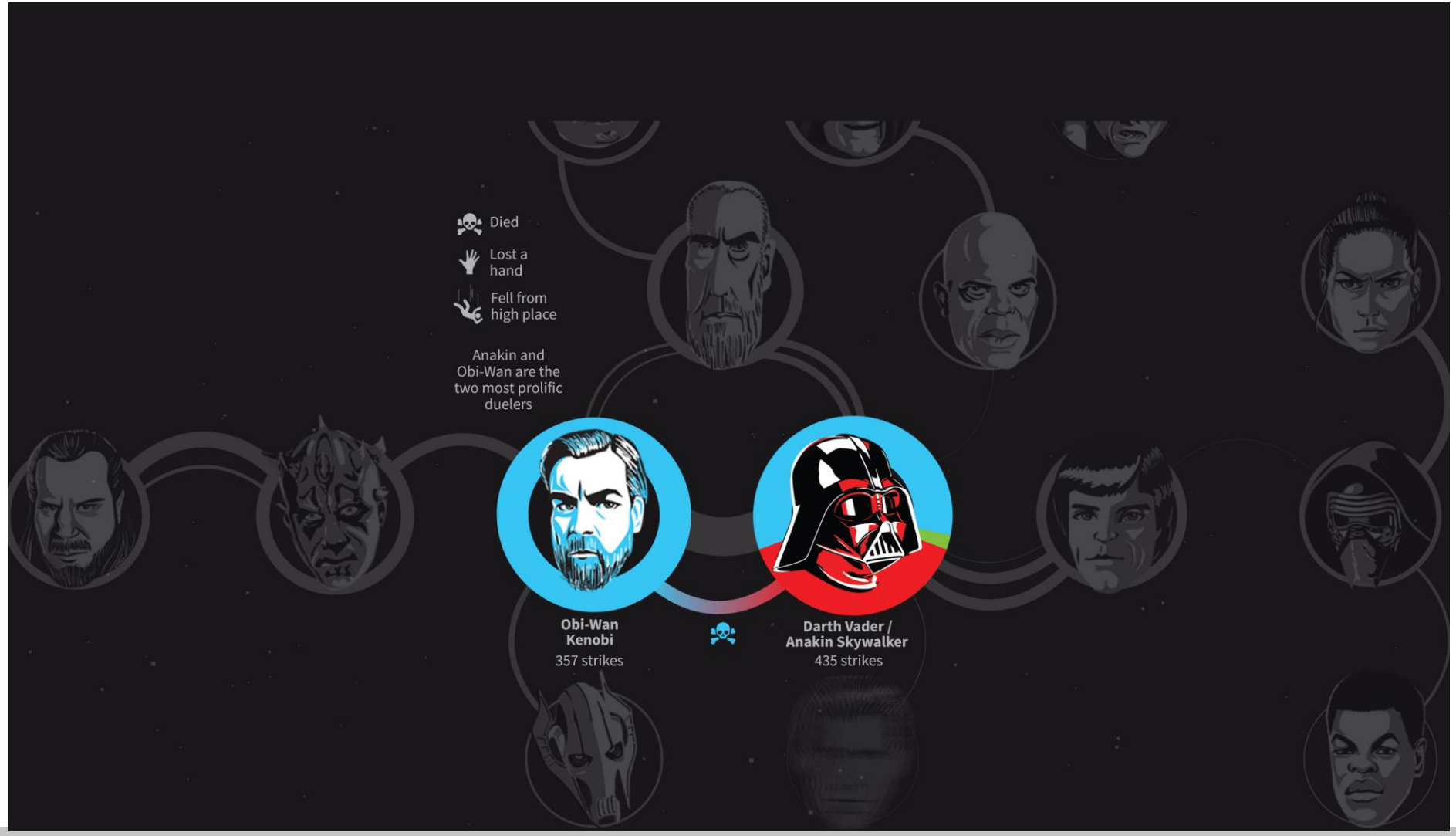
- If 100 people lived on earth…



https://www.linkedin.com/posts/stevenouri_datastorytelling-datavisualization-datascience-activity-6903685674508070912-RHW6/

Scrollytelling

- Lightsaber Duels in Star Wars, Reuters Graphics



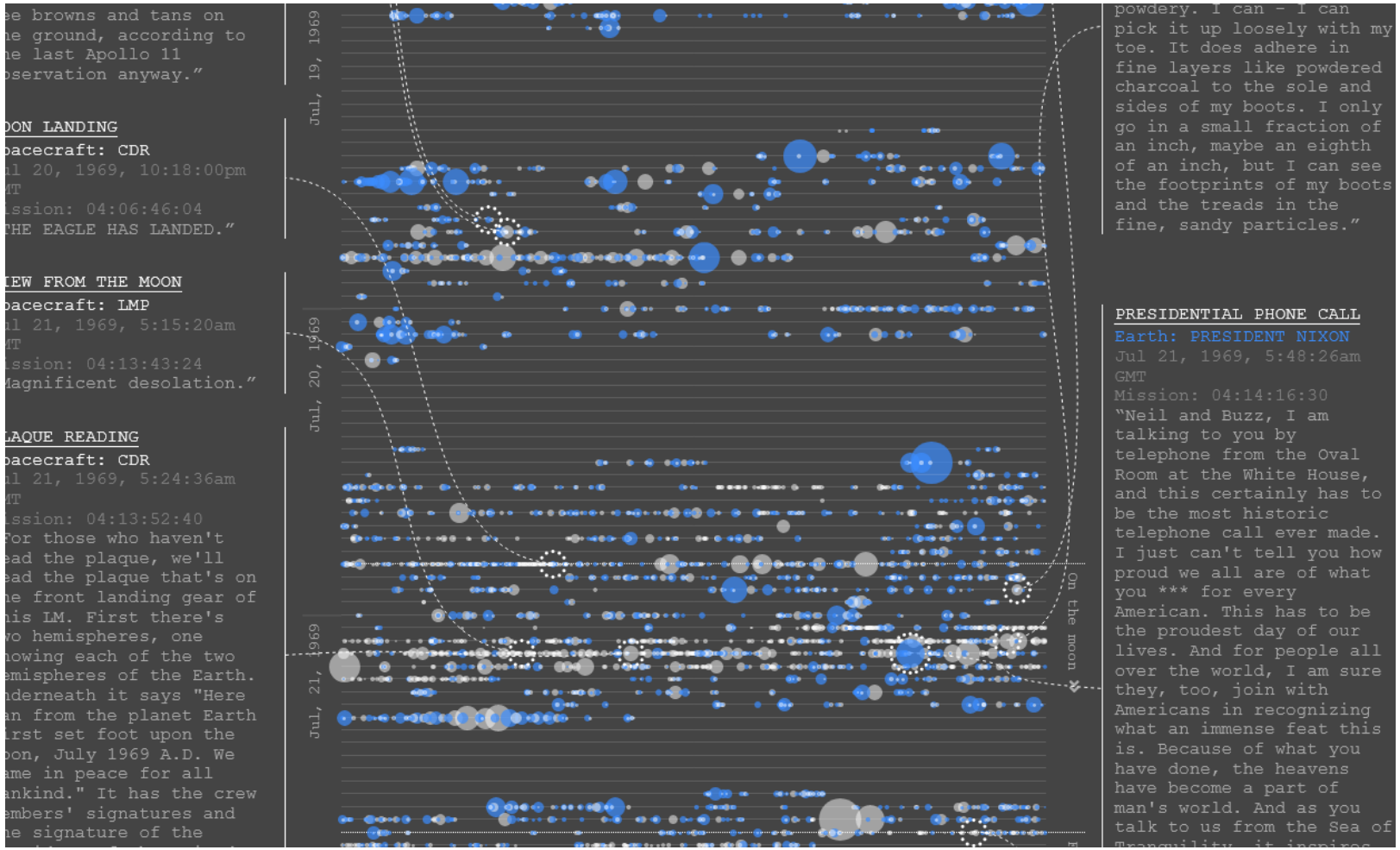
Scrollytelling

- No Epicentro What if all Covid-19 deaths in Brazil happened in your neighborhood?

Data-driven storytelling

- **Lunar Conversations**

  A timeline of the conversations between Earth and the spacecraft of the Apollo 11 mission from liftoff to splashdown



https://www.c82.net/work/?id=368

Scrollytelling

- The Deep Sea

Scrollytelling

- Byrne's Euclid

III IV V VI About Posters Puzzles Intro Symbols English Jump to

PROPOSITION V. THEOREM.

IN any isoſceles triangle  if the equal ſides be produced, the external angles at the baſe are equal, and the internal angles at the baſe are alſo equal.

Produce —— , and —— , (poſt. 2.), take —— = —— , (pr. 3.); draw —— and —— .

Then in  and  we have,

—— = —— (conſt.),  common to both, and —— = —— (hyp.) ∴  = ,

—— = —— and  =  (pr. 4.).

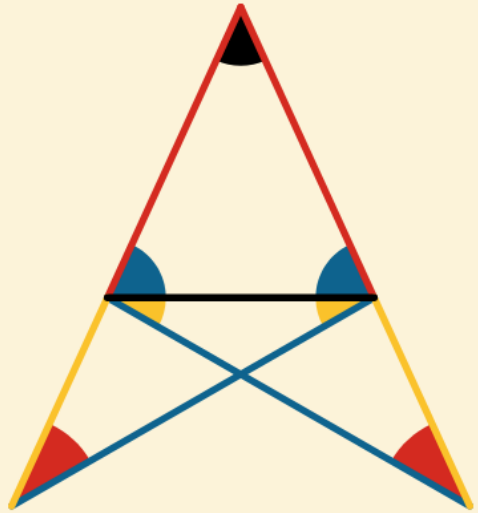
Again in  and  we have —— = —— ,

 =  and —— = —— ,

∴  =  and  =  (pr. 4.) but

 =  , ∴  =  (ax. 3.)

Q. E. D.



https://www.c82.net/euclid/

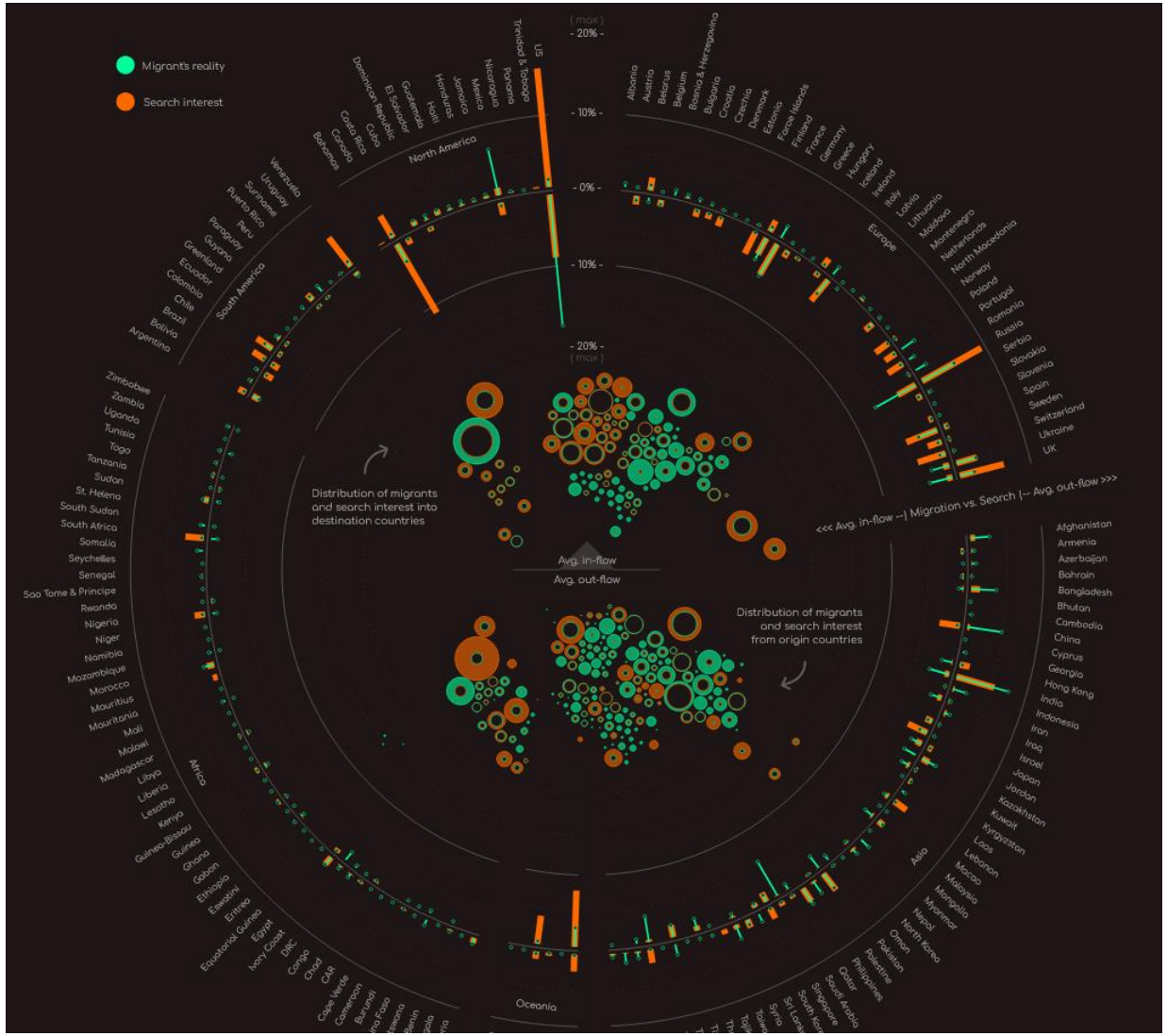
Scrollytelling

- The Data that Lies Beneath

  an interactive infographic that takes a look at the murky origins - and potential of dark data.

https://lucidworks.com/darkdata/

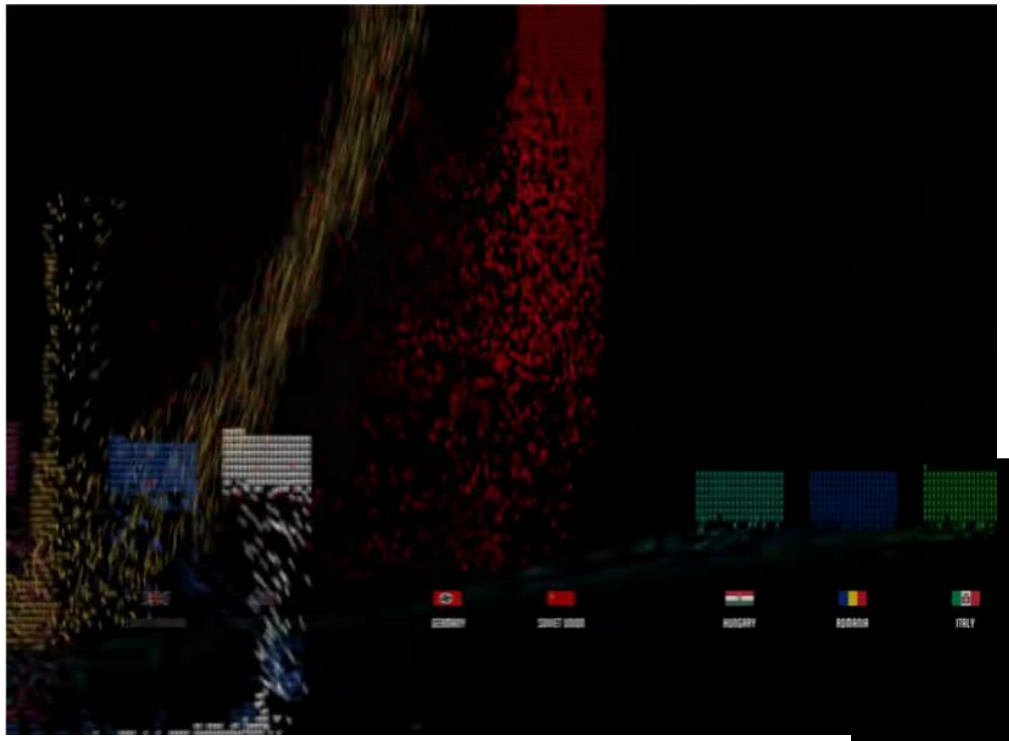
Scrollytelling



https://migrationinsearch.com/

Data-driven storytelling

- The Fallen of World War II animated data-driven video documentary

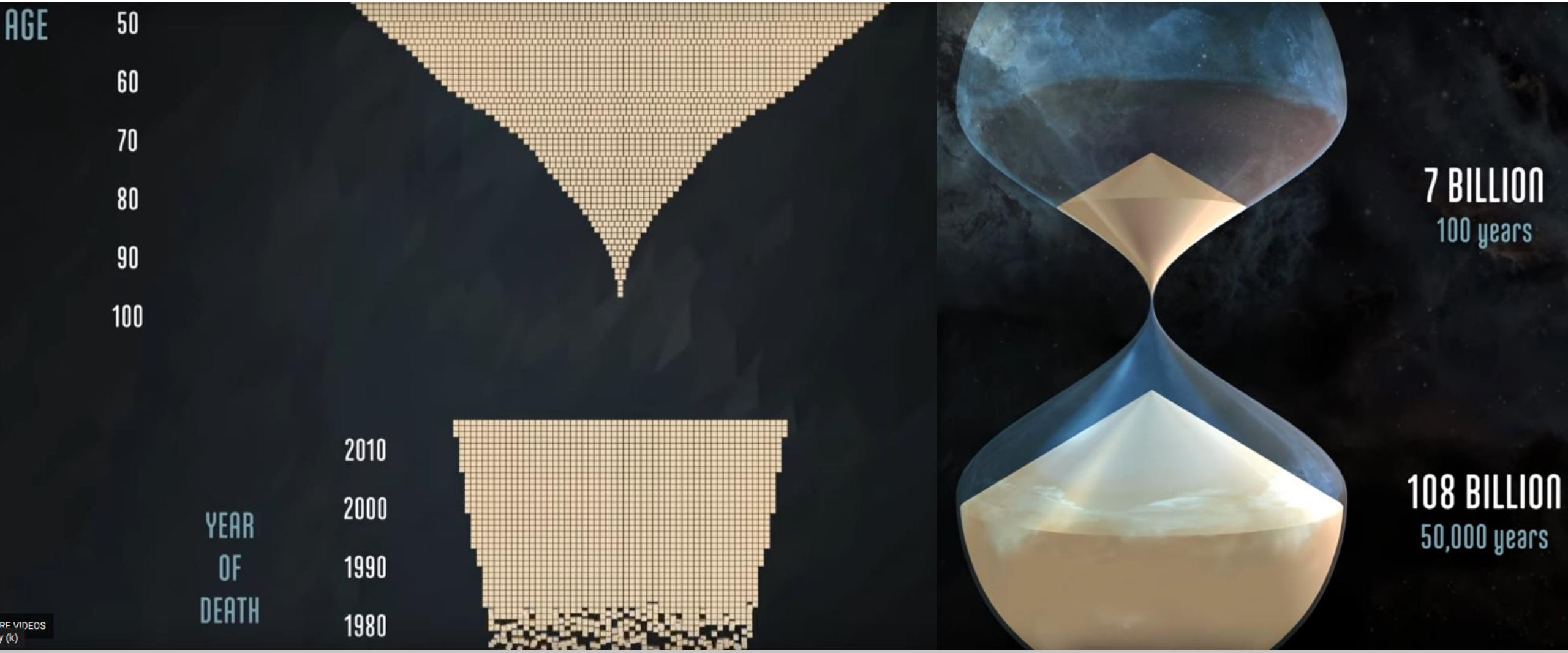


https://youtu.be/DwKPFT-RioU

http://www.fallen.io/ww2/

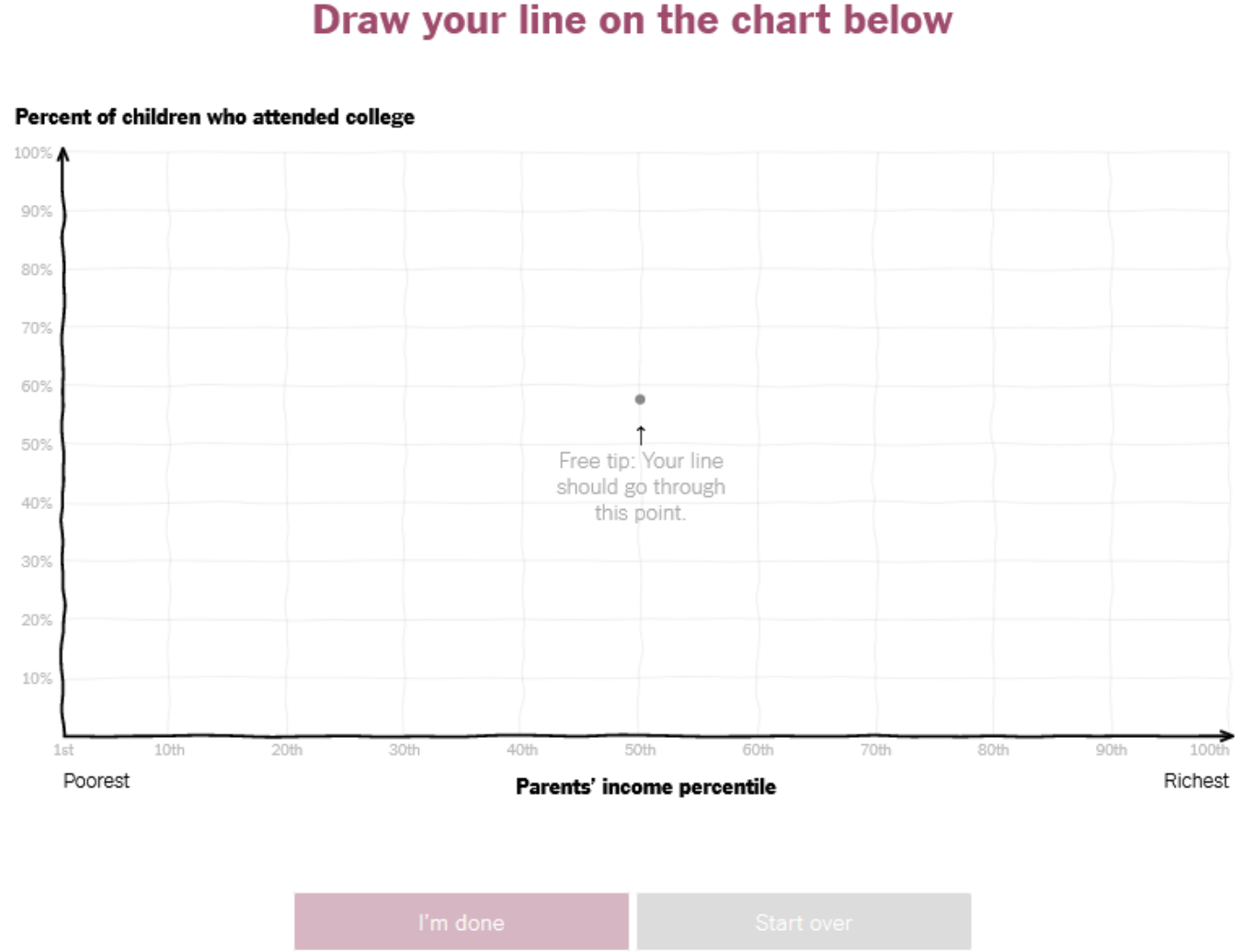
Data-driven storytelling

- The Shadow Peace sequel data-driven video documentary



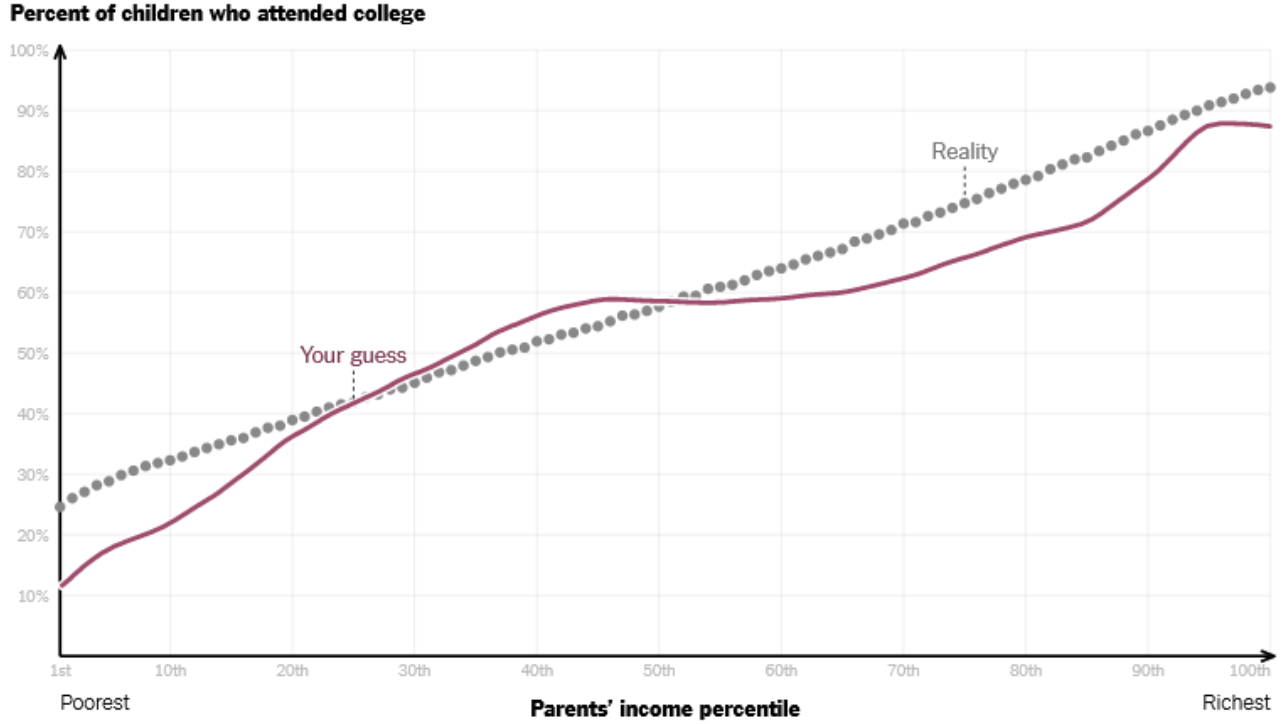
Data-driven storytelling

- You Draw It: How Family Income Predicts Children's College Chances



Data-driven storytelling

- You Draw It: How Family Income Predicts Children's College Chances

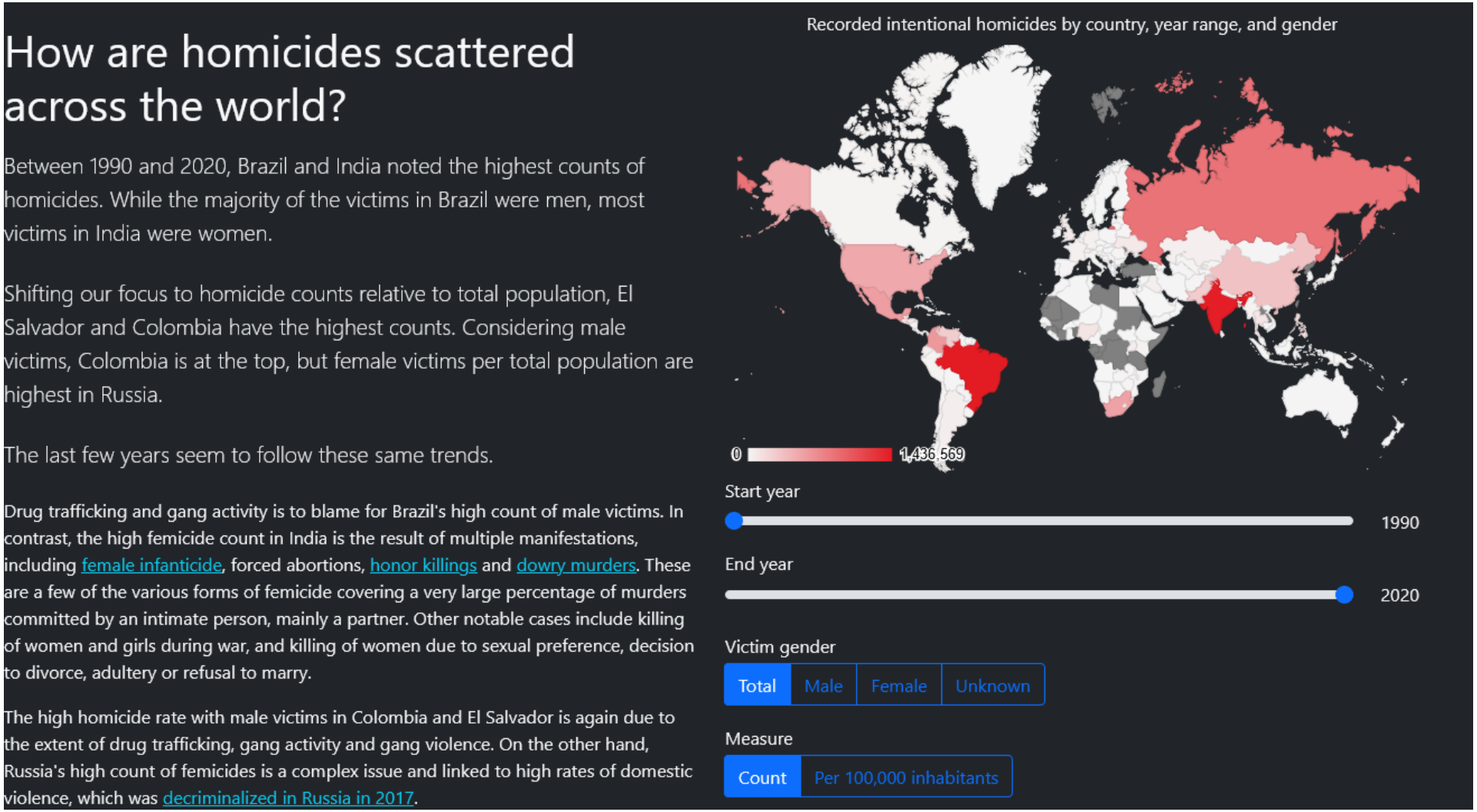


Thanks for drawing. Here's how you did:

- You drew a more accurate picture of reality than about 89 percent of people who have tried so far.
- You underestimated the chances of college enrollment for the very poorest children. In reality, about one in four children in America's poorest families go to college. (You guessed around 12 percent.)
- You correctly guessed the exceptionally high rates of college enrollment for children from the very richest families – about 94 percent.

Data-driven storytelling

- Violence against women, Data Viz course, 2022



Scrollytelling

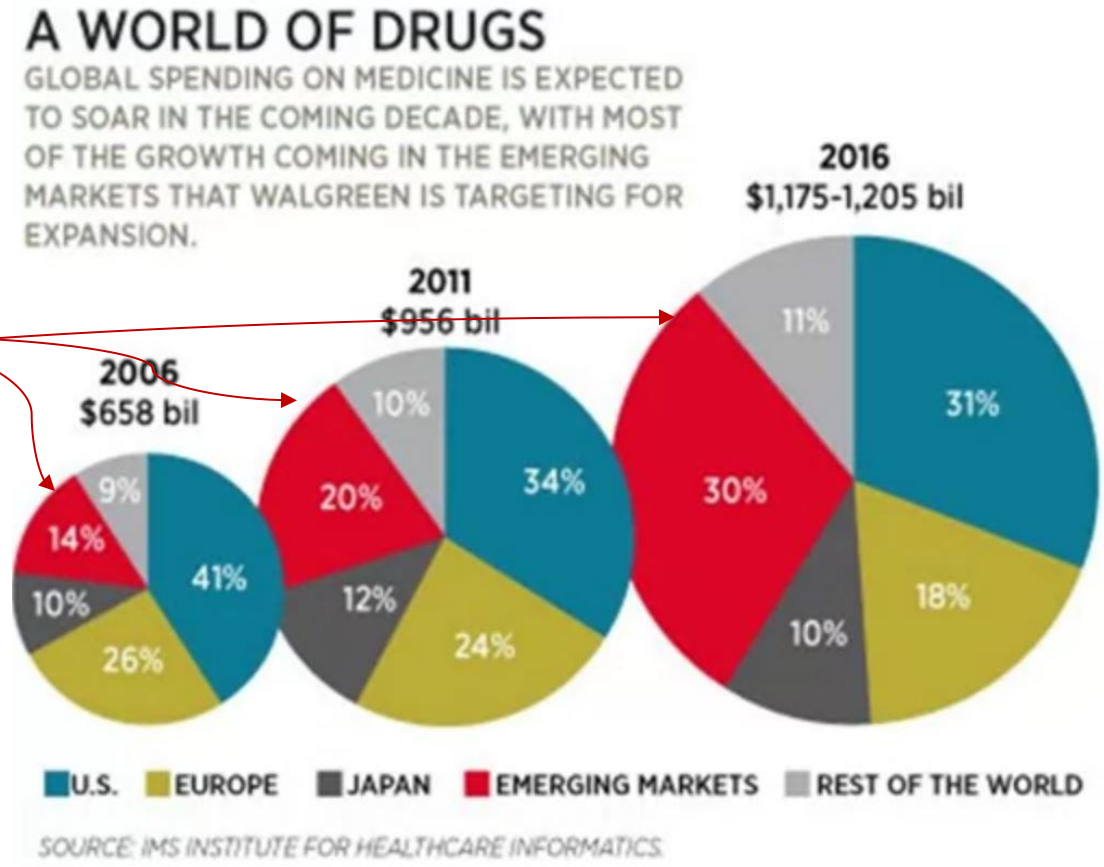
- More in e-class forum and resources slide deck

Assessing the quality of a data visualization

- How do you assess the quality of a visualization?
- How do you know that one visualization is better than another?

Assessing the quality of a data visualization - example

- 3 pie charts showing how the proportion of different markets in a global spending in drugs changes over time (2006, 2011, 2016)…



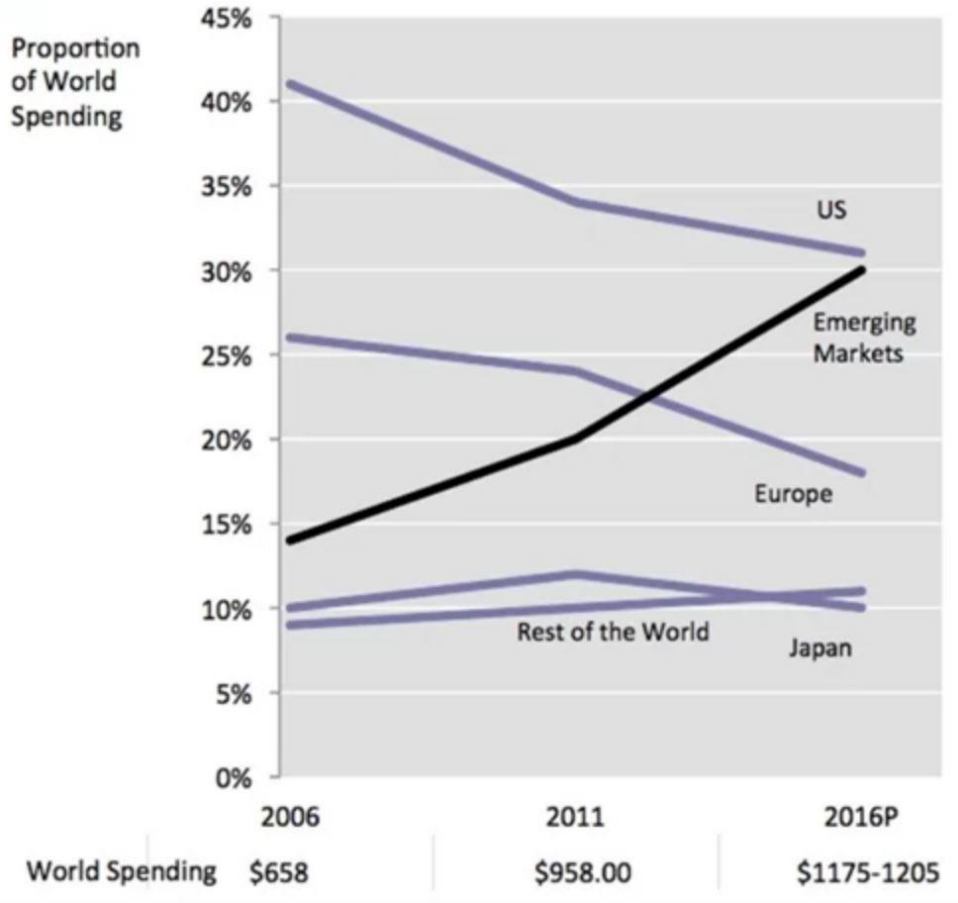
To see how proportions change over time, we have to mentally link these areas across the segments.
But they are not aligned, making these comparison even harder.

Quantity is represented with the angle of the pies, not the area of the segments.

The angle and the size interfere.

Assessing the quality of a data visualization - example

- The same dataset represented with a line chart, observing trend over time and how they relate to each other



Designing effective visualizations requires

- Knowing the design space (to create a certain number of alternatives)

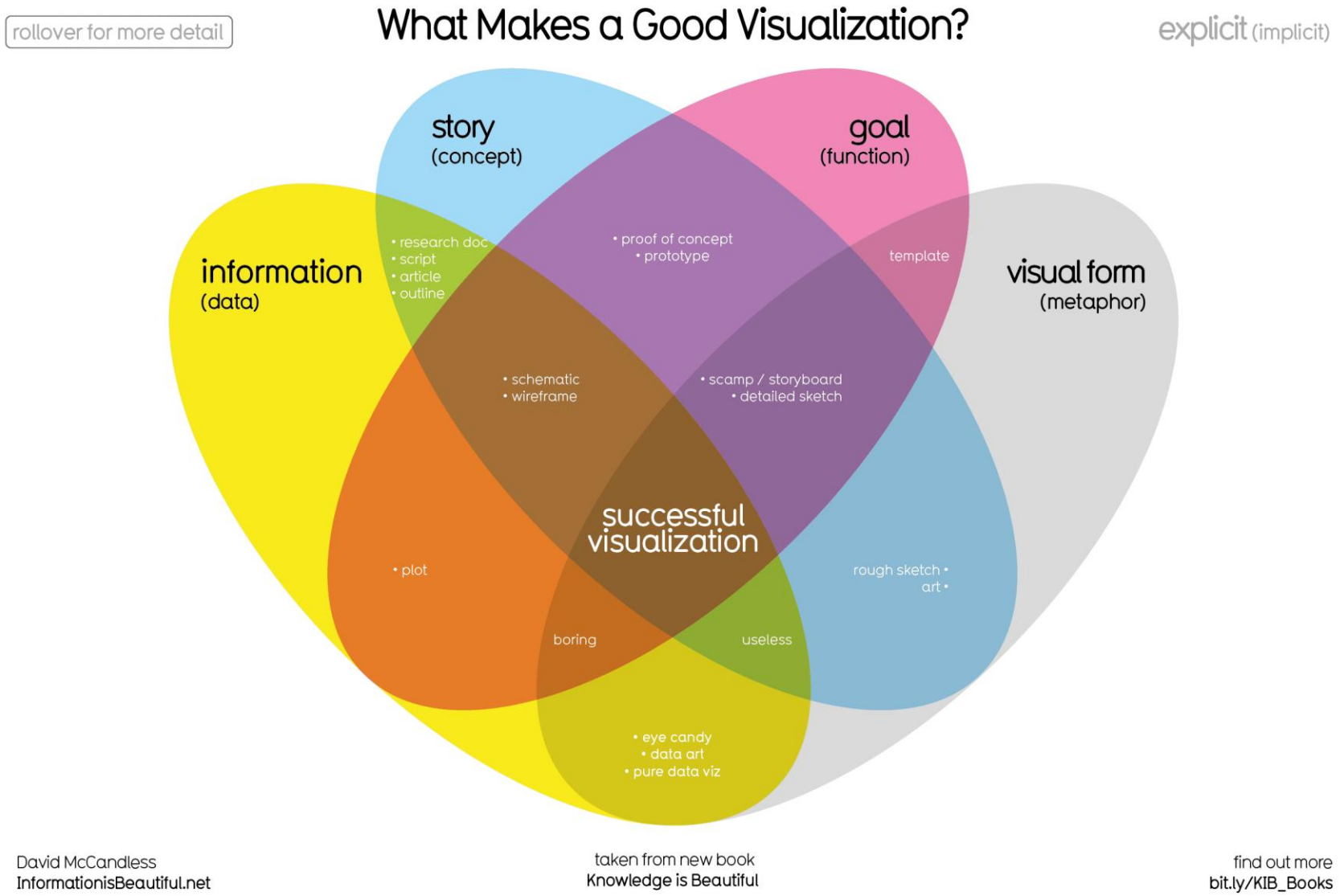
- Being able to compare the solutions

…in turn, comparing the solutions requires understanding how human perception works.

To be effective, the graphical display of data should:

- Show the data;
- Induce the viewer to **think about the substance** rather than about methodology, graphic design, the technology of graphic production, or something else;
- **Avoid distorting** what the data have to say;
- Make large data sets **coherent**;
- Encourage the eye to **compare** different pieces of data;
- Reveal the data at **several levels of detail**, from a broad overview to the fine structure;
- Serve a reasonably **clear purpose**: description, exploration, tabulation, or decoration;
- Be closely integrated with the **statistical and verbal descriptions** of a data set.

Assessing the quality of a data visualization



Visual Information-Seeking Mantra

Overview first, zoom and filter, and then details-on- demand

Shneiderman (2003)

- Overview: Gain an overview of the entire collection.
- Zoom: Zoom in on items of interest
- Filter: filter out uninteresting items.
- Details-on-demand: Select an item or group and get details when needed.
- Relate: View relationships among items.
- History: Keep a history of actions to support undo, replay, and progressive refinement.
- Extract: Allow extraction of sub-collections and of the query parameters

Big data visualization mantra

Search, show context,
expand on demand

Van Ham & Perer (2009)

To read

- Franconeri, S. L., Padilla, L. M., Shah, P., Zacks, J. M., & Hullman, J. (2021). The Science of Visual Data Communication: What Works. *Psychological Science in the Public Interest*, *22*(3), 110–161. https://doi.org/10.1177/1529100621105195 6

Thank you!

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http://eclass.uoa.gr/courses/DI411/