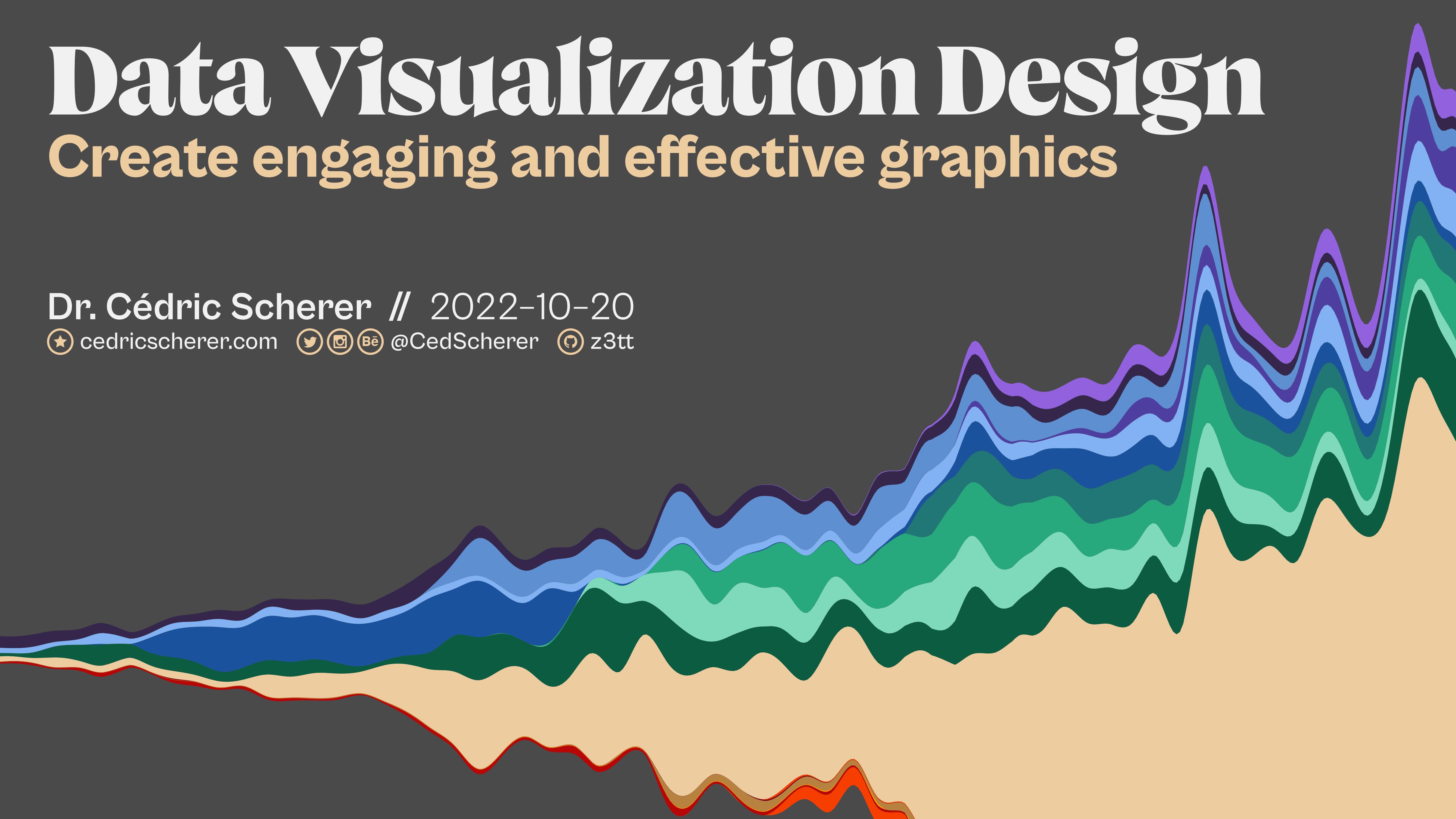


# Data Visualization Design

## Create engaging and effective graphics

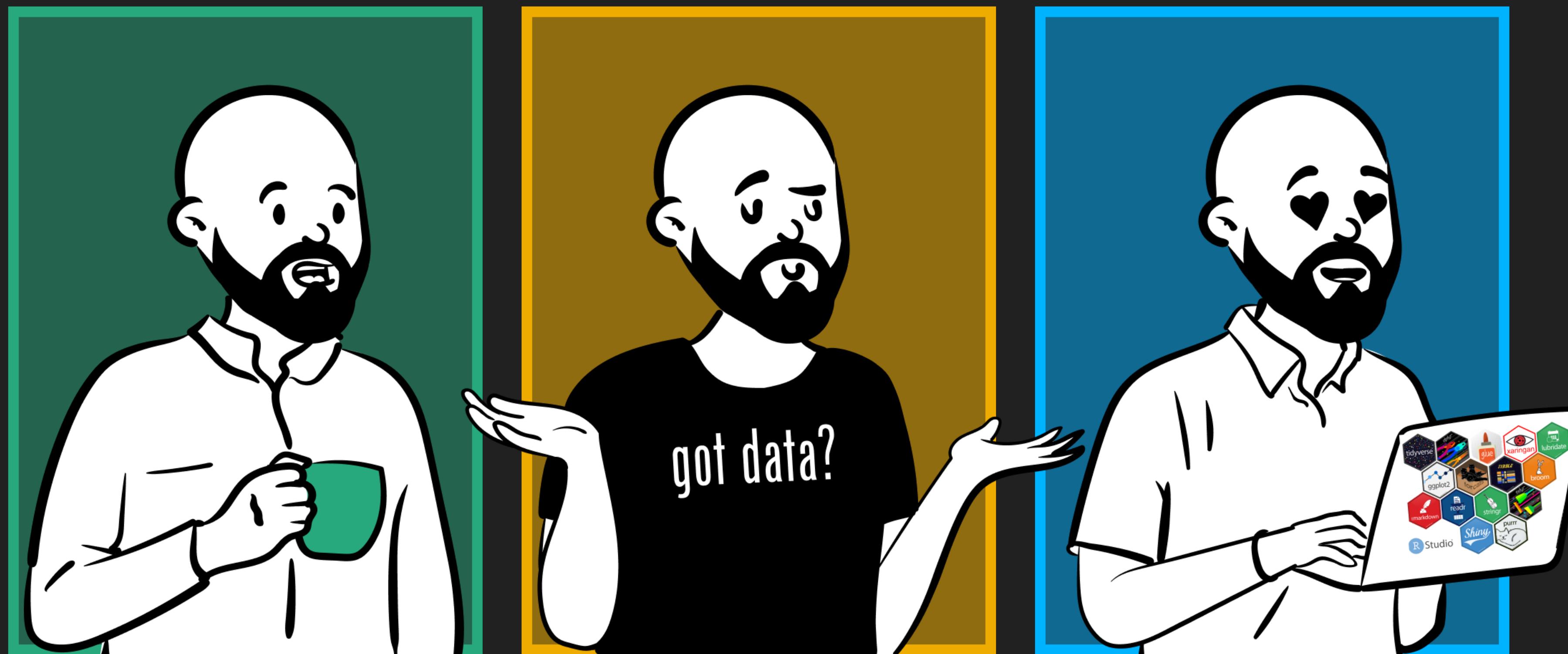
Dr. Cédric Scherer // 2022-10-20

 cedricscherer.com    @CedScherer  z3tt



# Cédric Scherer

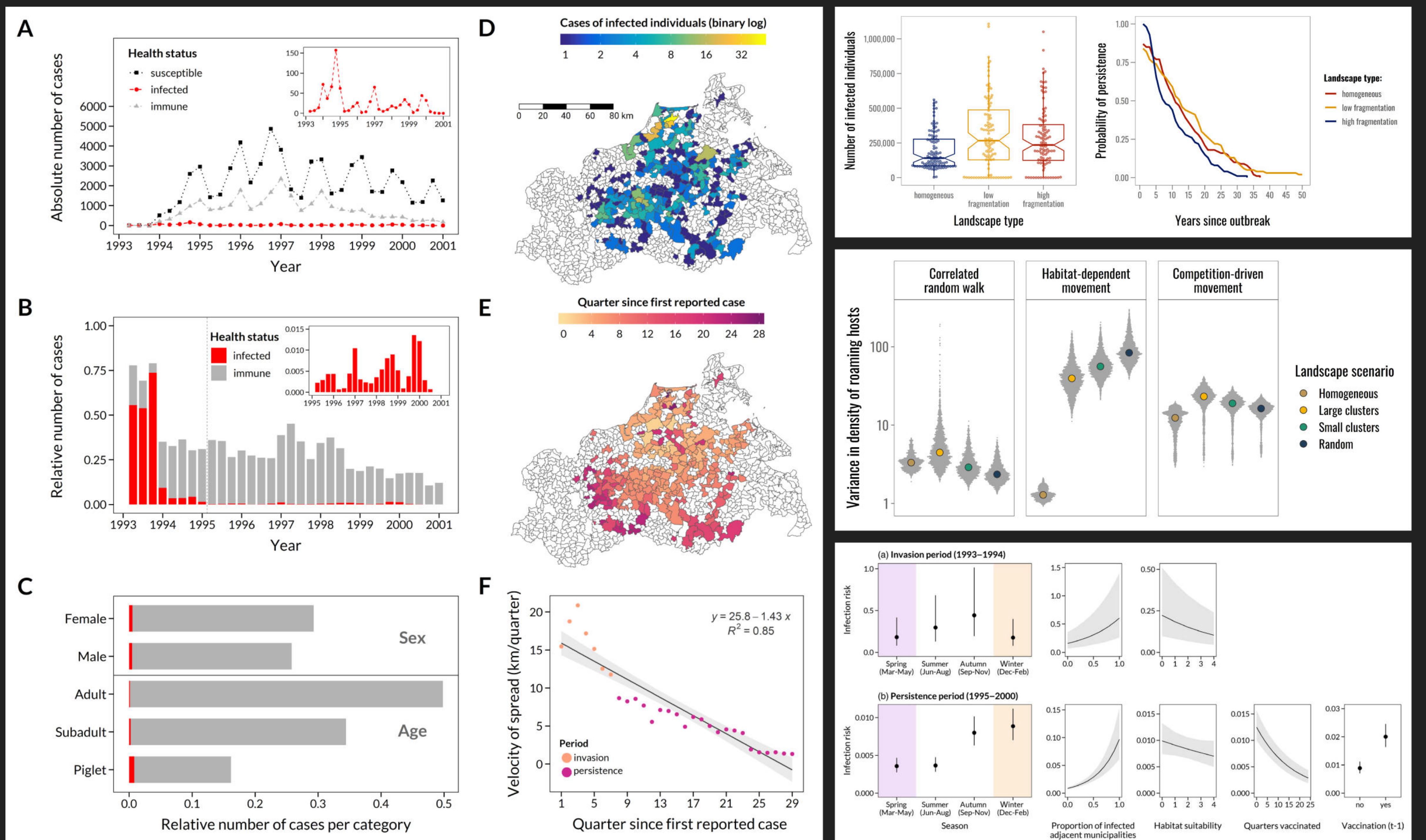
Independent Data Visualization Designer  
Computational Ecologist at IZW Berlin



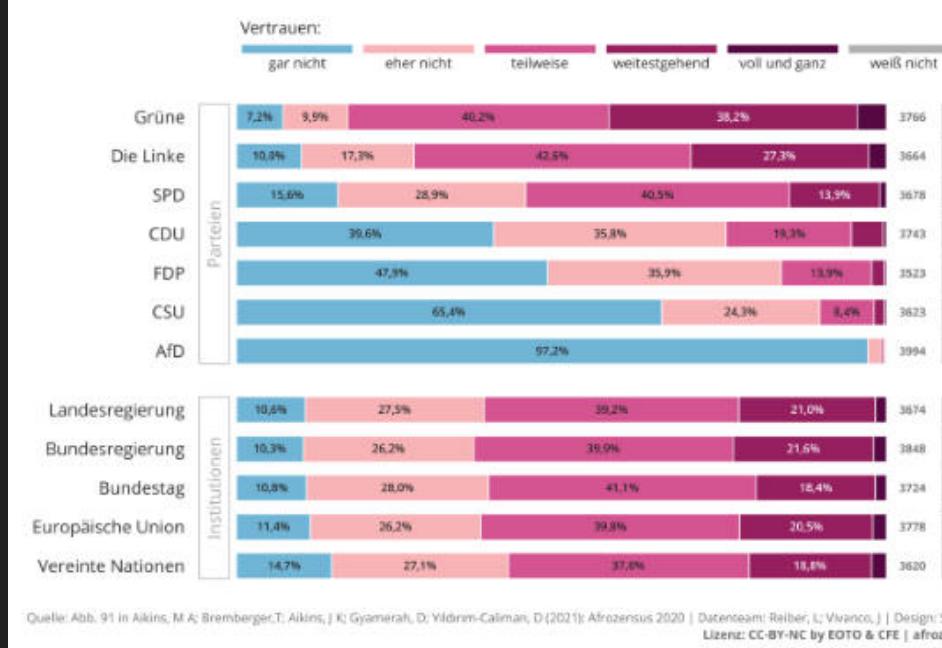
Consulting

*Coaching*

Coding



## Vertrauen der Afrozensus-Befragten in Parteien und politische Institutionen



Politiker rechnen bald mit einer Fortsetzung der Fußball-Bundesliga. Wenn auch nicht im Stadion, so ist es voraussichtlich bald wieder möglich Fußball im Fernsehen zu sehen.

Ich habe **einen** Vertrag mit einem Anbieter für Sportübertragungen.

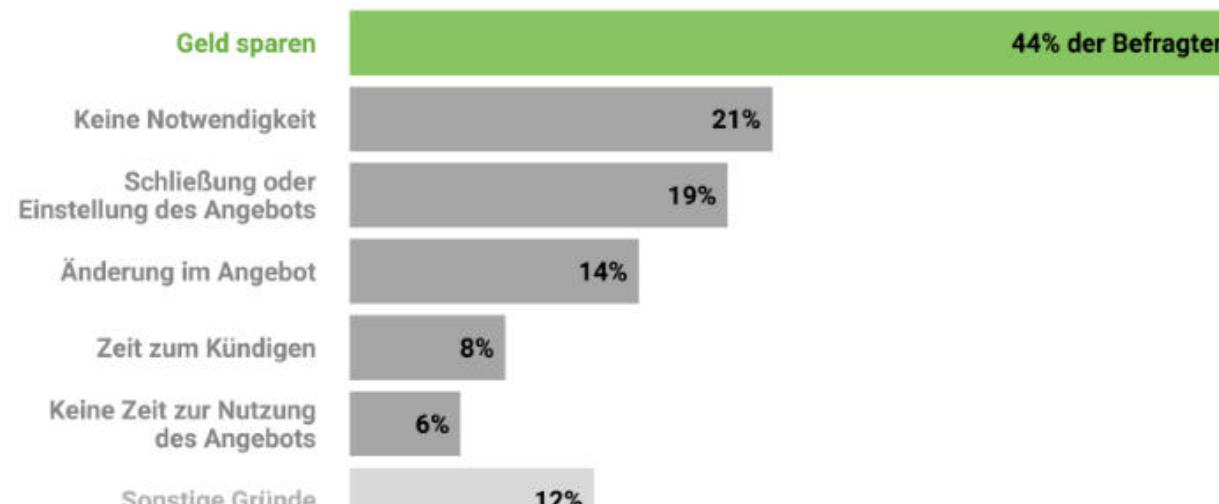
50% finden das richtig.  
16% haben dazu keine Meinung.  
34% finden das falsch.

Ich habe **keinen** Vertrag mit einem Anbieter für Sportübertragungen.

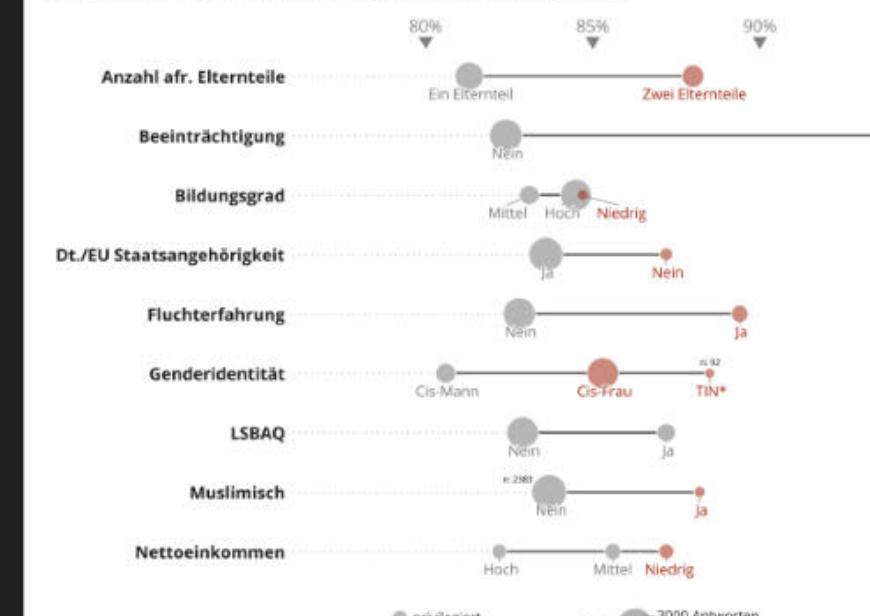
31% finden das richtig.  
35% haben dazu keine Meinung.  
33% finden das falsch.

Basierend auf 1146 Antworten auf eine Umfrage von KUENDIGUNG.ORG

## Was war der Grund während der Corona-Pandemie zu kündigen? (Mehrfachauswahl möglich)



## Häufigkeit von Diskriminierungserfahrungen entlang ausgewählter Vielfaltsdimensionen im Bereich „Arbeitsleben“



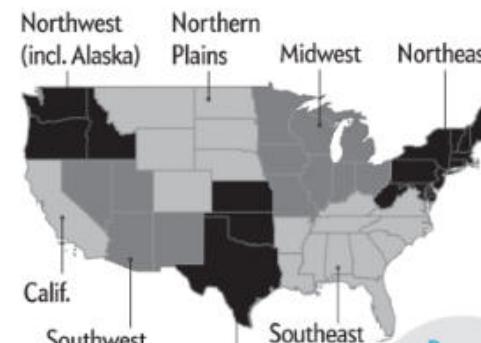
## GRAPHIC SCIENCE

Text by Clara Moskowitz | Graphic by Cédric Scherer and Georgios Karamanis

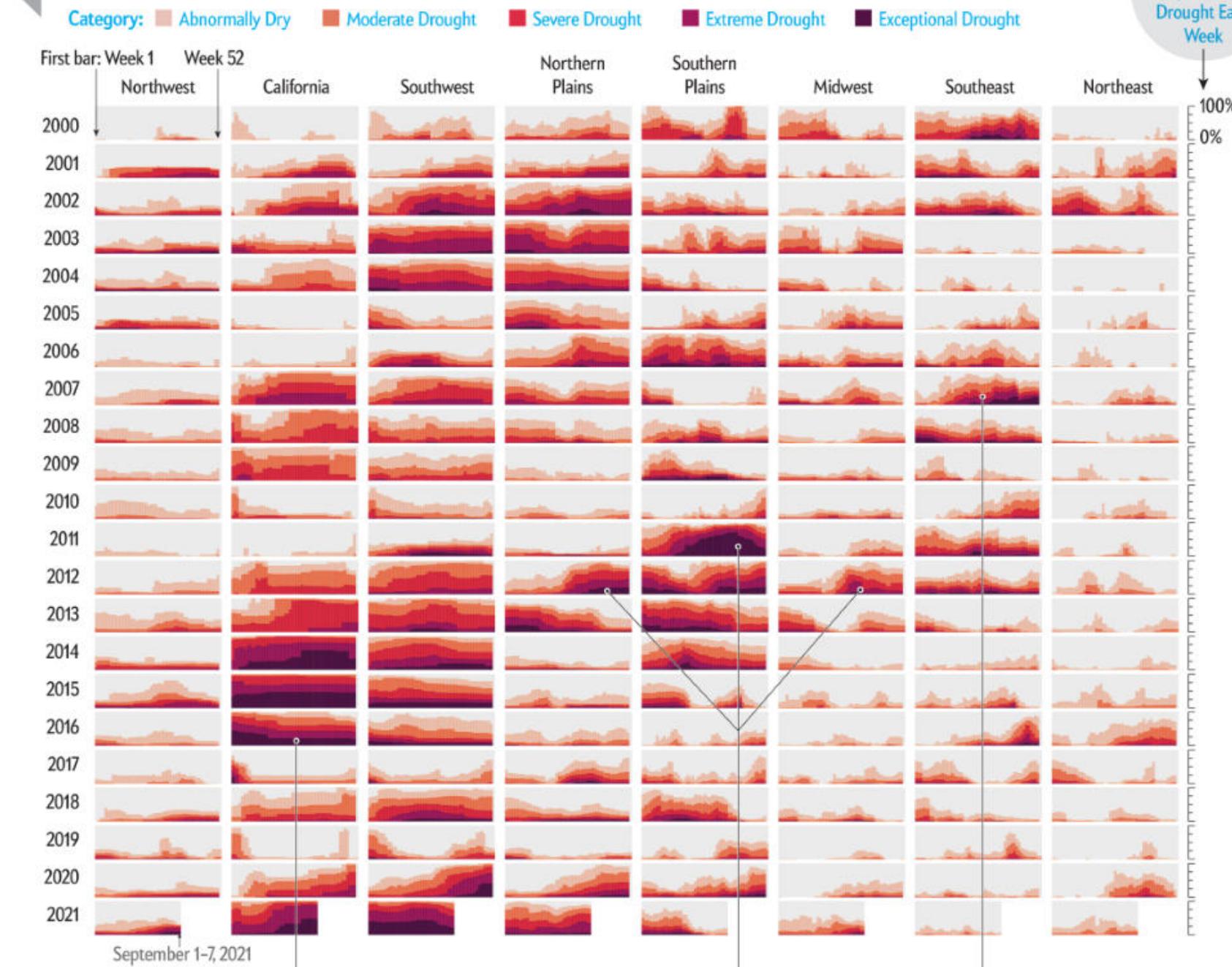
# Escalating Drought

Climate change is intensifying periods of extreme dryness, particularly in the U.S. West

For more than 20 years the National Drought Mitigation Center (NDMC) has been monitoring dozens of indices of drought around the country, including satellite measurements of evaporation and color in vegetation, soil-moisture sensors, rainfall estimates, and river and streamflow levels. Although the agency's weekly assessments have identified periods of exceptional drought before, lately dryness has been ramping up. "The changing climate is definitely contributing to more natural disasters, drought being one of them," says Brian Fuchs, a climatologist who oversees the weekly report at the NDMC. "We're seeing more frequent and high-intensity episodes. This year some of these areas in the West have been in drought more than they have been without drought."



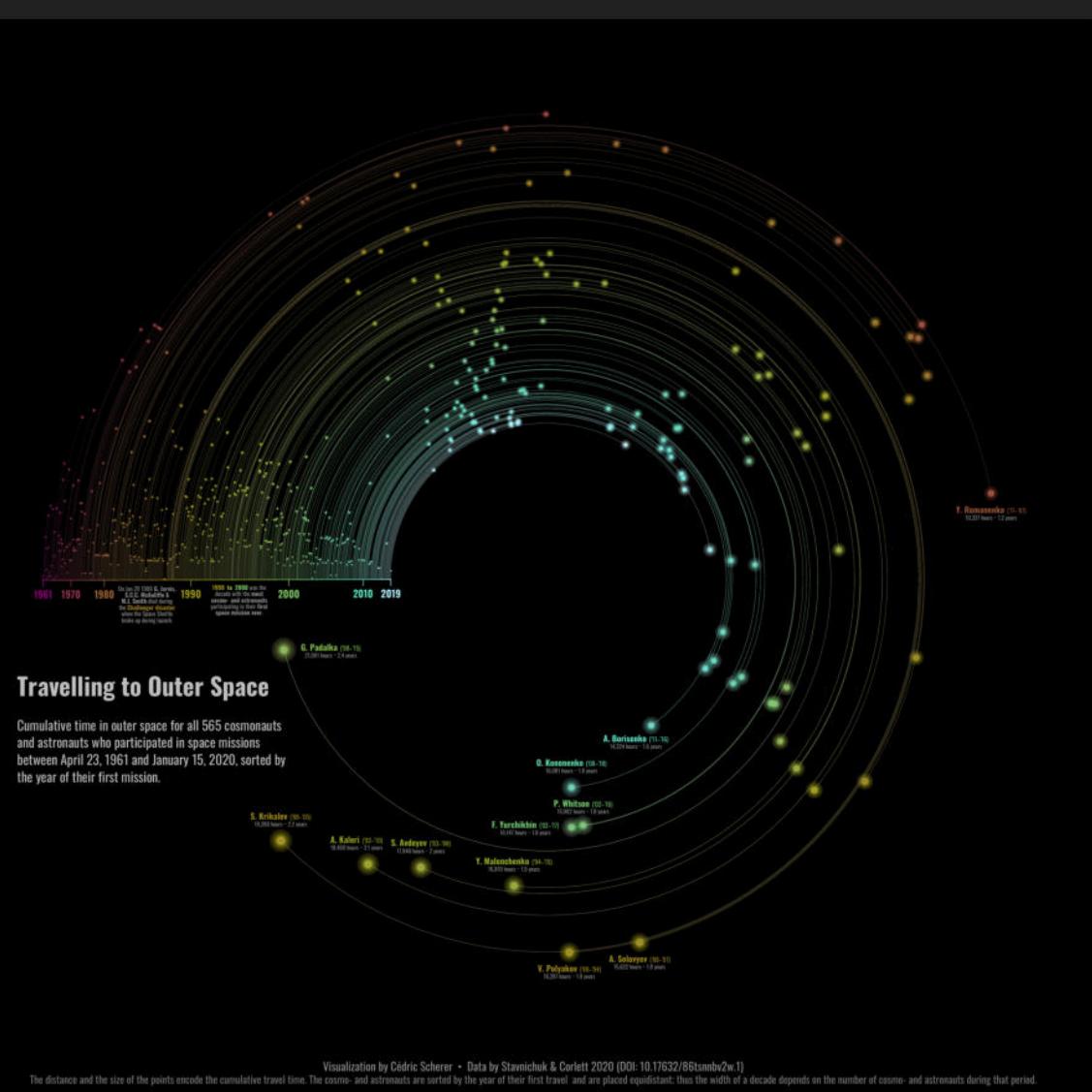
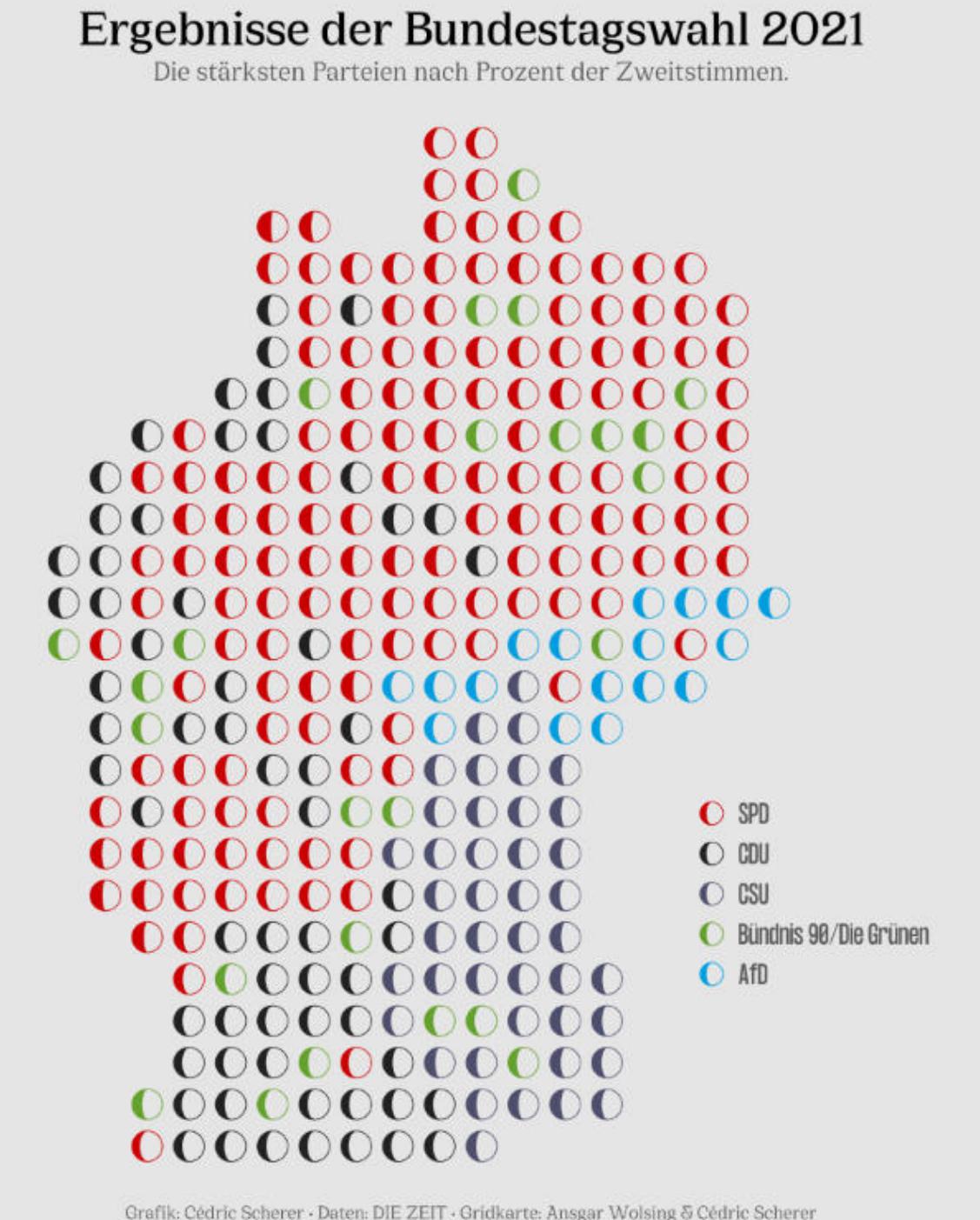
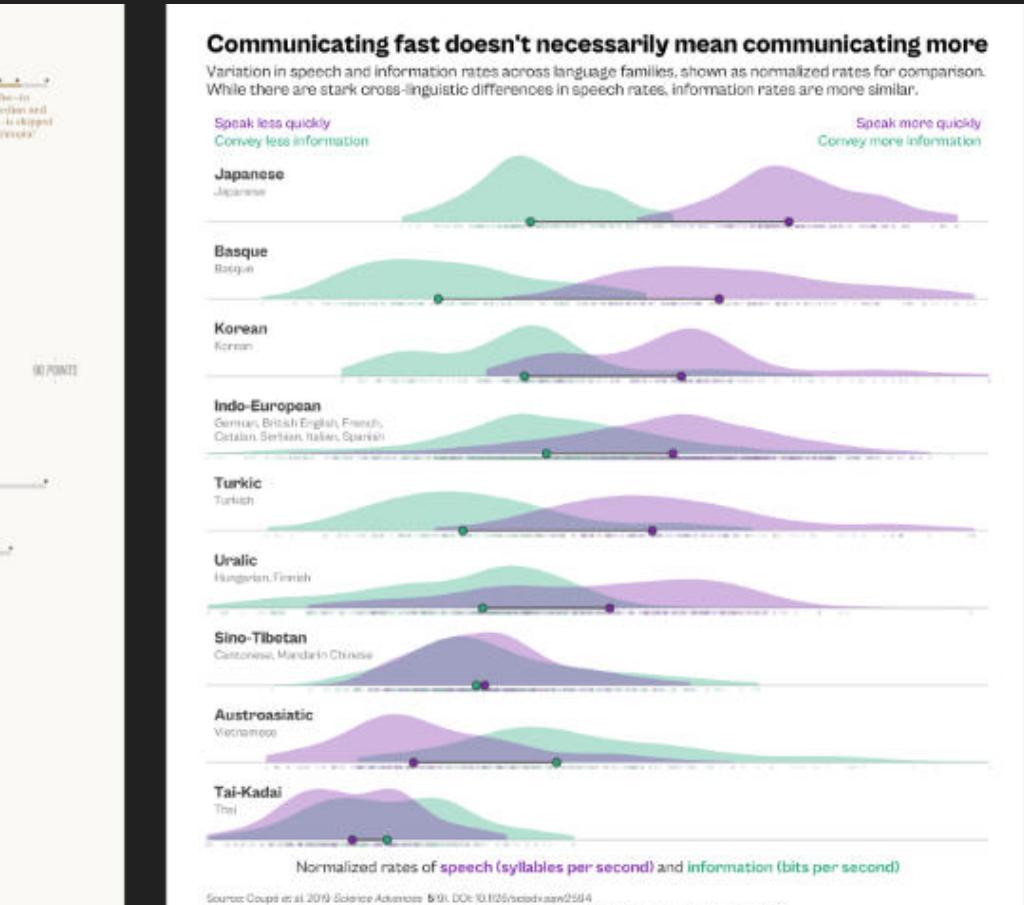
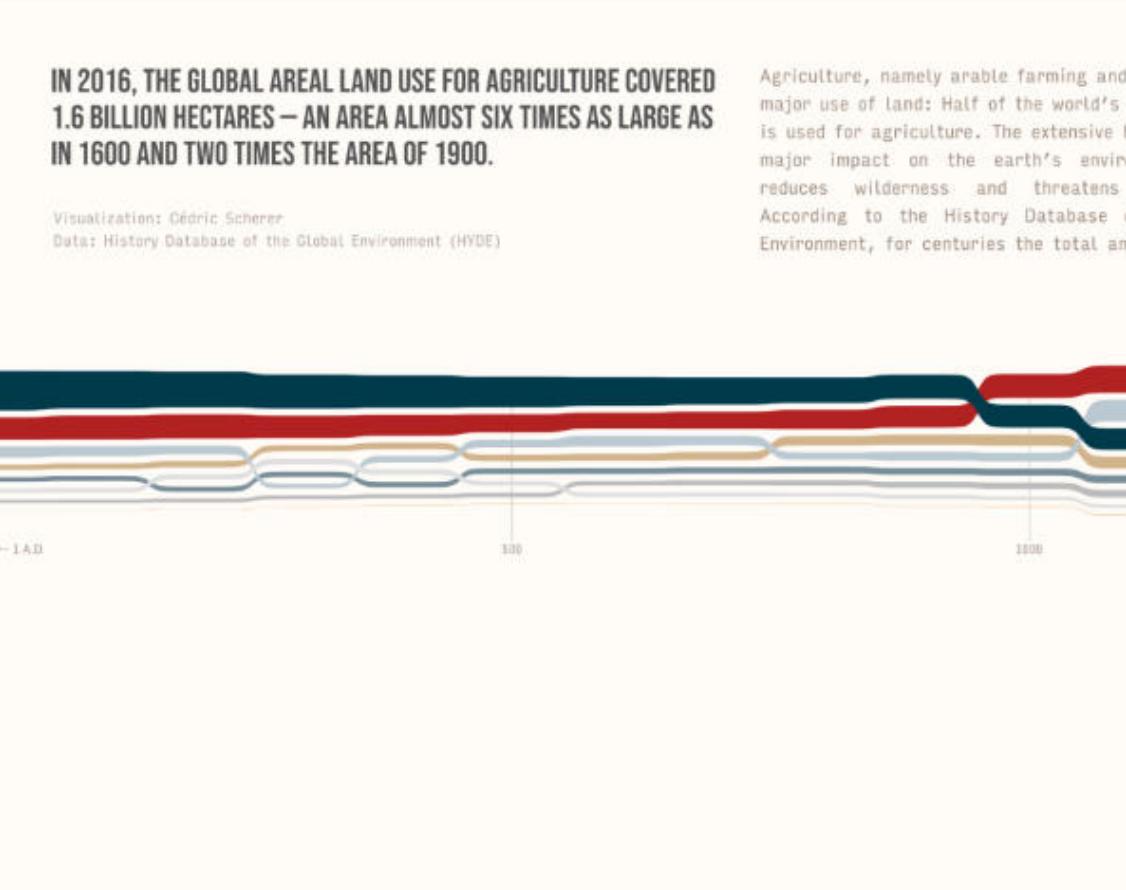
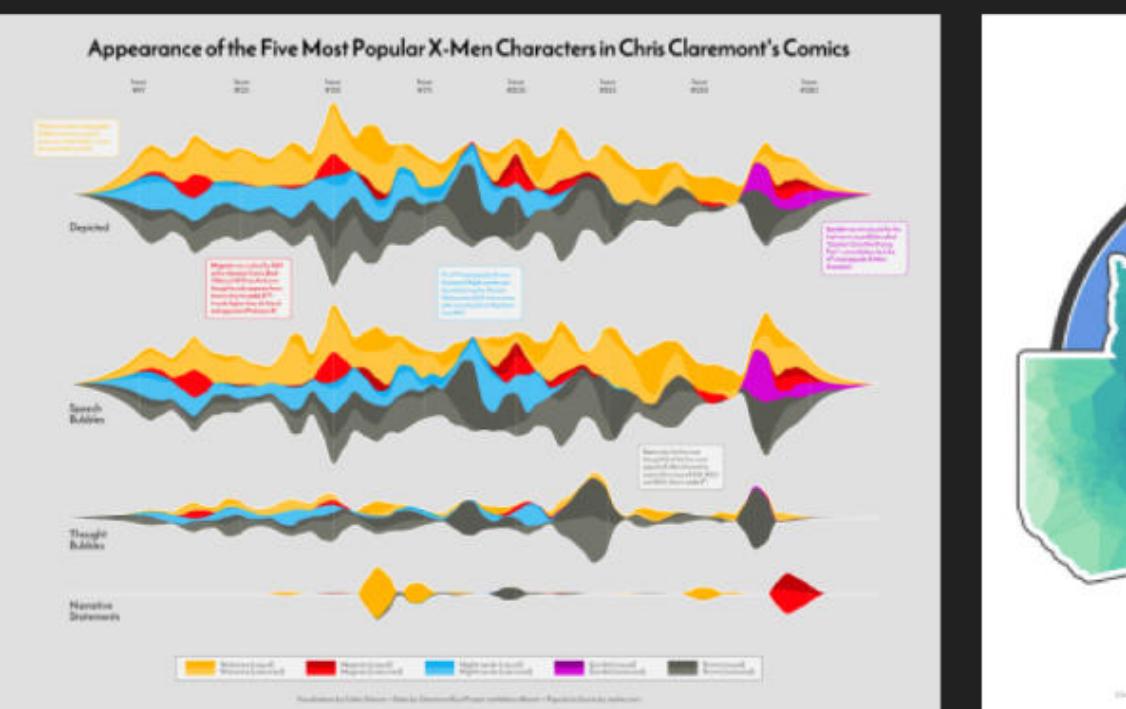
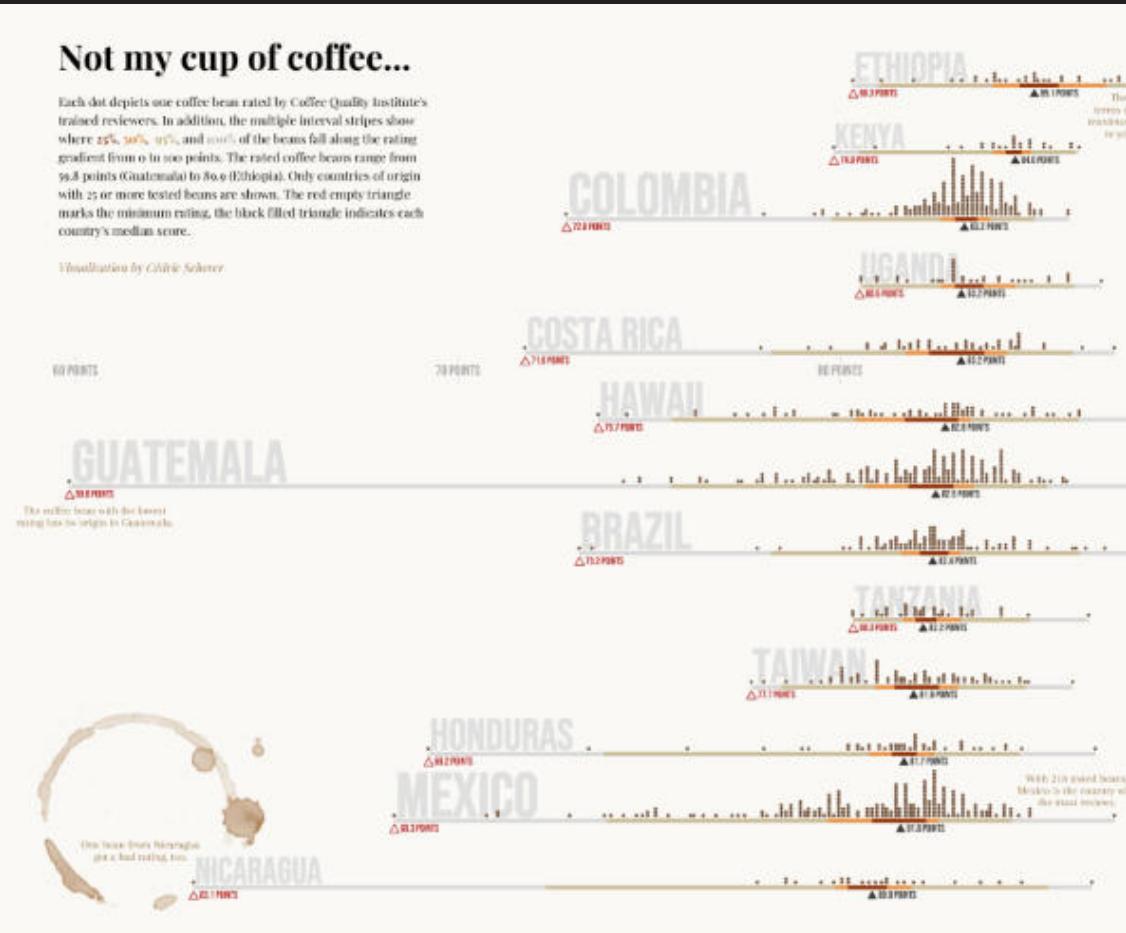
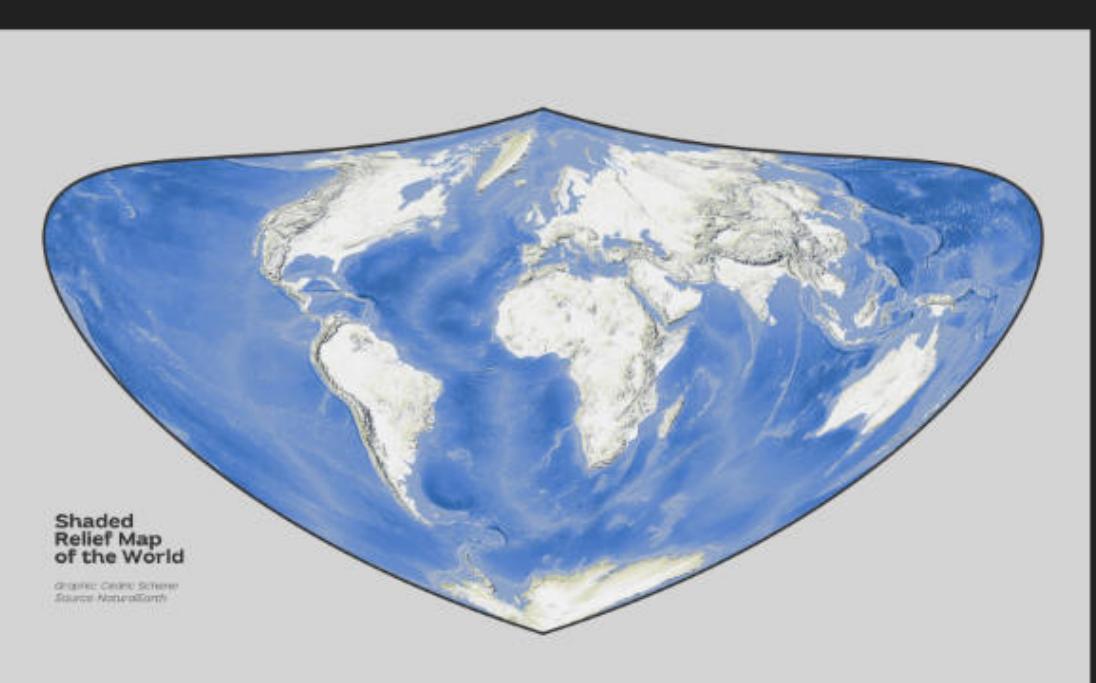
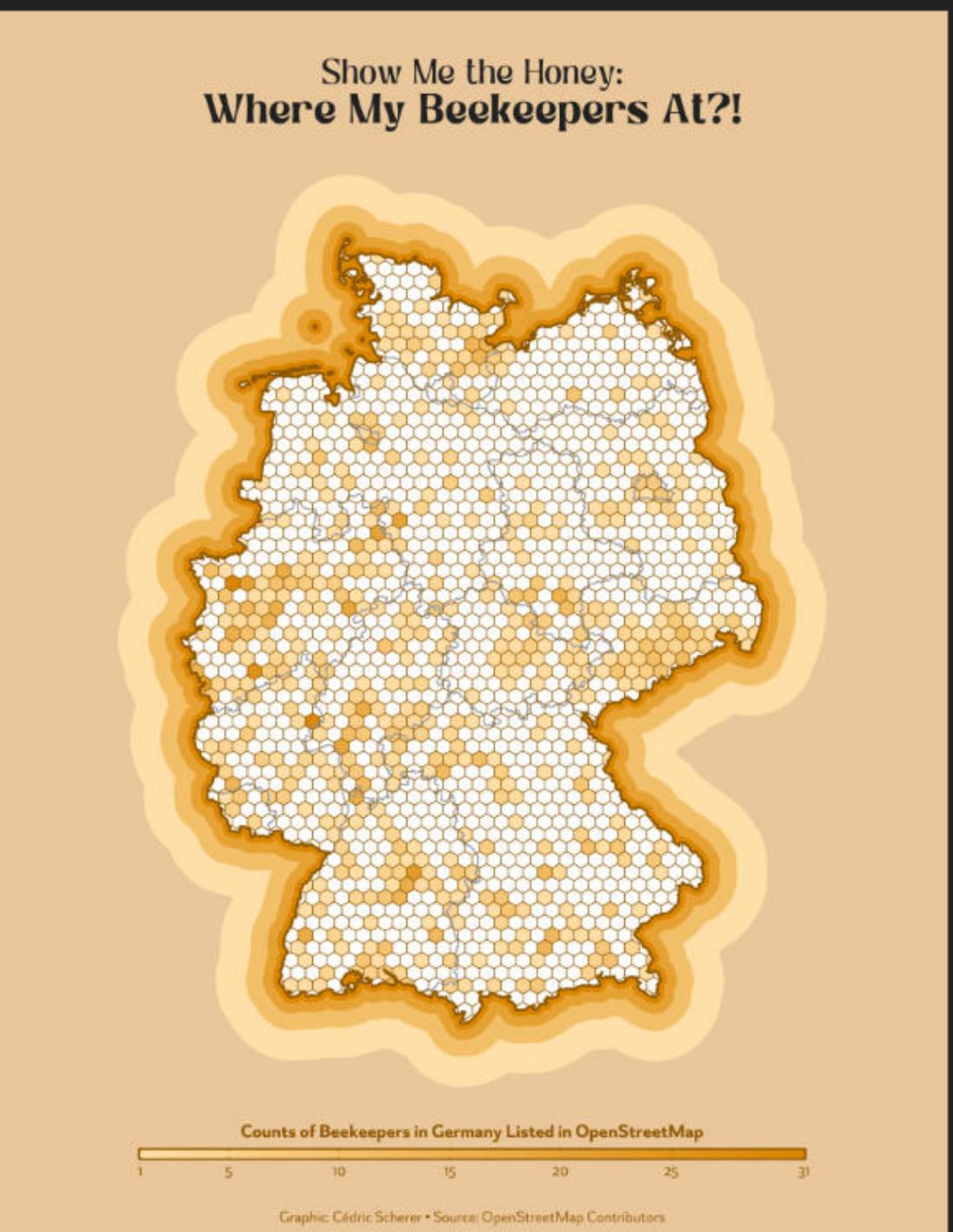
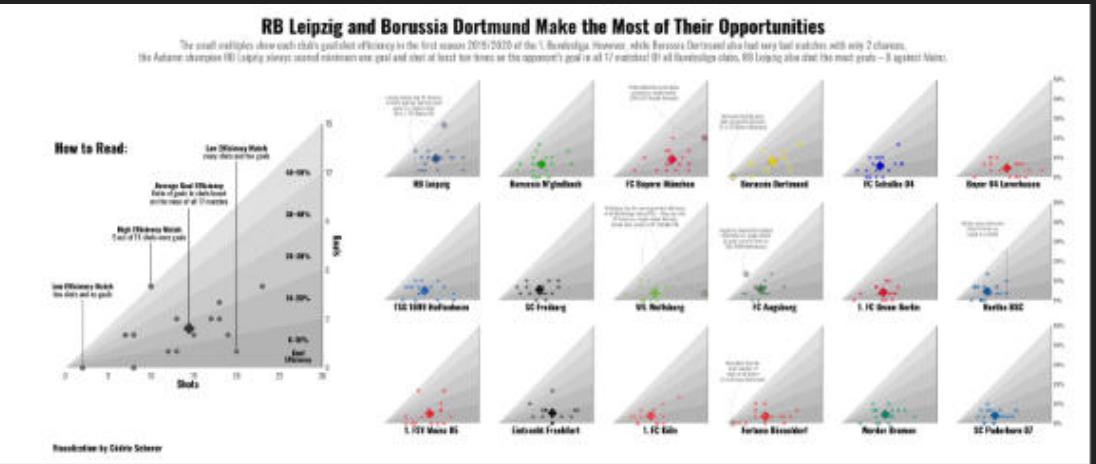
## Drought Extent and Intensity by Region over Time



California experienced its hottest drought in recorded history from 2012 to 2016. A warming climate makes the atmosphere thirstier, which increases evaporation and boosts drought.

A drought that originated in the Southern Plains in 2011 eventually spread to the Midwest and Northern Plains when the moisture coming in from the Gulf of Mexico was absorbed by the parched South before it could reach the North.

The Southeast's driest year to date was 2007, when only 31.85 inches of rain fell in Atlanta, 62 percent of its average yearly rainfall.



# slides

[cedricscherer.com/workshops/dataviz\\_citec.pdf](http://cedricscherer.com/workshops/dataviz_citec.pdf)



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# Data Visualization

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is any graphical representation  
of information and data.



# Data Visualization

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helps to amplify cognition, gain insights,  
discover, explain, and make decisions.

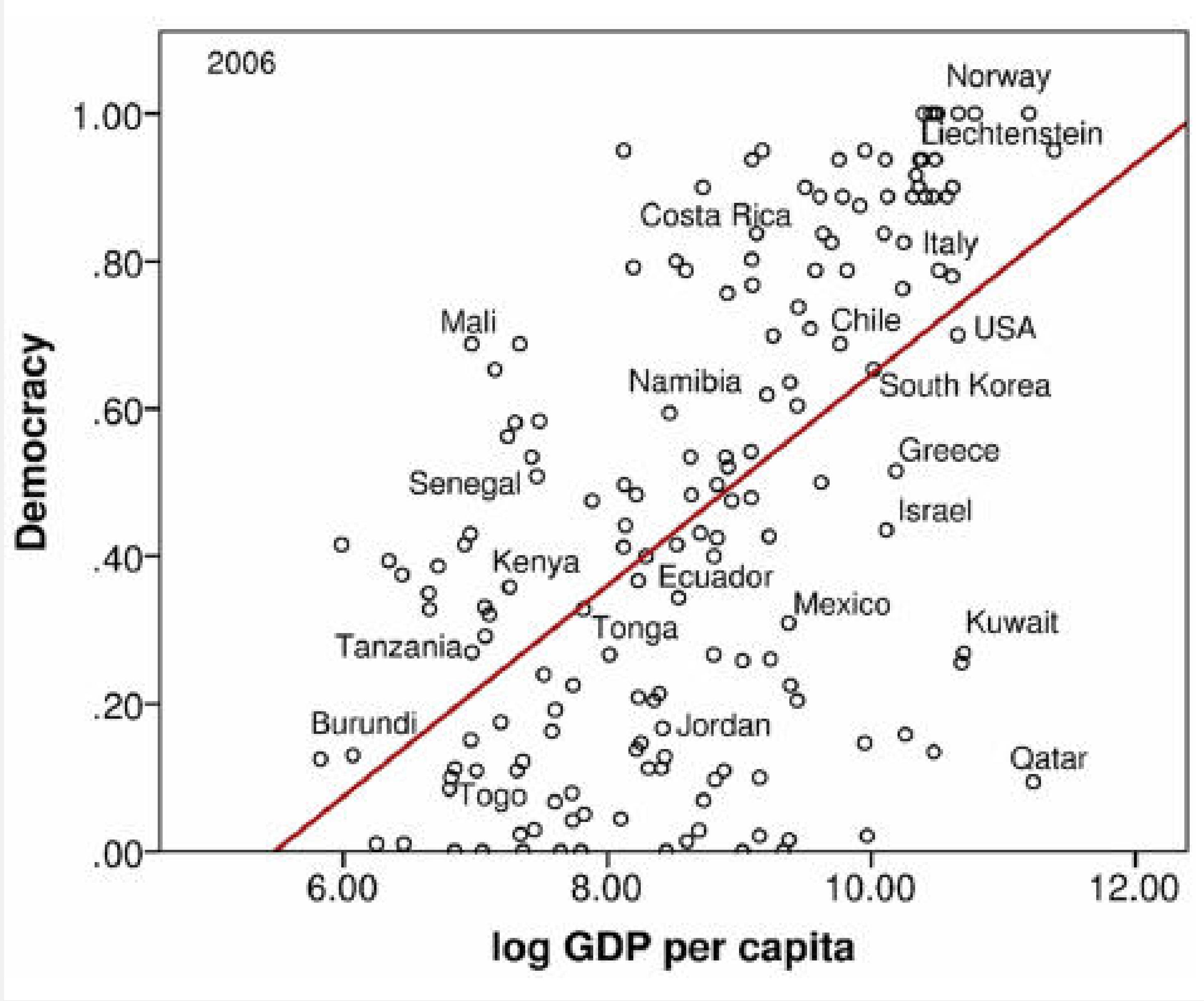


# Data Visualization

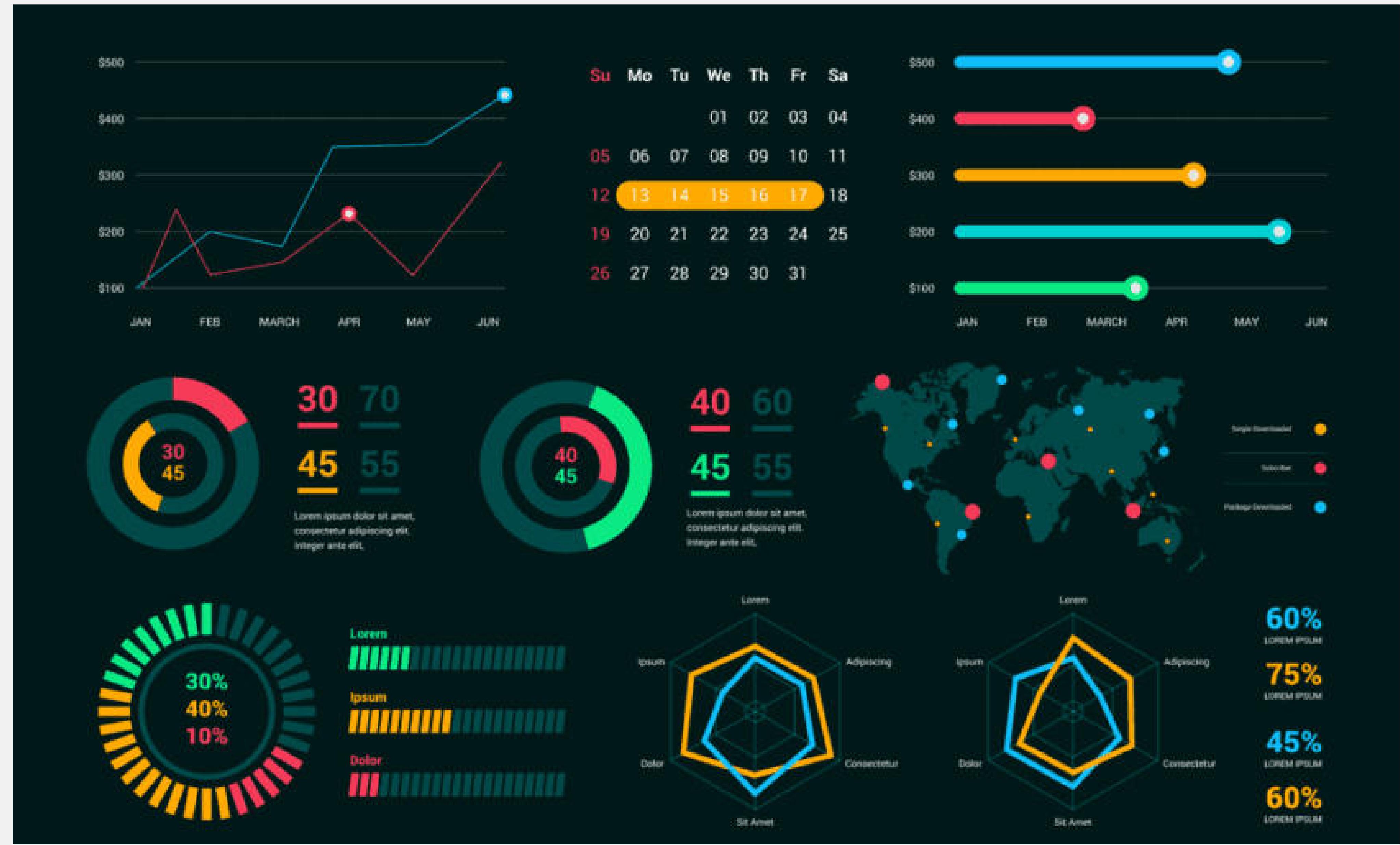
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converts information into visual  
forms as quantifiable features.





Source: *Ranganathan et al. 2014*



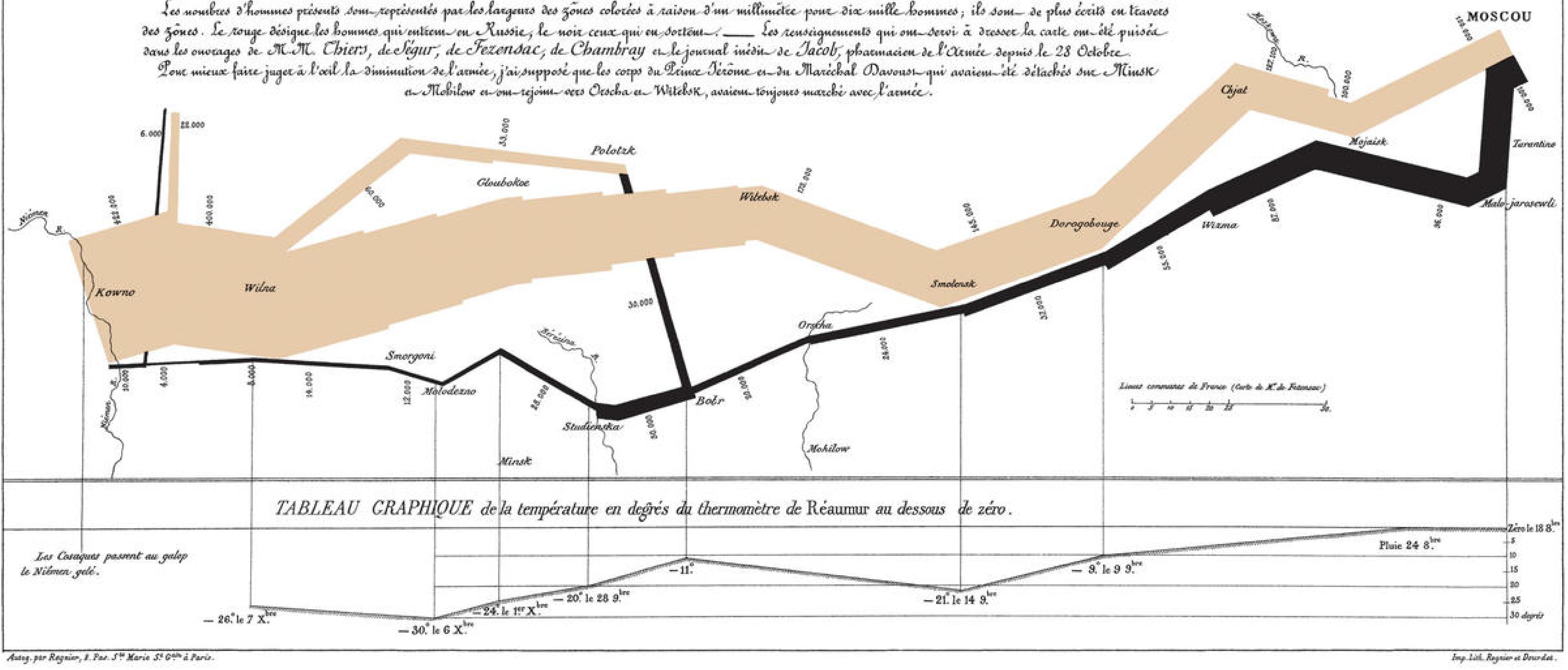
Source: [datameer.com](http://datameer.com)

# Carte Figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812-1813.

Dessiné par M. Minard, Inspecteur Général des Ponts et Chaussées en retraite Paris, le 20 Novembre 1869.

Les nombres d'hommes perdus sont représentés par les larges des zones colorées à raison d'un millimètre pour dix mille hommes; ils sont de plus écrits en lettres des zones. Le rouge désigne les hommes qui entrent en Russie, le noir ceux qui en sortent. — Les renseignements qui ont servi à dresser la carte ont été puisés dans les ouvrages de M. M. Chier, de Segur, de Fezensac, de Charnbray et le journal inédit de Jacob, pharmacien de l'Armée depuis le 28 Octobre.

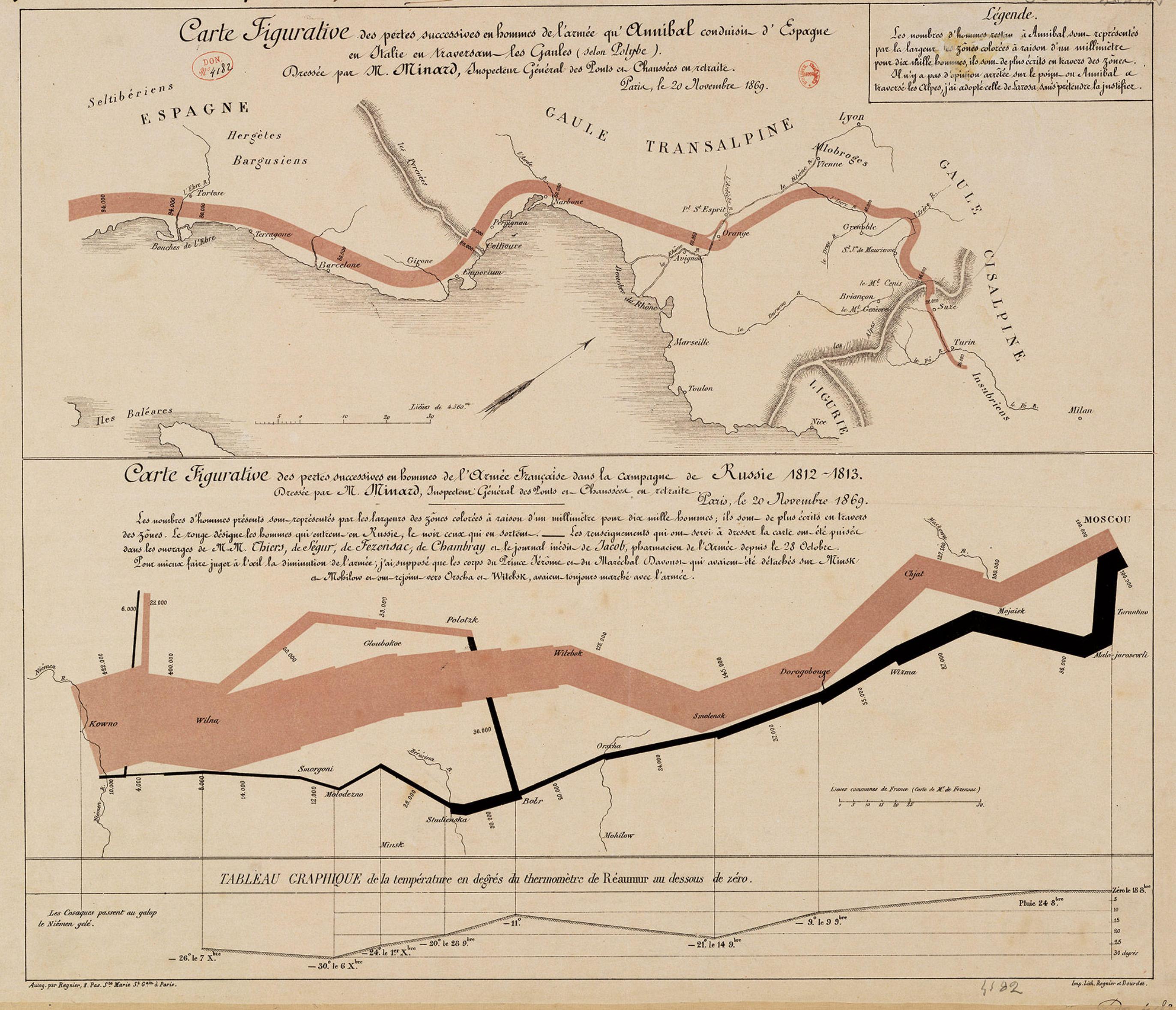
Pour mieux faire juger à l'œil la diminution de l'armée, j'ai supposé que les corps du Prince Jérôme et du Maréchal Davout, qui avaient été détachés de Minsk à Mohilow et qui rejoignirent Osscha et Wilcok, avaient toujours marché avec l'armée.



Carte figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812-1813 von Charles Joseph Minard

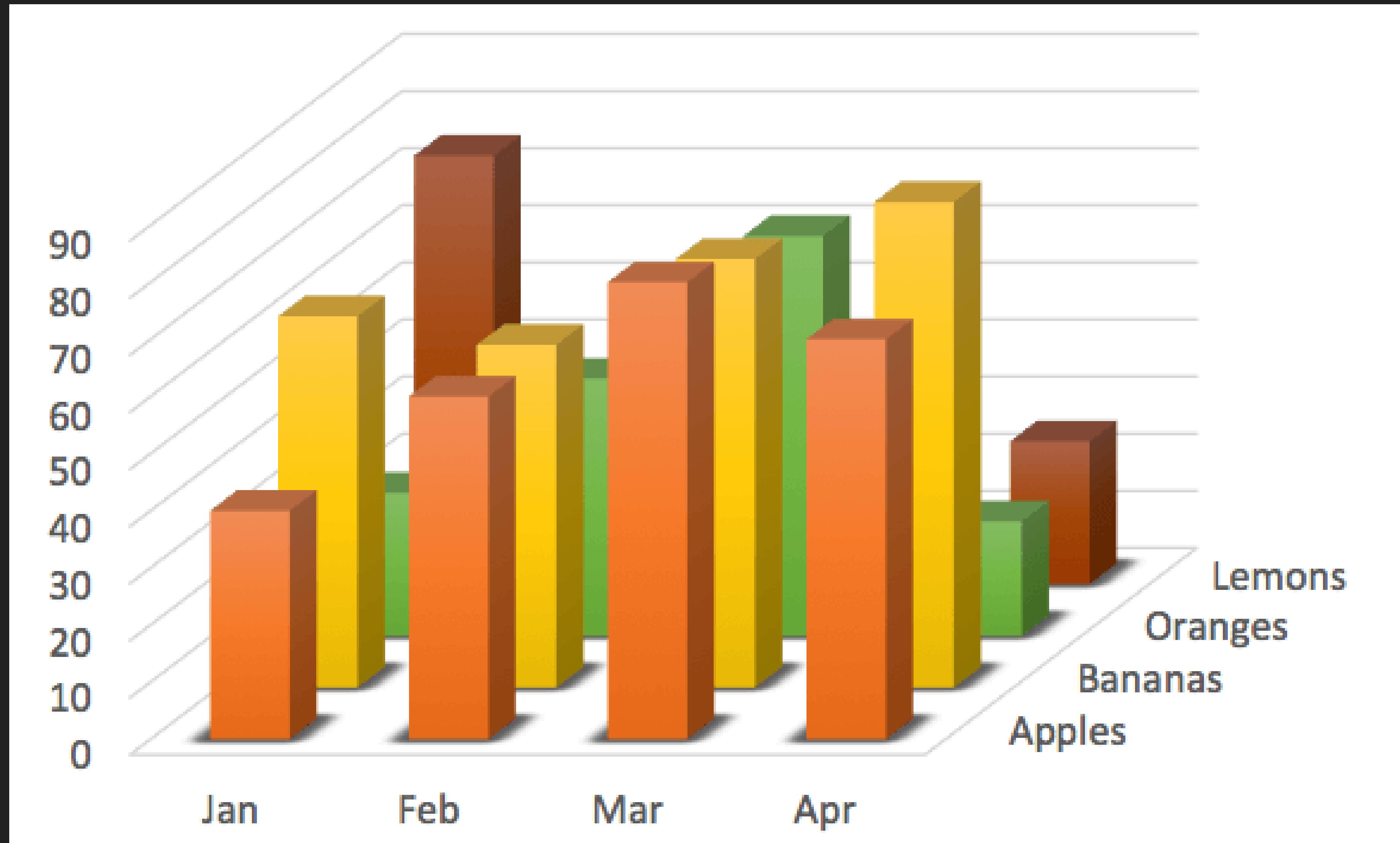
pour la Bibliothèque impériale

Ge Don X. 4182



Carte figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812-1813 and Carte figurative des pertes successives en hommes de l'Armée qu'Annibal conduisit d'Espagne en Italie en traversant les Gaules (selon Polybe) by Charles Joseph Minard

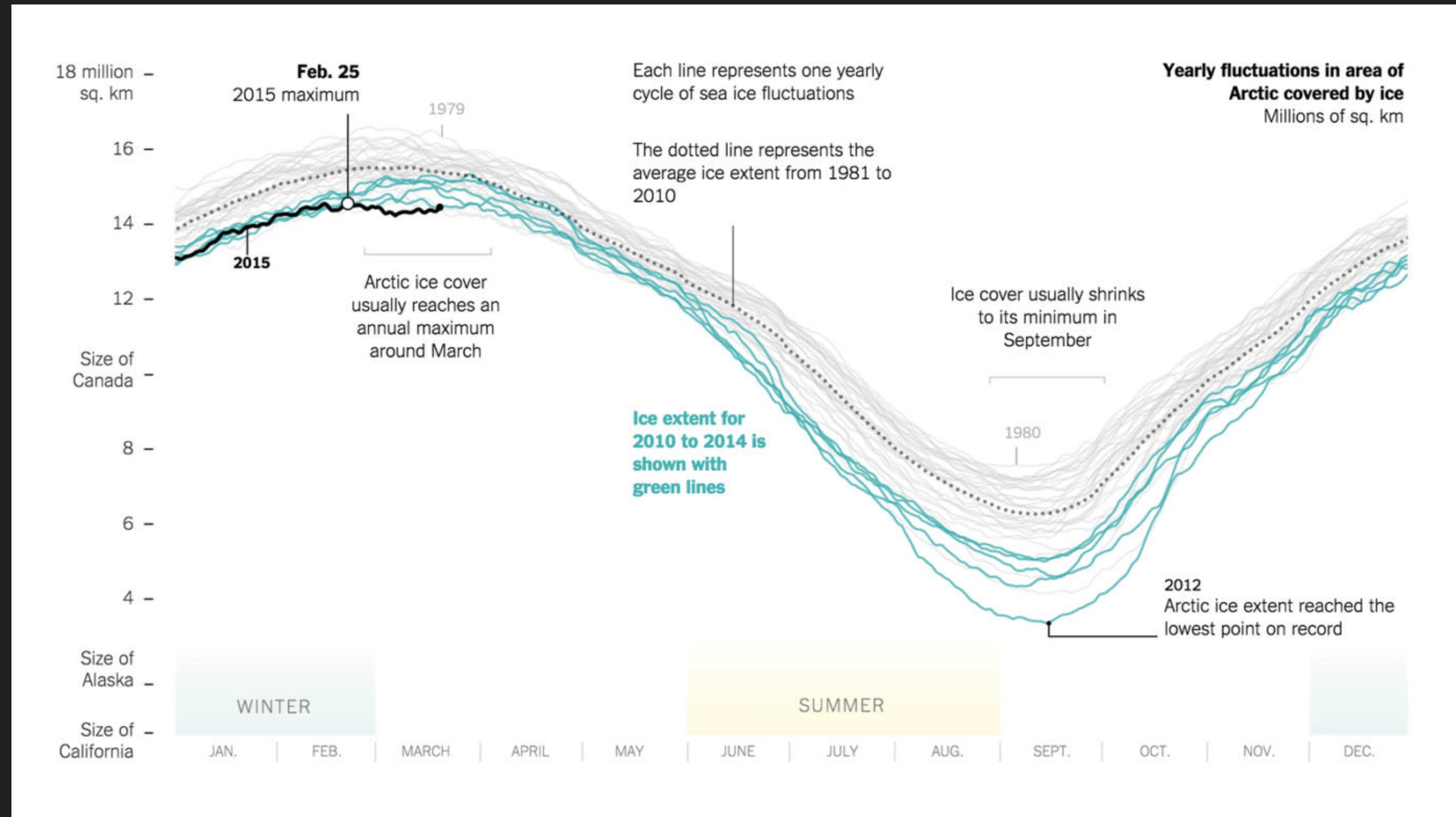
# What makes it a bad data visualization?



# What makes it a bad data visualization?

- 👉 **substantive problems** (bad data / story)
- 👉 **aesthetic problems** (bad design)
- 👉 **perceptual problems** (bad encoding)

# What makes it a good data visualization?



Source: “*Yearly Fluctuations in Area of Arctic Covered by Ice*” by Derek Watkins (New York Times)

# What makes it a good data visualization?



**INFORMATION** (integrity)



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@



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# What makes it a good data visualization?

→ **INFORMATION** (integrity)

→ **STORY** (interestingness)

# What makes it a good data visualization?

- ➔ **INFORMATION** (integrity)
- ➔ **STORY** (interestingness)
- ➔ **GOAL** (usefulness)

# What makes it a good data visualization?

- ➔ **INFORMATION** (integrity)
- ➔ **STORY** (interestingness)
- ➔ **GOAL** (usefulness)
- ➔ **VISUAL FORM** (beauty)

# INFORMATION

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Understand your data and be accurate



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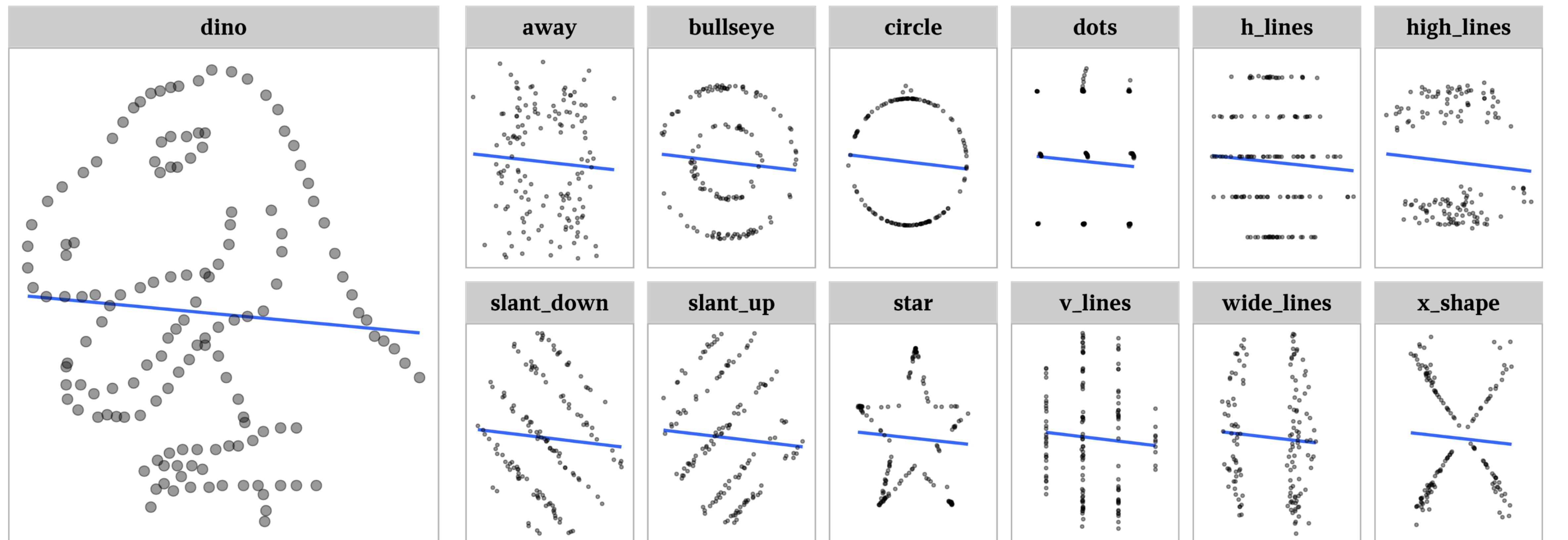


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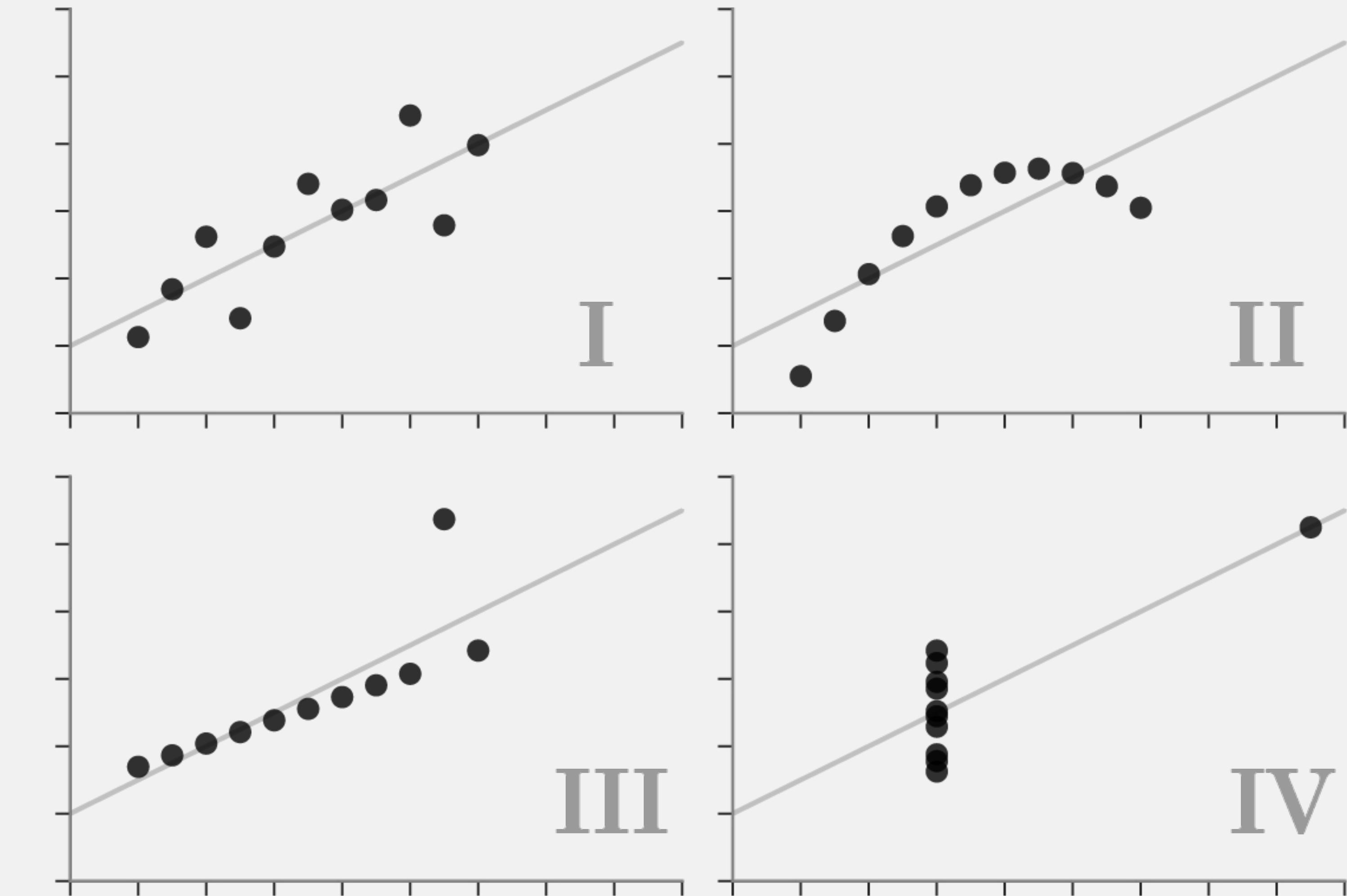
# Visualize Your Data



*“Same Stats, Different Graphs: Generating Datasets with Varied Appearance and Identical Statistics through Simulated Annealing”*  
by Justin Matejka & George Fitzmaurice, ACM SIGCHI Conference on Human Factors in Computing Systems 2017

# Anscombe's Quartet

**Each dataset has the same summary statistics  
but are visually distinct.**



*“Same Stats, Different Graphs: Generating Datasets with Varied Appearance and Identical Statistics through Simulated Annealing”*  
by Justin Matejka & George Fitzmaurice, ACM SIGCHI Conference on Human Factors in Computing Systems 2017

# Visualize Your Data

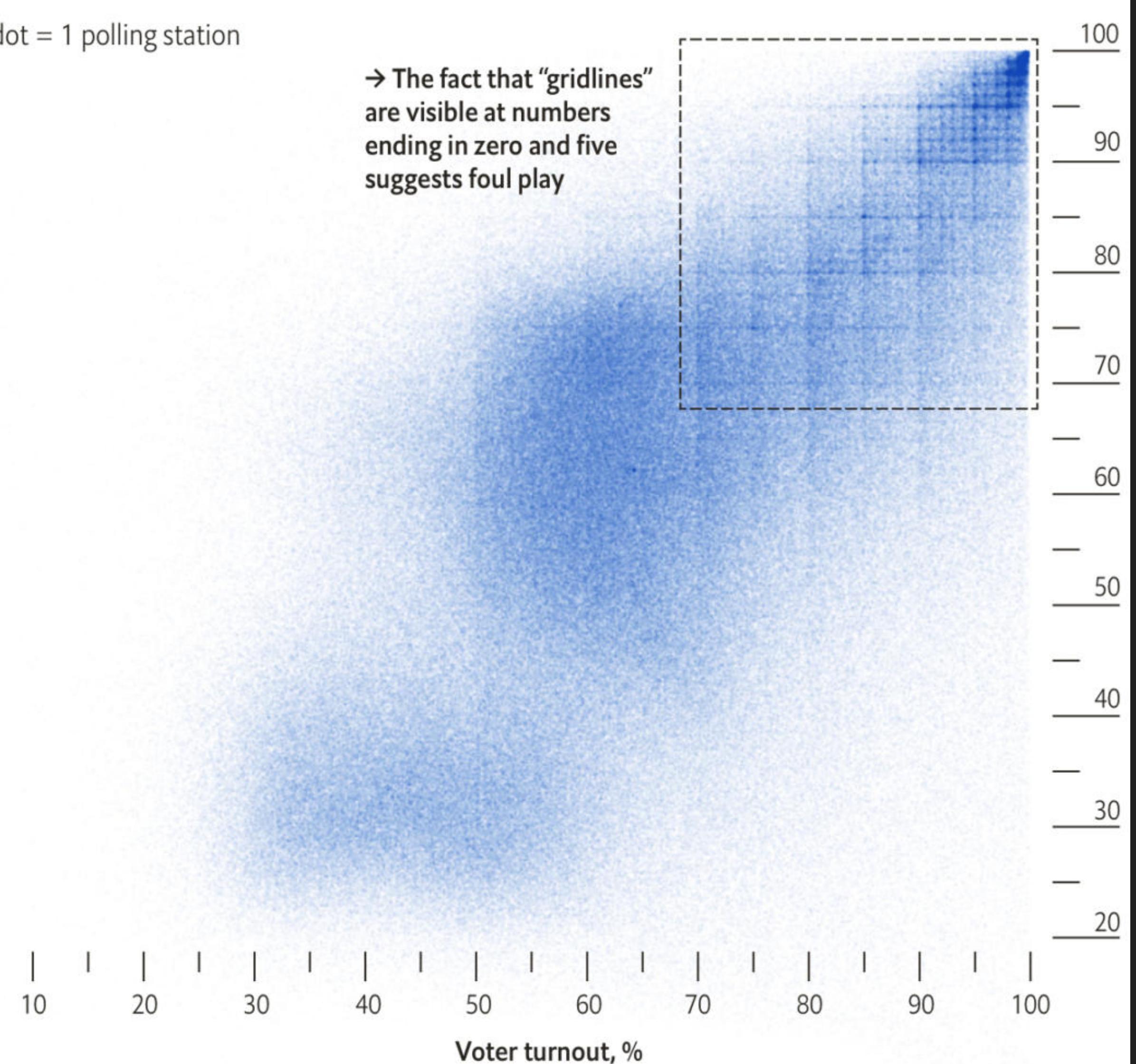
“When Dmitry Kobak and Sergey Shpilkin [...] analysed the results, they found that **an unusually high number of turnout and vote-share results were multiples of five** (eg, 50%, 55%, 60%), a tell-tale **sign of manipulation.**”

## Fair and square?

Russian federal elections, 2000-21

● 1 dot = 1 polling station

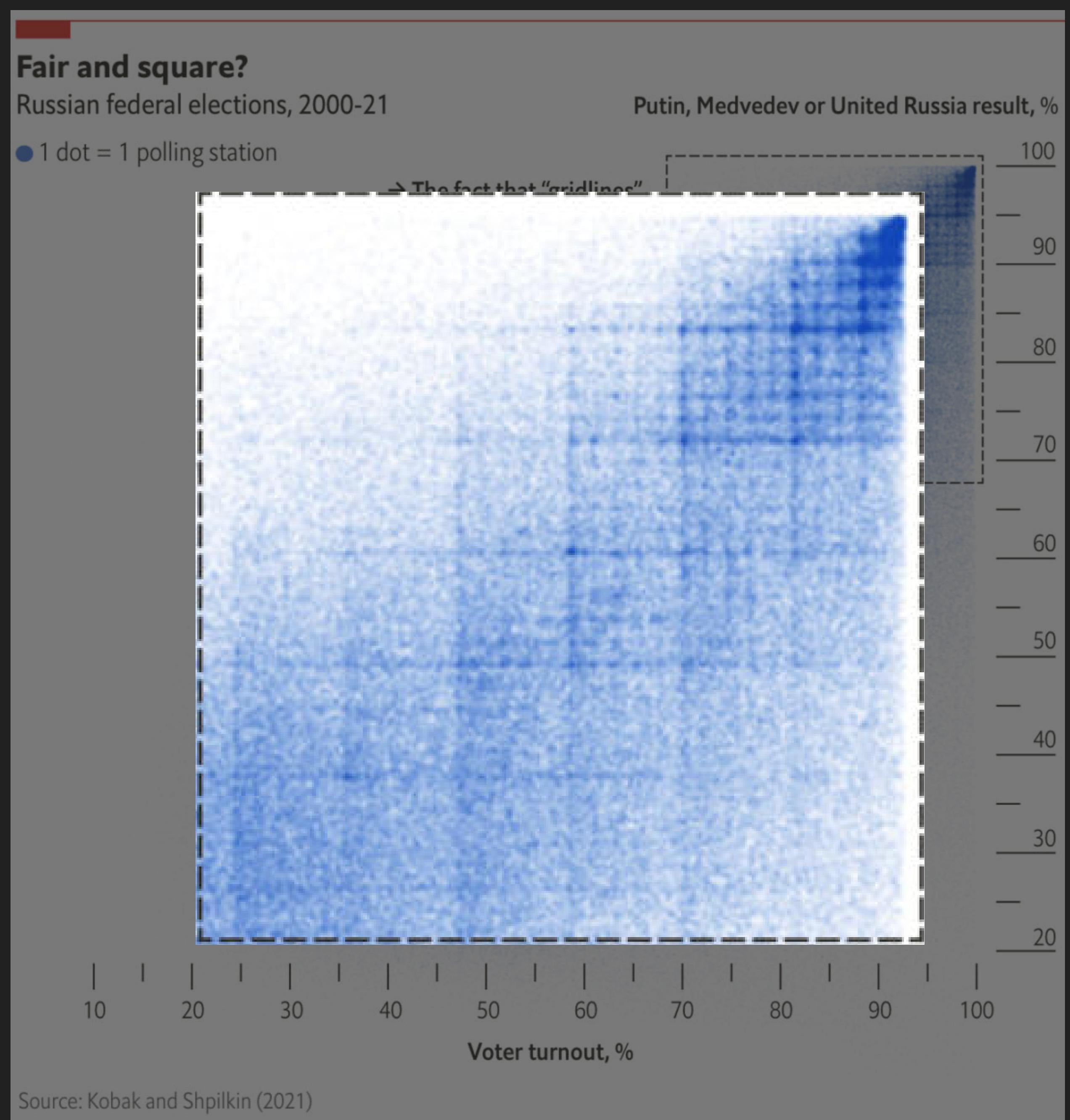
→ The fact that “gridlines” are visible at numbers ending in zero and five suggests foul play



Source: Kobak and Shpilkin (2021)

# Visualize Your Data

“When Dmitry Kobak and Sergey Shpilkin [...] analysed the results, they found that **an unusually high number of turnout and vote-share results were multiples of five** (eg, 50%, 55%, 60%), a tell-tale **sign of manipulation.**”

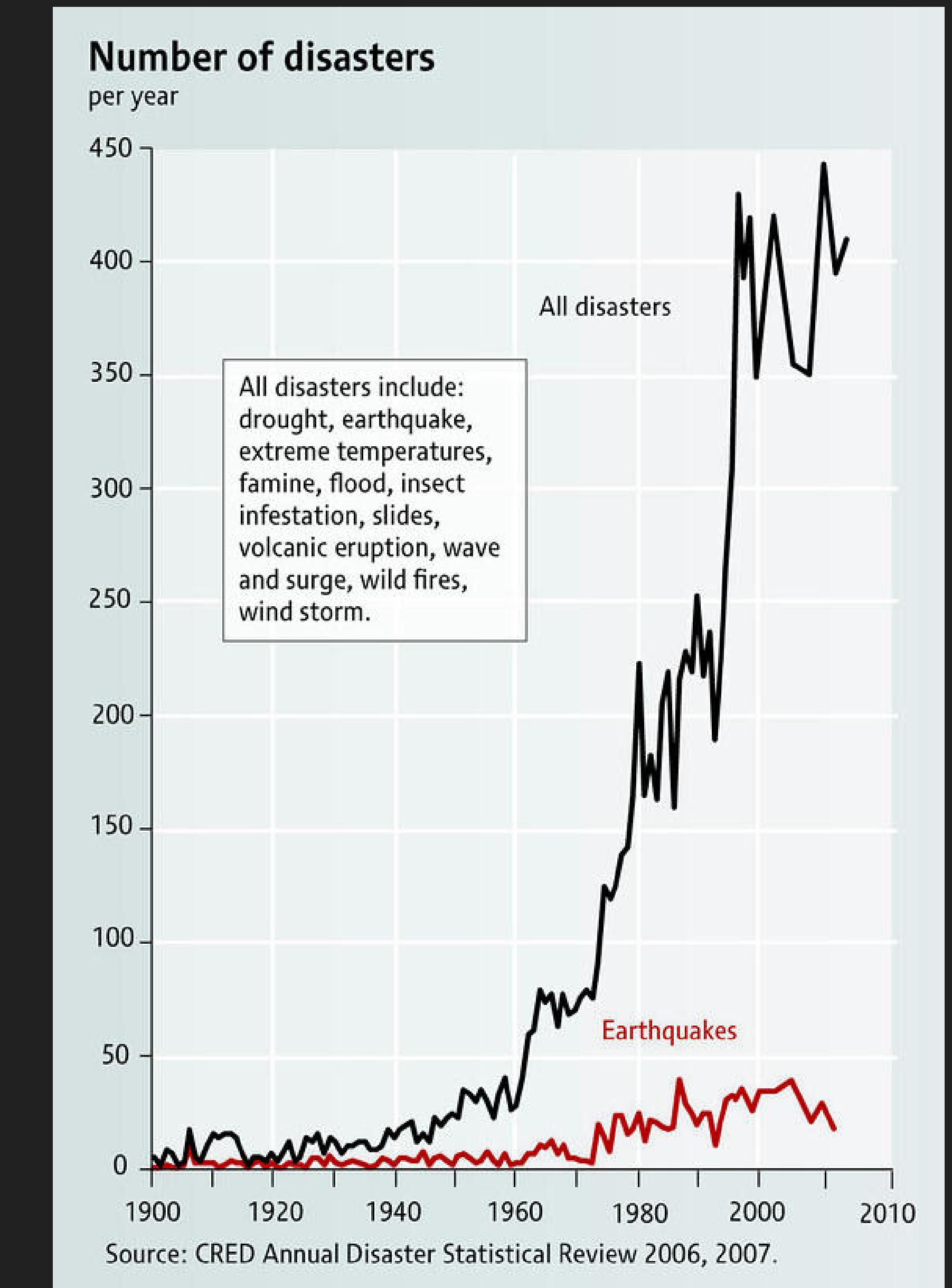


Our data is never a perfect  
reflection of the real world.



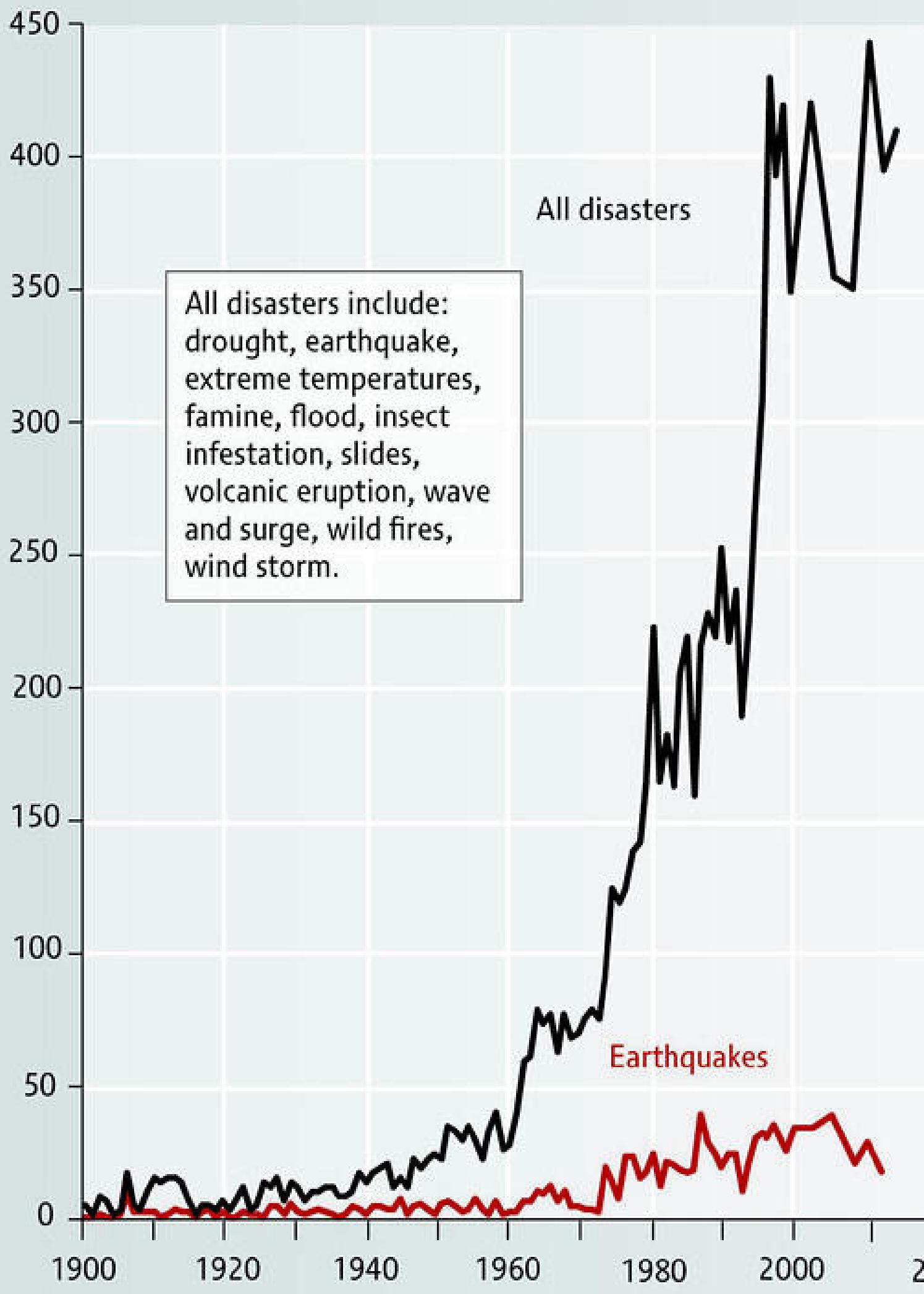
# Our data is never a perfect reflection of the real world.

- **only a subset:** not crime but reported crime
- **collected by humans:** guesstimation, precision and errors
- **collected by machines:** precisions and errors



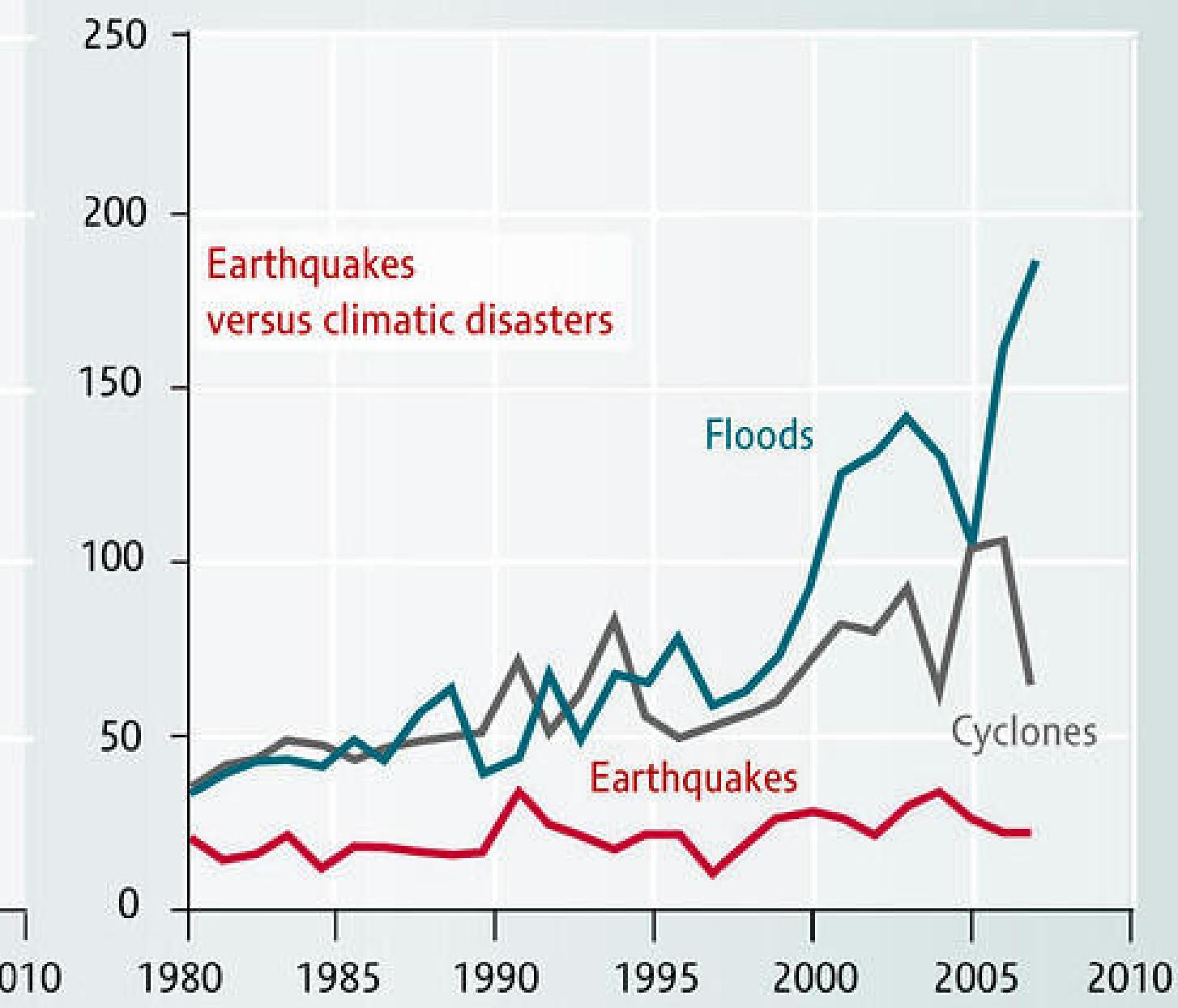
## Number of disasters

per year

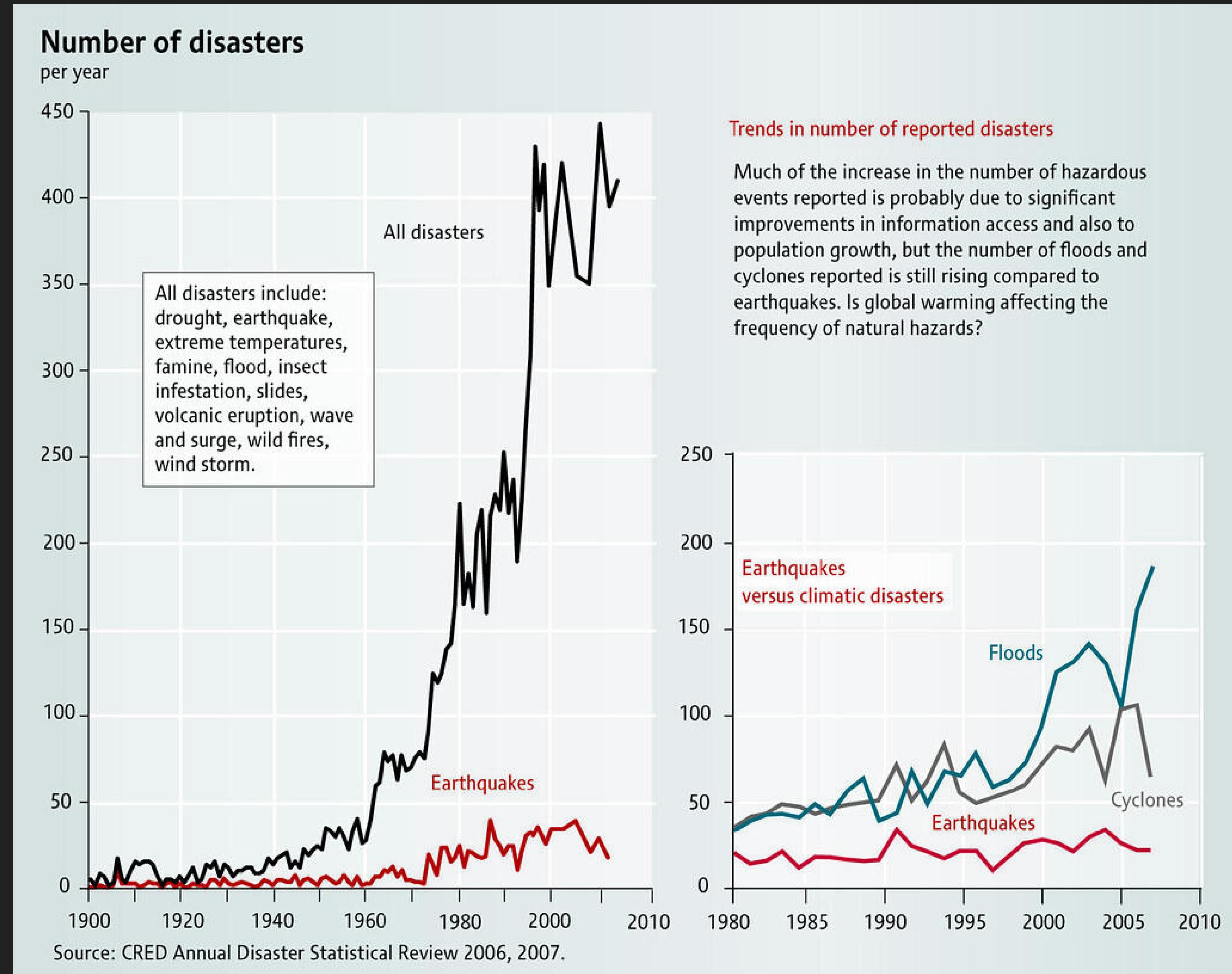


### Trends in number of reported disasters

Much of the increase in the number of hazardous events reported is probably due to significant improvements in information access and also to population growth, but the number of floods and cyclones reported is still rising compared to earthquakes. Is global warming affecting the frequency of natural hazards?



**“Much of the increase  
of hazardous events  
reported is probably  
due to significant  
improvements in  
information access”**



# STORY

---

Be clear about the message of your graphic



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# Typology of Information Graphics

by Juuso Koponen & Jonatan Hildén, "Data Visualization Handbook" (2020), p. 25

Is the **information** conceptual or measurable?

☞ **Type of information:** depict conceptual information <> convert information into visual forms



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# Typology of Information Graphics

by Juuso Koponen & Jonatan Hildén, "Data Visualization Handbook" (2020), p. 25

Is the **information** conceptual or measurable?

☞ **Type of information:** depict conceptual information <> convert information into visual forms

Is the **purpose** to explore or to explain the information?

☞ **Purpose of the graphic:** facilitate discovery <> communicate information

"Visualizations can be designed and experienced in various ways, by people of various backgrounds, and in various circumstances. That's why **reflecting on the purpose of a visualization is paramount before we design it—or before we critique it.**"

*Alberto Cairo*

*Excerpt from the foreword to "Data Sketches" by Nadieh Bremer & Shirley Wu (CRC Press 2021)*



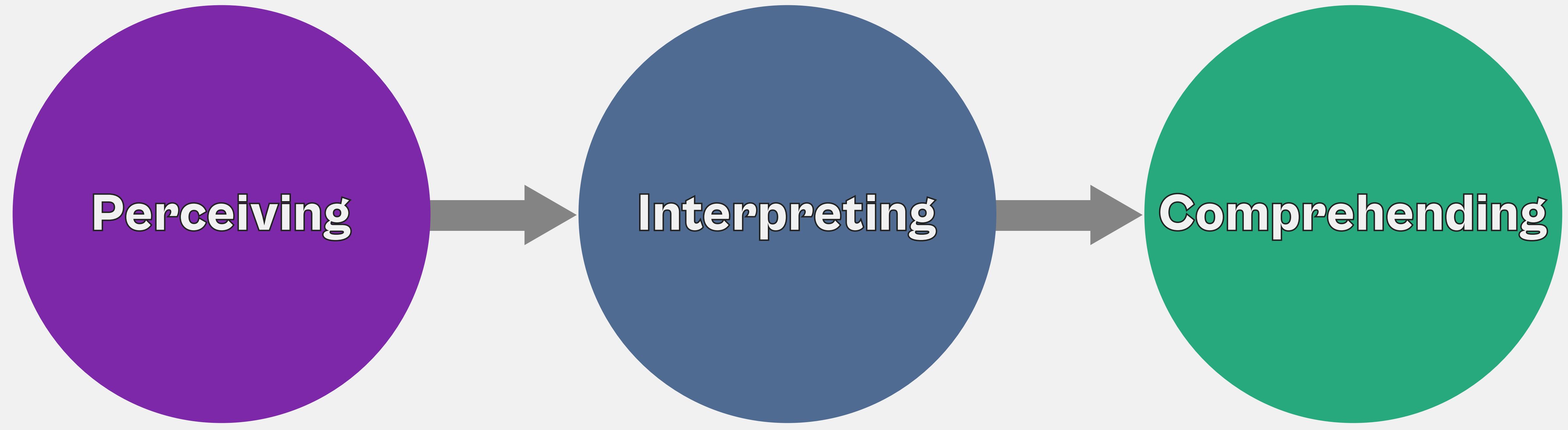
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Visualiser Control

Viewer Control

*Scheme by Andy Kirk*



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# Who is my audience?



Which story is **interesting** for them?



# Who is my audience?

- 🤩 Which story is **interesting** for them?
- 🤔 Which variables are **meaningful** to them?

# Who is my audience?

- 🤩 Which story is **interesting** for them?
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- 🤓 What are **relevant** details to include?

# Who is my audience?

- 🤩 Which story is **interesting** for them?
- 🤔 Which variables are **meaningful** to them?
- 🤓 What are **relevant** details to include?
- 👀 How will they **encounter** the visualization?

# Who is my audience?

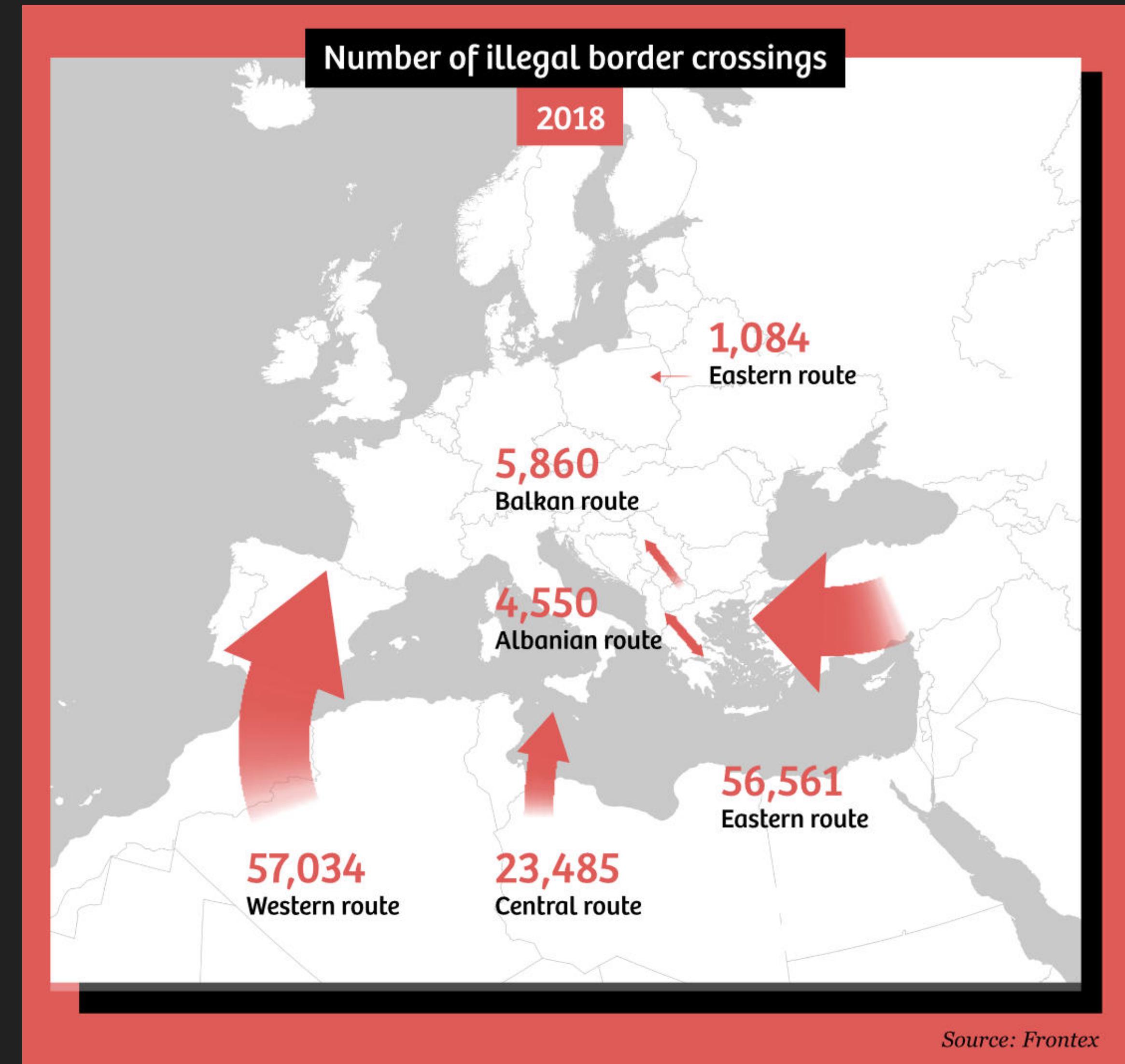
- 🤩 Which story is **interesting** for them?
- 🤔 Which variables are **meaningful** to them?
- 🤓 What are **relevant** details to include?
- 🔍 How will they **encounter** the visualization?
- 😢 **Do I need a visualization at all?**

# GOAL

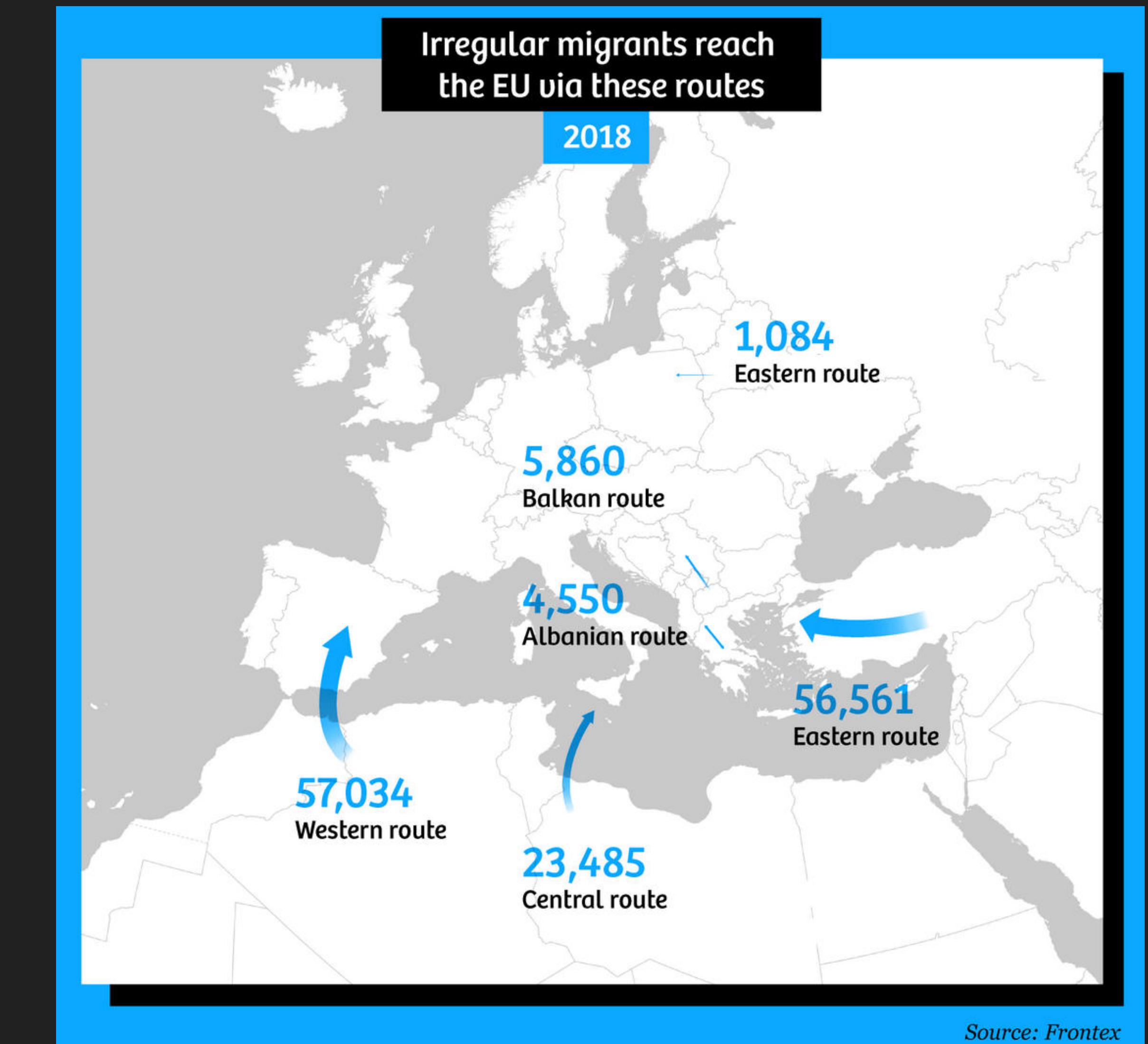
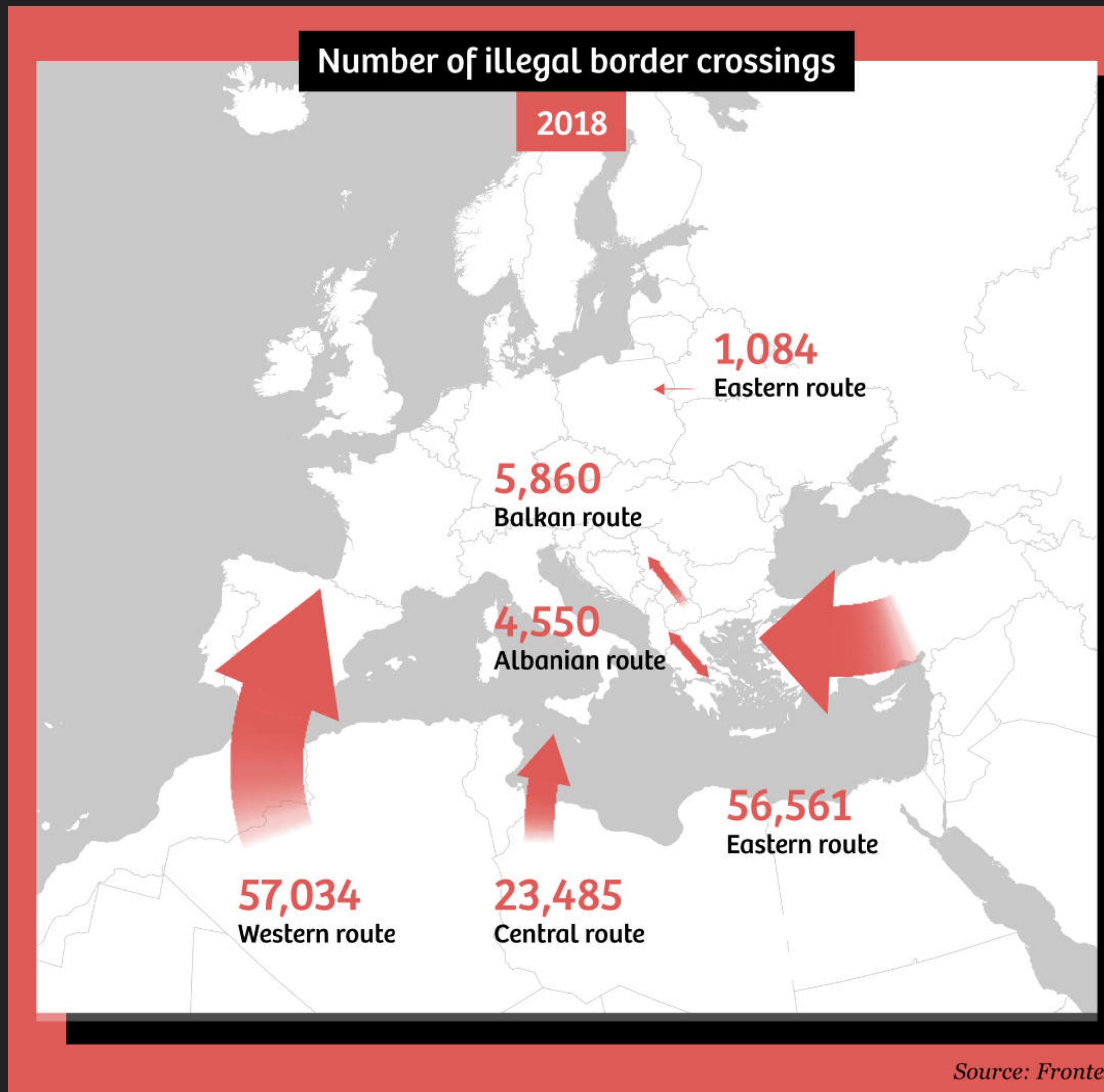
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Select charts that successfully tell your story

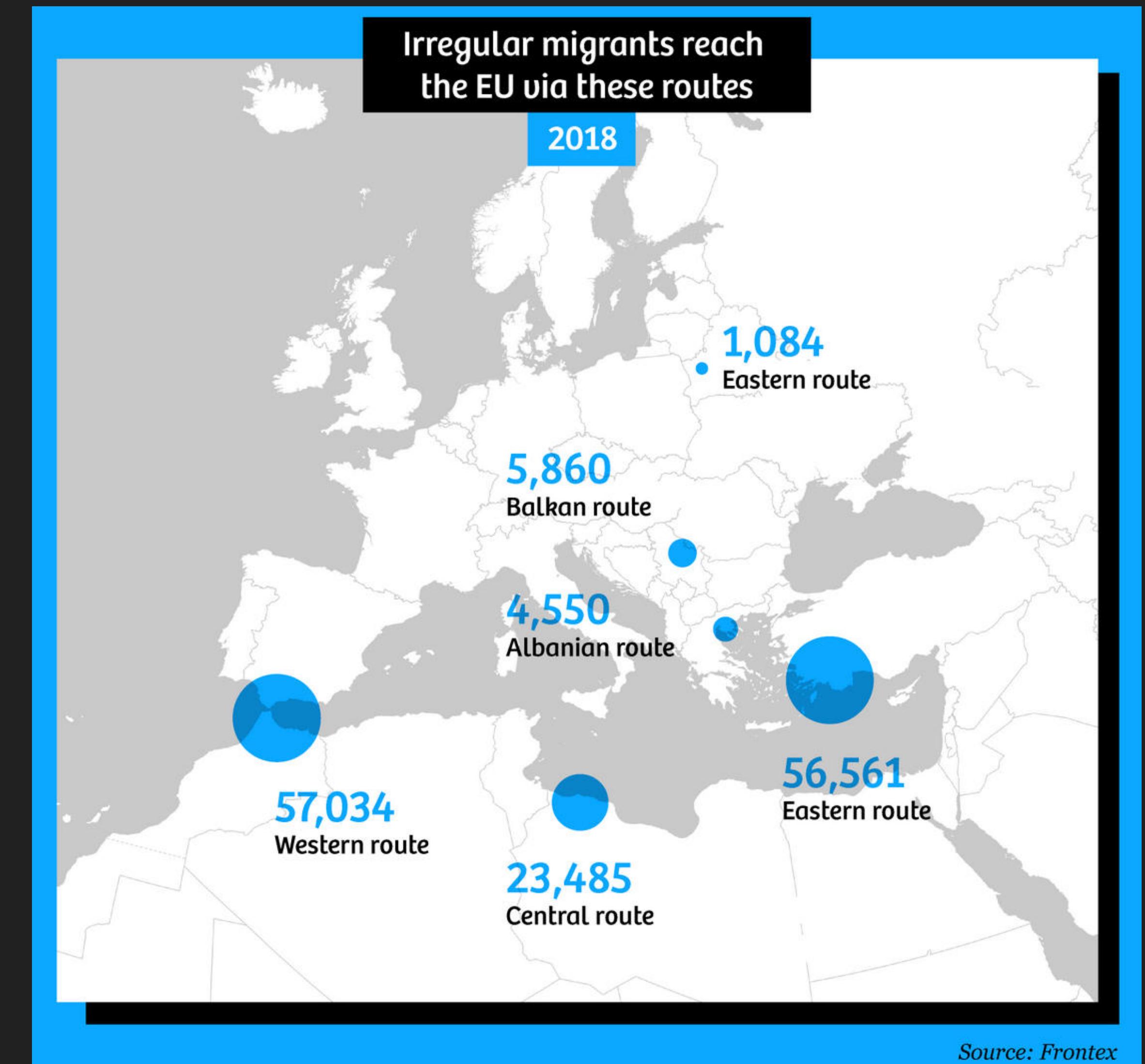




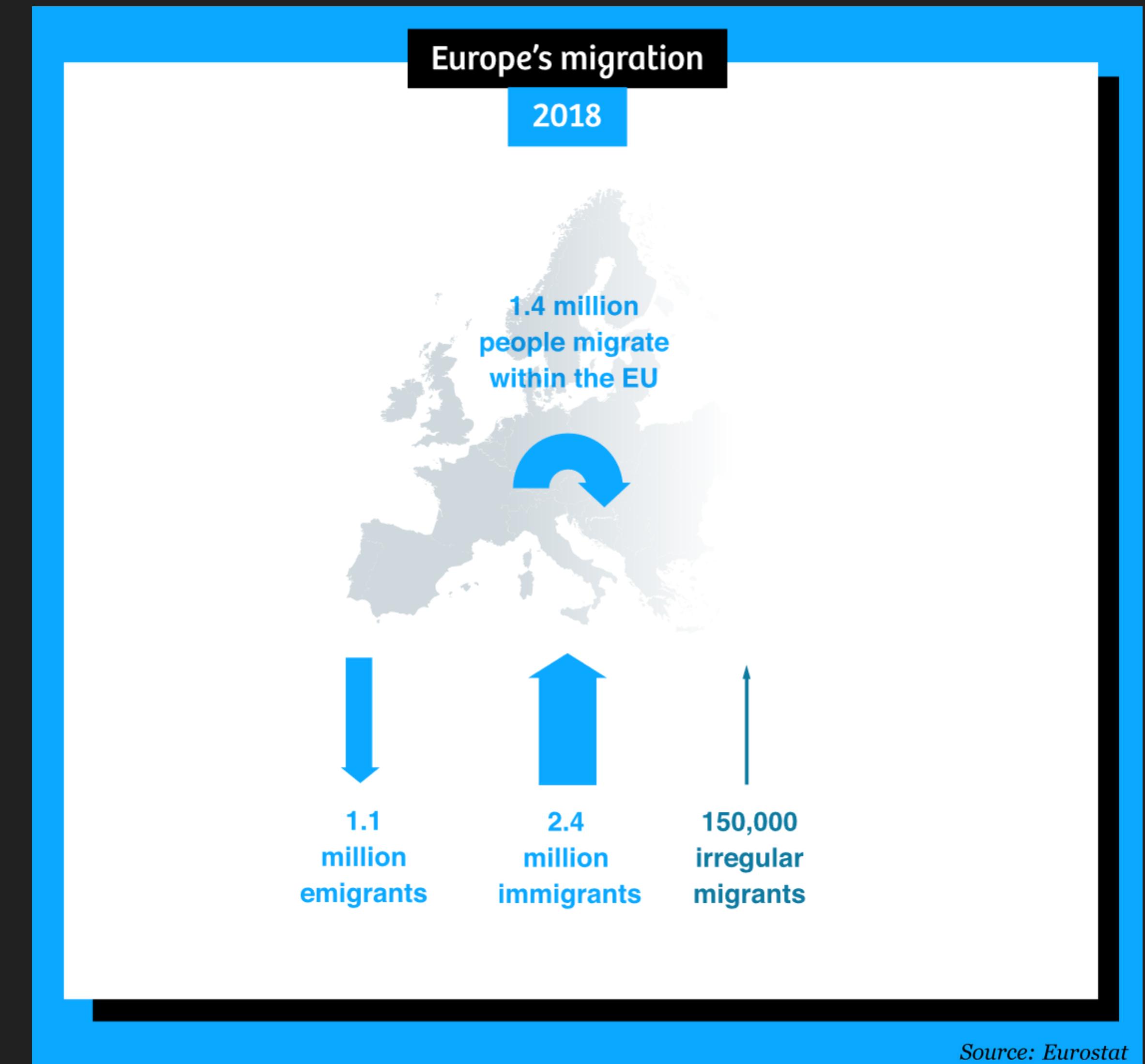
[“How maps in the media make us more negative about migrants” by Maite Vermeulen, Leon de Korte & Henk van Houtum](#)



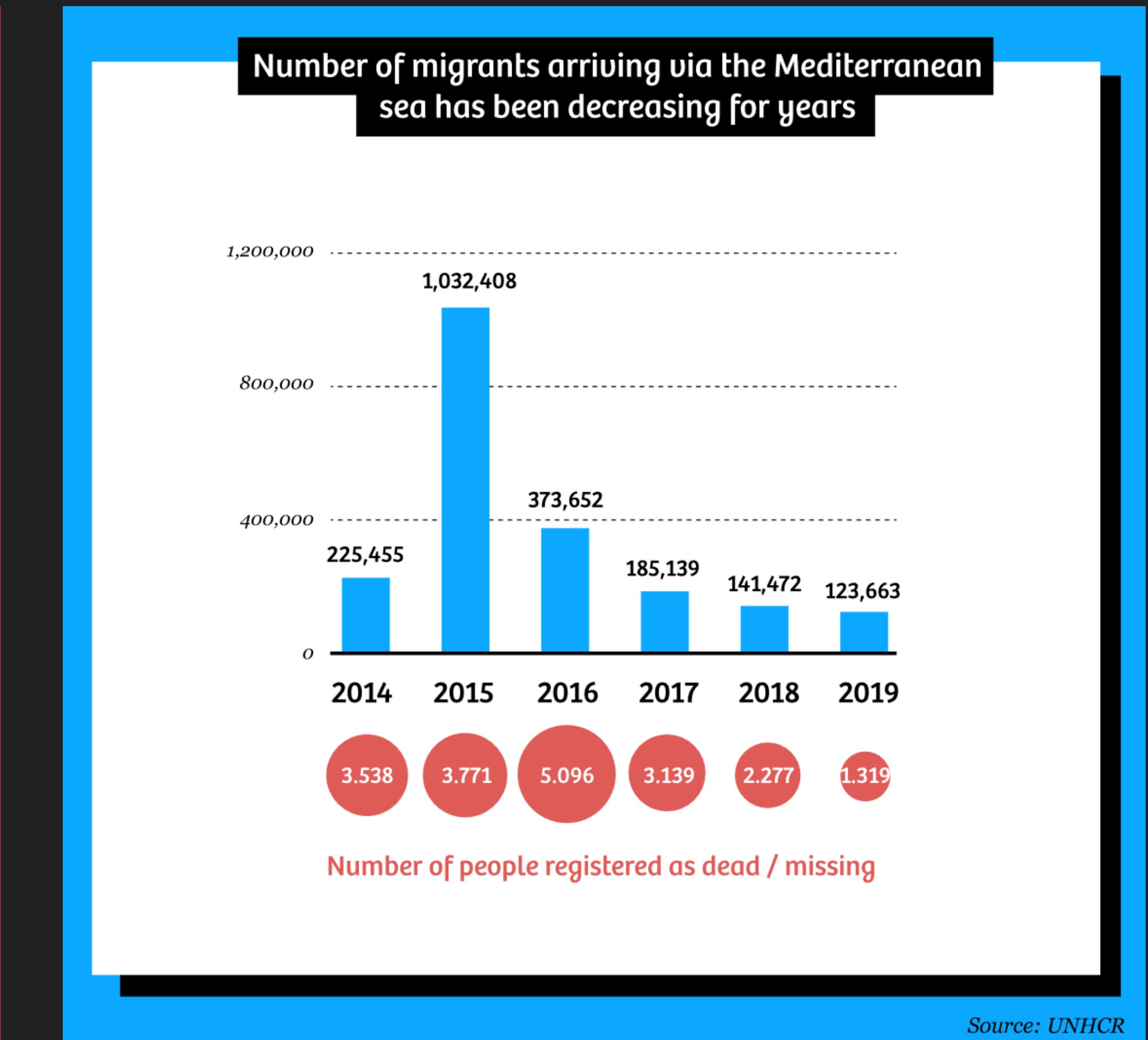
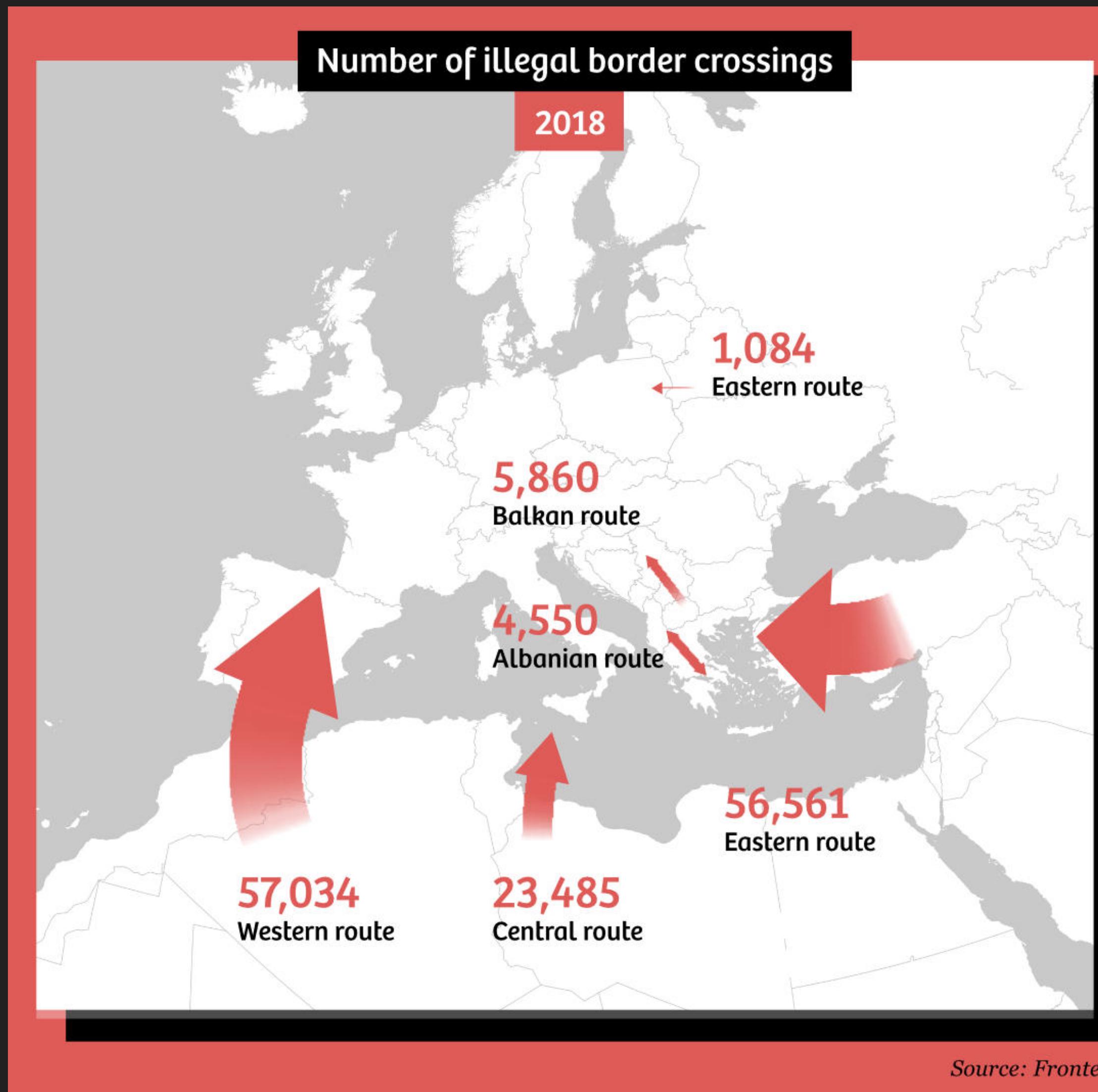
*“How maps in the media make us more negative about migrants” by Maite Vermeulen, Leon de Korte & Henk van Houtum*



*“How maps in the media make us more negative about migrants” by Maite Vermeulen, Leon de Korte & Henk van Houtum*

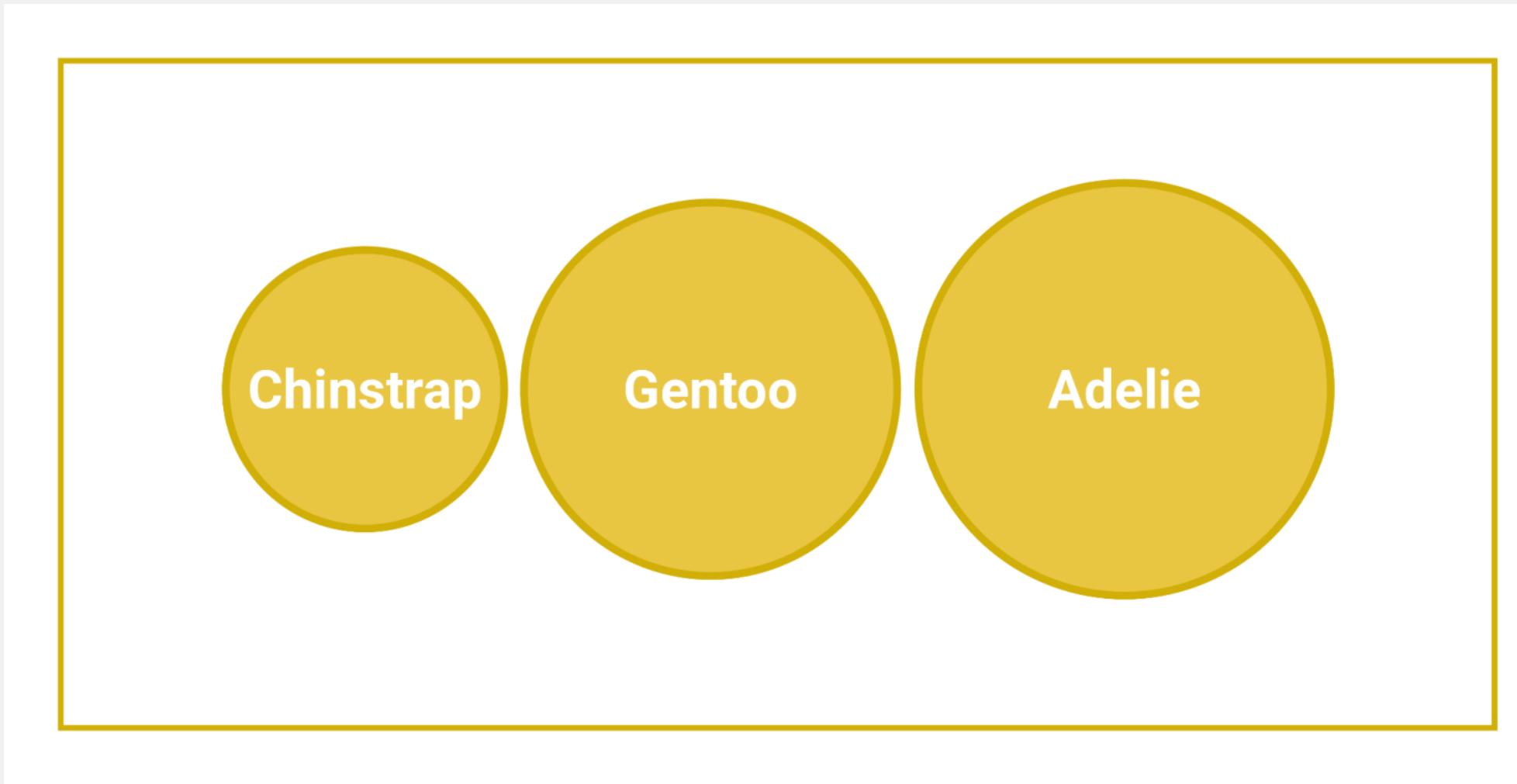


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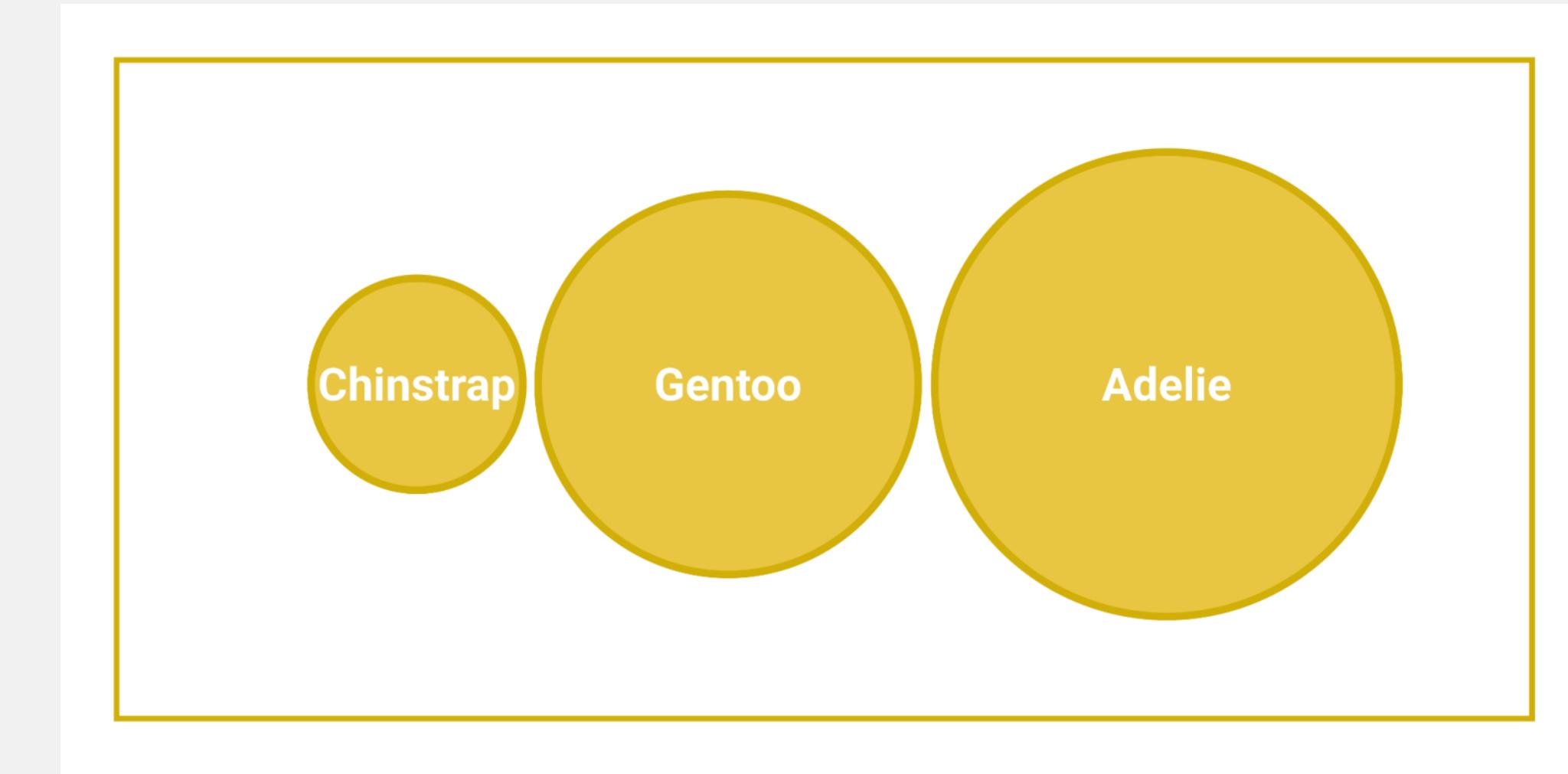


*“How maps in the media make us more negative about migrants” by Maite Vermeulen, Leon de Korte & Henk van Houtum*

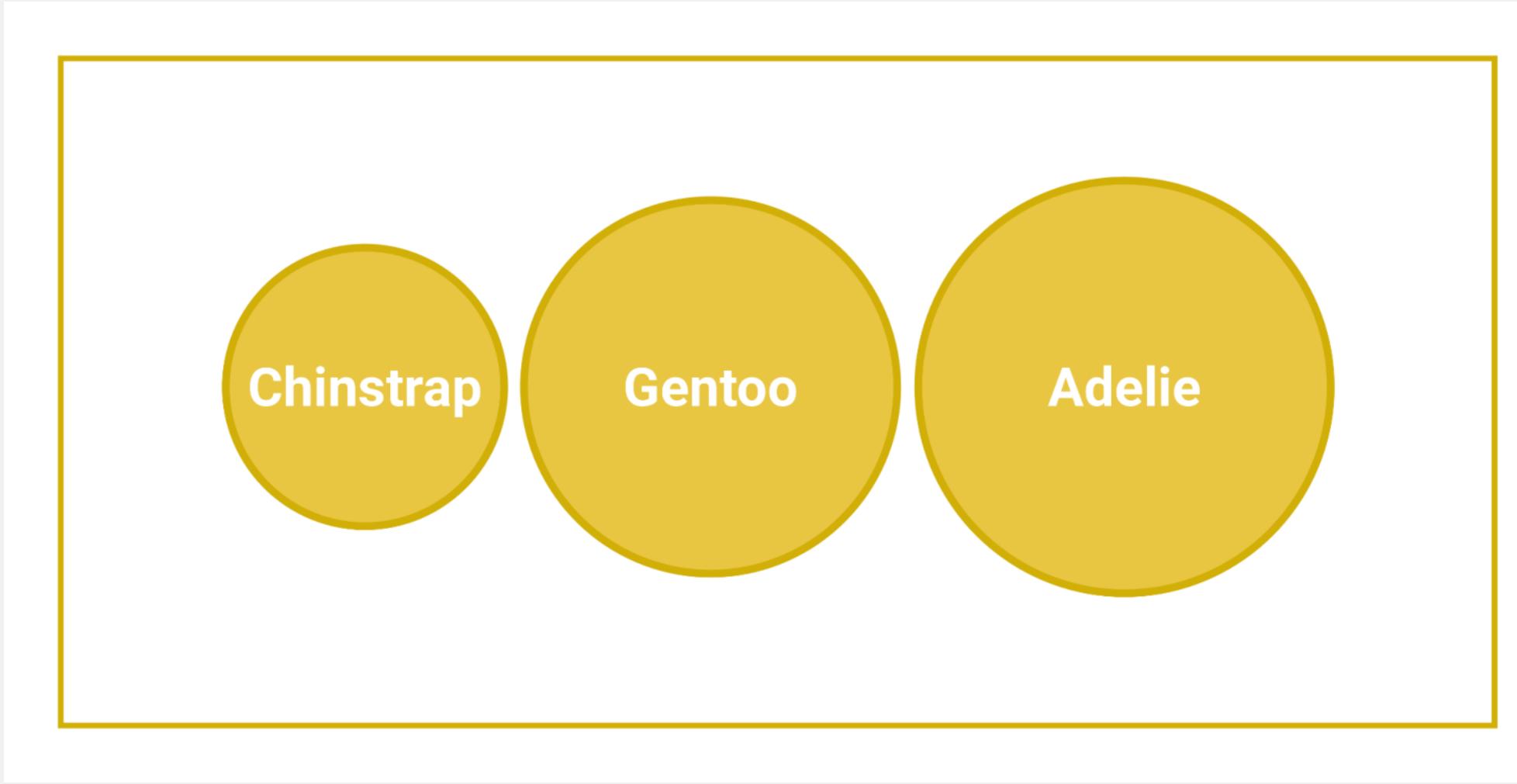
# Use area.



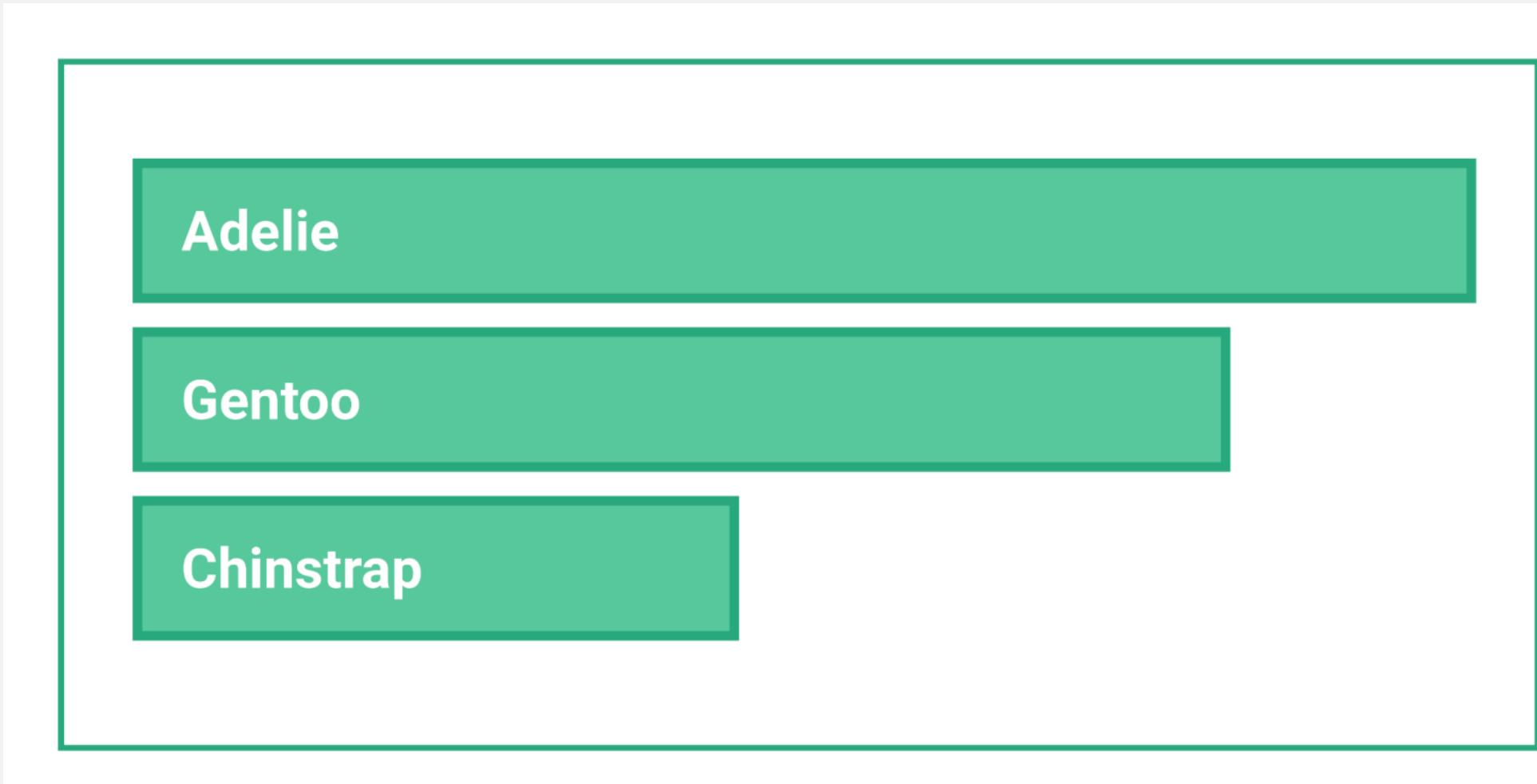
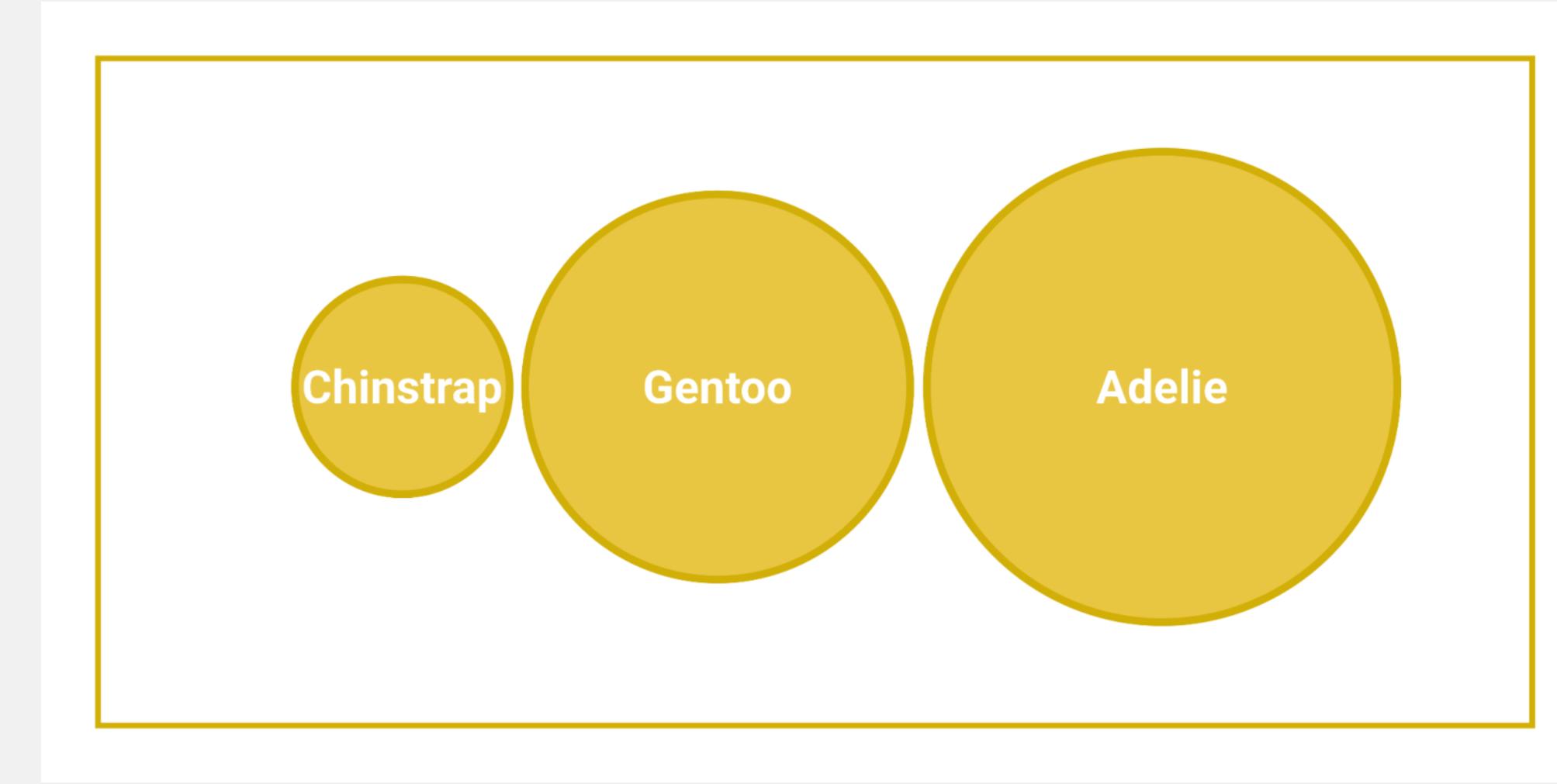
# Not radius!



# Use area.

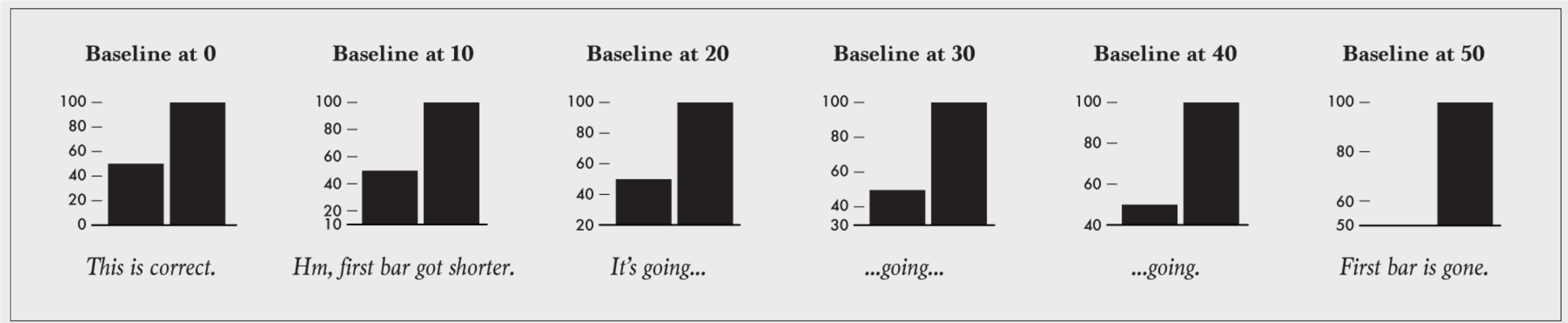


# Not radius!



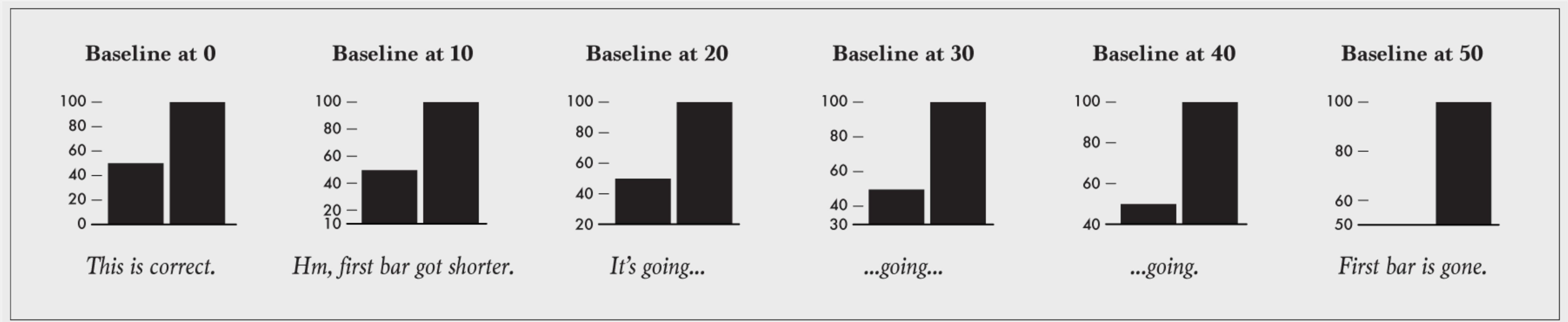
# or: bars!

# Bar Graphs Should Start at Zero



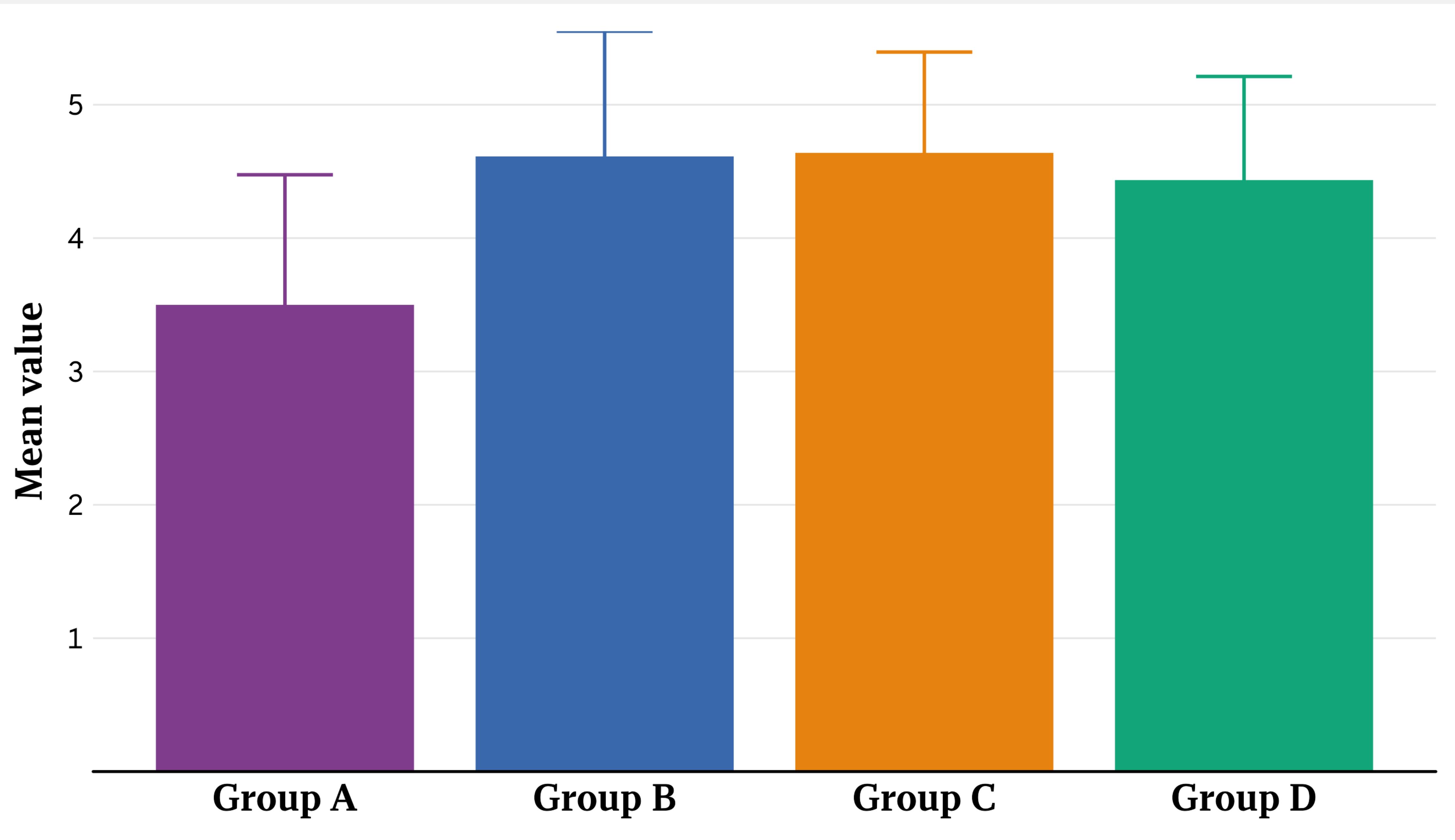
Source: Nathan Yau ([flowingdata.com](http://flowingdata.com))

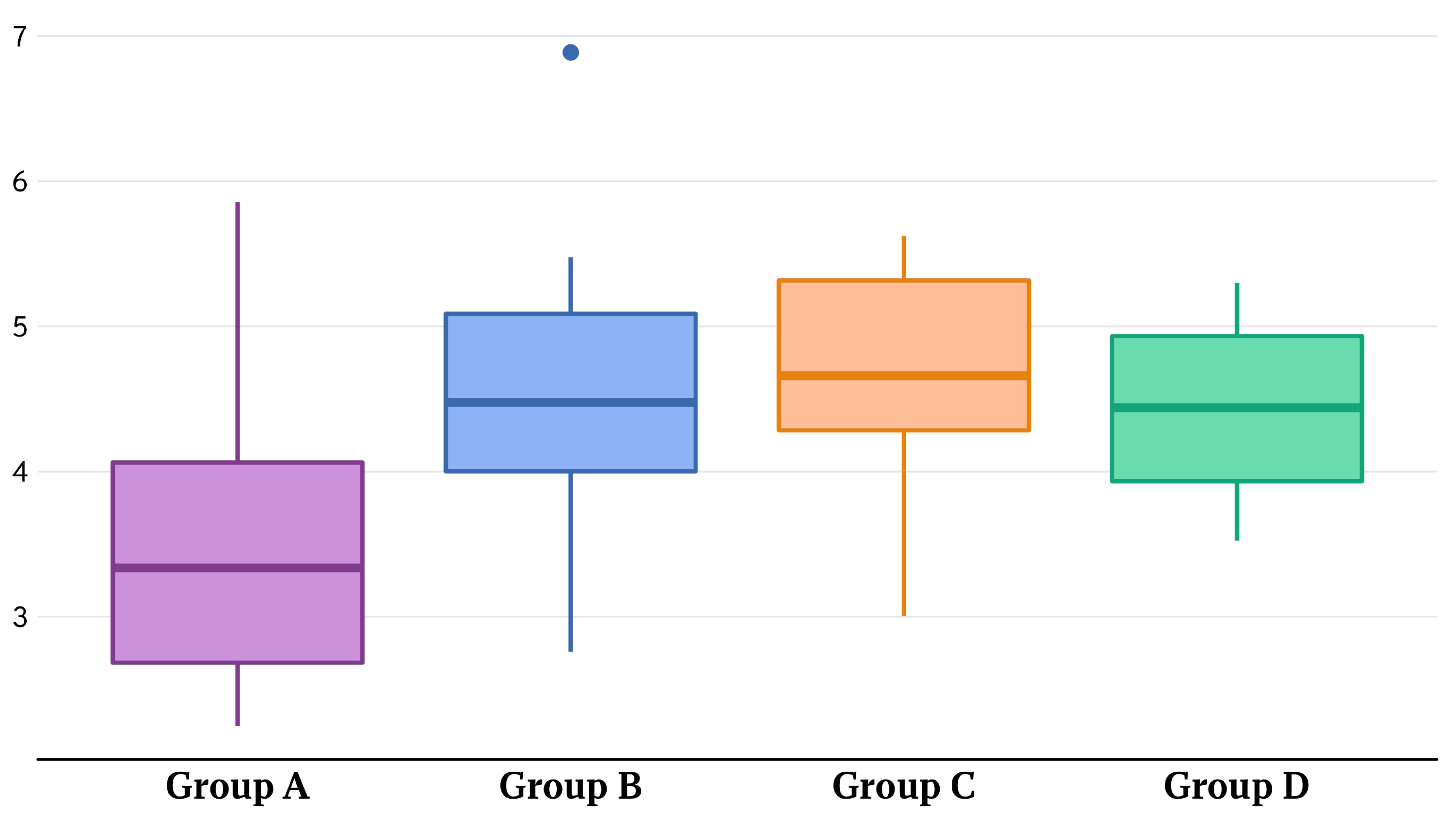
# Bar Graphs Should Start at Zero

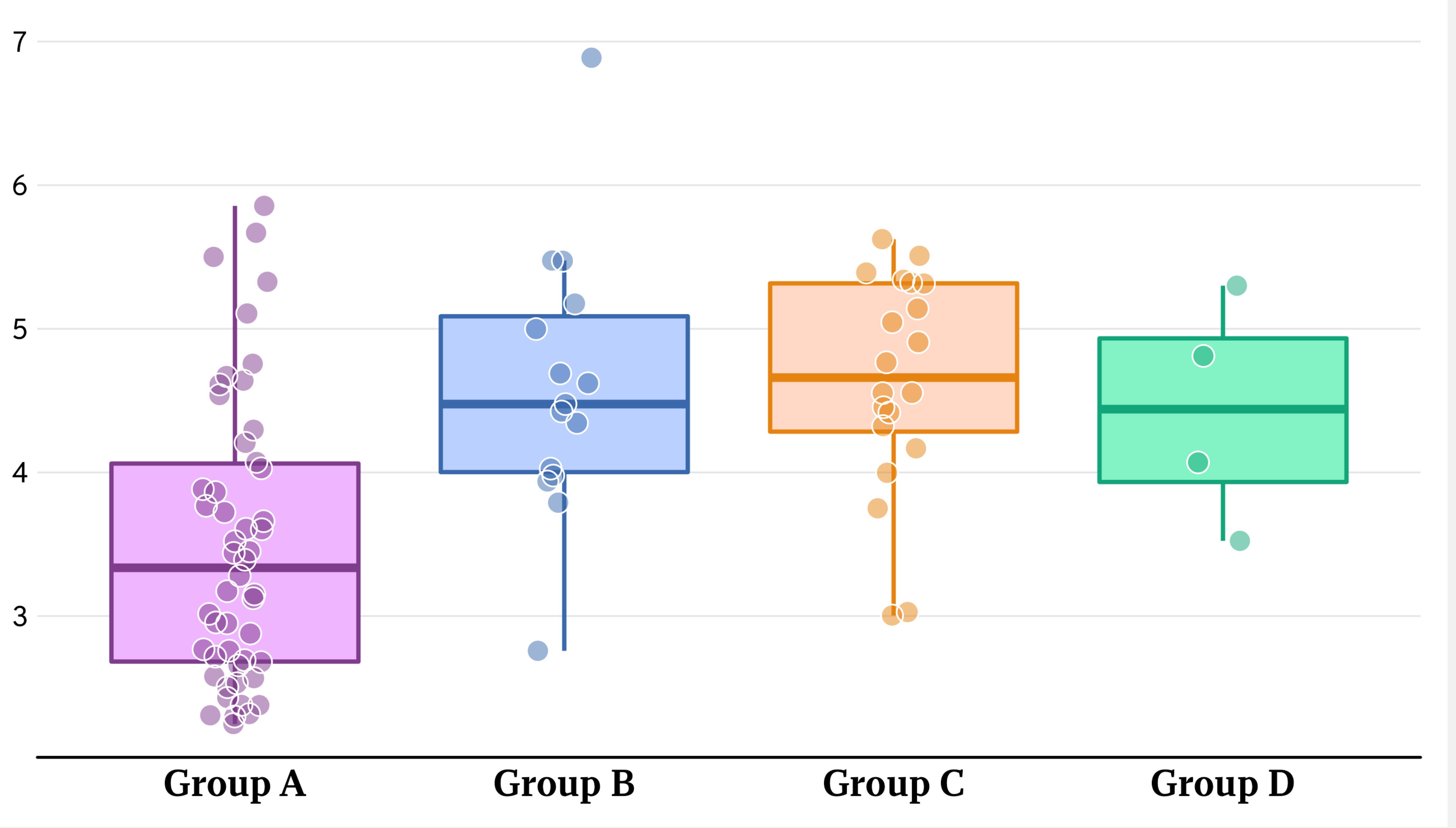


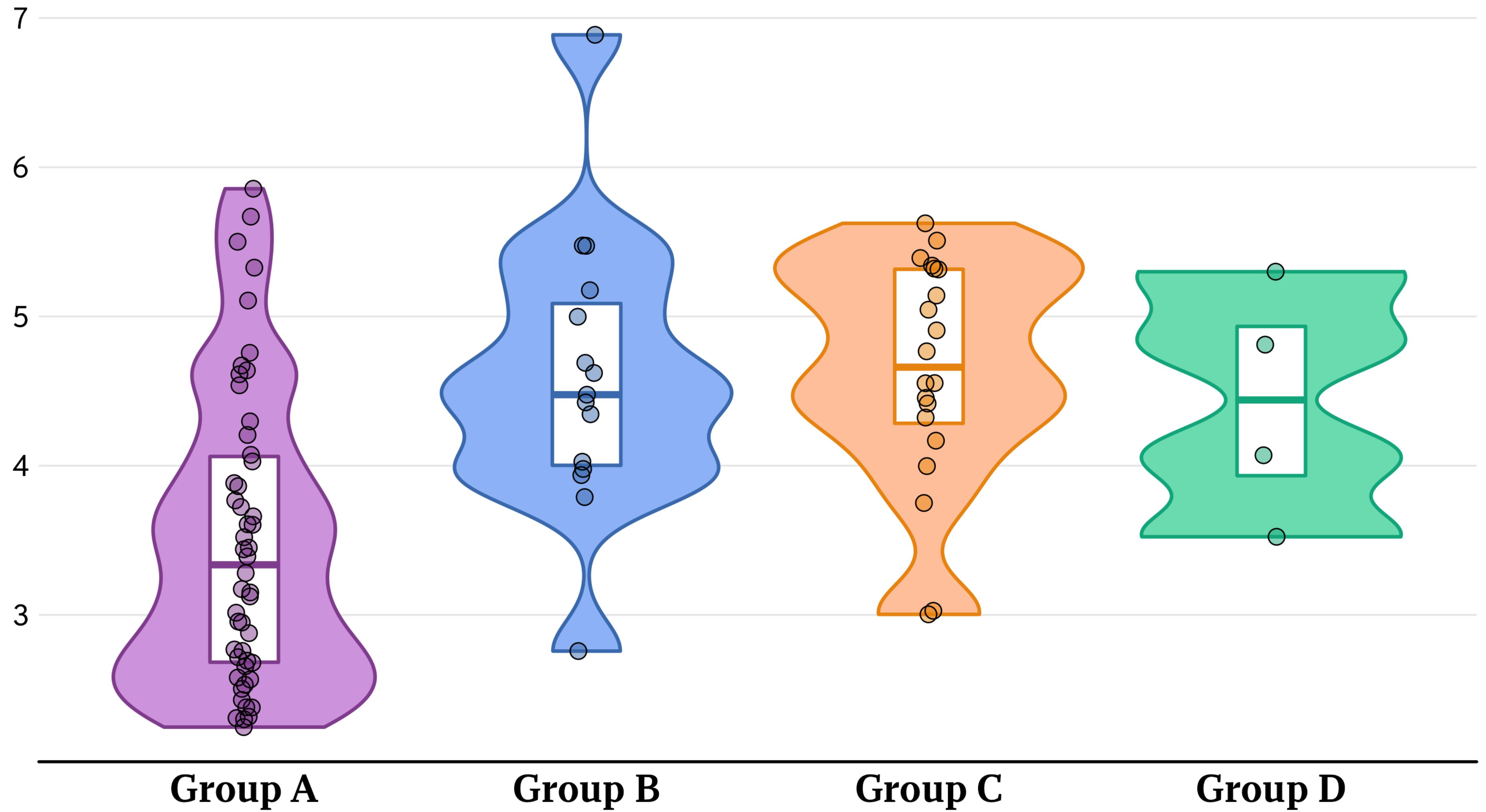
Source: Nathan Yau ([flowingdata.com](http://flowingdata.com))









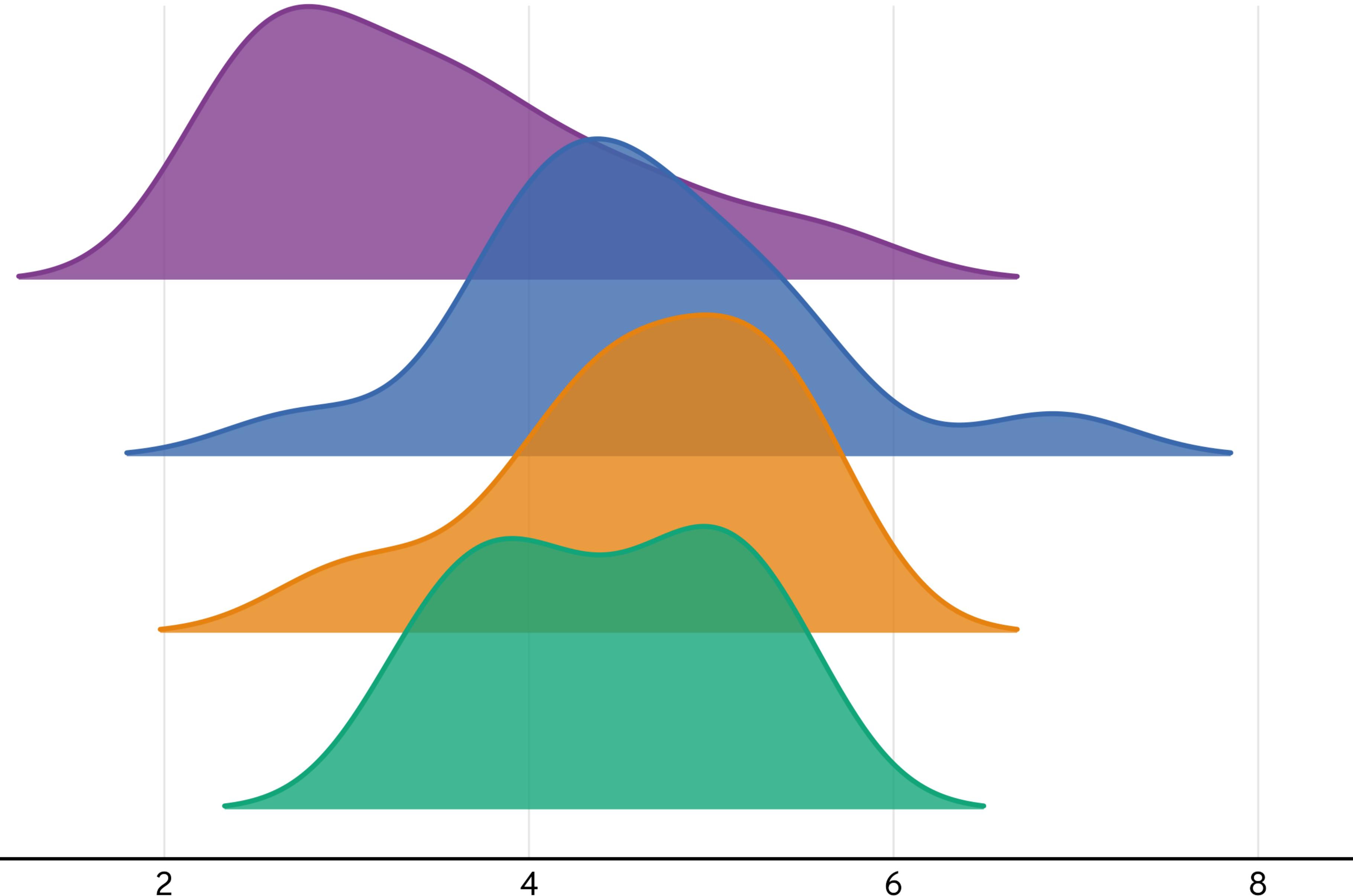


**Group A**

**Group B**

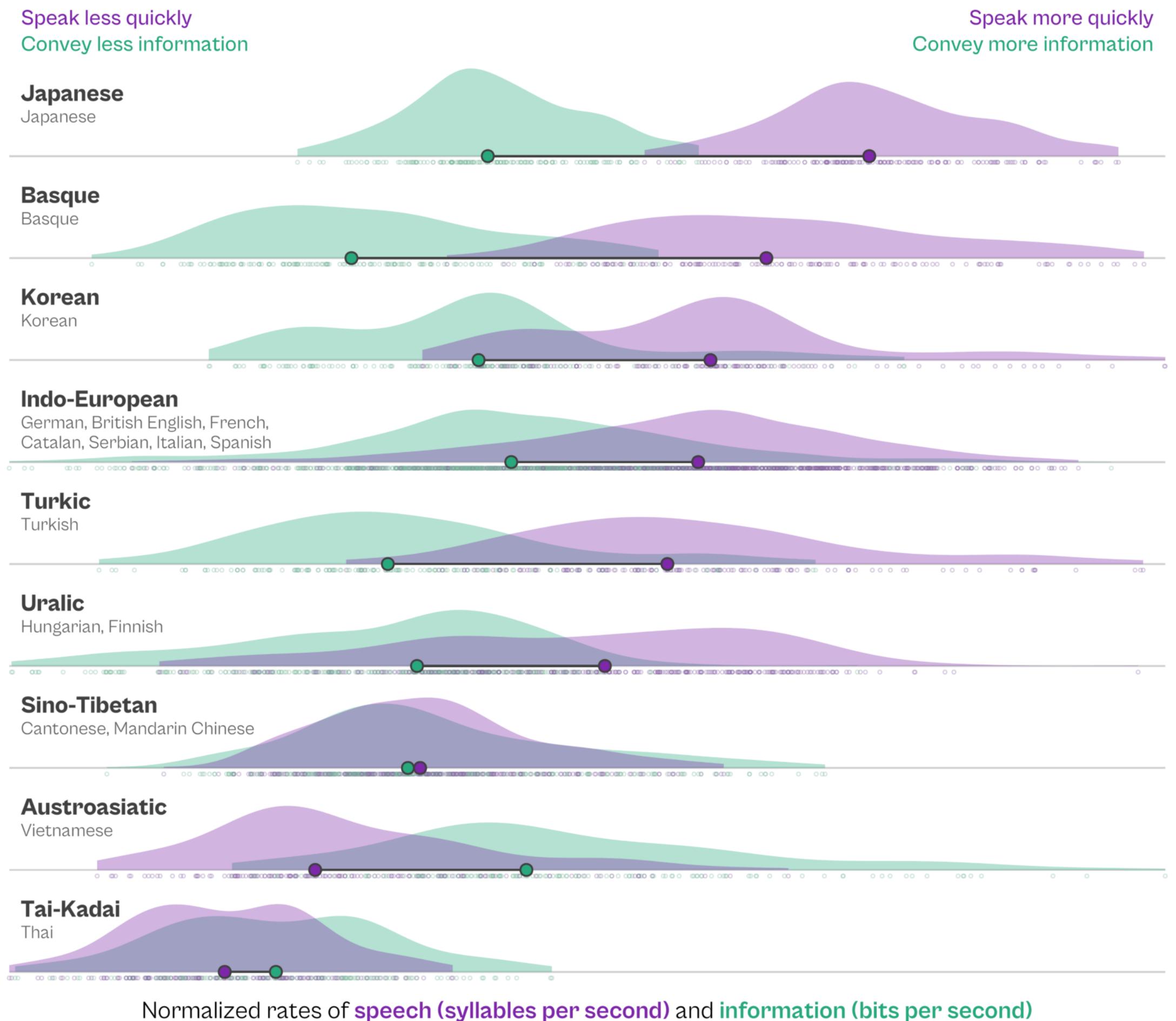
**Group C**

**Group D**



## Communicating fast doesn't necessarily mean communicating more

Variation in speech and information rates across language families, shown as normalized rates for comparison. While there are stark cross-linguistic differences in speech rates, information rates are more similar.



Source: Coupé et al. 2019 *Science Advances* 5(9). DOI: 10.1126/sciadv.aaw2594

Graphic: Cédric Scherer • Large dots show the median rates for each language family. Small dots show single estimates.

“Communicating fast doesn't necessarily mean communicating more”, #30DayChartChallenge Contribution

# Not my cup of coffee...

Each dot depicts one coffee bean rated by Coffee Quality Institute's trained reviewers. In addition, the multiple interval stripes show where 25%, 50%, 95%, and 100% of the beans fall along the rating gradient from 0 to 100 points. The rated coffee beans range from 59.8 points (Guatemala) to 89.9 (Ethiopia). Only countries of origin with 25 or more tested beans are shown. The red empty triangle marks the minimum rating, the black filled triangle indicates each country's median score.

Visualization by Cédric Scherer

60 POINTS

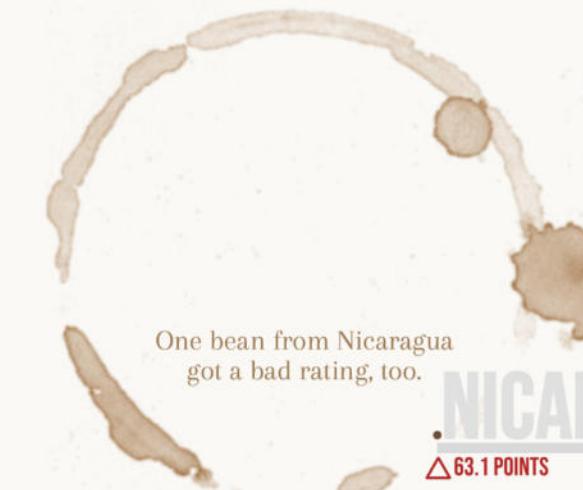
70 POINTS

80 POINTS

90 POINTS

## GUATEMALA

△ 59.8 POINTS  
The coffee bean with the lowest rating has its origin in Guatemala.



One bean from Nicaragua got a bad rating, too.

## NICARAGUA

△ 63.1 POINTS

## COSTA RICA

△ 71.8 POINTS

## HAWAII

△ 73.7 POINTS

## BRAZIL

△ 73.2 POINTS

## TANZANIA

△ 80.3 POINTS

## TAIWAN

△ 77.7 POINTS

## HONDURAS

△ 69.2 POINTS

## MEXICO

△ 68.3 POINTS

## COLOMBIA

△ 72.8 POINTS

## UGANDA

△ 80.5 POINTS

## ETHIOPIA

△ 80.3 POINTS

## KENYA

△ 79.8 POINTS

## TAIWAN

△ 81.9 POINTS

## ETHIOPIA

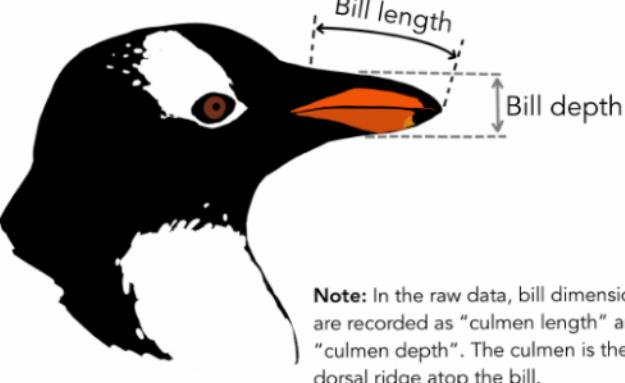
△ 85.1 POINTS

The best coffee—in terms of both median and maximum rating—is shipped to you from Ethiopia!

*“Not my cup of coffee”, #TidyTuesday Contribution*

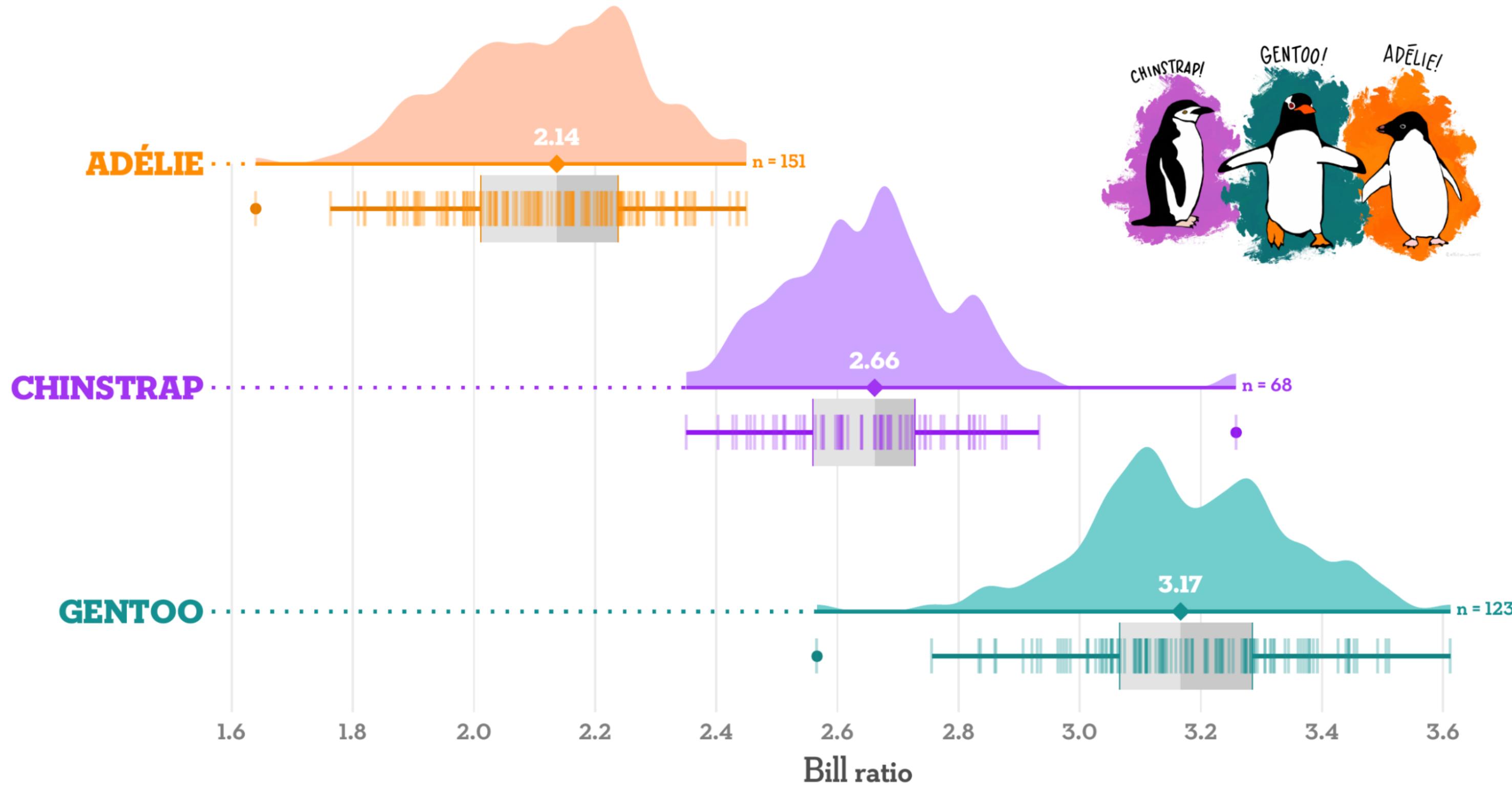
# BILL DIMENSIONS OF BRUSH-TAILED PENGUINS

*Pygoscelis adélieae* (Adélie penguin) • *P. antarctica* (Chinstrap penguin) • *P. papua* (Gentoo penguin)



Note: In the raw data, bill dimensions are recorded as "culmen length" and "culmen depth". The culmen is the dorsal ridge atop the bill.

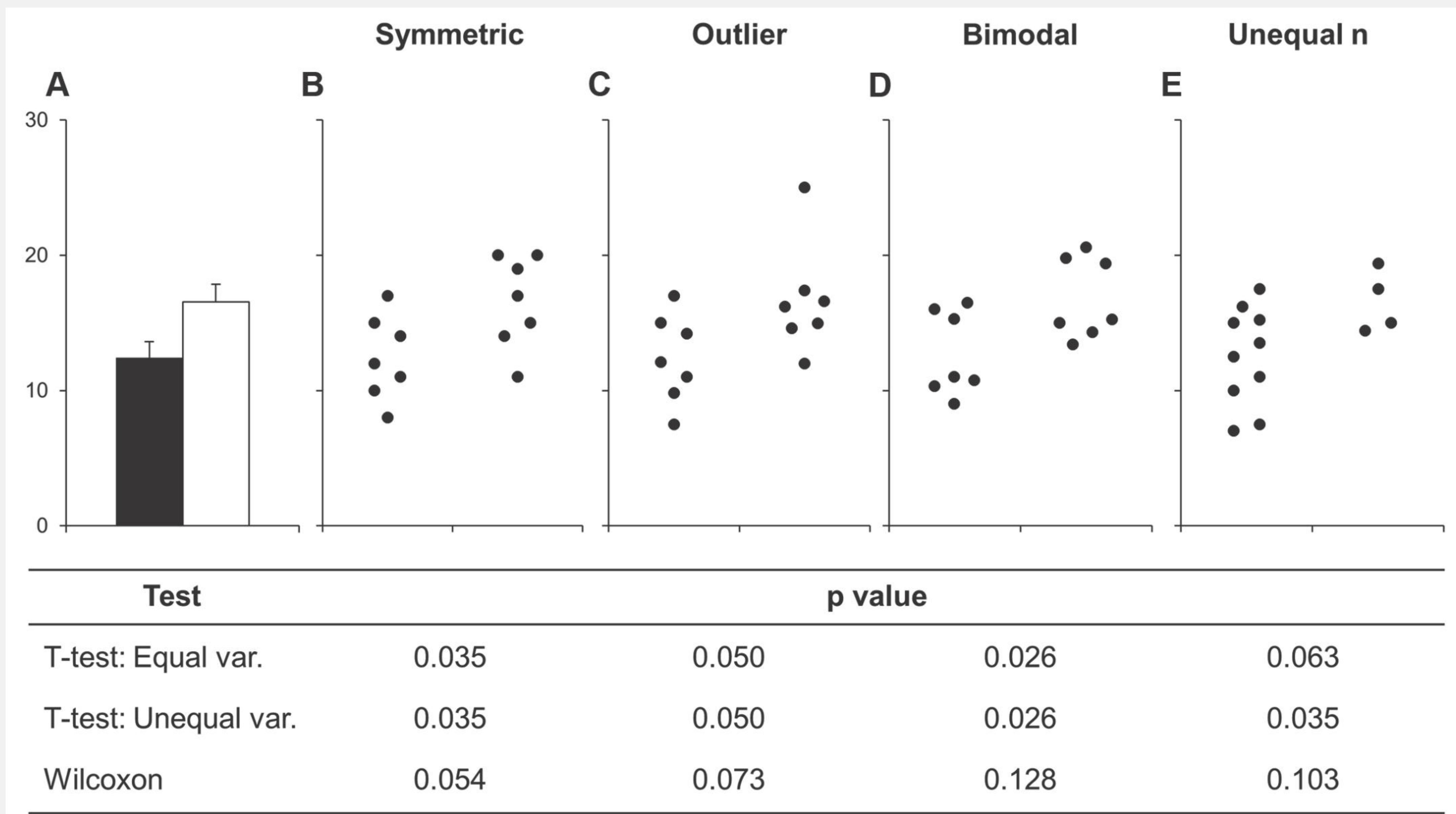
Distribution of the bill ratio, estimated as bill length divided by bill depth



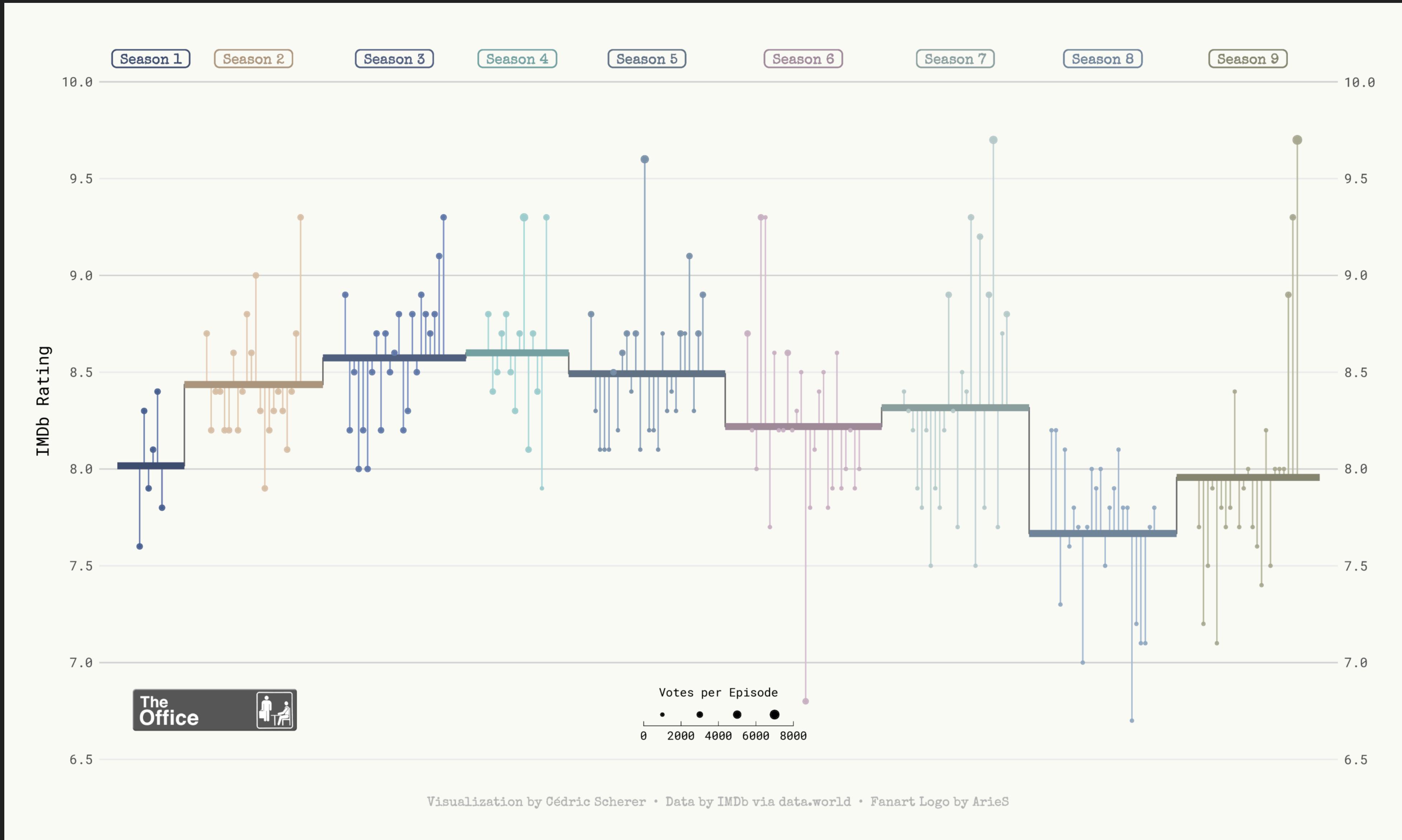
Note: In the original data, bill dimensions are recorded as "culmen length" and "culmen depth". The culmen is the dorsal (upper) ridge of a bird's bill.

Visualization: Cédric Scherer • Data: Gorman, Williams & Fraser (2014) DOI: 10.1371/journal.pone.0090081 • Illustrations: Allison Horst

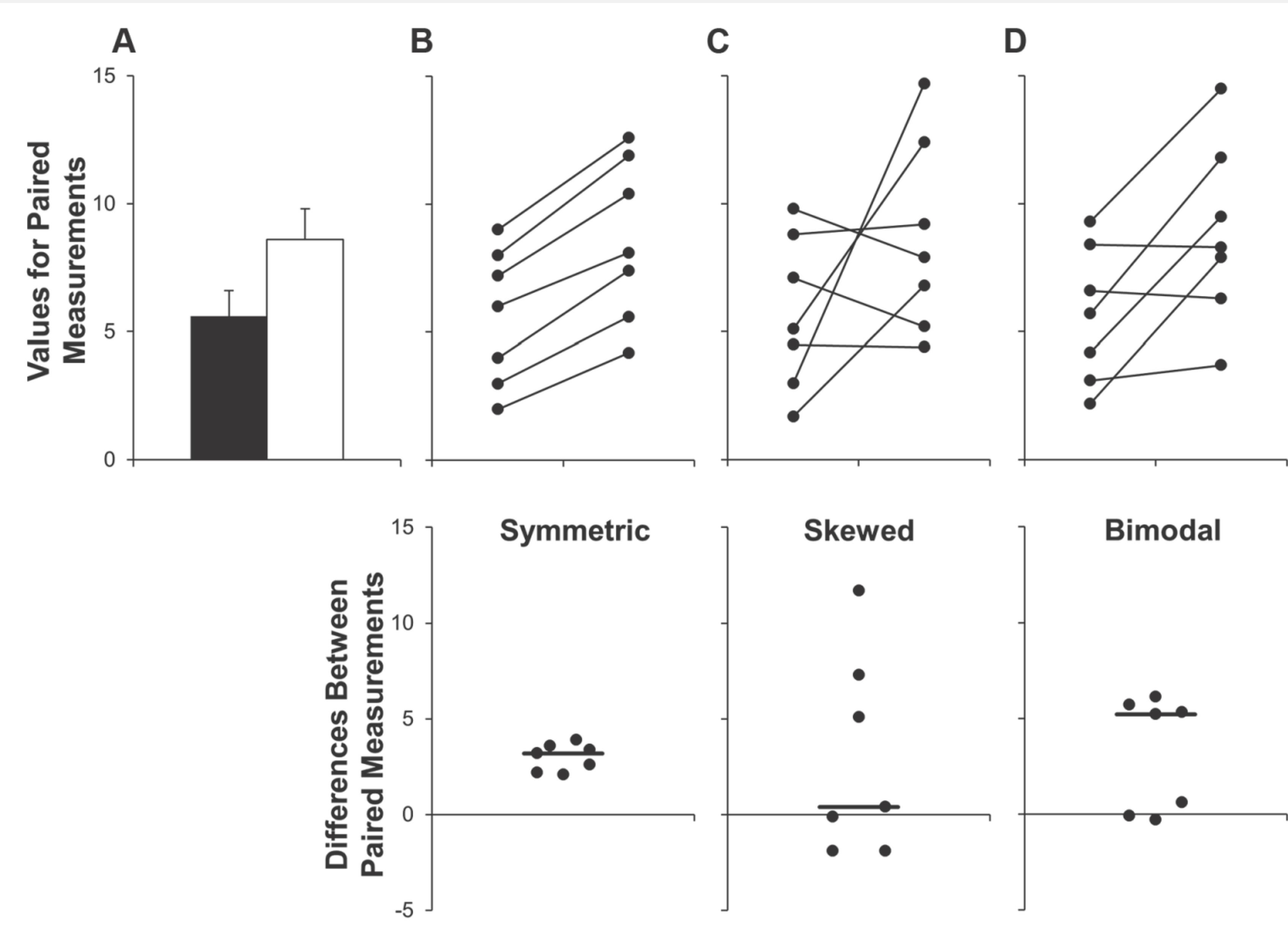
"Bill dimensions of brush-tailed penguins", part of a #TidyTuesday contribution



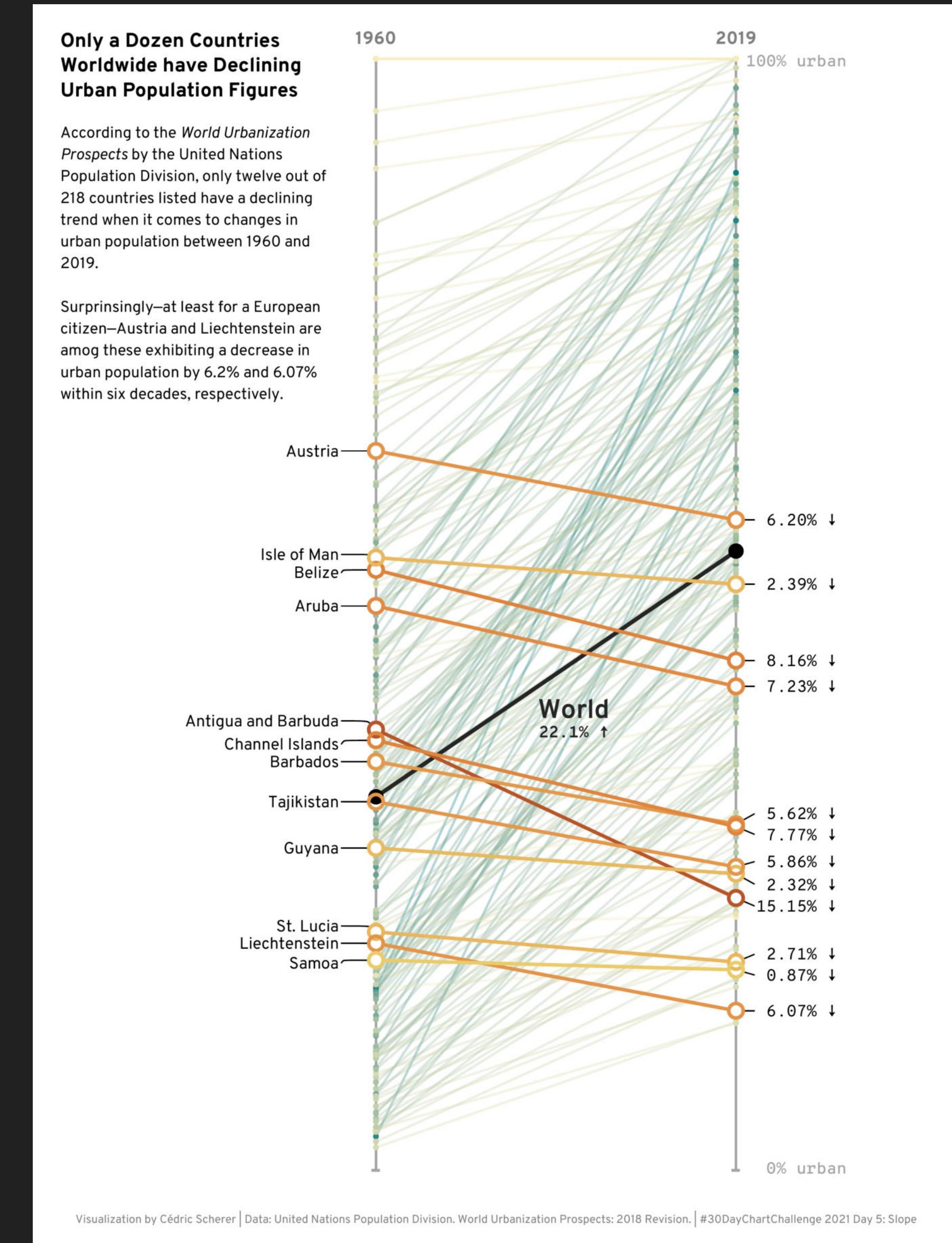
Source: Weissgerber et al. (2015) PLoS Biology



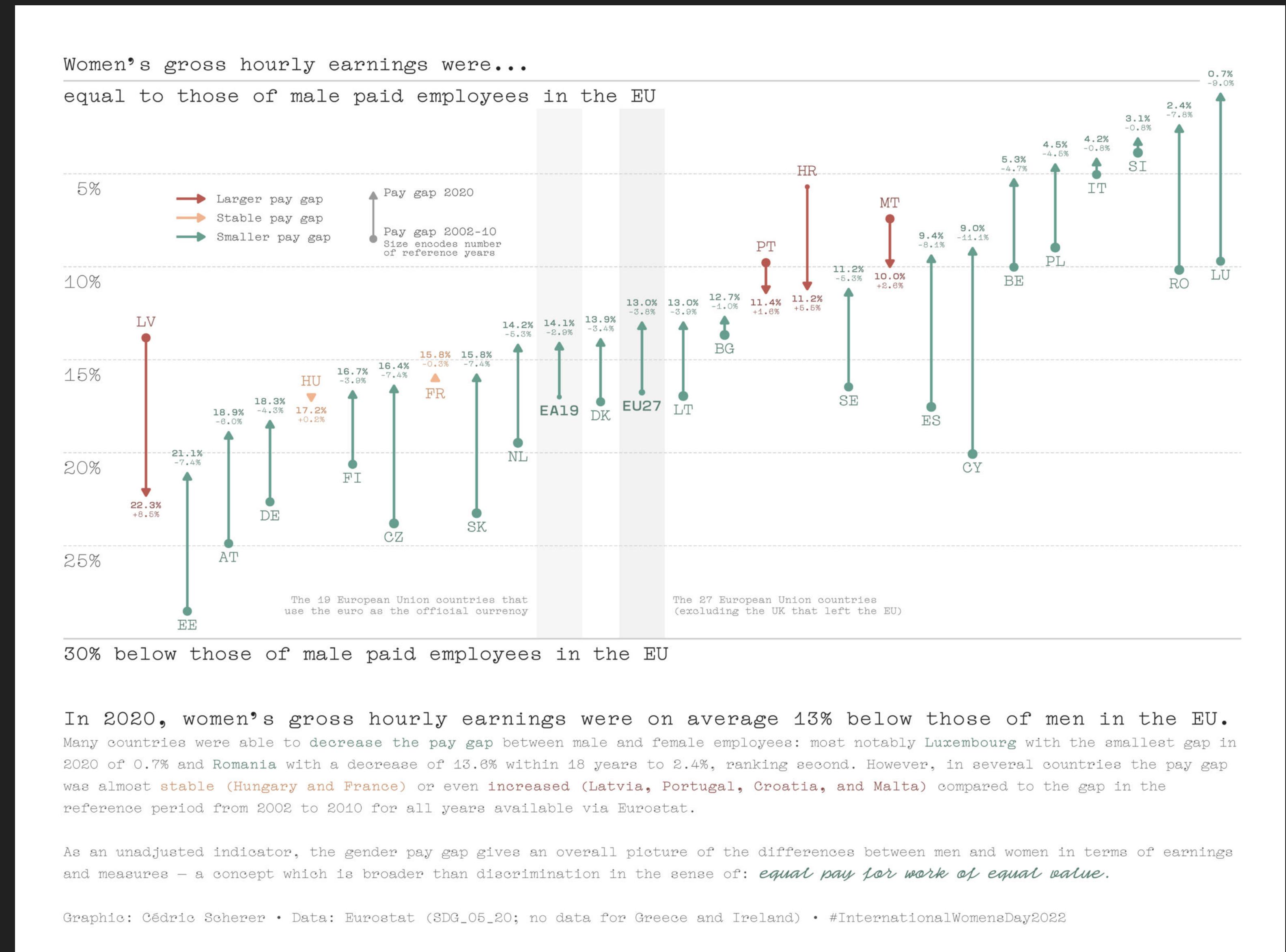
*The Office* IMDb Ratings, #TidyTuesday Contribution



Source: Weissgerber et al. (2015) PLoS Biology



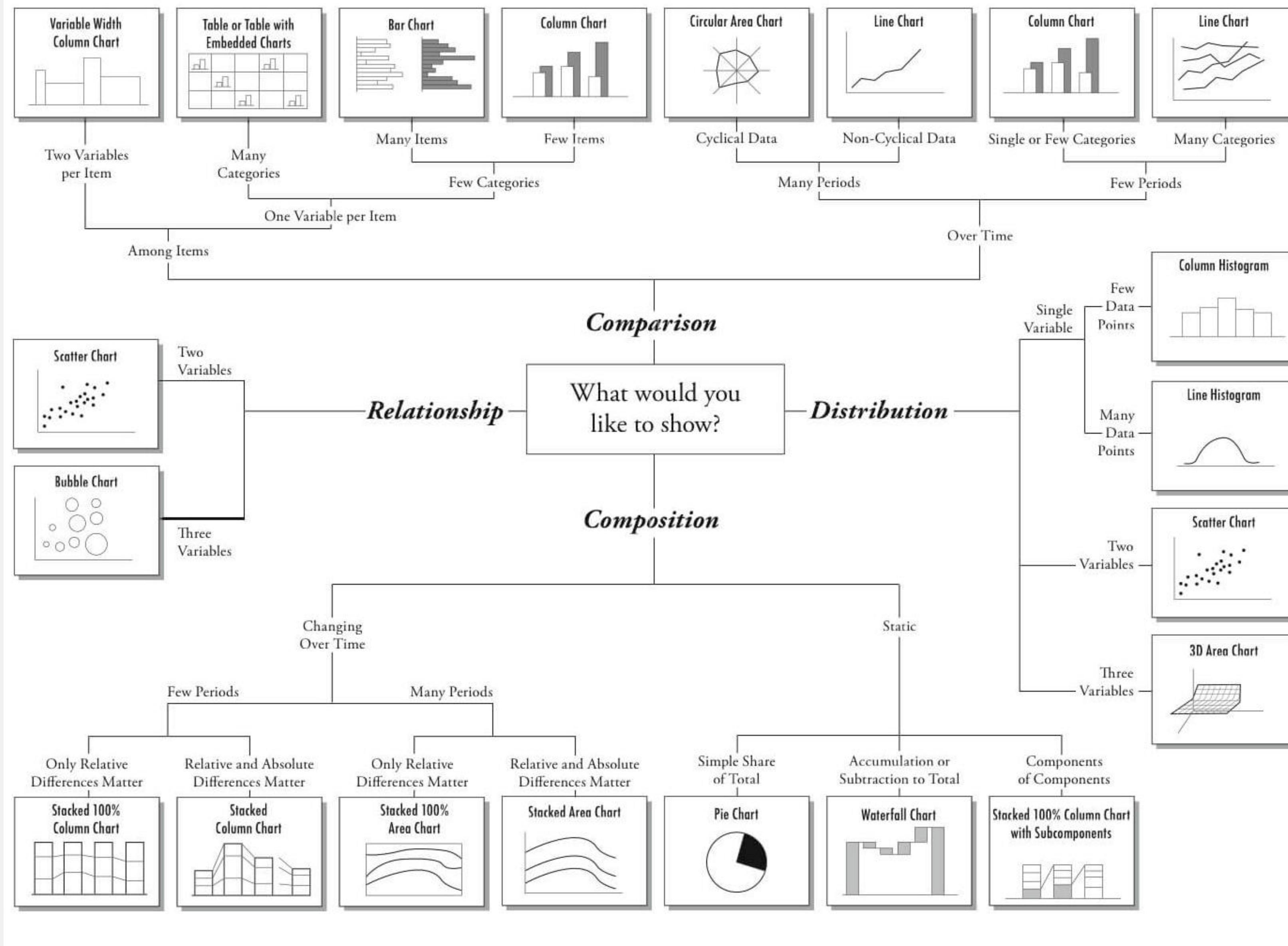
*Urban Population Trends, #30DayChartChallenge Contribution*

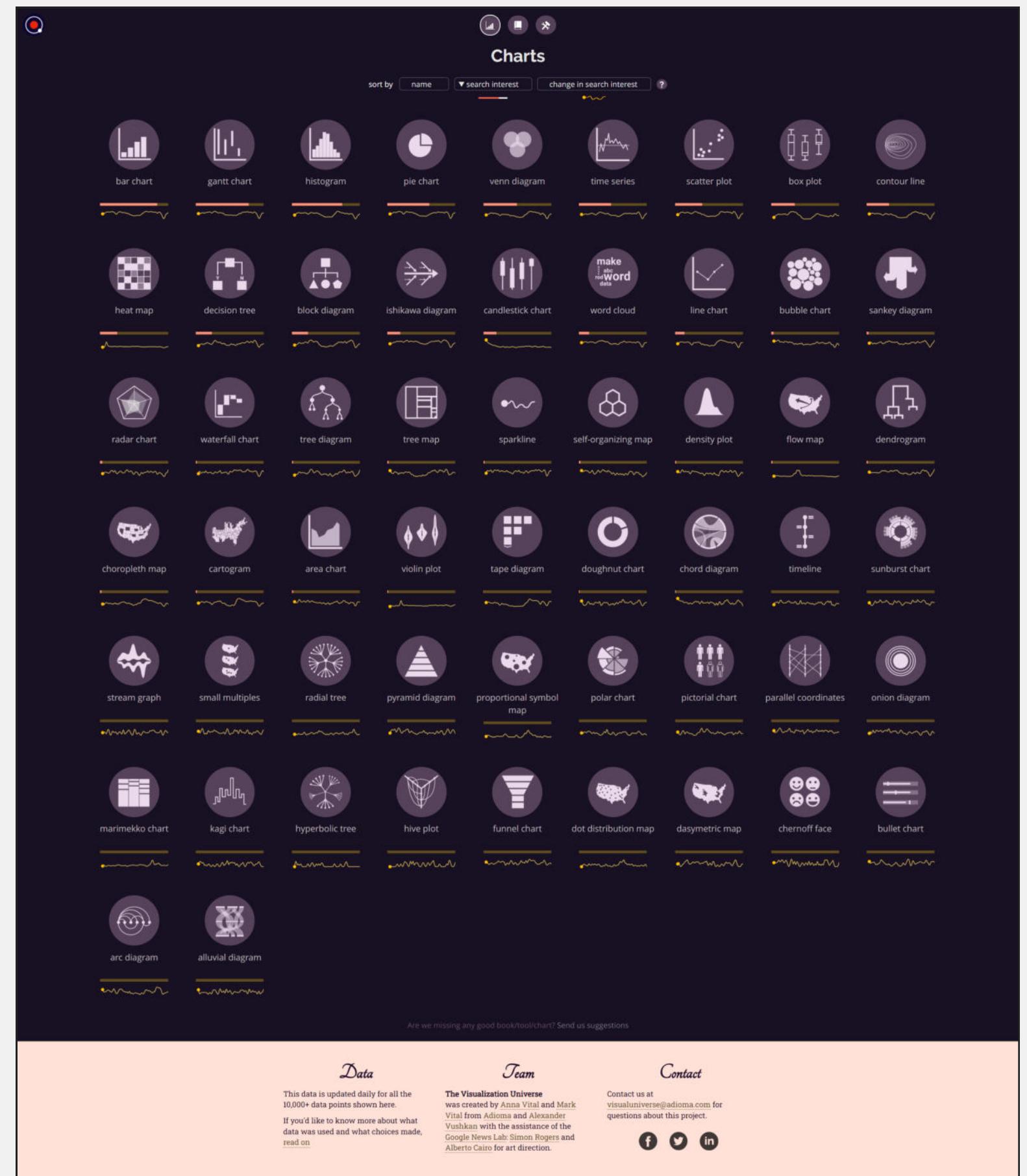
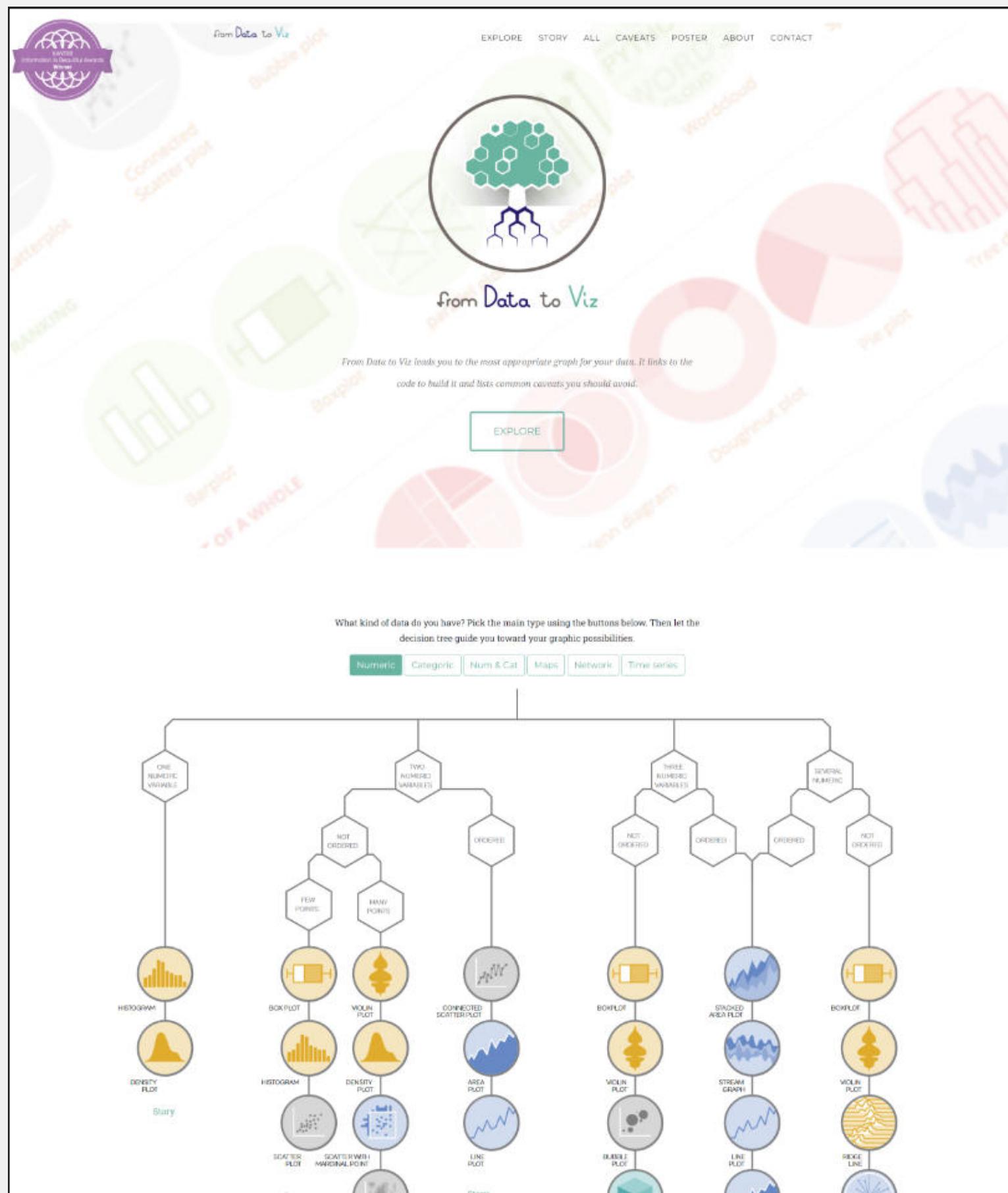


*“The Pay Gap in Europe”, personal project for International Women's Day 2022*

# Chart Suggestions—A Thought-Starter

www.ExtremePresentation.com  
© 2009 A. Abela — a.v.abela@gmail.com





[data-to-viz.com](http://data-to-viz.com)

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

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



# from Data to Viz

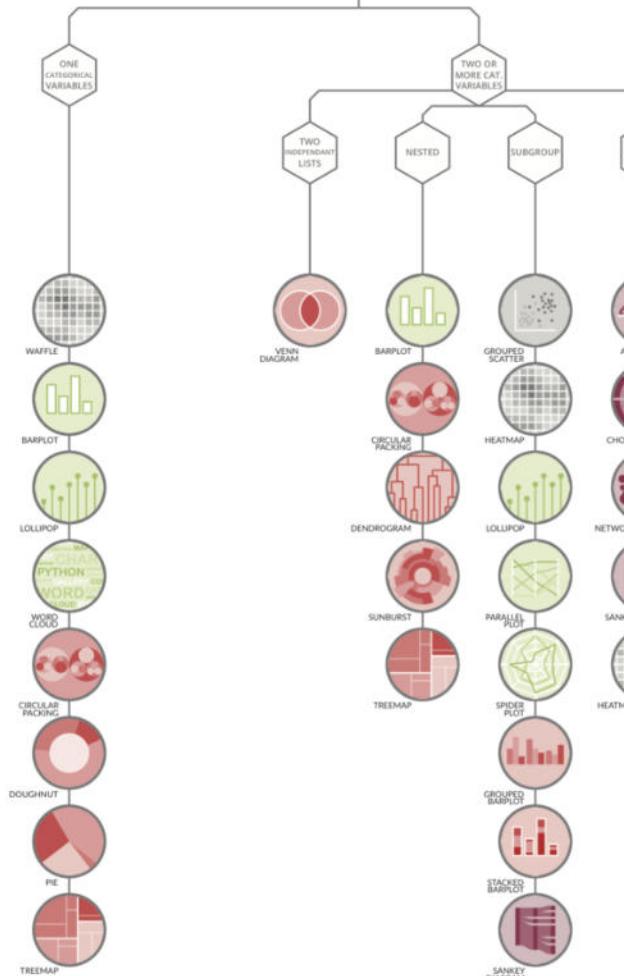
'From Data to Viz' is a classification of chart types based on input data format. It will help you find the perfect chart in three simple steps:

- 1 Identify what type of data you have.
- 2 Go to the corresponding decision tree and follow it down to a set of possible charts.
- 3 Choose the chart from the set that will suit your data and your needs best.

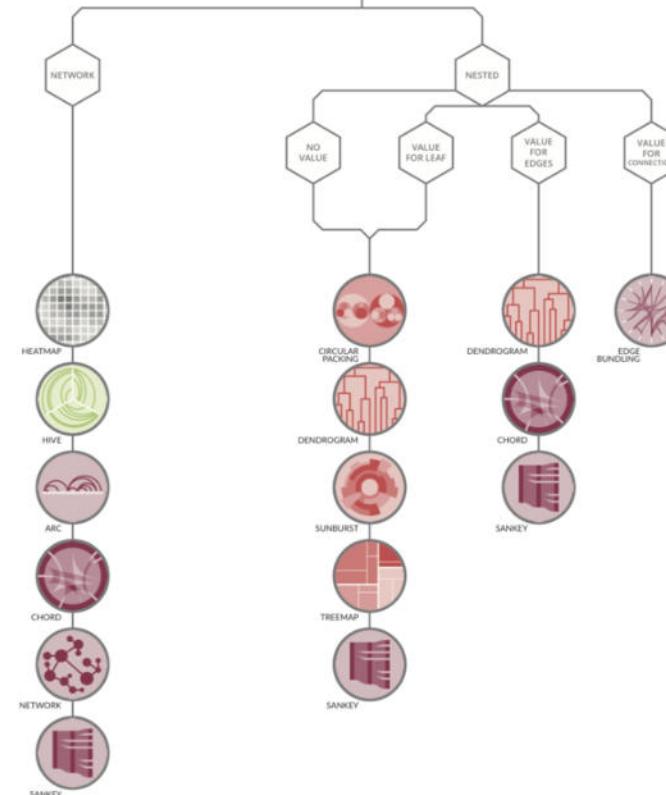
Dataviz is a world with endless possibilities and this project does not claim to be exhaustive. However it should provide you with a good starting point. For an interactive version and much more, visit:

[data-to-viz.com](http://data-to-viz.com)

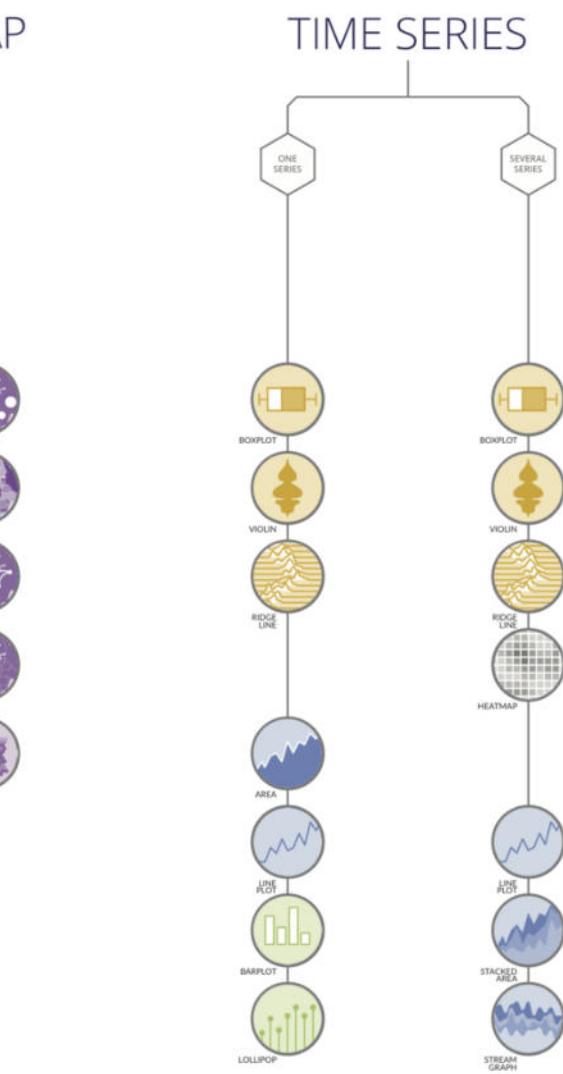
## CATEGORIC



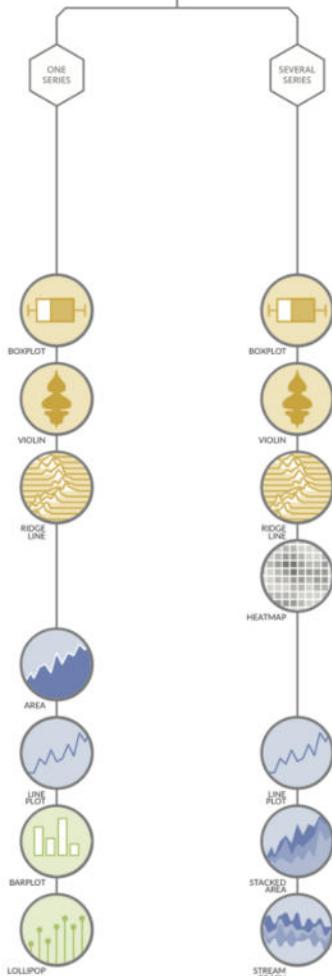
## RELATIONAL



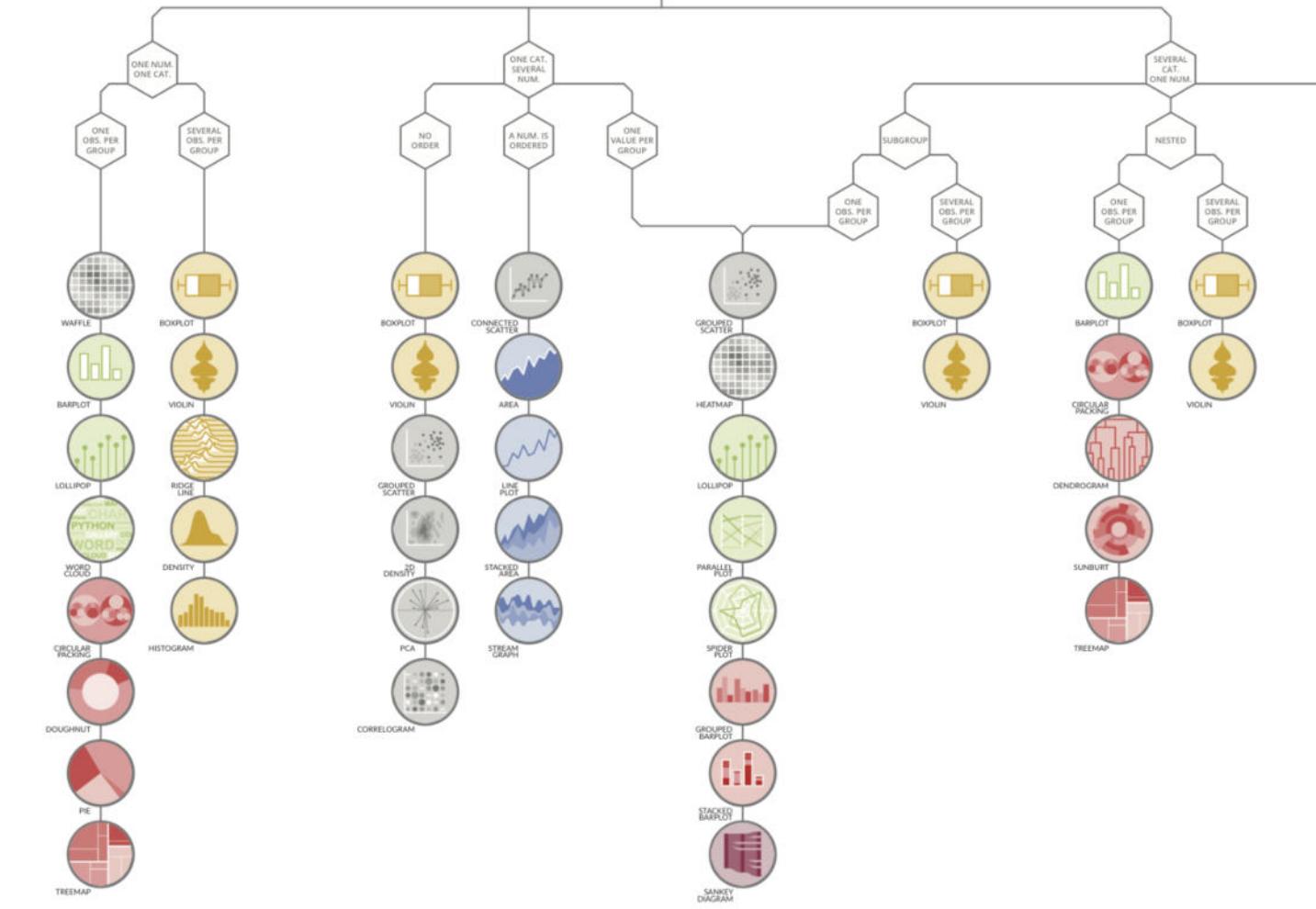
## MAP



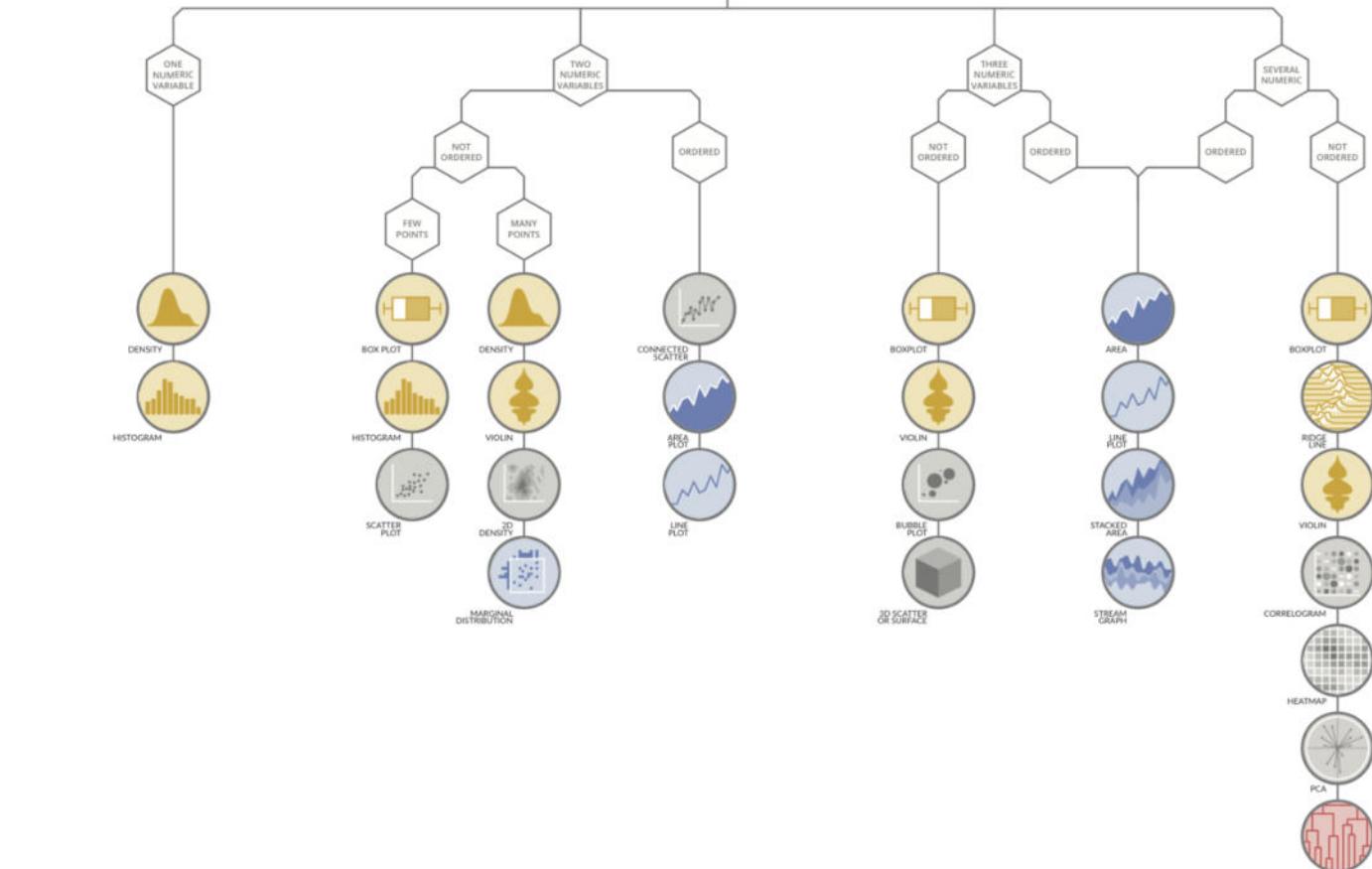
## TIME SERIES



## CATEGORIC AND NUMERIC



## NUMERIC



Source: [data-to-viz.com](http://data-to-viz.com)

The screenshot shows a modal window on the data-to-viz.com website. At the top left is a yellow circular icon containing a boxplot. To its right is a close button (X). Below the icon is the title "BOXPLOT". A subtitle "Summarize the distribution of numeric variables" follows. Underneath is a section titled "About" with a detailed description of what a boxplot is. Below this is a section titled "Common Mistakes" with a bulleted list of three items. Further down is a "Code" section with four buttons: "R graph gallery", "Python gallery", "D3js gallery", and "Flourish". At the bottom is a "Read More" section with a link to a dedicated page. The background of the modal is white, while the rest of the website has a dark grey background. On the right side of the dark grey area, there is a grid of 12 circular icons, each representing a different type of chart or visualization, such as Boxplot, Ridgeplot, Scatter, Connected scatter, Density 2d, Barplot, Lollipop, Circular Barplot, Treemap, Dendrogram, Circular packing, and Sunburst.

SSIBILITIES

presented in this website.

part of a whole Evolution Map Flow

Boxplot Ridgeplot Scatter

Connected scatter Density 2d Barplot

Lollipop Circular Barplot Treemap

Dendrogram Circular packing Sunburst

Source: [data-to-viz.com](http://data-to-viz.com)

# VISUAL FORM

---

Present information in a logical, coherent way



cedricscherer.com

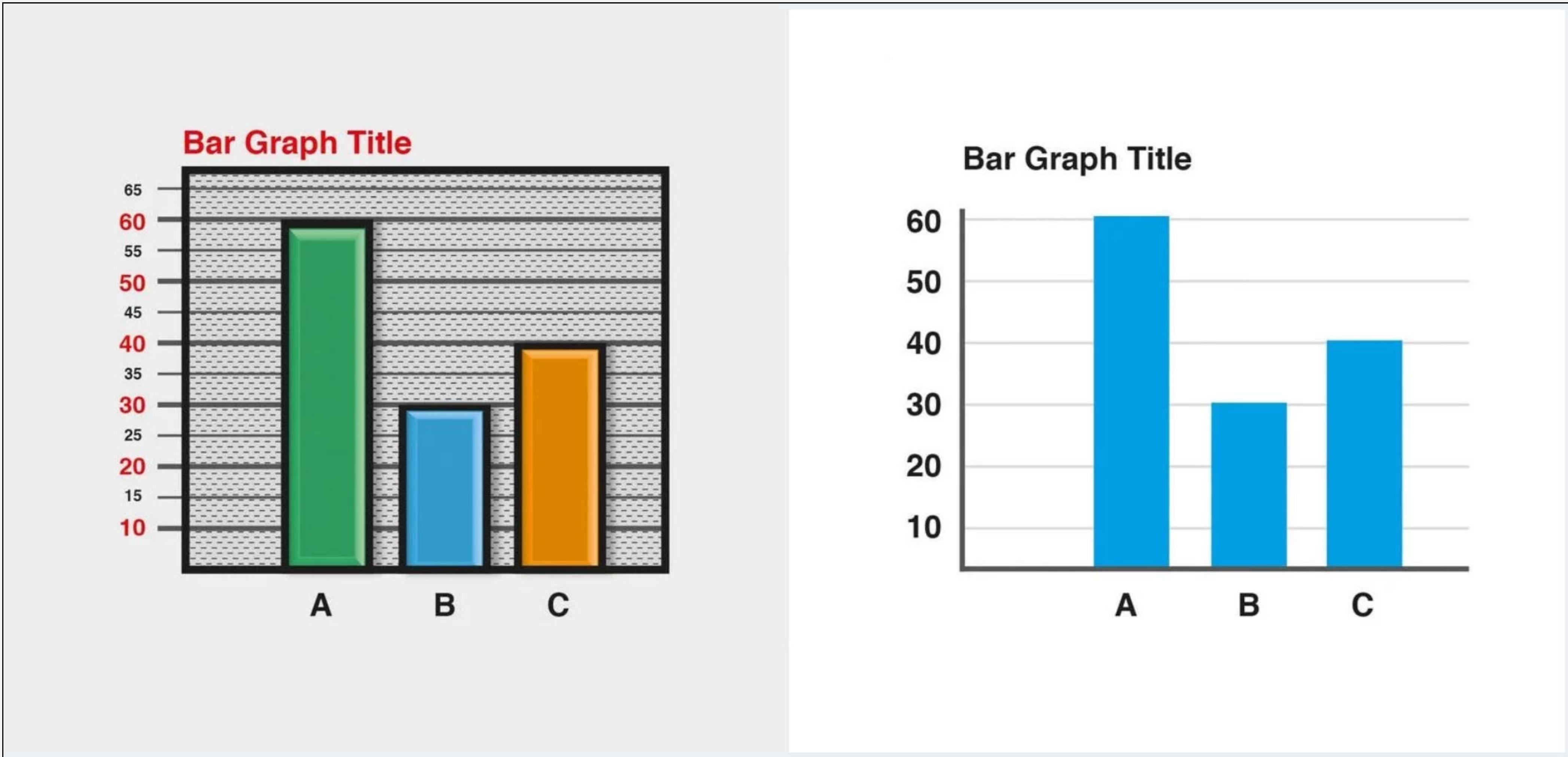


@CedScherer



z3tt

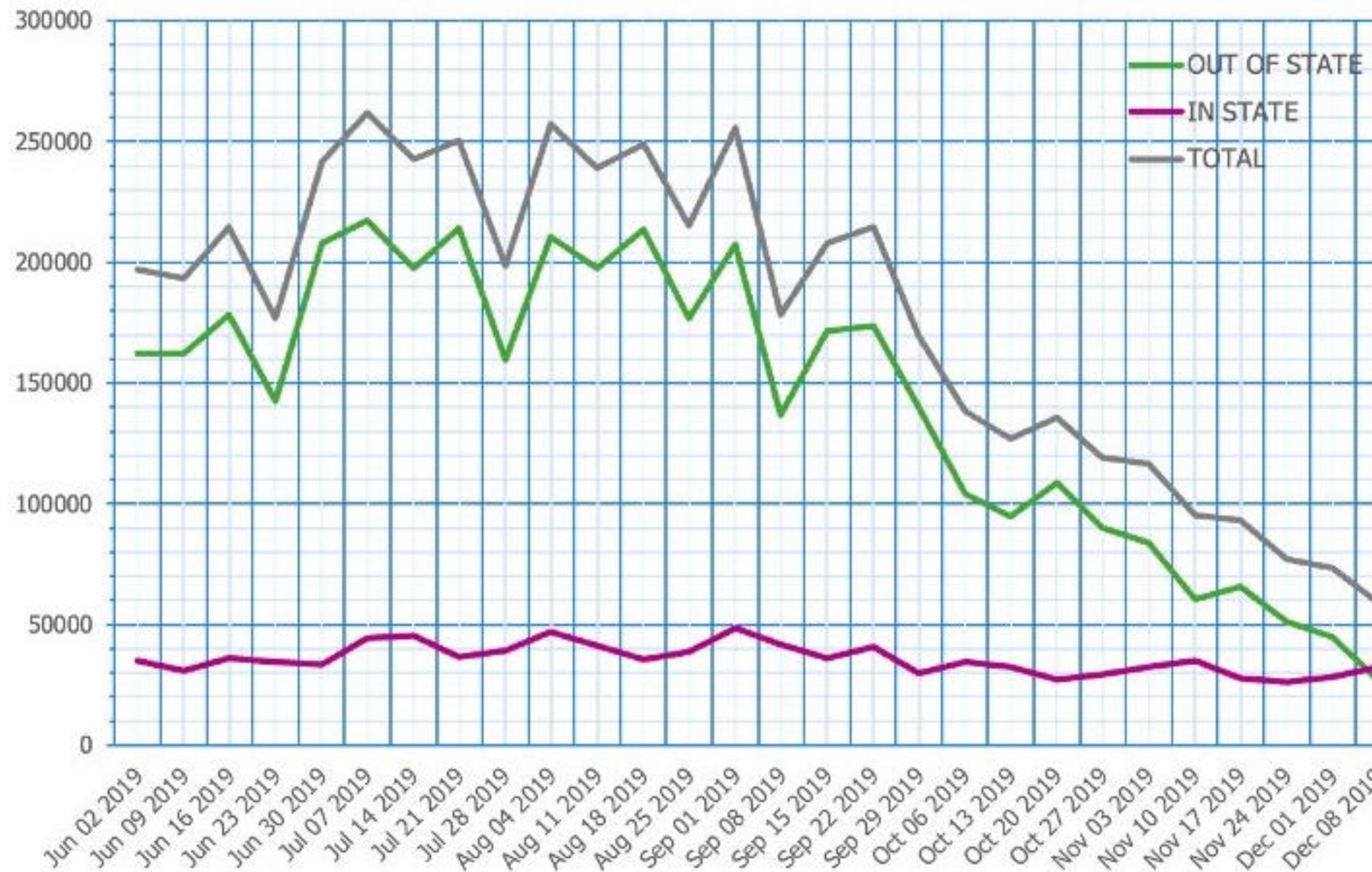
# Declutter Your Charts



Source: [canva.com](https://canva.com)

## BEFORE: SPOOKY SKELETON

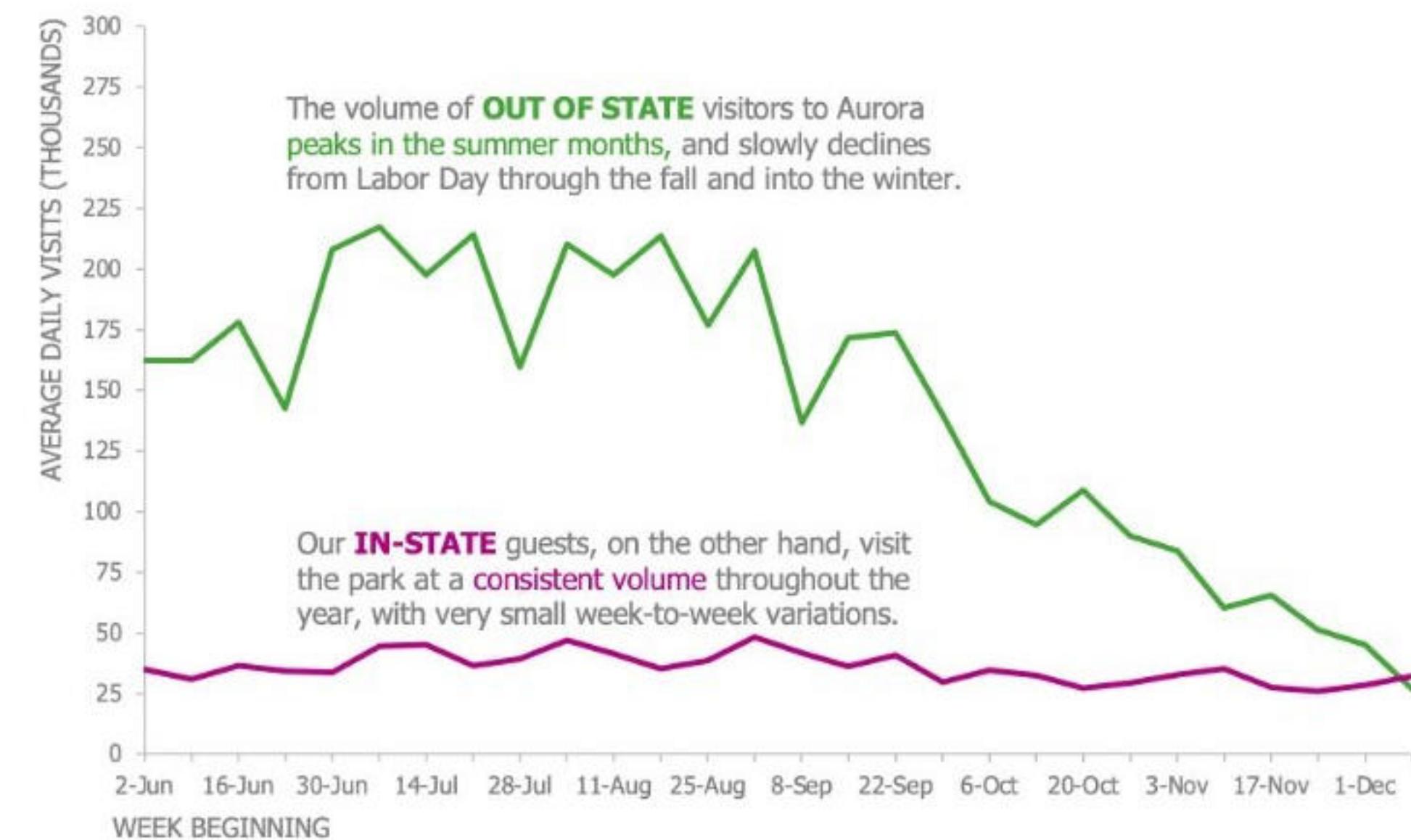
Daily Average Park Visitors By Week



## AFTER: GOOD BONES

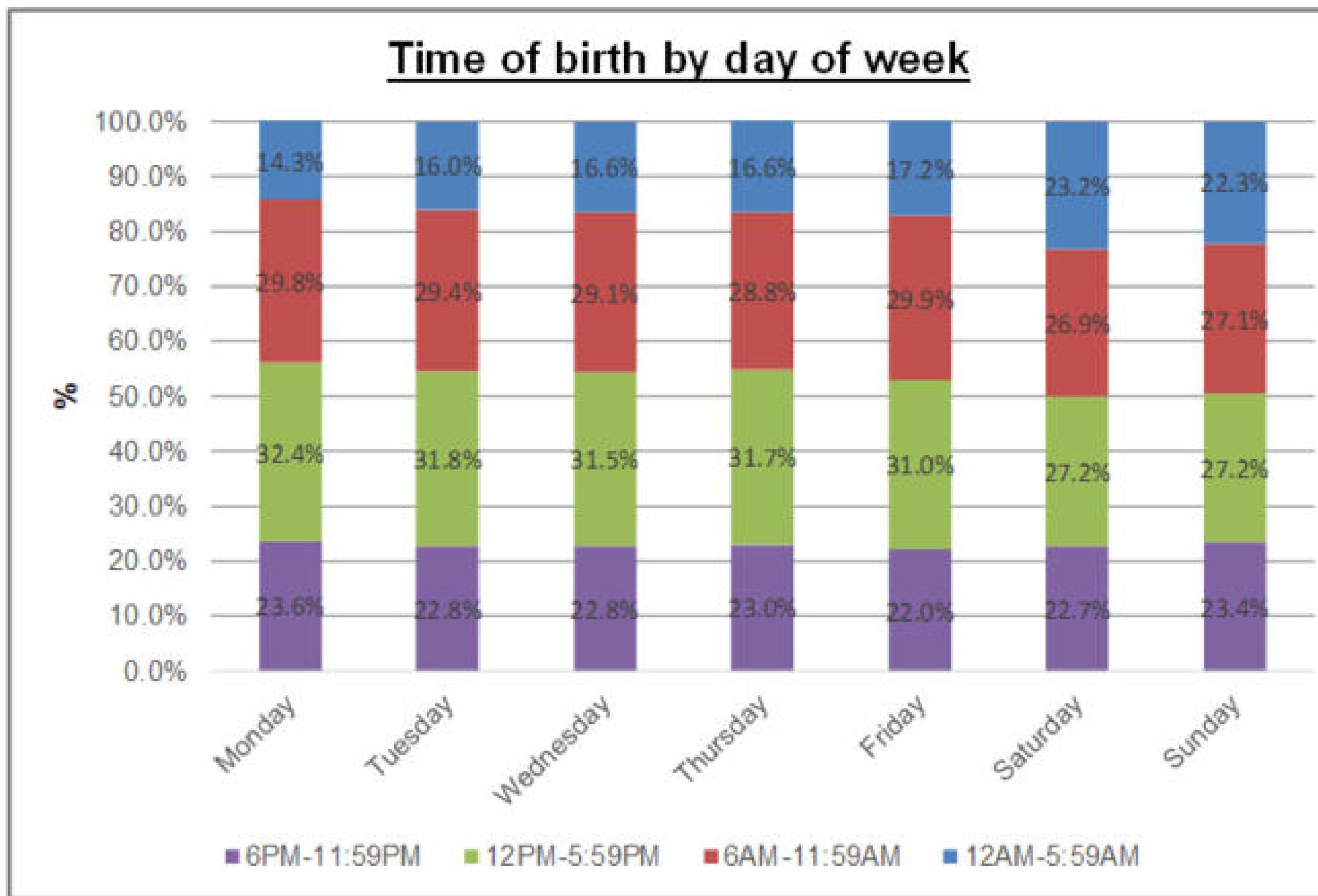
Daily visitors to Aurora Park in summer/fall 2019

VALUES ARE CALCULATED WEEKLY AS A 7-DAY AVERAGE



Source: “Your graph Skeleton Shouldn’t Be Scary” by Mike Cisneros (*Storytelling With Data*)

# BEFORE

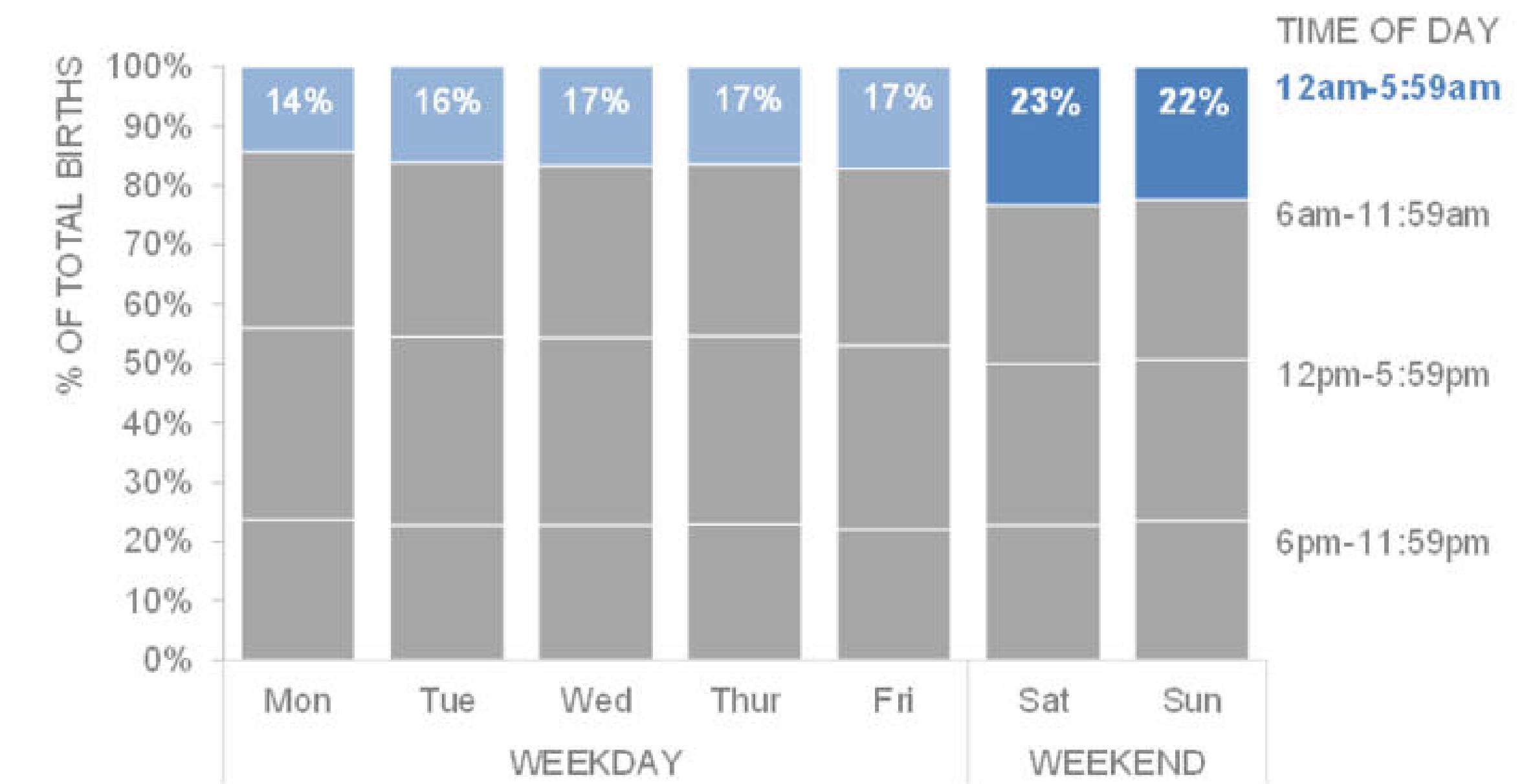


Data source: CDC (National Vital Statistics Reports, Vol. 67, No. 1, January 31, 2018)

# AFTER

## When babies are born

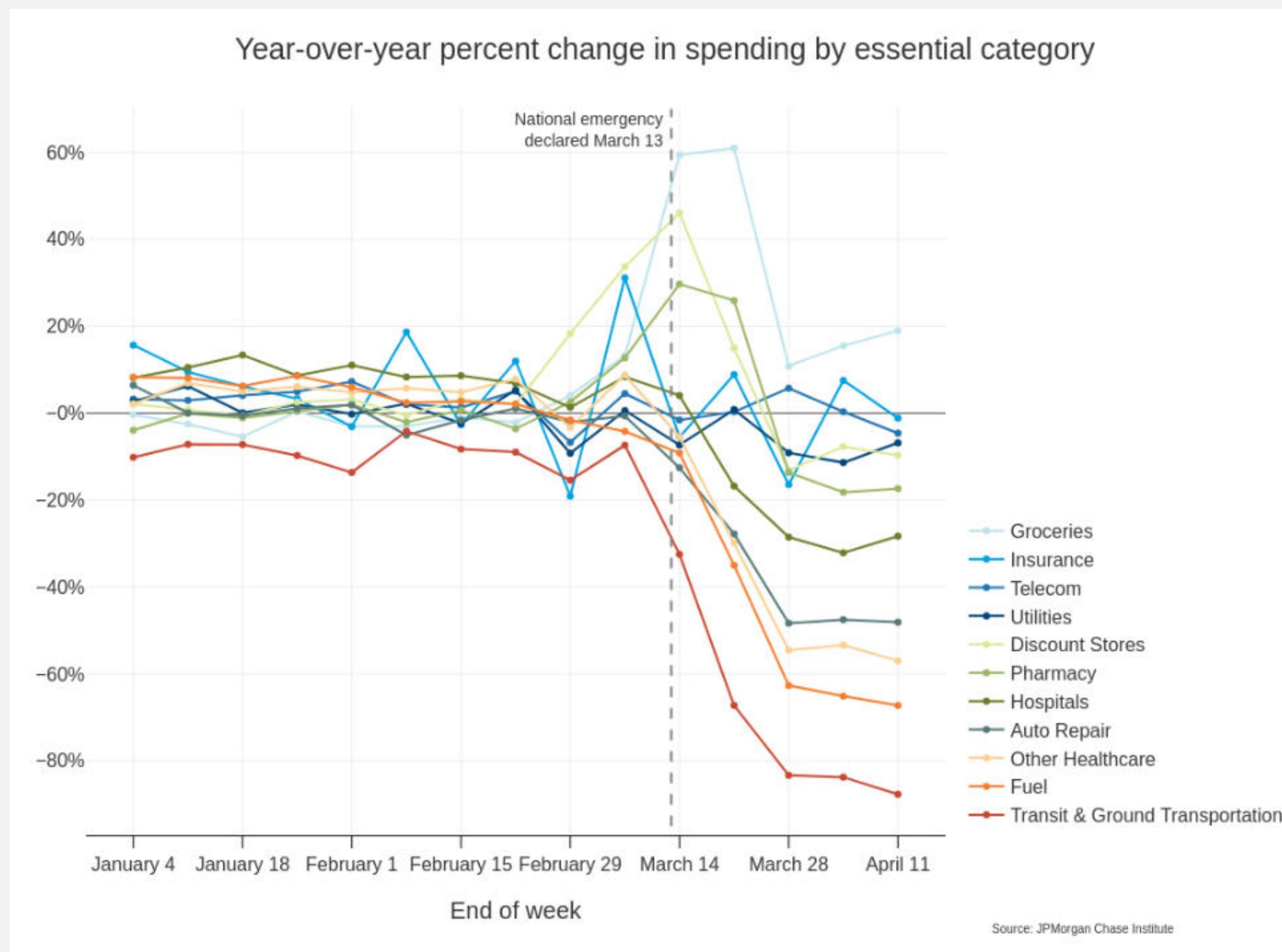
Weekend deliveries are more likely to be in early morning, compared to weekdays



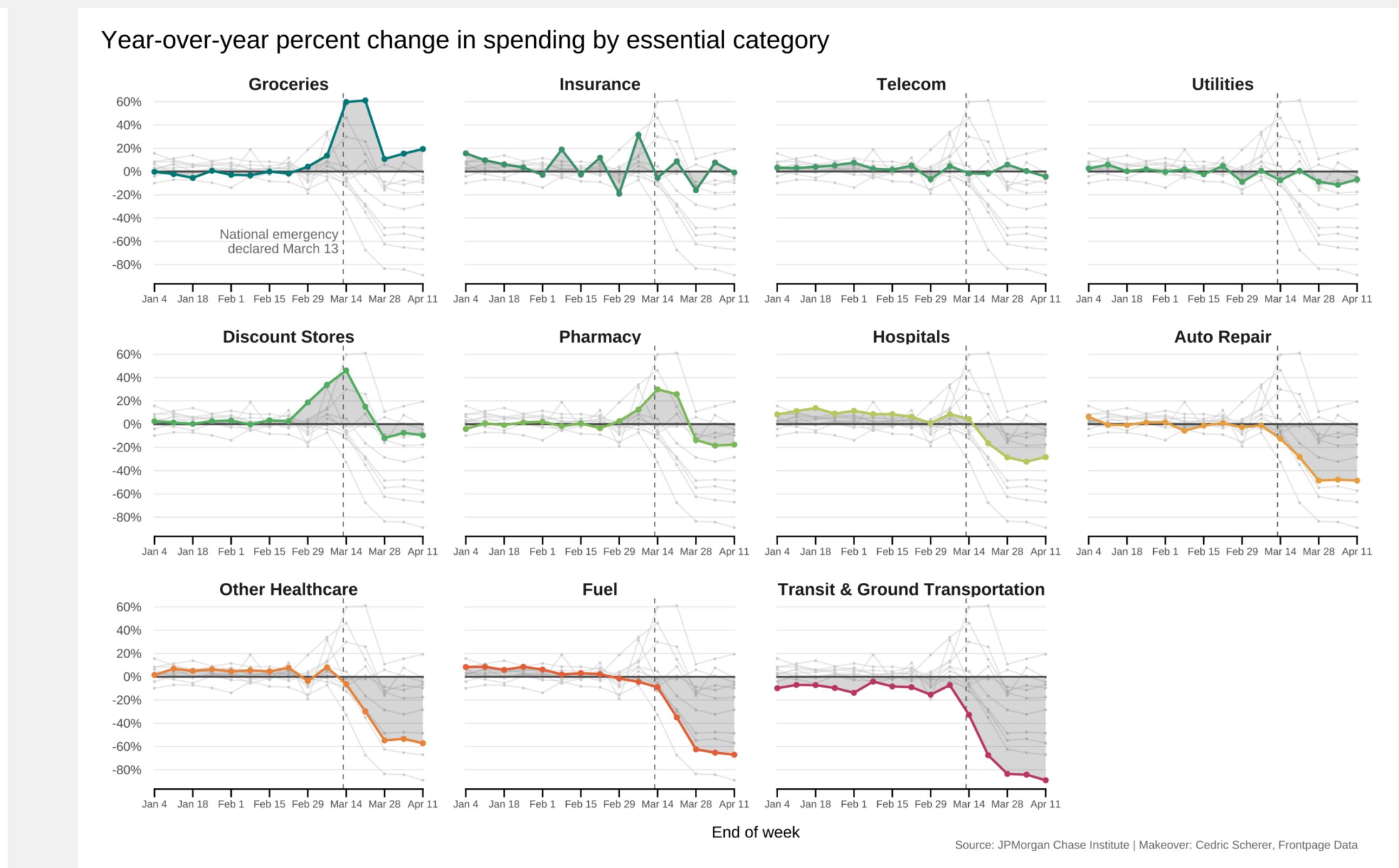
Data source: CDC (National Vital Statistics Reports, Vol. 67, No. 1, January 31, 2018)

Source: *"Declutter! (and Question Default Settings)"* by Elizabeth Ricks (*Storytelling With Data*)

# The Power of Small Multiples



*Original graphic by JPMorgan Chase Institute*



# *Makeover using small multiples*

## GRAPHIC SCIENCE

Text by Clara Moskowitz | Graphic by Cédric Scherer and Georgios Karamanis

# Escalating Drought

Climate change is intensifying periods of extreme dryness, particularly in the U.S. West

For more than 20 years the National Drought Mitigation Center (NDMC) has been monitoring dozens of indices of drought around the country, including satellite measurements of evaporation and color in vegetation, soil-moisture sensors, rainfall estimates, and river and streamflow levels. Although the agency's weekly assessments have identified periods of exceptional drought before, lately dryness has been ramping up. "The changing climate is definitely contributing to more natural disasters, drought being one of them," says Brian Fuchs, a climatologist who oversees the weekly report at the NDMC. "We're seeing more frequent and high-intensity episodes. This year some of these areas in the West have been in drought more than they have been without drought."



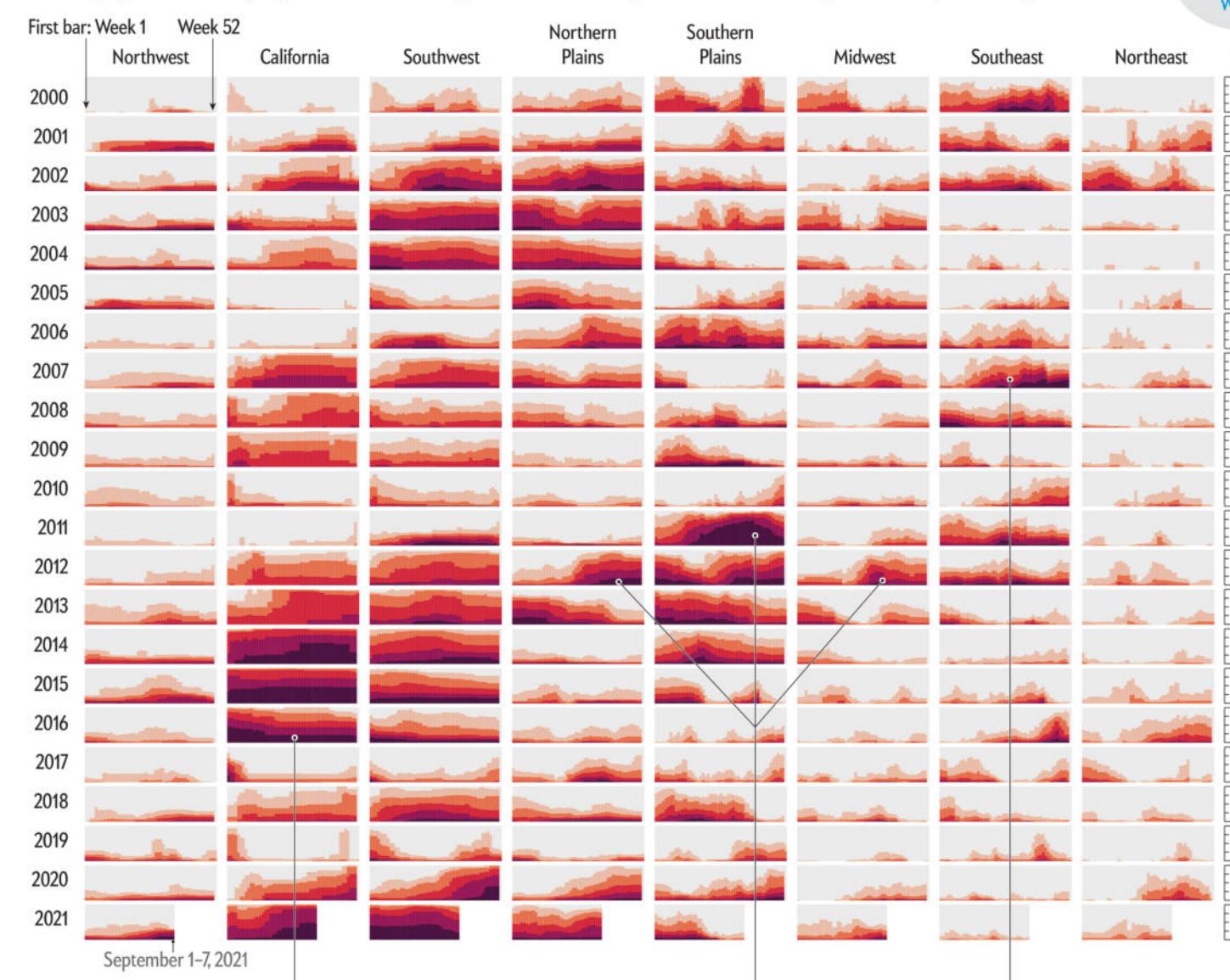
Percent of Region That Experienced Drought Each Week

100%

0%

### Drought Extent and Intensity by Region over Time

Category: Abnormally Dry Moderate Drought Severe Drought Extreme Drought Exceptional Drought



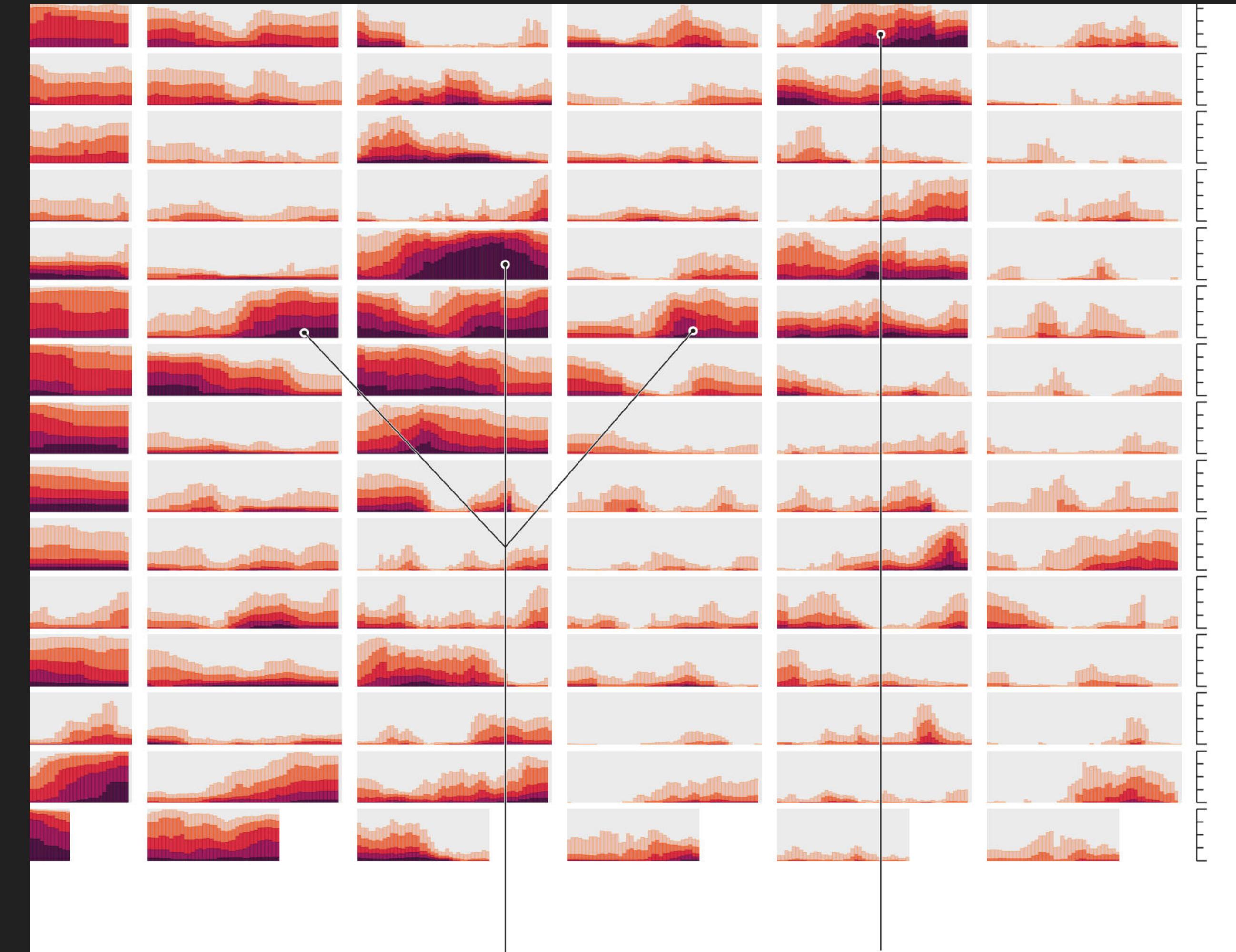
Source: U.S. Drought Monitor; jointly produced by the National Drought Mitigation Center at the University of Nebraska-Lincoln, U.S. Department of Agriculture, and National Oceanic and Atmospheric Administration (data)

California experienced its hottest drought in recorded history from 2012 to 2016. A warming climate makes the atmosphere thirstier, which increases evaporation and boosts drought.

A drought that originated in the Southern Plains in 2011 eventually spread to the Midwest and Northern Plains when the moisture coming in from the Gulf of Mexico was absorbed by the parched South before it could reach the North.

The Southeast's driest year to date was 2007, when only 31.85 inches of rain fell in Atlanta, 62 percent of its average yearly rainfall.

74 Scientific American, November 2021



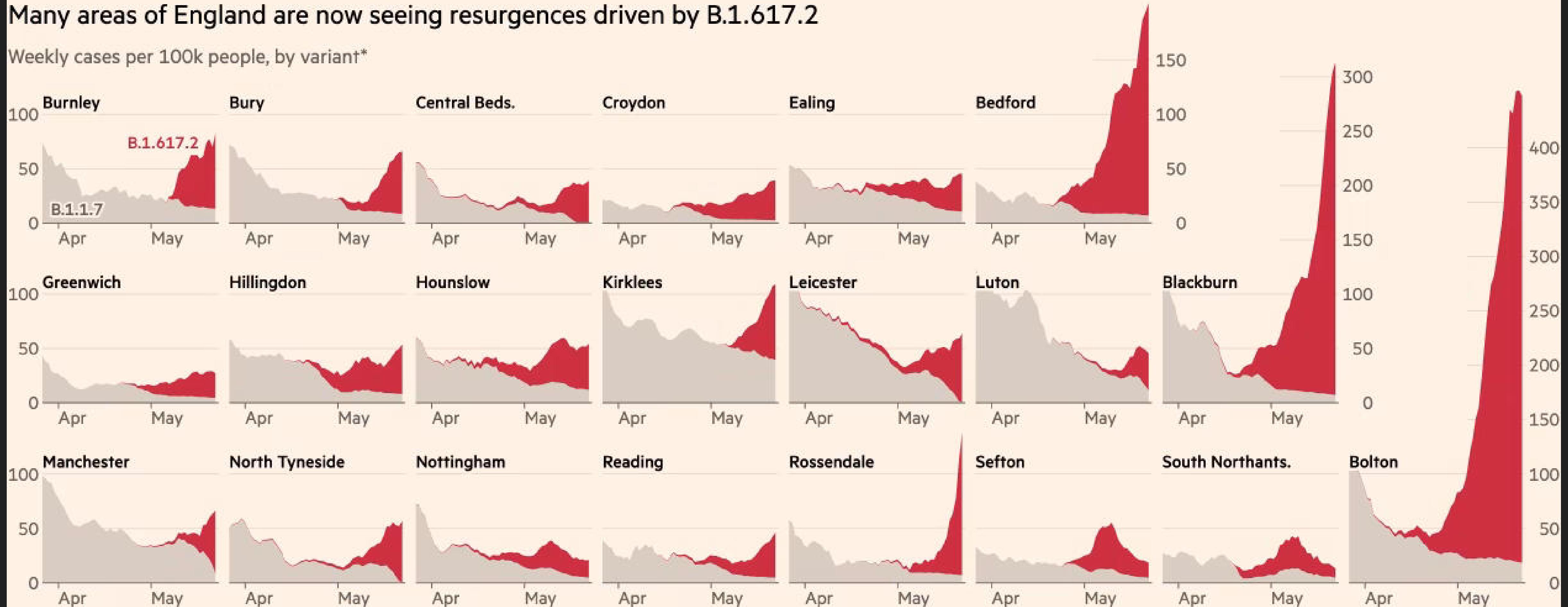
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The Southeast's driest year to date was 2007, when only 31.85 inches of rain fell in Atlanta, 62 percent of its average yearly rainfall.

Source: “Escalating Drought”, together with Georgios Karamanis for Scientific American, Issue Nov 2021

## Many areas of England are now seeing resurgences driven by B.1.617.2

Weekly cases per 100k people, by variant\*



\*Based on applying proportions of sequenced samples to total cases

Sources: FT analysis of data from the Sanger Institute and UK government Covid-19 dashboard

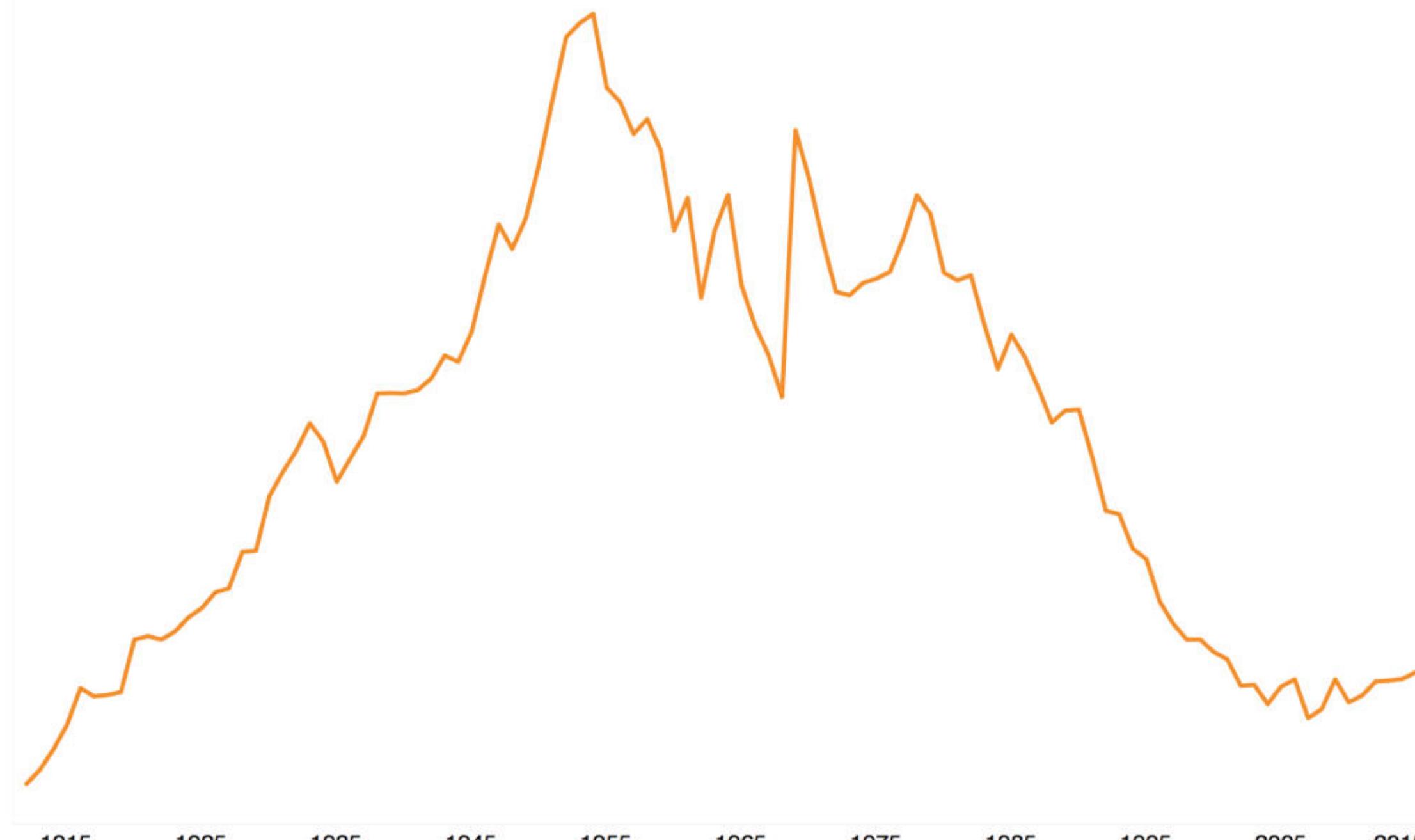
© FT

**"UK virus cases hit 6-week high but vaccines diminish threat"** by John Burn-Murdoch (Financial Times)

# The Power of Annotations

Rise and Fall of the name **Neil** in the USA  
Births 1912-2015

Source: data.gov



Visualisation: [@theneilrichards](#)

Source: ["Is white space always your friend?" by Neil Richards](#)

# The Power of Annotations

Rise and Fall of the name **Neil** in the USA  
Births 1912-2015

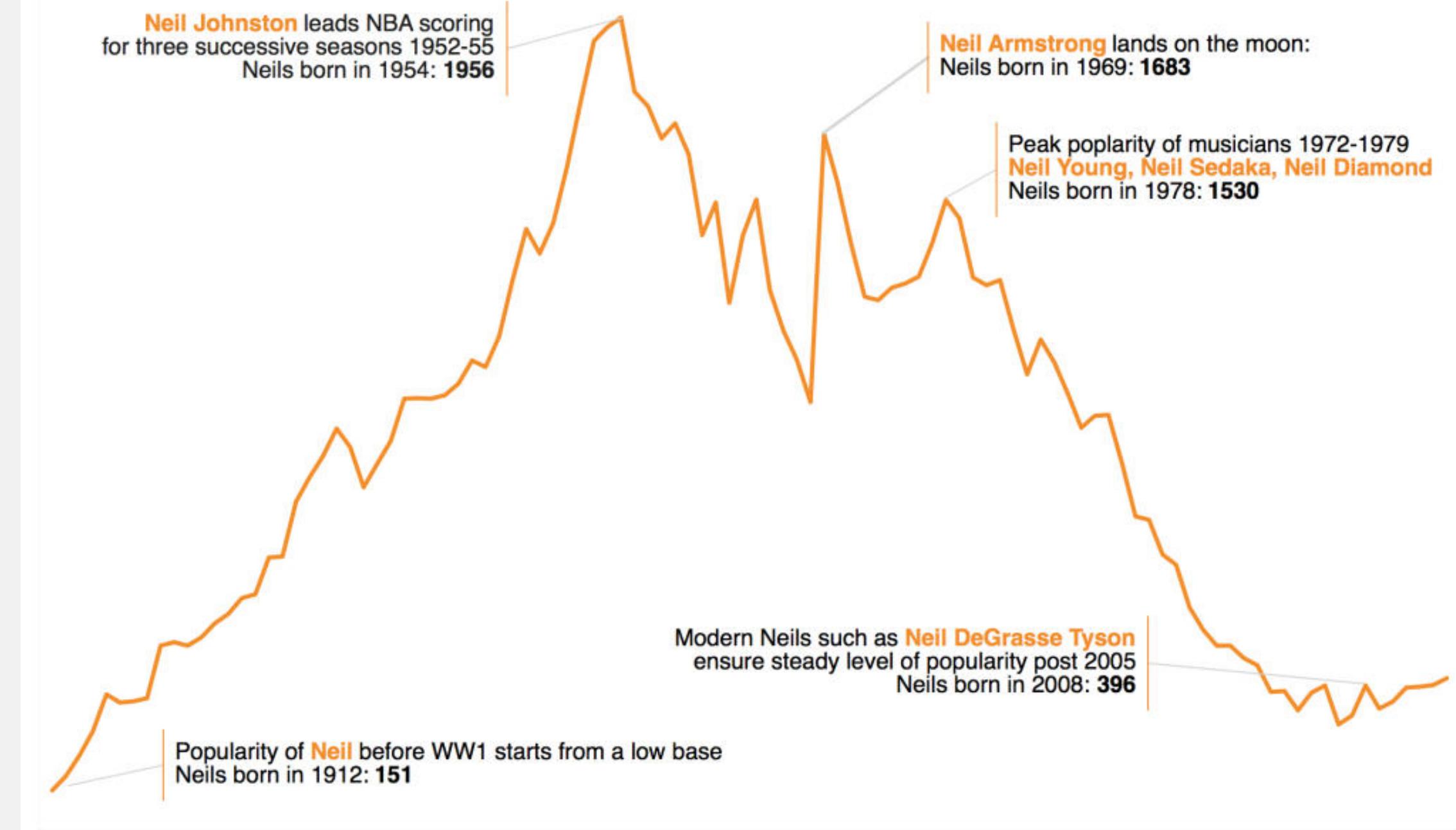
Source: data.gov



Visualisation: @theneilrichards

Rise and Fall of the name **Neil** in the USA  
Births 1912-2015

Source: data.gov



Visualisation: @theneilrichards

#SWDChallenge

Source: “Is white space always your friend?” by Neil Richards

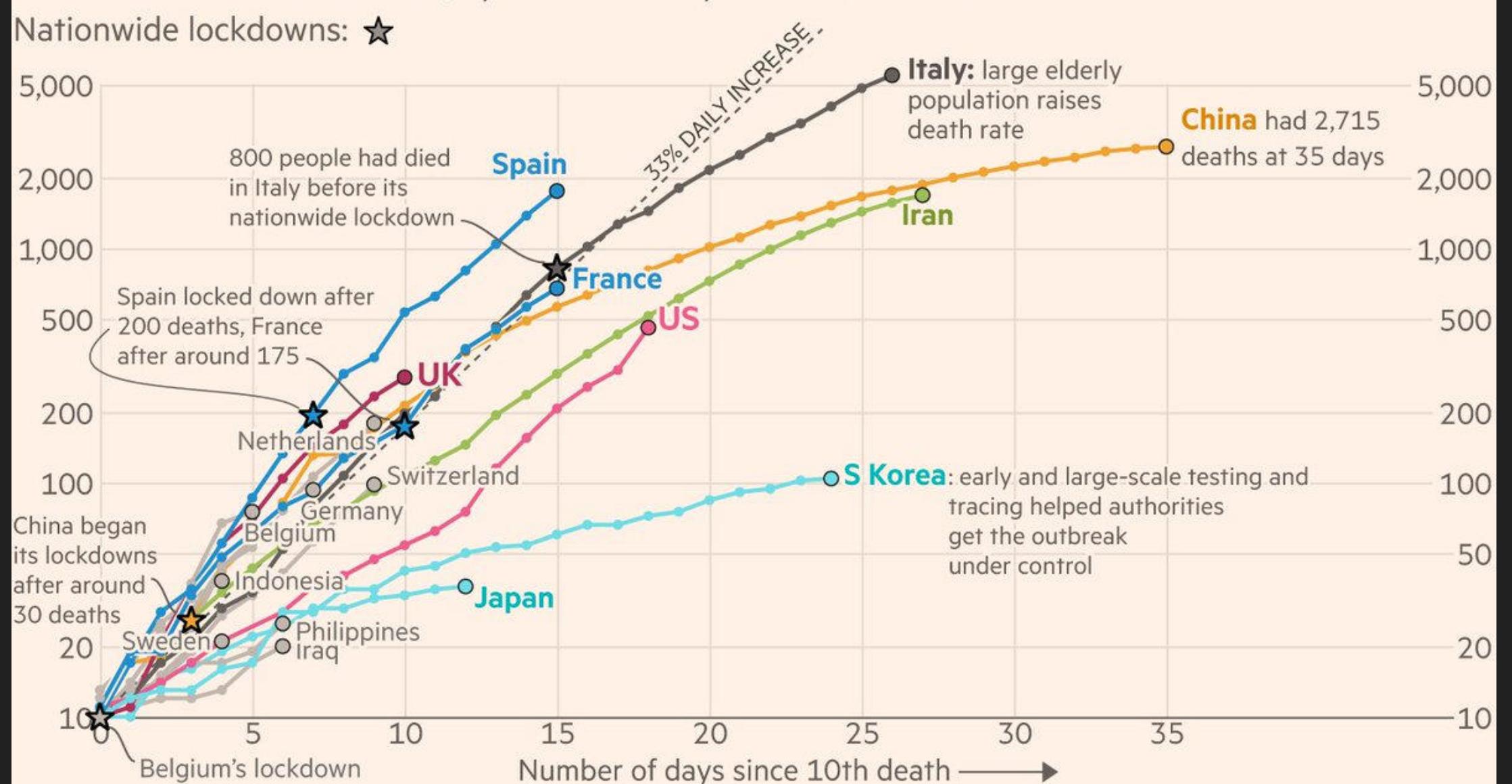
“The key thing we do is to add a title to the chart, as an entry point and to explain what is going on. **Text and other annotations add enormous value for non-chart people.**”

~ John Burn-Murdoch, Financial Times

Coronavirus deaths in Italy, Spain and the UK are increasing much more rapidly than they did in China

Cumulative number of deaths, by number of days since 10th death

Nationwide lockdowns: ★



FT graphic: John Burn-Murdoch / @jburnmurdoch

Source: FT analysis of Johns Hopkins University, CSSE; Worldometers; FT research. Data updated March 23, 09:00 GMT

© FT

Covid has grown gradually less lethal over the pandemic, mainly due to immunity, but it remains more dangerous than flu on average

Evolution of Covid-19's infection fatality ratio\* in England, relative to seasonal flu



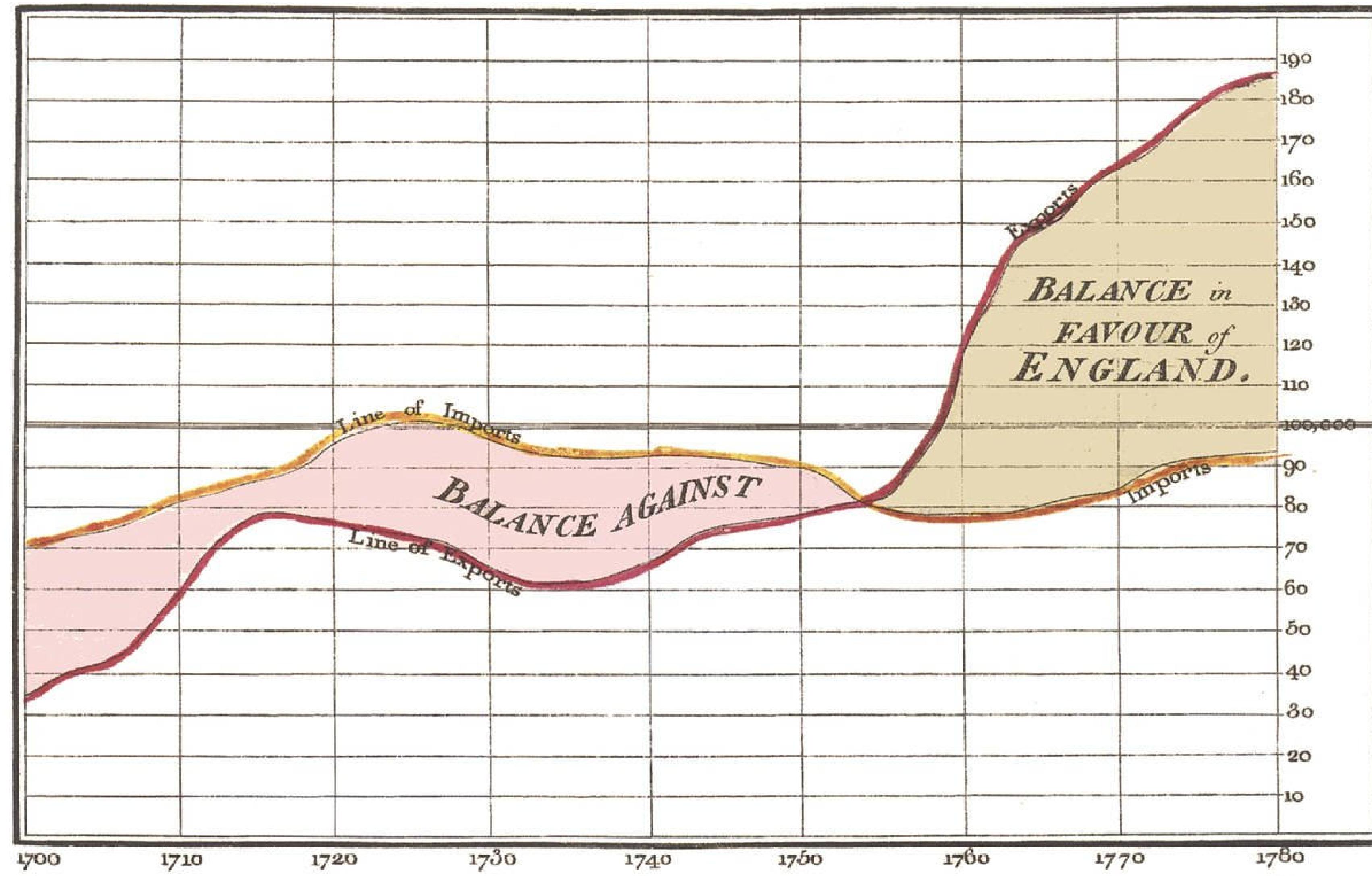
\*Covid IFR calculated using ONS death cert. mentions and ONS infection survey. \*\*IFR for seasonal flu as calculated for New Zealand in BMJ

Source: ONS. Based on prior work by Dan Howdon

FT graphic: John Burn-Murdoch / @jburnmurdoch

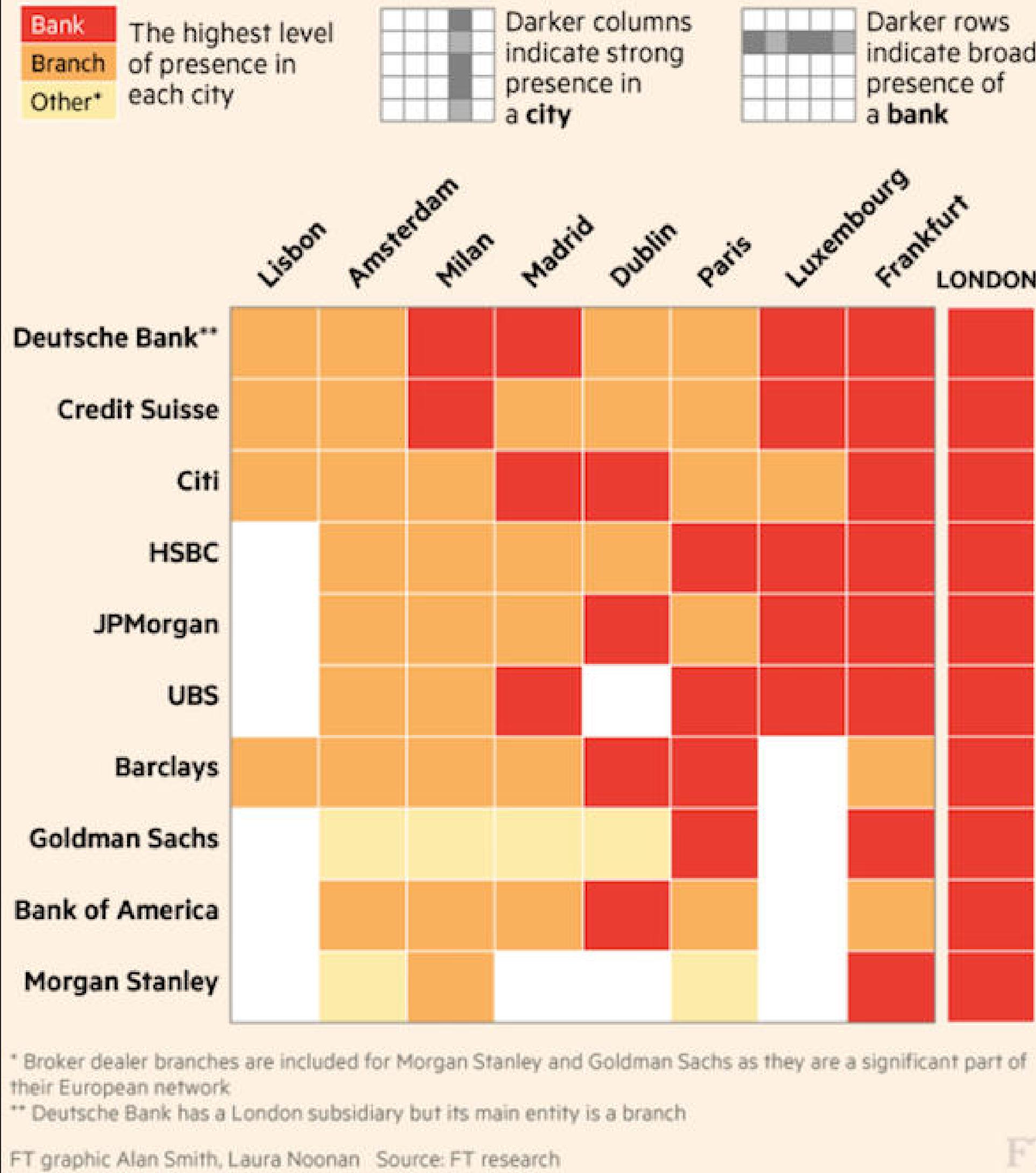
© FT

Exports and Imports to and from DENMARK & NORWAY from 1700 to 1780.



Annotated time-series chart by William Playfair from "The Commercial and Political Atlas and Statistical Breviary" (1786)

## The Brexit banking matrix: The contenders lining up for London's crown



Source: “*Frankfurt vies for UK banking jobs post-Brexit*” by Alan Smith and Laura Noonan (Financial Times)



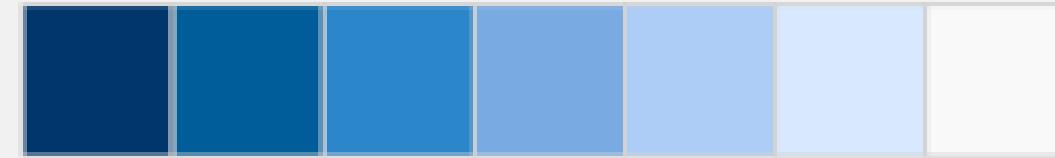
# COLORS

## and Pitfalls

# Color Palette Choice

## Sequential

Palette



Desaturated



*Use to encode  
**numerical information  
with order***

*use highest contrast for  
most important information*

*either single- or multi-hue*

*Modified from the `{colorspace}` R package vignette*

# Color Palette Choice

## Sequential

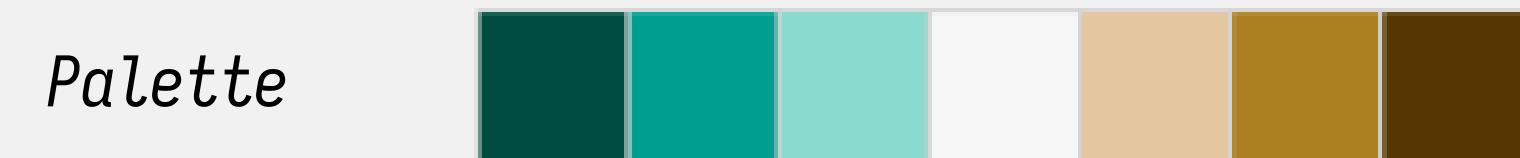


Use to encode  
***numerical information  
with order***

use highest contrast for  
most important information

either single- or multi-hue

## Diverging



Use to encode  
***numerical information  
with critical midpoint***

ensure a meaningful midpoint value  
and use balanced extremes

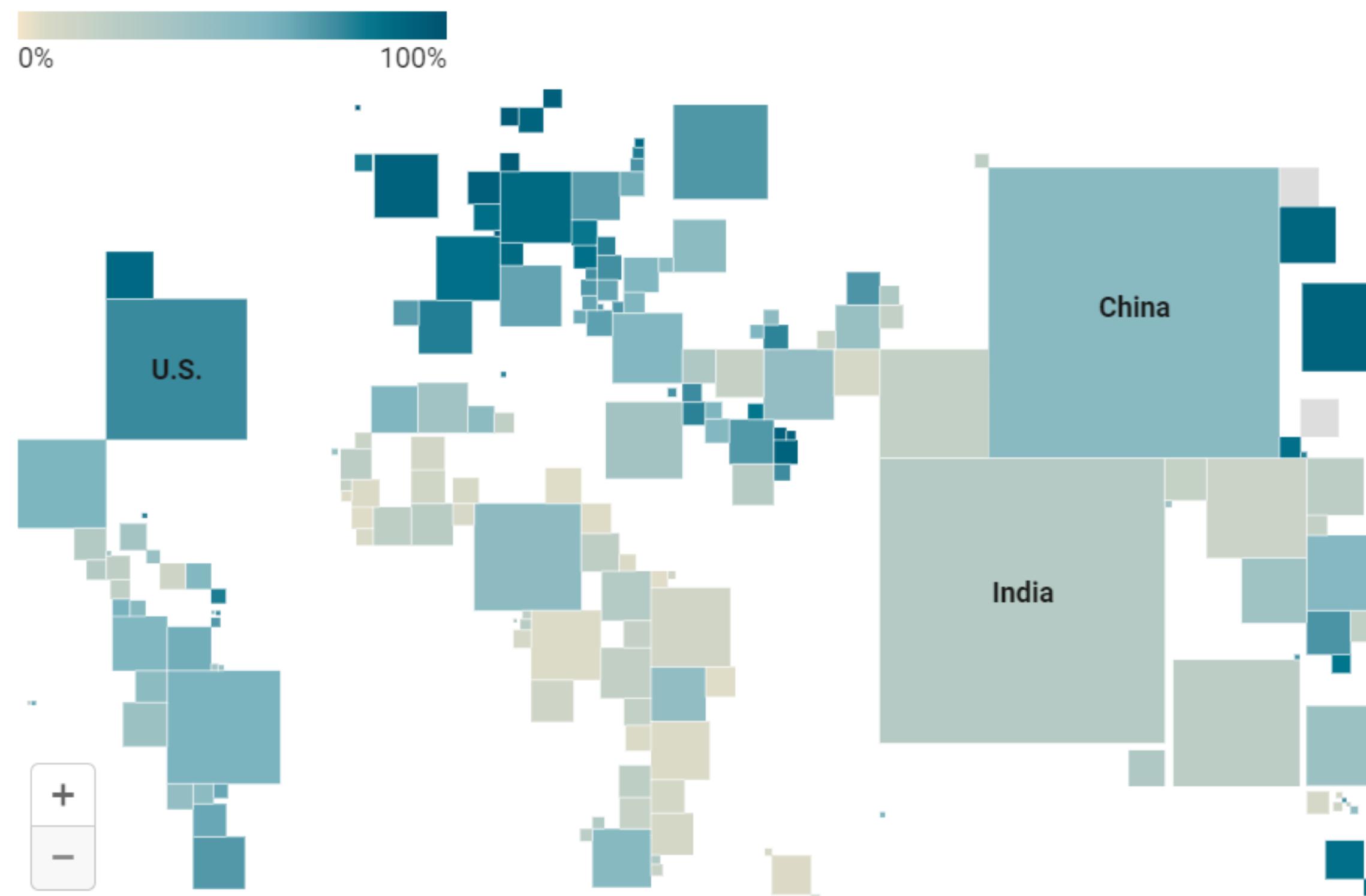
combination of  
two sequential palettes

Modified from the `{colorspace}` R package vignette

# Sequential versus Diverging Palettes

## The internet was mostly used by the Western World in 2015

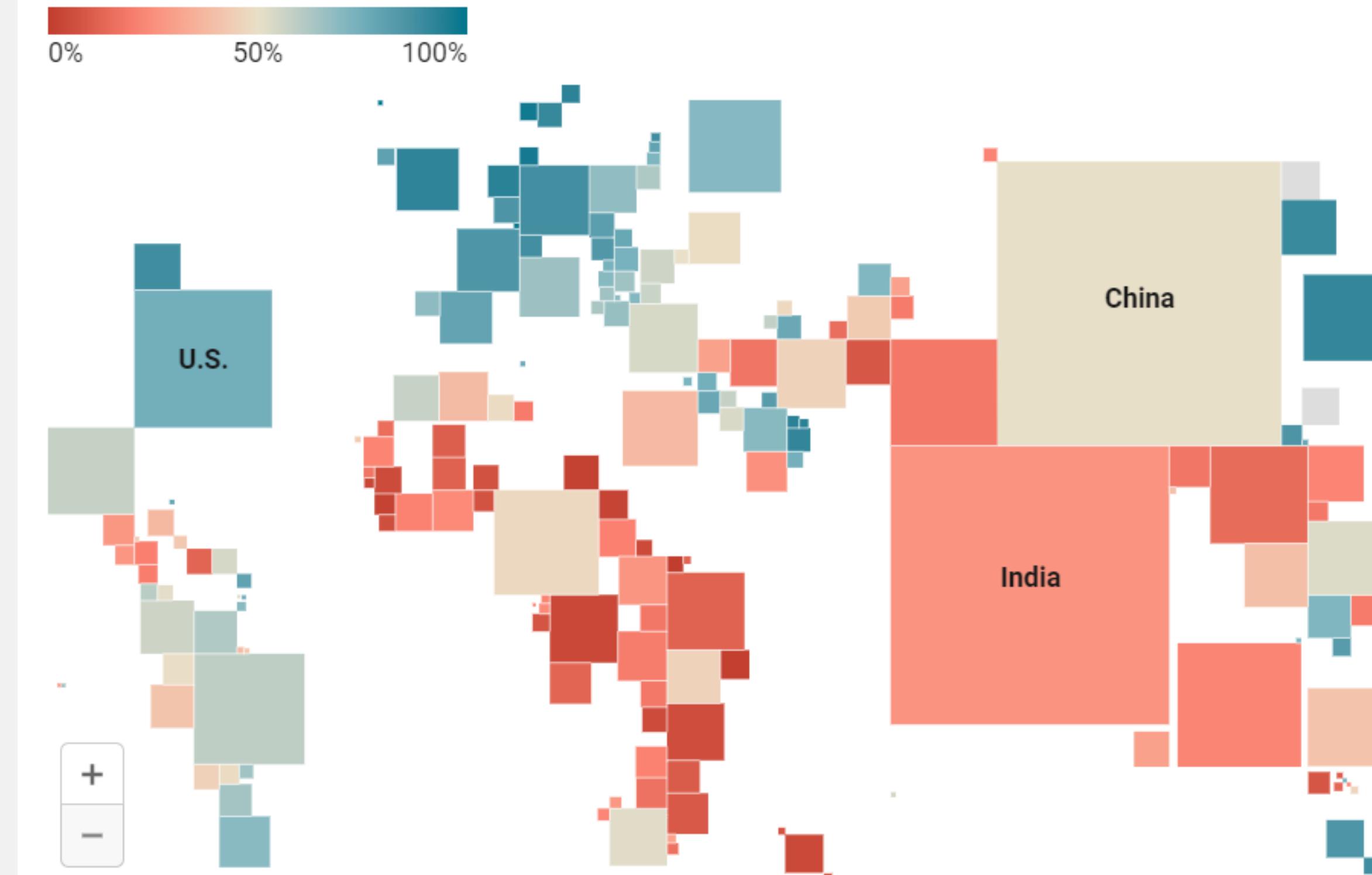
Share of individuals who have used the Internet in the last 3 months (via a computer, mobile phone, personal digital assistant, games machine, digital TV etc.), in selected countries, 2015



Map: Lisa Charlotte Rost, Datawrapper • Source: Our World in Data • Get the data • Created with Datawrapper

In most African and Asian countries, less than half of the population was using the internet in 2015.

Share of individuals who have used the Internet in the last 3 months (via a computer, mobile phone, personal digital assistant, games machine, digital TV etc.), in selected countries, 2015

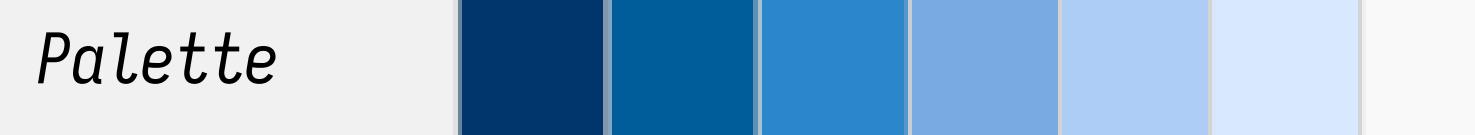


Map: Lisa Charlotte Rost, Datawrapper • Source: Our World in Data • Get the data • Created with Datawrapper

Source: “[When to use sequential and when to use diverging color scales](#)” by Lisa C. Muth / DataWrapper

# Color Palette Choice

## Sequential

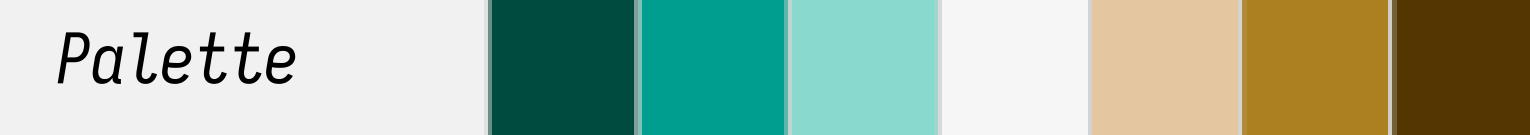


Use to encode  
***numerical information with order***

use highest contrast for  
most important information

either single- or multi-hue

## Diverging

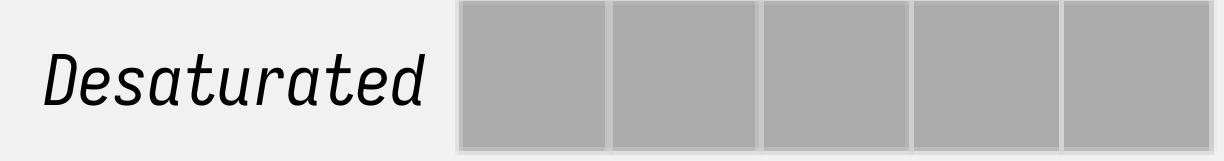


Use to encode  
***numerical information with critical midpoint***

ensure a meaningful midpoint value  
and use balanced extremes

combination of  
two sequential palettes

## Qualitative



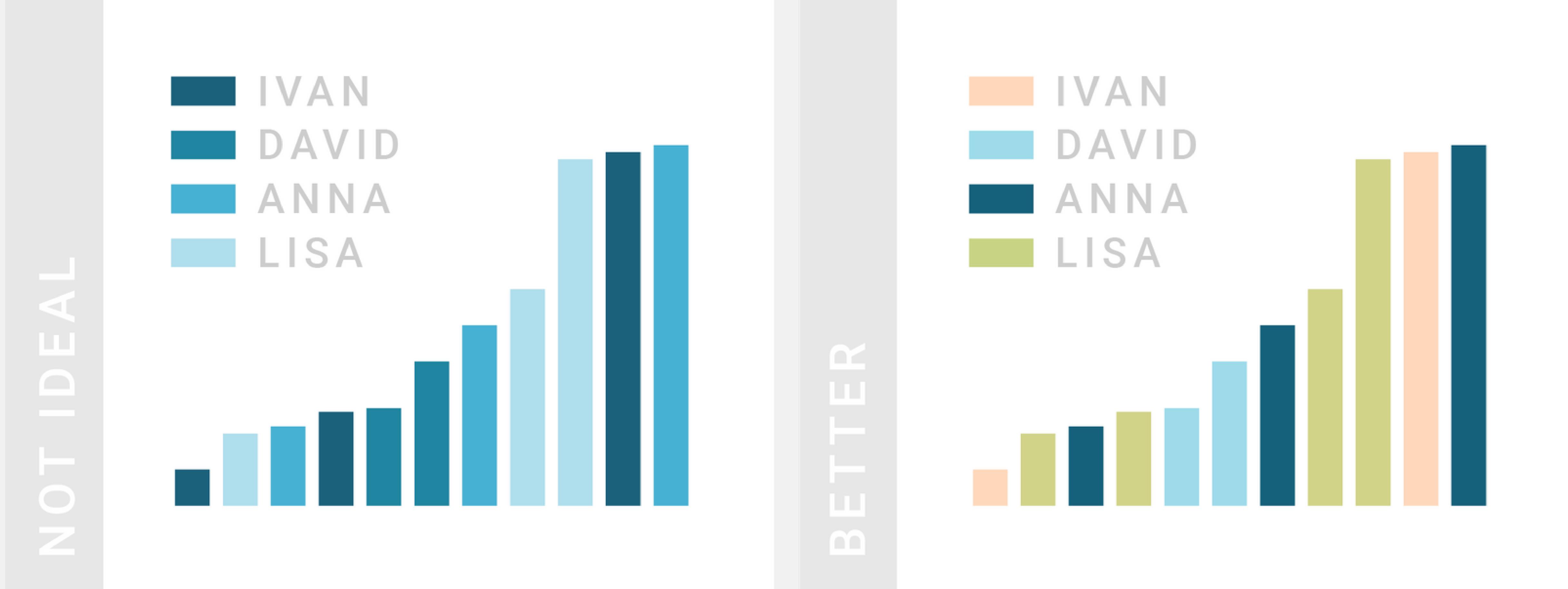
Use to encode  
***categorical information***

pick distinct colors with  
the same perceptual weight

limit categories to 6-8

Modified from the `{colorspace}` R package vignette

# Sequential versus Qualitative Palettes



Source: “[When to use sequential and when to use diverging color scales](#)” by Lisa C. Muth / DataWrapper

# Ensure Readability for Color-Blind Persons



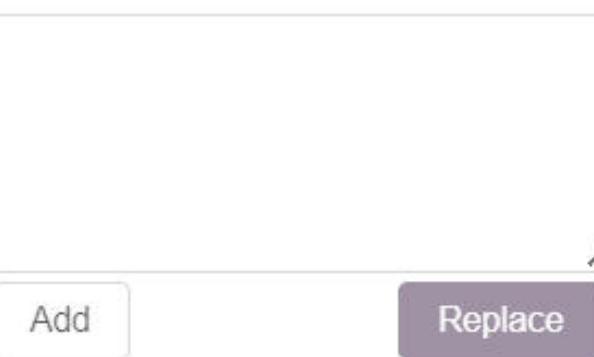
Source: [“Fundamentals of Data Visualization” by Claus O. Wilke](#)

# VIZ PALETTE

By: Elijah Meeks  
& Susie Lu

## PICK

Use Chroma.js



Use Colorgorical

Use ColorBrewer

## EDIT

- ≡ 1 ● #2a9571 [🔗](#) ×
- ≡ 2 ● #8fb9bf [🔗](#) ×
- 4 Colors      ≡ 3 ● #dfb468 [🔗](#) ×
- ≡ 4 ● #4b8cd8 [🔗](#) ×

#hex  rgb

hsl

## GET

#hex  rgb

hsl

String quotes

Object with metadata

```
[ "#2a9571",
  "#8fb9bf",
  "#dfb468",
  "#4b8cd8" ]
```

# COLORS IN ACTION

Background color:  #eeeeee [🔗](#)

Font color: ● #212121 [🔗](#)

Charts made with [Semiotic](#)

### Color Population:

No Color Deficiency - 96% Deuteranomaly - 2.7% Protanomaly - 0.66% Protanopia - 0.59% Deuteranopia - 0.56% Greyscale



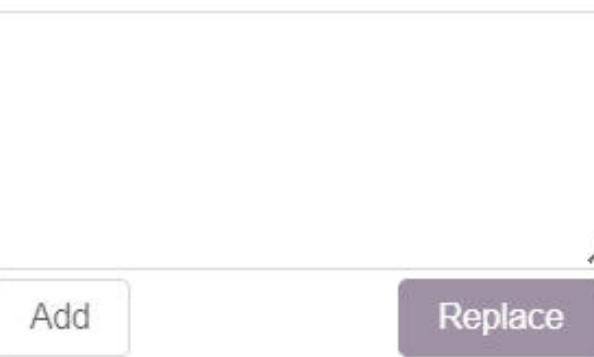
[Viz Palette](#) displaying the “colors in action” without color deficiency

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By: Elijah Meeks  
& Susie Lu

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Use Colorgorical

Use ColorBrewer

## EDIT

- ≡ 1 ● #2a9571 [🔗](#) ×
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#hex  rgb

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String quotes  
 Object with metadata

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[ "#2a9571",
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```

# COLORS IN ACTION

Background color:  #eeeeee [🔗](#)

Font color: ● #212121 [🔗](#)

Charts made with [Semiotic](#)

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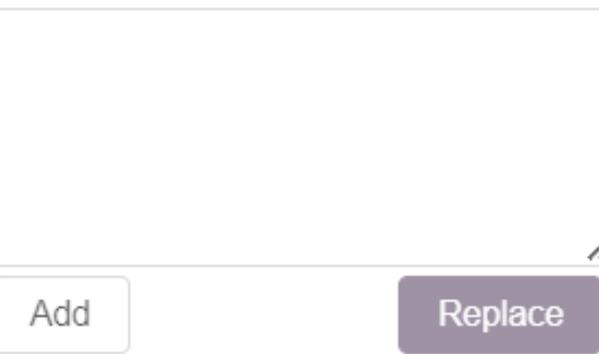
[Viz Palette](#) displaying the “colors in action” without color deficiency

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- ≡ 4 ● #4b8cd8 [🔗](#) ×

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hsl

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String quotes  
 Object with metadata

```
[ "#2a9571",
  "#8fb9bf",
  "#dfb468",
  "#4b8cd8" ]
```

# COLORS IN ACTION

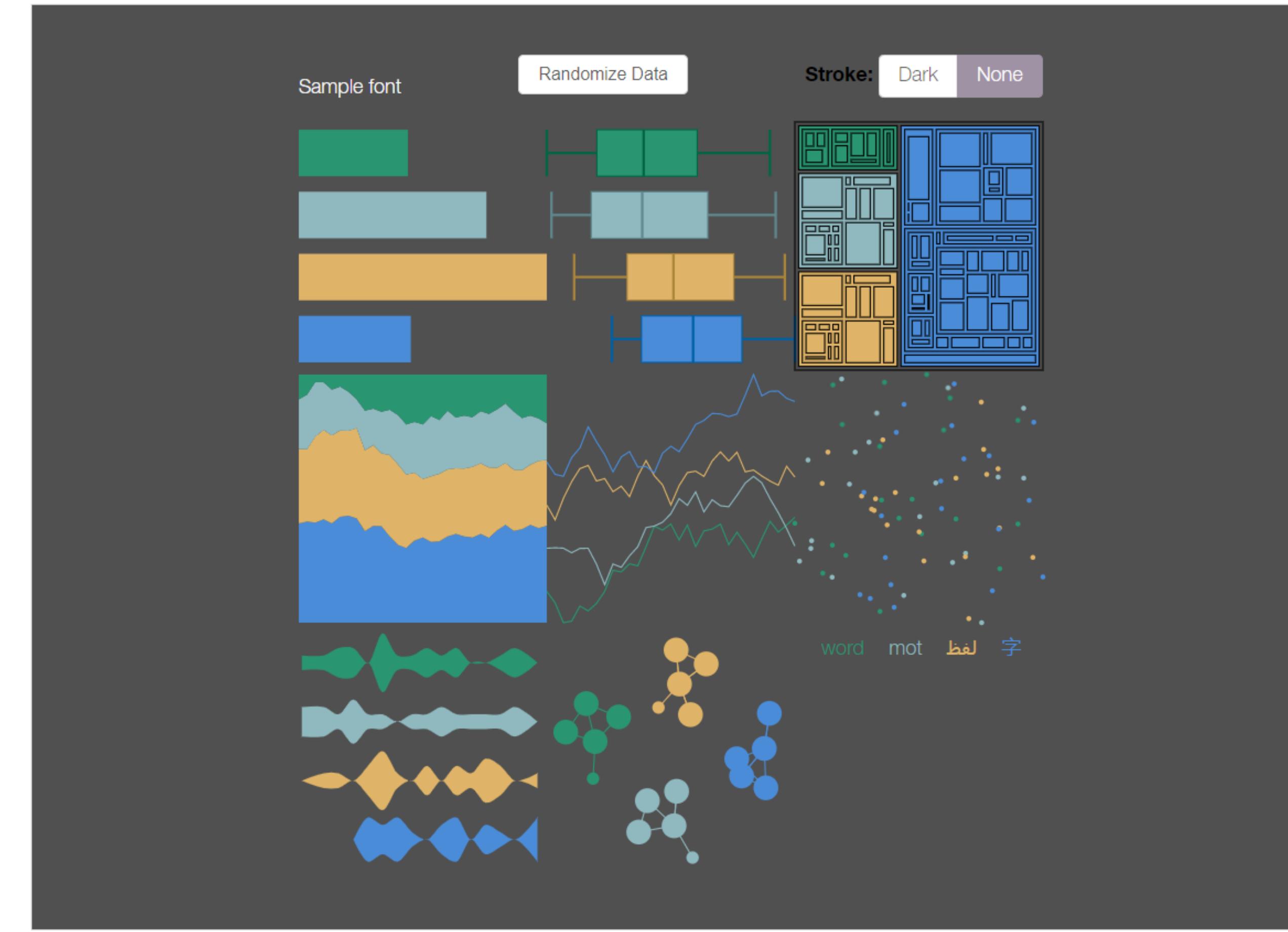
Background color: ● #505050 [🔗](#)

Font color: #fefefe [🔗](#)

Charts made with [Semiotic](#)

### Color Population:

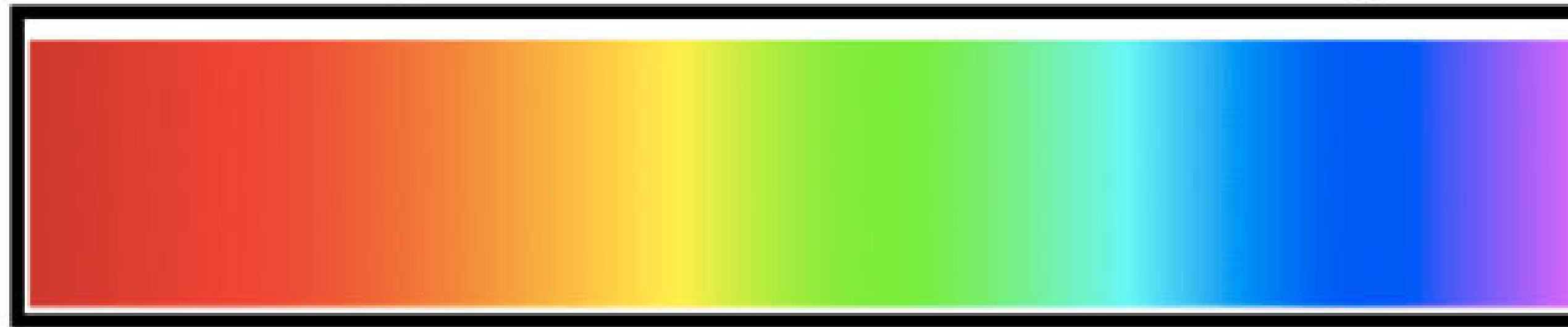
No Color Deficiency - 96% Deuteranomaly - 2.7% Protanomaly - 0.66% Protanopia - 0.59% Deuteranopia - 0.56% Greyscale



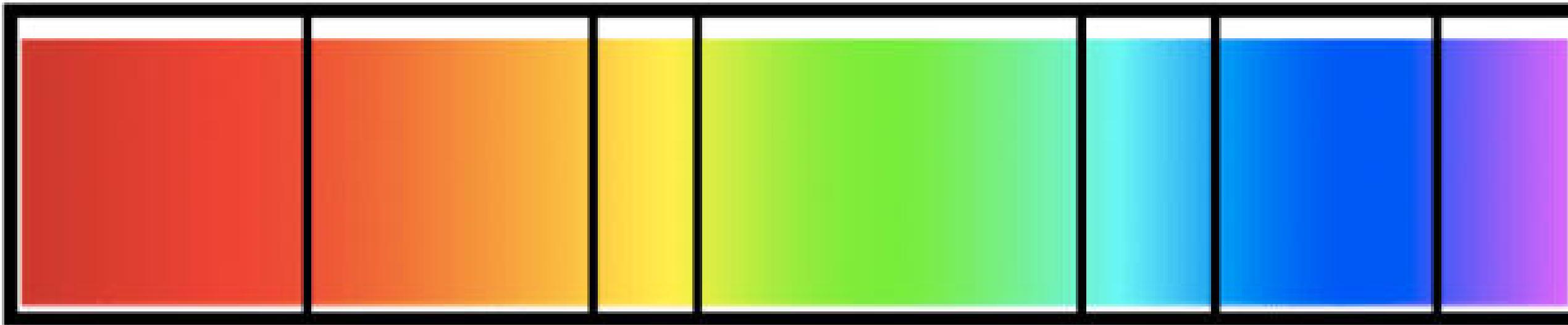
Viz Palette displaying the “colors in action” without color deficiency

# Non-Uniform Distances between Hues in the Newton Rainbow Colormap

Red      Orange      Yellow      Green      Blue      Indigo      Purple



Typical Rainbow Colormap



Non-Uniform Distances between Hues.

*Modified from [Fabio Cramer](#)*

Effect of color visualization and display hardware on the visual assessment of pseudocolor medical images

[Silvina Zabala-Travers](#), [Mina Choi](#), [Wei-Chung Cheng](#), and [Aldo Badano<sup>a</sup>](#)

Rainbow color map distorts and misleads research in hydrology – guidance for better visualizations and science communication

Michael Stoelzle<sup>1</sup> and Lina Stein<sup>1,2</sup>

<sup>1</sup>Faculty of Environment and Natural Resources, University of Freiburg, Freiburg, Germany

<sup>2</sup>Department of Civil Engineering, University of Bristol, Bristol, UK

**“The ad hoc manner in which color is handled and the lack of standard approaches have been associated with suboptimal and inconsistent diagnostic decisions with a negative impact on patient treatment and prognosis.”**

*Zabala-Travers, Choi, Cheng & Badano 2015 Med Phys.*

[IEEE Computer Graphics and Applications](#)

## Rainbow Color Map (Still) Considered Harmful

March/April 2007, pp. 14-17, vol. 27

DOI Bookmark: [10.1109/MCG.2007.46](https://doi.org/10.1109/MCG.2007.46)

Authors

[David Borland](#), University of North Carolina at Chapel Hill

[Russell M. Taylor II](#), University of North Carolina at Chapel Hill

10 March 2017

## Interpretation of the rainbow color scale for quantitative medical imaging: perceptually linear color calibration (CSDF) versus DICOM GSDF

[Frédérique Chesterman](#), [Hannah Manssens](#), [Céline Morel](#), [Guillaume Serrell](#), [Bastian Piepers](#), [Tom Kimpe](#)

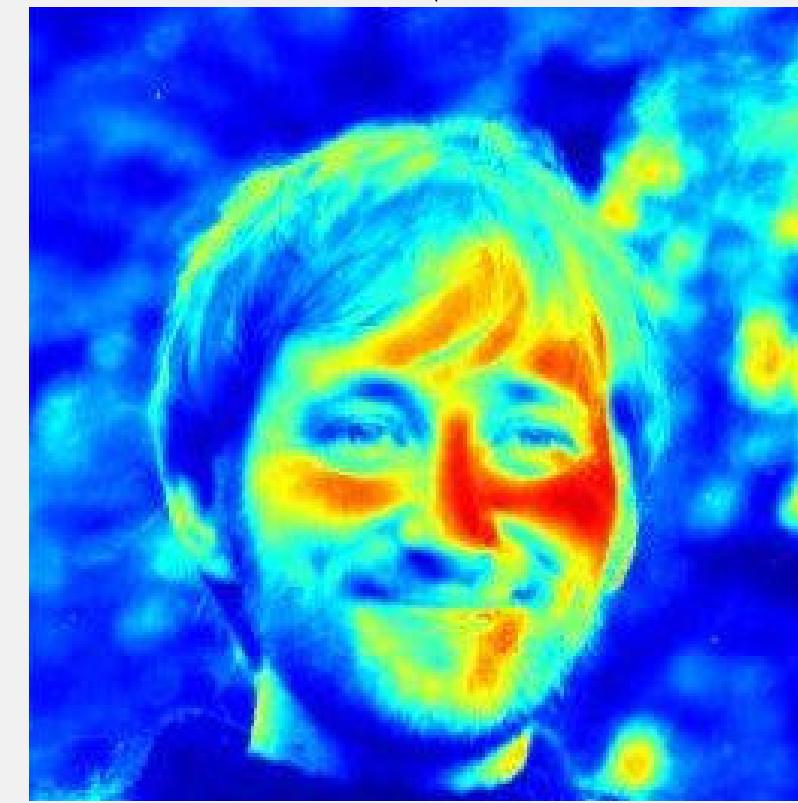
Author Affiliations +

[Proceedings Volume 10136, Medical Imaging 2017: Image Perception, Observer Performance, and Technology Assessment; 101360R \(2017\)](#) <https://doi.org/10.1117/12.2253885>

Event: [SPIE Medical Imaging](#), 2017, Orlando, Florida, United States



**true-color Phil**



**rainbow Phil**



**batlow Phil**

*Modified from Fabio Crameri*



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z3tt

# Wrap~Up

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



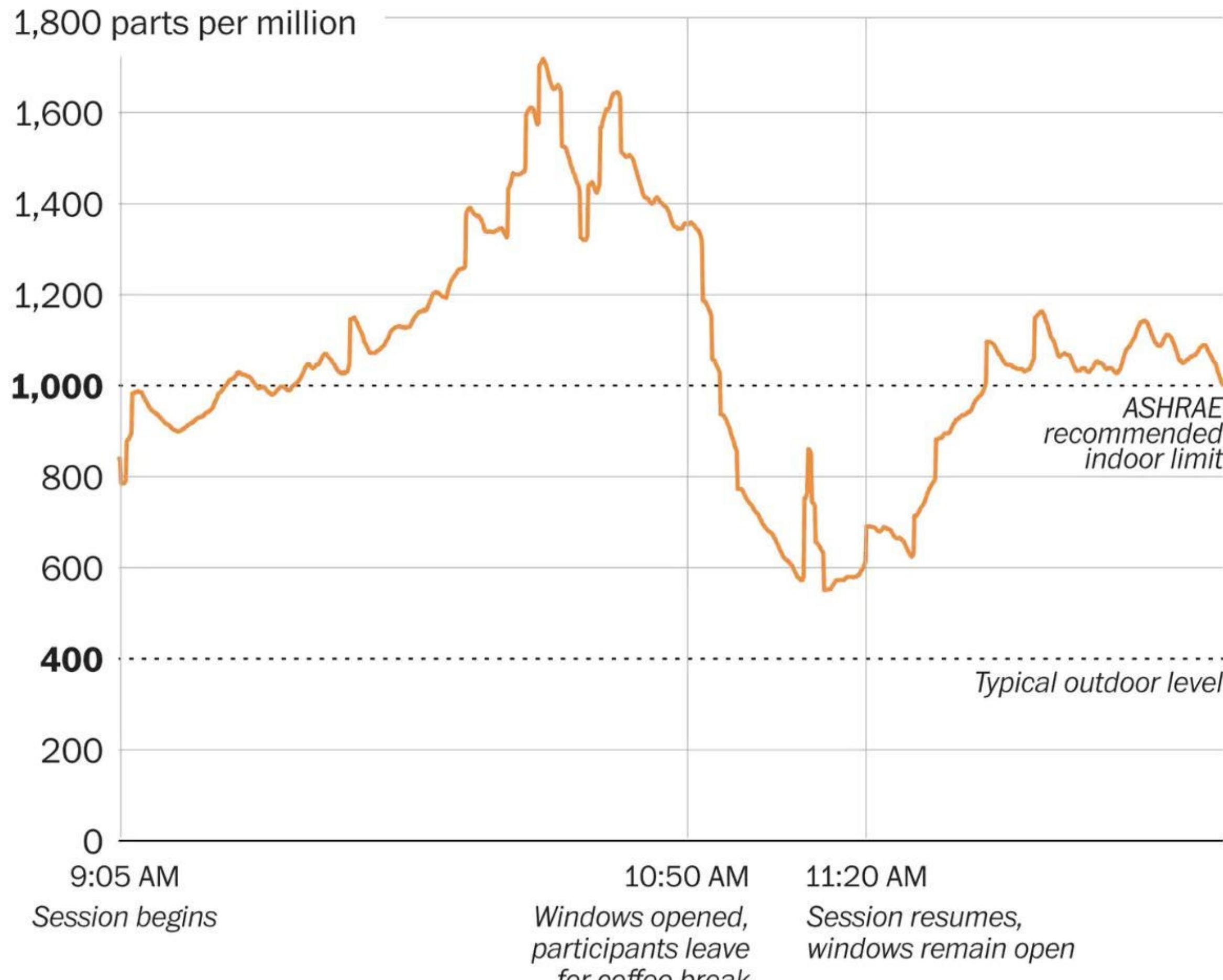
@CedScherer



z3tt

# Clearing the air

CO<sub>2</sub> levels in an occupied conference room on June 4, 2019



Source: Adam Ginsburg

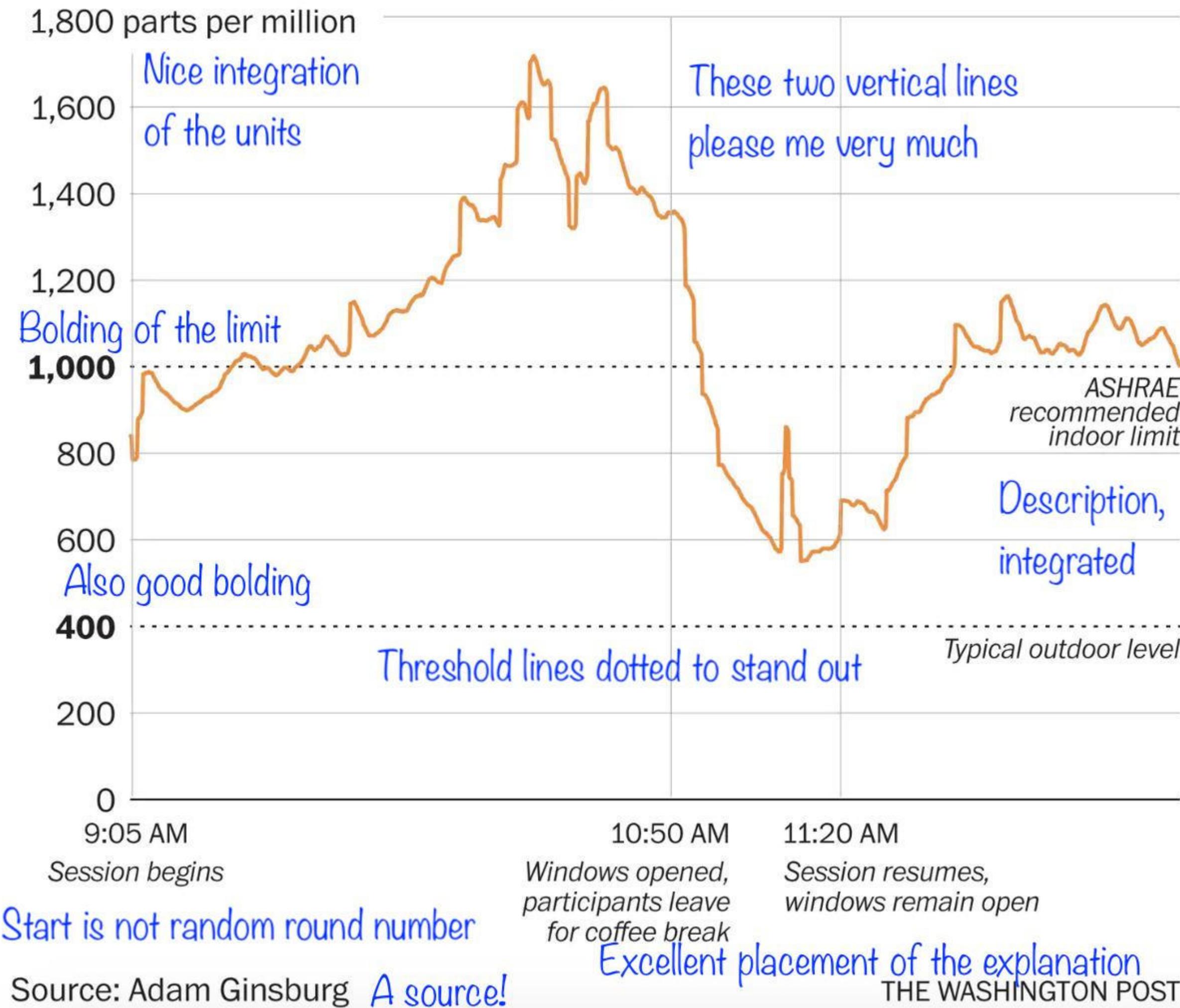
THE WASHINGTON POST

Source: “Clearin the Air” by Adam Ginsburg (Washington Post)

# Clearing the air

Fun and helpful title

CO<sub>2</sub> levels in an occupied conference room on June 4, 2019  
Units and metho in a subtitle, NOT in vertical text on the side



Notes by Francis Gagnon (Voilà)

# Information .....

Understand your data and be accurate.

# Story .....

Be clear about the message of your visualization.

# Goal .....

Select charts that successfully transport your story.

# Visual Form .....

Present information in a logical, coherent way.

# Thank you!

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